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A New Visual Proof Exploring the Collatz Conjecture Through Vertices Pattern Method

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Abstract : In this paper a Geometry proof for Collatz Conjecture is given. In this Geometrical proof that Collatz Conjecture is a problem of polygon. In polygon there are 2 types of structure of polygons. One is even polygons (even number of sides or vertex and another one is odd polygon structure (odd number of sides or vertex.) In this polygon the Collatz Conjecture is only works in trigons. Other than trigon all polygon fail to converge pentagon and its cycles breaks down.

Keywords – Collatz, Conjecture, Vertices.

I. INTRODUCTION

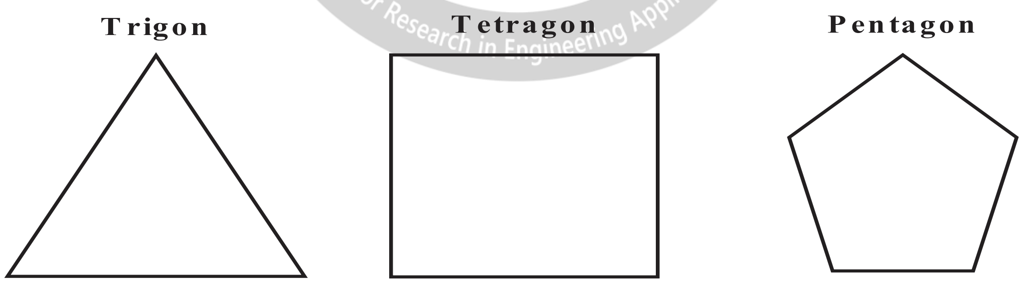
CollatzConjecture is concerns particular sequence it also known as the 3n+1 problem, JeffereyLoganiasin 2010 clamied that based only on know information about this problem, this is an extra ordinary difficult problem. Completely out of reach of present day mathematics as of 2020. The conjecture has been checked by computer for all starting value up to 2 to the power of 68. All the initial value tested so far eventually end in the repeating cycle (4, 2, 1) which has only three terms from this lower bound can also be obtained for the number of terms a repeating cycle other than (4,2,1) must have but this a computer evidence. And is not a proof over all this thesis aims to proof that the collatz sequence eventually reaches 1 for all positive integer.

The Collatz Conjecture is a conjecture in mathematics that concerns a sequence defined as follows: start with any positive integer N and each term is obtained from the previous term. If the previous terms is odd the next term is 3 times the previous term plus 1. The conjecture is that no matters what value N the sequence will always reach 1

For instance starting with N=12, one get the sequence 12, 6, 3, 10,5,16,8,4,2,1

N=19 for example takes longer to reach
1:19,58,29,88,44,22,11,34,17,52,26,13,40,20,10,5,16,8,4,2,1

II. GEOMETRY PATTERNS OF COLLATZ CONJECTURE



Collatz Conjecture is the cycle between trigon, pentagon and tetragon $\frac{3n+1}{2}$ here 3n indicates trigon, 3n+1 indicates tetragon in repeating cycles. Which finally end up with a perfect square (4, 2, 1) (Tetragon) 2^n where n is even number. In this polygon method trigon, pentagon and tetragon are involving the Collatz cycles and at last it converge into tetragon perfect square. In this converging path the only requirement is trigons are must to need to 4, 2, 1 cycle. Without trigon this cycle could not end up with 4, 2, 1 it repeat itself or it increasing large number of polygons which is nearest to circle 3(3,5,7,9,11,13,15…..) Here 3 means trigon, 5 means Pentagon, 7 means Heptagon…….as on.

Explaining Collatz Conjecture in polygon method when N = 3

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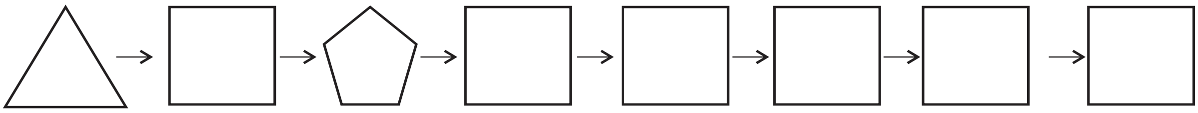
$$\frac{3n+1}{2} \rightarrow \frac{3(3)+1}{2} \rightarrow \frac{9+1}{2} \rightarrow \frac{10}{2} \rightarrow 5 \rightarrow \frac{3(5)+1}{2} \rightarrow \frac{15+1}{2} \rightarrow 8,4,2,1$$



