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A small work on Collatz Conjecture

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Abstract - In this paper a proof for Collatz Conjecture is given. Here I try to give very simple Mathematic, proof and explanation.

I. INTRODUCTION

This work is study of Collatz Conjecture that concerns a particular sequence. It is also known as the 3n+1 problem. Jefferey Loganiasin 2010 claimed 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 values up to 2 to the power of 68. All the initial values 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 is a computer evidence and is not a proof. Overall this thesis aims to prove 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 fallows: Start with any positive integer N and each term is obtained from the previous term. If the previous term is odd, the next term is 3 times the previous term plus 1. The conjecture is that no matters what value of N. the sequence will always reach 1.

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

N = 19 for example takes longer to reach 1: 19,58,29,88,44,22,11,34,17,52,26,13,40,20,10,5,16,8,4,21.

3. Proof of the conjecture:

Consider the following operation on an arbitrary positive integer. If the number is even, divide it by two, If the number is odd, triple it and add one, in modular arithmetic notation, define the function as follows.

$$f(n) = \begin{cases} \dfrac{n}{2} & \text{if } N \equiv 0 \pmod 2 \\ 3n+1 & \text{if } N \equiv 1 \pmod 2 \end{cases}$$

The Collatz Conjecture is : This process with eventually reach the number 1, regardless of which positive integeris chosen initially.

Introducing some sequences

S_1 = {1,2,3,4,5,6......................}

S_2 = {2,4,8,16,32,64................}

S_1-S_2 = {1,2,3,4,5,6,7,8,10...........}

S_1-S_2 = {1,3,5,6,7,9,10.................}

S_3 = {6,10,12,14,18.................}

$\frac{S_3}{2}$ = {3,5,6,7,9,10.................}

$\frac{S_3}{2} - S_3$ = {3,5,7,9,11,13..................}

S_1-(S_2+S_3) = {1,3,5,7,9,11.....................}

5. Proving the Collatz Conjecture through sequences Consider the sequence S_1 of positive integer.

S_1 = {1,2,3,4,5,6.....................}

S_2 = $\{2^n/N \in^{Z+}\}$

S_3 = {6,10,12,14....................}

S_2+S_3 = {2,4,6,8,10.....................}

Then S3 ={6,10,12,14...........} The terms in S_3 when we divide by 2 and subtract from S_3 gives an odd number which is in $\frac{S_3}{2} - S_3$ There are 3 cases.

Case 1: n is an integer of the form 2^n for some in this case it is easy to see that the series decreases to 1

Case 2: N is an odd number then 3n+1 is an even number if it is of the form 2^n it reduces to case 1.

For example : if n= 5 then $\frac{3(5)+1}{2}$ =16

We can write 16 as 2^n form.

N=21 then $\frac{3(21)+1}{2}$ = 64 $=2^6$

In case no 2 there are some unique odd numbers which are binary form of 4,16,64.... when odd number converge into this unique odd number then it converge into 4,16,64....

Not all the odd numbers converge into unique odd number only $\frac{2^n-1}{3}$ = odd number, where n =2,4,6,8,10.

We can judge this binary form as two series as S_4 and S_5 where S_4 is a even series and S_5 is the odd series both are converging each other.

S_4 = {4,16,64,256,1024............} or $\{2^2,2^4,2^6,2^8,2^{10}$...........................}

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S_5= {1,5,21,85,341..................} or $\left\{ \frac{2^2-1}{3}, \frac{2^4-1}{3}, \frac{2^6-1}{3} .... \right\}$

If 2^n {n =1,3,5,7,9........ } Then 2^n-1 does not divide completely by 3. So, odd powers of 2 fail to satisfy or converge some other odd numbers because 2^n where N is odd give an even number if we subtract 1 from this number the remainder never divide by 3 completely.

For Example (1) $\frac{2^1-1}{3} = 0.3333....$ (2) $\frac{2^3-1}{3} = \frac{8-1}{3} = \frac{7}{3} = 2.33333$

Case 3: If 3n+1 is not in the form 2^n for any N then it is must be in the series S_3 If it in series S_3 then it must converge into series S_1-(S_2+S_3) which eventually leads to an S_5 series.

