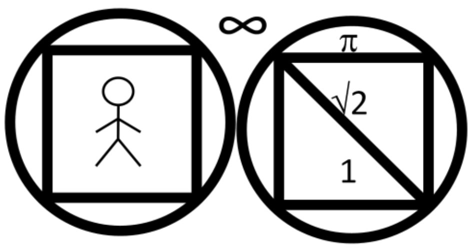
Integer - Ratio - Power Law - Chaos

Author: Jonathan Pearson
Version: 0
Date Started: 06/10/2020
Date First Version: 27/12/2020
Date Updated: 27/12/2020



Jonathan Pearson 2020
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Introduction

Numbers worry me – they seem so simple yet there is all this complexity and uncertainty.

A simple integer number line can have so many complicated dance routines (functions) like addition, subtraction, repeating (multiplication and division) and recursion that we get results that seem so interesting to us. *https://oeis.org/ The On-Line Encyclopedia of Integer Sequences® (OEIS®) Founded in 1964 by* ***N.J.A. Sloane*** (now over 300,000 integer number sequences identified)

0,1,2 seem very straight forward most of the time but 3,4,5 get far more complicated.

Non-integer results keep appearing after 2 like 2.4 and Pi appear frequently in the dance routines.

I don't like that the **Fundamental Theorem of Algebra** (polynomial solutions) has embedded in it THE imaginary number (the square root of -1)
https://en.wikipedia.org/wiki/Fundamental_theorem_of_algebra

I can see how it follows but I don't understand (i.e. how does it help?) why prime numbers are so important to definitions like the **Fundamental theorem of arithmetic /unique-prime-factorization theorem** (except for the number **1** of course – which is our **initial self-reference**) https://en.wikipedia.org/wiki/Fundamental_theorem_of_arithmetic - does it mean that addition can be expanded into multiplication and that multiplication can be grouped and that any grouping is unique for every integer? https://www.mathsisfun.com/numbers/fundamental-theorem-arithmetic.html **I mean the point is** that positive integer multiplication is **merely a form** of **repeating** addition – (moving in the direction of the **positive number line**). Then surely the arithmetic can be **extended** to the **negative number line** and just treating all the multiplications – as group and repeated "additions" which in this case are "subtractions". At the heart of this is the **recognition that Summation** – **takes both directions** forwards and backwards, positive and negative- the dance step is one simple step of direction and repeating some steps. This means that -3 times -3 means "take the minus 3 dance step in the minus direction again and again." – AT THE HEART OF THIS PROBLEM – the idea of the fixed number line with direction – and the idea that repetition (multiplication) is instructed by a **Positive integer i.e. we introduce an anomaly right at the start of our definitions. Instead the default is to say that -3 times -3 = +9 (clearly inconsistent). I understand counting** – Euler liked step counts - but we **count in two directions** as well (forwards) – the positive direction and backwards (the negative) direction – which also gives us position along the way. So why don't we use signs for the "repeating" instruction? This has implications for **log** and other functions.

*'The purpose of computing is insight, not numbers' :Author(**Richard Wesley Hamming**) :Year(1962) :Source Document(Numerical methods for scientists and engineers Front) :Keyword(Development Thinking Individual) https://archive.org/details/numericalmethods00hamm_0/page/n7/mode/2up https://en.wikipedia.org/wiki/Richard_Hamming*

The power Law worries me – I don't like the way it is formulated nor do I fully understand the purpose of the dance routine – it does not make sense to me.

I explored some of this previously here https://humanistman.com/wp-content/uploads/2020/08/Equality-Diversity-Measurement-Notice.pdf

It seems I am exploring the integer number line and the various dance routines – or to use current language – I am revisiting Diophantine equations and Hilbert's 10th problem to see how strongly connected integers, ratios and functions are and where the "break out" in the dance routines of integers takes place and why. **Kurt Gödel** suggests I cannot state a certain answer in our language https://en.wikipedia.org/wiki/Gödel's_incompleteness_theorems.

I am assuming/agreeing/hypothesizing there is a continuum hypothesis (**Georg Cantor**, **David Hilbert's** 1st problem) – that infinity *(article on NCATLAB.ORG)* (see **Bertrand Russell**, Zermelo-Fraenkel set theory, transcendental numbers) exists in infinite ways – there are limitations of proofs and logic (Gödel's Incompleteness Theorems) - there is an axiom of choice – there is a limit to simplicity (e.g. **Mojżesz Presburger** arithmetic).

Why do we need these infinitesimals, fluxions, “approaching”, decimals – infinitely running away into more and more precision but never getting there? If I change number bases from 10 to 2,3,4,5 or something else does that change things (no)? Is there some “golden” integer number which relates all ratios perfectly into integers? **Joseph Liouville** introduced Liouville numbers and proved they are transcendental, but not all transcendental numbers are Liouville numbers – pi, golden ratio, e,etc – can I understand why?

Framework

Universe, Bounds, Constraints

Population

Universe

Questions

1. Is there absolute, comprehensive, neatness, order and constant whole ratios? (not according to our math)
2. What makes complexity happen – at what point does it break out?
3. What are some of the bounds of certainty and probability?
4. Why is chaos so certain? Is it choice of paths?
5. Why do so many people want to square the circle?
6. Great minds throughout history have examined this – who do I think I am?

Initial Conditions

Universe, Notice, Observe, Measure

Self reference

Bounds and Constraints

Disclaimer

These are my own thoughts and I have provided links to many resources. I have extracted some information from other people and tried to present it and attribute it –generally as a **fair use** – extract or link - **research** and **education** and **non–commercial** reference. I refer to group and individual’s work and exploration – not as a personal reflection, criticism or evaluation – but recognition of the importance of their work for humanity in general. I try to name the sources of information used, extracted or explored while writing this paper. I have added my own **emphasis** and highlights to extracted text to highlight the points I am trying to explore.

Any objections can be referred to my website and I am not unwilling to remove references or material if there is a problem.

The bulk of the material accessed has generously been made publically available for research by many people – I appreciate their work and acting in the public interest.

Additional and supplementary information is presented in References.

Initial Thoughts

This is really daunting. There is so much to examine and so much to explore. I think I will be examining basic ideas around zero, one, two and then three but I have to traverse all the science, arithmetic and computing which goes with that. It is difficult for me to start to look at this.

I am puzzled and doing some work to investigate. I doubt my skills are at the same level as even several hundred years ago – before the mind numbing propaganda of TV – when families sat around reading books and talking about problems. Many would investigate puzzle books and work on problems like crosswords or thought puzzles. The general population was regularly interested and entertained by investigating conundrums and puzzles, asking questions and working diligently on solving problems. They made things, used their inventiveness and were keen to discover, create and enjoy the challenges of life. Even the most simple puzzles presented to children as games one hundred years ago seem difficult to me – I am out of practice and maybe lack the skills. Math for Fibonacci and the golden ratio were children's games 100 years ago. At least since the 8^{th} century, people were entertained and interested with solving the problem of a man getting the wolf, the goat and the cabbage across the river in a boat with room for two things without someone eating something or someone. There was real fear and tension – drama.

There are all these very intelligent full-time workers on these issues - ***Ed Gerck*** *http://gerck.com/* ***, Dr. Gerard P. Michon*** *and* ***Numperphile, Mathologer*** I noticed recently, but there are many others as well – gifted and hard working – Universities are full of them - how can I follow their work? – except to notice what they were focusing on , what they were interested in , what they thought were the interesting questions. Many are going back to basic integer numbers – looking at primes.

What worries me is that everyone who has done anything here has called their thing after themselves or had it named after them. So instead of some cohesive integrated framework we have personalized conjectures and ideas spread from **Pythagoras**, **Euclid**, **Archimedes** and **Diophantus** through to a cacophony of current scientists.

Interesting Number Sequences

A database of number sequences was started in 1963 by N J A Sloane. **Neil James Alexander Sloane** :Year(1939) :Keyword(Math, Sequence) https://en.wikipedia.org/wiki/Neil_Sloane http://oeisf.org/ http://neilsloane.com/ - The Online Encyclopedia of Integer Sequences https://oeis.org – is has been extensively updated and improved by mathematicians around the world. There must be more than million formulas (300,000 on oeis) and there is no way I can even attempt to cover the entire range of possibilities. Oeis - 7890 refer to the golden ratio , Phi. *My Favourite Integer Sequences Neil Sloane* *http://neilsloane.com/doc/sg.pdf*

There are two interesting number sequences describing shapes which stand out for me

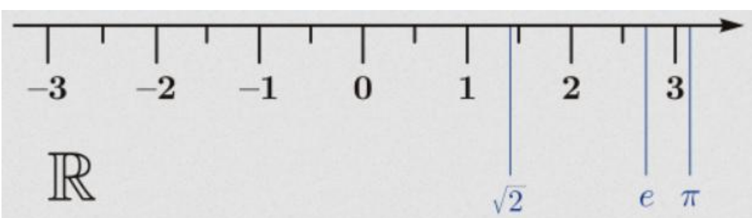
I. 3,4,5 right angled triangle (Pythagoras)
II. 1,2,3 volume comparison of cone, sphere, cylinder (Archimedes)

They seem so neat because each number increases by one, they are low numbers, they relate to two and three dimensional shapes. **Dimensional analysis** (Fourier, **George David Birkhoff** and **Garrett Birkhoff** (Lattice Theory)) examines a technique for understanding this. **Benoit Mandelbrot** has great insight into **scaling**, patterns and relativities – **fractal geometry**.

There is some hope that **stepping** conceptually from two dimensions to three or more dimensions can also be a "neat" number sequence. **Archimedes** result is intriguing because the ancient problems "**tri-secting the angle**" (vector), "**squaring the circle**" (area) ***Quadratrix of Dinostratus*** https://en.wikipedia.org/wiki/Quadratrix , "**doubling the cube**" (volume) (**Stephen Wolfram** https://mathworld.wolfram.com/CubeDuplication.html) have no answer using a simple fixed yardstick (the old tools of a straightedge and a compass).

The language of math is complex – irrational, rational, transcendental, algebraic, real, imaginary, series, log, power law, root, log, natural log, exponential, etc. These can overlap in meaning and use by mathematicians – language also changes over time - people want to put their own name on things and call them after themselves so you get "*Dr. X's (phd) theorem*" instead an abstract and cohesive definition which aligns with other work – even relabeling historical terms because a small improvement was added.

Things seem interesting with just the real number line without algebra, trigonometry or polynomials.



https://en.wikipedia.org/wiki/Real_number#/media/File:Real_number_line.svg
User:Phrood~commonswiki - Own work Public Domain

One of the people I have recently read (maybe others as well) noted that you need to understand the boundary between **arithmetic** and **physics** – the time we talk about numbers themselves versus some **relation to the observed universe**. When we talk about the number line it is **purely abstract** and we can make up dance routines using rules.

We invented the number line which has two basic ideas – adding and subtracting of unity – which we represent as numbers (units) in directions along an infinite line. **Unity is a declarative statement** of some strength – we **declare** a **thing to be a unit** – when we apply the abstract (arithmetic) to the physical (physics – observed universe). We are also declaring that instead of just continuums there is conceptually a boundary we can make to declare something as a unit. (bounded,constrained and defined)

It's a very binary thing to declare some thing as a thing and not another thing. (**initial self reference intended)** So we declare 1 is 1 and that 2 is 2 and that they are not the same – there are unique and different and that imbedded in their definition is summation (positives and negatives): 1+1 = 2 and so on. This is the basic statement of the integer number line.

This a **very strong** **CERTAIN** statement. We have turned a continuum into ordered, bounded fixed units.

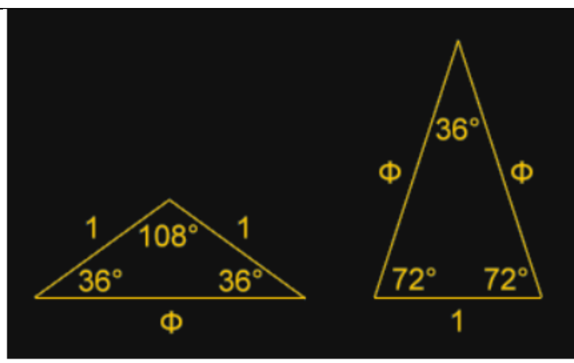
Then we put zero there as an afterthought to account for subtraction of 1 from 1 – then negative numbers to admit at least 2 directions.

I must also look at two old and repeating **number sequence** dance routines (recursion) – one is just adding two integers but also imbedded in it comes a convergence on a ratio – the Fibonacci sequence converges to the golden ratio. 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ... Once you get past the first two ratio steps (infinity, 1,2) - Each sequence of two numbers get closer to the golden ratio (Phi). 3/2 = 1.5,5/3 = 1.666.

Again phi itself has this annoying simple integer statement with the power law in it (1 + Square root of 5)/2 or expressed as a quadratic $x^2 - x - 1 = 0$. = 1.61805…. (what does the 5 mean here – it seems to be a limit of some kind?)

III. Fibonacci sequence 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...
https://en.wikipedia.org/wiki/Fibonacci_number
IV. Golden Ratio Phi https://en.wikipedia.org/wiki/Golden_ratio

Johannes Kepler had related Pythagoras to the Golden Ratio with Kepler's Triangle



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https://www.goldennumber.net/triangles/
Phi and Fibonacci in Kepler and Golden Triangles May 13, 2012 by ***Gary Meisner***
The isosceles triangle above on the right with a base of 1 two equal sides of Phi is known as a Golden Triangle. These familiar triangles are found embodied in pentagrams and Penrose tiles.

Note the **36 degrees** angle repeats – why **1/10 of the full circle** – is that our numbering system??

Sequences emerge as an idea. ***e*** and **pi** could be seen as the result of the sum of some kind of infinite sequence of terms – does this make them **transcendental** or not? If I imbed an already simple transcendental number in a sequence definition – doesn't that also make the sum a transcendental number as well? In other words – the **emphasis is in the repeating sequence structure** than the summed result. I would like/prefer/enjoy/investigate the most simple expressions to be used in sequences – 2 is about as simple you can get without being 1 (unity). **Is this the start of recursiveness?**

Gelfond–Schneider constant https://en.wikipedia.org/wiki/Gelfond%E2%80%93Schneider_constant .."$2^{\sqrt{2}}$ *The Gelfond–Schneider constant or **Hilbert number**[1] is two to the power of the square root of two:*

$2^{\sqrt{2}}$ *= 2.6651441426902251886502972498731...*

*which was proved to be a **transcendental** number by Rodion Kuzmin in 1930.[2] In 1934, Aleksandr Gelfond and Theodor Schneider independently proved the more general Gelfond–Schneider theorem,[3] which solved the part of **Hilbert's seventh problem** described below"….*

Focus – Scope, Coverage and Abstraction

Number theory, Algebra, geometry, trigonometry, topology, calculus, arithmetic, computation – a general list of language and terminology from the website – my selected entries

https://en.wikipedia.org/wiki/Mathematics_Subject_Classification General/foundations [Study of foundations of mathematics and logic]

- Number theory, set theory, Zero, Infinity
- Abstraction (variables) (The Diagonalization Lemma) , Ring Theory, Mathematical logic, Functions, Algebra
- Iteration, Recursion, Proof, Sequences, series, summability
- polynomials
- Euclidean spaces, geometry, trigonometry, complex, group theory, lattice, topology
- Derivatives, integrals, calculus, differential equations
- Vectors, Matrix, Combinations, Statistics, Probability, Complexity, Chaos

Number Schemes

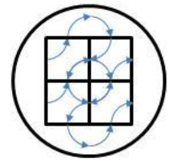
Galois Fields and binary addition and subtraction – using modulo concepts allows addition, subtraction ,multiplication and division. At the basic level everything can be thought of as addition of positive or negative units – or alternatively as directions along the fixed infinite number line.

It is worth noting that if everything is BINARY - either a zero or a 1 then strings of zeros and ones will never have infinitesimals (smallness), "decimals", fractions – it is all "digital". Hence the Fast Foruier transform notion of taking continuums of wave functions and transforming them into **discrete measurements** – frequencies.

Maybe I should look at the Octonian numbering system https://en.wikipedia.org/wiki/Octonion or some other hypercomplex number system https://en.wikipedia.org/wiki/Hypercomplex_number ..."*In 1958 **J. Frank Adams** published a further generalization in terms of Hopf invariants on H-spaces which still limits the dimension to 1, 2, 4, or 8."..*

So only 4 possible dimensions? I don't like it when they imbed e or pi in the formulas because I think they are imbedding the problem. I want to go beneath that.

https://en.wikipedia.org/wiki/Lagrange%27s_four-square_theorem implies that all natural numbers can be represented by adding 4 squares – does this mean that (like 4 prime numbers – 4 unique path



choices) we are in a universe of 4 where the universe itself is the 5th dimension?

These things generally converge around the basic problems of logic and philosophy – like **Georg Cantor**'s https://en.wikipedia.org/wiki/Georg_Cantor and other set theories – simple language issues like is/not/like/different – consists of, etc and the problems of adding and subtraction. Recursion and iteration mostly (initial self reference is unavoidable) sit above this in the dance routine – the rules – the process - but it is like we have to invent a new number routine after each change in complexity of the dance routine – functions, instructions, Programming Language Theory https://en.wikipedia.org/wiki/Programming_language_theory . **Alan Turing** https://en.wikipedia.org/wiki/Turing_machine invented a simple machine to test instructions in a forwards and backwards integer mode – like a number line and Paul Erdos (**Paul Erdős**) https://en.wikipedia.org/wiki/Paul_Erd%C5%91s posed a problem https://en.wikipedia.org/wiki/List_of_conjectures_by_Paul_Erd%C5%91s which **Terrence Toa** explored along the same simple number line. It's the **constant search for a neat dance floor and a neat dance routine.**

The **Euler–Riemann zeta function –** seems interesting as well (explored further in this paper).

Latin Squares – multivariate analysis - seem interesting as a way to eliminate "blocking" factors (not relevant) when doing factor analysis on data (stats). ***Penn State Eberly College of Science*** *https://online.stat.psu.edu/stat503/lesson/4/4.3*

Eluer's Totient – phi https://en.wikipedia.org/wiki/Euler%27s_totient_function /Retaively prime/ **Coprime** https://en.wikipedia.org/wiki/Coprime_integers GCD (**greatest common divisor**) algorithm.

Cunningham Number - counts/types of divisors/multipliers – **primes** and **factors** - https://en.wikipedia.org/wiki/Cunningham_number **Fermat** (Compiled by **Wilfrid Keller**) http://www.prothsearch.com/fermat.html , *(Welcome to GIMPS, the Great Internet Mersenne Prime Search)* Mersenne (**2^P-1**). https://en.wikipedia.org/wiki/Lenstra_elliptic-curve_factorization Lenstra **elliptic-curve factorization** (**Hendrik Lenstra**)

https://en.wikipedia.org/wiki/Simple_Lie_group , https://en.wikipedia.org/wiki/Kac%E2%80%93Moody_algebra **Groups/sets/smoothness "***Although it might seem that such functions are the exception rather than the rule, it turns out that the **analytic functions are scattered very thinly among the smooth ones**; more rigorously, the analytic functions form a meagre subset of the smooth functions. Furthermore, for every open subset A of the real line, there exist smooth functions that are analytic on A and nowhere else."*
/symmetry/continuous/holomorphic/able to be sensibly analyzed/density of derivatives in the domain space - Lie groups.

Groups Theory - Monster group (The Monster? **Richard E. Borcherds** American Mathematical Society 2002 http://www.ams.org/notices/200209/what-is.pdf) , https://en.wikipedia.org/wiki/Monster_group

Tropical Geometry – trying to simplify the math functions – (recently revived interest) https://en.wikipedia.org/wiki/Tropical_geometry

Binary – Digital – Sound – Image – Wave transform

The ability to turn information into digital format has expanded information enormously. Binary information – lists of zeros or ones – **I hypothesize** – can store information to a very high precision and accuracy.

(***Dr. Richard Baraniuk*** *founded* ***OpenStax (then Connexions)*** *in 1999 at* **Rice University** *Digital Computer Design - A Hands-On Approach Binary Arithmetic* *https://cnx.org/contents/UZM3jSVd@4.19:m8pZFghm@6/Binary-Arithmetic*)

Binary arithmetic also seems to be immune from the problems of fractions, decimal points, infinitesimals and rounding errors. It may not be immune from chaos – but then **I don't know where that chaos would impart itself**. Would chaos manifest in the initial encoding and transmission of binary information? - **probably**. Would chaos manifest in the decay of the material on which the digital information is stored? – Most likely - but not in abstract perfection.

When I worked in the A.B.S. the archive computer tapes would need to be "exercised' – read and copied to see if the data had changed while being stored - whether the digital storage media had become slightly corrupt over time.

Most information is not digital or even binary. Paintings, scenes, sounds, objects, movement, feelings, electromagnetic radiation, etc – everything is in constant motion and change.

The **Fourier transform** is one of the most important discoveries in science. Jean-Baptiste Joseph Fourier **(Wikipedia)** (1768-1830) … "*There were three important contributions in this work, one purely mathematical, two essentially physical. In mathematics, Fourier claimed that any function of a variable, whether continuous or discontinuous, can be expanded in a series of sines of multiples of the variable. Though this result is not correct without additional conditions, Fourier's observation that* ***some discontinuous functions are the sum of infinite series*** *was a breakthrough. The question of determining when a Fourier series converges has been fundamental for centuries.* ***Joseph-Louis Lagrange*** *had given particular cases of this (false) theorem, and had implied that the method was general, but he had not pursued the subject.* ***Peter Gustav Lejeune Dirichlet*** *was the first to give a satisfactory demonstration of it with some restrictive conditions. This work provides the foundation for what is today known as the* ***Fourier transform****.*

One important physical contribution in the book was the concept of ***dimensional homogeneity*** *in equations; i.e. an equation can be formally correct only if the dimensions match on either side of the equality; Fourier made important contributions to dimensional analysis.[11] The other physical* *contribution was Fourier's proposal of his **partial differential equation for conductive diffusion of heat**. This equation is now taught to every student of mathematical physics."…*

Fourier uses trigonometry functions of **sine** and **cosine**. Interestingly it applies to many things including N dimensional Euclidian space (like Euler's Identity) $e^{i\pi} + 1 = 0$

and include i, Pi and ***e*** together as well.

"Fourier transform on Euclidean space - The Fourier transform can be defined in any arbitrary number of dimensions n. As with the one-dimensional case, there are many conventions. For an integrable function f (x), this article takes the definition:

$$\hat{f}(\boldsymbol{\xi}) = \mathcal{F}(f)(\boldsymbol{\xi}) = \int_{\mathbb{R}^n} f(\mathbf{x}) e^{-2\pi i \mathbf{x}\cdot\boldsymbol{\xi}}\, d\mathbf{x}$$

where x and ξ are n-dimensional vectors, and x · ξ is the dot product of the vectors. The dot product is sometimes written as ⟨x, ξ⟩."..

While the **Thomas Edison** phonograph simply mirrored the vibrations from sound onto a recording medium which could then mirror those vibrations back through a speaker, modern electronics uses the ability to record signals (all which seem to be interpretable via a "cyclical" (or circular) type notion) by using an **inductor** – which is simple a coiled wire around a magnet which can induce an electrical current. This electrical current contains wave like properties itself (not surprising given that electrons are part of the electromagnetic spectrum) which can be stored digitally interpreted in a number of different ways. It is not surprising that the WAVE FUNCTION (the general description given to the large class of events associated with these periodic cycles) applies to many areas in science and engineering and that Fourier and similar transformations using trigonometric functions and **interpreting cycles** using Pi, i , sine and cosine – tan gives us the "perpendicular" – make up many of the scientific formulas applying to the world we see around us.

There are some simple characteristics of these wave functions – these cyclical events – which seem to resonate (get it?) :

1) **On or off** – Pulse – either the cycle **exists** or it does not.
2) **Amplitude** – Size – Relative height (say above background "Noise" and/or the "average"
3) **Frequency** - the relative length from peak to peak – the wave length - usually by some correlated measure – elapsed time or distance measurement.

Additionally to this is the complexity of multiple cycles and being able to "notice" or isolate them from the background noise, the mass of chaos, the cacophony. (paintings, light, sound, radio waves, chaos, babies in the womb are aware of quantum effects) .

You can determine the area of a circle and a two focal point ellipse using Pi.

Wikihow *https://www.wikihow.com/Calculate-the-Area-of-an-Ellipse.* ***Attribution-Noncommercial-Share Alike 3.0 Creative Commons License***

A circle has one focal point – the centre – and ellipse has two or more focal points. https://en.wikipedia.org/wiki/N-ellipse.

René Descartes described the Cartesian Oval ***- La Géométrie*** *:Author(**Rene Descartes**) :Year(1637) :Keyword(Individual Development Maths) http://www.gutenberg.org/ebooks/26400*
https://archive.org/details/lagomtrie00descuoft
https://en.wikipedia.org/wiki/La_G%C3%A9om%C3%A9trie

Finding the circumference of a circle is possible using Pi, but **no exact formula exists for ellipses.**

John D Cook *- Ramanujan approximation for circumference of an ellipse https://www.johndcook.com/blog/2013/05/05/ramanujan-circumference-ellipse/ , Final Answers © 2000-2020* ***Gérard P. Michon****, Ph.D. http://www.numericana.com/answer/ellipse.htm*

We can think that most common real world cyclic energy is multi-focal point ellipses – and their resultant wave forms – a very complicated area of mathematics.

Circles, and related objects, are abstract and ideal and Pi is a **precise simple abstract measurement** for their features , versus ellipses and more complex repeating paths.

Newton's/Kepler's formulae can help with calculating ellipses and multi dimensional areas can be calculated but **path lengths** – **circumferences** - can very difficult to **precisely** calculate for anything other than perfect circles (using our "perfect" pi infinity).

SO - Why does Archimedes show such a neat relationship – a comparison – between a cone, sphere and cylinder? What does it **mean?** –

American Mathematical Society *- The Method of Archimedes –* ***Tony Phillips*** *http://www.ams.org/publicoutreach/feature-column/fcarc-archimedes1 ,*

Mathematical Association of America *Archimedes' Method for Computing Areas and Volumes - Cylinders, Cones, and Spheres Author(s):* ***Gabriela R. Sanchis*** *June 2016 https://www.maa.org/press/periodicals/convergence/archimedes-method-for-computing-areas-and-volumes-cylinders-cones-and-spheres* **Copyright © 2020**

Archimedes "method" ***- GEOMETRICAL SOLUTIONS DERIVED FROM MECHANICS*** *-* ***A TREATISE OF ARCHIMEDES*** *http://www.gutenberg.org/files/7825/7825-pdf.pdf* (public domain - **partial extract)** *…"I have thought it well to analyse and lay down for you in this same book a* ***peculiar method*** *by means of which it will be possible for you to derive* ***instruction as to how certain mathematical questions may be investigated by means of mechanics.*** *And I am convinced that this is* ***equally profitable in demonstrating a proposition itself****; for much that was made evident to me through the medium of mechanics was* ***later proved by means of geometry****, because the treatment by the former method had* *not yet been established by way of a demonstration. For of course it is easier to establish a proof* ***if one has in this way previously obtained a conception of the questions****, than for him to seek it without such a preliminary notion. . . . Indeed I assume that someone among the investigators of to-day or in the future will discover by the method here set forth* ***still other propositions which have not yet occurred to us.****".*.

Descartes Circle Theorem - *Explore Descartes theorem.* ***Ronak Agarwal, Sameer Kailasa, Christopher Williams****, and 10 others contributed* *https://brilliant.org/wiki/descartes-theorem/*
http://www.gogeometry.com/geometry/soddy_descartes_circles.htm *(****Antonio Gutierrez****)*
http://www.gogeometry.com/problem/index.html
https://www.geogebra.org/?lang=en *(The* ***GeoGebra Group*** *consists of the non-profit organization* ***International GeoGebra Institute*** *and* ***GeoGebra GmbH*** *having their offices in Linz, Austria)*

Sound is a continuum with wavelike properties. Sound propagates through mass – air, water, solids – particles carry forward a sound pressure wave – particles move but only a little bit – passing on the energy to the next particle. We abstractly see this as a "wave" - a cycle of peaks and troughs that mirror what we see in water when you drop a pebble into a pond or see the waves on the beach. **Quantum acoustics** is the study of quantum level activity of sound and the "phonons" (photon or electrons) which take part in the transmission of sound energy.

The universe is full of things – many things we cannot see and we have previously assumed there was "nothing" – a vacuum. The idea of stuff all around us (and variations of that theme) – ether, aether – has been around for thousands of years and partially supported by Plato, Aristotle, Einstein (in various forms) and others, yet it is not accepted as proven. *(See* ***Michelson-Morley experiment*** *This entry contributed by* ***Leonardo Motta*** *https://scienceworld.wolfram.com/physics/Michelson-MorleyExperiment.html)*

Timaeus :Author(**Plato**) :Year(-360) :Keyword(Individual Development Philosophy)
http://classics.mit.edu/Plato/timaeus.html https://iep.utm.edu/timaeus/
https://stanford.library.sydney.edu.au/archives/spr2009/entries/plato-timaeus/

Timaeus ***by Plato*** *https://www.gutenberg.org/files/1572/1572-h/1572-h.htm* (public domain - **partial extract)***…"There are similar differences in the air ; of which the brightest part is called the* ***aether****, and the most turbid sort* ***mist and darkness****"…*

On The Heavens :Author(**Aristotle**) :Year(-350) :Keyword(Individual Development Philosophy)
http://classics.mit.edu/Aristotle/heavens.html https://www.ancient.eu/article/959/aristotles-on-the-heavens/ https://en.wikipedia.org/wiki/On_the_Heavens ***LOEB Classical Library*** *(****James Loeb*** *founded the Loeb Classical Library in 1911) Harvard University Press*
https://www.loebclassics.com/view/LCL338/1939/volume.xml

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https://onemorelibrary.com/index.php/en/books/science/book/physics-203/on-the-heavens-de-caelo-et-mundo-743

Aristotle, On the Heavens (public domain - **partial extract**) *..“THE science which has to do with nature clearly concerns itself for the most part with **bodies** and **magnitudes** and their **properties** and **movements**, but also with the principles of this sort of substance, as many as they may be. For of things constituted by nature some are bodies and magnitudes, some possess body and magnitude, and some are principles of things which possess these. Now a **continuum is that which is divisible into parts** always capable of subdivision, and a body is that which is every way divisible. A **magnitude if divisible** one way **is a line**, if two ways a surface, and if three a body. Beyond these there is no other magnitude, because the three dimensions are all that there are, and **that which is divisible in three directions is divisible in all**. For, as the Pythagoreans say, the world and all that is in it is determined by the number three, since **beginning and middle and end give the number of an ‘all’, and the number they give is the triad**.”…. “That there is no other form of motion opposed as **contrary to the circular** may be proved in various ways. In the first place, there is an obvious tendency to oppose the straight line to the circular. For concave and convex are a not only regarded as opposed to one another, but they are also coupled together and treated as a unity in opposition to the straight. And so, **if there is a contrary to circular motion**, **motion in a straight line must be recognized as having the** best claim to that name. But the two forms of rectilinear motion are opposed to one another by reason of their places; for up and down is a difference and a contrary opposition in place.”*

Cycles are often measured in Hertz – cycles per second. In this case one of the dimensions is TIME the other dimension is AMPLITUDE. The general model has the idea of a fixed zero point or average – and the amplitude varies above and below the zero or average LINE. So you set up a frame of reference where you pick and average point and you are doing two measurements – one “distance” type thing – the time or distance function – and the Amplitude – the measurement.

The thing about cycles too is that they do not have to be perfect circles (ellipses, not regular, etc) – the general cycle pattern is this idea of repeatedly ending up at the same measurement spot is some kind of pattern. The question of the wave/particle is explored by asking if we are seeing a particle on an elliptical path or the wave caused by that particle as it travels through time/distance on that repeating path. You can see why some would support notions of “string theory” or a vibrating and oscillating universe.

We tend to constrain things – we build boundaries based on the notion of **same** or **different**. Is this sound the **same** as the other sound? So we BOUND things – we arbitrarily draw boundaries – based on our particular frame of reference (the human frame). This can vary culturally and through history for things like sound – e.g. Chinese music, Japanese music,etc – strongly linked to the types of physical instruments used – some music is more about sliding around the boundaries and continuums and some is more strongly bounded with fixed notes out of the continuum.

The Piano scale can be measured in Hertz – ***Mathematics Of Music - Daniel Q Naimen*** ***http://www.ams.jhu.edu/~dan/*** **–** *John Hopkins University, Whiting School of Engineering* ***https://www.ams.jhu.edu/dan-mathofmusic/notes-intervals/*** **Copyright Assumed - Fair Use – research and education – non commercial – Partial Extract**…“$c=2^{1/12}\approx 1.059463$, *So moving up a half-step corresponds to* ***multiplying a note's frequency by a factor of about 1.059463****. Importantly, the note scale is an additive one: we speak of moving up by a certain number of half-steps. On the other hand, at the frequency level, this change is multiplicative. The process of going from an additive measure of length to a* ***multiplicative one leads us to what is arguably the most important function in all of mathematics, the exponential function and its inverse the logarithm function." …***

If we examine the European music scale based on a piano we note that each octave is a **doubling of the Hertz of the previous octave. So middle C is 261.62 Hertz – the next C is 523.25 Hertz –** Concert A is 440 (the one you hear the first violin playing at the start of an orchestral concert).

The 12 note scale is not a straight line relationship – it is a varying scale – the very heart of the math problem of numbers and power laws. But this is primarily a real world issue – **not an abstract number issue**. The Human ear finds these rules and boundaries somehow pleasing and sensible (a pattern?) – we can tell that one C is similar to another C – that they are somehow "octaves" apart – some neat similarity and familiarity of sound. Pleasing notes in the scale ere the 5^{th} (which approximates a 3/2 ratio) and the 3^{rd} as well in the 12 note range – some chord structures and scales are more *pleasing* to the human ear than others – this may be due to familiarity – some kind of **confirmation bias**, **sunk cost bias** – or it may be something intrinsic to human "sensibility" which itself is *intune* with some mathematical ratios of the universe. Different human cultures find different patterns of sound pleasing. Some like sliding around the notes – anticipation of a final resolving chord - others like strong, precise repetitive fixed note patterns.

Cents are used to describe the difference between each semitone ($1/100^{th}$) of the difference in hertz. https://en.wikipedia.org/wiki/Cent_(music) and humans vary but many will consider a difference of 5 cents enough to say a note is "out of tune". Trained others will detect 1 cent difference. Some claim perfect pitch.

Robert Munafo *– Blog - This work is licensed under a* ***Creative Commons Attribution-Non Commercial 4.0 International License*** *- http://mrob.com/pub/math/numbers-2.html* **partial extract** *..."*
1.01364326477... = $3^{12}/2^{19}$

This is the ratio between 12 "perfect fifths" (an interval in music, a pitch ratio of precisely 3/2) and 7 perfect octaves (a ratio of precisely 2/1).[193] It is called the ***Pythagorean comma*** *because of the practice in Pythagoras' time of* ***defining all musical intervals*** *(including all the notes on the major scale) as* ***ratios between some power of 2 and some power of 3****.*

The value is close to the 51st root of 2, however, dividing the octave divided into 51 parts with a note-to-note ratio of $2^{1/51}$ = 1.0136839... does not make a better musical scale. In the 53 equal temperament scale the "semitone" closely approximates the ratio $3^{12}/2^{19}$. See also 1.05946....

1.059463094359... = $2^{1/12}$

The ratio between successive pitches on the popular western 12-note "equal temperament" musical scale (see that article for much related history). $2^{1/12}$ is useful for this ***purpose because 7 intervals are very***

***close to the "perfect fifth" 3::2 ratio** (in other words, $2^{7/12} \approx 3/2$) and because 12 is a manageably small number: it is fairly practical to construct instruments and sheet music notation systems that work with a 12-notes-per-octave system. See also 1.01364" ....*

I remember seeing **Luciano Pavarotti** (1935-2007) sing with the world choir in Sydney (my mother was in the chorus). Pavarotti sang in a constant pitch which to me seemed slightly sharp – but was probably pitch perfect. The orchestra and choir will change pitch during a performance – particularly in hot weather and in general will tend to be slighty flat. There is always a problem when there are even slight differences in the pitches of the various voices and whether you "find the middle" (average) between all the slight variations or stick to your notes and hope the others "rise" to the occasion. Musicians and bands try to find that perfect balance of volume, dynamics, pitch to produce a sublime performance.

Humans can easily hear sounds from 20 hertz to 20 thousand hertz using the smallest bones in the human body in the ear - the hammer (malleus), anvil (incus) and stirrup (staples) and human voices can produce a vast array of sounds. The pure voices of boy choirs in cathedrals in England, yodeling, rock and roll, chants, Gregorian choirs, etc. Many singers can sing about 1 and half to 2 octaves on the piano – their range determines what voice class they are given – **Ivan Rebroff** – could sing 4 and half octaves from bass to soprano. (**Youtube**) https://www.youtube.com/watch?v=UyNRzuajxLc

Humans can also experience cycles of "sound" at other frequencies and these are experienced by parts of the body other than the ear. Inaudible noises which domestic and industrial machines (high pitched or low pitched) make can affect humans. Acoustics have some times been used as a weapon against people – especially if they are not obviously aware that the acoustic waves are being targeted at them.

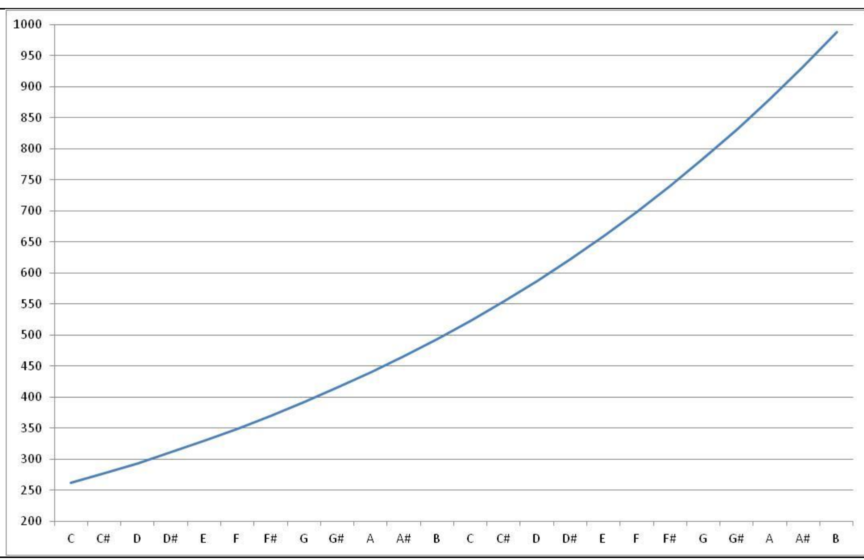


Diagram - Graph of Musical Scale Hertz to notes – Jonathan Pearson –2020 - Humanistman Public Domain

Recording sound digitally is a fairly recent human invention. The **Yamaha Sound Reinforcement Handbook** by **Gary Davis** and **Ralph Jones** is probably one of the best books written about digital sound in general *https://archive.org/details/YamahaSoundReinforcementHandbookByGaryDavisRalphJones , , Amazon https://www.amazon.com/Sound-Reinforcement-Handbook-Gary-Davis/dp/0881889008,*

Yamaha PM-1000 Manual *"This website **www.manualslib.com** (the "Site") is owned and operated by INTERNET ADVERTISING LIMITED, company registered in Hong Kong"* *https://www.manualslib.com/manual/341386/Yamaha-Pm-1000.html?page=6#manual.*

During my lifetime the sound recording and playback technology and exploration has developed at great speed. Sound continues growing as a creative industry in movies especially and many Australians have been involved in that industry as well.

Movies are now completely digital and the sound component could represent 50% of the total digital storage. Many compression and space saving techniques have been developed to save space for digital storage of sound and vision (stills and movies). Some of these claim to be "lossless" - information is not lossed (lost) – information is just recoded and "compressed". Other compression techniques have some loss which can be traded off - digital storage space – versus accuracy. Various standard **encoding** and **compression** techniques exist. See -***The Institute of Electrical and Electronics Engineers, Incorporated*** *https://www.ieee.org/.*

Compression (Simplify, abstract) is something humans do often – abstraction of same/different – categorization, etc. It is about **optimizing** on saving space and increasing speed to access. Sound systems historically were advertised as "High Fidelity" – meaning a greater level of detail – less abstraction. Speakers and systems were "matched" so the frequency range and steps were coherent throughout the sound system. Matching the impedance (Measured in Ohms) of speakers and amplifiers is especially important. Humans can take a wide collection of compressed information stored in the brain to create "higher fidelity" descriptions.

It must be remembered that digitizing information **is at best** **an approximation** in the first place. No recording device can fully capture all the information being received. The Fourier techniques are framed in a way to use averages and peaks and troughs – and many step wise investigations of the ranges within. (A continuous notion is like the trigonomic Tan function or the Calculus – differential/integral functions). The arbitrary bounds and constraints of our recording devices and techniques used to interpret and digitize (Sensitivity – precision and accuracy) – provide one framed view of the full continuum of information available. **Pulse Code Modulation** (PCM) is the name of the sound technique of bounding the digitization process of the continuous wave – essentially driven by a sampling frequency (how often the continuum is accessed in the time/distance dimension – more sampling means more accuracy and precision) and quanta bounds (smaller bounds means more accuracy and precision) – the specification of the boundaries of the amplitudes for the digitization. This general technique applies to all wave measurements.

An obvious example of making messages "quanta" is Morse code - A series of off and on pulses – short and long. You can also image the concepts of **signal to noise ratio** (peaks/troughs above the background). "*hello world" = ...-.. .-.. --- / .-- --- .-. .-.. -..*
https://morsecode.world/international/translator.html (***SC (Stephen) Phillips*** *https://scphillips.com/*)

Sometimes we **do not** **notice** information because it is swamped by background "noise"
https://humanistman.com/wp-content/uploads/2020/08/Equality-Diversity-Measurement-Notice.pdf

If we recognize that most things in the universe seem to be these energetic waves – this **repeating cycle of energy** – we can recognize that when all of these energies are being transmitted through the mass – **the ocean, for example** – that there will be times when the peaks of many waves will intersect and times when the troughs of many waves will intersect – hence we get "rogue" peaks and troughs. (Constructive "interference", Destructive "interference") https://en.wikipedia.org/wiki/Rogue_wave.

If a wave amplitude is twice the height or depth of the surrounding waves (the local average) it can be described as "rogue".

The infamous **Draupner Wave** in 1995 measured 25.6 metres.

Science Norway - Bård Amundsen *monday 16. april 2018 https://sciencenorway.no/forskningno-norway-oceans/worlds-highest-waves-form-west-of-norway/1455407*

The amount of energy in large waves at sea is enough to smash large ships.

One can also imagine theoretically that the ocean could be seen as completely flat in **two extreme situations** – there are no energy waves at all – or **all energy waves are perfectly aligned to cancel each other out**. Imagine a boiling sea – we can observe only really small ripples and movements in the surface of the sea but to us **it seems somehow full of energy** – some **potential** – some future event and pattern emerges to suggest that at sometime soon in the future the sea will "explode" or reach some "critical" point of change – a **potential** catastrophe – a large stepwise change from the sea unit (one) to something else. Is this our ability to **observe chaos** at some deep level – **straying too far** from golden ratios, perhaps? - maybe some awareness of quantum effects or patterns?? This general **awareness of potential catastrophic change** seems to be innate in some humans – hysteria feeds on it and the **potential change** does **not always certainly eventuate**. The change, itself, is neither good nor bad, but it is **noticeably binary – a bounded same/difference observation over time**. (see ***soothsayers, prophets, fortune-tellers, predictions, artificial intelligence, media commentators, algorithmic "systems"*** - those who like to foretell the future to others – they **sell certainty** to humans who gullibly believe. There is **profit in being a prophet**).

Would we **"feel"** happier if the sea was a regular set of partially chaotic waves – with occasional variances or "perfectly" flat or "perfectly" regular?

Waves of Translation – waves that seem to pass through each other without effect – other than phase changes - (**Solitons** https://en.wikipedia.org/wiki/Soliton) – also seem to be an interesting phenomenon **invoking much current research - *John Scott Russell*** *https://en.wikipedia.org/wiki/John_Scott_Russell.* It is also interesting to note this animation of the **Conchoid of Nicomedes** at **Stephen Wolfram** - *Weisstein, Eric W. "Conchoid of Nicomedes." From MathWorld--A Wolfram Web Resource.*

https://mathworld.wolfram.com/ConchoidofNicomedes.html $(x-a)^2\left(x^2+y^2\right)=b^2x^2$

Images which we know as pictures and movies are **framed through our eyes**. Visualization is one of our main abstraction techniques and we use it for the main method of taking information from a wide variety of sources. The Electromagnetic spectrum is a continuum and we use images to represent information from the full range and translate and represent it in the visual light spectrum - 380 – 740 nanometres (10^{-9} metres) 405-790 Tera (10^{12}) Hertz - so we "see" it.