3 10 5 16 8 4 2 1

What happen when we take pentagon or heptagon….N (Odd polygons)

Lets see

$$\frac{5(3)+1}{2} \rightarrow \frac{16}{2} \rightarrow 4,2,1 \quad \text{but} \quad \frac{5(5)+1}{2} \not\rightarrow 4,2,1$$

It Create repeating cycle itself and never converge into 4,2,1 there is only one possibility that trigon x polygon + 1= Tetragon other than all polygons > Trigon Never reach sequence 4,2,1 it's cycle breakdown only trigon x polygon is chance of become converge in tetragon (perfect square) because trigon < tetragon 2^n where n is a even numbers 2,4,6,8,10,12….

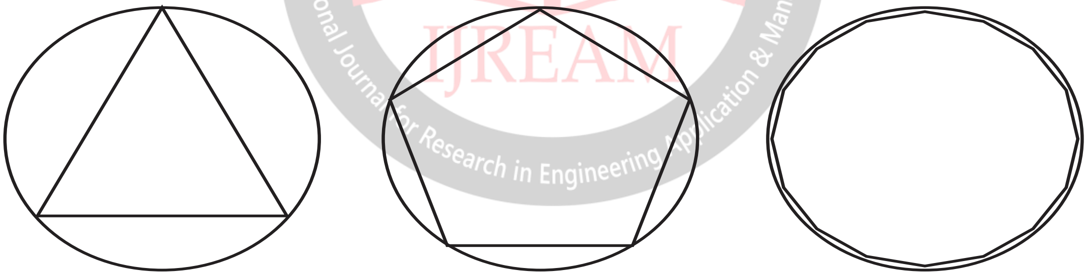
Then s $\frac{2^n - 1}{3}$ = polygon x trigon + 1 = 2^n (A perfect tetragon or perfect square)

For Example : $\frac{2^{10} - 1}{3} \rightarrow 341x3+1 = 1024 = 2^{10}$

Trigon is smaller than tetragon (i,e, in side or vertexvise) so whatever big number taken by trigon sides or vertex are lesser than tetragon, in this process trigon multiplied by polygon its sides or vertex are still smaller than tetragon sides or vertex until it reach pentagon.

In this case polygon are naturally more sides or vertex than tetragon when polygon x polygons $+ 1 = \frac{n}{2}$ is not equal to pentagon. So their number of sides, never reduces into pentagon for all n numbers except than 3. This mystery hidden in Collatz Conjecture make it more and more conflict.

Trigon in circle **Pentagon in circle** **Hexadecagon (Polygon) in circle**



$\frac{3n+1}{2}$ means (3 times sides or vertex) trigon in circle, $\frac{n}{2}$ means Natural even sides or vertex polygon or making trigons to adding 1 as even sides or vertex or tetragon. When polygons sides or vertex are even than simple divide by 2 and make it tertragon, if it is perfect tetragon than it reach 4,2,1 otherwise it generate odd numbers which is multiplied by trigon to make polygon and again add 1 to make this even polygons and divide it by 2 to make trigon. This process we called Collatz Conjecture in this process when we get pentagon then very next step will be a perfect square of tetragon. If we take more than pentagon sides or vertex if never converge with perfect tertragon (i,e divarge sequence for all N) Beacause pentagon sides or vertex are bigger than tetragon there is atleast one trigon needs to polygon to make tetragon (3) or trigon are natural co-efficient for all polygons to make perfect square i.e tetragon.

