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The Definitive Proof that Collatz Conjecture is True

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Abstract

In this paper and for the first time ever, I will provide the conclusive proofs that Collatz's conjecture is true, and how is it works on basis one of the greatest algorithms ever. And it is much more than a ($3n$ + 1), because as long as it was believed that for this conjecture only a ($3n$ + 1) mechanism applied, while this is not true at all.

Keywords: The collatz conjecture have solved definitely.

In short, it is known that Collatz's conjecture is a conjecture in the math. It is named after the mathematician Lothar Collatz, who introduced the idea in 1937. It is also known as the "$3n$ + 1" sequence.

*** Text of the Dilemma**

It is known that Collatz's conjecture is a special for the natural integeres non-zero, and it is phrase a sequence as follows:

1- If the number is even, divide it by two.

2- If the number is odd, triple it and add one.

3- In modular arithmetic notation, define the function f as follows:

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

4- If we repeat the process several times, we will always reach 1, no matter how many starts, and this is the conjecture that has not been proven true or wrong.

*** Distinctive Contribution of this Study**

What I was in need to solve Collatz's conjecture, only a pen and a paper in addition to some of meditition. While, I been through the impossible only to telling and prove that the Collatz's conjecture no longer a conjecture but became a reality. So, all the informations that I do not say it's known, means it was defenitly unknown info and no one knowed but me. I solved this conjecture already, and this is exactly the different between my research and the otheres's about this conjecture. Putted a valuble prizes on this conjecture, for who solve it.

*** Note**

The style that I will writing for explaining Collatz conjecture's true, is necessary to be understood clearly.

Now we are going to touch to something similar to the Big Bang literally, and it is phrase on the singularity point which everything will start from, as follows:

1 2 4 8 16 32 64 128 256 512 1024…

Well, it is known that the function responsible for the distribution of this sequence is as follows:

$f(n) = 2n$

$f(n) = 2 \times 1 = 2$

$f(n) = 2 \times 2 = 4$

$f(n) = 2 \times 4 = 8$

Well, here is the surprise:

2 8 32 128 512…

4 16 64 256 1024…

$f(n) = 3n - 1$

$f(n) = 3n + 1$

$f(n) = 3 \times 1 - 1 = 2$

$f(n) = 3 \times 1 + 1 = 4$

$f(n) = 3 \times 3 - 1 = 8$

$f(n) = 3 \times 5 + 1 = 16$

$f(n) = 3 \times 11 - 1 = 32$

$f(n) = 3 \times 21 + 1 = 64$

$f(n) = 3 \times 43 - 1 = 128$

$f(n) = 3 \times 85 + 1 = 256$

$f(n) = 3 \times 171 - 1 = 512$

$f(n) = 3 \times 341 + 1 = 1024$

1, 3, 11, 43, 171, …

1, 5, 21, 85, 341, …

$f(n) = 1+(n+n+n+\dots)$

$f(n) = 1+(n+n+n+\dots)$

$f(n) = 1+(2+8+32+128+512+\dots)$,

$f(n) = 1+(4+16+64+256+1024+\dots)$,

* **which means:** (1,3,11,43,171,683,…). which means: (1,5,21,85,341,1365,…).

Here we notice the next: (By adding Here we notice the next: (By adding the same even numbers to (1) the same even numbers to (1) sequencely, gives the distribution sequencely, gives the distribution of (*n*), of (*n*), which (*n*) is: 1, 3, 11, 43, 171, …). which (*n*) is: 1, 5, 21, 85, 341, …).

Each the previouse sequence's even number, either equals ($3n - 1$), or is equal to ($3n + 1$), exactly half of it's even numbers equal to ($3n - 1$), and the other half equal to ($3n + 1$).

Now, what will happen if we turn all the odd numbers to the sequences, same the previous sequence and with exact the same ascending value as follows: 1 2 4 8 16 32 64 128 256 512 1024… ?

Well, actually will not all the odd numbers turns but exactly

(2/3) of it including the number one itself, turns to the sequences according to a regular sequentialy distribution. And to each sequence applied same the previouse sequence's steps and equations, which each the sequences's even number, either equals ($3n - 1$), or is equal to ($3n + 1$), exactly half of each sequence's even numbers equal to ($3n - 1$), and the other half equal to ($3n + 1$). And by adding the same even numbers to (n) sequencely, gives the distribution of (n).