Maths Is Fun - ***Les Bill Gates, Dianne Gentry, David Sevilla, Jesus Ernesto Montes***
https://www.mathsisfun.com/aboutmathsisfun.html https://www.mathsisfun.com/physics/light.html
National Aeronautics and Space Administration, Science Mission Directorate. (2010). Visible Light. from ***NASA*** *Science website: http://science.nasa.gov/ems/09_visiblelight*
https://science.nasa.gov/ems/09_visiblelight, https://en.wikipedia.org/wiki/Visible_spectrum

Frequency and time/distance all relate to each other - Temporal (Time) Frequency, Spatial (Distance) Frequency and Angular (Rotation) Frequency are all processed mathematically the same way and cohere around the concepts of circles/ellipses/cycles/waves with time/distance.

Electromagnetic Radiation varies in time/distance measurement as well – the speed of light/EMR - C (wave/particle) has a theoretical upper limit of around **299.8 Million metres per second .**

(James T. Schwiegerling, PhD March 23, 2011 The Physics of Light – the Helio group "*The* ***Wyanoke Group*** *is the parent company for* ***Healio****, Healio LIVE, Healio Strategic Solutions, SLACK Incorporated, and Vindico Medical Education." https://www.healio.com/news/ophthalmology/20120331/the-physics-of-light ,* ***Lumen Learning*** *https://lumenlearning.com/about/team/* ***Dr. David Wiley*** *Founder & Chief Academic Officer https://courses.lumenlearning.com/boundless-biology/chapter/vision/*

Light speed can be less in other media – like Diamond - **123 Million metres per second** (we know and continue to learn much more about the of photon absorption and re-emission and the propagation of EMR). Also we get relative motions of Observer and Observee (the thing being noticed) – concepts like red-shift – The Doppler Effect named after **Christian Andreas Doppler.**

*(****Goddard Space Flight Centre*** *NASA The Imagine Team Project Leader:* ***Dr. Barbara Mattson*** *Curator:* ***J.D. Myers*** *NASA Official:* ***Phil Newman*** *- A service of the High Energy Astrophysics Science Archive Research Center (HEASARC),* ***Dr. Alan Smale*** *(Director)*
https://imagine.gsfc.nasa.gov/features/yba/M31_velocity/spectrum/doppler_more.html)

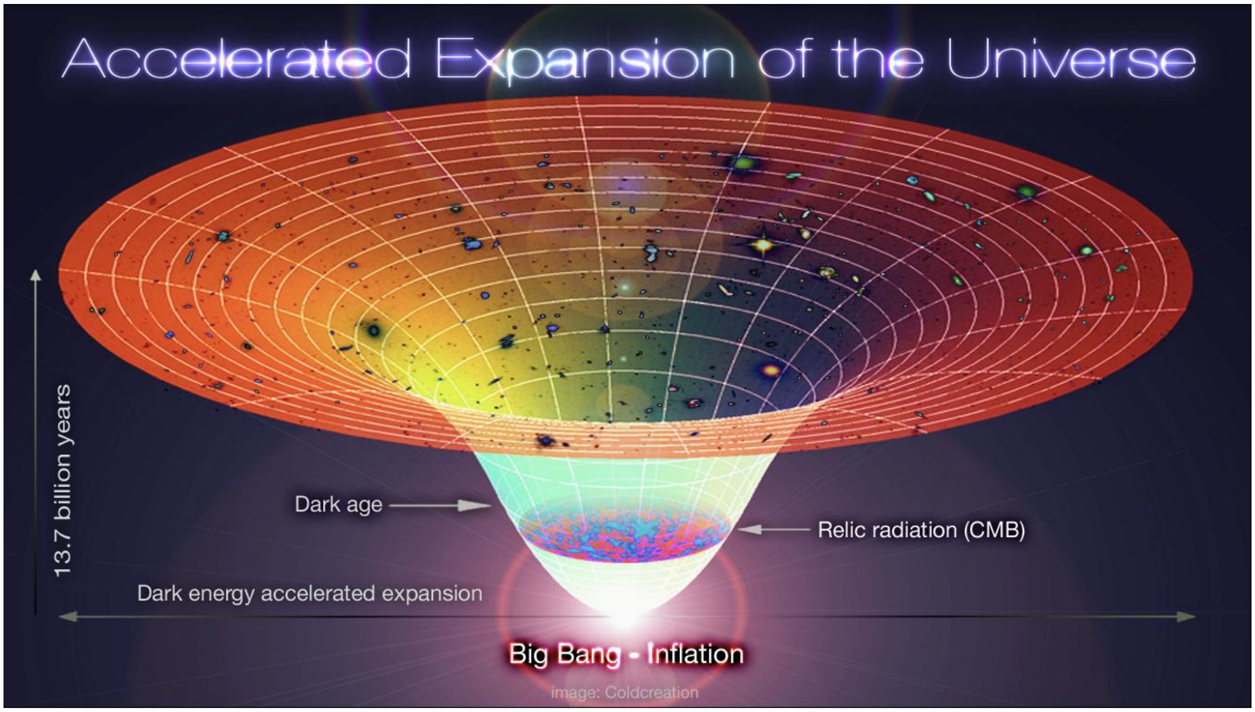
This leads to investigating Albert Einstein's Relativity.

*(****Elizabeth Landau****, NASA August 29, 2020 -* ***10 Crucial Things That Result From Einstein's Theories of Relativity****, "SciTechDaily offers the best intelligent, informed science and technology coverage and analysis you can find on a daily basis, sourcing a huge range of great writers and excellent research institutes. It was founded in 1998 by* ***Vicki Hyde****, a friend of Denis Dutton (of Arts & Letters Daily fame) and was essentially a sister site to ALDaily.com" https://scitechdaily.com/10-crucial-things-that-result-from-einsteins-theories-of-relativity/)*

So we build a relative framework to describe the context for the measurements and observations.

Why is the cosmic background radiation seen as equidistant from us in all directions we look in the sky?

https://en.wikipedia.org/wiki/Cosmic_microwave_background *The cosmic microwave background radiation is an emission of uniform, black body thermal energy **coming from all parts of the sky**… These measurements demonstrated that the geometry of the universe is **approximately flat**, rather than curved.* *https://en.wikipedia.org/wiki/Lambda-CDM_model Design **Alex Mittelmann**, Coldcreation Lambda-Cold Dark Matter, Accelerated Expansion of the Universe, Big Bang-Inflation (timeline of the universe) **CC BY-SA 3.0** File:Lambda-Cold Dark Matter, Accelerated Expansion of the Universe, Big Bang-Inflation.jpg Created: 1 January 2010.*



It is a little clearer with the diagram but I still do not understand why we see the radiation coming from all parts of the sky? Are we always the center of the universe – a la pre-Copernicus?

Or to put it another way – **if there is a place in the sky where we can look where we do not see background cosmic radiation – what would that place be? – the future? But we can't see the future – only the past – so time/space/distance/energy only travels forward – but we can see backward?**

Are we always on a FLAT surface looking out to the edges of a circle? – the circle keeps changing as time goes on – like on the surface of a black hole as explored by **Leonard Susskind**?

*https://www.youtube.com/watch?v=2DIl3Hfh9tY **Leonard Susskind** on **The World As Hologram** 4,003,837 views •Nov 4, 2011*

Sloan Digital Sky Survey - No need to Mind the Gap: Astrophysicists fill in 11 billion years of our universe's expansion history July 19, 2020 *The SDSS map is shown as a rainbow of colors, located within the observable Universe (the outer sphere, showing fluctuations in the Cosmic Microwave Background).*

We are located at the center of this map https://www.sdss.org/press-releases/no-need-to-mind-the-gap/

So if Red light is "slowed down" or "travels less distance" due to the media or Doppler affects – is it still red light – despite the fact we might observe it as a different frequency or energy – a different colour? When it escapes the "ether" where it is slowed down and speeds up again how should we describe it? Its frequency, speed other characteristics (energy?) are all different depending on the frame around it – the "stuff" it is in context with. https://en.wikipedia.org/wiki/Redshift - things are shifted lower (red) and higher (blue) – what we see as radio waves may be shifted from gamma waves, light or x-rays. How would we know if it was slowed down or our relative speeds were different and by how much – what measurement could we trust? The only way we can "see" the frame is by seeing what comes through it. This is what relativity tries to explain.

Sloan Digital Sky Survey *- https://www.sdss.org/ Sloan Digital Sky Survey, and found that gravitational redshift does happen —* ***exactly in line with Einstein's theory of general relativity.*** *Space.com - Proof Is in the Cosmos:* ***Einstein's General Relativity Confirmed*** *- By* ***Clara Moskowitz*** *September 28, 2011.*

This work was published in a Nature paper.

Published online 26 May 2003 | ***Nature*** *| doi:10.1038/news030519-10 News Dark matter's pull spotted Sky survey shows Universe's* ***unseen stuff shifting galaxies****.* ***Geoff Brumfiel*** *https://www.nature.com/news/2003/030519/full/news030519-10.html*

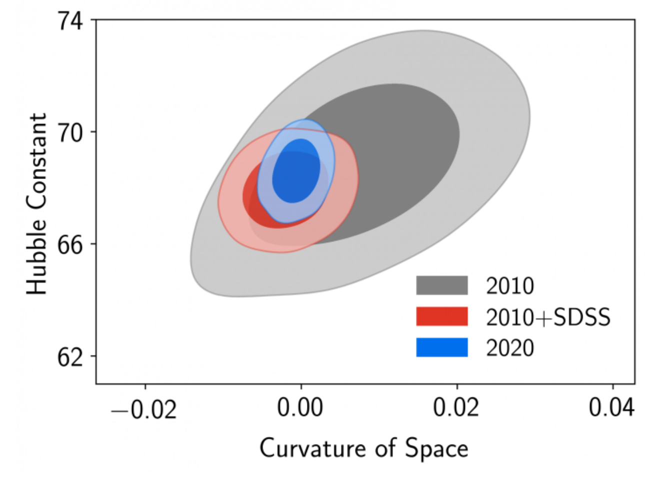
https://www.nature.com/articles/nphys2123 Published: 03 October 2011 ***Shift happens*** *-* ***Alison Wright***

https://www.nature.com/articles/477541a Published: 28 September 2011 Cosmology ***Gravity tested on large scales Gary Wegner*** *.* **Cornell University** *"****arXiv*** *is a free distribution service and an* ***open-access archive*** *for 1,815,395 scholarly articles in the fields of physics, mathematics, computer science, quantitative biology, quantitative finance, statistics, electrical engineering and systems science, and economics. Materials on this site are* ***not peer-reviewed by arXiv****." https://arxiv.org/pdf/1109.6571.pdf*

Gravitational redshift of galaxies in clusters as predicted by general relativity *-* ***Rados law Wojtak****,* ***Steen H. Hansen*** *&* ***Jens Hjorth*** *Dark Cosmology Centre,* ***Niels Bohr Institute****, University of Copenhagen, Juliane Maries Vej30, DK-2100 Copenhagen Ø, Denmark https://arxiv.org/pdf/1109.6571.pdf*

No need to Mind the Gap: Astrophysicists fill in 11 billion years of our universe's expansion history *July 19, 2020* ***(Fair use - Press Release)*** *https://www.sdss.org/press-releases/no-need-to-mind-the-gap/ The Sloan Digital Sky Survey (SDSS) released today a* ***comprehensive analysis of the largest three-dimensional map of the Universe ever created, filling in the most significant gaps in our possible exploration of its history…****This map represents the combined effort of more than 20 years of mapping the Universe using the Sloan Foundation telescope. The cosmic history that has been revealed in this map shows that about six billion years ago, the expansion of the Universe began to accelerate, and has continued to get faster and faster ever since. This* ***accelerated expansion seems to be due to a mysterious invisible component of the Universe called "dark energy," consistent with Einstein's***

General Theory of Relativity *but extremely* ***difficult to reconcile with our current understanding of particle physics****…"Only with maps like ours can you actually say for sure that there is a* ***mismatch in the Hubble Constant****," says* ***Eva-Maria Mueller*** *of the University of Oxford, who led the analysis to interpret the results from the full SDSS sample. "These newest maps from eBOSS show it more clearly than ever before."*



This image illustrates the impact that the eBOSS and SDSS maps have had on ***our understanding*** *of the* ***current expansion rate and curvature of the Universe*** *from the last 20 years of work. The gray region shows our knowledge as of 10 years ago. The blue region shows the best current measurement, which combines SDSS, eBOSS and other programs.*

See below for a more complete caption.

Image credit: ***Eva-Maria Mueller (Oxford University) and the SDSS Collaboration***

What I do not understand (of many things) – is the new map shows clearly the different radiation measurements – the wavelengths, frequencies (pulsars) and the background microwave radiation (**George Smoot's** work - **Nobel Foundation** - https://www.nobelprize.org/prizes/physics/2006/smoot/facts/) and the various groupings of galaxies appear in a pattern – apart from the empty bits because "the milky way "gets in the way"" of observations – the pattern - from **our observational perspective** shows **equidistance/space/time shift from our point of observation**. **What does this mean?** To me it seems an obvious question that if we are "seeing" **Quasar** like observations very far away -

(Black Holes – **Earthsky -** ***Deborah Byrd*** *created the EarthSky radio series in 1991 and founded EarthSky.org in 1994. Today, she serves as Editor-in-Chief of this website. - A quasar Milky Way six million years ago? Posted by* ***Deborah Byrd*** *in Space | September 4, 2016 https://earthsky.org/space/a-quasar-milky-way-six-million-years-ago)*

- then why are we not seeing **Quasar like** observations VERY CLOSE TO US AS WELL (not just at the centre of galaxies?) If there are these "highly energetic" sources – why only distant? - **what are their equivalents in OUR LOCAL AREA?** Is it possible that we cannot see black holes nearby for some reason of our local frame? If the milky way black hole is mainly "dormant" – then what do small, dormant black holes look like – radiation is not being emitted – how would we know they were there? The gravity effects may be too small to notice against the highly energetic local activity of mass, energy, rotation, etc. **I don't even know what questions to ask!?**

With physical objects, which emit electromagnetic radiation, we notice two different types of Frequency. Firstly there is the electromagnetic EMR **frequency ranges emitted** by an object (for example – the sun) and then the frequency which **we observe** the relative cycles of the physical object (the sun). The Sun to us seems to have a 24 hour cycle as our earth rotates. It also seems to have a "nearly" annual cycle (there is that pi again). Its Electromagnetic radiation is wide ranging by its Hertz – cycles per second is 1/86400 Hertz = ~ 115 Milli (10^{-3}) Hertz. So its cycle of observation in Hertz (earth rotating and revolving) is one type of frequency measurement – and its emitted electromagnetic radiation ranges is another type of frequency measurement.

We notice **Pulsars** (neutron stars) as rotating bodies emitting radiation at different frequencies – they rotate at a frequency and emit in ranges of frequencies.

(COSMOS the SOA Encyclopedia of Astronomy - Swinburne University of Technology https://astronomy.swin.edu.au/cosmos/P/Pulsar) , (CSIRO Australia Telescope National Facility *An Introduction to Pulsars Article by:* ***Maryam Hobbs (ATNF)*** ***Copyrighted – Non Commercial Fair Use extract*** *https://www.atnf.csiro.au/outreach/education/everyone/pulsars/index.html* .."***More than two-thirds of the currently known pulsars*** *were discovered using the* ***Parkes radio telescope*** *(the star of the film "The Dish"). The enormous Arecibo radio telescope in Puerto Rico"* (now being de-commissioned – article on **American Association for the Advancement of Science – science mag website** *Famed Arecibo telescope, on the brink of collapse, will be dismantled By* ***Daniel Clery*** *Nov. 19, 2020 , 11:30 AM* https://www.sciencemag.org/news/2020/11/famed-arecibo-telescope-brink-collapse-will-be-dismantled) *", the Green Bank telescopes in America, the* ***Molonglo telescope"*** (Hoskinstown) *" in Australia and the* ***Jodrell Bank telescope*** *in England have also made significant contributions in discovering pulsars."…*

Fast Radio Bursts – FRBs have been detected outside our galaxy as **single events** so it may be that they are cyclic events that **we** simply **cannot live long enough to notice** or they may be single events. How would we know?

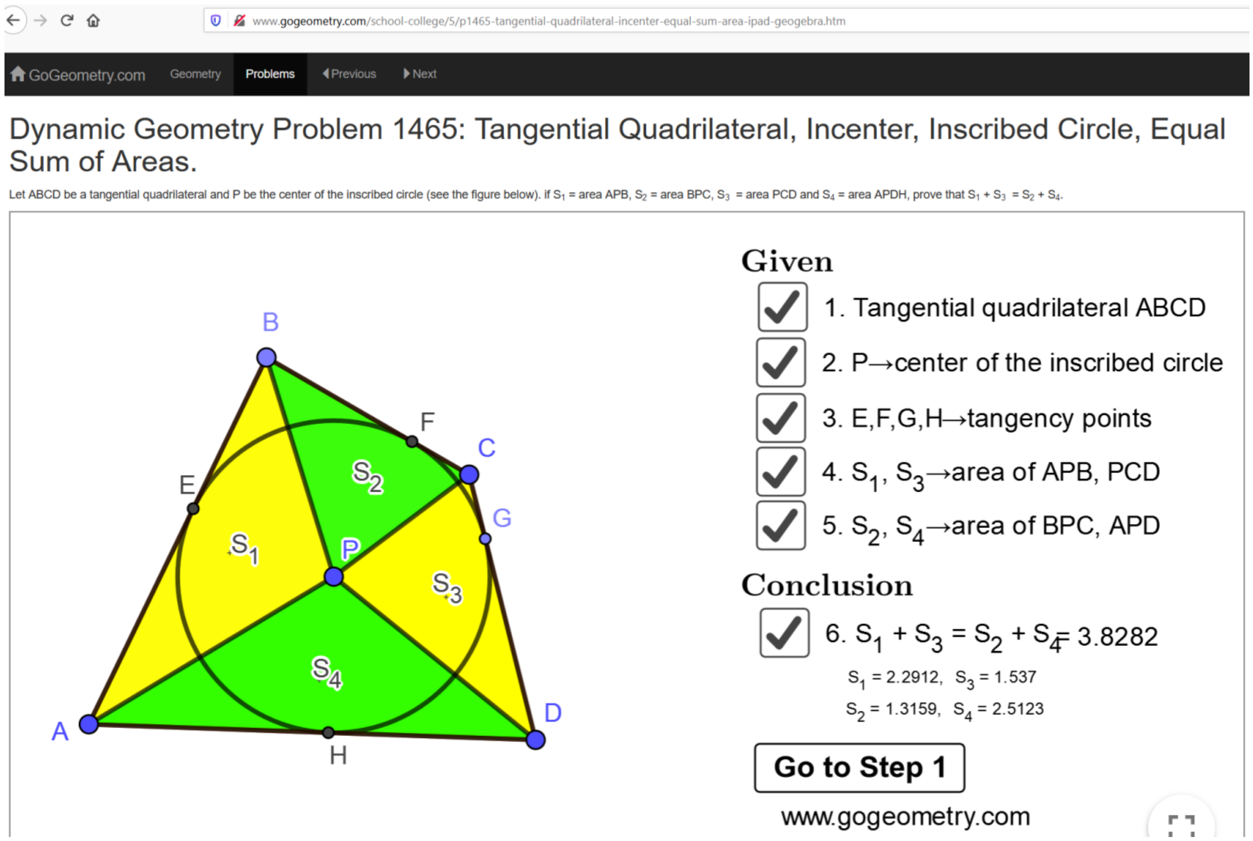
So while we have the Electromagnetic Spectrum cyclical issues we also have to explain cyclical rotating masses – and this is where Einstein's' Gravitational Waves comes in.

Kepler, Newton, Einstein and many others all explored the mathematic relationships between orbiting masses – **Ernest Rutherford** at the atomic level and then quantum physics. This wave function – cycles of repeated patterns - sine/cosine triangulation seems to appear as does pi – all very similar models, equations and relationships but all named and represented in slightly different ways. It is a huge undertaking to assess all of the collected research and information – **finding** the **cohesive** and **coherent** things **worth noticing** from all published material is not a simple task.

Moving pictures - Movies show images through time. The ability to store and repeat moving pictures allows us to re-examine images as they change over time. This has been a **major analytic improvement** for humans and can be compared to large historical constructions (Stonehenge, Pyramids, etc) used to mark repeated patterns of events – images – the place where the sun rises – through time. **Prediction** emerges from this patterning and cyclical repetition framework. We notice **probability** as well when predicted patterns do not happen.

We can also show abstractions – using symbols like lines, circles and triangles - geometry. Geometry has become more interactive with computer programs which show variations over time or with different values in formulas.

Geometry from The Land of the Incas ***Antonio Gutierrez.***
http://www.gogeometry.com/problem/index.html **Example - Fair use**

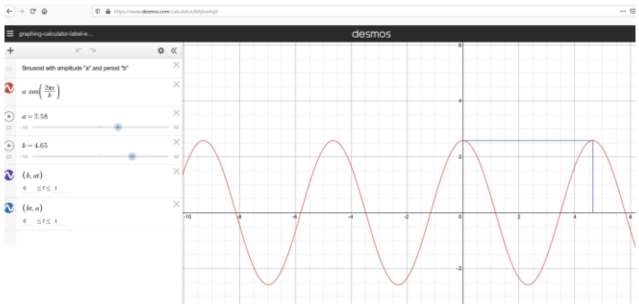


John Conway's Life program was one of the first computer systems to explore progression of simple shapes through iterations of certain rules. The types of repeated patterns seemed to emerge – **Still life** – shapes that remained stable, **Oscillators** – shapes that iterated through patterns (cycles) in the same space – **Spaceships** – oscillators which moved through space

John Horton Conway :Year(1937-2020) :Keyword(Maths)
https://en.wikipedia.org/wiki/John_Horton_Conway
https://en.wikipedia.org/wiki/Conway%27s_Game_of_Life https://www.conwaylife.com/

Some computer education tools allow models to be constructed and transformed using rules and formulas.

(***GeoGebra** is dynamic mathematics software https://www.geogebra.org/?lang=en-AU , **Desmos** "Desmos wants to build a world where every student learns math" https://www.desmos.com/team https://www.desmos.com/geometry* **Example - Fair use**



The artist **M.C. Escher** investigated **Tessellations** for many years – historically tile patterns date to Sumerian, Mesopotamia, Islamic, Rome and many other cultures – at least 4000 b.c.

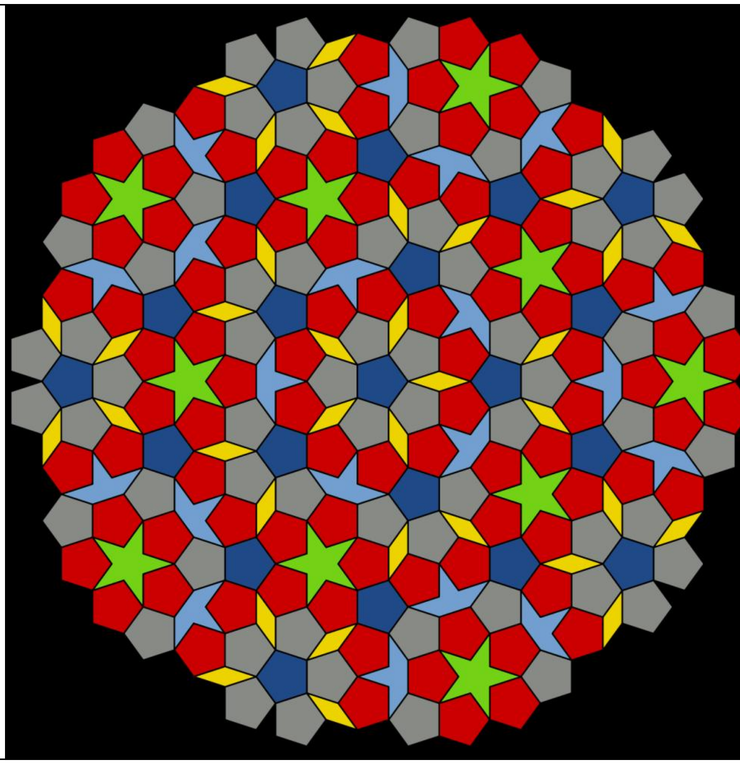
*"Welcome to **mcescher.com**, the official website published by the M.C. Escher Foundation and The M.C. Escher Company. We hope you enjoy this website and the wonderful art M.C.Escher has given us. f you want to use any of the work of M.C. Escher – as illustration in a book, magazine, an advertisement campaign, brochure, or on the Internet – you **must submit a request to our Copyright department**."*

Maurits Cornelis Escher :Year(1898-1972) :Keyword(Art) **https://mcescher.com/**
https://en.wikipedia.org/wiki/M._C._Escher https://www.wikiart.org/en/m-c-escher

Escher's work seems inspired by **Kepler's monsters** (tiling patterns of regular shapes) in his 1619 book *Harmonices Mundi.*

Harmonices Mundi :Author(**Johannes Kepler**) :Year(1619) :Keyword(Group Science Maths)
https://en.wikipedia.org/wiki/Harmonices_Mundi
https://archive.org/details/ioanniskepplerih00kepl/page/n13/mode/2up https://www.sacred-texts.com/astro/how/index.htm https://mathworld.wolfram.com/KeplersMonsters.html

Sir **Roger Roger Penrose** investigated Tiles – to find limits and repeated patterns - for many years. He discovered a form of tiling which fits – no gaps – but never fully repeats – **Aperiodic Tiling**.
https://en.wikipedia.org/wiki/Penrose_tiling There are many forms of these and they are called Penrose Tiles. The original one below contains 6 different "prototiles"

	(***Inductiveload** - Own work I, the copyright holder of this work, release this work into the **public domain**.)* https://en.wikipedia.org/wiki/Penrose_tiling Based on Roger Penrose's work.

Roger Penrose :Year(1931) :Keyword(Science) https://en.wikipedia.org/wiki/Roger_Penrose https://www.researchgate.net/scientific-contributions/Roger-Penrose-78762014 https://penroseinstitute.com/

Plato had already discovered that there were **only 5 three dimensional shapes** (Tetrahedron (4 triangles), Cube (4 squares), Octohedron (8 triangles), Dodecahedron (12 Pentagrams), Icosahedron (20 Triangles)) which could be constructed from regular polygons – the **platonic solids** https://en.wikipedia.org/wiki/Platonic_solid

Archimedes had investigated many things including **tiling of shapes** to form a square **Ostomachion -** https://en.wikipedia.org/wiki/Ostomachion

Geometry – especially two and three dimensional shapes – has been a fundamental area of study for humans in science, math, architecture, art, etc - **Elements** :Author(**Euclid**) :Year(-300) :Keyword(Group Philosophy Maths) https://archive.org/details/thirteenbookseu03heibgoog http://www.gutenberg.org/ebooks/21076 https://en.wikipedia.org/wiki/Euclid%27s_Elements

In my lifetime I have seen the growth of computers – computer games from simple maze games into full movie type games with characters, plots, landscapes in 3d and music and sound. Digital production and recording of information now spans many genres and facets of life.

Integer Sequence Formula Classification System

Formulas used to produce integer sequences need to be classified – so I can understand similarities and difference – **so I can notice** changes and what seems interesting and important. If there are millions of formulas which produce number sequences – how can I **make sense of them** unless I can **group** them and **order** them some way?

What is the meta model for formulas? I don't like everyone else's names – it just seems a *mish mash* to me – it seems too messy and convoluted – can it be simplified?

https://en.wikipedia.org/wiki/Integer_sequence, https://oeis.org/wiki/Integer_Sequences_Overview ***Journal of Integer Sequences*** *https://cs.uwaterloo.ca/journals/JIS/ ,* ***Directory of Open Access Journals*** *https://doaj.org/ , Classification of N Elements Sequence A005646, Classifications of N Elements* ***Robert Munafo*** *http://mrob.com/pub/seq/a005646.html , http://mrob.com/pub/math/numbers.html*

Stephen Wolfram is looking at metamodels https://writings.stephenwolfram.com/2020/09/the-empirical-metamathematics-of-euclid-and-beyond/

Is this a simple meta model?

- starts at zero or one
- tends to a value , tends to infinity, limit or cycle, convergent/divergent
- Number of sequences (groups) produced
- Number of variables (not constant) used
- Number of constants used
- Math operations (dance instructions) used – initial **self-reference** (**is** – declaration of number line choice and base - **order**) ,counting (bounding – **constraints**),counting (direction/**choice "forwards+"/"backwards-"**), **linking**, summation (plus, minus), mod, multiply (iteration, **recursion)**, power, bracketing (**grouping**), **order** (sequence (**hierarchy**)), ratio, divide, trig (sin,cos,etc),
- Math constants used – *e*, pi, i

One simple sequence is the positive integer line. A simple **theorem/(formula with variables and operators)** which can be **hypothesized** to express an **equation** (equality) to declare the **Sum operation** of a **sequence of integer numbers** from the start of the series up to a certain integer in the sequence was demonstrated in this example in an article on ***thought experiments*** from **Stanford Encyclopedia of Philosophy** website (I find it noteworthy because it contradicts the **Ramanujan** statement which I explore later in this paper – also too the **Riemann Zeta Function** – see **Mathologer** - https://www.youtube.com/watch?v=YuIIjLr6vUA)

Brown, James Robert *and* ***Yiftach Fehige***, ***"Thought Experiments"***, *The Stanford Encyclopedia of Philosophy (Winter 2019 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2019/entries/thought-experiment/>.*
https://plato.stanford.edu/entries/thought-experiment/

I also notice - The **Golden ratio** (phi) **may be**? a least energy / best choice option (1 + square root(5))/2) ***Numberphile –Ben Sparks*** https://www.bensparks.co.uk/ - https://www.youtube.com/user/numberphile (see the derivation, flowers, choices and turns – packing of seeds https://www.youtube.com/watch?v=sj8Sg8qnjOg *): 1 + 1/Φ = Φ (mrob -* ***Robert Munafo*** http://mrob.com/pub/math/numbers-2.html *)*

- *X = 1 + 1/X (Take your next step as one (unit yourself) - in ratio to/ over /divided by -your last step? - remainders of 1 recursive)*
- *X^2 = X + 1 (multiply both sides of the equals (=) by x)*
- *X^2 - X - 1 = 0 (subtract X and 1 from both sides)*
- *(x- ½) *(x- ½) -¼-1 = 0 (**refactor by quadratic equation (x- ½)^2** Which = x^2-½x – ½x +¼ – so then you have to subtract ¼ and you still have the minus 1 – so the equations are still the same – just refactored.*
- ***(x- ½)$^{2 = 5/4}$ (adding 1 and ¼ to both sides , 1 and 1/4 = 5/4)***
- *x- ½ = +or- Square root (5) over 2 (2 is square root of 4) (take square root of both sides)*
- *x = ½ +or- Square root (5)/2 (adding ½ to both sides)*

$$\phi = \frac{1+\sqrt{5}}{2}$$

Also note that: **Phi – 1 = 1 / Phi**

Note that **John Napier**'s number, **Leonhard Euler**'s ***e*** number can be represented by summing the series **(1 + 1/n)^n**

- **looks similar** to the **golden ratio initial formula** *X = 1 + 1/X and Φ =1 + 1/Φ.* - i.e. **? = (1+1/x)^x**

both suggesting a step towards infinity. ***Maths is Fun*** https://www.mathsisfun.com/numbers/e-eulers-number.html *.* This **power law issue** and **initial self reference** seems to have been recognized by **George Boole** and **Benjamin Peirce** (page 13 Linear Associative Algebra - concepts "nilpotent" , "idempotent" https://ia802305.us.archive.org/17/items/linearassocalgeb00pierrich/linearassocalgeb00pierrich.pdf) **.**

Things Noticed

- mathematical statements which produce number series can appear in many different forms but really be the same thing. This **makes it difficult for me** to explore everything and tell what the differences are between the large number of hypothesis/conjecture/theorem/lemma/postulate/proposition/axiom/equation/statement/function/sequence/relation/identities/variables/constants/methods/patterns/operations.
- The statement for the golden ratio of: x= 1+1/x seems to me to be the most simple and elegant statement of **initial self reference**, **recursion** and **optimal growth that could be expressed.** The

new version of 1 (unity) becomes X - increases by a standard growth factor at each stage of growth.

- Living cells growth seems to follow two types of paths – **rapid initial divide by two** and **grow until next divide phase** and divide by two again – a kind of "*squaring*" doubling multiplication function and a much less rapid cell replacement process of selected cells are required rather than a rapid doubling of the whole organism. Maybe these correspond to sequences we see in life like the Levy distributions and similar – Benford, Zipf, Gauss, central Limit theorem and Golden Ratio, Fibonnacci? A **difference** between "**doubling**" and "**growing**"?
- Are the Growth Functions and Decay Functions the same thing in opposite directions? Is the mathematics exactly the same?
- The **initial self-reference** problem and **recursion** problem are reflected in the formulas $(1+1/x)^x$ and the others – saying the same thing – the recursive power function – a thing to itself. Euler's identity is the same – it just uses the infinity symbols e and pi – with i for direction. 2^n-1 – is the same as well - instead of imbedding the "root 2" concept it imbeds the **declared** 2 concept – philosophically stating 2 as the starting point. Pytahgoras imbeds it in the equation *thing squared + thing squared = new thing squared.*

An interesting "identity" worth exploring **Brahmagupta-Fibonacci Identity** (Previously noted by Diophantus, later **Euler** and **Lagrange** and **Fermat**) https://en.wikipedia.org/wiki/Brahmagupta%E2%80%93Fibonacci_identity

Alexander Bogomolny http://www.cut-the-knot.org/m/Algebra/BrahmaguptaFibonacci.shtml *...* **Copyright – Partial Extract – Non Commercial - Fair use** *..."65 is "naturally" divided into two squares in two ways ... due to the fact that 65 is the product of 13 and 5, each of which numbers is the sum of two squares." ..*

Which seems to me to be closely related to the central limit theorem as well – indeed (Sherlock) maybe the concept of two separate life organisms combining and cooperating to generate a new result. **"$65=5\cdot13=(2^2+1^2)(3^2+2^2)$"** *Dot product https://www.mathsisfun.com/algebra/vectors-dot-product.html.*

So this is only interesting to me – it has **some meaning** to me – because I **can relate** the statement to another statement about the central limit theorem and that I relate the central limit theorem to measurements on observations about many real life collections. Without being able to **link this information together** – it has little meaning by itself.

A little note on multiplication operation – dot product/scalar product, cross product – different meanings – are more familiar to SQL type syntax based on **set theory** (and probably group theory as well – it depends who "owns" the definition of that term) – which multiplication of bracketed items represents – a kind of **imbedded set theory** within mathematical expressions. These math notations relate to the set theory concepts of INNER JOIN – and order (where sequence is important) LEFT OUTER JOIN and RIGHT OUTER JOIN and the concept of PRODUCT JOIN (everything "multiplied" by everything) or FULL OUTER JOIN. In set language, visualized sometimes using **Venn** Diagrams, the INTERSECT and similar set operations are also related concepts.

Set theory (**Georg Cantor** – formalizing infinity) is used now as the basis of "all" math.

***Bagaria, Joan**, "Set Theory", **The Stanford Encyclopedia of Philosophy** (Spring 2020 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/spr2020/entries/set-theory/>.*
https://plato.stanford.edu/entries/set-theory/

Set theory is **appropriate** when looking at sequences. **Bertrand Russell** would note when quoting **Frege** that Set, Collection, Class, Group, Manifold, Aggregate are all conceptually related. The **number three** describing a trio – a **collection** - is different to the number three – representing the **third element** (counting/countable) - for example. Collection/group versus Uniqueness/position.

What **Georg Cantor** did was **formalize a definition of infinity** by declaring some axioms and that the idea of COUNTING (using natural numbers 1,2,3..) is impossible for the REAL number line. The Real number line **does not have** a ONE to ONE correspondence with the Natural number line. https://en.wikipedia.org/wiki/Cantor%27s_theorem - this allows the inclusion of infinity - not as a repeating process – but as something which can be symbolically mathematically manipulated – as an UNCOUNTABLE INFINITE set. **Sir Isaac Newton**, **Gottfried Wilhelm (von) Leibniz** (fluxions – infinitesimals, in-betweens) – "limit approaching" – all get **neatly declared**, defined and linked with other math concepts and language.

Essentially - he was moving the **INITIAL SELF-REFERENCE** problem (**we all have to start somewhere**) to a place around infinity. And then having **declared that** as the **CONSTRAINT**, was able to have infinite infinities – the **RECURSIVE** operator – the operation on itself. The axiom of infinity, **Continuum Hypothesis** emerges from his work **(David Hilbert**'s first problem) and is the basis on which most humans will generally operate - there is **always a choice** – there **is the unknown** – there **is infinity** – **no real thing is perfect** – it is not possible to know all possibilities, etc. Neither proved or disproved (**certainty**) these become our **best working hypothesis.**

Nevertheless – this slight improvement/change/insight in bounded certainty (as recursive and self-referential as it was) – was enough for some in the **business** of **uncertainty and choice** – to become agitated and **Georg Cantor** experienced some criticism. The closed/open/fatalistic/deterministic/completeness/P-NP universe **problem remains**.

To me now - reading this - it seems clear that the **arbitrariness** of bounds and constraints – while assumed by most tends to be overlooked in some kind of **blind spot**. Things seems to emerge as the philosophical debate about the 'universe' rather than any new insight or utility of the model.

Joseph-Louis Lagrange - Lagrange's identity and vector calculus
https://en.wikipedia.org/wiki/Lagrange%27s_identity .."*In three dimensions, Lagrange's identity asserts that if a and b are vectors in ℝ3 with lengths |a| and |b|, then Lagrange's identity can be written in terms of the cross product and dot product:[6][7] "…*

All of these are related to the idea of complexity and linking/joining. It seems to me that there is **entrenched bias** in many of the equations which seem to be overlooked – that the **hidden trick or technique** is **so easily assumed** that it no longer is noticed. That is why we need **questions and exploration** to re-check and explore new avenues/doors/choices that we have long forgotten were even there.

I have no problem with https://mathworld.wolfram.com/DegensEight-SquareIdentity.html **Degen's Eight-Square Identity** and related ideas – it is just this reaffirmation of the binary and twos idea. These steps – the **doubling** and linking. The equations mean nothing by themselves – it is all a **round** an inbuilt cohesive bias (or set of them!) where **like feminists and other extremists** at a war strategy meeting – **everyone is agreeing with themselves!!**

Relating the math to real life patterns is enlightening.

The Golden ratio seems to me to be a ratio which helps to optimize life choices in a two dimensional frame. It might be the **extreme** of Fat, Dumb and Lazy - the **least exploration** option. It might also apply in multi dimensional frames as well. **Ben Sparks** from **Numberphile** shows flowers and seed production as an example. Maybe for a flower to optimize packing and reduce energy – but maybe it also applies for bodies which move – not just plants. The Golden ratio and the Fibonacci series are related and may be noticed in many real world things (rabbit populations, etc). **Dr. Ron Knott** highlights many of these http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Fibonacci/fibnat.html.

So if a life form can **MOVE** – then it might need to make choices of direction – forward backward – left right – we already seem to imply at least a two dimensional environment and hence we get the "circle" or the idea of rotating around the life for – the life form can **ROTATE** – and re- orient itself to a new direction choice.

One thing to notice is that the amount to rotate is often the same "step" – the **same ratio** – so regardless of the frame or how many prior moves or choices have been made – the life form only needs **standard mechanisms** to optimize choices.

There has been much study of bees and how they fly and search for honey sources and there are multiple hypotheses - around best search algorithms https://en.wikipedia.org/wiki/Search_algorithm , *"**Towards Data Science Inc**. is a corporation registered in Canada. Using Medium, we provide a platform for thousands of people to exchange ideas and to expand our understanding of data science. "Top Algorithms and Data Structures You Really Need To Know **Jason Roell** Dec 21, 2017 https://towardsdatascience.com/top-algorithms-and-data-structures-you-really-need-to-know-ab9a2a91c7b5* **Copyright - Extract Fair use – Non Commercial** *"Searching - Roughly speaking, there are two categories of search algorithms you'll need to know right away: **linear** and **binary**. **Depth First** Search (DFS) and **Breadth First** Search (BFS)"*

Levy Flight - https://en.wikipedia.org/wiki/L%C3%A9vy_flight_foraging_hypothesis

foraging, searching, etc - much of this is based on Levy flight and related concepts https://en.wikipedia.org/wiki/L%C3%A9vy_flight. ..”*Lévy flights are, by construction, Markov processes. For general distributions of the step-size, satisfying the power-like condition, the distance from the origin of the random walk tends, after a large number of steps, to a stable distribution due to the generalized central limit theorem, enabling many processes to be modeled using Lévy flights.*

*The term **"Lévy flight"** was coined by **Benoît Mandelbrot**,[1] who used this for one specific definition of the **distribution of** step sizes. He used the term **Cauchy flight** for the case where the distribution of step sizes is a Cauchy distribution”* (called also Lorenz, Breit–Wigner – Poisson, La place, etc) “ *,[2] and **Rayleigh flight** for when the distribution is a **normal distribution**[3] (which is not an example of a heavy-tailed probability distribution).*

Later researchers have extended the use of the term "Lévy flight" to include cases where the random walk takes place on a discrete grid rather than on a continuous space.[4][5]

*The particular case for which Mandelbrot used the term "Lévy flight"[1] is defined by the survivor function (commonly known as the **survival function**) of the distribution of step-sizes, U.”….*

Many advanced life form uses a variety of techniques for searching – depending on their success rates.

What amazes me is that **Benoit Mandelbrot** had already investigated this Levy Flight idea in *Mandelbrot, Benoit B. (1982). **The Fractal Geometry of Nature** (Updated and augm. ed.). New York: W. H. Freeman. ISBN 0-7167-1186-9. OCLC 7876824. https://archive.org/details/fractalgeometryo00beno*

I recently explored this idea using the Mandelbrot formula and the idea of an “explorer” sent out to dig and search in a structured pattern. I was unaware of Mandelbrot’s knowledge of this at the time – or maybe I was aware but forgot. The point being is that my interpretation of the Mandelbrot formula representing an “explorer” doing searches – aligns very well with Mandelbrot’s research and ideas about the process. Maybe he states this somewhere explicitly – yet I still appreciate the coincidence. https://humanistman.com/wp-content/uploads/2020/08/Equality-Diversity-Measurement-Notice.pdf

One of the current (as of 2020) explorers in search optimization techniques (especially using models from nature) is **Xin-She Yang** *:Keyword(Math, Computing)* ***Middlesex University London*** *- https://www.mdx.ac.uk/about-us/our-people/staff-directory/profile/yang-xin-she https://ieeexplore.ieee.org/author/38104337900* **Copyright - fair use – research and education – partial extract** *“He has been the chair of the **IEEE** Computational Intelligence Society Task Force on Business Intelligence and Knowledge Management and was listed as a **highly cited researcher** by Web of Science/Clarivate Analytics for four consecutive years (2016–2019)“ https://www.researchgate.net/publication/344443170_Nature-Inspired_Optimization_Algorithms_Second_Edition* who worked at the prestigious NPL – **National Physical Laboratory** https://www.npl.co.uk/ (where Turing worked).

Mandelbrot modified and generalized the Zipf Law - https://en.wikipedia.org/wiki/Zipf%E2%80%93Mandelbrot_law and brought in the same concepts of the **Pareto distribution** (**Vilfredo Pareto**) so it is sometimes called the **Pareto-Zipf law**. Conceptually to me it seems that the Zipf least cost type distribution applies in a **closed universe** – where there is a fixed number of highly constrained number of options (like a dictionary of words, numbers of people). But where the degrees of freedom are wider we get closer to the central limit theorem. This supports my general conceptual model of the bounds of choice looking like the **normal curve** (Gaussian - **Johann Carl Friedrich Gauss** 1777 -1855) and the **Zipf curve**. Additionally we see **Newcomb** (**Simon Newcomb** 1835-1909) **– Benford** (**Frank Albert Benford Jr.** 1883-1948) **law** looking a little like **Zipf's Law** (**George Kingsley Zipf** 1902=1950) because the Integer Number line is a closed and fixed set – infinite – but constrained and defined.

