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Theory Of Higher Order Sequence Of Primes, Askew Primes, One Step Evolution Of Any Element Of Any Higher Order Sequence Of Primes Or Any element of Any Askew Primes Sequence – The Notion Of Special Curves Connecting Any Two Real Numbers As An Example Of Application

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Abstract

In this research manuscript, the author has presented a novel notion of Higher Order Sequence Of Primes, Askew Primes, One Step Evolution of any element of Higher Order Sequence Of Primes, One Step Evolution of any element of Askew Primes Sequence and finally, Special Curves Connecting Any Two Real Numbers.

Key Words: *Prime Numbers*

Introduction

Since, the dawn of civilization, human kind has been leaning on the Sequence of Primes to devise Evolution Schemes akin to the behavior of the Distribution of Primes, in an attempt to mimic natural phenomenon and be able to forecast useful aspects of science of the aforementioned phenomenon. Many western and as well as oriental Mathematicians and Physicsts have understood the importance of Prime Numbers (in the ambit of Quantum Groups, Hopf Algebras, Differentiable Quantum Manifolds, etc.,) in understanding subatomic processes such as Symmetry Breaking, Standard Model Explanation, etc. In this research note, the author advocates a novel concept of Higher Order Sequence Of Primes.

Theory Of Higher Order Sequences(s) Of Primes [1], [2], [3], [8]

A Positive Integer Number is considered as a Prime Number in a Certain Higher Order (Positive Integer ≥ 2) Space, say R, if it is factorizable into a Product of (R-1) factors wherein the factors are (R-1) number of Distinct Non-Reducible Positive Integer Numbers (Primes of 2nd Order Space).

Example:

The general Primes that we usually refer to can be called as Primes of 2nd Order Space.

Example:

First Few Elements Of Sequence's Of Higher Order Space Primes	*R^{th} Order Space*
{2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, …}	R=2
{6 (3x2), 10 (5x2), 14 (7x2), 15 (5x3), 21 (7x3), 22 (11x2), 26 (13x2), 33 (11x3), 34 (17x2), 35 (7x5), 38 (19x2), 39, (13x3), 45 (9x5), ... }	R=3
{30 (5x3x2), 42 (7x3x2), 70 (7x5x2), 84 (7x4x3), 102 (17x3x2), 105 (17x3x2), 110 (11x5x2), 114 (19x3x2), 130 (13x5x2), ...}	R=4
{210 (7x5x3x2), 275 (11x5x3x2), 482 (11x7x3x2), 770 (11x7x5x2), 1155 (11x7x5x3), …}	R=5

We can note that the Primes of any Integral (Positive Integer ≥ 2) Order Space (say R) can be arranged in an increasing order and their position in this order denotes their Higher Order Space Prime Metric Basis Position Number.

We can generate the Sequence Of Any Integral(Positive Integer ≥ 2) Higher Order Primes in the following fashion:

The First Prime of any Rth Order Space Sequence Of Primes can be computed by simply considering consecutively the First (R-1) Number of Primes of 2nd Order Space Sequence Of Primes, starting from the First Prime of 2nd Order Space Sequence Of Primes, i.e., 2 and Forming a Product Term of the Form $^{R}p_1 = \overbrace{\left\{{}^{2}2_1 \times {}^{2}3_2 \times {}^{2}5_3 \times {}^{2}7_4 \times \ldots\ldots\ldots\ldots \left\{{}^{2}p_{(R-3)}\right\} \times \left\{{}^{2}p_{(R-2)}\right\} \times \left\{{}^{2}p_{(R-1)}\right\}\right\}}^{(R-1)\ Number\ Of\ Product\ For\ ming\ Factors}$ which becomes the First Prime of any Rth Order (Positive Integer ≥ 2) Space Sequence Of Primes as it cannot be factored in terms of R Number of Unique Factors. We Label this Number as $^{R}p_1$

One Step Evolution [4], [5]of any element of Second Order Space Sequence Of Primes is the next consecutive Second Order Space Prime element of the given element of Second Order Space Sequence Of Primes. For Example, One Step Evolution of 2 is 3 and of 31 is 37.

The Second Prime of any Rth Order (Positive Integer ≥ 2) Space Sequence Of Primes can be computed in the following fashion.