And the most important part for the each half, is the first even number in addition to the first (n), because these two numbers are responsible of distribution of the (n), as I explained it in the previouse sequence. And the only reason that make (2/3) of the odd numbers turns to the sequences not all, because we are always tripleing odd numbers so the number three and the odd numbers that divisible by three will never turns to the sequences.

But does a ($3n - 1$) mechanism true, as a ($3n + 1$) mechanism ?

Well, we will find out.

*** The distribution of the sequences**

At the next step we go back to the first sequence that everything starts from.

Well, exactly (2/3) of the next odd numbers (1, 5, 21, 85, 341, 1365, …) turns to the sequences as follows:

The Path No. : 1

1 2 4 8 16 32 64 128 256 512 1024…

The Path No. : 2

5 10 20 40 80 160 320 640 1280 2560 5120…

85 170 340 680 1360 2720 5440 10880 21760 43520 87040…

341 682 1364 2728 5456 10912 21824 43648 87296 174592 349184…

*** Note**

Each frame which inside it one sequence or more is phrase a path, to moves the numbers in general and the odd numbers in particular from a path to other's to reach 1, sequencely. And the number of each path is phrase the number of times that some specific's odd numbers in need to repeat the ($3n + 1$) mechanism to reach 1.

Now. Let's apply the same steps that we applied to the first sequence, I mean the same equations as follows:

5 10 20 40 80 160 320 640 1280 2560 5120…

$f(n) = 2n$

Well,

10 40 160 640 2560…

20 80 320 1280 5120…

$f(n) = 3n + 1$

$f(n) = 3n - 1$

$f(n) = 3 \times 3 + 1 = 10$
$f(n) = 3 \times 7 - 1 = 20$
$f(n) = 3 \times 13 + 1 = 40$
$f(n) = 3 \times 27 - 1 = 80$
$f(n) = 3 \times 53 + 1 = 160$
$f(n) = 3 \times 107 - 1 = 320$
$f(n) = 3 \times 213 + 1 = 640$
$f(n) = 3 \times 427 - 1 = 1280$
$f(n) = 3 \times 853 + 1 = 2560$
$f(n) = 3 \times 1707 - 1 = 5120$

3, 13, 53, 213, 853, …
7, 27, 107, 427, 1707, …

$f(n) = 3+(n+n+n+\ldots)$
$f(n) = 7+(n+n+n+\ldots)$
$f(n) = 3+(10+40+160+640+\ldots)$,
$f(n) = 7+(20+80+320+1280+\ldots)$,
which means: (3,13,53,213,853,…). which means: (7,27,107,427,1707,…).
Here we notice the next: (By adding Here we notice the next: (By adding
the same even numbers to (3) the same even numbers to (7)
sequencely, gives the distribution sequencely, gives the distribution
of (n), of (n),
which (n) is: 3,13,53,213,853,…). which (n) is: 7,27,107,427,1707,…).

85 170 340 680 1360 2720 5440 10880 21760 43520 87040…

$f(n) = 2n$

Well,

170 680 2720 10880 43520… 340 1360 5440 21760 87040…

$f(n) = 3n - 1$
$f(n) = 3n + 1$
$f(n) = 3 \times 57 - 1 = 170$
$f(n) = 3 \times 113 + 1 = 340$
$f(n) = 3 \times 227 - 1 = 680$
$f(n) = 3 \times 453 + 1 = 1360$
$f(n) = 3 \times 907 - 1 = 2720$
$f(n) = 3 \times 1813 + 1 = 5440$
$f(n) = 3 \times 3627 - 1 = 10880$
$f(n) = 3 \times 7253 + 1 = 21760$
$f(n) = 3 \times 14507 - 1 = 43520$
$f(n) = 3 \times 29013 + 1 = 87040$

57, 227, 907, 3627, 14507, …
113, 453, 1813, 7253, 29013, …

$f(n) = 57+(n+n+n+\ldots)$
$f(n) = 113+(n+n+n+\ldots)$
$f(n) = 57+(170+680+2720+\ldots)$,
$f(n) = 113+(340+1360+5440+\ldots)$,
which means: (57,227,907,3627,…). which means: (113,453,1813,7253,…).
Here we notice the next: (By adding Here we notice the next: (By adding
the same even numbers to (57) the same even numbers to (113)
sequencely, gives the distribution sequencely, gives the distribution
of (n), of (n),
which (n) is: 57, 227, 907, 3627,…). which (n) is: 113, 453, 1813, 7253,…).