Collatz Conjecture expressed in the geometry way : if N = 3

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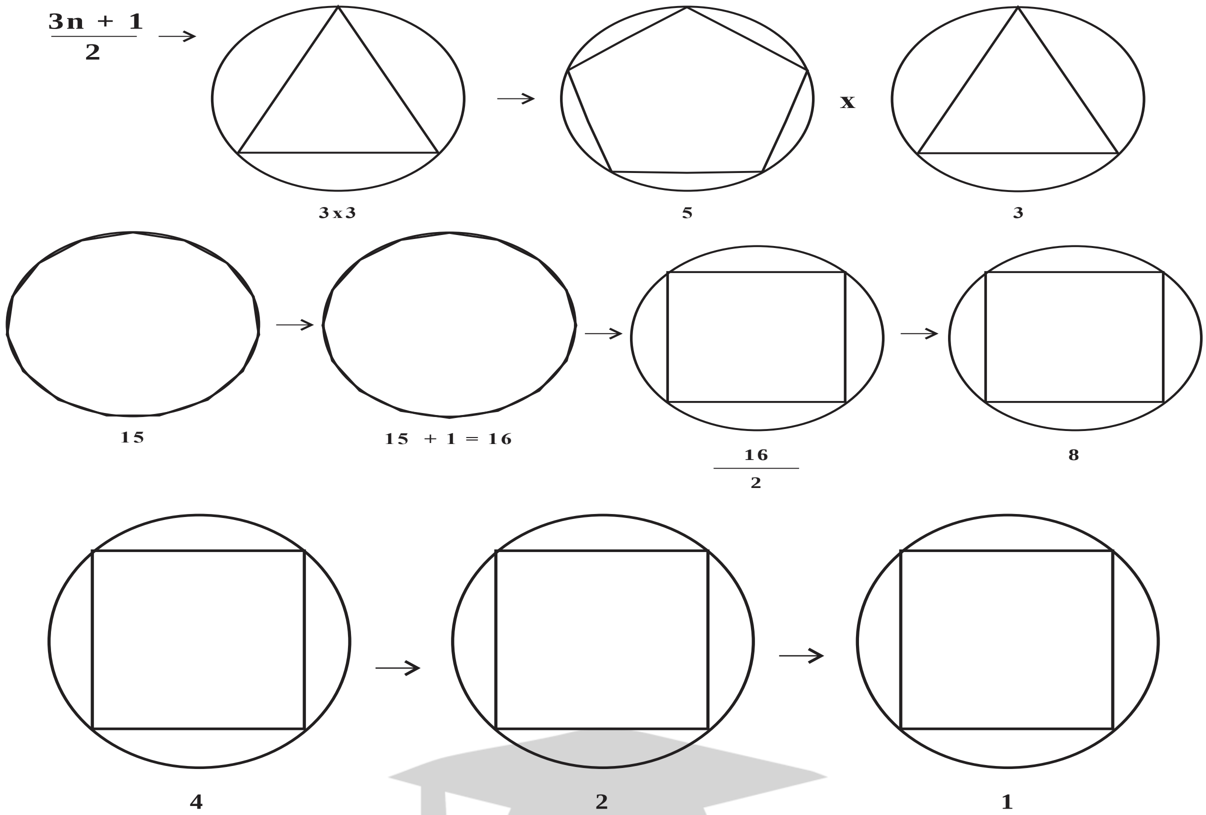

Perfect tetragon when trigon multiplied by polygon and when it converged into pentagon then its journey end up with 4,2,1.

So Collatz Conjecture only works for 3n and it doesn't work for greater than 3 < any N numbers (no of polygon greater than trigon) Collatz Conjecture is only converge to 4,2,1 when it is 3n and divarge when it is 3 < N i. e 5(n), 6(n), 7(n)………

Circle has a infinity vertex, if we choose any 3 vertices it make a Equilateral, triangle insribed a circle. When we multiplying this 3 vertices into any number it make a different pattern or shape, in a circle.

Any 3 vertex of Equilateral, triangle inscribed a circle multiplied by N number. If N is even then 3 x N and It divide by 2, if divident is than again divided by 2. Otherwise N is odd number then 3x N + 1 and divide it by 2, this process increasing and decreasing vertexes may lead a perfect square. There are some rules.

Theory No. - 1 : any one vertex must be N > 3 > 2. If we call this vertex as A and second Vertex is B Then it produce C Vertex (Shapes) which we already explained as A as Trigon, B as Polygon and C as Tretragon or square or pentagon.

$$\frac{3n+1}{2} \longrightarrow \frac{A(B)+1}{2}$$

For Example : N = 6 $\frac{6}{2} \longrightarrow 3x3+1 \longrightarrow \frac{10}{2} \longrightarrow 5$

This vertices rule modified in Collatz Conjucture which I already proved previous paper. That examning even number is better than odd number.

$\frac{3n+1}{2}$ Here A is 3, and B is N and +1 is even vertices in circle and 2 is makes of tetragon or pentagon in circle, no matter what is the value of B but A must be a N > 3 > 2 is required for square this vertices.