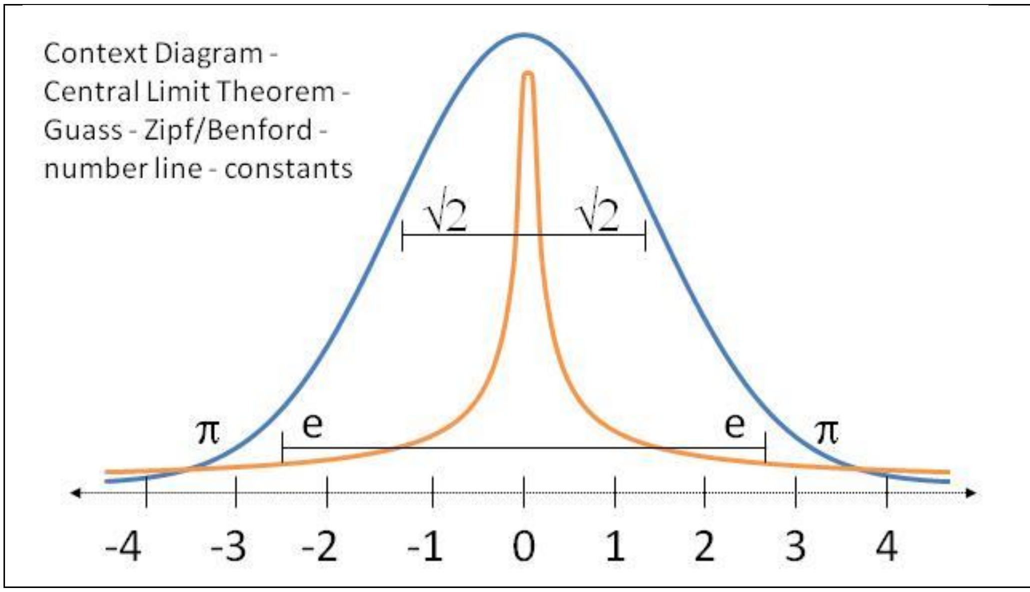


Diagram – Context of distributions by infinity constants – Jonathan Pearson –2020 - Humanistman Public Domain

I had already noticed the double gamma type function – the twist in the curve – the change from order into chaos and exploration https://humanistman.com/wp-content/uploads/2020/07/Optimizing-Between-Extreme-Distributions-Social-Justice.pdf .

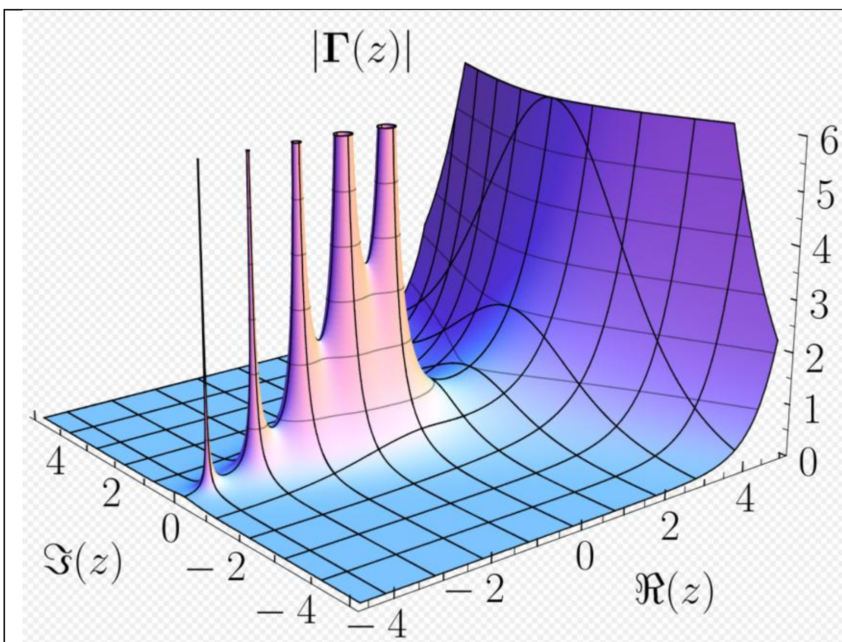
But it seems that this double gamma and other related functions have been around a while to try to explore the complex things we see. **Mandelbrot** did very impressive exploration and explanation of the maths around this. Others like https://en.wikipedia.org/wiki/Hurwitz_zeta_function by **Adolf Hurwitz** (I know nothing about his work) – but his work is significant and seems to be similar to the things I have glimpsed as well – although he seems to have deep knowledge and know what he is talking about – I am just exploring as best I can.

https://en.wikipedia.org/wiki/Hurwitz_quaternion **Adolf Hurwitz** ended up with a number system – the **quarternion** – which also seem to be exploring the idea that there is some very neat way – some number system – which is simple and a **solid dance floor** – with which to describe the numbers – specifically to overcome multiplication and division type issues and still have the concept of a starting point and **dance instructions** which take you along a path. These systems recognize the problems with the current basic math nomenclature and the precise interpretation of the "instructions". This was demonstrated by **Numberphile**'s program (Created by **Brady Haran** https://www.bradyharanblog.com/)– **notice** **Neil Sloane** on Dungeon numbers – and how reading powers in **different order** changes the answer ***Dungeon Numbers*** *– Numberphile 229,254 views •Jul 29, 2020* *https://www.youtube.com/watch?v=xNx3JxRhnZE* .

This is also alluded to by https://en.wikipedia.org/wiki/Riemann_surface by **Bernhard Riemann** - who was trying to reduce complexity to a "neat" dance floor for math. And so here I am exploring the most complex area of maths – or at least uncovering those who are – all trying to simplify and make sense of the complex world we see. E.g. **Eisenstein Integer** https://en.wikipedia.org/wiki/Eisenstein_integer.

The recurring theme of all of these equations, hypotheses, functions and groupings from all the mathematicians around this is that theytend to contain the standard math constructs to describe the formulas – pi, ***e***, i (square root of minus 1) and/or trigonometric functions. The power laws are also well used. Some will ignore the number plane – ignore the spacial world – and try to simplify numbers to a non dimensional construct (the pure line - as **Aristotle** does) – and here we get the reminders of **initial self-reference** and **recursion**.

Hurwirtz https://en.wikipedia.org/wiki/Hurwitz%27s_theorem_(complex_analysis) and **Riemann** combined, explore complexity and we see the same bi graph which **seems to me** to express this **twist** between order and stability – especially into **a solid pair** and **chaos/exploration** https://en.wikipedia.org/wiki/Riemann_mapping_theorem - almost like seeing a dripping tap go into chaos. See - *Chaos stalks the kitchen Beware: a* ***dripping tap has a memory and a tendency to chaotic behaviour****.* ***Philip Ball*** *https://www.nature.com/news/2000/001228/full/news001228-2.html* ,



3-dimensional plot of the absolute value of the complex gamma function

Wikipedia User:Geek3
CC BY-SA 3.0
File:Gamma abs 3D.png
Created: 1 January 2008

*Written by **J J O'Connor** and **E F Robertson** Last Update August 2015 https://mathshistory.st-andrews.ac.uk/Biographies/Hurwitz/* **Creative Commons Attribution-ShareAlike 4.0 International License – partial extract**. … "*Further topics studied by Hurwitz include complex function theory, the roots of Bessel functions, and difference equations. He also wrote several papers on Fourier series. Soon after he went to Zürich he was asked a question by Aurel Stodola, one of his colleagues, concerning when an nnnth-degree polynomial with real coefficients*

f(x)=a0xn+a1xn−1+...+anf (x) = a_{0}x^{n} + a_{1}x^{n-1} + ... + a_{n}f(x)=a0xn+a1xn−1+...+an

with positive leading coefficient a0>0a_{0} > 0a0>0 has only roots with negative real parts. Hurwitz solved this problem completely showing that the ***condition held if and only if a certain sequence of determinants are all positive.*** *He published this in 1895 in the paper Über die Bedingungen, unter welchen eine Gleichung nur Wurzeln mit negativen reellen Theilen besitzt Ⓣ which appeared in Mathematische Annalen in 1895. This remarkably influential paper was reprinted 100 years later in the proceedings of the Hurwitz Symposium on Stability theory in Ascona in 1995. The excellent review [7] appears in the proceedings of the same symposium, and in the paper [5] the* ***genesis of Hurwitz's version of the well-known stability criterion is described in detail."***

See also - ***Taylor & Francis Online*** https://www.tandfonline.com/doi/abs/10.1080/00207178908953500 ***Stodola, Hurwitz and the genesis of the stability criterion C. C. BISSELL*** *Pages 2313-2332 | Received 14 Feb 1989, Published online: 27 Apr* https://doi.org/10.1080/00207178908953500

Hurwitz also recognized the Golden ratio and the relationship of all irrational numbers to the ratio of prime integers https://en.wikipedia.org/wiki/Hurwitz%27s_theorem_(number_theory) …"*In number theory, **Hurwitz's theorem**, named after Adolf Hurwitz, gives a bound on a Diophantine approximation. The theorem states that for every irrational number ξ there are infinitely many relatively prime integers m, n such that*

$$\left|\xi - \frac{m}{n}\right| < \frac{1}{\sqrt{5}\, n^2}.$$

"

Which was an improvement on **Dirichlet's approximation theorem** (**Peter Gustav Lejeune Dirichlet**) *https://en.wikipedia.org/wiki/Dirichlet%27s_approximation_theorem* which was based on the ideas of https://en.wikipedia.org/wiki/Diophantine_approximation which was about finding the best approximations of irrational numbers using only integers (usually with the least possible mathematical manipulation – **usually a ratio** or one integer divided by another integer – but sometimes power laws as well) . See also - https://en.wikipedia.org/wiki/Diophantus .

In related work **Ivan Niven** https://en.wikipedia.org/wiki/Ivan_M._Niven solved **Waring's problem** *https://en.wikipedia.org/wiki/Waring%27s_problem (**Edward Waring**) **every positive integer is the sum of - at most - four squares of integers. –*** postulated by **Diophantus***,* explored in various ways by **Claude**

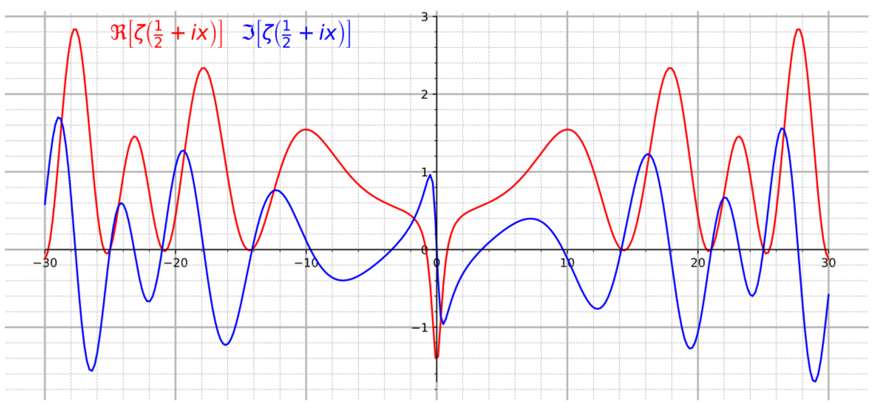
Gaspar Bachet de Méziriac , Joseph-Louis Lagrange, Pierre de Fermat (e.g. Fermat's last theorem), https://en.wikipedia.org/wiki/Waring%E2%80%93Goldbach_problem (**Goldbach problem** - **Christian Goldbach**), **David Hilbert** – most mathematicians explore this. E.g. The **Sums of three cubes problem** https://en.wikipedia.org/wiki/Sums_of_three_cubes , https://en.wikipedia.org/wiki/Hodge_conjecture, https://en.wikipedia.org/wiki/List_of_unsolved_problems_in_mathematics ,etc.

The https://en.wikipedia.org/wiki/Poincar%C3%A9_conjecture **Poincaré conjecture** is the only outstanding Millenium math problem to be solved https://en.wikipedia.org/wiki/Grigori_Perelman **Grigori Yakovlevich Perelman**.

The **Riemann Hypothesis** is probably the **most famous unsolved problem** *https://en.wikipedia.org/wiki/Riemann_hypothesis*

Stephan Wolfram explores it here and you can see similarities to the "chaos" in the Mandelbrot set. ***Weisstein, Eric W***. *"Riemann Zeta Function Zeros." From MathWorld--A Wolfram Web Resource. https://mathworld.wolfram.com/RiemannZetaFunctionZeros.html*

https://mathworld.wolfram.com/RiemannZetaFunctionZeros.html **Copyright - fair use research and teaching - partial extract**



Ramanujan POSTULATED that the sum of all positive integer numbers is **-1/12.**

Numberphile *- ASTOUNDING: 1 + 2 + 3 + 4 + 5 + ... = -1/12 7,944,002 views •Jan 9, 2014*
https://www.youtube.com/watch?v=w-I6XTVZXww ,
Numberphile *Why -1/12 is a gold nugget 2,298,945 views •Mar 18, 2014*
https://www.youtube.com/watch?v=0Oazb7IWzbA,
3Blue1Brown *-* ***Grant Sanderson*** *- Visualizing the Riemann hypothesis and analytic continuation 2,665,963 views •Dec 9, 2016 https://www.youtube.com/watch?v=sD0NjbwqlYw Reimann Zeta Function visualized*
Mathologer *- Ramanujan: Making sense of 1+2+3+... = -1/12 and Co. 2,431,046 views •Apr 22, 2016*
https://www.youtube.com/watch?v=jcKRGpMiVTw ,

C S Yogananda - *Professor and Head, Dept. of Mathematics****, Sri Jayachamarajendra College of Engineering, Mysore, INDIA - Srinivasa Ramanujan*** *"To commemorate his 126th birthday on 22nd*

*December 2013, we would like to make the published papers of Srinivasa Ramanujan as well as the unpublished manuscripts **available to the world at large via the Internet**."* *http://ramanujan.sirinudi.org/html/published_papers.html*

Srinivasa Ramanujan *(note these papers are complex and require some skill to understand)* –observed that the idea of tending to infinity allows many math equations to be manipulated a certain way whereas **definite end points change the result – THIS IS LIKE the observer effect in trying to determine both velocity and location of a particle being measured???**

Proof that almost all numbers n are composed of about log log n prime factors *Proceedings of the* ***London Mathematical Society****, 2, XVI,1917, Records for 14 Dec. 1916* *http://ramanujan.sirinudi.org/Volumes/published/ram32.html* **Public Domain - extract** *..." In these theorems ϕ is any function of x (or n) which* ***tends to infinity*** *with its argument: and either theorem is true in whichever manner the factors of n are counted. The only serious difficulty in the proof lies in replacing Landau's asymptotic relations (1) by inequalities valid for all values of v and x - Since log log n -* ***tends to infinity with extreme slowness****, the theorems are fully sufficient to explain the observations which suggested them."..*

All of this work by all these great minds - are all related - Hilbert's 8th problem and the **Christian Goldbach** conjecture *https://en.wikipedia.org/wiki/Christian_Goldbach* - *https://en.wikipedia.org/wiki/Goldbach%27s_conjecture … "A modern version of the marginal conjecture is:* ***Every integer greater than 5 can be written as the sum of three primes****. And a modern version of Goldbach's older conjecture of which Euler reminded him is:* ***Every even integer greater than 2 can be written as the sum of two primes."***

All of this work trying to turn all irrational numbers into some simple integer relationship – a neat dance floor of integers.

We notice that **complexity** – as we might express it – seems to be possible around simple integers of 0 , one and two but once we get to 3 or more it gets more complicated in many ways. There seems to be patterns but also we get this change – this twist in the math – two primes, to three squared primes and then four squared primes – but once you have four squares you need no more. Topology is solid and consistent via *Poincaré conjecture* – in three dimensions – everything is solid and relatively simple in 0,1,2,3 – but after that things get **complicated**. We can take things up to a point but once past that point nothing else seems to emerge as **simple**.

So much work on change of state - from "order" to chaos – so many formulas and investigations of the boundary layers – the constraints and patterns - https://en.wikipedia.org/wiki/Bose%E2%80%93Einstein_condensate e.g. **Bose - Einstein Condensate** (the 5th state of matter) produced in 1995 by **Cornell, Ketterle** and **Wieman** https://www.nobelprize.org/prizes/physics/2001/summary/ **Eric A. Cornell, Wolfgang Ketterle, Carl E. Wieman.**

So much work on trying to get this to **simple**, agreed, proved math statements.

Looking for patterns, making abstract models, trying to make sense, make things coherent, trying to simplify https://en.wikipedia.org/wiki/Douglas_Hofstadter - **Douglas Hofstadter** - shows insight about cognition/understanding – perception - (son of Nobel prize winner **Robert Hofstadter** https://en.wikipedia.org/wiki/Robert_Hofstadter , https://www.nobelprize.org/prizes/physics/1961/hofstadter/facts/ - the character in the TV show - Big Bang Theory was named after) https://en.wikipedia.org/wiki/Hofstadter%27s_butterfly , *https://web.archive.org/web/20200107084058/http://web.stanford.edu/group/SHR/4-2/text/hofstadter.html* **Copyright - Fair Use – Research and Education – partial extract from archive***. …" SEHR, volume 4, issue 2:* ***Constructions of the Mind*** *Updated July 22,* ***1995 on seeing A's and seeing As Douglas R. Hofstadter*** *- … "When presented this way,* ***visual perception*** *takes on a very different light. Its core seems to be* ***analogy-making****--that is, the activity of* ***abstracting out important features of complex situations*** *(thus filtering out what one takes to be superficial aspects) and finding resemblances and differences between situations at that* ***high level of description****. Thus the "annoying obstacle" that AI researchers often took perception to be becomes, in this light, a* ***highly abstract act****--one might even say a highly abstract art--in which* ***intuitive guesswork and subtle judgments*** *play the starring roles. It is clear that in the solution of* ***Bongard problems****, perception is pervaded by intelligence, and intelligence by perception; they intermingle in such a profound way that one could not hope to tease them apart. In fact, this phenomenon had already been recognized by some psychologists, and even celebrated in a rather catchy little slogan: "Cognition equals perception." Sadly, Bongard's insights did not have much effect on either the AI world or the PR world, even though in some sense his puzzles provide a bridge between the two worlds, and suggest a deep interconnection. However, they certainly had a far-reaching effect on me, in that they pointed out that* ***perception is far more*** *than the recognition of members of already-established categories--it involves the spontaneous manufacture of new categories at arbitrary levels of abstraction. As I said earlier, this idea suggested in my mind a* ***profound relationship between perception and analogy-making--indeed, it suggested that analogy-making is simply an abstract form of perception****, and that the modeling of analogy-making on a computer ought to be based on models of perception."…*

Analogy as the Core of Cognition ***by Douglas R. Hofstadter*** *http://prelectur.stanford.edu/lecturers/hofstadter/analogy.html* ***Reprinted by kind permission of The MIT Press. ©2001 The MIT Press*** **Copyright – fair use – research and education – partial extract - non-commercial** ..." *To make the claim more explicit, I must posit that such a* ***large-scale memory chunk*** *can be thought of as being stored in long-term memory as a "node" — that is, something that can be retrieved as a relatively discrete and separable whole, or to put it metaphorically, something that can be pulled like a fish out of the deep, dark brine of dormant memory. Once this "fish" has been pulled out, it is thrown in the "bucket" of short-term memory (often calling "working memory"), where it is available for scrutiny.* ***Scrutiny consists in the act of "unpacking"*** *the node to some degree, which means that inside it are* ***found other nodes*** *linked together by some fabric of relationships, and this process of unpacking can then be continued recursively, given that the contents of unpacked nodes themselves are placed in short-term memory as well, and hence are themselves subject to more detailed scrutiny, if so desired. (I suppose one could extend the fishing analogy by imagining that smaller fish are found in the* *stomach of the first fish caught, as it is "cleaned" — and so forth, **recursively**. But that fanciful and somewhat gory image is not crucial to my story.)…*

Back to Mandelbrot

Mandelbrot had also followed the idea of Area/Ratio (in a dimensional analysis framework) in Chapter 12 of his book on page 110 ***FRACTAL LENGTH-AREA RELATION*** **Copyright – fair use – research and education – partial extract - non-commercial** .. *"we form the generalized ratio (G-length)$^{1/D}$ I(G-area)$^{1/2}$."*

The Fractal Geometry of Nature *:Author(**Benoit Mandelbrot**) :Year(1982) :Keyword(Planet Development Math)* *https://en.wikipedia.org/wiki/The_Fractal_Geometry_of_Nature* *https://www.pdfdrive.com/the-fractal-geometry-of-nature-e33421309.html*
https://mjhztaci4l.pdcdn1.top/dl2.php?id=33421309&h=3d6b8afe0346acb14a9191fa1e5ec8da&u=cache&ext=pdf&n=The%20fractal%20geometry%20of%20nature

I need to investigate whether the golden ratio applies in search patterns and distributions - **Paul Lévy** – is one person I have not researched yet. I cannot find his works online in English. I suspect he was well ahead of his time - it might be worth republishing his books in English. *See **A. Chechkin** School Of Chemistry **Tel Aviv University** on Paul Levy*
http://www.maths.qmul.ac.uk/~klages/bee_wshop/bbees_chechkin.pdf

Paul Lévy seems to be one of the most intuitive mathematicians of recent time. He has explored complexity of Brownian motion, Probability, Convergence, distributions (adding **scale** https://en.wikipedia.org/wiki/Scale_parameter and **location** ***(****An alternative way of thinking of **location families** is through the concept of additive noise)* parameters) - Lévy alpha-**stable distribution** – *https://en.wikipedia.org/wiki/Stable_distribution* *(**Mandelbrot** referred to such distributions as "**stable Paretian distributions**")* and the **central limit theory**. Much of his work is still be examined and explored – the **Local Time** idea for Markov chains, Brownian motion (which seems to me like a way of linking Einstein's equations and time/distance issue with choice, recursions and life processes) and too many novel ideas to be easily understood - yet. Many students and researchers explored his work – especially **Kai Lai Chung** from China. *https://en.wikipedia.org/wiki/Chung_Kai-lai ..” was a Chinese American mathematician known for his significant contributions to modern probability theory.”..*

***Google Books - 'Paul Lévy** - **Maurice Fréchet**: 50 ans de correspondance mathématique' Paul Lévy and Maurice Fréchet 50 Years of Correspondence in 107 Letters - Marc Barbut, Bernard Locker ,Laurent Mazliak, Translation of the introductory sections and most of the notes by **Peter Kleban**, Professor Emeritus LASST & Department of Physics and Astronomy **University of Maine** - ISSN 2196-8829 (electronic)*
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj6ipjS09DsAhVoyzgGHZW3BhEQFjAFegQICBAC&url=https%3A%2F%2Flink.springer.com%2Fcontent%2Fpdf%2Fbfm%253A978-1-4471-5619-2%252F1.pdf&usg=AOvVaw2d3PM0RIMSLrA782qfrodr

https://books.google.com.au/books?id=wym5BAAAQBAJ&printsec=copyright&redir_esc=y#v=onepage&q&f=false

Numdam, the French digital mathematics library - PAUL LÉVY *Sur certains processus stochastiques homogènes Compositio Mathematica, tome 7 (1940), p. 283-339 <http://www.numdam.org/item?id=CM_1940__7__283_0 http://www.numdam.org/article/CM_1940__7__283_0.pdf*

PAUL LÉVY *articles in French on* ***Numdam*** *http://www.numdam.org/search/%22L%C3%A9vy,%20Paul%22-c/*

DONALD G. AUSTIN*, MATH PROFESSOR* ***James Janega****, Tribune Staff Writer* ***CHICAGO TRIBUNE*** *dec 22 2000* *https://www.chicagotribune.com/news/ct-xpm-2000-12-22-0012220397-story.html* seems to have tried new ideas in math as well and was recognized for his innovative work.

Encyclopedia of Mathematics (EoM) *This article was adapted from an original article by* ***I.V. Ostrovskii*** *(originator), which appeared in Encyclopedia of Mathematics - ISBN 1402006098.* *https://encyclopediaofmath.org/wiki/L%C3%A9vy-Cram%C3%A9r_theorem* **Creative Commons Attribution-Sharealike 3.0 Unported License – Fair use – partial extract – non commercial** ***Lévy-Cramér theorem …"****If the sum of two independent non-constant random variables is normally distributed, then each of the summands is normally distributed. This result was stated by P. Lévy [1] and proved by H. Cramér [2]…. There are generalizations of the Lévy–Cramér theorem to random variables in Euclidean spaces and in locally compact Abelian groups. The Lévy–Cramér theorem has the following* ***stability property****. Closeness of the* ***distribution of a sum of independent random variables to the normal distribution*** ***implies*** ***closeness of the distribution of each of the summands to the normal distribution; qualitative estimates of the stability are known.***

Theorems analogous to the Lévy–Cramér theorem have been obtained for the Poisson distribution (Raikov's theorem), for the convolution of a Poisson and a normal distribution, and for other classes of infinitely-divisible distributions (see [6]). "…

Scientific Press International Limited *- 11b Chevron Place, Ilam, Christchurch* ***Theoretical Mathematics & Applications Three remarkable properties of the Normal distribution for sample variance*** *https://www.scienpress.com/journal_focus.asp?main_id=60&Sub_id=IV&Issue=921023*

PubMed is a free resource – National Library Of Medicine (USA) - Stephen A Frank *- https://pubmed.ncbi.nlm.nih.gov/?term=Frank%20SA%5BAuthor%5D&cauthor=true&cauthor_uid=19538344 - J Evol Biol. Author manuscript; available in PMC 2010 Feb 18. Published in final edited form as: J Evol Biol. 2009 Aug; 22(8): 1563–1585. Published online 2009 Jun 17. doi: 10.1111/j.1420-9101.2009.01775.x*

NCBI – National Center for Biotechnology Information, U.S. National Library of Medicine - Frank SA. The common patterns of nature*. J Evol Biol. 2009;22(8):1563-1585. doi:10.1111/j.1420-9101.2009.01775.x* *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2824446/* **Fair Use – Research and**

Education – partial extract *..”The neutral **patterns** share a special characteristic: they describe the patterns of nature that follow from **simple constraints on information**. For example, any **aggregation of processes that preserves information only about the mean and variance attracts to the Gaussian pattern**; any **aggregation that preserves information only about the mean attracts to the exponential pattern**; any aggregation that **preserves information only about the geometric mean attracts to the power law pattern**. I present a simple and consistent informational framework of the **common patterns of nature based on the method of maximum entropy**. This framework shows that each neutral generative model is a special case that helps to discover a particular set of informational constraints; those informational constraints define a much wider domain of non-neutral generative processes that attract to the same neutral pattern.”…*

In Stephen's Hypothesis above - I am not sure what distinction is being made between exponential pattern and power law and why!

It is worth noting that human life expectancy follows an **exponential** (observed by **Benjamin Gompertz**) pattern - https://en.wikipedia.org/wiki/Gompertz%E2%80%93Makeham_law_of_mortality *Philos Trans R Soc Lond B Biol Sci. 2015 Apr 19; 370(1666): 20140379. doi: 10.1098/rstb.2014.0379 PMCID: PMC4360127 PMID: 25750242* ***Deciphering death: a commentary on Gompertz (1825)*** *'On the nature of the function expressive of the law of human mortality, and on a new mode of determining the value of life contingencies'* ***Thomas B. L. Kirkwood*** *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4360127/*

Invariant death *https://pubmed.ncbi.nlm.nih.gov/27785361/ Invariant death* ***Steven A Frank*** *PMID: 27785361 PMCID: PMC5063037 DOI: 10.12688/f1000research.9456.1* **Fair Use – Research and Education – partial extract** *… "Free PMC article* ***Abstract*** *In nematodes, environmental or physiological perturbations alter death's scaling of time. In human cancer, genetic perturbations* ***alter death's curvature of time****. Those* ***changes in scale and curvature*** *follow the* ***constraining contours of death's invariant geometry****.* ***I show that the constraints arise from a fundamental extension to the theories of randomness, invariance and scale****. A generalized Gompertz law follows.* ***The constraints imposed by the invariant Gompertz geometry explain the tendency of perturbations to stretch or bend death's scaling of time. Variability in death rate arises from a combination of constraining universal laws and particular biological processes.*** *Keywords: Gompertz distribution; Mortality; cancer; nematodes;* ***probability theory****." ...."****To restate the puzzle****: How can we* ***relate small-scale molecular and physiological process*** *to* ***population consequence****?* ***The problem remains unsolved****. Finch and Crimmins 8 emphasized: "A key question is how to connect … [linear] aging processes to the exponential rates of accelerating mortality that set life spans. … Although we can readily assess molecular aging, such biomarkers of aging are rarely robust as predictors of individual morbidity and mortality risk in populations."…*

Stephen Alan Frank (University of California) seems to me to be a leading author and researcher into evolution and biological relationships with maths – advancing on Charles Darwin, J. B. S. Haldane, R. A. Fisher, Anthony William Fairbank Edwards (the airforce base is **not named after him** it seems **I was wrong**), W. D. Hamilton (inclusive fitness), etc. His explorations show a wide array of connected concepts – especially in maths – I find it interesting and insightful. I value his exploration and openness.

He has altruistically https://stevefrank.org/ made much of this research and thinking very plain and easily accessible to the world. See *Foundations of Social Evolution Frank, Steven. (1998). Foundations of Social Evolution. 10.2307/j.ctvs32rv2.*
https://www.researchgate.net/publication/318725812_Foundations_of_Social_Evolution

His exploration of **Control Theory** is an interesting model https://stevefrank.org/control/control.html

Sequence as Continued Fractions and Partial Sums and Simplicity

I was noting some recent work from **Mathologer** presented by **Burkard Polster** who works at **Monash University** in Melbourne Australia - https://research.monash.edu/en/persons/burkard-polster. He has a wide interest and shares his work – including knots – or how to tie your shoes in NATURE **What is the best way to lace your shoes?** 05 December 2002 https://rdcu.be/cbcHa
https://www.nature.com/articles/420476a

How did Ramanujan solve the STRAND puzzle? ***Mathologer***
https://www.youtube.com/watch?v=V2BybLCmUzs **Burkard** explains how Ramanunjan used **continuous fractions** https://en.wikipedia.org/wiki/Continued_fraction to describe much of his work and this was standard way of describing math many years ago. Have we forgotten this technique? – because it seems to display the repeated patterns more vividly and allow a process of partial summation of these sequences – which also seem to provide much more clarity the patterns inherent in the sequence. It is very closely related to **Euclid's GCD** (greatest common divisor) algorithm – which is based on RATIOS and MODULO arithmetic and progressive partial expressions – which to me seems like a recursive technique (self defined) which can iterate to infinity (as integers tend to infinity). Euclid's algorithm is only looking at the remainder – but store a partial solution each step of the iteration.

It is high school math now to show these continued fractions https://nrich.maths.org/1351 **Alan and Toni Beardon from the University of Cambridge (***Copyright © 1997 - 2020. University of Cambridge. **All rights reserved.** NRICH is part of the family of activities in the Millennium Mathematics Project.)* – clearly showing the Fibonacci series emerges from a continued fraction just containing the integer one , the addition operator and the division operator. Also we get a relationship to the golden ratio.

Also the technique is very useful for showing pi and the square root of 2 (which also seem very closely related see **François Viète 1540 -1603**) – which leads into investigations of many of the math problems and theorems. An **estimate for pi** uses dot multiplication, addition and the square root of two.

$$\frac{2}{\pi} = \frac{\sqrt{2}}{2} \cdot \frac{\sqrt{2+\sqrt{2}}}{2} \cdot \frac{\sqrt{2+\sqrt{2+\sqrt{2}}}}{2} \cdots$$

It turns out the partial sums for the infinite CF for the square root of 2 is like the series for the Fibonnaci ratios above (using just addition and divide) except that after the first term , a 2 appears in each step.

Square Root of 2 as a 'Vulgar Fraction' Date: 05/04/2001 at 00:44:37 From: Dave - ***National Council of Teachers of Mathematics (USA)*** *http://mathforum.org/library/drmath/view/55994.html* ***Doctor Peterson****, The Math Forum http://mathforum.org/dr.math/*

Of course you never get a "prefect" fraction for pi no matter how you write it – this is **the Continuum hypothesis** – the infinity problem – **why do people still explore it so much?**

See also http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/contactron.html Dr. Ron Knott *hosted by the Mathematics Department of the University of Surrey, UK. © 1996-2018 Dr Ron Knott http://www.maths.surrey.ac.uk/hosted-sites/R.Knott/Fibonacci/cfINTRO.html*

It is a bit similar to the view that **everything needs to be a simple as it needs to be and no more (a kind of optimization least energy choice)** and even with very simple iterated constructs a large amount of **complexity** (choice/paths/uniqueness) can be generated**. Copyright – Fair use – partial extract – non commercial** *" Occam's razor, also spelled Ockham's razor, also called law of economy or* ***law of parsimony****, principle stated by the Scholastic philosopher* ***William of Ockham 1285-1347/9"*** ***https://www.britannica.com/topic/Occams-razor*** *Contributor:* ***Brian Duignan*** *Title Occam's razor Publisher Encyclopædia Britannica Date Published August 05, 2020 Url https://www.britannica.com/topic/Occams-razor Access Date December 26, 2020*

If you count the instances of the word 'simple' in my documents you will find it appears many times – the number count is a relatively large number. This is similar in concept to **David Hilbert's** unpublished 24th problem as noticed by **Rudiger Thiele** https://www.maa.org/sites/default/files/pdf/upload_library/22/Ford/Thiele1-24.pdf **Copyright – Fair use – partial extract – education and research - non commercial** *…"The 24th problem in my Paris lecture was to be: Criteria of simplicity, or proof of the greatest simplicity of certain proofs. Develop a theory of the method of proof in mathematics in general"….*

Only some of **David Hilbert**'s problems were presented in 1900 – others were found in his papers. Many were not understood and some became millennium problems and are still being worked on. For me the question is **Was David Hilbert posing the "right" questions? Are they good questions worth spending energy of exploration on and why?**

What is a "good" question?

These questions may well be overlooked or at least it is assumed or skipped over – is it too obvious? It seems to me that any human – who can think and has done some work – is very **aware of the limitations** of **any single human** so the idea that any work is taken as a "certainty" rather than an invitation to explore, disprove, discover, correct, enhance, modify, discard, etc – I think misses the point of the reason why people **share their ideas and thoughts** (in a humanism kind of way).

Have the people working on math problems stopped trying to explain their work and its meaning to the *"first man whom you meet on the street"?*

Project Euclid – "*Project Euclid was developed and deployed by the **Cornell University Library**, with start-up funding provided by The **Andrew W. Mellon Foundation**, and is now jointly managed by the Cornell Library and **Duke University Press**. It was originally created to provide a platform for small scholarly publishers of mathematics and statistics journals to move from print to electronic in a cost-effective way."* https://projecteuclid.org/download/pdf_1/euclid.bams/1183417035 MATHEMATICAL PKOBLEMS. LECTURE DELIVERED BEFORE THE INTERNATIONAL CONGRESS OF MATHEMATICIANS AT PARIS IN 1900.BY PROFESSOR DAVID HILBERT. *Hilbert, David. Mathematical problems. Bull. Amer. Math. Soc. 8 (1902), no. 10, 437--479. https://projecteuclid.org/euclid.bams/1183417035* **Copyright – Fair use – partial extract – education and research - non commercial**

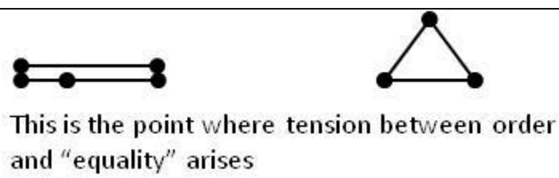
It is quite clear from his opening remarks he was encouraging questions – even of the questions he himself was posing.

*…"**WHO** of us would not be glad to lift the veil behind which the future lies hidden; to cast a glance at the next advances of our science and at the secrets of its development during future centuries ? **What** particular goals will there be toward which the leading mathematical spirits of coming generations will strive ? **What new methods** and new facts in the **wide and rich field** of mathematical thought will the new centuries disclose ? History teaches the continuity of the development of science. We know that every age has its own problems, which the following age either solves or casts aside as profit-less and replaces by new ones. **If we would obtain an idea** of the probable development of mathematical knowledge in the immediate future, we must let the **unsettled questions pass** before our minds and look over the problems which the **science of to-day sets** and whose solution we expect from the future. To such a **review of problems** the present day, lying at the meeting of the centuries, seems to me well adapted. For the close of a great epoch not only invites us to look back into the past but also **directs our thoughts to the unknown future**." …" Nevertheless **we can ask whether** there are **general criteria which mark a good mathematical problem**. An old French mathematician said: "A mathematical theory is not to be considered complete **until you have made it so clear that you can explain it to the first man whom you meet on the street.**" .. "The mathematicians of past centuries were accustomed to **devote themselves to the solution of difficult particular problems with passionate zeal**. They **knew the value** of difficult problems." …."..the **human mind**, encouraged by the success of its solutions, **becomes conscious of its independence**. It evolves from itself alone, often without appreciable influence from without, by means of logical combination, generalization, specialization, by separating and collecting ideas in fortunate ways, new and fruitful problems, and appears then it-self as the **real questioner.**" … "And it seems to me that the numerous and surprising analogies and that **apparently prearranged harmony***

*which the **mathematician so often** perceives **in the questions, methods and ideas of the various branches of his science**, have their origin in this ever-recurring **interplay between thought and experience.**"*

Notice – I think Aristotle also noted the need for experience and thought. I think it is worthwhile reading his speech in full.

I note that he postulates a problem –**4. PROBLEM OF THE STRAIGHT LINE AS THE SHORTEST DISTANCE BETWEEN TWO POINTS.** that has largely been **ignored as too vague** by current mathematicians – which means to me it is probably worth exploring. Here he looks at 3 points in space and questions straight lines and parallel lines. The ideas of Minkowski and Euclid feature but at the heart of it it looks like questioning the notions of space and triangles and many dimensions. For me it seems like the issue I was having trying to understand the switch from a straight line view to a vector type view of 3 points the relativities of distance (which in a real world sense means also energy, time). I don't understand the question but I do understand that switching from two (linked) to three (linked) is a step into greater complexity. It also exposes the issue when "creating" a diagonal "straight' line between opposite points on a "square"

	Diagram – Context of 3 numbers and 3 lines – Jonathan Pearson –2020 - Humanistman Public Domain

Also ignored is **23. FURTHER DEVELOPMENT OF THE METHODS OF THE CALCULUS OF VARIATIONS**. – which seems to be a call to explore further the type and rates of changes over interation/time – extending differential and integral calculus into something else – something more powerful and simple? This seems to explore the nature of complexity and the questions of simplicity. See also *Bulletin of American Mathematical Society - Contents of Volume 12, Number 2 - Lectures on the Calculus of Variations, by **Oskar Bolza**. Reviewer: **E. R. Hedrick*** **A MODERN CALCULUS OF VARIATIONS. Lectures on the Calculus of Variations. By OSKAR BOLZA.** https://www.ams.org/journals/bull/1905-12-02/S0002-9904-1905-01294-5/S0002-9904-1905-01294-5.pdf **Copyright – Fair use – partial extract – education and research - non commercial**

*..." Chapter V begins with the general explanation of **Kneser's transversal theory** as an **extension of the ordinary theory of geodetic lines**, and it is pointed out that this theory applies with peculiar force to the case in **which the end points are variable.** Kneser's principal theorems (on transversals, page 172 ; and on the envelope of a set of extremals, page 174) are given in § 33. It is shown in a note (page 175) that these theorems can be derived in a manner wholly analogous to Hubert's original considerations which led to **Hubert's invariant integral theorem**. These considerations are given in a note in the Addenda (page 266) in almost the same form in which Hilbert led up to his theorem in the course of lectures mentioned on pages 246 and 268."…*

*Oskar Bolza's lectures – **university of Michigan** - University of Michigan Historical Math Collection* *https://quod.lib.umich.edu/cgi/t/text/text-idx?c=umhistmath;idno=ACM2513*

It may be that **David Hilbert** was encouraging further investigation of **Adolph Kneser**'s ***Lehrbruch der Variationsrechnung*** technique of calculus to further explore the spacial problems (elliptical, cyclic changes, calculus, etc) in general and the 4th problem – as well as a way to open up some new nugget of exploration generally – open a new door in the castle.

https://mathshistory.st-andrews.ac.uk/Biographies/Kneser/ ***Lehrbruch der Variationsrechnung*** https://catalog.hathitrust.org/Record/000581385 *Kneser, A. (1900). Lehrbuch der Variationsrechnung. Braunschweig: F. Vieweg und Sohn. (published in 1900)*

The argument about infinity

Why is the discussion about Cantor's view on infinity important?

Apart from the basic question about infinity there is a mathematical methodological problem which is at the heart of the discussion. **Constraining** and bounding infinity gives it a **level of certainty** and manipulation which may obfuscate the meanings and hidden problems underneath. Mathematicians – may **not notice what is really going on** and "skip over" important insights as they manipulate formulas and functions in ever more complex ways based on all the **assumptions**. Leaving things as undefined is like having an **inviting open question** which can **encourage everyone** to revisit and explore rather than step automatically to the next level.

The argument in his time might not have manifested itself that way to him, and maybe his critics, themselves, were unable to communicate their deeply held views – the strong self evident assumptions – that drove their response. This is a pattern we see in all humans in arguments – this struggle to bring forward why they think something – when usually it only manifests as a **strong feeling**. It takes real effort and exploration and **too often** it is communicated by **outrage, anger, personal abuse, violence and mob type behavior** rather than enlightened and insightful discussion.

Just ask **Galileo** and **Copernicus**. **William of Ockham** had to choose his words carefully also. When there are mobs with "**strong and certain**" beliefs (certain "truths") around - one has to **choose words carefully**.

Progression of Number Lines – angles – 'inbetween" – infinitesimals – order of life choice

I was musing of the https://en.wikipedia.org/wiki/Poisson_point_process , *A guide to Brownian motion and related stochastic processes **Jim Pitman** and **Marc Yor*** *https://www.stat.berkeley.edu/~aldous/205B/pitman_yor_guide_bm.pdf* ***Copyright – Fair use – partial extract – education and research - non commercial****... "13. **Connections with number theory** According to the **central limit theorem of Erd˙os–Kac** [120] in the theory of additive number theoretic functions, if **ω(n)** is the number of distinct prime factors of n, then for n picked uniformly at random from the integers* *from 1 to N,as N→ ∞ the limit distribution* ***of (ω(n)−log log n)/√log log n*** *is standard normal. Billingsley [45] showed how Brownian motion appears as the limit distribution of a random path created by a natural extension of this construction",,*

This problem I have of wanting some kind of abstract neatness and certain framework –a **universal framework** which I can fit all of life into – all of maths and all numbers – is that too much to ask?

Too quickly – it seems to me – basic algebra verges into circles and angles – the complex plane appears quickly and all the theorems and formulas expand https://en.wikipedia.org/wiki/Complex_plane.

These – inbetween – non rational – non-neat - numbers and relationships – where do they first arrive? Are they there in numbers already or is it because we make change to numbers using functions which then results in these fluxions, infinitesimals and irrationals appearing?

I had a neat number line with fixed intervals and the same thing – just different names – I had all my apples lined up in a row and I was able to count them – an infinite line of "same" things which I could count. I could then use that count to answer the questions "how many?" of anything – anything I chose to call the same and count – suddenly I had mastery of all I observed. All I had to do was arbitrarily constrain the thing by definition – give it a name - call it a same thing then I could apply my magic number line to count them up. I could do more – I could distribute them using modulo – everyone gets a fair share of the apples with some left over for next time. The tribe was fed and happy.

But this function thing appeared – doing the same thing over and over – and self reference, recursions – things got more complicated and yet somehow more simple at the same time. Everything became more and more simplified and each time the **complexity and assumptions were hidden away in symbols**, **language** and **tools** and we suddenly had no real idea of what was going on – only how to use the tools.

Life – the things we observe – **there is a question of what comes first** – a succession of little steps forward? – what about rotation - do we rotate about ourselves first and then take a little step and another little step and then rotate again like a flower pushing out seeds in a pattern resembling the Fibonacci sequence using the golden mean as a rotation ration?

Life displays these things but we abstract them (or I try to at least) to make things **less messy** – to make them "neat" and to be able to be manipulated in some **kind of abstract way** for my own benefit – maybe like choice optimization or ***better*** "search" patterns for discovery of food and water or things worth noticing.