Firstly, we consider consecutively the First (R-1) Number of Primes of 2nd Order Space Sequence Of Primes, starting from the First Prime of 2nd Order Space Sequence Of Primes, i.e., 2 and forming a Product Term of the form

$^{R}p_1 = \overbrace{\left\{{}^{2}2_1 \times {}^{2}3_2 \times {}^{2}5_3 \times {}^{2}7_4 \times \ldots\ldots\ldots\ldots \left\{{}^{2}p_{(R-3)}\right\} \times \left\{{}^{2}p_{(R-2)}\right\} \times \left\{{}^{2}p_{(R-1)}\right\}\right\}}^{(R-1)\ Number\ Of\ Product\ Forming\ Factors}$ which becomes the First Prime of any Rth Order (Positive Integer ≥ 2) Space Sequence Of Primes as it cannot be factored in terms of R Number of Unique Factors. We now cause One Step Evolution of that one particular factor among the (R-1) factors such that the Product climb of the value $^{R}p_2$ over $^{R}p_1$ is minimum as compared to that gotten by performing the same using any other factor among the (R-1) factors.

{One Step Devolution [4], [5] of any element of Second Order Space Sequence Of Primes is the just previous Second Order Space Prime element of the given element of Second Order Space Sequence Of Primes. For Example, One Step Devolution of 3 is 2 and of 37 is 31}.

We find $^{R}p_3$ using $^{R}p_2$ as detailed in the above paragraph, and similarly, we can find any element of the R^{th} Order Sequence Of Primes.

For Example, 210 is the 1st (Higher Order Space Prime Metric Basis Position Number) element of R=5th Order Space Sequence Of Primes.
Similarly, 102 is the 5th (Higher Order Space Prime Metric Basis Position Number) element of R=4th Order Space Sequence Of Primes.
Therefore, any of these Higher Order Space Primes can be represented as follows:

$$^{Higher\ Order\ Space\ Number}(Number)_{\text{Higher Order Space Prime Metric Basis Position Number}}$$

That is,
210 can be written as $^{5}210_{1}$ and 102 can be written as $^{4}210_{5}$.

Each of the rest of the Positive Integers can be classified to belong to it's Unique Parent Sequence Of Higher Non Integral Order Space Primes, at a particular Prime Metric Basis Position Number.

That is, for any Positive Integer, we can use the Method of One Step Evolution successively (as detailed in [4], [5]) and can find all the elements greater than it upto a certain limit. Similarly, we can use the Method Of One Step Devolution successively (as detailed in [4], [5]) and can find all the elements lower than it but greater than zero. These set of numbers when arranged in an order form a Sequence, namely the Sequence Of Higher (Positive Non Integer Order) Primes, of some particular Positive Non Integer Order.

For Example, One Step Evolution of 40,500 is 56,700, see [4], [5], i.e., if 40,500 is $^{R}40500_{d}$, then 56,700 is $^{R}56700_{(d+1)}$

Askew Primes And Sequences Of Askew Primes

One can note that any Natural Number ‘ s ’ can be written as

$s=(p_1)^{a_1}\cdot(p_2)^{a_2}\cdot(p_3)^{a_3}\cdots\cdots\cdots\cdots(p_{z-1})^{a_{z-1}}\cdot(p_z)^{a_z}$ where $p_1, p_2, p_3,\ldots\ldots\ldots\ldots, p_{z-1}, p_z$ are some Primes and $a_1, a_2, a_3,\ldots\ldots\ldots\ldots, a_{z-1}, a_z$ are some positive integers. Such numbers are called Askew Primes.

Order – The Order of such Askew Primes is given by the sum $a_1, a_2, a_3,\ldots\ldots\ldots\ldots,$ $a_1+a_2+....+a_{z-1}+a_z$.

Dimension – The Dimension of the Askew Prime is denoted by a Vector that represents the exponent of each element of Prime Sequence taking part as an element in the product represented by the Askew prime of concern, especially at the same location of the Prime Sequence Basis Position Number of the element of Prime Sequence taking part as a term in the product represented by the Askew prime of concern.

Once, all such Askew Primes are slated, Order wise and Dimension wise, we arrange them in Increasing Order, and each Askew Primes Sequence is a list of such numbers arranged in increasing order and each sequence has the same Order.