Theory No. 2:

Two different process of transaction are always similar each other.

for example : N = 3

$$\frac{3(3)+1}{2} \longrightarrow \frac{10}{2} \longrightarrow 5 \longrightarrow \frac{5x5+1}{2} \longrightarrow \frac{16}{2} \longrightarrow \frac{8}{2} \longrightarrow \frac{4}{2} \longrightarrow \frac{2}{2} \longrightarrow 1$$

This is one transaction,

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and second transaction → N = 7

$$\frac{3(7)+1}{2} \to \frac{22}{2} \to \frac{11x3+1}{2} \to \frac{17x3+1}{2} \to \frac{52}{2} \to \frac{26}{2} \to \frac{13x3+1}{2} \to$$

$$\frac{40}{2} \to \frac{20}{2} \to \frac{10}{2} \to 5$$

This two different operation or transaction are similar in Collatz Conjecture Because its pattern are same at pentagon and tetragon.

A x B = C

Theory No. 3: A Single operation vertices method same pattern never meet each other, in other hand every time different pattern will be created when A is equal 3.

Theory No. 4: The operation create different pattern of polygon in the path of converging pentagon and tetragon. This pattern are also similar pattern of Collatz Conjucture.

For Example :

N = 27 → 41 → 31 → 47 → 71 → 107 → 161 → 121 → 91 → 137 → 103 → 155 → 233 → 175 → 263 → 395 → 593 → 445 → 167 → 251 → 377 → 283 → 425 → 319 → 479 → 719 → 1079 → 1619 → 2429 → 911 → 1367 → 2051 → 3077 → 577 → 433 → 325 → 61 → 23 → 35 → 53 → 5.

In this cycle there are 41 pattern in this circle, every pattern is a different. But every pattern are proportional with each other in circle. We call this similar or symmetry of Collatz Conjecture. Thus we calculate total pattern of each number in the similar pattern cycle.

For example : 27 has 41 pattern, 41 has 40 pattern, 31 as 39 pattern… etc.

Thereory No. 5 : Every pattern are different in same cycle. Because $\frac{3n+1}{2} \neq \frac{x}{2}$ where x is a even number pattern which is not equal in single cycle for N. If it is equal the pattern will be copy of the previous pattern. So, cycle will breakdown.

For example : A = 5, and B (N) = 5 then

$$\frac{5(5)+1}{2} \to \frac{52}{2} \to \frac{26}{2} \to \frac{5x13+1}{2} \to \frac{66}{2} \to \frac{33x5+1}{2} \to \frac{166}{2} \to$$

$$\frac{83x5+1}{2} \to \frac{416}{2} \to \frac{208}{2} \to \frac{104}{2} \to \frac{52}{2} \to ?$$

as per the Theory no. - 1, A = N > 3 > 2. Trigons never create same pattern other in circle.

Theory NO. 6 : If 3 (3,5,7,9,11…. n) are in similar patterns thus 3(3 x 5), 3 (3 x 5 x 7 x 9 …), 3 (3x5x7x9x11… N are also a similar pattern each in other cycle.

Example :

$$\frac{3(3x5)+1}{2} \to \frac{3(15)+1}{2} \to \frac{46}{2} \to \frac{23x3+1}{2} \to \frac{70}{2} \to \frac{35x3+1}{2} \to$$

$$\frac{106}{2} \to \frac{53x3+1}{2} \to$$

We know that 35 and 53 are pairs of Collatz Conjucture and this pattern leads to 4,2,1.

Now 3 (3x5x7) $\frac{3(105)+1}{2} \to 53$ Collatz Pairs, which lead 4,2,1

Theory No. 7 : 137 is a prime number. We don't know that the Number gives 4,2,1 cycle or not!

Examine 137 as a pattern of vertices in cycle. There are two methods.

Method 1 → when operating with 137 in Collatz Cycle if we get any one pattern which is a pattern of previous transaction pattern. Than 137 is also a pattern for 4,2,1.

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For Example: $\frac{137x3+1}{2} \rightarrow \frac{412}{2} \rightarrow \frac{206}{2}$ → 103 → 155 → 233 → 175 → 263 → 395 → 593 → 445 → 167 → 251 → 377 → 283 → 425 → 319 → 479 → … here 103 is the first smallest pattern of circle. Which we know that leads into tetragon or pentagon pattern. So, 137 is the unconditional pattern of tetragon or pentagon. In this method we check any large infinite prime numbers pattern.

Method 2 : Make 137 as a factors of 3, and then check into products in pattern method.