Planets both revolve and rotate – wheels (Archimedes wheel/screw in more dimensions) roll forward in the same direction they travel – they are linked – this forward movement and rotation – we see planets – we "see" atoms – although at quantum levels there is also other dimensions – "strangeness", "colour" , etc. Things happening which we can't make sense of yet.

Approximations of Pi - Archimedes https://en.wikipedia.org/wiki/Approximations_of_%CF%80 … "*The* ***magnitude of such precision (152 decimal places)*** *can be put into context by the fact that the circumference of the largest known object, the* ***observable universe, can be calculated from its diameter***

(93 billion light-years) to a precision of less than one Planck length *(at 1.6162×10−35 meters, the shortest unit of length that has real meaning) using π expressed to* ***just 62 decimal places****.[26]"..*

ARCHIMEDES *BY* ***Sir THOMAS HEATH*** *K.C.B., K.C.V.O., F.R.S.; Sc.D., Camb. Hon. D.Sc., Oxford 1920* https://www.gutenberg.org/files/35550/35550-h/35550-h.htm **Public Domain - partial extract** *... ". **The Measurement of a Circle**. This treatise, in the form in which it has come down to us, contains only three propositions; the second, being an easy deduction from Props. 1 and 3, is out of place in so far as it uses the result of Prop. 3. In Prop. 1 Archimedes inscribes and circumscribes to a circle a series of successive regular polygons,* ***beginning with a square****, and* ***continually doubling*** *the number of sides; he then proves in the orthodox manner by the* ***method of exhaustion*** *that the* ***area of the circle is equal to that of a right-angled triangle****, in which the* ***perpendicular is equal to the radius, and the base equal to the circumference*** **(??!!!)***, of the circle. Prop. 3 is the famous proposition in which Archimedes finds by sheer calculation upper and lower arithmetical limits to 39 the* ***ratio of the circumference of a circle to its diameter****, or what we call π; the result obtained is* ***31⁄7 > π > 310⁄71****. Archimedes inscribes and circumscribes successive regular polygons, beginning with hexagons, and doubling the number of sides continually, until he arrives at inscribed and circumscribed regular polygons with 96 sides; seeing then that the length of the circumference of the circle is intermediate between the perimeters of the two polygons, he calculates the two perimeters in terms of the diameter of the circle. His calculation is based on two close approximations (an upper and a lower) to the value of √3, that being the cotangent of the angle of 30°, from which he begins to work. He assumes as known that 265/153 < √3 < 1351/780. In the text, as we have it, only the results of the steps in the calculation are given, but they involve the finding of approximations to the square roots of several large numbers: thus 11721⁄8 is given as the approximate value of √(137394333⁄64), 3013¾ as that of √(9082321) and 18389⁄11 as that of √(3380929). In this way Archimedes arrives at 14688 / 4673½ as the ratio of the perimeter of the circumscribed polygon of 96 sides to the diameter of the circle; this is the figure which he rounds up into 31⁄7. The corresponding figure for the inscribed polygon is 6336 / 2017¼, which, he says, is > 310⁄71. This example shows how little the Greeks were embarrassed in arithmetical calculations by their alphabetical system of numerals."..*

Stephen Wolfram Math Pi https://mathworld.wolfram.com/PiFormulas.html

François Viète, Seigneur de la Bigotière (Latin: Franciscus Vieta; 1540 – 23 February 1603) https://en.wikipedia.org/wiki/Fran%C3%A7ois_Vi%C3%A8te , https://en.wikipedia.org/wiki/Vi%C3%A8te%27s_formula

$$\frac{2}{\pi} = \frac{\sqrt{2}}{2} \cdot \frac{\sqrt{2+\sqrt{2}}}{2} \cdot \frac{\sqrt{2+\sqrt{2+\sqrt{2}}}}{2} \cdots$$

"However, by publishing his method as a mathematical formula, Viète ***formulated the first instance of an infinite product known in mathematics****,[2][3] and the* ***first*** ***example of an explicit formula for the exact value of π*** *{\displaystyle \pi } \pi .[4][5] As the first formula representing a number as the result of*

an infinite process rather than of a finite calculation, Viète's formula has been noted as the ***beginning of mathematical analysis[****6] and even more broadly as "the dawn of modern mathematics".[7]"*

Leibniz formula for π https://en.wikipedia.org/wiki/Leibniz_formula_for_%CF%80

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \cdots = \frac{\pi}{4},$$

How do these series relate to each other?

Another problem which helps explore this dates back to the ancient Babylonian and Greek concept of trying to "**Square the circle**" – this is unsolvable and has been around a long time. The idea is to try to make the circle and the square have exactly the same **AREA** using the tools of a compass and straight edge. So it is a bit like the circle and ellipse problem in that we are trying to work out the circumference measurements of different but similar shapes. Calculus helps us with integration - which is used to "find the **area** under the curve"

https://en.wikipedia.org/wiki/Squaring_the_circle , https://rationalwiki.org/wiki/Squaring_the_circle
 .."squaring the circle would require constructing the length $\sqrt{\pi}$ *. (A circle with radius* ***r*** *has area* πr^2 *. Hence a square with the same area must have a side of* $\sqrt{\pi r}$ *If this number could be constructed, that would prove that* ***π*** *is an algebraic number, meaning there is some possible set of rational numbers you can use to calculate it. "..*

How not to Square the Circle *- How Not to Square the Circle –* ***Tony Phillips*** *- Posted May 2011.* ***American Mathematical Society*** *- Nicholas of Cusa was attacking a problem dating back to the ancient Greeks. The solution would have made him famous forever...*
http://www.ams.org/publicoutreach/feature-column/fcarc-cusa

Carl Louis Ferdinand von Lindemann (1852 –1939) , **Karl Theodor Wilhelm Weierstrass** (1815-1897) theorem https://en.wikipedia.org/wiki/Lindemann%E2%80%93Weierstrass_theorem is the proof that ***e*** and pi ***π*** are "**transcendental".**

Calculus - Integration gives us area under the curve. – take 1 integral to get the **area**, 2 volume, 3....?

So we also get the idea of "**area** under the curve" by using logarithms (how many times (dances steps) did we have to multiply some number to get here) and especially using the natural log **LN** which is log using base **e** – (which is transcendental).

Again we get formulas and statement using loglogloglog.... Or lnlnln... repeated notions as their own special potentially infinite dance routines. (see **Terrence Tao** explaining primes on youtube)

This notion of "**area** under the curve" and these various issues with integration, logs and series are interesting to me but I am daunted by the work involved.

I **hypothesize** (with**OUT** any real detailed analysis) that there **might exist** some statements representing series OR continued fraction expressions which can be used to describe the **transcendental constants** – especially in relation to pi and *e* , which could be manipulated by various techniques to produce statements which would **not contain** transcendental constants, but would still contain the notion of **infinity**, (as represented by limits or continuing fractions), which could provide a more linked and usable statement which could be applied in a number of domains. I think that this type of hypothesis is similar too, and partly related to, the various historical explorations into mathematics in general and can be described as simplification, rationalization and integration.

I **hypothesize** (with some exploration of the history) that **this is highly unlikely** and that there will be an **unavoidable** point of **initial self-reference** – the circular argument (tish boom).

James Joseph Sylvester *– "All roads are said to lead to Rome, so I find, in my own case at least, that all algebraical inquiries sooner or later end at that Capital of Modern Algebra over whose shining portal is inscribed "**Theory of Invariants**"." Trilogy (1864)* *https://mathshistory.st-andrews.ac.uk/Biographies/Sylvester/quotations/*

At the heart of these general problems is **zero** – or some initial self-reference point and **infinity. Constraints and Bounds help our language.** It is interesting to notice how people who manipulate these concepts around are not always overt about these particular problems or assumptions. Infinity as a concept is very important – but it needs to be conceptualized in different ways. It is one concept but – like every **continuum** – there is always another extreme. So what is at the other side of infinity? One answer could be "null" – the nothing as opposed to the definite zero. This is more related to EXISTS.

Infinity for us – **is at the other end of the thing we are conceptualizing** about. Minus infinity and plus infinity – especially for our strongest measurement concept – the yardstick, the relationship between two "things", two points, the line, the number line. Aristotle knew this.

Mixing up, conceptually, the number lines and the physical universe for some integrated solution - So we have the number line – but what about the other type of infinity – which is not this type of unit measurement but another different type of measurement – accuracy and precision. This is conceptualized as another infinity number line at right angles (**perpendicular**) to the first number line, infinity exists, the direction via + and – infinity, then **measurement** by yardstick/distance/energy/time (**linking** -**relativity – between two things** - counting number – observer/observe – (also and two points on a triangle)), then **measurement** by accuracy and precision (**bounds and constraints**).

So infinity has been symbolically captured in different ways – whenever Cantor's set theory is in play or you see symbols for infinite series like the transcendental ***e*.** The other way it s has been captured is by the transcendental **pi** π**–** which shows the **limit to precision and accuracy** – the **bounds and constraints.**

One way to image this is to think of yourself having a really clever camera. It has a **zoom lens** which can go in and out to infinity and it has a **focus** lever which can go from minus infinity to plus infinity.

As you **zoom** in and out - the width – the section of the universe you are capturing - changes.

As you change the **focus** you will see different things appearing and the going out of focus.

Just like the Mandelbrot set – the close you zoom in – you will see smaller and smaller parts of the universe – if you change your focus it will come in and out of focus but you will never "see" infinity.

If you **zoom** to the infinite universe and **focus** out – then it is the unit 1. **One undifferentiated blob**. One unit.

If you **zoom** way out and **focus** infinitely in - you – pass by - seeing galaxies and planets – you see quarks then smaller and smaller still till all you see as all the infinitely smallest things that make up everything in the universe.

Arguments about Least squares – mean – central limit theorem - Optimization

No free lunch algorithm – "best" technique – average out over time. What ever works now is not the best solution for every situation. Local time, local event techniques – versus long term strategies. Sustainability, search technique – computer optimization. Balance between multiple strategies versus monolithic (totalitarian) solutions.

This is the heart of the **diversity** question – mathematically - **cohesion** and **stability** too.

Many techniques are being used to find close relationships between things – statistics, lattice, theory, lie, groups – whole number dance floors are swapped and changed around just to find the patterns – how close things are to each other, whether they are in a special relationship of some kind. These ideas are conceptually linked to a **certainty** and **probability** framework – especially for **choice**.

Ieee https://ieeexplore.ieee.org/document/585893 ***D. H. Wolpert*** *and* ***W. G. Macready*****, "No free lunch theorems for optimization***

Nature-Inspired Optimization Algorithms*: Second Edition September 2020 Publisher: Academic Press/Elsevier ISBN: 9780128219867 https://www.researchgate.net/publication/344443170_Nature-Inspired_Optimization_Algorithms_Second_Edition* (X S Yang)

HISTORIA MATHEMATICA 21 (1994), 39-63 **Dirichlet's Contributions to Mathematical Probability Theory HANS FISCHER** Polkostrafle 41, D-81245 Muiichen, Germany https://core.ac.uk/download/pdf/82372732.pdf

Clay Mathematics Proceedings Volume 7 - Analytic Number Theory **A Tribute to Gauss and Dirichlet** - **William Duke, Yuri Tschinkel** Editors http://www.claymath.org/library/proceedings/cmip07.pdf

Radians – Pi – angles - rotation

https://www.mathsisfun.com/geometry/radians.html with **rotation** we are already at infinity and infinitesimals. Pi , zero, relativity (zero/one – "other") all start there followed closely by time/distance/energy.

Infinity by degrees. (tish boom)

The triangle is the first circle – the vectors completely return. We can come back to the same spot in space. **BUT** the angles of triangles always add to 180 degrees – yet they all fit inside circles and ellipses (360 degrees - For a circle – but polygons inner angles **increase by 180 degrees for each side** so how do we end up at 360?) – where every point on the triangle is on the circumference of the circle or ellipse.

Straight lines – between two points - are **also considered to have 180 degrees!!**

There is an **infinite** number of triangles with different **ratios of line lengths** whose points all **fit exactly** on a circle. These could be considered conceptually as "stable" or a feature like the central limit theorem. But the next **infinity** is the infinite number of triangles whose points fit exactly on the circumference of an ellipse. There are no triangles which do not fit on an ellipse (including a circle) of some kind.

The **3 body problem** helped Newton and Kepler explore this issue. See ***Stephen Wolfram*** *A New Kind of Science - Online - Chapter 7: Mechanisms in Programs and Nature Section 4: Chaos Theory and Randomness from Initial Conditions* *https://www.wolframscience.com/nks/notes-7-4--three-body-problem/ .." In Henri Poincaré's study of the collection of possible trajectories for three-body systems he identified* ***sensitive dependence on initial conditions*** *(see above), noted the* ***general complexity*** *of what could happen (particularly in connection with so-called homoclinic tangles), and developed topology to provide a simpler overall description. With* ***appropriate initial conditions*** *one can get various forms of simple behavior. The pictures below show some of the possible repetitive orbits of an idealized planet moving in the plane of a pair of stars that are in a perfect elliptical orbit."*

There are many possible stable patterns for 3 bodies – but we experience mainly ellipses close to circles.

One general conceptual view would be to always use the longest axis as the center of the ellipse and the other point becomes the "orbiting" body tracing the path of the ellipse. Every ellipse has **two focal** points and can have different ***eccentricity***. Whereas circles have one focal point (the centre). So we see a step in complexity from one to two by going from circles to ellipses. Real life Ellipses are less stable - **over repeated cycles** - and depending on the **relative lengths** and **relative mass.**

The next step to a **square** or four sided special spacial object **DOUBLES** the number degrees of the triangle. (How can going from three to 4 double things? I don't understand this other than conforming to the general pattern of twos/ doubling and 2^n) We now have 360 degrees – the **same as the circle.** Once again there are **infinitely many** four sided objects whose points fit exactly on the circumference of the circle. These are stable where the square would be considered the most stable (like the equilateral triangle) – a kind of central limit theorem.

Also too there are infinite four sided shapes whose points fit exactly on an ellipse but then infinite four sided objects than only fit on more complicated curves. It gets more complex every step we take. More infinities, more complexity.

Sine, **Cosine** and **Tangent** should/ought to be represented as integer ratios – because that is what they are – they take a spacial object – a triangle and relate the 3 sides. All sides are arbitrarily assigned (with reference to what exactly?) and then it is all about relativities of lengths – the ratios. Of course sine and cosine make circle – because the **tangent** **is the right angle** – the stable (square like) base (ratio of adjacent to opposite – either sides of one of the right angles) – while the other lengths are free to change via the hypotenuse. It is just a way of squaring the circle and **hiding infinity**.

Of course the 3,4,5 triangle is prefect and shows the relationships. 4/5,3/5,4/3. And when the triangle flips ("adjacent" and the "opposite") the ratios stay together in lock step.

What - exactly – is the "opposite" side of a triangle?

Using the 1 unit square and its diagonal we get Tan = 1/1 , Sine - √ 2/1 , Cos = 1/√ 2.

Infinite series, bracketing (grouping), Sequence, Ratios and other math tricks – the secret language of the highly paid experts – with a twist

What is the language of math all about? What is the META model?

My confirmation bias likes my simple model I developed at the start of humanism – getting some simple concepts solid and not stepping over the obvious and important – recognizing the leaps and definitions. My **meta frames** https://humanistman.com/home/frames/meta-frames/

is (declare), order, grouping, linking, hierarchy - Energy - hypothesis (question/exploration/complexity/cohesion) -
Mass (is/certainty/exists)

In math everything seems to be a person's name!! That way - the experts own the superiority of the discussion!! The secret language – the special knowledge – the "guild". The effort required to rationalize and simplify is significant – some spend their life times on simplification/optimization in search of discovery and aiding communication with a wider audience.

Doing things in order. Do one thing – then the next thing. Iterate. Take steps one at a time on an Euler walk.

The ratio expressed by **4/2/6/3 –** can be processed in a countable number of ways. i.e. there are different ways to look at it – different perspectives. If we look at it through the FRAME of division we get 4/2=2 and 6/3=2, therefore 2/2 = 1 **OR (for example)** 6/3 = 2, 2/2 =1, 4/1 = 4. This a **partial sum** type approach where the solution to each part is stored in working memory and used against the next calculation. I can see it in a frame of a **series** – the whole thing all at once.

Ratios are not division.

This is a **common** trick/mistake/error/unaware/choice/inbuilt bias. – Following the rules of math is not straightforward or intuitive – even at primary school level. **WHY NOT????**

The number 3 represents a position on the number line. We habitually ignore specifying the direction indicator (+) – it is assumed to be. This is really short hand for the expression +3 which indicates its position on the number line using the direction indicator (+ or -) meaning the number of COUNTS from zero in + direction. -3 is the position on the number line in the negative (minus) direction from zero. So direction AND position are indicated by the Plus (+) and Minus (-) symbols. So our very first dance step routine is to COUNT in a direction and FIND a POSITION on the number line relative to zero. Relative positions gives us the notion of GREATER THAN or LESS THAN (**order/sequence/rank**) – and then eventually EQUALS (**Same/Different/bound/constraint**).

The problem is the constant changes to the "dance floor" – always switching between number lines – the Cardinal number line, Euclidian number line, Natural number Line, Integer Number Line, Real Number line, Ordinal, Extended (with infinity), Hyperreal (which is similar but not the same as my number line concept), a whole lot of special subsets (perfect, ideal, prime, rings), complex, transcendental, algebraic, polynomial–(integers with simple functions), field theory, ring theory, topology, group theory, "planes" and structures, etc.

Simple statement – **THE** basic dance routine.

COUNT steps from first_number to second_number by third_number. (use breadcrumbs (memory) like Hansel and Gretel)

This works for all positive and negative numbers and is like MODULO arithmetic. This is the basis of most simple functions including multiplication and division.

SUMMATION – include all negative and positive directions.

Bracketing (grouping, constraining – the many statements of **is**) and **processing order** (hierarchy – what we do (energy and process) with the **iss**) have been given several different names depending on the scientific "field" you are working in.

Jacobi Identity https://en.wikipedia.org/wiki/Jacobi_identity , **Carl Gustav Jakob Jacobi**. Some call it logic, rationale, Epistemology https://plato.stanford.edu/entries/epistemology/ , natural language, rule, proof, **Lie** (**Marius Sophus Lie**) algebra, homomorphism, symmetry, balance, **coherence, linking/cohesion,** sense, meaning ,etc

I am **going to try** to relate everything to my models, set theory and natural language, epistemology, etc.

Equality (equation) – statement of is - versus repeated term – recursion – dance routine – dance steps towards a destination – limit approaching infinity.

Variations of declarative is – levels of declaration - simple equality (rules) then patterns (Pattern recognition) is.

Then destination is – constants – (infinity substitutes (**e**, and other arbitrary constant symbols) – if not already simple equality) – converging diverging series.)

Partial sums to find convergence and divergence "speeds", average and limits (calculus) **Cesaro convergence – finding patterns at different levels within series using partial sums, averages and grouping terms) Mathologer** https://www.youtube.com/watch?v=jcKRGpMiVTw

Negative direction in two dimensions fractions -1/4 or -1/-4? – implied grouping or bracketing?? Power laws explored (I don't like power laws – especially the concept of fractions/divisions of powers).

Calculus – integration and differentiation are the same self-referencing functions and extensions to the log exponent functions – including self referencing constants. Calculus operates mainly on the **pi inifinity line** as part of **"focus".**

Order – sequence of terms – bracketing infinite series – what about the last term? And the next one? There is a problem of **hiding implicit order** of processing functions within calculations.

https://en.wikipedia.org/wiki/Abelian_group **Abelian Group** (order is not important)
https://en.wikipedia.org/wiki/Niels_Henrik_Abel **Niels Henrik Abel**

I hypothesize that order is **always important** (**vectors exist**) – we all **have to conceptually start somewhere.**

Exploring Ramanujan's technique – **eliminating infinity in pairs** Ramanujan: Making sense of 1+2+3+... = -1/12 and Co. ***Mathologer*** *Ramanujan: Making sense of 1+2+3+... = -1/12 and Co.* *https://www.youtube.com/watch?v=jcKRGpMiVTw*

Ramanujan's bracketing technique to simplify **is flawed** – it groups and patterns things – but any group of infinity will not be correct no matter where you start. The *"if we group things like this"* is completely arbitrary and will miss other grouping and the starting and remainder terms – i.e. the term after the last group bracket.

Other **techniques of simplification** - over infinity series especially – **can be flawed**.

I am not convinced with the rules of simplifying over power series because I don't like power series as they are currently specified. Especially fractions and the positive and negative signs. I think this whole "function" needs to be re-examined to be more simple and cohesive.

Mixing up square **root** language with **roots** of polynomials is confusing and **misleading.**

All functions which embed Pi (and all trigonometric functions, the current **i** definition as well) or **1 as "special"** (i.e. anything raised to the "power" of zero) are operating on the **pi infinity line** are "focus" like functions using the pi infinity line. I think most squaring and rooting functions are "focus".

Functions like count, summation, (some multiplication type) squaring are operating on the **unit infinity line** and are “zoom” functions.

My **zoom and focus type functions** are continuous and go bigger towards infinity (plus or minus) and smaller towards zero. This is the inherent ‘twist’ in the function and **eliminates the need** for absolute value or +- square root notions. **i (the square root of minus 1) is not needed**. This simplifies things and makes things consistent.

It also keeps the dance floor stable and allows the various dance routines to use the whole floor in their own way. It **stabilizes the dance floor** and stabilizes the **dance routine language**.

I don’t like the power type laws – exponents, logs etc - **and instead I have THREE main multiplicative/divisive type functions** – with a twist. The conceptual frame is trying to reconcile my zoom and focus frames. The idea being that apart from **counting** and **summation** – these three types of routines cover much of what I have observed but also arranged them into what seems to me to be a neat and cohesive differentiation. They also allow signs and both inwards and outwards processing.

The **FIRST** function is the **doubling/halving function (because I think 2 is special case)** - essentially multiplying any integer by + or minus $2^{n.}$ In the zoom out – getting bigger kind of way it doubles everything away from zero. Other kinds of mixed direction (+-) use give a kind of oscillating dance routine. In the zooming in kind of way it tends towards zero and here we get the notion of remainders and “primes” because only even (+-) integers leave no remainders. It’s a kind of “division” – which is the opposite of multiplication.

Halving only works “neatly” – with self-referential integrity - with ***even*** numbers – **yet** doubling works for all integers. This is a ‘twist’ which is related to the notion of prime number dance routines.

The **SECOND** Function a **generalized integer version** of the **FIRST function** and is ***related to*** the current notion of power and log. The Zoom out towards plus and minus infinity is via a kind of self referential **multiplying/dividing** itself (instead of 2) – which is a little similar but “faster(towards infinity)” than the **doubling/halving** continuous function. e.g. 3 * 3 * 3 * 3 = 81, -3 * -3 * -3 * -3 = -81 . So this is **not the same as the current multiplication or power law** because I allow direction to be consistent with the number line, the Count from x to y by function and the modulo type functions. I.e. I keep direction consistent.

In the zoom in direction the same thing applies with the first function – there is a twist in that the increased self referential integrity is when you reach zero with **NO REMAINDER.** **Again – this is the notion of primes and non-primes.** This continuous “division” function towards zero is a zoom in type function. This function **stops on any iteration** which is **not an integer**. To this extent it is like the Greatest Common Factor function or Euler’s theorem.

The **THIRD** type zoom function is a **recursive generalization** of the **SECOND** function (and I **hypothesize** that 3 are the basic ones – this relates – but it is different to the thinking in the **Ackermann function** https://en.wikipedia.org/wiki/Ackermann_function and related to **Reuben Louis Goodstein’s**

Hyperoperation notion https://en.wikipedia.org/wiki/Hyperoperation) – again looks like the other two functions and you can think of it as a kind of doubling/halving type thing just like the other two functions. But this is a combination of the doubling and the power – with a 'twist'. This is also like the notion of **Donald Knuth**'s up arrow notation https://en.wikipedia.org/wiki/Knuth%27s_up-arrow_notation (which you could argue also includes and defines my second function (except for the +- difference) as the first instance). In a Euler's walk, Hansel and Gretal breadcrumbs type thing it is like saying at the end of each iteration take everything you did to this point and repeat. It needs to be done in a **certain order**. (this is where the logloglog.. and power to power type **processing problems arise** – hence it is often used with brackets). So one of the main features of this function is that both **GROUPING** and **SEQUENCE** feature in its use – whereas in the other two types of functions they do not. This could conceptually be applied to all basic functions I think). So instead of going 2 * 2 * 2 * 2 = 8 (which is 2 ↑ 4 – a single up arrow) , you have 2 ↑ 2 ↑ 2 ↑ 2 ↑ = 2^{16} = 65536 (which according to Knuth's syntax is 2 ↑↑ 4).

I am not sure about the symbology but you can see that this zooms out very quickly and also has the remainder issue when zooming in towards zero. It is self referential and **implies a down arrow** type zoom in function 2 ↓ 4 (but this inverse function is not mentioned on wiki?). These type of 'beyond exponential' type thinking has been around for a while – revisiting the whole thing. See "Hydra numbers" **Reuben Louis Goodstein** (15 December 1912 – 8 March 1985) , Hyperoperations, https://en.wikipedia.org/wiki/Goodstein%27s_theorem *"…every Goodstein sequence eventually terminates at 0"*

Donald Knuth :Year(1938) :Keyword(Computing) https://en.wikipedia.org/wiki/Donald_Knuth
https://www-cs-faculty.stanford.edu/~knuth/
https://www.youtube.com/playlist?list=PL94E35692EB9D36F3.

Fermat's Last Theorem as a Statement of Complexity in Life – primes - cohesion, complexity, certainty, chaos

https://en.wikipedia.org/wiki/Fermat%27s_Last_Theorem ,
https://en.wikipedia.org/wiki/Proof_of_Fermat%27s_Last_Theorem_for_specific_exponents

Fermat's Last Theorem for n = 5 states that no three coprime integers x, y and z can satisfy the equation

$x^5 + y^5 + z^5 = 0$

also $x^2 + y^2 = z^2$ for integer values - works for power 2 and no other integer power.

Two things – binary - experience a **shared** 1 or 2 squared **function** SAME function to **achieve** a **cohesive** result. This is the basic function of **joining two things to form another thing**. It **confirms two as the conceptual basis of most logic**. The power of 0 is nonsense – that is mere an arbitrary rule (on the infinity - focus dimension). The power of 1 is simply the starting declaration – the **is**. The power of 2 –

the squaring/square root statement is the **basic structure** – everything after that is just 2 **repeated** – the "many" of the squaring continuum.

https://en.wikipedia.org/wiki/Sophie_Germain%27s_theorem primes – odd primes.,
https://mathshistory.st-andrews.ac.uk/Biographies/Germain/ ***Marie-Sophie Germain***
https://mathshistory.st-andrews.ac.uk/Biographies/Kummer/ ***Ernst Eduard Kummer***

*The (**Andrew Beal**) Beal Conjecture* https://en.wikipedia.org/wiki/Beal_conjecture - shared bases, primes , power laws, integers.

Hence we get some illustrations of the steps from unity to 2 (binary and then to three) – I **hypothesize** that shared functions – or processes - do not exist past two for binary objects - and for three objects in combination – you cannot make it to 5 to have a shared process. Given that combinations of three – is a major leap forward from twos and can handle all of complexity – grouping, hierarchies, order and all the main abstractions that I am aware of – that puts 5 towards the limit of our universe. (one of my particular confirmation biases).

The main thing here is that we are seeing the physical world as WHOLE UNITS – these INTEGER NUMBERS of CERTAIN DEFINED THINGS – which is how we talk naturally about the word. We talk about apples and people – their units – as individual bounded and constrained things – not as a continuum. Is a single apple a continuum – how?

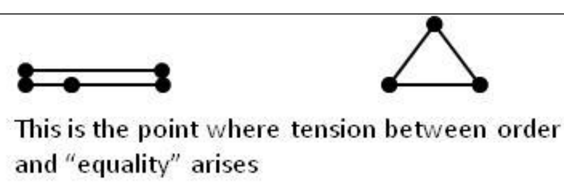
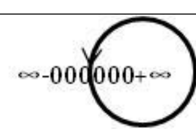
Random walks has come a long way since Euler. Brownian, Stochastic, Mandelbrot, Levy searching etc.

Loop Erased Random Walks - *https://en.wikipedia.org/wiki/Loop-erased_random_walk* ***.... "Three dimensions*** *The scaling limit exists and is invariant under rotations and dilations.."*

Initial Conditions – Choices - Dimensions

Initial note: I came back and revisited this chapter many times and added things in - so it might look out of sequence with following chapters.

This is the step from nothing to something - One of the big questions. In Math it is going from ZERO to ONE. The problem is whether ZERO is EXISTENCE or NOT. This is called the initial self-reference problem – the big question – let us just ignore that question because it is circular. Read about it with all the history of philosophy if you want.

	 Diagram – Context of 3 numbers and 3 lines and Circle Jonathan Pearson –2020 - Humanistman Public Domain

I WANT to figure out my number line!!!

All lines (continuums) fit inside a circle with 2 points on the circle. All triangles fit inside a circle where 3 points touch the circle. There are many theorems and relationships between triangles and circles - infinity is clearly on display yet there are entrenched similarities. There are relationships between the circles (incircles) within a triangle and the circles which touch the outsides (excircles) of a triangle in certain ways – hence we have infinity with many threes inside a circle of "stability" and circles of stability in relation to other circles of stability with entrenched threes.
https://en.wikipedia.org/wiki/Incircle_and_excircles_of_a_triangle

Newton, Kepler, **ellipses, stability** – the stablity of two bodies in proximity and movement (energy, change, function) but a stable three sometimes emerges – the triangles and centres of triangles and circles all neatly intreacting – sometimes stable and saometime in chaos untill **stable patterns emerge**. All the time trying to use our miriad unit measurements and **constrained infinities** to make sense of it all.

Different shaped triangles have different sized circles – hence we see infinity recursive in a structure of threes – structure/infinity – together – this where chaos emerges. Infinite triangular relationships and infinite circles.

Fermat, Pythagoras, others – the "square" function – all observed the same thing but expressed it different ways – the relationships – the progression – the changes through iterations – the rules of growth etc. All the theories – rings, fields, graphs, groups, etc. **The squaring (2) and square root continuum function** is at the heart of everything. Why did $2^{\sqrt{2}}$ as a solution for Hilbert's 7^{th} problem, why didn't **Gelfond–Schneider** **recognise the issue** at the heart of the matter ? --
https://en.wikipedia.org/wiki/Gelfond%E2%80%93Schneider_constant -- Why did it **not get written** and **compared to** the problem of pythagoras??? The first neat - "**squaring the triangle**" (**I just made that up**) – (***Stephen Wolfram*** *solves the problem using two steps using a "midpoint" of a triangle via an internal right angle triangle (initial self reference –* ***pythagoras theorem****)* .*https://mathworld.wolfram.com/TriangleSquaring.html* and then rectangle to square, *https://mathworld.wolfram.com/RectangleSquaring.html)* using integers and not transcendental (infinity) number units?

I.e - if you write it as $(1^2 + 1^2) = n^2$ the right angle triangle!! $\sqrt{n} = \sqrt{(1^2 + 1^2)}$ which is $\sqrt{2}$ - this **shows the conceptual relationship of the problem** at the basic level – the **illustration of the initial self-reference recursion problem**. A thing to a basic function of itself - And taking two things via a function to a new thing.

The pythagorean functions is a good working hypothesis, but it is also something to notice, question and learn from – to explore. I am recognising that this Pythagorean theorem seems to a fundamental declaration of functions in the threes relationships and an important declaration of the **squaring type continuum function (in two directions)**.

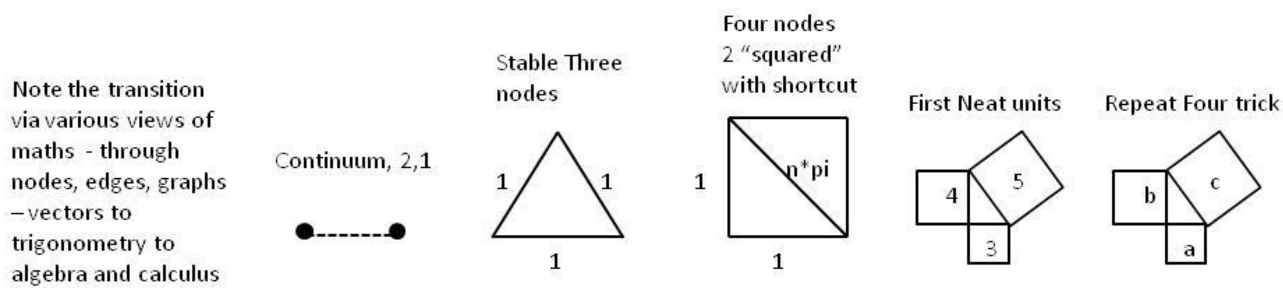
This is not easy to explain , and maybe I am not making sense, but I see this as the starting problem area – the math is a little self referential – it is trying to figure (get it) it out where the critical assumptions and self reference is being made. **Pi is the first kind universal infinity we notice** but then we invent processes and functions to **create other types of infinity** – we creates rules, steps, procedures which either end up at infinity - infintesimals (small) and inifinity – (large).

There is also a real-life notion – which I cannot conceptually reconcile with my same/different type notion – this idea that it is not just 2 or binary The (binomial theorem) – but there is more – there is at least 3 (we play with pascal's triangle). But two is so entrenched but it **always seems** to come with a "twist" of some kind. And once having invented or discovered the twist that twist then becomes a 2 which then gets its own new "twist".

We start with notice, subject/object/dimensions/mass and continuum is there straight (oops) away – the time/distance/energy between.

The **right angle** triangle first makes neat sense with a 3 ,4, 5 triangle – before that it is not neat and confusing and after that it is like the 1,2 Many structure – it is just the same twist repeated; Too many of our manipulation tricks ignore zero or make exemptions for one and sometimes even two.

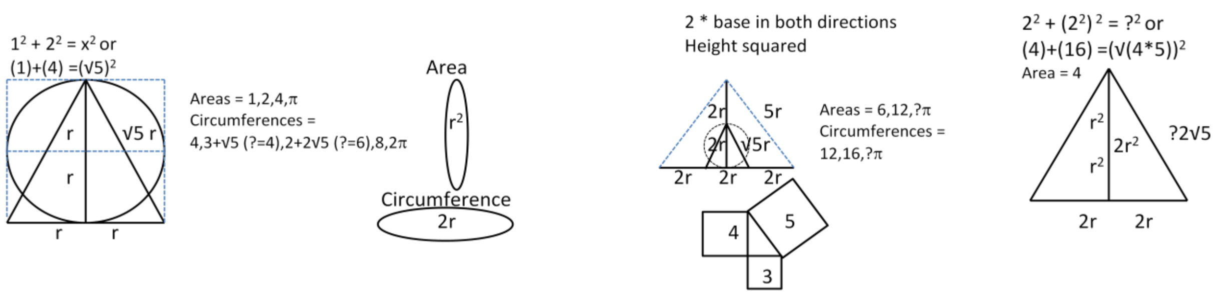
Diagram – Context of Lines, Triangles and Right Angle- Jonathan Pearson –2020 - Humanistman Public Domain



I played around a bit with the number "plane" – as many have done and still do. I was trying to get neatness and patterns – especially making sense of the neat relationship of Archimedes cone, sphere and cylinder. Could I draw circles, triangles and squares and just use r (radius) to get neat ratios between shapes. I explored the initial cross section of the cone – it's a triangle – so I have taken away the "volume" dimensions – is that just like some kind of calculus technique?

I then noticed that the square root of 5 comes out straight away – but the base of the triangle is a TANGENT to the circle – and I had some kind of notion of trying to get a triangle to fit fully inside the circle where each point touched the circumference. I thought that this was neater and somehow represents a "better" representation of the nature of the universe – and would align with much of current math. I then **mucked around** with changing the height of the triangle to represent the AREA formula for the circle while the base of the triangle represents the CIRCUMFERENCE formula for the circle – maybe that's the trick? So treating the base differently to the height we might add the base to each side – positive and negative or we might just multiple the base by 2 while "squaring" the height. I got the 3,4,5 triangle out and the 5 or square root of 5 kept showing up. But I still did not fit it inside a circle.

Diagram – Context of Exploration of Shapes- Jonathan Pearson –2020 - Humanistman Public Domain

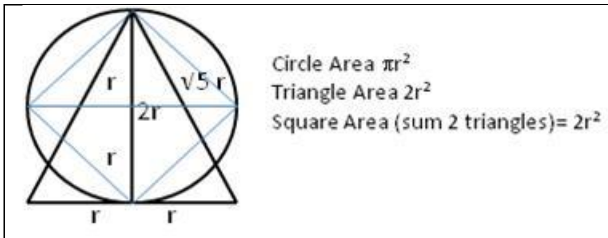


Then I went back to research and saw all the work that everyone had done on this – I cannot understand all or even compare insights! BACK TO THE BASICS – What have I missed – where are the hidden assumptions?

The idea to me is that these steps from 2 to 3 in space and then 4 - steps out into another dimension (infinite) which is the pi type infinity. We see this as the ability to draw diagrams and make pictures. We know that this is some kind of infinity – different to the infinity of the unit number line – which goes forwards or backwards infinitely and up and down in units – infinitely (but we always end up at 1 something **to use** (mod, remainder) at the lowest level). **This pi infinity is a different kind of infinity!**

If I take Archimedes triangle as the cross section of his cone and then "morph" – **change the base of the triangle to fit those points to the circle** – I effectively end up transforming the triangle into a square by taking the mid point of the base as a **NEW POINT** (to create a four pointed/nodes/vectors object) and moving those points to inside the circle! This three pointed object – transforms to a four pointed object inside the circle. I progressively move them I can see that as I move those points upwards the number of degrees changes from 180 to 360. By adding one point and fitting to a circle I double the degrees. But - here is the main point – the **AREAS ARE THE SAME!! – Morphing from 3 to 4 like this keeps the same area.** **Is this where the complexity takes another step?**

Is "squaring the triangle" (relative to what? – a circle??? – two parallel tangents on the circle???) a major leap into more complexity? Is this why Archimedes wanted the 3 dimensional objects – the cylinder, sphere and cone to be has monument? – That they linked everything so neatly?

	Diagram – Context of Archimedes Triangle - Jonathan Pearson –2020 - Humanistman Public Domain

You can see how this transformation (topology) is about recognizing what is changing. Mobius comes to mind as well and the algebraic geometry. What does having the **same area** mean anyway? The 3 steps out from the unit number line when we want to connect it – but **where does it step out to**?

Note too that the circumference of the triangle is 2r + √5r + √5r = 2+2√5, The circumference of the square is 4 * √2. So these specific shapes are related by the formula 2+2√5 = 4 * √2. This is some kind of ratio or circumference/area for these shapes but I could play math tricks with this to calculate some kind of answer. 2+2√5 = 6.47 on a calculator 4 * √2 = 5.656. Clearly not equal but I could add some kind of other number – maybe the number of sides – would that help? There is probably some kind of maths on this like area problem – Gauss, Greens Theorem, Or using the apothem method – ***Tutors - Tom Grupa, CEO*** *https://tutors.com/math-tutors/geometry-help/how-to-find-the-area-of-regular-polygons* - so number of sides * length of one side * **apothem** (radius from centre to middle of side with a kind of right angle to it) all divided by 2 - we seem to get the idea that as regular polygons tend to infinite sides – what happens to the formula – how do we get to πr^2? Playing with this infinity we could say infinite large number * infinite small number * r – is all that remains = r(small or large or 1)/2? So if we divided both sides to somehow equate the polygon formula to the standard formula we get π =r(very small,1,0,very large?)/$2r^2$

In my triangle to square movement above from Archimedes triangle - Is this related to the golden ratio as well? – this transformation from 3 to 4? To me this also looks like a **least effort** thing. An optimal change. Take a point halfway between the longest base of the triangle of "things" – so the point is furthest away for each thing at the end of the line (the continuum) and just bend each "thing" equally (2 things) "towards" to fit neatly into a circle. Do it gently and just stretch the angles out of the other two lines (continuums) just gradually stretch them out to go from 180 degrees to 360 degrees. This seems the optimal step from a triangle to a square. **As long as I move both extreme axis points upwards at the same time** (twos again!) – the **area stays exactly the same for every shape** – even if I extend the movement in the opposite way – Approaching **INFINITY. Both shapes have area of $2r^2$**

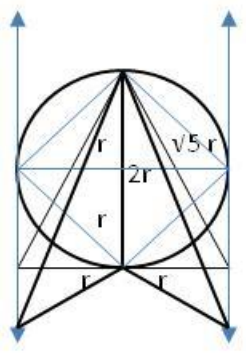


Diagram – Context of Moving Archimedes Triangle - Jonathan Pearson –2020 - Humanistman Public Domain - So let us imagine the two type of infinity here – the infinitely large and small morph – the very small movement of the base two points in a co-ordinated direction. As soon as we change from a base straight line triangle to the slightest non-triangle we instantly add 180 degrees – because every quadrilateral internally adds up to 360 degrees. So this means **each straight line with two points on it represents 180 degrees**. Every step with another point adds 180 degrees (n−2) × 180° *https://www.mathsisfun.com/geometry/interior-angles-polygons.html* . The area remains the same but the **number of points** change. Towards infinity along the parallel tangents the **question remains** whether the areas **remain the same** as the triangle/square or **approaches zero**.
A straight line with two points (nodes) has 180° but only **two direction choices on the line (unless we leave!)**

So we just take this idea form Archimedes and just keep extending it to a related inner circle (somehow) each new circle **will be**?? **(I OUGHT TO EXPLORE THIS)** slightly relatively smaller??? (As we head toward πr^2) than the next as we progressively repeat this process taking our **line of choice** , **bisecting it** and adding one new node and 180° each time. We end up towards **infinity degrees of internal angles** in **area** (πr^2) – and at the other end of this continuum we started with an **infinite line** with two points and 180° of **2 choices**.

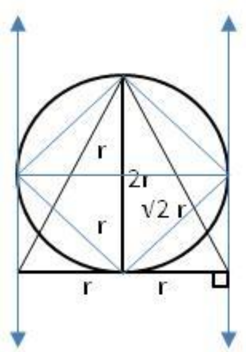


Diagram – Context of Moving Archimedes Triangle 2 - Jonathan Pearson – 2020 - Humanistman Public Domain But **I missed** the obvious neatness of this . What conceptually is happening is that it is **not** one point breaking out from the line – instead it is the whole line deciding to leave a mid point behind. That midpoint is firmly ensconced in the perfect circle and the whole line – the extreme end points take a step towards the center towards a prefect right angle and only stop when those two end points meet the circle. The triangle becomes the square.

This seems ***elegantly neat* – I like it. It seems nice and makes some kind of sense – least effort or something – the least you can do to change.**

So this once again is the central limit theorem *thing* as well. Triangles and circles seem commonly stable and strongly related. Also see **Catalan numbers** for polygons and triangles.

Bill Casselman *University of British Columbia, Vancouver, Canada AMS Archimedes on the Circumference and Area of a Circle* http://www.ams.org/publicoutreach/feature-column/fc-2012-02

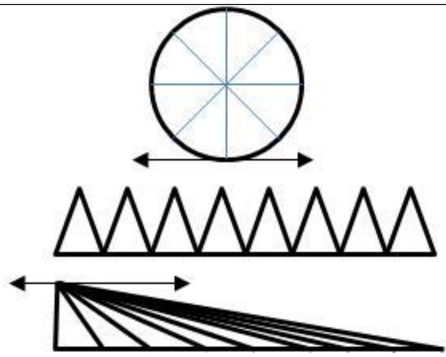
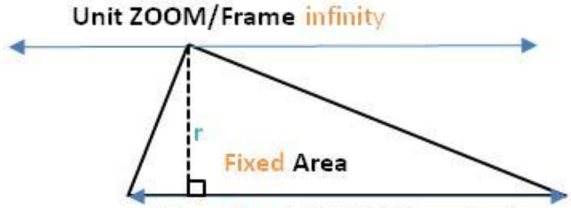
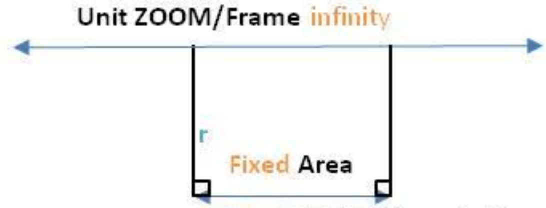
	Diagram –Archimedes Circle Area Estimation - Jonathan Pearson –2020 - Humanistman Public Domain - From this example (inspired by **Archimedes** and ***Bill Casselman)*** of Archimedes method I can see some things which align with my **zoom/frame** on the infinite unit number line and the **focus/granularity concept** on the π infinity line. It seems that the base of the triangle becomes fixed to the $2\pi r$ measurement to a certain bound but the top of the triangle – which has been morphed by Archimedes **away from the zero point** of the circle to **become the top of the triangle** - can now occupy any position on the infinite unit/frame number line and the AREA will **always (approaching infinity) be the same** – because the perpendicular height – r - will always be the same. So πr^2 once again "works" as a method for both the circle and the equivalent triangle as a calculation of area.

