CS167 - Intro Programming

Albert Schueller
Spring 2016, 10TThF, Olin 165

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Homework 03: Hailstone Sequence (due Feb 09, 2016)

1. Each person in the group create a free account at Project Euler. As a group do one of the first 10 problems. Include an A&B element. Submit the .py file to me via the file upload link on the class web page.
2. The well-known (to mathematicians) Collatz conjecture states that:

   The Hailstone Sequence terminates for every integer $n_0 > 0$.

   The Hailstone Sequence starts with a positive integer n_0 and subsequent terms are generated by the following rule:

   $$n_{i+1} = \begin{cases} 1, & \text{if } n_i = 1, \\ n_i/2, & \text{if } n_i \text{ is even}, \\ 3n_i + 1, & \text{if } n_i \neq 1 \text{ and } n_i \text{ is odd}. \end{cases}$$

   We say that the sequence *terminates* if $n_\ell = 1$ for some ℓ. Furthermore, we say that the *length* of the sequence corresponding to n_0 is the first ℓ for which $n_\ell = 1$.

   Collatz' conjecture simply says that for any $n_0 > 0$, ℓ is finite. This is interesting because the rules in the Hailstone Sequence sometimes cause the terms to grow (go away from 1) and other times cause the terms to shrink (go towards 1). There is no *a priori* reason to think that the *shrinking* will always win out over the *growing*. However, experimental evidence (computer) has shown this to be the case for values up to $2^{60} \approx 1.153 \times 10^{18}$. -Wikipedia

   For example, suppose we start with $n_0 = 10$. According to the Hailstone formula, since $n_0 \neq 1$ and n_0 is even, $n_1 = 10/2 = 5$. Since $n_1 \neq 1$ and n_1 is odd, $n_2 = 3 \cdot 5 + 1 = 16$. Continuing we get the sequence:

   $$\begin{aligned} n_0 &= 10 \\ n_1 &= 5 \\ n_2 &= 16 \\ n_3 &= 8 \\ n_4 &= 4 \\ n_5 &= 2 \\ n_6 &= 1 \end{aligned}$$

   Hence, the length, ℓ, of the sequence corresponding to 10 is 6. Write a program the computes the length of the Hailstone Sequence corresponding to a positive integer, n_0, that the user enters. Your program should have the following features:

   I. Request a starting integer n_0 from the user. Keep requesting the integer until it is positive.
   II. Use a while loop to compute the length of the requested sequence.
   III. Provide user feedback.
   IV. Offer to show the terms of the sequence upon request.
   Loading [MathJax]/extensions/MathMenu.js f the requested sequence.
   VI. Have a well-designed input and reporting scheme.

VII. An Above & Beyond comment.

Once you get your program up and running, explore, but don't get obsessed.

Homework 03 Pairings:

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['Eastland-Fruit, Ridley', 'Bruns, Adam']
['Mullins, Will', 'Klein, Emily']
['Hoffman, Daniel', 'Mueller, Spencer']
['Blausapp, Yarden', 'Robinson, Nick']
['Valence, Jini', 'Clark, Zachary']
['Hochfeld, Nick', 'Over, Clayton']
['Wang, Jingyuan', 'Donner, Eliza']
['Novak, Hannah', 'Coutret, Eloise']
['Jarriel, Kaylin', 'Brothers, Robby']
['Karneus, Louise', 'Wheeler, Noah']
['Walker, Stanley', 'Obey, Kevin']
['Fernandez Orozco, Pablo', 'Stanley, Jenna']
['Ashley, George', 'Salkind, Quinn']
['Hayes, Nelson', 'Warren, Tyler']
['Chun, Catie', 'Anderson, Alec']
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