For example: 137x5x3 = 2055. which factors are 15,3,5,137. if any one factors are converging pattern in circle, the 2055 and 137 both are converging pattern in circle. Or we can check 2055 or in first method.

Theory no 8: if largest 9 odd number are converging as 4,2,1 pattern then rest all 90 numbers are all part of the patterns.

For example : 1 to 99. if last ten digit like 91,93,95,97,99 are converging into pattern 4,2,1, then it create a similar pattern for rest 1 to 90 numbers for example : N = 99.

$\frac{3(99)+1}{2}$ → 297 → 298 → 149 → 447 → 448 → 224 → 112 → 56 → 28 → 14 → 7 → 21 → 22 → 11 → 33 → 34 → 17 → 51 → 52 → 26 → 13 → 39 → 4 → 20 → 10 → 5 → 15 → 16 → 8 → 4 → 2 → 1.

This number are copy of the 99 numbers pattern. So we don't need to check this numbers pattern. Because it's a axioms that these pattern are converge into 4,2,1.

So, like this when we checking last 10 or 20 odd of any particular group of number, its shows the pattern of previous and future patterns which I explain in my last paper, future, past, present numbers (IJREMV0610565052)

This past → present → future patterns are related, similar and copy of the each other.

in a circle there are infinity vertices. This infinity vertices are create natural infinity unique patterns. Which are largest number of collatz conjucture without computer evidence, lets see.

unique pattern No. 1

$$\frac{2^n - 1}{3} \quad (n = 2,4,6,8,10...)$$

For Example $\frac{2^2 - 1}{3}, \frac{2^4 - 1}{3}, \frac{2^6 - 1}{3} \ldots\ldots \frac{2^{68} - 1}{3}, \frac{2^{70} - 1}{3}, \ldots \frac{2^{100} - 1}{3}, \ldots\ldots \frac{2^n - 1}{3}$

Unique patterns No. 2

$2 \rightarrow 5(2^n)$ (n = 0,1,2,3,4… n)

Common patterns

1) $2\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

2) $3\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

3) $5\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

4) $7\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

5) $9\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

6) $11\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

7) $13\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

8) $15\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

9) $17\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

10) $19\ (2^n)$ n = 0,1,2,3,4,5,6,7……. ∞

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N (2^n) n = 0,1,2,3,4,5,6,7……. ∞

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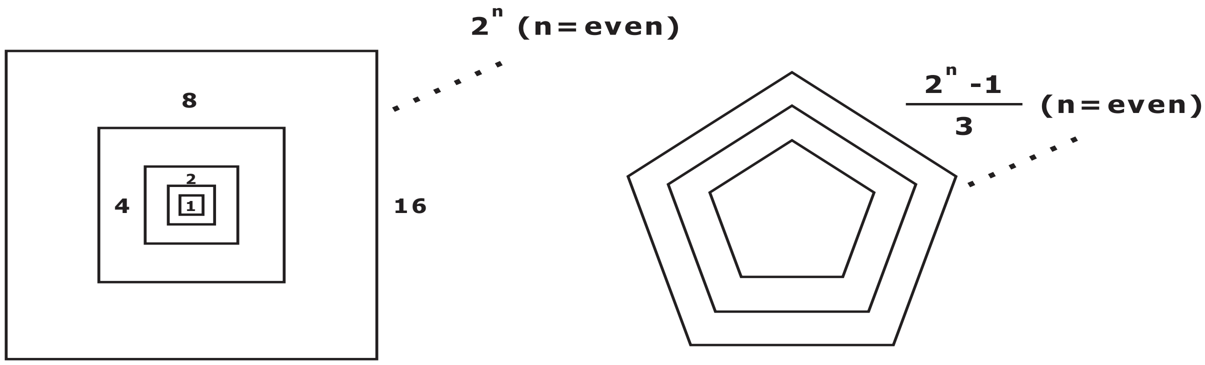
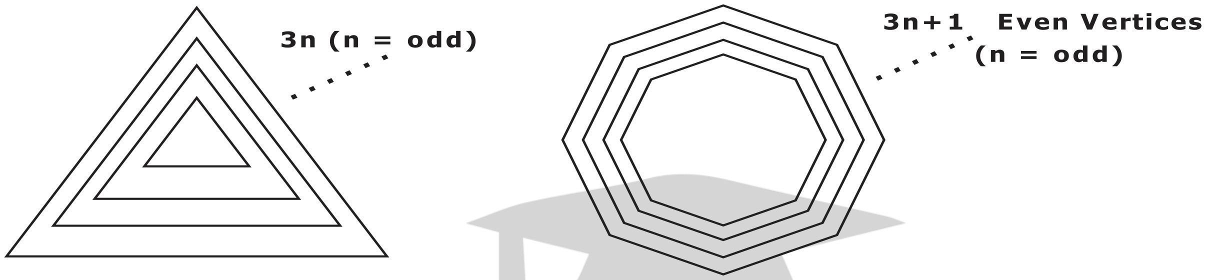
The help and evidence of this pattern we can find any largest number, even, odd or prime may leads this any one of the pattern. Then unconditional that large number follow tetragon pattern particularly.