Diagram –Triangle on 2 infinities - Jonathan Pearson –2020 - Humanistman Public Domain	Diagram –Square on 2 infinities - Jonathan Pearson –2020 - Humanistman Public Domain
	

Maybe David Hilberts 4th problem is related to this? These parallel lines are intriguing – one truncated and fixed with infinity imbedded as constant (pi π) and the other infinite units. Would this technique work for squares and polygons? See that the equivalent area square has less degrees of freedom – is more fixed/stable? on the unit line – the frame can still be change a little – bend a bit maybe? on the zoom/frame unit line – but not as easily as the triangle where the top point for the triangle meets the line with more degrees of freedom to explore. Triangle seems like a nice balance between a fixed base and room to look. The Square prefers the right angles to keep the area the same where as the triangle can range more widely. So is this another kind of support for the notion that every triangle can fit on a circular plane? Is it self-evident? **Thales Therom** and Euclid support circles for right angle triangles (which is another way of saying that **every polygon** with at least one right angle between any three connected points can have an exact circle drawn to connect those three points – and hence that perfect circles, triangles, squares (the right angle – we see as 4) are **coherently** connected in this spacial dimension. (Did we make it that way by inventing fixed distance and the notion of a direction? Is pi inescapable in the real world?)

I hypothesize that every triangle can **probably** fit on some kind of ellipse – and that the "bending" of the right angle – the change of the distance to the parallel lines so that the area remains the same as the point of triangle moves – is another kind of "tension" where we can get the idea of a central limit theorem – a distance kind of thing where can be too much deviation from the right angle and too much exploration along the infinite unit number line for our little single point as it goes exploring. Tension between keeping **area** the same, the **distance** of the point from the base points and the **bending of the right angle** are three continuums of tension. If we upset the base points (the solid **binary pair**) **too much** with all this pushing and pulling maybe the third point will just escape never to be seen again? Like a "child lost in the wilderness", prodigal son, etc or a "different one" expelled from the tribe – if the "vibrations" are **too much** or **inharmonious**.

I have just noticed (I think I have heard of his work before?) **Arthur Cayley** https://mathshistory.st-andrews.ac.uk/Biographies/Cayley/ who seems to advanced many things in math including groups, matrix, geometry and spaces. His level of abstract thinking is far greater than mine and yet he seemed very capable of explaining his thinking to people. His work is foundation work for many disciplines.

*"Here is **G B Halsted's** tribute [23]:- "Cayley, in addition to his wondrous originality, was assuredly the most learned and erudite of mathematicians. Of him **in his science** it might be said he knew everything, and **he was the very last man who ever will know everything**."..*

https://mathshistory.st-andrews.ac.uk/Biographies/Cayley/quotations/ *.."Not that the propositions of geometry are only approximately true, but that they **remain absolutely true in regard to that Euclidean space which has been so long regarded as being the physical space of our experience."..***

https://www.britannica.com/biography/Arthur-Cayley ***Contributor:Tony Crilly*** *Title Arthur Cayley Publisher Encyclopædia Britannica Date Published August 12, 2020 Url https://www.britannica.com/biography/Arthur-Cayley Access Date December 10, 2020* *"Cayley made important contributions to the algebraic theory of curves and surfaces, group theory, linear algebra, graph theory, combinatorics, and elliptic functions. He formalized the theory of matrices. Among Cayley's most important papers were his series of 10 "Memoirs on Quantics" (1854–78). A quantic, known today as an algebraic form, is a polynomial with the same total degree for each term"..*

Terry Tao blogs about his work *https://terrytao.wordpress.com/tag/cayley-salmon-theorem/* *.."The Monge-**Cayley**-Salmon theorem via classical differential geometry… Among other things, this theorem was used in the **celebrated result of Guth and Katz** that **almost solved the Erdos distance problem in two dimensions**, as discussed in this previous blog post. …. The idea is to "integrate" the lines {l_x} indicated by the flecnode to produce smooth curves {\gamma} on the surface {{\bf Z}_{{\bf R},2}}; one then uses the vanishing (1) and some basic calculus to conclude that these curves have zero torsion and are thus planar* *curves. Some further manipulation using (1) (now just to second order instead of third)* ***then shows that these curves are in fact straight lines*****, *giving the ruling on the surface***.

Update: Janos Kollar has informed me that the above theorem was essentially known to Monge in 1809; see his recent arXiv note for more details. I thank Larry Guth and Micha Sharir for conversations leading to this post."…

I have not read all of Cayley's work – a brief glimpse shows him talking about Absolutes as a conic – I wonder if this is my fixed unit number line? **GeographicLib** - **Charles Karney** - **Google Books** – University of Michigan – The Collected Mathematical Papers of Arthur Cayley https://geographiclib.sourceforge.io/geodesic-papers/cayley-V8.pdf **Public Domain Assumed – fair use – non commercial – research and education – partial extract** "page 89 - *493 ON EVOLUTES AND PARALLEL CURVES. In abstract geometry we have a conic called the Absolute; lines which are harmonics of each other in regard to the absolute, or, what is the same thing, which are such that each contains the pole of the other in regard to the absolute, are said to be at right angles.".*.

(also ***Forgotten Books*** *https://www.forgottenbooks.com/en/books/TheCollectedMathematicalPapersofArthurCayley_10031198)*

Let me examine the language concepts – the words. This area **standardization technique** is **like** the "**like"** or "**similar"** words we use. They have **one thing the same** (**area**) and **many other things which are different**. We already had **same** (equals) **different** (**greater** than or **less than** on the well **ordered** number line of infinite units). So our vocabulary expands and a **new technique** of recognizing sameness and difference emerges. Many of the new "spaces" and concepts of "homogeneity" are designed to find some definition of "sameness" or likeness in things – hence statistics and other techniques.

It may not be obvious so I will say it here. This pi infinity number line gives us our spacial framework – the one Cayley recognizes as the Euclidian space central to our physical experiences - but it has the **area problem** and the **coordinates problem.** This provides an added layer of complexity of understanding things in coordinates (using a fixed infinite number line overlay) which is going to keep confronting the **different type of infinity** that pi represents and then trying to understand **area – that squared type function** – which is seen as **only one direction** (positive) hence this is inconsistent with the unit number line. So many people **get lost in the differences** – and hence the continual creation of more complex transformations to "solve" the problem. Seeing things as angles, or ratios etc are some of these techniques. It may also be noted that **concept of area** is like the **constraints and bounds** concepts I have described in my earlier papers. It also relates to **coherence, like, similar, link.** It is a general kind of connectedness. **Archimedes** noticed the step from 2 to 3 dimensions – from **area** to **volume**.

Cut the Knot - https://www.cut-the-knot.org/Generalization/Brahmagupta.shtml Brahmagupta's Formula and Theorem is used to find the area of shapes where each point/node/vertices is on a circle. Add up all the lengths for path/sides/vector/edge/line and divide by 2 to get a sum of the lengths divided by 2 – the perimeter/circumference divided by 2 – the semi-perimeter. Then add up all the differences between subtracting each individual length from the semi-perimeter to get a new sum – the sum of differences. And then take the square root of that and it will give you the area.

Guass developed a formula using cartesian coordinates *https://www.thecivilengineer.org/education/calculation-examples/item/1319-calculation-example-three-point-resection* *Gauss's Area Calculation Formula Written by TheCivilEngineer.org*

I have thought some more! What about seeing things made up of triangles? I like triangles because for me they seem the first step into some kind of other dimension - space. There is only so much fun you can have with drawing infinite lines – it is when things become connected it becomes more interesting. Obviously (or maybe not) - connecting infinite numbers (**unit** counting) of infinite lines at the same point gives us the **ZERO point** **– but then –** we **had to** (ought – or wasn't about time we moved that line? I was **"feeling"** a bit **differentiated** from all the "others" – the "others" and this ONE line got a little estranged) **move one line** (as defined by **two points** connected by **something** (was it space, distance, energy, time, language or a preference to eat bananas which connected them in the first place?) **away from the zero point**. This equates to the model I have shown above where I turn Archimedes Triangle into a square inside the circle. I did this by leaving the mid point of the base on the circle and moving the two extreme points of the triangle on to the circle. This seemed "neat" and least cost to me.

Who chose to leave the line and go **spacial**? This **initial movement** -

(" in the beginning there was **a two** **related to** **an infinity** of infinities" – which was a **one** or **zero point** (is/existence?) – self reference" – or another way to look at it – what is a big bang?)

- **away from the infinite zero point** seems like it could be the **first instance of a two or a binary** – which then **instantly becomes linked/related** to **the thing (zero/one/singularity) it just stepped away from**.

So the movement I used to morph Archimedes triangle can be seen in a number of ways. Was it like the initial **creation of a 3 from 2?** by a mid point of a line **choosing** to **stay on an existing circle** (maybe the circle of x number of points already existed?) while the end points **chose** to move **from** **some other existing circle** (maybe larger) **to this same circle** that the mid point was on?

OR

That the binary pair – the line – **chose** to **create a new circle** (because every triangle is the start of a new circle) with the mid point **left on an existing circle** but now **also joined to the new circle**?

OR

That the mid point – **all on its own** – it was there all the time but those end points – the big wigs – the "elite" nodes - ignored the mid point's existence –it was fussing , vibrating, full of energy - agitating and it was lonely and feeling disconnected from the end points of the line – **torn** between two lovers – that it decided just to give everyone a little "space" and "time" and move on to another circle of "friends" (as a friendly circle passed by)– while still maintaining some links with the old gang.

I mean **who chose to leave who** exactly? And why? – was an energy/time/distance involvement thing? Was it a repetition or regular and circular paths problem ("I'm sick of this – I'm out of here"). Was everyone in a rut and they just needed some exploration or chaos in their lives?

It all seems a bit wobbly to me! Just like String theory!

As far as I can tell – the transition from 3 to 4 is **reversible** (at least in a geometric kind of way as described by my process) - the mid point can re-join the line in the middle –it can go back and sit in the middle of the two points which just left the line (it still remains what happens to any other circles it may be connected to or formed recent connections with when the line split to three– maybe that's **another tension point** was well?) – making it possible to go forward and backwards through this process iteratively. This kind of oscillation between 3 and 4 could be seen as a kind of wave function I suppose – perturbations and general constraints within concentric and enclosed circles – much like many others have explored in many ways.

I was also playing with the notion of connecting all triangles at to each other **by one point** – which is the simple case. I think from these propositions we get a complexity which relates to network topology – the questions of **how many points** of any shared objects connect to each other. Or to put it another way if an infinite circle connects another infinite circle on every point are they exactly the same? If every no points are the same – are they opposite or different and all ways – **inside – outside or spacial distant**? How many points of difference of infinity count anyway? What happens when circles collide? So here we have this infinity thing again and the very small numbers and steps at the other extreme.

Caution: too much certainty causes over confidence. I do not want to stake my certain flag on any particular notion as a dogma which is the "right" cause. Let us continue to explore Archimedes work and my frames.

Diagram – Exploration of parallel lines, right angles and Triangles - Jonathan Pearson –2020 - Humanistman Public Domain

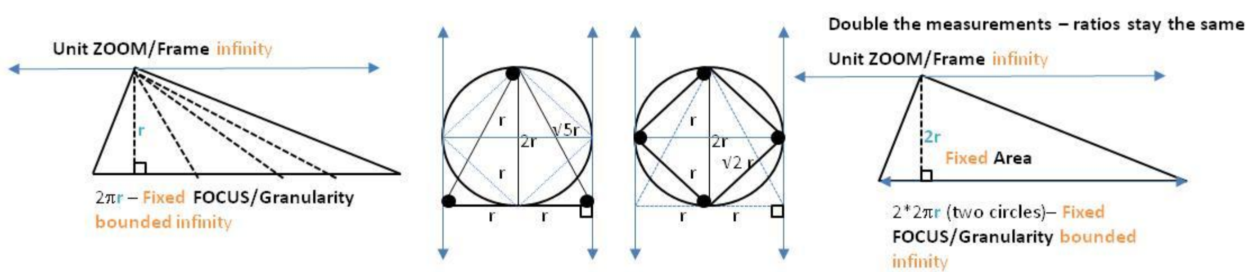
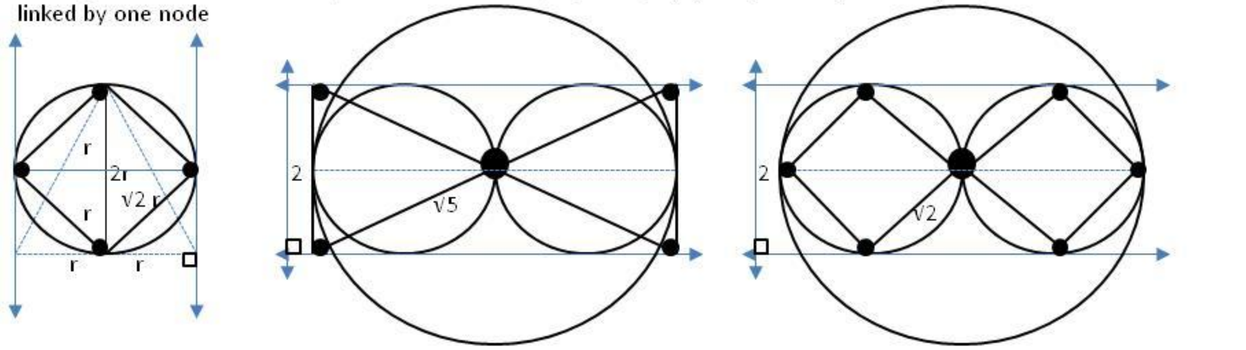


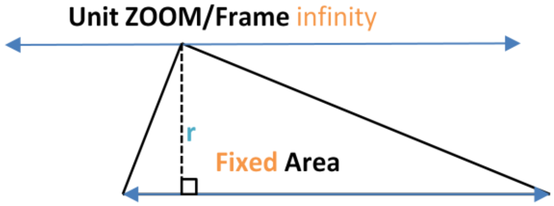
Diagram – Exploration of Moving 2 Archimedes Triangles to Squares - Jonathan Pearson –2020 - Humanistman Public Domain

Two circles inside a circle – with nodes "popping out" too far (central limit theorem) from the big circle and center mass. We might see this as oscillation, vibration. We see 2, right angle (square), circles (recursion) √5, √2 and we create 5 nodes linked by one node



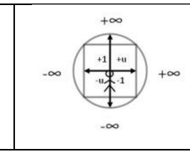
What this shows is both a triangle which can have a fixed base and a wide roaming point and **two triangles** – with two points - **working together to act in a parallel way** – a parallelogram around a square.

You will not too that the sine and cosine functions are complementary to each other in this process – it does not really matter who is called opposite or adjacent as the points range around infinitiy – because the base is fixed (tangent) by a right angle perpendicular to the infinity of movement of the "roaming" third point. Tracking the roaming of this point backwards and forwards – as it passes by the right angle point on the base – will look like waves (like a circle) – depending on your frame of reference and how you display the information.



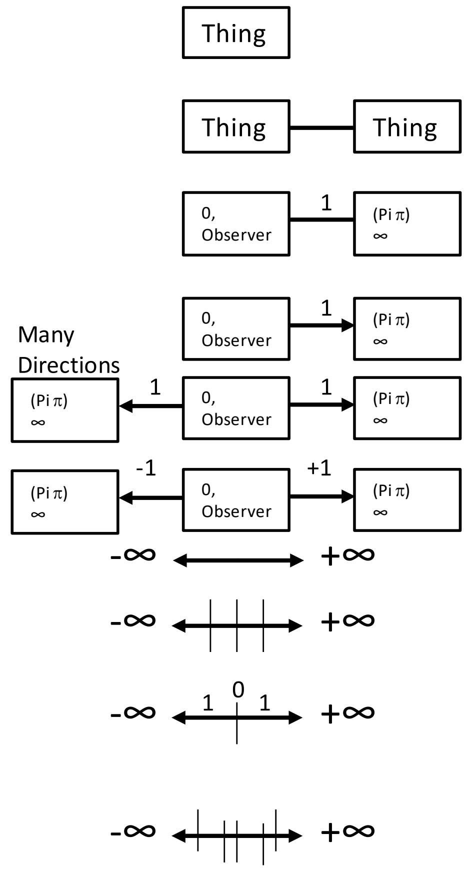
Latest Model

I think this is close. You will note from the final diagram a few pages on that I provide context for the idea of "finding the area under the circle" on the unit number line – verses the 1/pi/infinity certainty on the pi infinity number line. A central idea is that the **CERTAIN UNIT 1** on the pi infinity line **cannot** be divided any further – where as all other unit systems can.



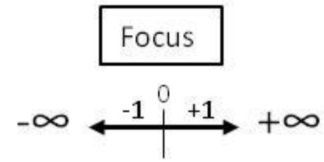
I Notice and Observe the Hypothesis

0) **Thing Is** (Thing, Declaration (is), **2,constraints, bounds,** *recursion?*) ("on denoting" Bertrand Russell)
1) Thing has(is) **relation/Link** to Thing (Thing,is, 2, constraints, bounds, **link, recursion,**)
2) **0** has(is) **Unit (1) Measurement** to **pi/infinity** (like a focus lens on a camera), (Thing,is, 2, constraints, bounds, link, recursion, **0, infinity, measurement, 1**)
3) Infinity is **A Direction** (vectors, graph theory – Leonhard Euler) (…**direction**)
4) There are(is) **more than 1/many/plural** directions (**…many**)
5) There is 1 direction **Choice** - **forwards(+) or backwards (-)** direction/choice (…**choice , +,-**)
6) There is **Continuum** between infinity (**… continuum**)
7) Continuum is divided/partitioned/**measured by units** (**…measured by units**)
8) 1 is the **unique certain unit** measurement to infinity from the observer (…**unique, certainty** – see prime numbers, uncertainty principle)
9) 1 cannot (**NOT**) be divided by measurement units – **many other measurement units/other than 0 to infinity/** can be(is) used to divide continuums. (…**NOT, many other measurement units**)



If we establish the idea of infinity early on then all discussions can focus on that rather than finding infinity lurking hidden away in some later theorems or ideas.

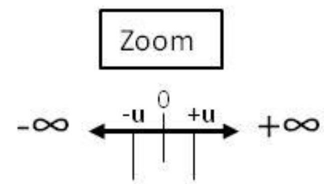
This is a way of **simplification** – bring the contentious, critical, foundation ideas to the first instance (**bounds, constraints, hypothesis, certainty, 0, infinity**)



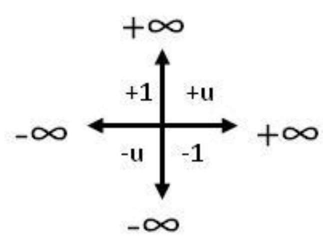
There are **2 types of infinity** – that type which is defined by Pi π (∞)

– the initial choice and initial certain unit. This becomes a thing on its own and is related to the notion of logarithms, infinitesimals and fluxions – this journey towards infinity of "*smallness*" which I relate to the focus lens of a camera. (the uncertainty principle). The log function is used for focus.

The other type of infinity is different because its is in the other direction on the continuum – related to measurement by other units, distance/time and an extension to the concept of initial unit. I relate this to the Zoom lens of the camera – this changes the constraints/boundaries/units of measurement.



Part of this is the **squaring function** – the power law is an extension to the squaring function and is **used for the Zoom and maybe focus?** – in the same way that loglogloglog is the extension to the **log function used for focus**?

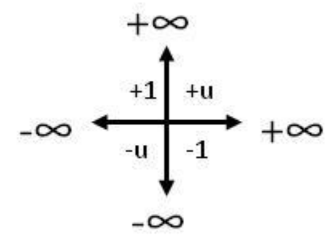


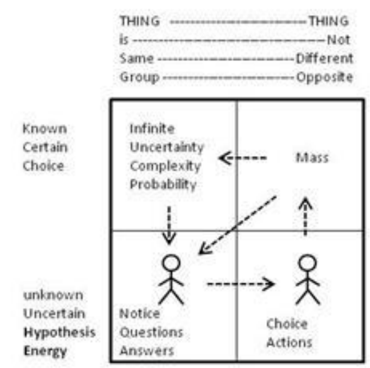
There is only one continuum of the function for pi type infinity with two choices - (focus lens) focus in (smaller) or focus out (bigger)

There is only one continuum of the function for "other" type of infinity – (zoom lens) zoom in (smaller units) or zoom out (bigger units).

These two different continuums of infinity **meet at zero** – the observer - and **no-where else.** There seem to be different types of infinity.

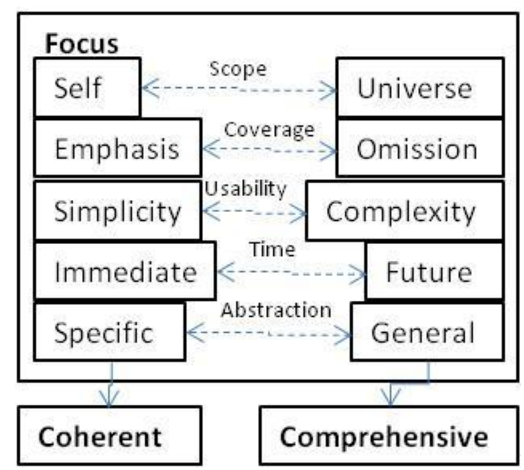
We can see relationships with my other models – the conceptual model I developed from Einstein's relativity equation – the ideas of **same/different, certainty, hypothesis, the questions , energy and mass.** https://humanistman.com/home/articles/ "Pattern Worship Choice God", "Humanist Information Taxonomy". Conceptually we could imagine an alignment between –u (as the **questions** of units) +u (the **certainty** (mass) of units used). Similarly we can see +1 representing **certain initial unit** and **-1** being more like **uncertain active exploration energy**





We notice the apparent problem – "the one thing I know with absolute certainty is absolute certainty does not exist" https://humanistman.com/home/articles/ https://humanistman.com/wp-content/uploads/2019/07/Absolute-Certainty.pdf this is tied up with making uncertainty certain – or in this case declaring infinity to be the "same" as **1 certain unit**.

I had already aligned my thinking with the focus model – and pre-empted the idea of changes across the continuums. https://humanistman.com/wp-content/uploads/2020/05/Relativity.pdf *".. This **roughly equates** to the x Axis concept and the Power law concept – where the left side of the axis is towards the fluxions or infinitesimals and the right side of the axis is towards the higher powers.' ..." So maybe we see the **tension in math** around this competing division, **continuum of frame from the very beginning**? It is definitely **not clear to me**."*



These continuums are underpinned and relatable to the new model. A combination of Camera like **Zoom** and **Focus** helps explore my Focus model. In my language I have been using "Frame" or "Framework" – which can be models etc.

Exploring the continuums via various frames can help discover and improve things.

This model aligns with several general notions – including initial self reference, recursion, Same/Different, Group, Order, continuums and repeating 2s.

The idea that having defined a function called "squaring" – doing it again is not a new function – it is just repetition – then we get repeating repeating (like Graham's number, etc).

Having defined a function called initial self reference = n^n – repeating it does not make it a different thing in a different way – a **difference of difference.**

This constant two idea seems more initial and basic than the concept of 1 itself.

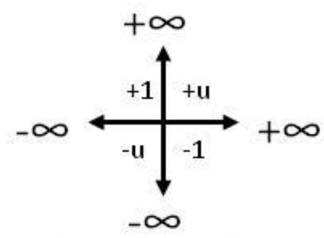
If you use a numbering system which conceptually describes numbers as 1, 2, many – then this seems the minimum needed to explore the differences.

It is this constant **"twist" type thing** around some point on the continuum like the CLT, zeta, gamma, ellipsoids, **conchoid of Nicomedes** concepts – where the function or rule changes from one type of process on the continuum to another type – but similar process where past one certain point another function from another continuum comes into play https://mathshistory.st-andrews.ac.uk/Curves/Conchoid/

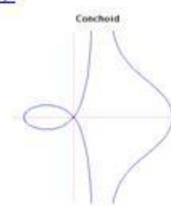
A **point of difference/change of frame –** which varies as many different things interact.

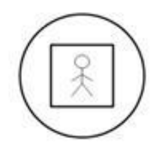
Conceptually – as a "homage" to the squaring the circle and related problems – and also to my own symbology I can transform this new model into a mix of representations of the square and the circle and show some context of the changes from the TWO main starting continuum structures.

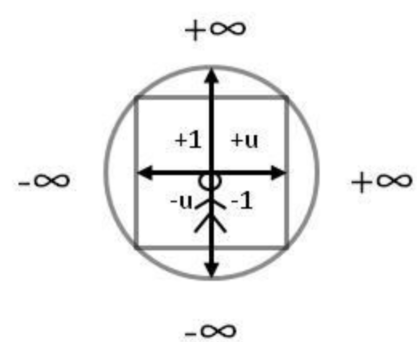
This model is abstracted away from things like choice, physics, real word patterns, etc – this is about as abstract as I think reasonable – it is a "fit" level of abstraction and before and beneath other math disciplines – field, group, graph, topology, etc



https://mathshistory.st-andrews.ac.uk/Curves/Conchoid/







Archimedes– Golden ratio – Pythagoras – Infinity – with a Twist

Archimedes explored many things – he was working with curves and triangles – using area https://en.wikipedia.org/wiki/The_Quadrature_of_the_Parabola but also he found the neat relationship between the volume of the cone, the sphere and the cylinder – 1,2,3. He wanted this is on his tomb.

We know the integral and differential calculus continuum function (**self referential** function of "squaring" – the **focus**) is the function to move between volumes, areas and circumferences, e.g. for circle we get circumference = $2\pi r$, area = πr^2, volume $4/3\ \pi r^3$.

We note too that is a type of "morphing" which retains the topology and "self-referential consistency" that many math spaces try to achieve (e.g. topology)

If we imagine the cone – its height is the diameter of a circle D or 2r and its base is a circle with the same diameter.

If we then go from the cone to the triangle shape – the 3 nodes with continuums – we can find two right angle triangles which form the triangle of the cone. Using Pythagoras we can see that $r^2 + 2r^2 = xr^2$ or $1^2 + 2^2 = x^2$ or $(1)+(4) =(\surd 5)^2$ so x becomes the square root of 5 - **√5 , the golden ratio number**. See also Heron's formula https://www.mathsisfun.com/geometry/herons-formula.html for area.

If Archimedes postulted that the arae of a triangle can be related to the area of the circle by saying the perpendicular of the triangle is the radius if the cirle and that the base of the triangle is the circumference – then this is conextually saying that this **thee pointed thing in space connected by lines** – becomes the **first example of the circle**!!!– and hence the infinite pi.

So the two sides of the triangle are like Kepler observed with his triangle with the golden ratio.

But when we went to a triangle from "3 dimensions" of Archimedes Cone we went to not being able to caclulate volume – **something changed** – we are now only able to look at area and circumference.

But lets do some trickery – you can imagine that we wanted our triangle to have **equal sides** – that would mean than instead of the height being the same "ratio" as the base instead each side of the triangle would have length 2r or D. So imagine is some kind of continuation of a function – some integral and diffrential process. But then we could go even on step further – we could get rid of the third node and only have one line , one continuum – where this length "ratio" would somehow be able to be transformed up to the triangle, circle, cone, sphere and cylinder.

You can imagine how Pythagoreans, Kepler and just about eveyone wanted to have a go at this and this became the "squaring the circle" and other type or ancient problems – or in my case "triangulating the circle". We also get circling the square, triangulating the square, circling the triangle, squaring the triangle.

We get some hints from many places – but we just need to see where the 'twist' takes place.

One tirck is that for the height of the triangle we could relate it to the **area of the circle** formula (i.e. one dimension less than volume) – and for the base of the triangle – we could relate that the the **circumference of the circle** - (one dimension less than the area formula) – to give some conceptual notion of stepping from the line to the area to the volume.

It seems to me – I HYPOTHESISE – that the step away – the twist – into the number plane as we know it with pi as one type of infinity is really **all about the squared function** of **two** variables. I know that **seems obvious** but it encloses infinity within a circle. We naturally get this pi ratio appearing in formulas. But we also get a way of looking at the central limit theorem as well. Tending to the mean – also means tending to **a** **(one of many)** "stable" view.

So what I could do is construct a view of the triangle and the line in relation to the notion or r – being the raduis of a circle by ignoring Pi – as it is embedded in the equations – and just using simple notions of equality – e.g. equal lengths and pythagoras' theorem to find relationships and where the possible tricks and changes could be taking place as we move from once transformation to the next.

No – this has already been done! – by everyone for ever. **What can I add which is new or overlooked?**

Bertrand Russell and Hermann Grassmann

Introduction to Mathematical Philosophy :Author(**Bertrand Russell**) :Year(1919) :Keyword(Individual Philosophy Maths) https://www.gutenberg.org/files/41654/41654-pdf.pdf
https://archive.org/details/introductiontoma00russuoft/page/n6/mode/2up
http://www.gutenberg.org/ebooks/41654

He recognized the idea of Zoom and Focus and the exploration along the continuum. He also recognized the middle – the bits which connect the really simple and the really complex – the bits which help us makes "sense" of things. The right kind of focus – the awareness of the continuum – the exploration of the ranges and the reason and rationale for 'centering' on some notions.

Public domain – partial extract .."PREFACE *… "The most obvious and easy things in mathematics are not those that come logically at the beginning; they are things that, from the point of view of logical deduction, come somewhere **in the middle**. Just as the easiest bodies to see are those that are neither very near nor very far, neither very small nor very great, so the **easiest conceptions to grasp** are those that are neither very complex nor very simple (using "simple" in a logical sense). And as we need two sorts of instruments, the telescope and the microscope, for the enlargement of our visual powers, so we need **two sorts of instruments** for the enlargement of our logical powers, one to take us forward to the higher mathematics, the other to take us backward to the logical foundations of the things that we are **inclined to take for granted** in mathematics. We shall find that by analysing our ordinary mathematical notions we acquire **fresh insight**, new powers, and the means of reaching whole new mathematical subjects by adopting fresh lines of advance after our backward journey."..*

It occurs to me that older men in particular (on average – using gender as a delineator so feminists can become engaged) are more likely to take that backward journey – the exploration of fundamentals looking for new insights and that younger people are encouraged to sprint forward to widely cover as many topics as they can – to do a rapid wide search of the area of the universe – to discover their interest for further exploration. This seems sensible to me because to find new insights requires a wide range of learning and experience which tends to come with age not youth (or feminism or the other group certainty extremist dogmas).

"..1,2,3,4, ...etc. Probably only a person with some mathematical knowledge would think of beginning with 0 instead of with 1, but we will presume this degree of knowledge; we will take as our starting-point the series:0,1,2,3, ... n, n+ 1,..."

Here, Bertrand – right at the start - takes infinity and calls it **etc** – which is the abbreviation of the latin **et cetera** (and the rest – and the other **parts** (of the whole?)) then turns that into a general symbology of **n, n+1** and **…**

So there are some **very fundamental ideas** are exposed but **mainly assumed.**

*"..Very few people are prepared with a definition of what is meant by "number," or "0," or "1." It is not very difficult to see that, starting from 0, any other of the natural numbers can be reached by repeated additions of 1, but we shall have to define what we mean by "**adding 1**," and what we mean by "**repeated**." These **questions** are **by no means easy**.".. "The three primitive ideas in **Peano**'s arithmetic are: **0, number,** successor. …The five primitive propositions which Peano assumes are:(1) 0 is a number.(2) The successor of any number is a number.(3) No two numbers have the same successor.(4) 0 is not the successor of any number.(5) Any property which belongs to 0, and also to the successor of every number which has the property, belongs to all numbers."*

My concepts of **Thing, Notice, Is , Bounds/Constraints**, **same/different**, **NOT, link, group, order, hierarchy** sit conceptually beneath where Bertrand starts with his book. He does explore them further on but as **related concepts to numbers** rather than underlying concepts of "things" in general – e.g. Collections, class, sets, etc (grouping), equality, etc. He also assumes many things without direct explanation – as we all do – and this is a problem for all of us – taking for granted the "shared" meaning of the words we use – **you know what I mean, right?**

I keep moving things to a simple level - conceptually. I take them from complex and very specific places and group them to "universals" – basic concepts – things at the beginning – the start, the foundation, the common area, the well worn paths. I take them from art, science, philosophy – anywhere – and find all the links and how well they "cohere". Simple and useful.

Although *successor* is mentioned – it is obviously order (that is it's **link** – each number linked to another) – as in "well ordered set", etc. It is a binary direction. This concept gives rise to the series, sequence notion – the repeated fractions and the general idea of recursions and functions. Bertrand highlights the need to start somewhere and the unavoidable (in my view) **initial self reference**. *"..On the other hand, it is also possible that, when analysis has been pushed far enough, we can reach terms that really are simple, and therefore logically incapable of the sort of definition that consists in analysing. This is a question which it is not necessary for us to decide; **for our purposes it is sufficient** to observe that, since* *human powers are finite, the definitions known to us must always begin somewhere, with terms undefined for the moment, perhaps not permanently"*

While exploring this I happened upon **Grassmann** – who like many recent thinkers and authors – has not been fully translated into other languages so that English speakers and those not proficient in the various languages, can read his work. I rely on what others say about his work – and they seem impressed. Not many of his books or notions appear in the https://opensyllabus.org/ database – it may be that his is not well known in universities. It seems he may be ahead of his time. The German universities are well aware of him – Potsdam https://www.uni-potsdam.de/u/philosophie/grassmann/Werke/Hermann/Ausdehnungslehre_1844.pdf and others.

My confirmation bias tells me to be impressed with his work because we seem to have some similarity in our views. Others rate him well - **David Hestenes** Arizona State university January 1996 DOI: 10.1007/978-94-015-8753-2_20 ***Grassman's Vision*** https://www.researchgate.net/publication/266575537_Grassmann%27s_Vision **Assumed public – fair use – partial extract – non commercial** ..*"Grassmann himself identified a more critical condition for comprehending his vision, namely **immersion in his conceptual system.** That system is, after all, a rich mathematical language, so it takes years to develop the proficiency that opens up mathematical insights. Having acquired such proficiency, the **superiority of his system in applications throughout geometry and physics was obvious to Grassmann**, so it was a great frustration to him that others, even distinguished mathematicians, were unable to recognize this...The purpose of this paper is to point out that the missing ingredient in Grassmann's theory has been found and put in place to create a geometric calculus that fully realizes his vision. Indeed, the seeds for this advance were already present in Grassmann's work. Moreover, Grassmann's bold prophecy is in the process of fulfillment even today, as his insights are revived to enrich modern mathematics and physics*"..

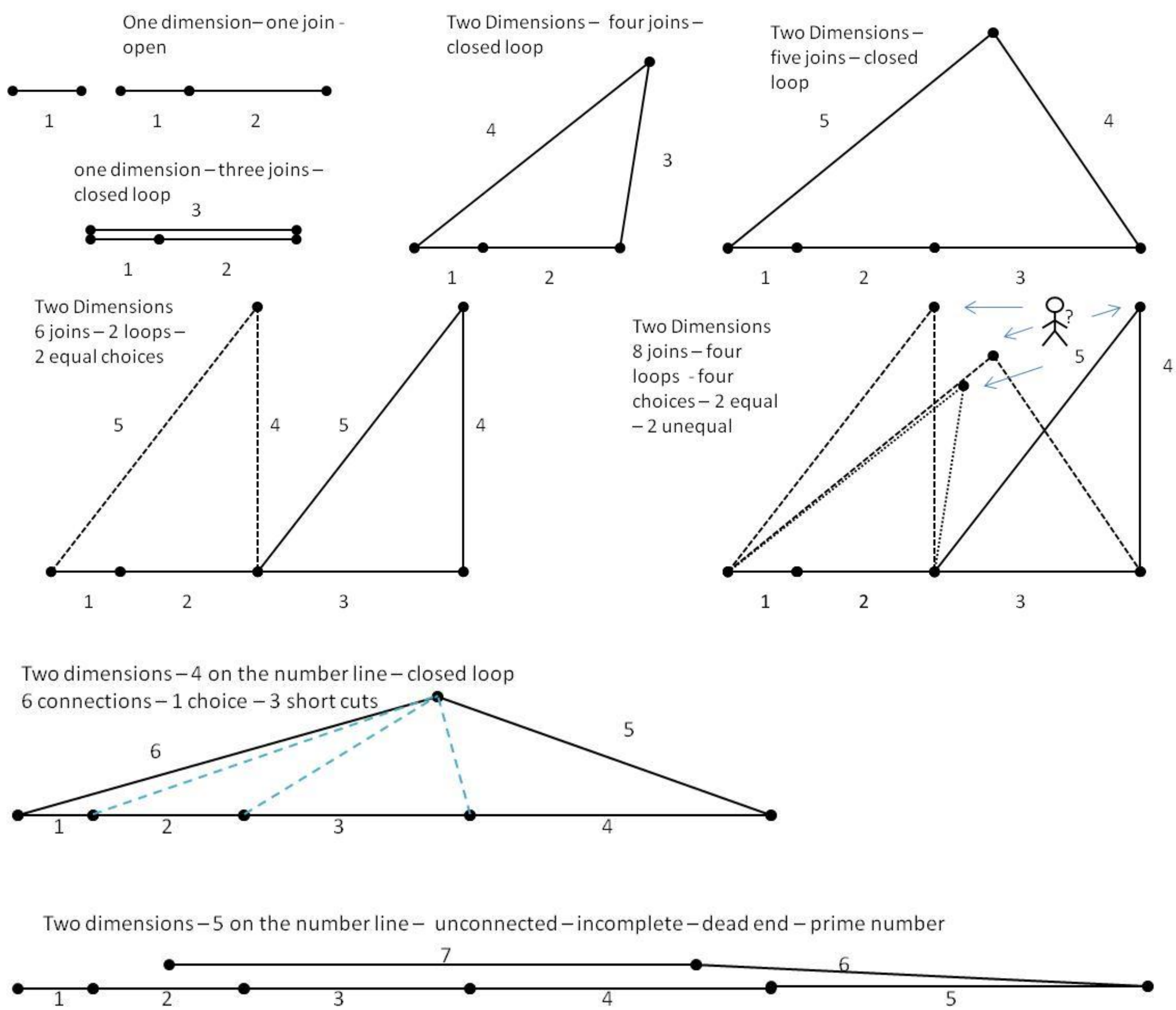
It is my view that the number line and the number plane (as we know) it are very different things and that the **step we take away from the number line** (the twist) into what we **take for granted** as the number plane – while obvious and seemingly simple to us – has a lot more to it that we realize. Here I think Grassmann has recognized the issue and sought to explore the maths around that. At the heart of the issue to me is that the SQUARED – kind of two dimension x/y axis – polar coordinate, planar view we take for granted (and the infinity dimensions of that) – changes the number line maths dance routines significantly and that reconciling these and exploring the issues is not easy.

The FIRST step to THREE – creates an ELLIPSE, (using direction - vector graphs going round and around) every ellipse has two focal points. Some triangles fit perfectly on a circle. (the central limit theorem) – most are close to a circle but are really ellipses.

Forming triangles - 3 is the first step away from the number line in enclosed one directional vectors – **push to an equilateral triangle** then 4,5,6 . There are no more steps away from the number line after that – everything becomes a **relative of the equilateral triangle** and spacial dimensions.

Notice that when 4 and 5 step away from the fixed number line we get **2 points** *pathable* by **right angled triangles** and **1 point** which is *close* to a right angled triangle and *close* to the other two points. We will also get other points (not drawn) with various combinations of 1,2,3,4,5 –*"enclosed"* in the space.

Diagram – Exploration of numbers, lines and links between Number Line and Space - Jonathan Pearson –2020 - Humanistman Public Domain



We can imagine mass, vectors, spacial, distance, energy, math, etc conceptual alignments with this model.

For me it seems that symmetry, neatness, coherence, homology and related concepts *appear visually more appealing* in the option of leaving 1,2,3 on the number line and then taking the leap to 4 and 5 in the spacial dimension. Things *seem* more connected, balanced, reusable and well aligned with other maths. Distance and options choice are considerations for my intuitive pleasure. I also like that the leap of 4,5 is the middle choice of three options. The first option at 3,4 is very simple and stable but pushes out the top point "outside" the bounded space, the middle option seems well bounded and stable with the point closer to the centre of the space and the **big shock to me** (because I saw 5 as a likely limit) as there was a third option the 5,6 which seems too "squashed" and "cramped" – too many paths are too close to each other. I like the uncertainty of everything and discovering things at the edges. I like that 5 seems to be a stable configuration – this is my **confirmation bias.**

I am deliberately mixing narrative, vagueness and specifics as an approach to exploring this topic.

Squaring (the spacial dimension) continued - For example squaring and rooting, exponents, logs, polynomials – are all related and seem very similar to me –as does calculus and that the notion of "area" and hence volume and other dimensions all emerge from that first step away. We already have zero, unit (one) and "many" (etc, **infinity**) and order then **direction** – but this step away is a **big step indeed** (Sherlock!) and gives us all the chaos, complexity and uncertainty we see. Throw in Euler paths, graph theory, and the rest and it gets complicated. **William Clifford** dealt with Grassmann's work and looked at the i issue – square root of negative 1 - and also advanced this work significantly into **Geometric Algebra.**

William Kingdon Clifford :Year(1845-1879) :Keyword(Philosophy, Maths) https://en.wikipedia.org/wiki/William_Kingdon_Clifford https://plato.stanford.edu/entries/ethics-belief/ https://www.brainpickings.org/2017/04/14/the-ethics-of-belief-william-kingdon-clifford/

Hermann Günter Grassmann :Year(1809-1877) :Keyword(Math, Philosophy) https://mathshistory.st-andrews.ac.uk/Biographies/Grassmann/ https://ncatlab.org/nlab/show/Hermann+Grassmann https://www.researchgate.net/publication/266575537_Grassmann%27s_Vision , https://archive.org/details/dielinealeausde00grasgoog

So I think he saw this problem – the **area problem** – the squaring the circle, triangle, and other shapes – the bounds of pi etc. The idea that all these vectors, (line with directions and the concept of "area" at the same time (as a result of the SQUARING function (**making squares** **as well as** the **multiplication of numbers** in x/y coordinates **problem**) and he came up with a way of trying to make sense of it. This was called Grassmann Algebra and now Exterior Algebra - a kind of "universal calculus" method. He saw the relationships – the similarity – the **plurality** (**Hannah Arendt**) – the combinations and complexity.

Michael Otte https://www.researchgate.net/profile/Michael_Otte4 suggests that Leibnitz too saw this **geometry versus maths problem** as well *https://core.ac.uk/download/pdf/82042248.pdf*

So I think I understand why he explored this and I think I understand the technique he was using and why. He was abstracting to a level so that things could be compared to each other. This is similar to the topology type maths which is also looking and the key **"sameness"** of things.

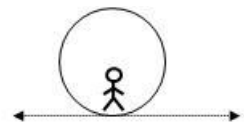
Combination, complexity, probability, tendency, central limit theorem, like, similar, different, converging, diverging, simple/complex, bounds/constraints – where do we draw the line?

I see. I notice.

Others notice too. The latest fad/trend is to see things as a part of a *categorical theory*. We see "morphing" of maths from arithmetic, algebra, geometry, topology, graphs, fields, etc into Categorical theory. I.e. let us see how well we can generalize, categorize and investigate things. Carnegie Mellon University is physically (not organizationally – it is a kind of "group"(pun intended) collective blog) hosting a web site where people are doing this kind of thing https://ncatlab.org/nlab/show/nPOV

Also - Author: Stephen Wolfram Title: A New Kind of Science Year: 2002 Publisher: Wolfram Media Place: Champaign, IL ISBN: 1-57955-008-8 URL: www.wolframscience.com https://www.wolframscience.com/nks/p1--an-outline-of-basic-ideas/ **The Foundations for a New Kind of Science**

Really Ignorant of Maths

Ok I think I can pull together a narrative about numbers and the universe. 