Lets check a multiply table Nx 2

N	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	. . . .
1	2	4	8	16	32	64	128	256	512	1024	. . . .
2	4	8	16	32	64	128	256	512	1024	2048	. . . .
3	6	12	24	48	96	192	384	768	1536	3072	. . . .
4	8	16	32	64	128	256	512	1024	2040	4080	. . . .
5	10	20	40	80	160	320	640	1280	2560	5120	. . . .
6	12	24	48	96	192	384	768	1536	3072	6144	. . . .
7	14	28	56	112	224	448	896	1792	3584	7168	. . . .
8	16	32	64	128	256	512	1024	2048	4096	8192	. . . .
9	18	36	72	144	288	576	1152	2304	4608	9216	. . . .
10	20	40	80	160	320	640	1280	2560	5120	10240	. . . .
.	.	.	.	.	.	.	.	.	.	.	
.	.	.	.	.	.	.	.	.	.	.	

In this table N is a natural number and N_1,N_2,N_3... are mutation number of its own. Taking any number in N_1, N_2,N_3... is like taking the its odd N number.

Example

$\left(\left(\left(\frac{\frac{\frac{1792}{2}}{2}}{2}\right)\right)\right)$ 7 taking 1792 is equivalent to taking 7.

This example proves taking the odd number is more convenience than taking

N_1,N_2,N_3,N_4..... numbers, if we taking any N_1,N_2,N_3.... number the conjecture reduce

This number into N. We have already achieved this in series S_1 -(S_2+S_3).

6. Odd form route or typical way of odd numbers

In this way we see some unique odd numbers, which in series S_5. We know that we can also put those numbers in $\frac{2^n-1}{3}$ form. Now lets take a tour in typical way of odd number, in this way all numbers beyond number 1, will reach the number 5.

So we know that number 5 is form of $\frac{2^4-1}{3}$ =5 i.e 16, series S_4 and S_5 which

eventually reach 16,8,4,2,1.

In this typical way we consider only odd number (odd steps) of $\frac{3n+1}{2}$

P_1 1 → $\frac{2^2-1}{3}$ = 1 (S_5 series unique number)

P_2 3 → $5\left(\frac{4^2-1}{3} = \frac{15}{3} = 5, S_5 \text{ series unique number}\right)$

P_3 5 → P2 (Achieved in P2)

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P_4 7 → 11 → 17 → 13 → 5
P_5 9 → 7 → 11 → 17 → 13 → 5
P_6 11 → 1 7 → 13 → 5
P_7 13 → 5 (Because we observed that 13 goes to 5 in P_4, P_5 and P_6)
P_8 15 → 23 → 35 → 53 → 5
P_9 17 → 5 (P_4, P5 ,P6)
P_{10} 19 → 29 → 11 → 5 (P_4, P_5 ,P_6)
P_{11} 21 → 5 $\left(\frac{2^6-1}{3} = \frac{64-1}{3} = 21 \text{ a unique number}\right)$
P_{12} 23 → 5 (P_8)
P_{13} 25 → 5 (P_{10})
P_{14} 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 → 5 (P_8, P_{12})
P_{15} 29 → 5 (P_4,P_6,P_{10})
P_{16} 31 → 47 → 5 (P_{14})
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})
P_{28} 55 → 83 → 125 → 47 → 5 (P_{24})
P_{29} 57 → 43 → 65 → 5 (P_{22})
P_{30} 59 → 5 (P_{20})
P_{31} 61 → 23 → 5 (P_{12})
P_{32} 63 → 95 → 143 → 215 → 323 → 485 → 91 → 137 → 5 (P_{14})
P_{33} 65 → 49 → 5 (P_{25})
P_{34} 67 → 101 → 5 (P_{20})
P_{35} 69 → 13 → 5 (P_7)
P_{36} 71 → 107 → 161 → 121 → 5 (P_{14})
P_{37} 73 → 55 → 83 → 125 → 47 → 5 (P_{23})
P_{38} 75 → 113 → 85 → 5 $\left(\frac{2^8-1}{3} = \frac{256-1}{3} = \frac{255}{3} = 85 \text{ a unique odd number}\right)$
P_{39} 77 → 29 → 5 (P_{15})
P_{40} 79 → 119 → 179 → 269 → 101 → 19 → 29 → 11 → 17 → 13 → 5 (P_{20})
P_{41} 81 → 61 → 5 (P_{31})
P_{42} 83 → 125 → 47 → 5 (P_{24})
P_{43} 85 → 5 (P_{34} a unique number)
P_{44} 87 → 131 → 197 → 37 → 5 (P_{19})
P_{45} 89 → 67 → 5 (P_{34})
P_{46} 91 → 137 → 5 (P_{14})
P_{47} 93 → 35 → 53 → 5 (P_8)
P_{48} 95 → 143 → 5 (P_{32})
P_{49} 97 → 73 → 5 (P_{37})
P_{50} 99 → 149 → 7 → 5 (P_4)
P_{51} 101 → 5 (P_{20})
P_{52} 103 → 155 → 5 (P_{14})
P_{53} 105 → 79 → 5 (P_{40})
P_{54} 107 → 5 (P_{14})
P_{55} 107 → 5 (P_{21})