For Example:



Tetragon Pentagon



Trigon Polygon

$$\frac{3(3x5x7x9x11x13x15x17....n)+1}{2} \longrightarrow \frac{2^n-1}{3} \quad (n = \text{Even})$$

Every number has a different kind of pattern in circle, let 5 is one of the pattern, then its other pattern are

Ex. :	$5 + 1 \rightarrow 6$	$5 \times 2 \rightarrow 10$
	$5 - 1 \rightarrow 4$	$5 \times 3 \rightarrow 15$
Ex. :	$7 + 1 \rightarrow 8$	$7 \times 2 \rightarrow 14$
	$7 - 1 \rightarrow 6$	$7 \times 3 \rightarrow 21$

III. SIMPLE PATTERN OF CIRCLE

The strong evidence of pattern which are proportional pattern each other in circle.

	1	3	5	7	9	11	13	15	17	19	21	…
+1→	1	1	1	1	1	1	1	1	1	1	1	…
	2	4	6	8	10	12	14	16	18	20	22	…
÷2→	/2	/2	/2	/2	/2	/2	/2	/2	/2	/2	/2	…
	1	2	3	4	5	6	7	8	9	10	11	…
+1→	1		1		1		1		1		1	…
	2	2	4	4	6	6	8	8	10	10	12	…
÷2→ /2	/2	/2	/2	/2	/2	/2	/2	/2	/2	/2	…	
	1	1	2	2	3	3	4	4	5	5	6	…
+1→	1	1			1	1			1	1		…
	2	2	2	2	4	4	4	4	6	6	6	…
÷2→ /2	/2	/2	/2	/2	/2	/2	/2	/2	/2	/2	…	

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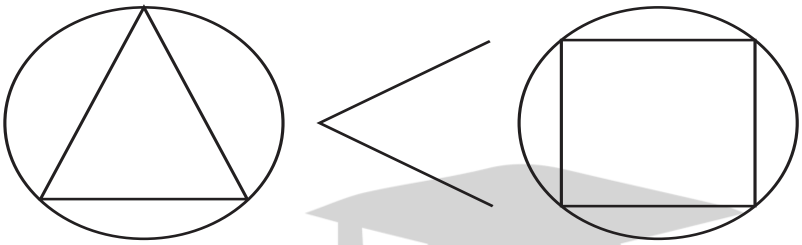
	1	1	1	1	2	2	2	2	3	3	3	…
+1→ 1	1	1	1					1	1	1	…	
	2	2	2	2	2	2	2	2	4	4	4	…
÷2→ /2	/2	/2	/2	/2	/2	/2	/2	/2	/2	/2	…	
	1	1	1	1	1	1	1	1	2	2	2	…

Continuously this process leads even number converge into 4,2,1, which is alternative form of $\frac{3n + 1}{2}$

A Simple pattern of circle is alternative form of $\frac{3n + 1}{2}$, So we can understand Collatz Conjucture through simple pattern of Circle method. Now we can answer why No. 3 is chosen in Collatz Conjecture equation. There is another reason why number 3 works in pattern method because a circle circumference 3 times the diameter. (Approximate for whole number) of circle. And a equilateral triangle is the only triangle inscribe the circle which is 3 vertices are equal in length.



$$\frac{A(B)+1}{2}$$

3 vertices 4 vertices

A is always smaller than 4, if A value equal or more than 4, then the pattern of circle are because repeating cycle itself of growing pattern itself.