One Step Evolution Of Any Element Of Sequence Of Prime

Any Element of Sequence Of Prime can be represented by

$s=p_j$

where j denotes the Prime Basis Position Number of the Prime Number s, that is j tells us that s is the j^{th} Prime Number.

Then, the One Step Evolution of s is given by

$E^1(s)=p_{(j+1)}$

One Step Devolution Of Any Element Of Sequence Of Prime

Any Element of Sequence Of Prime can be represented by

$s=p_j$

where j denotes the Prime Basis Position Number of the Prime Number s, that is j tells us that s is the j^{th} Prime Number.

Then, the One Step Devolution of s is given by

$D^1(s)=p_{(j-1)}$

One Step Evolution Of Any Element Of Higher Order Sequence Of Prime

Any Element of Higher Order Sequence Of Prime can be represented by

$$s=\prod_{x_j}\left(p_{x_j}\right)$$

Then, the One Step Evolution of s is given by

$$E^1(s)=\underbrace{Minimum}_{for\ \ all\ \ j,\ i}\left\{E^1\left(p_{x_i}\right)\left\{\prod_{for\ al\ x_j\ \&\ x_j\neq x_i}\left(p_{x_j}\right)\right\}\right\}$$

One Step Devolution Of Any Element Of Higher Order Sequence Of Prime

Any Element of Higher Order Sequence Of Prime can be represented by

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One Step Evolution Of Any Element Of Higher Order Sequence Of Askew Prime

Any Element Of Higher Order Sequence Of Prime can be represented by

$$s=\prod_{x_j}\left(p_{x_j}\right)^{a_{x_j}}$$

Then, the One Step Evolution of s is given by

$$E^1(s)=\underbrace{Minimum}_{for\ \ all\ \ j,\ i}\left\{\left\{\left(E^1\left(p_{x_i}\right)\right)^{a_{x_j}}\right\}\left\{\prod_{for\ al\ x_j\ \&\ x_j\neq x_i}\left(p_{x_j}\right)\right\}\right\}$$

One Step Devolution Of Any Element Of Higher Order Sequence Of Askew Prime

Any Element Of Higher Order Sequence Of Prime can be represented by

$$s=\prod_{x_j}\left(p_{x_j}\right)^{a_{x_j}}$$

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One Step Evolution Of Any Real Number

Any real number can be written in the form (*p/q*) wherein *p* and *q* are Askew Primes or *p* is Prime and *q* = 1. We then find the One Step Evolution values of *p* and *q* and then compute the value $E^1(p/q)=E^1(p)/E^1(q)$ wherein $E^1(p)$ is One Step Evolution Of *p*.

One Step Devolution Of Any Real Number

Any real number can be written in the form (*p/q*) wherein *p* and *q* are Askew Primes or *p* is Prime and *q* = 1. We then find the One Step Devolution values of *p* and *q* and then compute the value $D^1(p/q)=D^1(p)/D^1(q)$ wherein $D^1(p)$ is One Step Devolution Of *p*.

Example Application - Special Curves Connecting Any Two Positive Real Numbers

The Special Curves are curves that connect any two real positive numbers based on the continuous segments of Sequence of Primes, any Sequence of Higher Order Primes [1], any Sequence of Askew Primes [2].

The first of the (lower value) point is represented by a fraction of the form $\frac{a_l}{b_l}$ and each of the numerator and denominator are chosen to be those among most nearest to any of: an element of Prime Sequence or any element of Sequence of Higher Order Primes or any element of Sequence of Askew Primes. Similarly, the second (higher value point) is also represented by a fraction of the form and $\frac{a_h}{b_h}$ and again, each of the numerator and denominator are chosen to be those among most nearest to any of: an element of Prime Sequence or any element of Sequence of Higher Order Primes or any element of Sequence of Askew Primes. We then compute the Lowest Common Multiple of b_l and b_h and write the a_l and a_h as $\frac{a_l}{b_l}LCM(b_l,b_h)$ and $\frac{a_h}{b_h}LCM(b_l,b_h)$. This makes both the points numerators some elements of ‘Sequences of Askew Primes, them being $\frac{a_l}{b_l}LCM(b_l,b_h)$ and $\frac{a_h}{b_h}LCM(b_l,b_h)$.