The infinite **UNIT number line** is OK (counting apples) and has the basic dance routines. This is out "discrete" type line – we use for accounting, money, items, trade and the like. It has binary **direction**. It is fixed – our permanent yardstick. We do have the concept of infinite **precision** and **accuracy** as well for our units as we can use smaller and smaller measurements as well as larger and larger. (the zoom idea)

The summation routine handles positive and negative values and modulo arithmetic is the only sensible routine for the idea of "division". Ratios are fine and the multiplication dance routine is Ok as well – except in my version it handles the problem of multiplication of negative numbers as an extension of the general syntax I mentioned before - **COUNT** STEPS unit FROM unit TO unit BY unit. This is a kind of general technique which allows us to not always have to start at zero – the FROM unit. We can get a **measurement** of DISTANCE and DIRECTION which we can compare and use for **choice** (same/different/like, equal, greater, smaller) as a simple method of optimization (e.g. shortcuts – less energy, etc (fat,dumb,lazy), - or long paths – **exploration** and options (hypothesis)).

Notice there is a wide variety of understanding of basic maths and functions – just see all computer languages and math books ,etc. Some Computer Environments I am familiar with (PL1, DB2, ADABAS, NATURAL, SAS, COBOL, FORTRAN, R, PYTHON, HTML, XML,UNIX, DOS, C, SQL, and more).

My COUNT statement relates to the iterate, loop, select, do functions. i.e. "Do something" – (instructions for an explorer ***'Mount and begone. The world awaits you.'*** *:Author(Mervyn Peake) :Year(1959) :Source Document(The Gormenghast novels) :Keyword(Choice Chaos Explore)* *https://archive.bookfrom.net/mervyn-peake/40634-the_gormenghast_trilogy_titus_groan_gormenghast_titus_alone.html* *https://www.azquotes.com/author/11447-Mervyn_Peake*) in my example I use the word COUNT – because it "connects" well (to many simple things) in set theory, etc. The word COUNT – forms a **good number** of connections to **conceptually well related** other things to provide some **immediate context**.

I digress - Parse, Parsimony and Part – are related concepts of analysing something (a kind of focus) and examining the various parts. We take this technique for granted in ourselves but to formally specify meanings, structure, order, etc – takes a large amount of work and training – especially if large numbers of people are going to share the same conceptual view of the world in some given domain and be able to communicate sensibly (with some shared sense) about the same observed things. Ockham's Razor – the law of parsimony - is an example of this type of process. Parsimonious as a "penny pincher" is really just a light twist on "frugal" and illustrates the general technique of turning/twisting words and concepts for humorous or satirical commentary – which can add more meaning (with a smile or smug knowing reinforcement of preconceived biases) but can also add so much "nuance" that the original meaning and "sense" of things becomes lost from focus. So for me – not only is history of humanity – via stories, art, science, books – important but the study of words and their meaning as they change – can also help bring a greater understanding of the underlying issues. I love dictionaries and will read them from cover to cover and browse them often.

What is summation? - **SUM** from unit to unit by unit. I looked at numbers in many of my documents but I tried to explain much of it here https://humanistman.com/wp-content/uploads/2020/05/Questioning-Numbers.pdf I also touched in it by examining Euler and the Hansel and Gretal story in https://humanistman.com/wp-content/uploads/2020/04/Pattern-Worship-Choice-God.pdf and https://humanistman.com/wp-content/uploads/2020/01/Corruption-Measurement-and-Implementation.pdf and my frame - ***16 Humanism Complexity Structure*** https://humanistman.com/wp-content/uploads/2020/04/16-Humanism-%E2%80%93-Complexity-Structure.pdf in the data frame section in particular.

We can get a modulo arithmetic from this as well – which gives us a step count or a sum of numbers with a **left over bit** – which is the **remainder** in whole units. The **answer of the questions** – the dance "quest" on the number line – comes back with a story of how many steps were taken and what happened when they reached "the end". This still allows the direction to take place forward or backwards but it also has some interesting features. Notice that there are some instructions which make no sense – no dance step can be taken. It will not work. i.e. you cannot count from -2 to +6 by -2 – you are going the wrong way and will "never" get there.(barring infinity and circular numbers??) This is a little like the rule that division by zero is "undefined" – in that – it is a RULE. i.e. we can make up dance routines on our dance floor which have some **basic rules** that go along with them. It is Ok to make up rules that help the dance steps work. In this case I want **two directions to be maintained on the number line. I want direction to mean some thing.**

Notice too that we get the notion of **precision** and **accuracy** – emerging with the specification of the count or sum function and the **result** and the **remainder**. I **slightly digress** to explain that up until very recently (less than 50 years ago – and still not in all countries) the whole **measurement system** was **completely separate** to the decimal number system. Measurements where in chains, furlongs, grains, acres, roods, sacks, elbows, hogsheads, etc – where the units were not consistent- **standardized** - for like things – distance, area, volume, mass, density, energy, time, etc. Now most (not time – although the after the French Revolution (around 1792) the French tried decimalizing that as well - what were they thinking!!) measurement units are "decimalized" (**as a rule**) to match the numbering system. But **even**

so we could specify a statement like Count steps from 1 to 2.05 by 0.45 – giving an **answer** of 2 with a **remainder** of 0.15. The **answer** is precisely 2 to an accuracy of plus or minus 0.45. The **remainder** is precisely 0.15 to an accuracy of 0.01. Some of you will **note how** counting **looks a lot like division** – but in this case it is a modulo type operation (giving me **remainders**) and **both directions** (according to my rules) – which maintains the integrity of the number line. It keeps my dance floor (line) solid! Also you will note that Euler walks are maintained and there is similarity with Euler's greatest common factor algorithm.

So by **explicitly keeping direction** division and multiplication look like the same thing on the continuum - **opposites** of the same process.

The sum statement does the same kind of thing but instead of counting steps it adds values (which is like starting a new **Count statement** against the number line. So the **Sum statement** is a count statement of a count statement (recursive) usually **forcing the count to start at ZERO**.

<u>Instructions for Explorer on the number line</u>

Count ?**Steps** from **Start** to **Finish** By **Yardstick** **,** Tell me what you learnt on the way , Give me **answer** and **remainder**

Start=0, Finish = +11, Yardstick= +3 . Answer(steps) = 3, remainder = 2 (Modulo, Multiplication and **Division)**

+11 mod +3 = +3 remainder +2, +11/+3 = +3 +2parts of +3, +3 * +3 + 2 = +11

Start=+11, Finish = -1, Yardstick= -3 . Answer(steps) = -4, remainder = 0 (Modulo, Multiplication and **Division)**

[+11-1] mod -3 = -4 remainder zero, [+11-1]/-3 = -4, -3 *-4 = [+11-1]

Count **Steps** from **Start** to ?**Finish** By **Yardstick**

Step=+1, Start=+11, Yardstick= -3 . Answer(Finish) = +8, remainder = 0 (Summation)

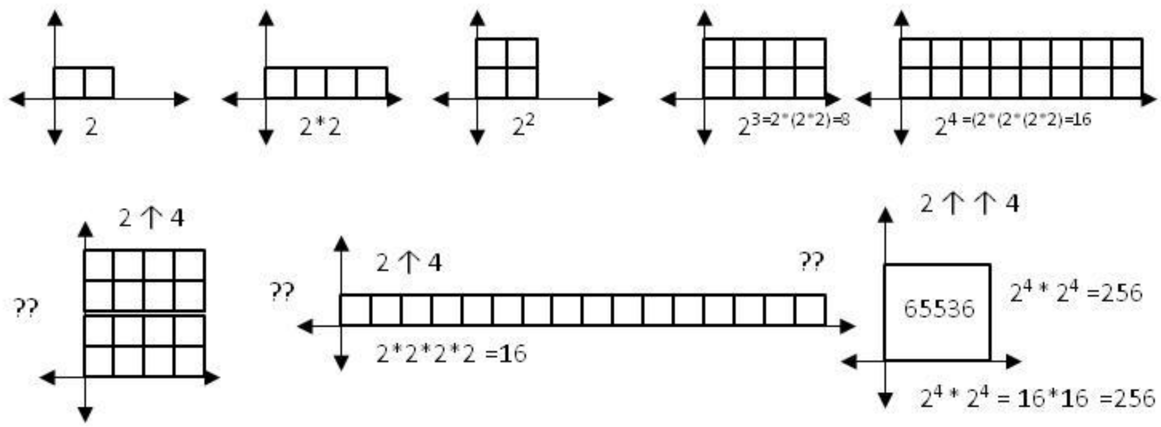
Count ?**Steps** from **Start** to **Finish** By **Yardstick** **,** Tell me what you learnt on the way , Give me **answer** and **remainder**

Start=+4, Finish = +11, Yardstick= +2 . Answer(steps) = +3, remainder = +1 : use these in next count (recursion/summation) Count Answer(steps) = +3 from **Zero** to ?**Finish** By **Same Yardstick,** , Give me **answer** and **remainder**

Answer(Finish) = +6, remainder = 0, +4+(+3*+2)+1(first remainder) = +11, +4+6+1(first remainder)=+11

This is a very solid foundation but does not handle complexity. For that we need a twist – and as it happens it is so obvious we take it for granted. It's the infinite choice of direction – direction to notice, explore, move, etc. This is what we see as Pi. This can also be called the "squared" number frame.

This **squared number plane** is where exponents, squaring and square roots all get **conceptually mixed up**. We may get the same **area number** **but we can visualize the process a number of ways.** The polar/Cartesian coordinates are strongly attached to the conceptual model so the idea of triangles, square roots, logarithms, hyperoperations and Pythagoras and vary in use.



So it depends very much on how you shape things. We can also see that the square is there all the time and the implied circle (because of the certain distance from the zero point) but also see how we can draw some short cut type lines – a triangle or two between the four extreme points – but we have this **problem** of getting the shape into a square and also the problem of the Cartesian co-ordinates and reconciling area (always positive) with length and height positions on a positive and negative axis. Or as I call it - the **area problem on the squared number plane**. **Euclid's Elements** describes the squared plane - and areas as measured by squares (see **David E Joyce - Clark University** the **Department of Mathematics and Computer Science** https://mathcs.clarku.edu/~djoyce/java/elements/toc.html)

Archimedes, Pythagoras – all knew about area and shapes. They wrote the book on the subject. Archimedes was really, really, really, clever – no, really! - really clever – like a million times more clever (cleverer) than any feminist.

He also knew that the twist in maths which took us to **area –** also opened up an infinity of what we call spatial (**space**/**spacial**) dimensions. So not only do we get a certain standard measure **(area)** conceptually but we get the idea of dimensions as represented by the power laws and the polynomial type equations as well. Infinity manifested in multiple ways – by moving one step away from the number line and into "space". Instead of **Unit** (**constrained and bound**) and simple **binary direction** – we get **infinite direction** – and instead of neat Units – we get **infinite units. Everything we touch turns to infinity.**

We FIGHT to Bound and Constrain but the Universe keep opening up!!!

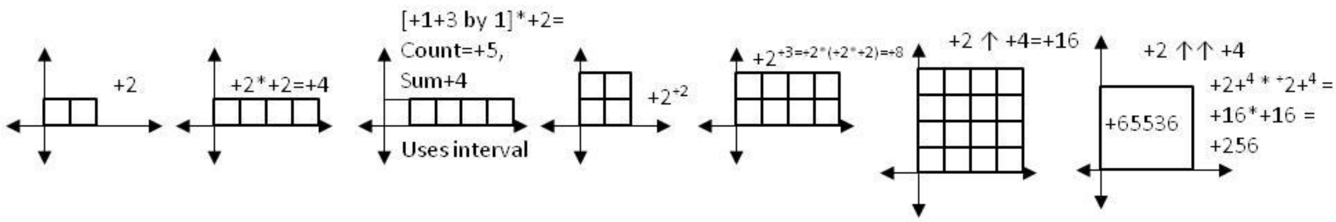
This **area thing** seems to be a well used measure – we talk about it all the time – it's a step into another kind of number position somewhere – a twist – not exactly count or sum – although they too are a kind of step away from the line as well – another "type" of measure. It's a little similar to statistics – the sum, frequency measures – it is a **different kind of measure** of grouped kinds of things – it is where we dive into sets, rings, fields, topology, matrix, graphs, vectors, eigens, blah etc.

Statistics use the same spacial concepts and hence "area" – ANOVA, etc (analysis of variances) where counts, summations of anything are examined and explored and then the **multiple variable analysis** problems as well – the central limit theorems of “normality”, circles, stable ellipses, “degrees of freedom” – distances between things are calculated as “area” and “distances” and hence the squares and averaging (the mean) idea. We are conceptually in this infinite and complex spacial dimension – many types of infinities and many complexities to be explore. Many languages and techniques – all a little inconsistent and uncertain and sometimes wrong or incoherent.

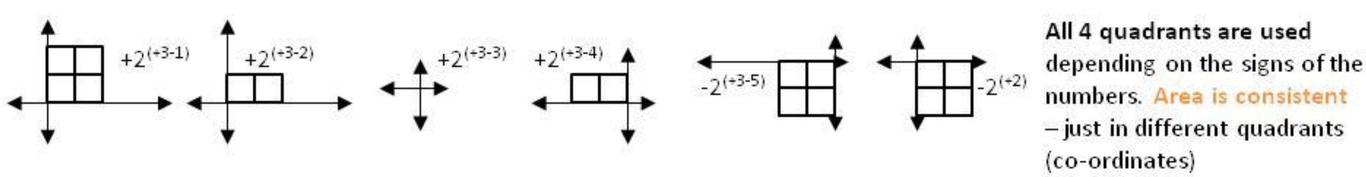
There are **many complex techniques and functions** for getting explorers to do things in the infinite spacial area e.g. *(**Weisstein, Eric W**. "Heptadecagon." From MathWorld--A Wolfram Web Resource. https://mathworld.wolfram.com/Heptadecagon.html)*

I wanted to just touch on the inverse operations of “squaring” and the up arrow (what do people think of the down arrow? *(**John D. Cook** https://www.johndcook.com/blog/2018/04/10/up-arrow-and-down-arrow-notation/)* and the **importance of the right angled triangle as a tool** - because a right angled triangle is **half the area** of the equivalent “square” and so **triangling the square** becomes a **useful technique** – and an appealing visual conceptual representation (to me at least). Other techniques are **squaring the rectangle** https://mathworld.wolfram.com/RectangleSquaring.html , **squaring the triangle** https://mathworld.wolfram.com/TriangleSquaring.html (Stephen Wolfram’s website covers much of this quite well but I do not always agree – for example- ***Weisstein, Eric W**. "**Down Arrow Notation**." From MathWorld--A Wolfram Web Resource. https://mathworld.wolfram.com/DownArrowNotation.html* using *e* and ln in the equation misses the point I am trying to make about the special dimensions and also imbeds infinite constants rather than a simple stepwise process.)

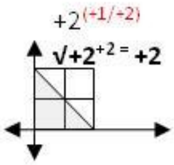
Some simple visual maths using my explcit signs from the unit number line and count functions.I explore the **problem of how to display units on a number plane** – along one line or in a square? A simple look at the single up and (reurcsively) double arrow notation of hyperoperations.



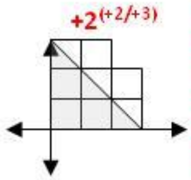
Now lets see how exponents might work in the co-ordinate plane.Note how I can use the **summation** (recursive count of count) unit line function in the brackets = (+3-2) = +1. **Area is consistent** but also **direction is maintained** and the **concept of distance** as well.



Now I try to understand the consistency of the fraction powers and fail dismally.



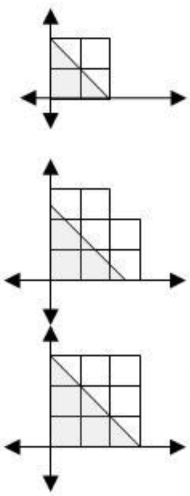
How do I get to zero?? Why is it not allowed?



This is where the power fraction gets messy - I do one square process of 3 and 2 root processes of in the positive quadrant? Which one gets done first? In What order?

The opposite continuum function of the square is the right angled triangle. We need to understand remainders

Now I express some hope in the idea of hyperoperations – with modification – for some consistency – but also note problem areas and failings.



+2↑+2=4
+4↓+2=+2

+2↑+3=+8
+8↓+2=+3?
i.e. neat integer units arrive but it is not obvious when looking at it and computer processing generally **does not discover it.**
+3↑+2=+9

Conceptually the up arrow notation is **trying** make us **think in squares** – not just simple counts of units. More than that – its is trying to get the square root line – the hypotenuse of the **right angled triangle** – to move **in** and **out (zoom/focus)** by synchronized movement on the axes – using the same units. This allows ZERO and all four quadrants. **But current notation has stuck using multiplication - not coordinates. Ackerman function, Hyperoperations ,etc i.e. the idea is good but needs work.**
Euler's method of greatest common divisors might help.

You will note that although this operation is in one quadrant – we can also do simultaneous functions in **all other quadrants** which gives us our **middle square** made up of the four quadrant triangles but also ties in very well to a circle with four points touching – an all the associated triangle forms which emerge.

Different types of infinity present **different problems** and challenges. It is not simple to understand and explore. I am not sure if there is anything new or undiscovered in my work – and it would take many life times to explore. No artificial intelligence can do this work. I can take this further but I need to let this sit for a while and take a break.

0	14	14	9	4	1	1	6	21	56	126	252
-14	0	5	5	3	1	1	5	15	35	70	126
-14	-5	0	2	2	1	1	4	10	20	35	56
-9	-5	-2	0	1	1	1	3	6	10	15	21
-4	-3	-2	-1	0	1	1	2	3	4	5	6
-1	-1	-1	-1	-1			1	1	1	1	1
-1	-1	-1	-1	-1			1	1	1	1	1
-6	-5	-4	-3	-2	-1	-1	0	1	2	3	4
-21	-15	-10	-6	-3	-1	-1	-1	0	2	5	9
-56	-35	-20	-10	-4	-1	-1	-2	-2	0	5	14
-126	-70	-35	-15	-5	-1	-1	-3	-5	-5	0	14
-252	-126	-56	-21	-6	-1	-1	-4	-9	-14	-14	0

Except I just thought I would fit Pascal's triangle (summation) to the frame because it seemed like a nice thing to do and it matches the right angled triangle with equal sides concept.

I suppose I could fit the count function somehow was well – in a coordinate kind of way? Or another function using the "cells" "behind" and maybe coordinates (which "fix" the position)
Maybe later for fun.

You can see how Pascal structured his path to pi infinity and the circle.

Note the relationship to Fibonacci, Turing, Automata, arithmetic, geometry, Hansel and Gretal, Boole, Mandelbrot

THE PROBLEM EXPLORED SO FAR

Confirmation bias is one of our biggest biases – it is one that makes us completely blind to the most obvious of things.

Humans tend to overlook their biases and assumptions.

All humans – not matter how intelligent, studied, well read, how far they have explore – everyone is still exposed to this lack of complete certainty. We conceptually put it into **infinity** but infinity takes a number of different forms – many that we simply (in order to simplify in a kind of utility way at one end of the **extreme of the continuum of fat dumb and lazy**).

For **Srinivasa Ramanujan** and many others it was **constraining** and **bounding** and **grouping** terms (**bracketing and manipulating**) and then eliminating infinity as "etc" – I mean - if you move it further and further away from your frame of focus it just disappears right? It is like how feminists ignore rational arguments or facts – it's the same bias.

For algebra and related fields it was sigma notation Σ, "approaching", "diverging' and infinity "constants" – *let's just call it x shall we?. If we ignore the smaller for the larger, etc.*

For the Greeks, Babylonians, Indian, Egyptians, Chinese it was largely Geometry and **recursion (initial self reference).**

For computer maths it was called Turing machines, Automata, "new math" and, once again, "**etc".**

How can be so sure Jon?

Well - Squaring the circle (or polygoning the circle for that matter) is an **infinity problem.**

Are you saying the Greeks, Pythagorians were **wrong!!!?**

No – That's too binary - I am saying that they just **didn't clearly notice the infinity problem and where they were putting it – how they shifted it around.**

And it seems it has been **difficult to notice** it – except people like Euler, Heisenberg and Einstein (and those who understand bounds and constraints and infinity) because our **"lived experience"** of the **spacial dimension is so strong** – it "works" very well in our local space.

No right angle is really a right angle. It is just an **assumption** in the spacial dimensions.

So are you saying that $x^2 + y^2 = z^2$ is wrong?? Pythagoras and Euclid and all the others – who do you think you are???

No – that's too binary - I am saying that it **works on the unit number** line according to maths but **visualizing** that in the spacial dimensions as a "right" angled triangle is a **confirmation bias** based on our real life experiences and day to day choices in the world around us.

Well prove it THEN!!!

Well I understand how upsetting it must be – but as you know – **"one thing I know with absolute certainty is absolute certainty does not exists"** or to express it another kind of way **"never say never"**

To explain the general problem - it is really quite simple – all you need to do is **recognize (take notice) where you put infinity**.

Who decided that a square consists of 4 right angles and why? What is a right angle exactly? Is it a sine, cosine thing (some kind of ratio of **fixed unit** numbers) or a pi thing (infinity) or a radians or degrees (bounding infinity)? Space is measured by spacial dimensions – **Area** and **Direction** (as well as between **formally declared connected** objects to **UNCONNECTED** objects). The direction problem is that we have order (sequence), bounds and constraints – all firmly conceptually fixed on the number line – but not when making connections between UNCONNECTED things – we have to **make up a language** for **Area** and **connecting** UNCONNECTED things. The language we made up to describe area – just happened – as a confirmation bias – be called **squares.** It could have been called trees, bees, bananas, density, energy of walking, – or anything else. We just happened to use the first thing that came to hand and that was distance measurement units from the fixed number line. Drawing the unit square and **then a line from opposite corners** (the diagonal) is a number that looks **very close** to the "square root" of 2 – i.e. a number multiplied by itself gives two (this gives the Pythagorean formula it's big start). The square root of 2 is **transcendental** – which is another way of saying "**infinity" – just like pi, e, etc. Infinity hides in the Square root of 2 – and hence the right angled triangle concept.**

I have shown the method Archimedes used – exhaustion (towards infinity) to equate triangles and circles. The foundation of all geometry (And topology, etc) is the right angle. The degrees and radians related measures all have infinity bounded in their definitions. The sine and other ratios are just comparisons of numbers on the unit number line.

Well JON! - how is a square NOT square??!! (some humans will never understand the problem with this question)

We can define an object as having four equal edges but when we try to define some kind of relationship between the opposite and **non joined** edges we are exploring greater uncertainty in the spacial plane and in this plane - **infinite pi rules!**

It is obvious sin't it? If Pythagoras was correct then $a^2 + b^2 = c^2$ – which is also Fermat's last theorem and the basis of a whole lot of maths. Now the problem is the 2*2 = 4 and 3*3 = 9 – so we think that "squaring" things is just multiplying a number by itself – **but these are different continuum functions**. Then we think that gives us the area of "square" where each side (four sides) is 2 (i.e. we get tricked into thinking these are equivalent expressions **2^2=4** and **2*2 =4**) . Then we assume that as each side is equal and we guess some kind of "right angle" using a **right angle measurement stick** - it is "squared". Then we try to "halve" the units of the "square". So they **found the square root function** which is designed to **space out the length** from opposite corners. It seemed to **work just the same** as using the **mid points** from each of the four **line pairs – to halve the area of the square.** We know it is just an approximation because **THERE EXISTS NO SUCH SQUARE** WHERE THE DIAGONAL IS IN EQUAL/SAME/INTEGER/**UNITS** to the sides. This is because the diagonal of all squares is transcendental – this because it is subject to the pi infinity measure not the unit infinity measure. The **square root of 2 is transcendental** and **so is every other square root!** So all of geometry has this problem in it. All the sines, cosines, radians, pi, etc – all the same "squared area unit" problem.

Look - I will try to simplify it - the definition of the square root of two is entirely self-referential – it is the **starting point of all the rooting, power law problems**. The Pythagorean laws (our lived experience in the spacial dimensions) $a^2 + b^2 = c^2$ immediately creates the concepts of **Squaring** and **Square Rooting** **- which specifically spacially means – making a square (with four arbitrary right angles and equal sides) -** and drawing a diagonal line from opposite points and then counting up the little smaller squares inside. And If you count up all the little smaller squares inside to infinity to get a "halving" of the area – which is called square rooting. So if we take the number 4 and square it you get a 4 by 4 "SQUARE" with 16 units. When we square 4 on a calculator we get 16. When we take the **square root of 16** we get 4 (with apparently two answers – plus and minus). All good so far on the number line calculator. But what is the length of the **diagonal line** on the four by four square called? Is it a hypotenuse of a right angled triangle? What is the length? Well using Pythagoras we get $4^2 + 4^2 = c^2$, $16 + 16 = c^2$, c = **square root of 32** as a unit length. So to get that answer we have to ask the question – what is the square root of 32 – which is a **different question** to what is the square root of 16. Now you might say **"so what"** – they are different things. Yes they are – then we get to unit 1. A 1 by 1 square. **We get lost here** – because when we are at any integer from 2 and above on the positive line (let us not get into the **sign problems of rooting** – which I have already covered as part of the "area" problem) we can square the integer and the take the square root – back and forth – as a nice continuum function – **until** we reach **1 squaring** and **2 taking the root**, Remember up until now squaring something gave you a number the represented the **number of units in the square** made up of **those sides** – an **area conversion** function. So what is 1 squared?=1, And What is the square root of 1?=1 and what is the area of 1 squared. And what is the diagonal of a unit 1 squared? square root of 2? **So infinity hides** in the square and rooting and power laws all around 1. So what is two squared = 4? And what is the square root of 4? = 2, and what is the square root of 2? = itself – **initial self reference (infinity)**. So between 1 and 2 things all fall apart depending on which direction you are using the function. So The diagonal line and the square line on equal x,y coordinate units on a spacial plane was giving us neat spacial unit SQUARES (area) that represent the total units, the half unit area and the length of the diagonal line – three things were going on – the x coordinate, the y coordinate and number of area units and using Pythagoras – the length (we needed to pace out) on the diagonal line.

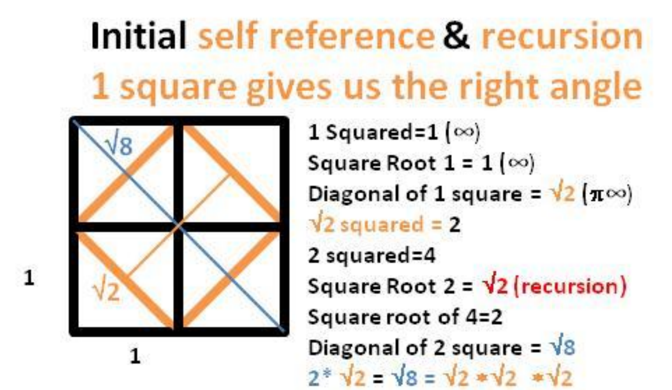


Diagram – Exploration Squaring and Rooting Problems - Jonathan Pearson –2020 - Humanistman Public Domain

Jon but it looks so good when you draw it with little square boxes and remainder boxes and a little bit over – just like that Golden Mean and Fobonacci sequence box diagram. But what about right angled triangles Jon!! – what about Pythagoras' theorem!! Everyone uses it all the time.

It does **look like** a **good pattern** – we **like** the way it looks and it feeds our confirmation bias just like fermions. It is a consequence of our math frames and mixing up number lines and spacial maths. It is just another way of mixing the fixed unit infinity line with the pi infinity line. But think of Pythogoras, Fermat, etc - the "right" triangle bit. Let us try making a "square" where **each side is equal to one.** The **diagonal has to follow the rule - right?** The total area of a four sided square where each side is equal to one is what exactly? **How much area is it?** Why wouldn't you think that it was One? I.e. One acre – one hectare I unit are - 1^2 even (tish boom)? (**area**)

Remember - according to Pythagoras - a square has 4 right angles and four sides. Everyone knows this.

According to Pythagoras - $a^2 + b^2 = c^2$ or if we make a and b the same integers then $1^2 + 1^2 = \sqrt{2}^{2..}$ This is a little confusing don't you think? So when we see math which say $\mathbf{2^2 + 2^2 = 8}$ **or 4+4 or** $\mathbf{2^3}$ (we see 2^2 as 2*2) and then at the same time Pythagoras says $2^2 + 2^2 = C^2$ so **take the square root of both side** gives us $\sqrt{C^2} = \sqrt{(2^2 + 2^2)} = \sqrt{(4 + 4)} = \sqrt{8}$ or to put another way using maths that is being taught in schools - $\sqrt{8}^2$ - well the square root of 8 is $8^{1/2}$ so when you square a square root using fraction exponents it looks like this $8^{2/2} = 8$. So using the current power laws as being taught in schools we get the same answer via different methods - BOTH $2^2 + 2^2 = 8$ or 2*2+2*2 or 4+4 or 2^3 or 2*2*2 **And via Pythagoras** $2^2 + 2^2 = 8$ or $\sqrt{8}^2$ or $8^{2/2}$ - one involves simply addition of terms and the other involves square roots and power laws and using an **INFINITY concept of √2.**

It is like starting math and saying **$\sqrt{1}^2 + \sqrt{1}^2 = \sqrt{2}^2$ – having infinity imbedded in the basic number function from the start. The initial self reference – with inescapable power laws. You can no longer have one apple = you have plus or minus the square root of an apple – squared.**

So they seeing the same symbology and rules and not being told the difference between spacial maths and number line maths. The confirmation bias is that there some **internal coherence** and **consistency** in even the most simple math routines. Indeed (Sherlock) there seems **no way** of just looking at an equation with the simple symbols and working out **which particular technique you are using** or what the context is.

Yes Jon – but this has been proved and shown many times very clearly and you can see that if you take the square root of both sides it is clearly self-evident the square root of (+1+1) = square root of +2 – addition tells us that! (notice - do not get **tricked** into thinking that $\sqrt{1}+\sqrt{1} = \sqrt{2}$)

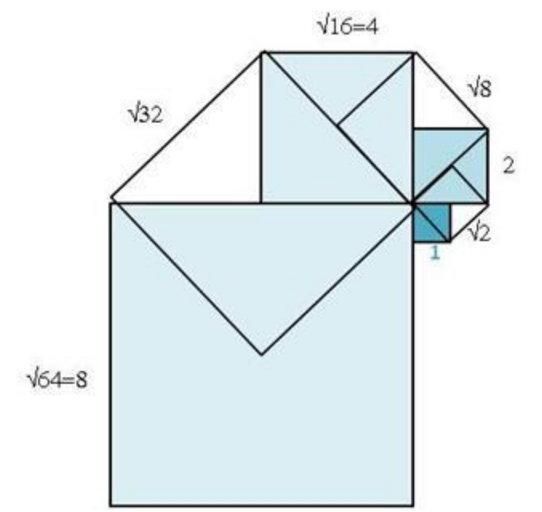


Diagram – Explaining Squaring and Rooting - Jonathan Pearson –2020 - Humanistman Public Domain

This shows the doubling in numbers but also the spacial steps in between.

What might not be obvious is that the Pythagorean formula is illustrated by the step from 1 to 2 using the square root of 2 and that the square root of 2 is the initial self reference point on the pi infinity space.

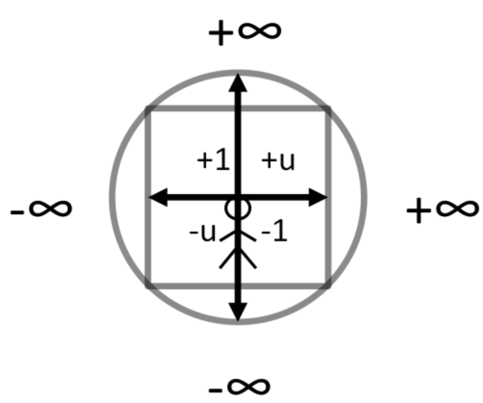
Square root of 2 at one end and pi π infinity at the other end of the pi spacial infinity continuum.

As I said – adding two numbers together to get another number is a **number line** math problem. Suggesting that they form a triangle is a **spacial assertion.** To then state that one angle is a right angle and that two right angle triangles **form** a rectangle of 4 sides is a linking type process of two numbers to create an object of 4 sides – in a spacial dimension – **spacially asserted**. All the proofs are self-referencing – i.e. they assume the spacial dimensions and they assume the square root/square continuum function –which has pi infinity embedded in it – in the example of 1 unit square this infinity first appears as the square root of 2.

Yes Jon but the **area** of those two triangles are equal!!! We can cut sheets of paper to prove it! And what about the 3,4,5 triangle !! that proves Pythagoras and the area hypothesis!

The two triangles are the **SAME – or at least SEEM the same in the spacial plane and the "AREA" (as defined by the math equation) is EXACTLY the same in the unit number line.** Look - I am not saying that these things **seem** very consistent and accurate in our "lived" experience Euclidian space but you need/ought to know when you relate two things together – joining them some how **spacially –** with edges or nodes which were previously not connected (by a fixed ruler) by mathematics on the unit number line – then you are operating in the spacial plane (Euclidian) – and all of the pi infinity problems appear. 90 degrees is an approximation of pi because degrees are another way to measure pi infinity – the circle. Radians have pi embedded as well.

As far as the 3,4,5 "right" triangle – it is not a "square" – it is half a rectangle. So squaring and rooting seems a little different doesn't it . It is like saying instead of squaring and square rooting let us go "diagonalizing" (like Pascal) the four sided area. Just the same **problem of pi infinity** arises (symmetry - if you prefer) – we have taken a **Neat relationship** of numbers – multiplied by themselves and added together to get an equality. Then we asserted that this forms a Triangle of a neat right angled thing (**not a SQUARE!**) **in spacial dimensions.** The Corollary of transcendental root 2 proof is that there is **no two equal sides** of a "right" angled triangle which have the same units/integer/neat measurements of the "hypotenuse". So we just go from **moving infinity** from the hypotenuse to the other sides of this "perfect" square or changing the rules of square to the rules for right angles of any kind. (i.e. squaring the circle, squaring the rectangle, squaring the triangle). This is why **I do not like** exponents, squaring or rooting.



I made all of this pretty clear I think with my work so far and my conceptual model

The pi infinity space is different to the bounded number line. You cannot circle a square or any regular polygon

Euler's identity is in **plain (pun intended)** **sight**

$\mathbf{e^{i\pi} + 1 = 0}$

where the **certain 1** is the radius to the pi π infinity from **intersection zero** – with i to standardise direction to the **certain unit 1**. The "Squaring" coordinates function is used.

I don't believe you Jon! – you are just making all of this up – let us **agree to disagree**.

I cannot **make you think** or **make you believe** anything – why would I?

I am just stating my **Hypothesis** – and by way of further example – note that the **area for polygons** are all based on embedded pi (by way of trigonometric functions) or- by using a **RIGHT ANGLE** from a side towards the "center space" – all have pi infinity embedded. And note that as you tend to infinity you cannot say the **nearly infinite polygon** is equal to circle in area (spacial dimensions) – you can never say (say never) that πr^2 = area formula for infinite polygon. This problem has been known since at least about 830bc by **Dido** of Carthage (sister of brother **Pygmalion of Tyre**) https://en.wikipedia.org/wiki/Dido from various accounts and **Virgil's epic poem**, the **Aeneid** as the **Isoperimetric inequality** *(***Ancient History Encyclopedia Foundation** *https://www.ancient.eu/Dido/* **fair use - partial extract** Dido and her followers were allow to claim land for the new settlement (Carthage) from *"The condition was that they could only have the area of land covered by an ox-hide "* - cut a 'hide' of an animal into long thin strips so she could claim an encircled piece of land*)* .

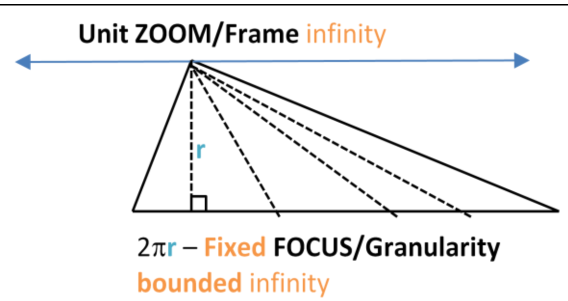
No matter whether you use degrees, radians, pi, trigonometry – you have embedded infinity into the calculation. The **conceptual problem** is that people naturally (**as a strong confirmation bias** - as **entrenched in everyday language**) assume that when you multiply (using the fixed number line) 4 by itself – that is to say 4 * 4 you get a number 16 – which according to our number line is absolutely 100% correct. They call this "Squaring" and they **visualize it as a square (with 16 little squares inside)** and they visualize the **square root process** (rooting) **NOT** as **THE OPPOSITE PROCESS** (the square root of 16 = 4) because **it is just the opposite of multiplying by itself**) - But **INSTEAD** making a diagonal from opposite corners of a square and say that it is a "right" angled triangle with a hypotenuse length = square root of (4^2+4^2) = square root of 32 **= 5.65685..!**

So immediately **- the SPACIAL PLANE – and all its INFINITY assumptions** – are embedded in the maths **AS IF THEY ARE NUMBER LINE FUNCTIONS.** But instead they switch backwards and forwards using the Pythagorean theorem and all of its assumptions.

But **JON** there as wealth of "lived experience", proofs, books, formulas and so many who absolutely certainly believe many things Jon – **what makes you think you are right?** Do you think you are **BETTER than them??**

Hypothesiing, analyzing and discussing things is always going to lead to a variety of responses from humans.

You will note David Hilbert's 4^{th} problem and the general problem of parallel lines and Tangents to a circle – all have the spacial infinity problem. In a way – the statement of parallel lines – is the **first example of trying to reconcile** the infinite unit number line – with the infinite spacial pi infinity space. **Trying to link different types of infinity.**

	This conceptual model highlights the general problem of bounds and constrains and connecting types of infinity. The unit number line and the pi spacial line. All of "spacial" maths has tried to deal with this infinity problem – relating unrelated things by some kind of "area" type "spacial dimension" function – polynomials, multi-variate analysis, matrix, string theory, etc. trying to connect unrelated things somehow. Looking for patterns.

Another type of infinity problem is the simplification process. This drive to the most simple structures and just using recursion or very simple rules to implement – will **SOMEHOW (unspecified)** – make the infinity problems go away. Simple rules – the "best way" to reduce complexity and uncertainty is to simplify – Charles Babbage differential engines, Turing machines, Computers, Automatons, "artificial intelligence", rules, procedures, etc.

Look - it all aligns well in our lived experience – a little like Newton and Kepler getting planetary motions **usefully correct** (**John Mills** - utility) (**Patero**'s *Cours d'économie politique (1896-97)* nuance "ophelimity" desire of connection) . But as we explore more we see the "wobbles" – the eccentricities, etc (tish boom). The **choices.**

Diagram – Explaining Squaring and Rooting with imbedded infinity - Jonathan Pearson –2020 - Humanistman Public Domain

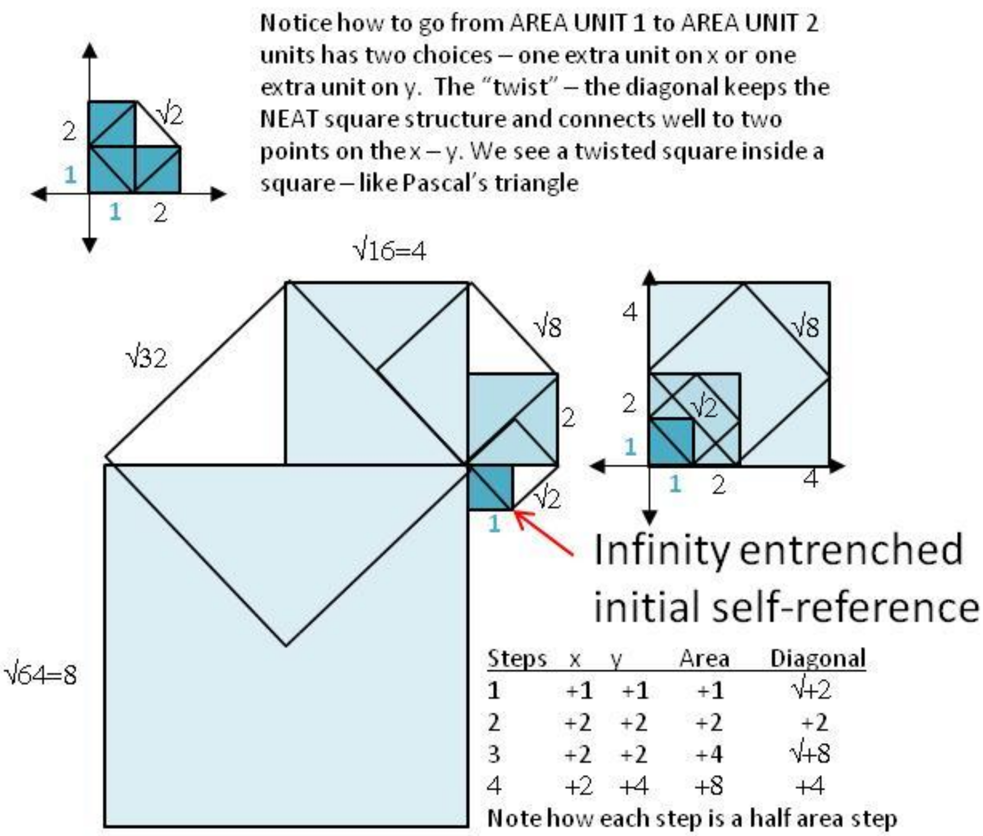
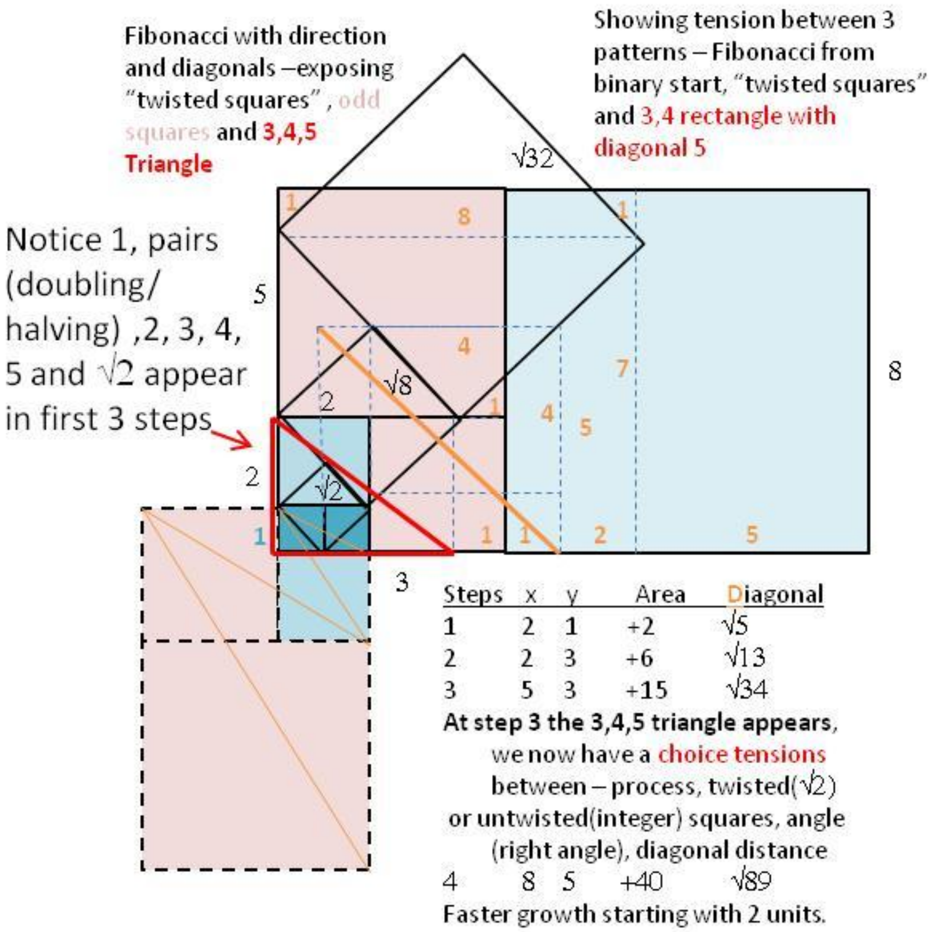
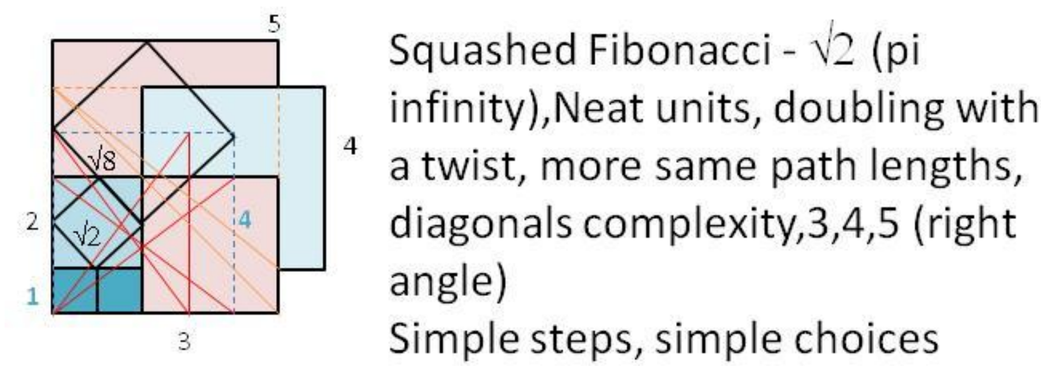


Diagram – Context – Squashing Fibonacci - Jonathan Pearson –2020 - Humanistman Public Domain





Philosophically – I quite like the idea of the number 2 being the starting point. You **need 2 to exist** to get the square root of 2 to exist to get back to 1. But if you start at 2 it seems more like life as we know it. Yet this accords with my initial work https://humanistman.com/home/frames/meta-frames/ of the observer and the observed. To Notice something you **have to have (need recursively)** both something with ability to notice and something able to be noticed.

