Proof of Syracuse-Collatz-3n+1-conjecture

Objet: Proof of Syracuse-Collatz-3n+1-conjecture.

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Remarque's:

- ✓ I am not a professional of mathematics.
- ✓ My English is poor. I use **google translate** to write these pages.

I build an array that contain all the even integers as below:

$c \backslash 2^n$	$2^1=2$	$2^2=4$	$2^3=8$	$2^4=16$	$2^5=32$	$2^6=64$	$2^7=128$	...
1	$1*2^1$	$1*2^2$	$1*2^3$	$1*2^4$	$1*2^5$	$1*2^6$	$1*2^7$	...
3	$3*2^1$	$3*2^2$	$3*2^3$	$3*2^4$	$3*2^5$	$3*2^6$	$3*2^7$	...
5	$5*2^1$	$5*2^2$	$5*2^3$	$5*2^4$	$5*2^5$	$5*2^6$	$5*2^7$	...
7	$7*2^1$	$7*2^2$	$7*2^3$	$7*2^4$	$7*2^5$	$7*2^6$	$7*2^7$	...
9	$9*2^1$	$9*2^2$	$9*2^3$	$9*2^4$	$9*2^5$	$9*2^6$	$9*2^7$	...
11	$11*2^1$	$11*2^2$	$11*2^3$	$11*2^4$	$11*2^5$	$11*2^6$	$11*2^7$	...
13	$13*2^1$	$13*2^2$	$13*2^3$	$13*2^4$	$13*2^5$	$13*2^6$	$13*2^7$	...
...	...	...	...	...	...	...	...	...

- The first row contains the sequence 2^n.
- The first column contain a list of odd integers (b)
- Each box contain ($b = c*2^n$)

$$a = (b - 1) / 3$$

This array contain all even integers

$c \setminus 2^n$	$2^1=2$	$2^2=4$	$2^3=8$	$2^4=16$	$2^5=32$	$2^6=64$	$2^7=128$	...
1	2	4	8	16	32	64	128	...
3	6	12	24	48	96	192	384	...
5	10	20	40	80	160	320	640	...
7	14	28	56	112	224	448	896	...
9	18	36	72	144	288	576	1152	...
11	22	44	88	176	352	704	1408	...
13	26	52	104	208	416	832	1664	...
15	30	60	120	240	480	960	1920	...
17	34	68	136	272	544	1088	2176	...
19	38	76	152	304	608	1216	2432	...
21	42	84	168	336	672	1344	2688	...
23	46	92	184	368	736	1472	2944	...
25	50	100	200	400	800	1600	3200	...
27	54	108	216	432	864	1728	3456	...
29	58	116	232	464	928	1856	3712	...
31	62	124	248	496	992	1984	3968	...
33	66	132	264	528	1056	2112	4224	...
35	70	140	280	560	1120	2240	4480	...
37	74	148	296	592	1184	2368	4736	...
39	78	156	312	624	1248	2496	4992	...
41	82	164	328	656	1312	2624	5248	...
43	86	172	344	688	1376	2752	5504	...
...	...	...	...	...	...	...	...	...

Each row contain a geometric progression

- The initial term is an odd integer
- The constant is 2

The initial term divides any even integer in progression

any even integer can be represented as
$b = c * 2^n$ (c : odd integer, b :even integer)
So, In this array all even integers are present one and only one once

The array shows some geometric progression

In the 3 following pages, we will remove even integers that cannot be in the form $(3a + 1)$
Only even integer (modulo 3 =1) is in form 3a+1.

Remove from this array integers cannot be equal to 3a+1 (1st case, c multiple of 3)

$c \backslash 2^n$	$2^1=2$	$2^2=4$	$2^3=8$	$2^4=16$	$2^5=32$	$2^6=64$	$2^7=128$	...
1	2	4	8	16	32	64	128	...
3								...
5	10	20	40	80	160	320	640	...
7	14	28	56	112	224	448	896	...
9								...
11	22	44	88	176	352	704	1408	...
13	26	52	104	208	416	832	1664	...
15								...
17	34	68	136	272	544	1088	2176	...
19	38	76	152	304	608	1216	2432	...
21								...
23	46	92	184	368	736	1472	2944	...
25	50	100	200	400	800	1600	3200	...
27								...
29	58	116	232	464	928	1856	3712	...
31	62	124	248	496	992	1984	3968	...
33								...
35	70	140	280	560	1120	2240	4480	...
37	74	148	296	592	1184	2368	4736	...
39								...
41	82	164	328	656	1312	2624	5248	...
43	86	172	344	688	1376	2752	5504	...
...	...	...	...	...	...	...	...	...