341 682 1364 2728 5456 10912 21824 43648 87296 174592 349184…

$f(n) = 2n$

Well,

682 2728 10912 43648 174592… 1364 5456 21824 87296 349184…

$f\ (n) = 3n + 1$ $f\ (n) = 3n - 1$

$f\ (n) = 3 \times 227 + 1 = 682$ $f\ (n) = 3 \times 455 - 1 = 1364$

$f\ (n) = 3 \times 909 + 1 = 2728$ $f\ (n) = 3 \times 1819 - 1 = 5456$

$f\ (n) = 3 \times 3637 + 1 = 10912$ $f\ (n) = 3 \times 7275 - 1 = 21824$

$f\ (n) = 3 \times 14549 + 1 = 43648$ $f\ (n) = 3 \times 29099 - 1 = 87296$

$f\ (n) = 3 \times 58197 + 1 = 174592$ $f\ (n) = 3 \times 116395 - 1 = 349184$

227, 909, 3637, 14549, 58197, … 455, 1819, 7275, 29099, 116395, …

$f\ (n) = 227+(n+n+n+\ldots)$ $f\ (n) = 455+(n+n+n+\ldots)$

$f\ (n) = 227+(682+2728+10912+\ldots)$, $f\ (n) = 455+(1364+5456+21824+\ldots)$,

which means: (227,909,3637,…). which means: (455,1819,7275,…).

Here we notice the next: (By adding Here we notice the next: (By adding

the same even numbers to (227) the same even numbers to (455)

sequencely, gives the distribution sequencely, gives the distribution

of (n), of (n),

which (n) is: 227, 909, 3637,…). which (n) is: 455, 1819, 7275,…).

Well, as we see that (1/2) of the even numbers which in the path no 2, equal to ($3n + 1$), and the other half equal to ($3n - 1$). Well, exactly (2/3) of the next odd numbers: (3, 13, 53, 213, 853, …), (113, 453, 1813, 7253, 29013, …), (227, 909, 3637, 14549, 58197, …)… turns to the sequences as follows:

The Path No. : 3

13 26 52 104 208 416…
53 106 212 424 848 1696…
853 1706 3412 6824 13648 27296…
.
.
.
113 226 452 904 1808 3616…
1813 3626 7252 14504 29008 58016…
7253 14506 29012 58024 116048 232096…
.
.
.
227 454 908 1816 3632 7264…
3637 7274 14548 29096 58192 116384…
14549 29098 58196 116392 232784 465568…

And exactly (1/2) of the path number three's even numbers, equal to ($3n - 1$), and the other half equal to ($3n + 1$), and exactly (2/3) of the odd numbers which is equal to (1/2) of the path number three's even numbers when apply a ($3n +$

1) mechanism to them, turns to the sequences. In short, no matter how many times we repeat those steps and equations, they will continue giveing the sequences and paths one by one until the last sequence and path, and this is the algorithm which controling the sequences's distribution, by the first sequence and (2/3) of the next odd numbers: (1, 5, 21, 85, 341, 1365, …)

It is known that each odd number, located in the middle of two even numbers as follows: (0 1 2 3 4 5 6). But if we note the next: (0, 1, 2), (2, 3, 4), (4, 5, 6), we can see very clearly that the next two numbers (2, 4) are in two wheres. Well, this will not happen to the sequences's even numbers, which the number three and each odd number that divisible by three located in the middle of two even numbers which they are only for each odd number. If we put all the sequences's even numbers together as follows: (2, 4), (8, 10), (14, 16), (20, 22), (26, 28), (32, 34), (38, 40)… we will see that very clearly.

Now, let's back to the next question: Does a $(3n - 1)$ mechanism true, as a $(3n + 1)$ mechanism?