Well Jon – you wrote all this – why didn't you point out every step of the way exactly where all the problems are??

It was **deliberate** - for one thing – a journey needs/ought to show the exploration and thinking – the challenges and choice – a bit like an interesting Tale. We also need to make mistakes – try things and get them wrong and refine things. I cannot read every author, every paper, every opinion, etc – I can scan and dive in and discover, learn, explore and think – I can work hard and try to be coherent and consistent and not hypocritical or abusive of others. I can see others as they journey and I will make some judgement on their work – does it help me or not ?– I may even venture an opinion of their capabilities in some kind of personal reflection – but it is not for me to say who is good or bad is some kind of **binary choice** way. If anything - it is only by exploring a wide range opinions and reserving your assumptions and biases that you get your chance to explore a bit further. **Not choosing to criticize** Geometry - because everyone has already done everything – is like **continually shutting and locking doors** in the castle – closing off all the rooms and not even venturing outside. The other reason I did not display the thinking all the way at the time – is because I did not have it. I had to work very long hours and spend time on research, thinking and investigation to get to a point where I could write my thinking and my research down and try to communicate it. I had to **do the work** – follow the lead of others – even the ones that have not yet lead anywhere. I am not **afraid** of "making a fool" of myself – I know I am human and that **being imperfect** is not a **binary exclusion principle** for thinking, discussion or debate.

Well Jon I am not convinced!

I have no idea why you think I was trying to convince you of anything. Most of this has already been done in many number of ways by ,many people. I am not saying anything new really – I am just **working my way** through the issues. Here is a little experiment – we have all done this – we do it at school. Take a sheet of paper. Draw a square. Now look at it from a little sideways – tilt the paper. It changes how it looks. Now grab the paper from both ends and wave the sheet up and down. See how as your perspective changes the "square" looks different? Roll and join it together like Einstein.

Yes Jon – but that's **just the curvature of space argument** – everyone knew that long ago! So how is that related?

The context is that 95% of the universe is **unobservable** to us - By some estimates – let's just call it "**the axiom of choice"** exists **because** the (vast – really, really, big compared to our local frame) **unknown exists somewhere**. The vast unknown dwarfs anything we might "see".

That's just it – They are not related by much at all – **except by the infinite unit number line** (our **perfect abstraction**) – and that is the point. In the first case – the sheet of paper – on our initial local Euclidian space – seems very flat locally but it **still has the pi infinity** problem (making polygon space = circle space) **even if** it was perfectly flat. When we move, shake, squash, burn etc the paper we are getting **infinity of other types of things including the pi infinity problem.** This is where scientists hypothesize all kinds on "otherness" on infinite scales. One of the first examples of this "otherness" was Einstein's **Gravity waves – does gravity exist in infinite dimensions as well? - On its own continuum.** The idea of relating Mass to Gravity is the **same kind of problem** of relating a fixed number line to spacial dimensions – we get a new infinity continuum to work with. **Another is Time.** They keep postulating more types of continuums and more rules to relate them.

Notice - the imaginary constant - square root of minus 1 or the constant variable **i** – is a half (literally) baked idea of **dealing with direction** on the number line while somehow dealing with spacial dimensions. What is the opposite of i? **How do you describe forwards or backwards or in towards zero and out from zero**? At the same time as dealing with area (**what does negative "area" mean?**) People do not understand the questions around this and the inherent problems. And then we have the problem if the square root of -1 has special meaning then what does the square root of minus two, three or four mean?

While formulas using squares logs, power laws can **work on calculators** – you will notice that most people immediately **try to explain their ideas on a "fixed number plane"** i.e. with square and infinity pi embedded and implied Cartesian coordinates – so even if the "numbers" and "Formula" make some kind of sense – the visualization can cause more problems – this is where they **play the loglogolog and exponent game – on the fixed axis** – **not realizing** that the **problem is** that the axes are different types of infinity.

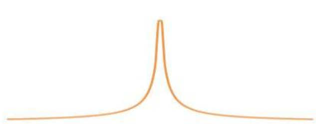
Many humans explore the infinity problems and will continue to do so.

So JON – Everyone is stupid but you, despite everyone doing lots of work you somehow know more than them and nothing is certain then? You're not perfect (I suppose if I admit I am not perfect either) – therefore **nothing matters at all – what's the point????**

Trying to find **personal fault in me** or attacking me in some kind of **moral superiority or positioning game** does not change the ideas being discussed. It **does not invalidate** my hypothesis. I had to examine and discover everyone's work – I had to explore. It was good that previous explorers leave their information behind. Without that history - we cannot explore further.

Well – **Life matters** – imagine if everything was certain, discovered, ruled, measured, explored, expected, "fate", "destined" – choices didn't matter? There are examples, rules, guides, hints, patterns, histories, explorations – some **help for us** all around us when we make choices. **Choices do matter** and we can all choose.

See the following transformations and context diagrams. I suppose in some sense I am taking Euler's formula and making the math problem of the Square root, square problem more explicit.



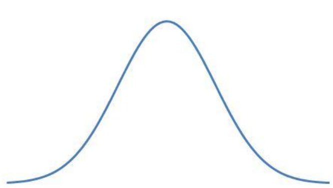


Diagram – Context – Fitting the Curves to square and circle - Jonathan Pearson –2020 - Humanistman
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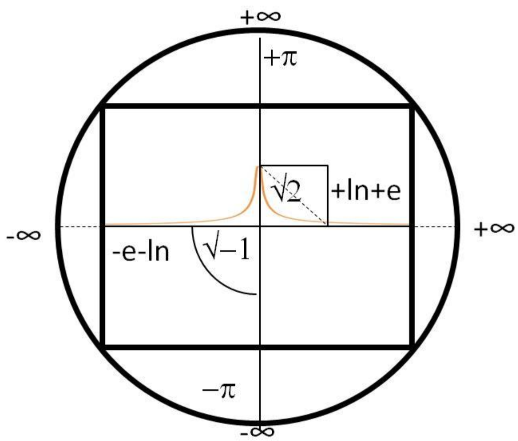
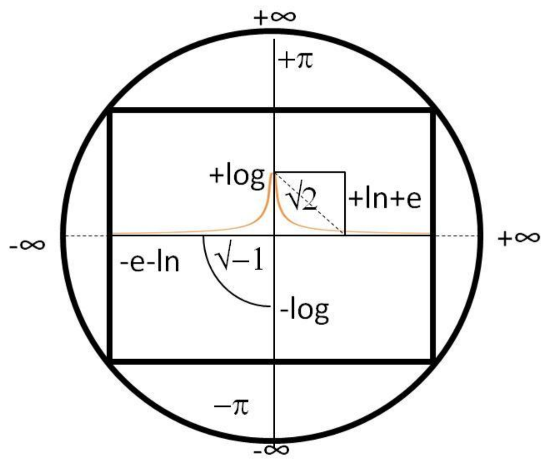
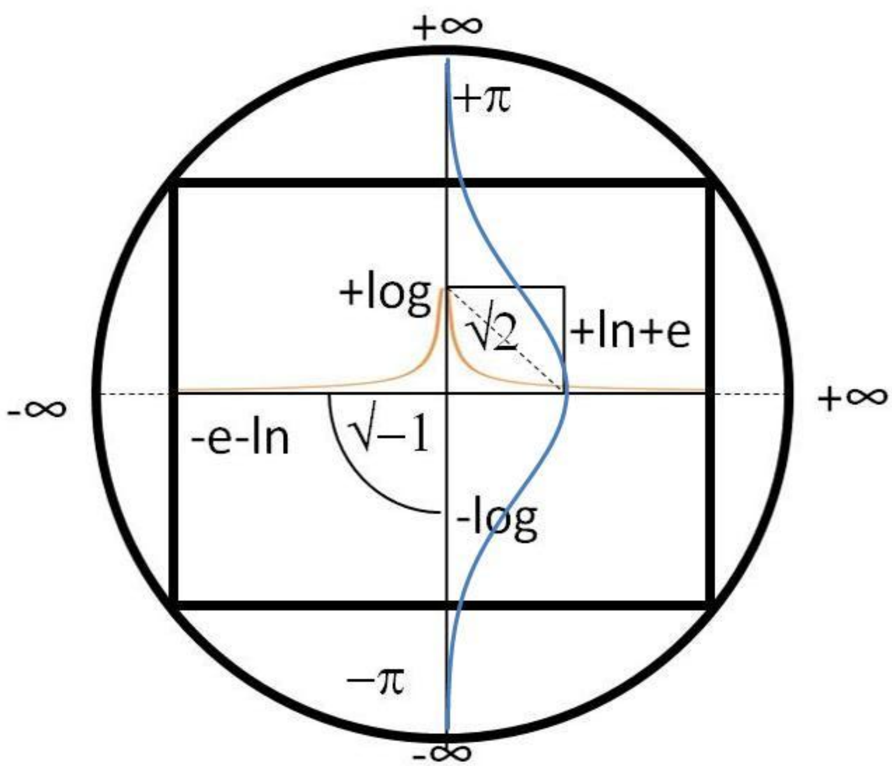






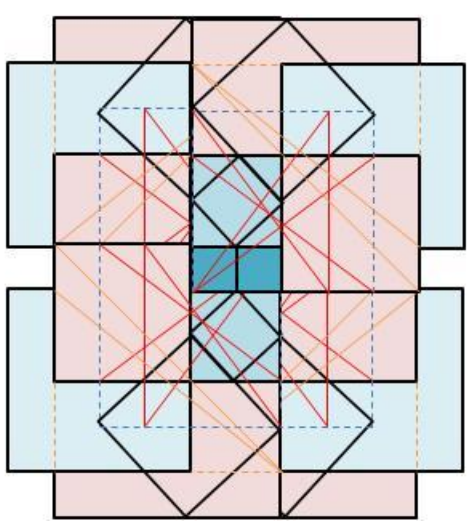
My Little Grand Unifying Theory Conceptual Exploration Rant

I suppose there is nothing new or enlightening here – it has all been done before – many times in many ways by many people.

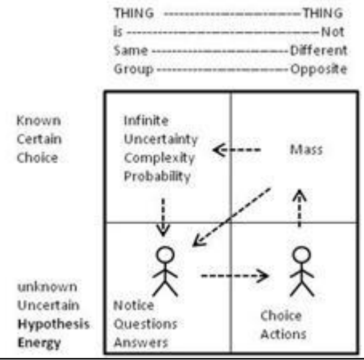
The squashed Fibonnaci model might look like some kind of certain frame work – and maybe at best it is a pattern of some choices and options. We have our little central units beating away like a heartbeat, atomic nucleus or star under tension and all these Euler steps away. The square root of 2 is our **infinity pi** surrogate – because we can only notice and measure things in fixed units we will always get mismatches when we take diagonal shortcuts. What started as "squaring and area – turned into "right angle" (or maybe it was the other way a**round**?)

It would be tempting to think that stability oscillates around something like the squashed model (our little "universal" pattern) – maybe 5 * 5 matrix – but let us explore. Many single nodes or mass points – many paths choices and infinity shortcuts. Then path patterns of single point (vibrating), two nodes – direction, paths of 3,4,5 and upwards to the limit of a "stable" 5* 5 (for example) matrix. Remember the paths can have two directions – forwards or backwards. But then this maybe only one of four matrices from a central point on an x/y plane – which are all connected around the right angle type concept. This adds to complexity. But then there is more - these collected 5* 5 matrices – all interconnected with all conceivable paths – fixed type units and diagonal (infinity pi length type) shortcuts exist in Euclidian space of n dimensions – which we see as three (as a kind of central limit theorem around mass). If you could calculate these numbers – even at 5 – they would not only be large but full of the uncertainty of infinity pi and general uncertainty as well. Or to put it another way – if the answer was 42 – the question would have no real meaning.

Diagram – Context – Confusion of Models - Jonathan Pearson –2020 - Humanistman Public Domain



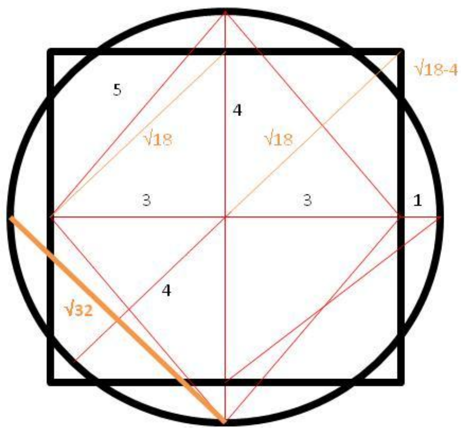
Or to reconcile with my visual mode of Einstein's formula:



We hide the various infinities in the top left "certain" infinity box – the driver of all things. We explore the bottom two maybe using the full squashed and optimized Fibonacci model (based on solid pair start) across all Euclidian dimensions and directions - examining paths and choices in the hypothesis space – which incorporates already observed (internal and external) mass and paths – occasionally breaking pout of fixed paths, rearrange well worn paths, nodes and masses – choosing and creating new mass certainty as part of our ongoing framework.

A little more exploration to ponder:

Circle Radius 4
Square sides 6
("radius" 3)
They overlap a little
at **1** and √18-4
(0.2426)



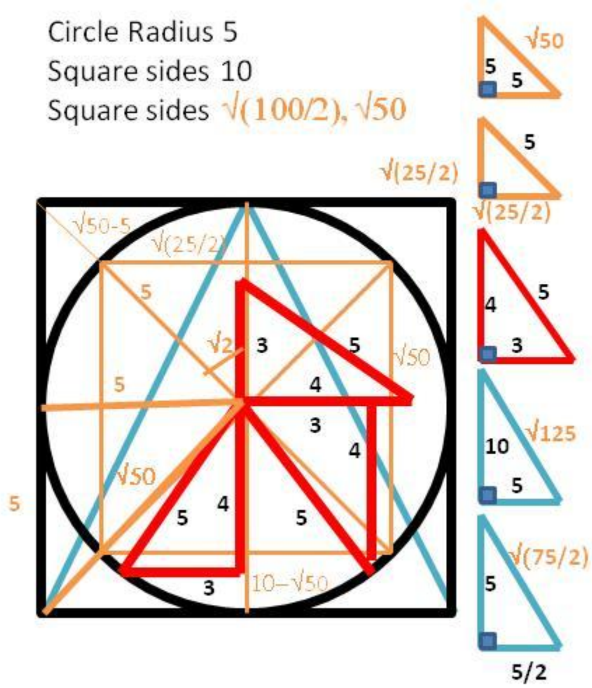


Diagram – Context – 5s - Shapes in Colour - Jonathan Pearson –2020 - Humanistman Public Domain

If you restrict spacial dimensions to the unit 4 by using the "right" angled rule and all the associated rules (Pythagoras) it is obvious that units will work well for numbers lower than 4 and between 4 and 5 is where we put many (not all) infinities.

We worked backwards and threw in root 2 as an infinity at the very start to bisect the right angle problem.

5 is around our limits and boundaries because we framed the world view that way – it matches our lived experiences quite well.

Archimedes Triangle fits well with a base of 10. Is that why they liked 10 so much?

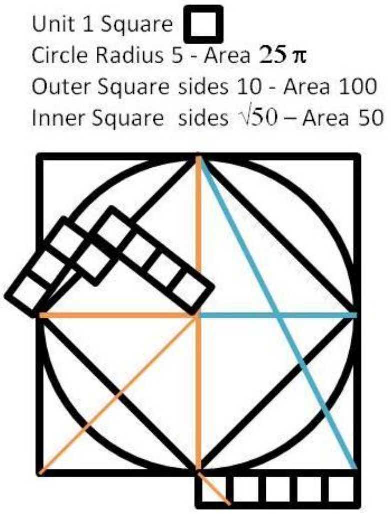


Diagram – Context – 5s - Shapes in units - Jonathan Pearson –2020 - Humanistman Public Domain

Many people have observed the Euclidian Space – **I notice Adrien-Marie Legendre**

Elements of Geometry and Trigonometry: With Notes :Author(**Adrien-Marie Legendre**) :Year(1830) :Keyword(Planet Development Maths)
https://archive.org/details/elementsgeometr01brewgoog/page/n6/mode/2up
https://www.forgottenbooks.com/en/books/ElementsofGeometryandTrigonometryFromtheWorksofAMLegendre_10474557
https://archive.org/details/elementsgeometr01unkngoog/page/n21/mode/2up
(also available on Google books)

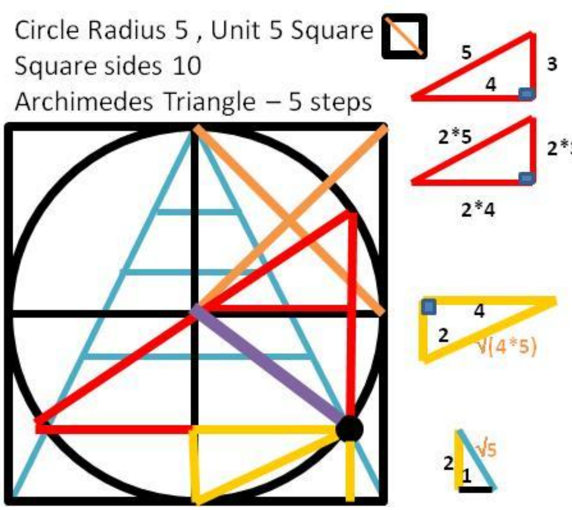


Diagram – Context – 5s Shapes – Stepping Archimedes – Connection points - Jonathan Pearson –2020 - Humanistman Public Domain

Archimedes Triangle of height 10 base 10 can be seen in relationship to the square and the circle. If we progress through integer sequences of the blue Archimedes triangle where we take a right angle from the base of the triangle to the top – stepping by 2 (to divide into 5 steps) we get a neat sequence of 10,8,6,4,2 in the height on the right angle and 5,4,3,2,1 in the base of the right angle. So we can see the Pythagoras formula for the hypotenuse of the Archimedes right triangle is $n^2 + 2*n^2 = h^2$ – where n is an integer. If we calculate the results of the first 5 from 10 height backwards we get √125, √80, √45, √20, √5 – kind of like a eureka moment. Or √(5^{2*}5), √(4^2*5), √(3^2*5), √(2^2*5), √5. (but then we made up the square rule to do this anyway)

Am I just adding to Archimede's **Ostomachion? loculus Archimedius. Moving it to base 5?**

Sloane's integer sequence database for 5,20,45,80,**125** yields **one result** A033429 described as **a(n) = 5*n^2.**

I tried all this before in another article – I tried to explore the 3,4,5 triangle – I tried to arrange it to fit squares and circles and I thought I could not do it. My **confirmation bias** kept on trying to keep points and lines together – especially the 5 – I wanted the 5 to stay in one place so I kept on working with 3,4 rectangles instead of two or more different 3,4,5 triangles. The **trick is** to recognize the triangle as a pattern then place it in some frame where all the triangles can exist. The **ONLY frame** which **neatly** works for the circle, square, triangle is a 10 by 10 square. It also highlights the square root of 2 being the basis of spacial math and its relationship with pi. 3,4,5 Triangles **can flip** as shown rather than staying in the same orientation.

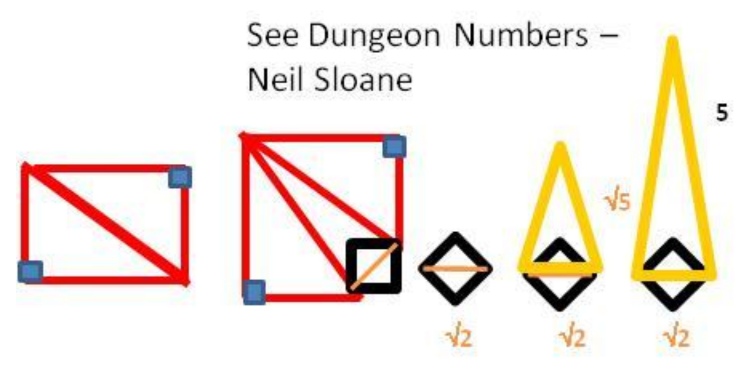


Diagram – Connection points - segment exploration - Jonathan Pearson –2020 - Humanistman Public Domain

The **3,4,5 triangle** (6,8,10) **AND** Archimedes triangle intersect at **the same point (I hypothesize)** – providing a permanent spacial relationship between 3,4,5 relating to squares, triangles and circles, cones, spheres and cylinders. So as well as the **triangles, squares and circles pattern**s there is also a **rectangle pattern of 3*4. I must be wrong – it seems too neat. Am I just repeating the errors that everyone else has made?** My little triangle 1,2 $\sqrt{5}$ has a hypotenuse of the square root of 5. This means the total length of the hypotenuse of the large Archimedes right angle triangle is equal to $5*\sqrt{5}$. But the right angled triangle is 5,10, $\sqrt{125}$? So how can $5*\sqrt{5} = \sqrt{125}$? Well $\sqrt{125} = \sqrt{(5^2*5)}$. Does that mean I can take the square root of 5^2 outside of the equation and leave the square root of 5 inside? So I get $\sqrt{(5^{2)}} * \sqrt{5}$ or $5 * \sqrt{5}$? So that means I have confirmed the Archimedes triangles? And the hypotenuse is neatly a multiple of $\sqrt{5}$ for each doubling of the height? So as far as square roots go I can factor out anything being multiplied together or summation?

What have I done wrong?

How can a radius circle 5, a 3,4,5 right triangle and an Archimedes base 10, height 10 triangle intersect neatly? That thick purple line and the black dot cannot be correct??

I cannot see where I have gone wrong???

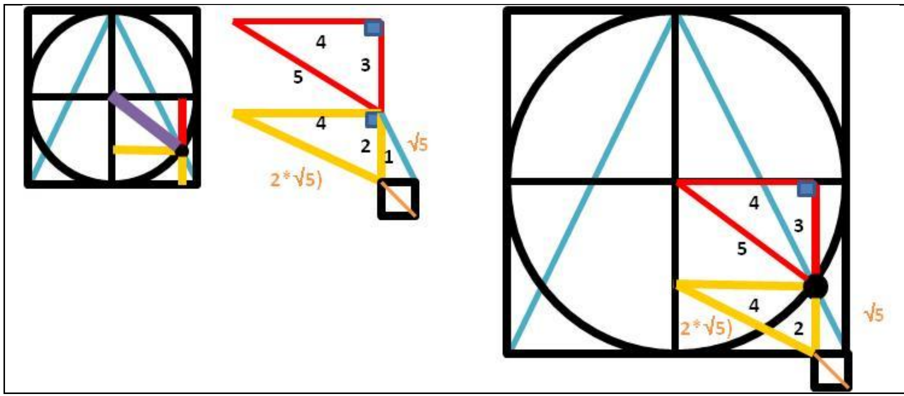


Diagram – Simplified 5s shapes - Jonathan Pearson –2020 - Humanistman Public Domain

Both the red triangle 3,4,5 and the yellow triangle 2,3, 2* root 5 have to meet in the same point in space they share 4 and the right angle and add to 5. And as I have constructed them inside a 5*5 square the circle radius 5 is also there and will meet the point on the triangle.

I think I see it – if I take a 5 by 5 square and put a 3,4,5 right triangle in it then I can also put a 1,2 root 5 triangle (Archimedes) in it to complete the numbers. The 2 completes the 3 and the 1 completes the 4 and the 5 is both the radius and the length of the sides of the square – and then we can get 4 squares to make one big square doubled in both directions to cover the circle with radius 5.

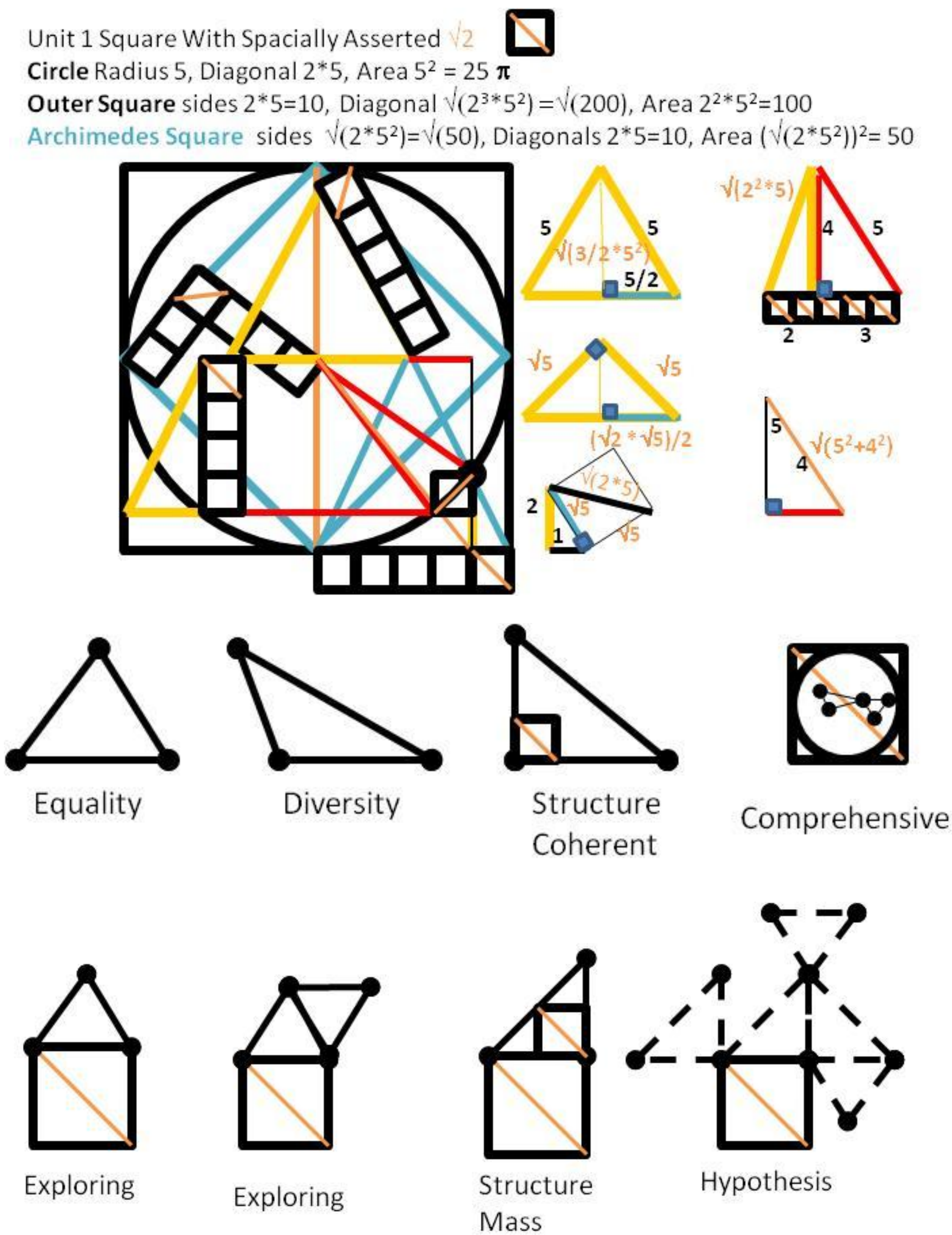
This is no big deal – all I have done is found another kind of integrated touch point on the circle – a kind of central limit theorem – another neat relationship where things seem to coalesce. There are already a number of "well trod" paths and regular connections. Explorers always look for more.

But there is something there. If we morph Archimedes Triangle into the inner square the **area stays the same** and two points on the parallel tangents (the edges of the outer square) stay together as well – **perpendicular line** to the direction of movement. But also **notice** that the three triangles (which exist in rectangles as well) remain **somehow** connected to each other as the Point moves, the squares and the point on the circle – in perfect unison. So we could decide which side of each triangle to keep **fixed in space** while the other two sides join the point as it travels around the circle. We could choose the **4** of the 3,4,5 triangle, the **2*√5** of the yellow triangle and the **1** of the Archimedes right triangle. It seems somehow – "Golden". The ratios **√5, 2*√5** and **5** stay connected somehow for **movement around the circle** – this represents some kind of limit in the same way that **√2** represented another kind of **limit to infinity**. Movement **within the circle** is infinity of another kind.

This 10 by 10 square with circle radius 5 with pi infinity and root 2 is closely related to the approximation of pi by Ramanjunan (I had not seen this when I did my work – I came across it while in final edit) https://en.wikipedia.org/wiki/Ramanujan%E2%80%93Sato_series called the **Ramanjunan**-**Sato** (T. Sato – Japan) series $\mathbf{1/\pi = 2\sqrt{2}/99^2}$ – also related to **James Stirling**'s Approximation for Factorials https://en.wikipedia.org/wiki/Stirling%27s_approximation Also see **Abraham de Moivre.**

Complex numbers are another method used to try to describe this spacial dimension.

Diagram – Complex 5s shapes and Concept shapes - Jonathan Pearson –2020 - Humanistman Public Domain



A little extra

In the spacial dimension I am trying to reconcile real life with pure abstraction – seeking the best most cohesive – the most touchpoints and overlap – between all the things I am considering – all the shapes, angles, numbers. I am also trying to be comprehensive – at a mid focus level – not too much detail and not too much abstraction – something in between.

We could imagine some rules for objects in space.
We could imagine that there is some kind of connection –cohesions between objects – some thing they are trying to share and maintain. There are many things – infinite – which can be shared but let us examine my Euclidian square, circle and triangle model.
In this space we have infinite **rotation** but only 2 **orientations** (left or right – forward or backward – **mirror image** – "flipping"). Some objects can flip but they look the same both ways.
We also have Euler walks (edges to nodes **– graph theory**). We can make new edges by taking **shortcuts** (optimizing) within a **shape** from one **node** to another node.
In terms of **Euler walks** we could imagine – using graph theory – that we could go in different **directions** around the same shape **or** that when we go in a different direction – we have to "**flip**" the shape. (There are some deep math problems linked to this concept – complexity theory).
The things which can be connected/shared are any **edges** or nodes, area and shape (all edges and nodes fixed).

I hypothesise that good sharing is in-between **everything** and **nothing** extremes - and will generally be 2 or 3 things like shape and area and a node. (like **Thales' Theorem** and others.) So a shape can double by "flipping" on one edge for example. (see Roger Penrose, Euclid, Archimedes, Aristotle, Évariste Galois and others involved in Geometry, Algebra,etc) See Kepler, Newton, Joseph-Louis Lagrange, Adrien-Marie Legendre and others for laws relating to bodies in space.

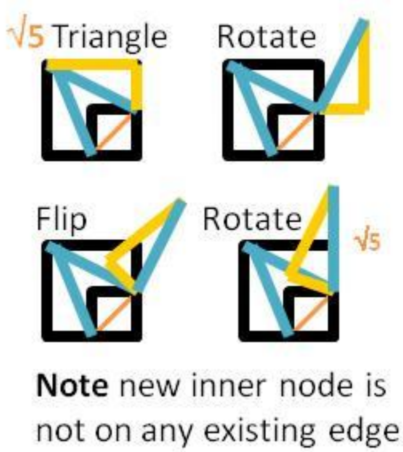


Diagram – Life movement by Shapes- Jonathan Pearson –2020 - Humanistman Public Domain

So we could get our little **√5** in our current spacial number plane in only a few steps by these rules.
We **start with one square** (our *unavoidable* **initial self reference**) – which we call a square because it has a"right" angle (**a perpendicular**) and 4 equal sides.
Then we take a short cut and call it **√2** because when we measure it with a stick and compare to numbers on our perfectly abstracted neat number line we find it is very nearly the same as the number that when multiplied by itself gives the answer 2.
Then double the single square to 2 and double that to 4 squares.
Taka new short cut from the middle of the big square to the top corner of the big square (Archimedes) – giving a 1,2, **√5** triangle. Rotate, Flip and Rotate to get 1+, **√5** **on one edge and get new edges and a new internal node to connect to.**

I also notice that Archimede's ratios for the cone, sphere, cylinders **volumes 1,2,3** relate to their 2 dimensional cross - sectional equivalents of for triangle, circle, square **areas 1,π,2 suggesting a** unit consistency of π infinity when adding extra dimensions. This like the **Poincaré conjecture** as well.
The **proof of Fermat's last theorem** uses spacial maths – therefore **has at its heart** – the squaring, rooting, pi infinity problem? This seems to have gone unnoticed? It is not a statement of relationship of integers. It is a spacial statement. If anything it shows that maths deals well with 2 coordinated dimensions of x and y integers in one spacial plane with one infinity continuum (root 2 and pi). It confirms a 2 dimensional framework which is our current maths.

The **quartic equation** $ax^4 + bx^3 + cx^2 + dx^1 + e = 0$ and its proofs also supports the 3,4,5 triangle and the general limit to this infinity spacial plane as 5.

Archimedes understood this I think and when he saw pi being inserted between 1 and 2 for area but then moving to the other dimension in volume – but still in between things.

He saw that infinity pi continuum had infinite spacial universes – it could continue to be inserted between 1 and 2 for more dimensions but because it had already done its trick **again** into 3 dimensions where was the next trick going to be? Where would we find infinity next?

Recent Investigations

Fairly wide ranging on old philosophy and history – looking at questions, problems, math. Looking for deep insight and simplicity – watched a lot of video clips of mathematicians teaching about their research and investigations. I allowed a lot of time between research and writing – to allow things to settle in my mind before starting writing and researching again.

Recent Documents

The Art of Doing Science and Engineering :Author(**Richard Wesley Hamming**) :Year(1997) :Keyword(Group Teaching Science)
https://en.wikipedia.org/wiki/The_Art_of_Doing_Science_and_Engineering
http://worrydream.com/refs/Hamming-TheArtOfDoingScienceAndEngineering.pdf
https://calhoun.nps.edu/handle/10945/62468

FOUNDATIONS OF THE DIGITAL (DISCRETE) REVOLUTION 15

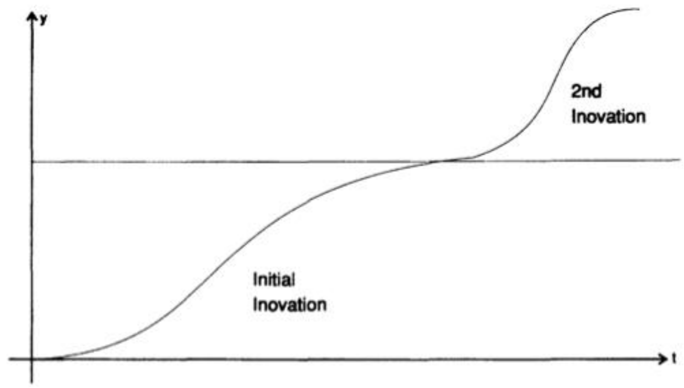
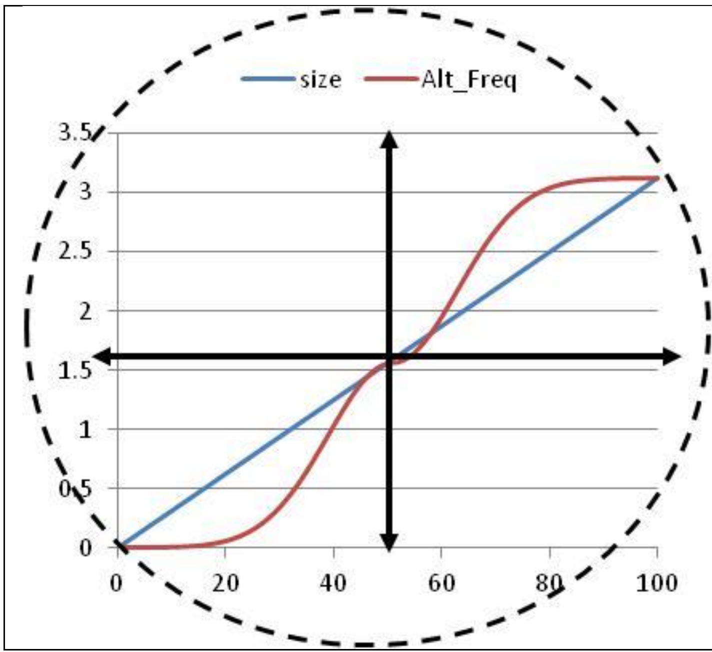


Figure 2.II

Looks a little like the work from my previous article https://humanistman.com/wp-content/uploads/2020/08/Equality-Diversity-Measurement-Notice.pdf



But then we have this **weird mix of things being displayed** – the height represents all of humanity – the average height which we arbitrarily have decided is **1.56252 metres tall.** We then made the x axis exactly 100 partitions where all the humans are supposed to line up. Then as a special trick we decided to call the middle partition – the group of humans with the average height – we decided to call the Y-Axis – their height – using a fixed number line yardstick as well – EXCEPT we swapped the direction after the middle point. SO WHAT IF we changed the curve so it increased instead of decreased after the middle point? Using Alt_Freq (adding the increments each partition step)

Notice that the idea of centralizing the mean – making it zero - is from **Lorenz, Cauchy** and others. Which itself is a technique of playing with the “other dimension” of measures - the count, sum, - the transformed information – on types of distribution models – many based on the “squared” and “square root” **spacial arithmetic** https://encyclopediaofmath.org/wiki/Stable_distribution. We “see” it - spacially. Many of these **statistical frames** will also embed infinity by using e and ln and related functions.

You and Your Research :Author(**Richard Wesley Hamming**) :Year(1986) :Keyword(Group Research Science) https://www.cs.virginia.edu/~robins/YouAndYourResearch.html
https://d37ugbyn3rpeym.cloudfront.net/stripe-press/TAODSAE_zine_press.pdf
https://carnivas.com/you-your-research-notes-d4421ae895ea

Harmonices Mundi :Author(**Johannes Kepler**) :Year(1619) :Keyword(Group Science Maths)
https://en.wikipedia.org/wiki/Harmonices_Mundi
https://archive.org/details/ioanniskepplerih00kepl/page/n13/mode/2up https://www.sacred-texts.com/astro/how/index.htm

The Trial :Author(**Franz Kafka**) :Year(1914) :Keyword(Group Philosophy Law)
http://www.gutenberg.org/ebooks/7849 https://www.planetebook.com/free-ebooks/the-trial.pdf

Elements :Author(**Euclid**) :Year(-300) :Keyword(Group Philosophy Maths)
https://archive.org/details/thirteenbookseu03heibgoog http://www.gutenberg.org/ebooks/21076
https://en.wikipedia.org/wiki/Euclid%27s_Elements

Sam Loyd's Cyclopedia of 5000 Puzzles Tricks and Conundrums :Author(**Sam Loyd**) :Year(1914) :Keyword(Individual Development Maths)
https://en.wikisource.org/wiki/Index:Cyclopedia_of_Puzzles_by_Samuel_Loyd.pdf
https://archive.org/details/CyclopediaOfPuzzlesLoyd/page/n5/mode/2up
http://djm.cc/library/Cyclopedia_of_Puzzles_Loyd.pdf

Extraordinary Popular Delusions and the Madness of Crowds :Author(**Charles Mackay**) :Year(1852) :Keyword(Individual Development Maths)
https://en.wikipedia.org/wiki/Extraordinary_Popular_Delusions_and_the_Madness_of_Crowds
https://www.gutenberg.org/files/24518/24518-h/24518-h.htm
https://archive.org/details/memoirsextraord10mackgoog **Public Domain - partial extract**
*"In reading the history of nations, we find that, like individuals, they have their whims and their peculiarities; their **seasons of excitement and recklessness**, when they care not what they do. We find that whole communities suddenly **fix their minds upon one object**, and **go mad in its pursuit**; that millions of people become **simultaneously impressed with one delusion**, and run after it, till their attention is caught by some **new folly** more captivating than the first. We see one nation suddenly seized, from its highest to its lowest members, with a fierce desire of military glory; another as suddenly becoming crazed upon a religious scruple; and **neither of them recovering its senses until it has shed rivers of blood and sowed a harvest of groans and tears**, to be reaped by its posterity. At an early age in the annals of Europe its population lost their wits about the sepulchre of Jesus, and crowded in frenzied multitudes to the Holy Land; another age went mad for fear of the devil, and offered up hundreds of thousands of victims to the delusion of witchcraft. At another time, the many became crazed on the subject of the philosopher's stone, and committed follies till then unheard of in the pursuit. It was once thought a venial offence, in very many countries of Europe, to **destroy an enemy by slow poison**. Persons who would have revolted at the idea of stabbing a man to the heart, **drugged his pottage without scruple**. **Ladies of gentle birth and manners caught the contagion of murder, until poisoning, under their auspices, became quite fashionable**. Some delusions, though notorious to all the world, have subsisted for ages, **flourishing as widely among civilised and polished nations** as **among the early barbarians with whom they originated**,—that of duelling, for instance, and the belief in omens and divination of the future, which seem to defy the progress of knowledge to eradicate them entirely from the popular mind.*
*Money, again, has often been a cause of the delusion of multitudes. Sober nations have all at once become desperate gamblers, and **risked almost their existence** upon the turn of a piece of paper. To trace the history of the most prominent of these delusions is the object of the present pages. Men, it has been well said, **think in herds; it will be seen that they go mad in herds**, while **they only recover their senses slowly, and one by one.***

Some of the subjects introduced may be familiar to the reader; but the Author hopes that sufficient novelty of detail will be found even in these, to render them acceptable, while they could not be wholly omitted in justice to the subject of which it was proposed to treat. The memoirs of the South-Sea madness and the Mississippi delusion are more complete and copious than are to be found elsewhere; and the same may be said of the history of the Witch Mania, which contains an account of its terrific progress in Germany, a part of the subject which has been left comparatively untouched by Sir Walter Scott in his Letters on Demonology and Witchcraft, the most important that have yet appeared on this fearful but most interesting subject.

Popular delusions *began so early, spread so widely, and have lasted so long, that instead of two or three volumes, fifty would scarcely suffice to detail their history. The present may be considered more of a miscellany of delusions than a history—a chapter only in* ***the great and awful book of human folly which yet remains to be written****, and which Porson once jestingly said he would write in five hundred volumes! Interspersed are sketches of some lighter matters,—amusing instances of the imitativeness and* ***wrongheadedness of the people****, rather than examples of folly and delusion.*

Religious matters have been purposely excluded as incompatible with the limits prescribed to the present work; a mere list of them would alone be sufficient to occupy a volume."