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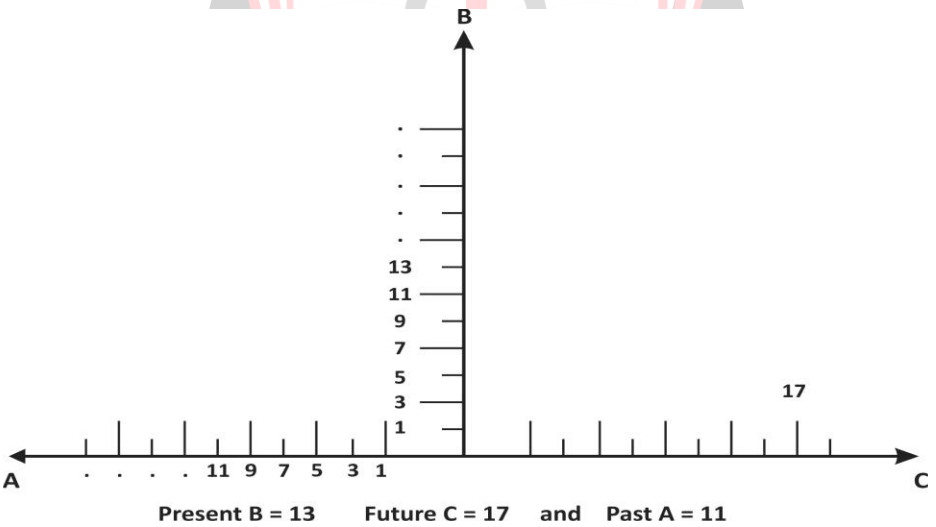
P_{56} 111 → 167 → 251 → 377 → 283 → 425 → 319 → 479 → 719 → 1079 → 5 (P_{14})
P_{57} 113 → 85 → 5 (P_{38}, P_{43})
P_{58} 115 → 173 → 65 → 5 (P_{22}) (P_{33})
P_{59} 117 → 11 → 5 (P_{6})
P_{60} 119 → 179 → 79→ 5 (P_{40})
P_{61} 121 → 91 → 5 (P_{46})
P_{62} 123 → 185 → 139 → 209 → 157 → 59 → 5 (P_{20})
P_{63} 125 → 47 → 5 (P_{24})
P_{64} 127 → 191 → 287 → 431 → 647 → 971 → 1457 → 1093 → 205 → 77 → 5 (P_{39})
P_{65} 129 → 97 → 5 (P_{49})
P_{66} 131 → 197 → 37 → 5 (P_{19})
P_{67} 133 → 25 → 5 (P_{10}, P_{13})
P_{68} 135 → 203 → 305 → 229 → 43 → 5 (P_{22})
P_{69} 137 → 103 → 5 (P_{52})
P_{70} 139 → 209 → 157 → 5 (P_{62})
P_{71} 141 → 53 → 5 (P_{18},P_{27})
P_{72} 143 → 215 → 323 → 485 → 95 → 5 (P_{48})
P_{73} 145 → 109 → 5 (P_{21},P_{55})
P_{74} 147 → 221 → 83 → 5 (P_{42})
P_{75} 149 → 7 → 5 (P_{4})
P_{76} 151 → 227 → 341 $\left(\frac{2^{10}-1}{3} = \frac{1024-1}{3} = 341\right) \to 5$ Z 5

Theory-1

In this typical way we observe odd steps create future odd steps (numbers) which alternatively prove that odd numbers also converge into 4,2,1. This odd steps prove that Collatz Conjecture produce past→present→future numbers.

Here we can take 5 or 4,2,1 as past numbers, what odd n Number you chose is called present number and what number gives more bigger than you chosen odd N number is called future number.