<u>1st case</u>

(3a+1) is prime with 3 because 3 not divide (3a+1)

In all suites, that odd integer is a multiple of 3, (a = b-1 /3) cannot be an integer

integer modulo 3 = 0 is prime with (3a+1)

Remove from this array integers cannot be equal to 3a+1 (2nd case integer “c modulo 3 = 1” and “2^n modulo 3 = 2”)

$c \setminus 2^n$	$2^1=2$	$2^2=4$	$2^3=8$	$2^4=16$	$2^5=32$	$2^6=64$	$2^7=128$	...
1		4		16		64		...
3								...
5	10	20	40	80	160	320	640	...
7		28		112		448		...
9								...
11	22	44	88	176	352	704	1408	...
13		52		208		832		...
15								...
17	34	68	136	272	544	1088	2176	...
19		76		304		1216		...
21								...
23	46	92	184	368	736	1472	2944	...
25		100		400		1600		...
27								...
29	58	116	232	464	928	1856	3712	...
31		124		496		1984		...
33								...
35	70	140	280	560	1120	2240	4480	...
37		148		592		2368		...
39								...
41	82	164	328	656	1312	2624	5248	...
43		172		688		2752		...
...	...	...	...	...	...	...	...	...

2nd case

$b = c * 2^n$

If (c modulo 3 = 1) and (2^n modulo 3 = 2) than (b modulo 3) cannot be equal 1.

Remove from this array integers cannot be equal to 3a+1 (3rd case : "c modulo 3 = 2" and "2^n modulo 3 = 1")								
c \ 2^n	**2^1=2**	**2^2 =4**	**2^3=8**	**2^4 =16**	**2^5 =32**	**2^6 =64**	**2^7=128**	**...**
1		4		16		64		...
3								...
5	10		40		160		640	...
7		28		112		448		...
9								...
11	22		88		352		1408	...
13		52		208		832		...
15								...
17	34		136		544		2176	...
19		76		304		1216		...
21								...
23	46		184		736		2944	...
25		100		400		1600		...
27								...
29	58		232		928		3712	...
31		124		496		1984		...
33								...
35	70		280		1120		4480	...
37		148		592		2368		...
39								...
41	82		328		1312		5248	...
43		172		688		2752		...
...	...	...	...	...	...	...	...	...

3rd case

b = **c * 2^n**

If (c modulo 3 = 2) and (2^n modulo 3 = 1) than (b modulo 3) cannot be equal 1.

This array contain even integers "integers Collatz" :

b = x/2 and b= 3a+1

List of integers 3a+1			
a	**3a + 1**	**(3a + 1) – 4/ 6**	
1	4	0	
3	10	1	
5	16	2	
7	22	3	
9	28	4	
11	34	5	we can notice that the list of integers (3a+1) is an arithmetic progression that:
13	40	6	The initial term = 4
15	46	7	The constant = 6;
17	52	8	a ==➔ 3a +1
19	58	9	a + 2 ==➔ 3(a +2) + 1= 3a + 6 + 1
21	64	10	a + 4 ==➔ 3(a +4) + 1= 3a + 12 + 1
23	70	11	
25	76	12	we can subtract 4 from each term and divide it by 6, we obtain list of natural numbers
27	82	13	
29	88	14	
31	94	15	$3a+1 = c * 2^n$
33	100	16	
35	106	17	
37	112	18	
39	118	19	
41	124	20	
43	130	21	
..	...	..	

Now, Calculate odd integers (a = b – 1 / 3)

We take away 1 from Each even integer, and divide it by 3, we get an odd integer
as the array shows the even integers of the form 3a+1, so we calculate **a = (b – 1) / 3**

$c\backslash 2^n$	$2^1=2$	$2^2=4$	$2^3=8$	$2^4=16$	$2^5=32$	$2^6=64$	$2^7=128$	...
1		1		5		21		...
3								...
5	3		13		53		213	...
7		9		37		149		...
9								...
11	7		29		117		469	...
13		17		69		277		...
15								...
17	11		45		181		725	...
19		25		101		405		...
21								...
23	15		61		245		981	...
25		33		133		533		...
27								...
29	19		77		309		1237	...
31		41		165		661		...
33								...
35	23		93		373		1493	...
37		49		197		789		...
39								...
41	27		109		437		1749	...
43		57		229		917		...
...	...	..	...	...	...	...	...	...

The odd integers listed in this array in row and in column

Each column (2^n) constitute a arithmetic progression
(Constant = 2^{n+1})

This array should contain any odd integer

To summarize

- The array contains all even integers;
- Each integer is present one and only one once;
- Remove from this array integers cannot be equal to 3a+1;
- We calculate odd integers from even integers a = (b - 1) / 3;
- The array contains all odd integers

The first line (row-1)
Any odd integer, if we multiply it by 3 and add 1 to it will result is $1 * 2^n$
Simply divide by 2^n, we arrive to 1
Row-1 contains 1→1; 5; 21…
These odd integers (5; 21…) are initial terms in other rows
5→3; 13; 53; 213…
21→
In these new rows there are other odd integers that are initial terms in new rows;
And so on...
follow the opposite path, we reach 1

Any odd integer c exist in the first column one and only one once
Any odd integer a exist in array one and only one once
Any odd integer a in array, have odd integer c, and any odd integer c exist in array.

The proof of the conjecture is made