For Example : A = 5, N = 1,3,5,

$$\frac{5(1)+1}{2} \rightarrow \frac{6}{2} \rightarrow 3 \rightarrow \frac{15+1}{2} \rightarrow \frac{16}{2} \rightarrow 4,2,1$$

$$\frac{5(3)+1}{2} \rightarrow \frac{16}{2} \rightarrow 4,2,1$$

$$\frac{5(5)+1}{2} \rightarrow \frac{26}{2} \rightarrow 13 \rightarrow \frac{66}{2} \rightarrow 33 \quad \frac{166}{2} \rightarrow 83 \rightarrow \frac{416}{2} \rightarrow$$

$$\frac{208}{2} \rightarrow \frac{104}{2} \rightarrow \frac{52}{2} \rightarrow \frac{26}{2} \rightarrow 13 \quad \textbf{Fail to converge}$$

Example 2 : A = 7, N = 1,3,5,7,9

$$\frac{7(1)+1}{2} \rightarrow \frac{8}{2} \rightarrow 4,2,1$$

$\frac{7(3)+1}{2} \rightarrow \frac{22}{2}$ →11→ 39→ 137 →15 →53 →93 →163 → 571 → 1999 →6997→3499→12247→1531→5359→18757→131299→229775→14361→100527→6283→43981→21991→153938→76969→16837→29465→12891→45119→315833→157917→105419→276355→967243→3385351→23697457… growing cycle.

$$\frac{7(5)+1}{2} \rightarrow \frac{36}{2} \rightarrow \frac{16}{2} \rightarrow \frac{7(9)+1}{2} \rightarrow \frac{64}{2} \rightarrow \frac{36}{2} \rightarrow 16,8,4,2,1$$

$$\frac{7(9)+1}{2} \rightarrow \frac{64}{2} \rightarrow \frac{32}{2} \rightarrow \frac{16}{2} \rightarrow 8,4,2,1$$

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Note : 9 is the trigen form 3x3, N = 7,9, converge because it reach pattern $\frac{2^6-1}{3}$ before multiply 7 as next step.

What happen if A = 5 and N = 7.

$$\frac{5(7)+1}{2} \rightarrow \frac{36}{2} \rightarrow \frac{18}{2} \rightarrow \frac{9x5+1}{2} \rightarrow \frac{46}{2} \rightarrow 23 \rightarrow \frac{115+2}{2} \rightarrow$$

$$\frac{29x5+1}{2} \rightarrow \frac{146}{2} \rightarrow \frac{73x5+1}{2} \rightarrow \frac{366}{2} \rightarrow \frac{183x5+1}{2} \rightarrow \frac{916}{2} \rightarrow \frac{229x5+1}{2} \rightarrow$$

$$\frac{1433x5+1}{2} \rightarrow$$

A growing pattern

IV. CONCLUSIONS

In this paper I discussed about geometrical proof for Collatz Conjecture which as visual proof for Collatz Conjecture is this geometrical proof that visualize Collatz Conjecture through sides or vertex of inner circle. Here I presented some imagination about Collatz Conjecture which proves Collatz Conjecture is only true for 3 I,e trigon and false for more than trigon sides or vertex. Only trigon leads to converge Collatz Conjecture into 4,2,1. More than trigon which is co-efficient of N needs to diverge of series the main technical issue which hard to understand that Collatz Conjecture is solved and a new approach on Collatz Conjecture is given in this paper. At finally I want to present, That Collatz Conjecture trigons converge to pentagon when we reach the

$\frac{2^n - 1}{3}$ (n=2,4,6,8,10……)

Collatz Conjucture converging in pentagon.

P_1 **$1 \rightarrow \frac{2^2-1}{3} = 1$**

P_2 **$3 \rightarrow \left(\frac{4^2-1}{3} = \frac{15}{3} = 5\right)$**

P_3 **$5 \rightarrow$ P2 (Achieved in P2)**

P_4 **$7 \rightarrow 11 \rightarrow 17 \rightarrow 13 \rightarrow 5$**

P_5 **$9 \rightarrow 7 \rightarrow 11 \rightarrow 17 \rightarrow 13 \rightarrow 5$**

P_6 **$11 \rightarrow 17 \rightarrow 13 \rightarrow 5$**

P_7 **$13 \rightarrow 5$ (Because we observed that 13 goes to 5 in P_4, P_5 and P_6)**

P_8 **$15 \rightarrow 23 \rightarrow 35 \rightarrow 53 \rightarrow 5$**

P_9 **$17 \rightarrow 5$ (P_4, P5 ,P6)**

P_{10} **$19 \rightarrow 29 \rightarrow 11 \rightarrow 5$ (P_4, P_5 ,P_6)**

P_{11} **$21 \rightarrow 5 \left(\frac{2^6-1}{3} = \frac{64-1}{3} = 21 \text{ a unique number}\right)$**