Let we consider that numbers as A = Past number, B = Present number, C- Future number.

Then $A \in B$ and $B \in C$ then $C \in A$, $A<B<C$

If we write past number in left side, present number in middle, future number in right side then example for 127 is.

Past (A)	Present (B)	Future (C)
5,13,17,11,29,77	← 127 →	191,287,431,647,971,1457,1093,205

We saw there some numbers goes to high and suddenly falling down to 4,2,1. What is the reason for this? The reason is rate of growth and rate of falling down.

Yes the rate of growth of odd steps 3 x N+1 (N=odd) is fixed for every step. But rate of falling down is not fixed. Rate of falling down rates 2 for even steps, but not fixed for every number, some times it is random.

For Example : N=5

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Rate of growth is 3 x 5 +1 =16

$$\text{Random}\left(\left(\frac{\left(\frac{\left(\frac{16}{2}\right)}{2}\right)}{2}\right)\Big/2\right) = 1$$

The rate of falling down rate depend on even number and his randomness.

7. Odd Formation of Conjecture

In this method we can see all odd numbers goes to base unique number of 5.

And we also know 5 goes to 16 and 16 goes to 8,4,2,1. In this way all numbers beyond number 1, will goes through number 5.

$P_1 \quad 1 \rightarrow \frac{(1+1+1+1)}{2} \rightarrow 2 \rightarrow 1$

$P_2 \quad 3 \rightarrow \frac{(3+3+3+1)}{2} \rightarrow \frac{(5+5+5+1)}{2}$

$P_3 \quad 5 \rightarrow P_2$(We already achieved in P_2)

$P_4 \quad 7 \rightarrow \frac{(7+7+7+1)}{2} \rightarrow \frac{(11+11+11+1)}{2} \rightarrow \frac{(17+17+17+1)}{2} \rightarrow \frac{(13+13+13+1)}{2} \rightarrow \frac{(5+5+5+1)}{2}$

$P_5 \quad 9 \rightarrow \frac{(9+9+9+1)}{2} \rightarrow (P_4)$

$P_6 \quad 11 \rightarrow (P_4)$

$P_7 \quad 13 \rightarrow (P_4)$

$P_8 \quad 15 \rightarrow \frac{(15+15+15+1)}{2} \rightarrow \frac{(23+23+23+1)}{2} \rightarrow \frac{(35+35+35+1)}{2} \rightarrow \frac{(53+53+53+1)}{2} \rightarrow \frac{(5+5+5+1)}{2}$

$P_9 \quad 17 \rightarrow (P_4, P_8)$

$P_{10} \quad 19 \rightarrow \frac{(19+19+19+1)}{2} \rightarrow \frac{(29+29+29+1)}{2} \rightarrow \frac{(11+11+11+1)}{2} \rightarrow (P_4, P_6)$

$P_{11} \quad 21 \rightarrow \frac{(21+21+21+1)}{2} \rightarrow \frac{(5+5+5+1)}{2}$

$P_{12} \quad 23 \rightarrow \frac{(23+23+23+1)}{2} \rightarrow (P_8)$

$P_{13} \quad 25 \rightarrow \frac{(25+25+25+1)}{2} \rightarrow \frac{(19+19+19+1)}{2} \rightarrow (P_{10})$

If n is a odd number then the process began as

$$\left[\frac{(n+n+n+1)}{2} \cdots\cdots\cdot \frac{(5+5+5+1)}{2} \rightarrow 8,4,2,1\right]$$

or

$$\left[\frac{(3n+1)}{2} \cdots\cdots\cdot \frac{(3(5)+11)}{2} \rightarrow 8,4,2,1\right]$$

Odd formation of N integer is main proof of Collatz Conjecture. In this method we can divide all N integer into two part, Part - 1 and Part - 2. Part 1 is belong to all N integer which we can write odd formation method, Part-2 is those numbers which we cannot write in odd formation method, they are 2^n (where n is 1,3,5,7.....). But they can easily reach 4,2,1. So here we give the strong proof that every N integer goes to 4,2,1 in Collatz Conjecture.

Now the biggest question is why Collatz Conjecture always reach 4,2,1?

Because it follows a hidden number theory. The theory is each pairs of odd steps

divided by each other, step 2 divided by step 1 (odd steps) or p/q (p=step 2 and q is step 1) Then the value is always between 1.666.... to 1.5. When we deal with big number. Then value close to came 1.5 which is similar to 3/2. So if we replace any denominator or nominator of 3/2 It will break the average 1.5 to 1.666.... We also know that every even step, previous even step X divided by next even step y then x/y=2.