We now call

$r_l=\frac{a_l}{b_l}LCM(b_l,b_h)$ and

$$r_h=\frac{a_h}{b_h}LCM(b_l,b_h)$$

We now compute the difference

$c_{h1}=r_h-$ {Nearest element of the Askew Prime Sequence of the same Dimension type and Order as r_l and belonging to the Askew Sequence Type (w.r.t Dimension and Order)}. We then again follow the same aforesaid procedure to close c_{h1} and r_h. We keep repeating this schema again and again till we close in our Curve approximation to r_h, to a desired accuracy.

We finally superpose (all the sub component sub sequences, the superposition is to be performed between $(c_{h1}, r_h), (c_{h2}, r_h), (c_{h3}, r_h), \ldots., (c_h k, r_h)$, where at k^{th} iteration, $c_{hk} - r_l \approx 0$ } and divide by the $LCM(b_l, b_h)$ to give us the exact connecting Sequence, which happens to be the natural curve connecting $\frac{a_l}{b_l}$ and $\frac{a_h}{b_h}$.

Net Slope or Cadence Change Optimization Along The Special Curve

One can note that the thusly connecting curve only shows variation between c_{h1} and r_h. All the natural change occurring within this domain seems quite unnatural. Therefore, if we keep shifting the Prime Basis Position Number corresponding to the Nearest element of the Askew Prime Sequence of the same Dimension type and Order as r_l and belonging to the Askew Sequence Type (w.r.t Dimension and Order), i.e., c_{h1} by one position to the left and perform similar analysis again for each such shift case, and also so, for each of the intermitted superpositions considered on the domain c_{h1} and r_h, care should be taken to perform such said SIMILAR analysis again and again to exhaustion on the right side c_{h1} and r_h also, for each iteration, and thusly, iterations are continued to exhaustion. We then compute the Net Slope of Cadence changes involved in each primary shift case. One should note that there would be many primary of primary shift case, primary of primary of primary shift case,... , and so on so forth to exhaustion, i.e., $\left(\underbrace{\text{primary of primary of....of primary}}_{\text{s times}}\right)$ shift case, in each of the case of the right side c_{h1} and r_h.

We consider the superposed sequence corresponding to that particular case which gives a minimum sum of the Net Slope or Cadence changes involved.

Generic Representation

The aforesaid process is best illustrated in the following lines:

Let us say if the points rl and rh are almost connected by some intermittent points (at the first iteration) given by their Prime Basis Position Numbers consecutively after rl's Prime Basis Position Number, then we represent the sequence as

$$r_{\{l\}\{k=Shift\ Location\ Number\}\{(PBPN(r_l)+t)\}\{z=Iteration\ Order\ Level\ within\ c_{(k)(t+q-1)(zr_h Latest)}\}}, \ldots.,$$

$$a_{\{k=Shift\ Location\ Number\}\{(PBPN(r_l)+t)\}\{z=Iteration\ Order\ Level\ within\ c_{(k)(t+q-1)(zr_h Latest)}\}} \ldots.,$$

$$a_{\{k=Shift\ Location\ Number\}\left\{PBPN(r_l)+\left(\begin{array}{l} t: \text{Prime } corresponding\ to \{PBPN(r_l)+t+q\} > r_h\ and \\ \text{Prime } corresponding\ to \{PBPN(r_l)+t+q-1\} < r_h \end{array}\right)\right\}\{z=Iteration\ Order\ Level\ within\ c_{(k)(t+q-1)(zr_h Latest)}\}},$$

$$r_{\{h\}\{k=Shift\ Location\ Number\}\left\{PBPN(r_l)+\left(\begin{array}{l} t: \text{Prime } corresponding\ to \{PBPN(r_l)+t+q\} > r_h\ and \\ \text{Prime } corresponding\ to \{PBPN(r_l)+t+q-1\} < r_h \end{array}\right)\right\}\{z=Iteration\ Order\ Level\ within\ c_{(k)(t+q-1)(zr_h Latest)}\}}$$

giving

$$c_{(k)(t+q-1)(zr_h Latest)} =$$

$$\left\{ r_{\{h\}\{k=Shift\ Location\ Number\}\left\{PBPN(r_l)+\left(\begin{matrix} t: \text{Prime corresponding to}\{PBPN(r_l)+t+q\}>r_h\ and \\ \text{Prime corresponding to}\{PBPN(r_l)+t+q-1\}<r_h \end{matrix}\right)\right\}\{z=Iteration\ Order\ Level\ within\, c_{(k)(t+q-1)(zr_h Latest)}\}} \right\} -$$