P_{12} **$23 \rightarrow 5$ (P_8)**

P_{13} **$25 \rightarrow 5$ (P_{10})**

P_{14} **$27 \rightarrow 41 \rightarrow 31 \rightarrow 47 \rightarrow 71 \rightarrow 107 \rightarrow 161 \rightarrow 121 \rightarrow 91 \rightarrow 137 \rightarrow 103 \rightarrow 155 \rightarrow 233 \rightarrow 175 \rightarrow 263 \rightarrow 395 \rightarrow 593 \rightarrow 445 \rightarrow 167 \rightarrow 251 \rightarrow 377 \rightarrow 283 \rightarrow 425 \rightarrow 319 \rightarrow 479 \rightarrow 719 \rightarrow 1079 \rightarrow 1619 \rightarrow 2429 \rightarrow 911 \rightarrow 1367 \rightarrow 2051 \rightarrow 3077 \rightarrow 577 \rightarrow 433 \rightarrow 325 \rightarrow 61 \rightarrow 5$ (P_8, P_{12})**

P_{15} **$29 \rightarrow 5$ (P_4,P_6,P_{10})**

P_{16} **$31 \rightarrow 47 \rightarrow 5$ (P_{14})**

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P_{17} **33 → 25 → 5 (P_{13}, P_{10})**

P_{18} **35 → 53 → 5 (P_8)**

P_{19} **37 → 7 → 5 (P_4)**

P_{20} **39 → 59 → 89 → 67 → 101 → 19 → 5 (P_{10})**

P_{21} **41 → 31 → 5 (P_{16})**

P_{22} **43 → 65 → 49 → 37 → 5 (P_{19})**

P_{23} **45 → 17 → 5 (P_6)**

P_{24} **47 → 71 → 5 (P_{14})**

P_{25} **49 → 37 → 5 (P_{19})**

P_{26} **51 → 77 → 29 → 5 (P_{15})**

P_{27} **53 → 5 (P_{18})**

Some numbers before trigon converge into pentagon is

$$\frac{2^2 - 1}{3}, \frac{2^4 - 1}{3}, \frac{2^6 - 1}{3}, \frac{2^8 - 1}{3} \ldots\ldots\ldots \frac{2^n - 1}{3}$$

Here 3 is the trigon which gives pentagon is next step of operation, but we replace more than trigon i, e, 4,5,6,7,8…………… Than this operation fail to get pentagon i, e, 5.

Here I try to understand what is Collatz Conjucture and how it is form in circle, it is a visual proof. I think this concept is one of the Best concept to understand the Collatz Conjucture. The pattern method is one of the best method to calculate total steps of cycle, as per the computer evidence. We achieved 2^{68} numbers are successfully reach 4,2,1. But in patern method we can write it as between 2^5 - 2^{10} digits numbers as patterns of steps. And also 2^{68} checked numbers created big numbers patterns (future pattens) which is bigger than 2^{68} is also helpful to checking to reach 4,2,1. it also proved larger and infinite numbers through this pattern method without computer evidence, this is the one of the important achievement. We can write 2^0 to 2^{68} steps as particularyly and arranged digits for exampe : N = 3, total pattern is → 9 → 10

5 → 15 → 16 → 8, 4,2,1. and N = 5. Total pattern is → 15 → 16 → 8 → 4 → 2 → 1 if we check common number of both pattern then total pattern is 9. but this step method is 15. total steps. This pattern methods produce total steps of large number as well as total large numbers steps also.

counting total patterns of cycle is more easy when we reduce counting by without common pattern. For exampe 3 and 5 cycle in this cycle we get.

3 → 9 - 10 - 5 - 15 - 16 - 8 - 4 - 2 - 1

5 → 15 16 8 4

The common pattern is 15,16,,8,4,2,1. So we can write 3 and 5 cycle pattern are 9,10,5. ie., 3 patterns in the some way we can write total patterns of 2^{68} as few digits. When our cycle expand to big number some way patterns will reduce as compared by previous patterns.

at last,

$$\frac{3n + 1}{2} = \frac{3(3,5,7,11,13\ldots\ldots\infty) + 1}{2} =$$ Trigon, polygon, pentagon, tetragon and approximately circle.

At last, Dirichlets theorem why do prime numbers make these spirals, may be a answer of these vertices method!

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