Some Examples: N=7

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$\frac{3n+1}{2}$ → 7 → 22 → 11 → 34 → 17 → 52 → 26 → 13 → 40 → 20 → 10 → 5 → 16 → 8 → 4 → 2 → 1

Here 11 and 7 are odd pairs because between this two odd number there are only one even number 22 occurs. This kind of odd numbers called odd pairs of Collatz Conjecture. If we divide this number as p/q then it gives a average between 1.666 .... to 1.5.

If 7+7+7+1 = 22, 4 terms equal to next two term 11+11 = 22 is called odd pairs.

a+a+a+1 =b+b =odd pairs. a,b are odd.

$$\frac{\text{Step2}}{\text{Step 1}} = \frac{p}{q} = 1.666.... \text{ to } 1.5$$

$$\frac{11}{7} = 1.571428571439 \qquad \frac{17}{11} = 1.54545454.....$$

So every pairs of steps will gives result like this. N=7 → 1.57142857143, 1.54545454... 2,2,2,2,2,2,1

Example : N=111

Example: N = 111

111 → 334 → 167 → 502 → 251 → 754 → 377 → 1132 → 566 → 283 → 850 → 425 → 1276 → 638 → 319 → 958 → 479 1438 → 719 → 2158 → 1079 → 3238 → 1619 → 4858 → 2429 → 7288 → 3644 → 1822 → 911 → 2734 → 1367 4102 → 2051 → 6154 → 3077 → 9233 → 4616 → 2308 → 1154 → 577 → 1732 → 866 → 433 → 1300 → 650 → 325 → 488 → 244 → 122 → 61 → 184 → 92 → 46 → 23 → 70 → 35 → 53 → 160 → 80 → 40 → 20 → 10 → 5 → 16 → 8 → 4 → 2 → 1

$$\frac{167}{111} = 1.50450450......, \quad \frac{251}{167} = 1.50299401198, \quad \frac{377}{251} = 1.50199203187$$

$$\frac{425}{283} = 1.50176678445, \quad \frac{479}{319} = 1.50156739812, \quad \frac{719}{479} = 1.50104384134,$$

$$\frac{1079}{719} = 1.50069541029, \quad \frac{1619}{1079} = 1.50046..., \quad \frac{2429}{1619} = 1.50030883....,$$

$$\frac{1367}{719} = 1.50054....., \quad \frac{2051}{1367} = 1.50036576.... \quad \frac{3077}{2051} = 1.5002437.......,$$

$$\frac{35}{23} = 1.52173913043, \quad \frac{53}{35} = 1.51428571429....,$$

So every $\frac{3n+1}{2}$ transaction will gives a model result like (1.666 to 15) (2) (1.666 to 1.5) (2) (1.666 to 1.5) (2) (2) (2) 1.

This kind of result generate only when N is multiplied by 3, add 1 and divided by2 if any changes in this process the increasing rate or average will break the chain and N does not reach to 4,2,1 and create short cycle or which does not satisfy Collatz Cycle taking the long process which never decrease.

Below the example indicate pairs of odd steps and pairs of even steps taking long process which never average rate is maximum 1.666... to minimum 1.5 for odd steps, even pairs of steps decrease average is always 2 and its randomness so if any continue mathematics operation go on this average that we will clearly reach 4,2,1 perhaps this average system works only 3 x n.

This method only works for Number 1,2,3 depending on its position in Collatz Conjecture. Actually this is not a 4,2,1 problem this is a 1,2,3 solution.

8. Another View of Collatz Conjecture

Take any positive integer, if it is odd multiply by 3 and add 1, Now find out the factors of that number. In this factors choose a big factor of odd, and go on the same process. If your number is even then select large odd factor of that number, now multiply by 3 to that large odd factor number, add one, go on the process. In this process if you reach large odd factor like S_5 = {1,5,21,85,341....} then process end up with 4,2,1. If it fail to reach large odd factor S_5 (N>1) then eventually reach 4,2,1 because S4={2,4,8,16.... } are only single large odd factor that is 1.

Collatz Conjecture is a process of finding large odd factor of even number and also finding large even factor of even number. In this process we finally reach 1.