Lectures On Number Theory :Author(**Peter Gustav Lejeune Dirichlet**) :Year(1897) :Keyword(Individual Development Maths)
https://books.google.com.au/books/about/Lectures_on_Number_Theory.html?id=8h8aWmnp1k8C&redir_esc=y https://archive.org/details/glejeunedirichl00dirigoog/page/n5/mode/2up
http://www.worldcat.org/identities/lccn-n83-62956/

Disquisitiones Arithmeticae :Author(**Johann Carl Friedrich Gauss**) :Year(1798) :Keyword(Individual Development Maths) https://en.wikipedia.org/wiki/Disquisitiones_Arithmeticae https://gdz.sub.uni-goettingen.de/id/PPN235993352?tify={%22pages%22:[5],%22view%22:%22info%22}
https://la.wikisource.org/wiki/Disquisitiones_arithmeticae

Introductio in analysin infinitorum :Author(**Leonhard Euler**) :Year(1748) :Keyword(Individual Development Maths) https://en.wikipedia.org/wiki/Introductio_in_analysin_infinitorum
https://scholarlycommons.pacific.edu/euler-works/
http://www.17centurymaths.com/contents/introductiontoanalysisvol1.htm

The Design of Experiments :Author(**Ronald Aylmer Fisher**) :Year(1935) :Keyword(Individual Development Maths) https://archive.org/details/in.ernet.dli.2015.502684
https://en.wikipedia.org/wiki/The_Design_of_Experiments http://tankona.free.fr/fisher1935.pdf

Statistical Methods for Research Workers :Author(**Ronald Aylmer Fisher**) :Year(1925) :Keyword(Individual Development Maths) http://psychclassics.yorku.ca/Fisher/Methods/
http://www.haghish.com/resources/materials/Statistical_Methods_for_Research_Workers.pdf
https://link.springer.com/chapter/10.1007/978-1-4612-4380-9_6

Opus palatinum de triangulis :Author(**Georg Joachim von Lauchen Rheticus**) :Year(1596) :Keyword(Individual Development Maths, Trigonometry)
https://archive.org/details/bub_gb_ZsiBnreW1-oC

https://books.google.com.au/books?id=ZAyQDvYPTXoC&pg=PA3&source=gbs_toc_r&cad=3#v=onepage&q&f=false https://www.lindahall.org/georg-joachim-rheticus/

Dynamical systems with two degrees of freedom :Author(**George David Birkhoff**) :Year(1917) :Keyword(Individual Development Math) https://www.ams.org/journals/tran/1917-018-02/S0002-9947-1917-1501070-3/home.html https://www.ams.org/journals/tran/1917-018-02/S0002-9947-1917-1501070-3/S0002-9947-1917-1501070-3.pdf https://archive.org/details/dynamicalsystems00birk

Notes From The Underground :Author(**Fyodor Dostoevsky**) :Year(1864) :Keyword(Group Development Tale) https://en.wikipedia.org/wiki/Notes_from_Underground https://www.planetebook.com/notes-from-the-underground/ http://www.gutenberg.org/ebooks/author/314

A VITAL Question; or What is to be done? :Author(**Nikolay Gavrilovich Chernyshevsky**) :Year(1863) :Keyword(Group Development Humanism)
https://en.wikipedia.org/wiki/What_Is_to_Be_Done%3F_(novel)
https://www.marxists.org/reference/archive/chernyshevsky/1863/what-is-to-be-done.pdf
https://en.wikisource.org/wiki/A_vital_question;_or,_What_is_to_be_done%3F

Who is to Blame? :Author(**Alexander Ivanovich Herzen**) :Year(1847) :Keyword(Group Development Humanism) https://en.wikipedia.org/wiki/Who_Is_to_Blame%3F
http://self.gutenberg.org/articles/eng/alexander_herzen
https://archive.org/details/selectedphilosop032757mbp

Foundations of Social Evolution :Author(**Stephen Alan Frank**) :Year(1998) :Keyword(Planet Development Evolution) https://stevefrank.org/foundations/foundations.html
https://www.researchgate.net/publication/318725812_Foundations_of_Social_Evolution
https://www.nature.com/articles/6885351

Contributions to the Founding of the Theory of Transfinite Numbers :Author(**Georg Cantor**) :Year(1915) :Keyword(Planet Development Maths)
https://www.maths.ed.ac.uk/~v1ranick/papers/cantor1.pdf
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The Collected Mathematical Papers of Arthur Cayley :Author(**Arthur Cayley**) :Year(1895) :Keyword(Planet Development Maths) https://geographiclib.sourceforge.io/geodesic-papers/cayley-V8.pdf https://www.jstor.org/stable/2969674?seq=1#metadata_info_tab_contents
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Elements of Geometry and Trigonometry: With Notes :Author(**Adrien-Marie Legendre**) :Year(1830) :Keyword(Planet Development Maths)
https://archive.org/details/elementsgeometr01brewgoog/page/n6/mode/2up
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The Cambridge and Dublin Mathematical Journal - Volume 5 :Author(Many) :Year(1850) :Keyword(Group Development Maths) https://openlibrary.org/books/OL23457907M/The_Cambridge_and_Dublin_Mathematical_Journal

A History of Mathematics :Author(**Florian Cajori**) :Year(1909) :Keyword(Group Development Maths, History) https://www.gutenberg.org/files/31061/31061-pdf.pdf https://www.gutenberg.org/ebooks/author/34987

An Investigation of the Laws of Thought :Author(**George Boole**) :Year(1853) :Keyword(Group Development Maths, Logic) http://gutenberg.org/files/15114/15114-pdf.pdf https://plato.stanford.edu/entries/boole/ https://www.maa.org/press/periodicals/mathematical-treasure-boole-s-laws-of-thought

Here in this extract Boole identifies the pattern exemplified by **extremist idiotologies** everywhere – the certaintists – the **feminists and other extremists**. For inexperienced, uneducated and self-centered individuals – everything is "unprecedented"

Public Domain – partial extract "They are in all cases, and in the strictest sense of the term, **probable conclusions**, approaching ,indeed, ever and **ever nearer to certainty**, as they receive more and more of the **confirmation of experience**. But of the **character of probability**, in the strict and proper sense of that term, **they are never wholly divested**. On the other hand, the knowledge of the laws of the mind **does not require** as its basis any **extensive collection of observations**. The **general truth** is seen in the **particular instance**, and it is not confirmed by the repetition of instances. We may illustrate this position by an obvious example. It may be a question whether that formula of reasoning, which is called the dictum of Aristotle, de omni et nullo, expresses a primary law of human reasoning or not; but it is no question that it expresses a general truth in Logic. Now that truth is made manifest in all its generality by reflection upon a single instance of its application. And this is both an evidence that the particular principle or formula in question is founded upon some general law or laws of the mind, and an illustration of the doctrine that the perception of such general truths is not derived from an induction from many instances, but is involved in the clear apprehension of a single instance. In connexion with this truth is seen the not less important one that our knowledge of the laws upon which the science of the intellectual powers rests, whatever may be its extent or its deficiency, is not probable knowledge. For we not only see in the particular example the general truth, but we see it also as a **certain truth**,–a truth, our confidence in which will not continue to increase with increasing experience of its practical verifications."

Linear associative algebra :Author(**Benjamin Peirce**) :Year(1870) :Keyword(Group Development Maths) https://ia802305.us.archive.org/17/items/linearassocalgeb00pierrich/linearassocalgeb00pierrich.pdf https://mathshistory.st-andrews.ac.uk/Biographies/Peirce_Benjamin/

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Recent Messages

*'Teachers should prepare the student for the student's future, not for the teacher's past.' :Author(**Richard Wesley Hamming**) :Year(1997) :Source Document(**The Art of Doing Science and Engineering**) :Keyword(Development Teaching Individual)*
https://en.wikipedia.org/wiki/The_Art_of_Doing_Science_and_Engineering
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*'Personal freedom is a magnificent thing; by it and by it alone can a nation achieve its true freedom. Man **must respect and honor his freedom in himself no less than in his neighbor or in the people at large**.' :Author(**Aleksandr Ivanovich Herzen**) :Year(1849) :Source Document(Letter from Paris to His Friend in Moscow (March 1st, 1849) Imperial Russia, A Sourcebook 1700-1917) :Keyword(Humanism Freedom Group) https://en.wikiquote.org/wiki/Alexander_Herzen*

Recent People

Richard Wesley Hamming :Year(1915-1998) :Keyword(Math, Computing)
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John Napier :Year(1550-1617) :Keyword(Science) https://en.wikipedia.org/wiki/John_Napier
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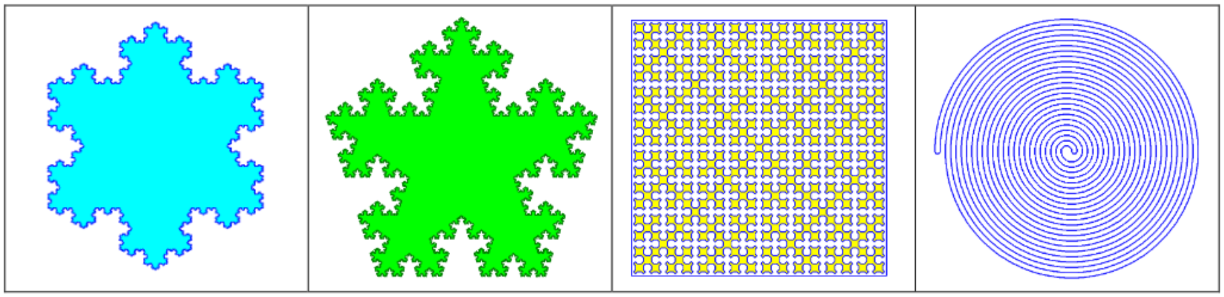
Marie Ennemond Camille Jordan :Year(1838-1922) :Keyword(Math, Engineering)
https://en.wikipedia.org/wiki/Camille_Jordan https://mathshistory.st-andrews.ac.uk/Biographies/Jordan/ https://mathshistory.st-andrews.ac.uk/Strick/jordan.pdf .... the ***JORDAN curve theorem****: Every closed non-intersecting JORDAN curve in the Euclidean plane divides it into two disjoint regions whose common edge is the JORDAN curve and whose union with the JORDAN curve is the whole plane. Exactly one of the two regions is bounded. A graph is called a closed JORDAN curve if its*

points can be described by a continuous representation of parameters and if the start and end points are identical.. (**constraining** - bounding shapes in two dimensions – closed)

Fractal curves can also fulfil this condition (see the first three examples below). In the continuous loop on the right, on the other hand, it is hardly possible to tell which of the points are inside and which are outside.



Augustin Louis Cauchy :Year(1789-1857) :Keyword(Math, Science)
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William Rowan Hamilton :Year(1805-1865) :Keyword(Science)
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Alexis Claude Clairaut :Year(1713-1765) :Keyword(Astronomy) https://mathshistory.st-andrews.ac.uk/Biographies/Clairaut/ https://www.maa.org/press/periodicals/convergence/the-four-curves-of-alexis-clairaut https://royalsocietypublishing.org/doi/abs/10.1098/rstl.1737.0045 **Fair Use – research – non- commercial - partial extract ..**
"Taking a=1, the general form for Clairaut's equation is $x^{n+1/n}=\sqrt{(x^2+y^2)}$*"*

Nikolay Gavrilovich Chernyshevsky :Year(1828-1889) :Keyword(Humanism)
https://en.wikipedia.org/wiki/Nikolay_Chernyshevsky https://spartacus-educational.com/RUSchernyshevsky.htm
https://www.marxists.org/reference/archive/chernyshevsky/index.htm

Alexander Ivanovich Herzen :Year(1812-1870) :Keyword(Humanism)
https://en.wikipedia.org/wiki/Alexander_Herzen https://spartacus-educational.com/RUSherzen.htm
http://www.twickenham-museum.org.uk/detail.php?aid=134&cid=7&ctid=1 **© The Twickenham Museum – Fair Use – research – non- commercial - partial extract**
"Another friend, Pavel Annenkov, commented: "I must own that I was puzzled and overwhelmed, when I first came to know Herzen - by this ***extraordinary mind*** *which* ***darted from one topic to another*** *with unbelievable swiftness, with* ***inexhaustible wit and brilliance****; which could see in the turn of somebody's talk, in some simple incident, in some* ***abstract idea****, that vivid feature which gives expression and life. He*

*had a most **astonishing capacity for instantaneous, unexpected juxtaposition of quite dissimilar things**, and this gift he had in a very high degree, fed as it was by the **powers of the most subtle observation and a very solid fund of encyclopedic knowledge**. He had it to such a degree that, in the end, his **listeners were** sometimes exhausted **by the inextinguishable fireworks of his speech, the inexhaustible fantasy and invention, a kind of prodigal opulence of intellect which astonished his audience.**" ..*

Benjamin Gompertz :Year(1779-1865) :Keyword(Statistics) https://mathshistory.st-andrews.ac.uk/Biographies/Gompertz/
https://www.actuaries.org.uk/system/files/documents/pdf/0203-0212.pdf
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6. ***MacTutor*** *https://mathshistory.st-andrews.ac.uk/ "MacTutor is created and maintained by* ***Edmund Robertson****, and* ***John O'Connor****, of the School of Mathematics and Statistics at the* ***University of St Andrews****, and is hosted by the University. Their contributions to the history of mathematics have been recognised by the Comenius medal of the Hungarian Comenius Society in 2012 and the Hirst Prize of the London Mathematical Society in 2015."* **Copyright - Creative Commons Attribution-ShareAlike 4.0 International License.**
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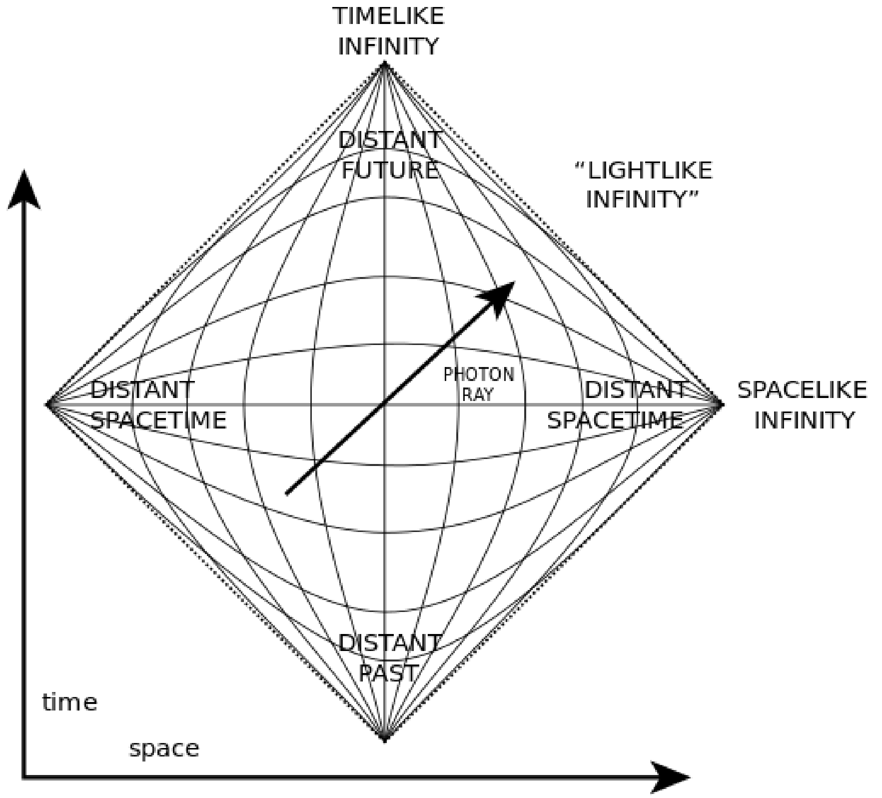

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https://www.researchgate.net/post/Can_infinitesimals_be_eliminated_from_mathematics_SOLVED **Copyright - fair use – partial extract – non-commercial – research and education**
"This thread then, opens mathematics to a new understanding, as follows: (1) one keeps infinitesimals, Cauchy, and continuity, even though NOT observable ever, and proceeds with these hypothesis as IF true (very academic!); or, (2) one takes the side of the opposite hypothesis, uses only finite integer extension fields (e.g., Galois fields), explores it as IF true, and pursues further its consequences. This was the consensus solution of this thread. "..
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45. Euclidian Alorithm *https://en.wikipedia.org/wiki/Euclidean_algorithm*
46. *Golden ratio* *https://en.wikipedia.org/wiki/Golden_ratio* *German mathematician Simon Jacob (d. 1564) noted that consecutive Fibonacci numbers converge to the golden ratio;[26] this was rediscovered by Johannes Kepler in 1608.[27]*
47. Mathsisfun - *https://www.mathsisfun.com/numbers/golden-ratio.html* **Copyright - fair use – partial extract – non-commercial – research and education** ..*"Fibonacci Sequence There is a*

special relationship between the Golden Ratio and the Fibonacci Sequence: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ... (The next number is found by adding up the two numbers before it.) And here is a surprise: when we take any two successive (one after the other) Fibonacci Numbers, their ratio is very close to the Golden Ratio."..

48. ***Kepler Triangle*** *https://en.wikipedia.org/wiki/Kepler_triangle*
49. *The Golden Ratio: Kepler Triangle https://brilliant.org/discussions/thread/the-golden-ratio-kepler-triangle/* **Copyright - fair use – partial extract – non-commercial – research and education** *… "PI IS NOT NEEDED FOR ANYTHING* (??? I disagree although there may be really close approximations) *.. AFTER THE CIRCLE'S CIRCUMFERENCE HAS BEEN DIVIDED INTO 12 EQUAL PARTS WITH 12 EQUAL CHORDS AROUND THE CIRCLE'S CIRCUMFERENCE WITH A COMPASS AND STRAIGHT EDGE THEN* ***COMMON SENSE*** *SHOULD TELL THE GEOMETER THAT 1 QUARTER OF THE CIRCE'S CIRCUMFERENCE IS EQUAL TO 3 BECAUSE 12 DIVIDED BY 4 = 3. "* **(I suspect this blog is trying to do the squaring the circle problem but I am not convinced that it has solved the problem)**
50. *Phi and Fibonacci in Kepler and Golden Triangles May 13, 2012 by Gary Meisnerhttps://www.goldennumber.net/triangles/ Creating a Triangle based on Fibonacci numbers No three successive numbers in the Fibonacci series can be used to create a right triangle.* ***Marty Stange****, however, contributed the following relationship in January 2007:* ***Every successive series of four Fibonacci numbers can be used to create a right triangle****, with the base and hypotenuse being determined by the second and third numbers, and the other side being the square root of the product of the first and fourth numbers.*
51. ***Modulo - Division – Euclid's Algorithm*** *https://en.wikipedia.org/wiki/Euclidean_algorithm (**finding the greatest common divisor**) .. The Euclidean algorithm is one of the oldest algorithms in common use.[25] It appears in Euclid's Elements (c. 300 BC), specifically in Book 7 (Propositions 1–2) and Book 10 (Propositions 2–3). In Book 7, the algorithm is formulated for integers, whereas in Book 10, it is formulated for lengths of line segments. (In modern usage, one would say it was formulated there for real numbers. But lengths, areas, and volumes, represented as real numbers in modern usage, are not measured in the same units and there is no natural unit of length, area, or volume; the concept of real numbers was unknown at that time.) The latter algorithm is geometrical. The GCD of two lengths a and b corresponds to the greatest length g that measures a and b evenly; in other words, the lengths a and b are both integer multiples of the length g.".*.
52. *https://www.archimedes-lab.com/* ***Archimedes Laboratory Project™*** *Mental & Perceptual Activities that Enhance Critical and Creative Thinking Skills -* ***Gianni A. Sarcone*** *and* ***Marie-Jo Waeber*** *are writers, designers and inventors with more than seventeen years of experience in the fields of visual creativity and education. They are co-founders of Archimedes' Laboratory™, a consulting network of experts specializing in improving and developing creativity. Their purpose is to promote the puzzle as an educational aid useful for training, socialization and communication.*
53. *Pascal's Theorem https://www.archimedes-lab.com/wp/2019/05/04/pascals-theorem/*
54. *Cut The Knot https://www.cut-the-knot.org/wanted.shtml*
55. *Wolfram Demonstrations https://demonstrations.wolfram.com/*

56. ***Towards Data Science***- *Understanding Audio data, Fourier Transform, FFT and Spectrogram features for a Speech Recognition System An introduction to audio data analysis (sound analysis) using python Kartik Chaudhary* ***Kartik Chaudhary*** *Jan 19* *https://towardsdatascience.com/understanding-audio-data-fourier-transform-fft-spectrogram-and-speech-recognition-a4072d228520* *. July 21 2020* *https://dropsofai.com/understanding-audio-data-fourier-transform-fft-and-spectrogram-features-for-a-speech-recognition-system/*
57. *Fourier Series WOLFRAM Mathwold* *https://mathworld.wolfram.com/FourierSeries.html*
58. *Edison Phonograph* *https://www.loc.gov/collections/edison-company-motion-pictures-and-sound-recordings/articles-and-essays/history-of-edison-sound-recordings/history-of-the-cylinder-phonograph*
59. ***Learn about electronics*** *Digital Electronics © 2007− 2020* ***Eric Coates*** *MA BSc. (Hons) All rights reserved. (Revision 14.01 18th July 2020)* *https://learnabout-electronics.org/Digital/dig10.php*
60. *How Stuff Works Radio* *https://electronics.howstuffworks.com/radio.htm*
61. *Types of Ocean Surface Waves, Wave Classification General Basic Hydrodynamics and Wave Dynamics* ***Alessandro Toffoli Elzbieta M. Bitner-Gregersen*** *First published: 06 March 2017* *https://doi.org/10.1002/9781118476406.emoe077Waves* *https://onlinelibrary.wiley.com/doi/full/10.1002/9781118476406.emoe077*
62. *Descarte's Theorem* *https://en.wikipedia.org/wiki/Descartes%27_theorem*
63. ***Dr. Gerard P. Michon - Numericana.com*** *is the online companion to* ***Dr. Michon's*** *future Numericana book, presenting the recreational and serious sides of mathematics and physics to a wide audience of scientists, engineers, teachers, parents, students and adults teaching themselves Science.* *http://www.numericana.com/*
64. ***Making Walks Count****: From Silent Circles to Hamiltonian Cycles* ***Max A. Alekseyev*** *and* ***G ́erard P. Michon*** *1.* *https://arxiv.org/pdf/1602.01396.pdf*
65. *Greatest Common Divisor* *https://en.wikipedia.org/wiki/Greatest_common_divisor*
42 Euclid's Algorithm .."*For example, to compute gcd(48,18), divide 48 by 18 to get a quotient of 2 and a remainder of 12. Then divide 18 by 12 to get a quotient of 1 and a remainder of 6. Then divide 12 by 6 to get a remainder of 0, which means that 6 is the gcd. Here, we ignored the quotient in each step, except to notice when the remainder reached 0, signalling that we had arrived at the answer.".. * *https://en.wikipedia.org/wiki/Euclidean_algorithm*
67. ***Millenium Problems*** *- Luuk* *http://mp2000.nl/the-7-unsolved-mathematical-problems/* *Table of Contents* ***The 7 Unsolved Mathematical Problems*** *Poincaré Conjecture Birch and Swinnerton-Dyer Conjecture Hodge Conjecture Navier–Stokes Existence and Smoothness P Versus NP Problem Riemann Hypothesis Yang-Mills Existence and Mass Gap .* ***Clay Mathematics Institute*** *https://www.claymath.org/millennium-problems/riemann-hypothesis*
68. *Elliptic Modular Forms and Their Applications* ***Don Zagier Max-Planck-Institute*** *Elliptic Curves and modular forms* *https://people.mpim-bonn.mpg.de/zagier/files/doi/10.1007/978-3-540-74119-0_1/fulltext.pdf* *,* ***Leiden University*** *- Mathematics Institute - Elliptic curves,*

modularity and the conjecture of Birch and Swinnerton-Dyer ***Peter Bruin***
http://pub.math.leidenuniv.nl/~bruinpj/modforms/notes-17-5.pdf

69. ***Levy Flights*** *- Lévy flight and Brownian search patterns of a free-ranging predator reflect different prey field characteristics David W. Sims, Nicolas E. Humphries, Russell W. Bradford, Barry D. Bruce,First published: 17 October 2011, https://doi.org/10.1111/j.1365-2656.2011.01914.x Citations: 90* *https://besjournals.onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2656.2011.01914.x*
70. *Springer link - Sources and Studies in the History of Mathematics and Physical Sciences Book Series There are 55 volumes in this series Published 1992 – 2020* *https://link.springer.com/bookseries/4142*
71. *A new proof of Birkho 's theorem* ***Hans - J˙urgen Schmidt*** **University Potsdam**, *Institut f˙ur MathematikD-14415 POTSDAM, PF 601553, Am Neuen Palais 10, Germany* *https://cds.cern.ch/record/334866/files/9709071.pdf*
72. ***Forbes*** *- Ask Ethan Segal - black holes* ***Ethan Siegel*** *Nov 3, 2018,10:00am EDT* *https://www.forbes.com/sites/startswithabang/2018/11/03/ask-ethan-how-do-black-holes-actually-evaporate/#1e06a52024a1*
73. *MIT Open Courses - 19.* ***Dynamic Programming I: Fibonacci, Shortest Paths*** *https://www.youtube.com/watch?v=OQ5jsbhAv_M*
74. *The History Of Mathematics A HISTORY OFM A T H E M A T I C SBY FLORIAN CAJORI, Ph.D. Formerly Professor of Applied Mathematics in the Tulane University of Louisiana; now Professor of Physics in Colorado College* *https://www.gutenberg.org/files/31061/31061-pdf.pdf*
75. ***Pattern Recognition*** *- Index of Bongard* *https://en.wikipedia.org/wiki/Bongard_problem* *problems* *https://www.foundalis.com/res/bps/bpidx.htm* ***Harry Foundalis***
76. *Polynomial equations of degree 5 or higher cannot be solved Abel's impossibility theorem* *https://en.wikipedia.org/wiki/Abel%E2%80%93Ruffini_theorem*
77. ***Groups*** *- https://www.3blue1brown.com/ -* ***Grant Sanderson*** *https://www.youtube.com/watch?v=mH0oCDa74tE*
78. *Basel problem* *https://www.youtube.com/watch?v=d-o3eB9sfls* ***Grant Sanderson***
79. *Matiyasevich theorem* *http://www.scholarpedia.org/article/Matiyasevich_theorem*
80. ***Butterfly Effect*** *Catherine Rouvas-Nicolis, Royal Meteorological Institute of Belgium, Brussels, Belgium , Gregoire Nicolis, Universite Libre de Bruxelles, Brussels, Belgium*
81. *Action Angle Coordinates* *https://en.wikipedia.org/wiki/Action-angle_coordinates*
82. *Quantum Chaos* *https://en.wikipedia.org/wiki/Quantum_chaos*
83. ***Sturm–Liouville theory*** *https://en.wikipedia.org/wiki/Sturm%E2%80%93Liouville_theory*
84. ***Search algorithms -*** *Sensors (Basel). 2019 Oct; 19(19): 4067. Published online 2019 Sep 20. doi: 10.3390/s19194067 PMCID: PMC6806177 PMID: 31547143* ***Autonomous Unmanned Aerial Vehicles in Search and Rescue Missions Using Real-Time Cooperative Model Predictive Control*** *Fabio Augusto de Alcantara Andrade,1,2,3,* Anthony Reinier Hovenburg,2 Luciano Netto de Lima,3 Christopher Dahlin Rodin,2 Tor Arne Johansen,2 Rune Storvold,1,2 Carlos Alberto Moraes Correia,3 and Diego Barreto Haddad3* ***https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6806177/***

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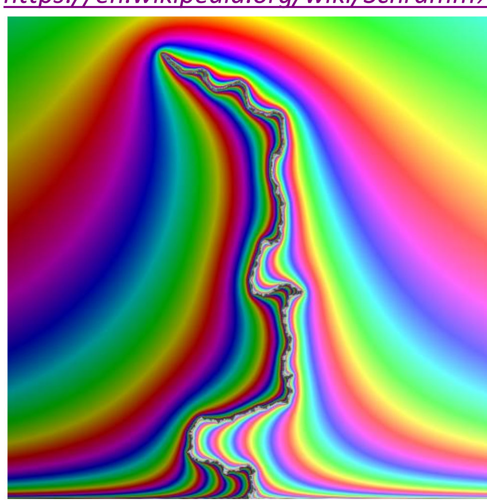
86. ***Penn State Eberly College of Science*** *- Stat Courses online - https://online.stat.psu.edu/statprogram/ Multivariate Normal Distribution https://online.stat.psu.edu/stat505/book/export/html/636*
87. ***Middlesex University Dr Xin-She Yang*** *Reader in Modelling and Simulation ROLE: Associate Professor in Simulation & Modelling https://www.mdx.ac.uk/about-us/our-people/staff-directory/profile/yang-xin-she*
88. *National Physical Laboratory – UK https://www.npl.co.uk/*
89. *X.-S. Yang Nature-inspired metaheuristic algorithms Luniver press (2010) Google Scholar - https://scholar.google.co.uk/citations?user=fA6aTlAAAAAJ&hl=en https://books.google.com.au/books?hl=en&lr=&id=iVB_ETlh4ogC&oi=fnd&pg=PR5&ots=DxaxugCKp9&sig=hE_UUCJz929s2VGULm8WvfSCTEM&redir_esc=y#v=onepage&q&f=false , TY - BOOK AU - Yang, Xin-She PY - 2020/09/14 SP - SN - 9780128219867 T1 - Nature-Inspired Optimization Algorithms: Second Edition ER - https://www.researchgate.net/publication/344443170_Nature-Inspired_Optimization_Algorithms_Second_Edition Nature-inspired Metaheuristic Algorithms - Xin-She Yang - Google Books https://books.google.com.au/books?hl=en&lr=&id=iVB_ETlh4ogC&oi=fnd&pg=PR5&ots=DxaxugCKp9&sig=hE_UUCJz929s2VGULm8WvfSCTEM&redir_esc=y#v=onepage&q&f=false .. at*
90. ***Schramm – Loewner - Evolution*** *https://en.wikipedia.org/wiki/Schramm%E2%80%93Loewner_evolution*



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91. ***Modular Elliptic Curves and Fermat's Last theorem Annals of Mathematics,141(1995), 443-551 Pierre de Fermat Andrew John Wiles Modular elliptic curves and Fermat's Last***

Theorem By Andrew John Wiles*For Nada, Claire, Kate and Olivia
http://scienzamedia.uniroma2.it/~eal/Wiles-Fermat.pdf

92. *BULLETIN (New Series) OF THE AMERICAN MATHEMATICAL SOCIETY Volume 40, Number 1, Pages 39–53S 0273-0979(02)00963-1Article electronically published on October 10, 2002 THE PRINCIPLE OF FUNCTORIALITY* ***JAMES ARTHUR*** *https://www.claymath.org/library/cw/arthur/pdf/57.pdf*
93. *Group Theory https://en.wikipedia.org/wiki/Classification_of_finite_simple_groups Group theory is central to many areas of pure and applied mathematics and the classification theorem has been called one of the great intellectual achievements of humanity.[1] The proof consists of tens of thousands of pages in several hundred journal articles written by about 100 authors, published mostly between 1955 and 2004.*
94. *Galois Theory https://en.wikipedia.org/wiki/Galois_theory*
95. ***The Three Body problem*** *https://en.wikipedia.org/wiki/Three-body_problem* - it is impossible to solve and chaotic – modeling, computing and experience suggests it eventually resolves to a two body solution with the third body leaving the relationship
96. ***Continued Fractions*** - *Évariste Galois* - *https://en.wikipedia.org/wiki/Continued_fraction*
97. ***Lie Groups*** *https://en.wikipedia.org/wiki/Lie_group* **(power law - mutiplication/division)**
98. ***Theory Of Equations*** *https://en.wikipedia.org/wiki/Theory_of_equations*
99. ***Primes - prime formulas - Heegner Numbers – Euler's lucky numbers*** ***https://en.wikipedia.org/wiki/Heegner_number***
100. ***163 Stephen Wolfram Mathworld*** ***https://mathworld.wolfram.com/163.html***
101. *A Proof related to the* ***three body problem*** *–- An extension of Poincaré's last geometric theorem George D. Birkhoff https://projecteuclid.org/euclid.acta/1485887647*
102. ***Henri Poincaré*** *Papers – Universitie Lorraine http://henripoincarepapers.univ-lorraine.fr/*
103. *Poincar´e and the* ***Three-Body Problem*** *-* ***Alain Chenciner*** *Observatoire de Paris, IMCCE (UMR 8028), ASD77, avenue Denfert-Rochereau, 75014 Paris, Francechenciner@imcce.fr& D´epartement de math´ematique, Universit´e Paris VI Poincar´e, 1912-2012, S´eminaire Poincar´e XVI (2012) 45 – 13 http://www.bourbaphy.fr/chenciner.pdf* **partial extract - fair use** *"Since the time of Newton himself, the* ***Three-Body Problem*** *was a major source of development of analysis: it is enough to mention the names of Euler, Clairaut, d'Alembert, Laplace, Lagrange, Jacobi, Cauchy,..."*
104. *Encyclopedia of Mathematics wiki is an open access resource designed specifically for the mathematics community https://encyclopediaofmath.org/wiki/Main_Page*
105. *Project Euclid https://projecteuclid.org/*
106. *Journal für die reine und angewandte Mathematik | Volume 1990: Issue 404 Equidecomposability and discrepancy; a solution of* ***Tarski's circle-squaring problem*** *M. Laczkovich DOI: https://doi.org/10.1515/crll.1990.404.77 |Published online: 09 Dec 2009 https://www.degruyter.com/view/journals/crll/1990/404/article-p77.xml*
107. Blog by John J. G. Savard - http://www.quadibloc.com/math/ide01.htm
108. **Whitney Embedding theorem** (**2 dimensions is a good representation of n dimensions**) https://en.wikipedia.org/wiki/Whitney_embedding_theorem

*109. The **Price Equation** https://en.wikipedia.org/wiki/Price_equation .. The equation uses a covariance between a trait and fitness, to give a mathematical description of evolution and natural selection*

*110. **The Evolution of Reciprocal Altruism** Robert L. Trivers https://www.journals.uchicago.edu/doi/10.1086/406755*

111. Terry Tao https://www.youtube.com/watch?v=MXJ-zpJeY3E The World's Best Mathematician (*) – Numberphile

*112. **Mathologer https://www.youtube.com/watch?v=YuIIjLr6vUA Numberphile v. Math: the truth about 1+2+3+...=-1/12 – reimann zeta function***

*113. **Mathologer Times Tables, Mandelbrot and the Heart of Mathematics 2,292,192 views •Nov 6, 2015*** https://www.youtube.com/watch?v=qhbuKbxJsk8

*114. **Cantor's Infinities - Professor Raymond Flood https://www.youtube.com/watch?v=SqRY1Bm8EVs***

*115. **Bertrand Russell** INTRODUCTION TO MATHEMATICAL PHILOSOPHY – 1920 https://www.gutenberg.org/files/41654/41654-pdf.pdf *

*116. How did Ramanujan solve the STRAND puzzle? **Mathologer** https://www.youtube.com/watch?v=V2BybLCmUzs*

*93 Continued Fractions - Continued fractions from Euclid to the present day **Ilan Vardi** http://www.chronomaitre.org/ContinuedFractions.pdf*

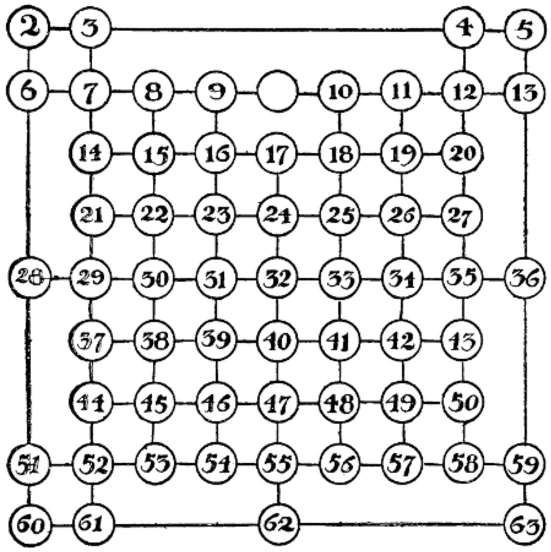
*118. Continued Fractions I Age 14 to 18 Article by **Alan and Toni Beardon** Published May 1999,February 2011. https://nrich.maths.org/1351*

*119. **Henry Earnest Dudeney** Amusements in Mathematics , http://www.gutenberg.org/files/16713/16713-h/16713-h.htm The Canterbury Puzzles, and Other Curious Problems by Henry Ernest Dudeney http://www.gutenberg.org/ebooks/27635*

*120. The Moscow Puzzles - **Boris A. Kordemsky** - The Moscow Puzzles : 359 Mathematical Recreations Boris Kordemsky , Translated by **Albert Parry** , Volume editor Martin Gardner https://www.readpbn.com/pdf/The-Moscow-Puzzles-359-Mathematical-Recreations-Sample-Pages.pdf , https://www.pdfdrive.com/the-moscow-puzzles-359-mathematical-recreations-boris-a-kordemsky-d43133059.html - see problems 355 and 356 -*

121. Puzzle books on Gutenberg http://www.gutenberg.org/ebooks/search/?query=puzzles&submit_search=Go%21

122. Home Fun - CECIL H. BULLIVANT – 1910 http://www.gutenberg.org/files/61685/61685-h/61685-h.htm **public domain** *7. Catching the Donkey A man once wanted to saddle a donkey, and proceeded, bridle in hand, to the field where Ned was feeding. Let Fig. 5 represent the field, which the man entered by the gate at 63, whilst the ass was standing in the opposite corner at 2. Now you can move either the man or the donkey to any number in the straight line, but neither must cross or rest upon a line covered by the other. For instance, if the donkey be at 2, the man can move to 62, 61, 59, 36, or 13; but he cannot go to either 60 or to 5, for then the donkey would gallop up and let fly with his heels. Ned, on the other hand, can go to 6, 28, 51, 3, or 4, but if he were to go to 60 or 5 the man at 63 would catch him at once. Giving the donkey the first move, how soon can you place the man* *in such a position that the ass is cornered and cannot escape being bridled?*



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124. *CONCHOID OF NICOMEDES -* ***Robert FERRÉOL, Jacques MANDONNET*** *2017* *https://mathcurve.com/courbes2d.gb/conchoiddenicomede/conchoiddenicomede.shtml*

125. ***School of Mathematics and Statistics University of St Andrews, Scotland*** *- Mactutor Cochloid or Nicomedes* *https://mathshistory.st-andrews.ac.uk/Curves/Conchoid/*

126. ***Pierce, Rod. "Math is Fun" Math Is Fun. Ed. Rod Pierce. 21 Jul 2020. 27 Nov 2020 http://www.mathsisfun.com/index.htm Pascal's triangle https://www.mathsisfun.com/pascals-triangle.html***

127. ***Australian Government*** *– Pascal's triangle senior years Australian Mathematical Services Institute – Pascal's triangle* *http://amsi.org.au/ESA_Senior_Years/SeniorTopic1/1c/1c_2content_4.html*

128. *Cut the Knot Pascal's triangle* *https://www.cut-the-knot.org/arithmetic/combinatorics/PascalTriangleProperties.shtml*

129. ***Binomial Theorem*** *-The most basic example of the binomial theorem is the formula for the square of x + y:* $(x+y)^2 = x^2 + 2xy + y^2$. *(x+y)^{2}=x^{2}+2xy+y^{2}*

130. ***Reuleaux Traingle https://en.wikipedia.org/wiki/Reuleaux_triangle***

131. ***Golden ration triangle, Square, Pentagon https://www.cut-the-knot.org/do_you_know/3-4-5-GoldenRatio.shtml 3-4-5, Golden Ratio The following has been posted by Tran Quang Hung at the CutTheKnotMath facebook page on May 2, 2017.***

132. ***Cut the knot Alexander Bogomolny, https://www.cut-the-knot.org/geometry.shtml***

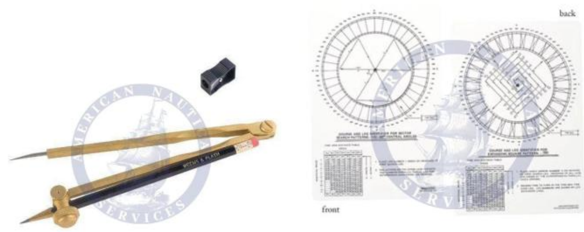
133. ***Cut the Knot 3,3 vertices problems – bridges problem https://www.cut-the-knot.org/do_you_know/3Utilities.shtml , Euler's formula https://www.ics.uci.edu/~eppstein/junkyard/euler/***

134. ***Magic Tile*** ***http://roice3.org/magictile/***

135. ***Vi Hart Suspend Your Disbelief (or, how to ruin everything in 7 steps) 336,640 views •Jun 29, 2018https://www.youtube.com/watch?v=deg1wmYjwtk***

136. *Dividers and Compasses – The Smithsonian https://americanhistory.si.edu/collections/object-groups/dividers-compasses*

137. ***American Nautical Instruments*** *https://www.amnautical.com/collections/instruments-accessories/dividers* **fair use - non commercial - partial extract** *Course & Leg Identifier for*



Search & Rescue (Weems & Plath 113)

138. *Fortran https://ourcodingclub.github.io/tutorials/fortran-intro/*

Modeling – statistics – prediction – techniques and tools - MCMCglmm Course Notes ***Jarrod Hadfield*** *(j.hadfield@ed.ac.uk)April 17, 2019 https://cran.r-project.org/web/packages/MCMCglmm/vignettes/CourseNotes.pdf*

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141. *Grassman's Vision -* ***David Hestenes*** *https://www.researchgate.net/publication/266575537_Grassmann%27s_Vision*

142. *Horst Herrlich – Categorical Theory https://en.wikipedia.org/wiki/Horst_Herrlich*

143. *Perfect infinities and finite approximation* ***Boris Zilber*** *University of Oxford November 20, 2012 http://people.maths.ox.ac.uk/zilber/inf-to-finite.pdf*

144. *Archimedes Cattle problem https://en.wikipedia.org/wiki/Archimedes%27s_cattle_problem , Sir Thomas Heath Archimedes https://www.gutenberg.org/files/35550/35550-h/35550-h.htm .."* **public domain** *"Geometry is said by many to have* ***been invented among the Egyptians****, its origin being due to the* ***measurement of plots of land****. This was necessary there because of the rising of the Nile, which obliterated the boundaries appertaining to separate owners. Nor is it marvellous that the discovery of this and the other sciences should have arisen from such an occasion, since everything which moves in the sense of development will advance from the imperfect to the perfect. From sense-perception to reasoning, and from reasoning to understanding, is a natural transition."*

145. *Gnomon https://en.wikipedia.org/wiki/Gnomon_(figure)*

146. *Computational logic* ***Stephen Wolfram*** *https://www.wolframscience.com/nks/p807--implications-for-mathematics-and-its-foundations/*

147. *Combinators – A Centennial view https://writings.stephenwolfram.com/2020/12/combinators-a-centennial-view/*

148. *Keplers' conjecture – sphere packing* *https://mathworld.wolfram.com/KeplerConjecture.html Kobon Triangle* *https://mathworld.wolfram.com/KobonTriangle.html*

149. *Dido, Pygmailion, Virgils Aeneid https://www.britannica.com/topic/Aeneid , https://www.ancient.eu/Dido/*

150. *Gnaeus Naevius http://www.attalus.org/poetry/naevius.html*

151. *Austrlian Acedemy of Science https://www.science.org.au/curious/space-time/infinity*

152. ***NOTE I SAW THIS after I did my work – it is close to my conceptual view*** *- Intuitive Understanding Of Euler's Formula – Better Explained* *https://betterexplained.com/articles/intuitive-understanding-of-eulers-formula/*

153. ***NOTE I SAW THIS after I did my work – it is close to my conceptual view - Interesting*** *https://www.lockhaven.edu/~dsimanek/pseudo/fibonacc.htm Donald E. Simanek*

154. *The 3-4-5 Right Triangle and the Golden Mean discovered by **Gabries Bosia*** *http://www.math.uwaterloo.ca/~ljdickey/geometry_corner/3-4-5.html*

155. ***Archimedes****- The Illustrated Method of Archimedes: Utilizing the Law of the Lever to Calculate Areas, Volumes, and Centers of Gravity - **Andre K. T. Assis** and **C. P. Magnaghi** Published by C. Roy Keys Inc. 4405, rue St-Dominique Montreal, Quebec H2W 2B2 Canada http://redshift.vif.com © Andre K. T. Assis and C. P. Magnaghi 2012First Published 2012* *https://www.researchgate.net/publication/314487434_The_Illustrated_Method_of_Archimedes_Utilizing_the_Law_of_the_Lever_to_Calculate_Areas_Volumes_and_Centers_of_Gravity*

156. ***NOTE I SAW THIS after I did my work – it may have similar diagrams*** *"**Neo4j** is the world's leading graph database - **Bryce Merkl Sasaki** is the Editor-in-Chief at Neo4j"* *https://neo4j.com/docs/operations-manual/4.0/introduction/*

157. *A History of Mathematics FLORIAN CAJORI 1909* *https://www.gutenberg.org/files/31061/31061-pdf.pdf*

158. ***NOTE I SAW THIS after I did my work*** *Langlands Program* *https://en.wikipedia.org/wiki/Langlands_program*

159. ***NOTE I SAW THIS after I did my work*** *Ramanujan–Sato series* *https://en.wikipedia.org/wiki/Ramanujan%E2%80%93Sato_series*