

Discrete Structures: CMPSC 102

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Fall 2019
Week 9

Let's Discuss

Discrete
Structures:
CMPSC 102

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Let's Discuss

Rules

Survey

Further
Learning

Key Questions

How do I place an equation and a system of logic into Python code?

Learning Objectives

To **remember** and **understand** some the concepts involved with placing mathematical logic into code.

An Easy, *Hard* Problem

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A problem for which Mathematics is not ready. Paul Erdős

Rules: the **Collatz** or **Hailstone** Problem

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

- The $3x+1$ problem concerns an iterated function
- The question is to determine whether the function always reaches a value of 1 when starting from any positive integer.

Trajectory

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$$f(x) = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even} \\ 3n + 1 & \text{if } n \text{ is odd} \end{cases}$$

- Start = 4 (is even)
 - $f(4) = \frac{4}{2} = 2$ (is even)
 - $f(2) = \frac{2}{2} = 1$ (stop here)
- Last three elements of sequence: {4, 2, 1}

- Start = 5 (is odd)
 - $f(5) = 3(5) + 1 = 16$ (is even)
 - $f(16) = \frac{16}{2} = 8$ (is even)
 - $f(8) = \frac{8}{2} = 4$ (is even)
 - $f(4) = \frac{4}{2} = 2$ (is even)
 - $f(2) = \frac{2}{2} = 1$ (stop here)
- Last three elements of sequence: {4, 2, 1}

Trajectory

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[+] Seed Number: 7

1.	7	odd
2.	22	even
3.	11	odd
4.	34	even
5.	17	odd
6.	52	even
7.	26	even
8.	13	odd
9.	40	even
10.	20	even
11.	10	even
12.	5	odd
13.	16	even
14.	8	even
15.	4	even
16.	2	even
17.	1	odd

[+] Seed Number: 15

1.	15	odd
2.	46	even
3.	23	odd
4.	70	even
5.	35	odd
6.	106	even
7.	53	odd
8.	160	even
9.	80	even
10.	40	even
11.	20	even
12.	10	even
13.	5	odd
14.	16	even
15.	8	even
16.	4	even
17.	2	even
18.	1	odd

[+] Seed Number: 70

1.	70	even
2.	35	odd
3.	106	even
4.	53	odd
5.	160	even
6.	80	even
7.	40	even
8.	20	even
9.	10	even
10.	5	odd
11.	16	even
12.	8	even
13.	4	even
14.	2	even
15.	1	odd

- All sequences end with {8, 4, 2, 1}

Trajectory

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[+] Seed Number: 106

1.	106	even
2.	53	odd
3.	160	even
4.	80	even
5.	40	even
6.	20	even
7.	10	even
8.	5	odd
9.	16	even
10.	8	even
11.	4	even
12.	2	even
13.	1	odd

[+] Seed Number: 600

1.	600	even
2.	300	even
3.	150	even
4.	75	odd
5.	226	even
6.	113	odd
7.	340	even
8.	170	even
9.	85	odd
10.	256	even
11.	128	even
12.	64	even
13.	32	even
14.	16	even
15.	8	even
16.	4	even
17.	2	even
18.	1	odd

39.	29	odd
40.	88	even
41.	44	even
42.	22	even
43.	11	odd
44.	34	even
45.	17	odd
46.	52	even
47.	26	even
48.	13	odd
49.	40	even
50.	20	even
51.	10	even
52.	5	odd
53.	16	even
54.	8	even
55.	4	even
56.	2	even
57.	1	odd

- All sequences end with $\{8, 4, 2, 1\}$

Your Task!

06_survey_theeXPlusOne_starter

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Make your own sequence builder

- Add functionality to model system of equations to build a sequence
- Allow user to input seed numbers
- Output to screen the *3xplus1* sequence
- Allow program to run without errors.

https://classroom.github.com/a/_XVhojpu

THINK

- Wikipedia: Collatz Conjecture
 - https://en.wikipedia.org/wiki/Collatz_conjecture
- The Simplest Math Problem No One Can Solve - Collatz Conjecture
 - <https://www.youtube.com/watch?v=094y1Z2wpJg>
- UNCRACKABLE? The Collatz Conjecture - Numberphile
 - <https://www.youtube.com/watch?v=5mFpVDpKX70>