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For Example N=68

Factors of 68 is1,2,4,17,34... The large even factor is 34 and large odd factor is 34

We can write $\frac{3n+1}{2}$ as 2

If n is odd =N x 3+1 → (Large odd factor) x3 +1 → (Large odd factor) x3+1 ..... 4,2,1.

If n is even = Large even factor → Large even factor → Large even factor at last large odd factor ie., 16 → 8 → 4 → 2 → 1

Collatz Conjecture is mixed process for some N number then factor system also go on as mixed factorization.

Odd factorization converge N number into S_5 Series

Even factorization converge n number into S_4 Series

Mixed factorization converge n number into S_1 -S_2 series. Which is always converge into S_4 and S_5 series.

9. The Last series of Collatz Conjecture

In this series proves that any odd number multiply by 3 and add one and divide by2 until reach odd number, this process give a odd number which belong to S_1 - (S_2+S_3) no matter how big odd number you choose to this process. The remaining odd number is always part of S_1-(S_2+S_3). If odd N = ∞(Infinity) No problem it repeat a part of S-(S_2+S_3) series in this process if it give number, any term in S6 series then Collatz Conjecture will stop, lets check the series:

S_1 -(S_2 +S_3) {1,3,5,7,9,11 ....}

In Collatz Conjecture we always multiply 3 by this series (term)

So,

S_6 = 3 {1,3,5,7,9,11,13,15,17,19,21,23............................}

S_6 = { 3,9,15,21,27,33,39,45,51,57,63,69.........................}

Now add 1 to each term = {4,10,16,22,28,34,40,46,52,58,64,70.........................} = S_7

Now divide each term of S_7 by 2 = {1,5,1,11,7,17,5,23,13,29,1,,35.........................} = S_8

(untill get odd number)

We get S_8 dividing S_7 by 2 is always part of S_1-(S_2+S_3) series if it remain a part of S_6 then Collat Conjecture will stop.

If we add 1 to S_6 series (each term) and divide by 2, continue the process then the process convert one by one number into 2^n form, this is the clear proof that N+1/2 (N=odd) continue process convert N (odd) into 2^n form.

10. Reverse Collatz Conjecture

Can we find past number or starting number? Yes we can find the starting number also.

Series S_6 are no previous steps, they generate only next step in Collatz Conjecture so, this series terms or numbers are no reverse step. Only S_8 series are give previous steps and next step.

Example : Find the base number of 23

Step 1 : Divide 23 by 3 (if not divide completely)

Step 2 : Multiply by 2 (23 x 2 =46)

Step 3: Now substract 1 from 46 (46 -1 =45)

Step 4: Now divide 45 by 3 (45 ÷ 3 =15)

Step 5: 15 is your base number (that mean you came from 15 or 15 x 2 x 2 x 2.....)

Finding base number of N is always N or N x 2 x 2 x 2 .... depending on steps (N=odd)

According to these examples we define reverse Collatz Conjecture as

$$fn = \left\{ \begin{array}{ll} \frac{2n-1}{3} & \text{If N is odd then } 2n \\ & \text{If n is even then } \frac{N}{2} \\ & N \neq S_6 \\ & N = S_8 \\ & \text{If } N = S_6 \text{ then } \frac{N}{3} \end{array} \right\}$$

Example 3 : Find the base number of 97

97 is not divisible by 3

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So 97 x 2 =194 -1 =193

193 is not divisible by 3

So 194 x 2 =388 (Take the 194 because random divisible by2)

=388 -1

=387

=129 (you came to 97 from 129 or 129 x 2 x 2 x 2.....)

$$\frac{3n+1}{2} = x \quad \text{and} \quad \frac{2x-1}{3} = n \text{ then} \quad x = n$$

$$\frac{3n+1}{2} = \frac{2n-1}{3}$$

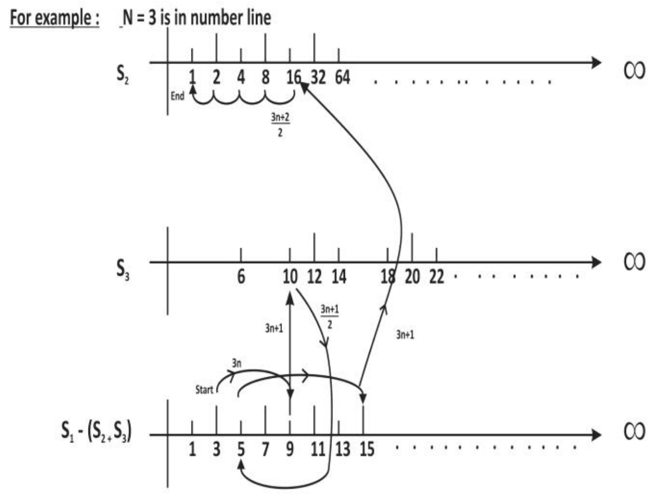
If we simply adding 1 to each term of S6 series and divided by 2 randomly and again add 1 if term became greater than 1, and again divide by 2. This process also give the same result like Collatz Conjecture i.e.., every number reach 1.