Well, the answer is defenitly no. Simplly, because this mechanism leads to change distribution of sequences, which means changing the distribution of the odd numbers that turns to the sequences. When apply this mechanism, some odd numbers will not reach 1, thus those numbers will not let some other odd numbers reach 1. What makes the odd numbers reach 1, is when apply a $(3n + 1)$ mechanism, any two odd numbers never become into the sequences of each other at the same time, only one of them does and the other one moves to another sequence which is closer to 1, for sure. While a $(3n - 1)$ mechanism it does. These two mechanism are diametrically opposite. So it is impossible that these two opposite mechanisms leads to the same result.

For example:

<u>11 22 44 88 176 352 704 1408…</u>

<u>22 88 352 1408…</u>

$f(n) = 3n + 1$

$f(n) = 3 \times 7 + 1 = 22$

$f(n) = 3 \times 29 + 1 = 88$

$f(n) = 3 \times 117 + 1 = 352$

$f(n) = 3 \times 469 + 1 = 1408$

.

<u>7 29 117 469…</u>

$f(n) = 7+(22+88+352+1408+\ldots)$,

which means: (7, 29, 117, 469, 1877, …).

Well, now for example the next odd numbers (7, 29, 117, 469, 1877, …), when we apply a $(3n + 1)$ mechanism to them, can be divide by two until arriving to eleven. But the number eleven itself, will never become into any sequence of those numbers. When we triple it and adding one to it, will move to another sequence which is closer to 1.

Now, let's apply the same steps to the number 5, but not by a ($3n$ + 1) mechanism this time, but by a ($3n$ – 1) mechanism as follows:

5 10 20 40 80 160 320 640…

20 80 320…

$f(n) = 3n - 1$

$f(n) = 3 \times 7 - 1 = 20$

$f(n) = 3 \times 27 - 1 = 80$

$f(n) = 3 \times 107 - 1 = 320$

7 27 107…

$f(n) = 7+(20+80+320+\ldots)$,

which means: (7, 27, 107, 427, …).

Now, the next odd numbers (7, 27, 107, …) when we apply a ($3n$ – 1) mechanism to them, can be divide by two until arriving to five. And the number five itself, will become into an sequence of those odd numbers after applying ($3n$ – 1) mechanism to it, which is into the number seven's sequence. That's why a ($3n$ – 1) mechanism is not true.

No matter which of the mechanism we apply, whether it is: ($3n$ + 1), ($6n$ + 2), ($12n$ + 4), ($24n$ + 8), ($48n$ + 16), ($96n$ + 32), ($192n$ + 64)… the number of steps will be constant and does not change. Meanning: (How many times an odd number needs to repeat a ($3n$ + 1) mechanism to reach 1, is the same when we apply those mechanisms). How could be that possible ? Well, it is possible and simple as follows:

1 2 4 8 16 32 64…

\+ + + + + + +…

$3n$, $6n$, $12n$, $24n$, $48n$, $96n$, $192n$…

Well, since a ($3n$ + 1) mechanism is true, the equation is the same as follows:

1 1, 1 1, 1, 1, 1 1, 1, 1, 1, 1, 1, 1, 1…

3 3, 3 3, 3, 3, 3 3, 3, 3, 3, 3, 3, 3, 3…

What happening is the two halves will exchange according to the mechanism that we apply, and they are working together with the odd and even numbers which divisible by three, to keep the equation constanting and do not change. And the next numbers (3, 6, 12, 24, 48, 96, 192, …) are multiplying with exact same the sequences's values. Which means the distances as a value, will be the same.

In short, the Collatz conjecture is true, only when we apply mechanisms as follows:

$(3n + 1)$, $(6n + 2)$, $(12n + 4)$, $(24n + 8)$, $(48n + 16)$, $(96n + 32)$, $(192n + 64)$…

My next research for publishing, will be about the prime numbers. What is it, what is the function that responssible of it's distribution, why they become rare when progress, how to break all systems that encoded by two or more of prime numbers, and more. In addition to whether (p = np), or (p $\neq$ np). Imposed Me Collatz's conjecture, to publish these two conjectures also as soon as possible.

Actually, I have already solved both of them as well, but at the moment I will be waiting for mathematicianes, to decide about Collatz conjecture firstly.

*** At The End**

Not everything math tells us necessarily mean already it exists. Sometimes, it tells us what it can exist at any time and any where. And there is nothing in what is called the invention, and everything that we calles it an invention is nothing but a discovered of what was unknown and can be discovered later.