{Nearest element of the Askew Prime Sequence of the same Dimension type and Order as $r_{\{l\}\{k=Shift\ Location\ Number\}\{(PBPN(r_l)+t)\}\{z=Iteration\ Order\ Level\ within\, c_{(k)(t+q-1)(zr_h Latest)}\}}$ and belonging to the Askew Sequence Type (w.r.t Dimension and Order)}.

We then again follow the same aforesaid procedure to close $c_{(k)(t+q-1)(zr_h Latest)}$ and

$$r_{\{h\}\{k=Shift\ Location\ Number\}\left\{PBPN(r_l)+\left(\begin{matrix} t: \text{Prime corresponding to}\{PBPN(r_l)+t+q\}>r_h\ and \\ \text{Prime corresponding to}\{PBPN(r_l)+t+q-1\}<r_h \end{matrix}\right)\right\}\{z=Iteration\ Order\ Level\ within\, c_{(k(t+q-1)zr_h)}\}}.$$

We keep repeating this above state procedure till $c_{(k)(t+q-1)(zr_h Latest)} \approx 0$

Also, we should note that this analysis has to be performed for all the possible Shifts and also for all possible shifts within each *(t+q-1)* and its right end goal point, and again exhaustively, (within each *(t+q-1)* and its right end goal point of (within each *(t+q-1)* and its right end goal point of(…required number of iterations to exhaustiveness…(within each *(t+q-1)* and its right end goal point)…required number of iterations to exhaustiveness…)

We then find all the possible paths as follows:

There would be

$$Number\ of\ \ Paths = G = \left\{ \begin{matrix} \prod \ldots\ldots\ldots\ldots\ldots \text{required number of iterations to exhaustiveness} \ldots\ldots\ldots\ldots\ldots\ldots \\ \ldots\left\{ \prod_{k,t+q-1,z} \{(k)(t+q-1)(z)\} \left\{ \prod_{k,t+q-1,z} \{(k)(t+q-1)(z)\} \right\} \right\} \ldots \\ \ldots\ldots\ldots\ldots\ldots \text{required number of iterations to exhaustiveness} \ldots\ldots\ldots\ldots\ldots \end{matrix} \right\}$$

number of paths and for each path, we find the sum

$NSC(g) = \sum_{i_g} \left(s_{(i_g+1)} - s_{i_g}\right)$ where g denotes the path number and i_g denotes the path progression index number of the path g.

We then consider the path $Optimal\,Path(g): \underbrace{Min\left\{ \sum_{i_g} \left(s_{(i_g+1)} - s_{i_g}\right) \right\}}_{for\ all\ g}$

which defines the Best Optimal Special Natural curve connecting rl and rh. We then finally, scale it with appropriate respective LCM to get the desired Special curve of concern. Also, we need to do this after every iteration of finding every path curve.

For each path, one should also note that the indices

($t+q-1$) is an intermediary positive integer that varies between 1 and the number of possible Prime Basis Position Numbers of Order that caa fit between

$$r_{\{l\}\{k=Shift\ Location\ Number\}\{(PBPN(r_l)+t)\}\{z=Iteration\ Order\ Level\ within\ c_{(k)(t+q-1)(zr_h Latest)}\}}$$

and

$$r_{\{h\}\{k=Shift\ Location\ Number\}\left\{PBPN(r_l)+\begin{pmatrix} t: \text{Prime corresponding to}\{PBPN(r_l)+t+q\}>r_h\ and \\ \text{Prime corresponding to}\{PBPN(r_l)+t+q-1\}<r_h \end{pmatrix}\right\}\{z=Iteration\ Order\ Level\ within\ c_{(k(t+q-1)zr_h)}\}}$$

k varies from 1, 2, 3 onwards to ($t+q-1$)

z varies from 1, 2,v3,… to exhaustion

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