If N $\neq$ S_3 ={1,5,21,85,341............}

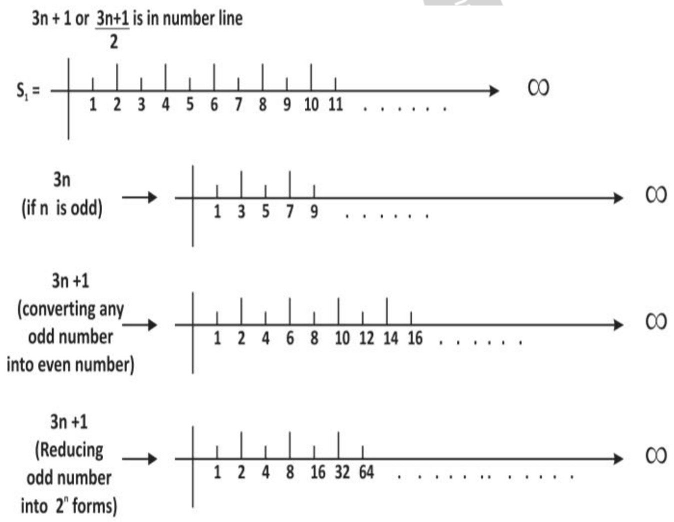
Then Collatz Conjecture Predict like

$$\cdots\; 3\left(\frac{3\left(\frac{3\left(\frac{3\left(\frac{3n+1}{2}\right)+1}{2}\right)+1}{2}\right)+1}{2}\right)+1 \cdots$$

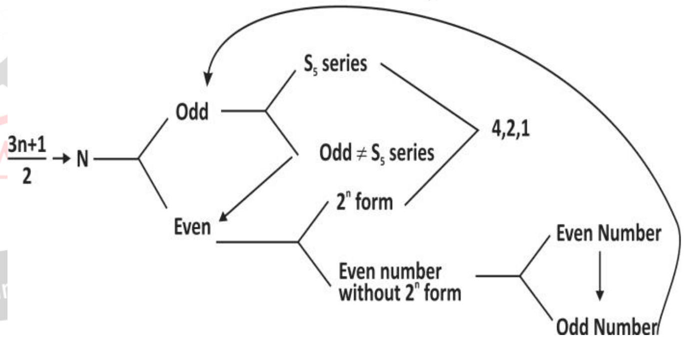
$$\vdots$$



Collatz Conjecture in Number line



Collatz Conjecture cycle



II. CONCLUSIONS

Here I presented some imagination and ideas of Collatz Conjecture which proves logically as well practically. That Collatz Conjecture is true for all N integers. The odd formation of Conjecture, we presented clearly proof that every natural numbers goes to 5 is a significant theoretical proof. And also various type of series logically and Mathematically proved that every natural numbers converge into 4,2,1. Described about simple imagination of past - present - future numbers A $\in$ B $\in$ C Converge into 4,2,1. Try to argue that odd numbers are more convenience to examine than even number. This method save our time and effort also. I presented reverse of Collatz Conjecture where we check, Collatz Conjecture is true here I explore some fundamental properties of odd numbers and its unique series, in Collatz Conjecture increasing rate is always smaller than decreasing rate 1.6666 to 1.5 < 2. We can also

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find the total steps of any N integer through the odd formation data or typical way of odd number, below every N odd integer have its limited steps. Interesting fact is I recognized when working on Collatz Conjecture is a pair of set number which is 35 → 53, 359 → 539, 395 → 593. If you got 35 your next step will be 53. Adding 1 to S_6 (each term) and divide by2. The continue process leads one by one term to reach 4,2,1. This is one of the main theoretical proof. If any N > 3 in this system, then increasing rate is higher than decreasing rate.

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