

## Hailstone Sequence

Douglas Hofstadter's Pulitzer-prize-winning book Gödel, Escher, Bach contains many interesting mathematical puzzles, many of which can be expressed in the form of computer programs. In Chapter XII, Hofstadter mentions a wonderful problem that is well within the scope of the control statements from Chapter 4. The problem can be expressed as follows:

Pick some positive integer and call it  $n$ .  
If  $n$  is even, divide it by two. If  $n$  is odd, multiply it by three and add one.  
Continue this process until  $n$  is equal to one.

On page 401 of the Vintage edition, Hofstadter illustrates this process with the following example, starting with the number 15:

15	is odd, so I make $3n+1$ :	46
46	is even, so I take half:	23
23	is odd, so I make $3n+1$ :	70
70	is even, so I take half:	35
35	is odd, so I make $3n+1$ :	106
106	is even, so I take half:	53
53	is odd, so I make $3n+1$ :	160
160	is even, so I take half:	80
80	is even, so I take half:	40
40	is even, so I take half:	20
20	is even, so I take half:	10
10	is even, so I take half:	5
5	is odd, so I make $3n+1$ :	16
16	is even, so I take half:	8
8	is even, so I take half:	4
4	is even, so I take half:	2
2	is even, so I take half:	1

As you can see from this example, the numbers go up and down, but eventually—at least for all numbers that have ever been tried—comes down to end in 1. In some respects, this process is reminiscent of the formation of hailstones, which get carried upward by the winds over and over again before they finally descend to the ground. Because of this analogy, this sequence of numbers is usually called the Hailstone sequence, although it goes by many other names as well.

Write a program that reads in a number from the user and then displays the Hailstone sequence for that number, just as in Hofstadter's book, followed by a line showing the number of steps taken to reach 1. For example, your program should be able to produce a sample run that looks like this:

The screenshot shows a window titled "Hailstone". The menu bar includes "File" and "Edit". The main text area displays the following sequence of numbers:

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Enter a number: 17
17 is odd, so I make 3n + 1: 52
52 is even so I take half: 26
26 is even so I take half: 13
13 is odd, so I make 3n + 1: 40
40 is even so I take half: 20
20 is even so I take half: 10
10 is even so I take half: 5
5 is odd, so I make 3n + 1: 16
16 is even so I take half: 8
8 is even so I take half: 4
4 is even so I take half: 2
2 is even so I take half: 1
The process took 12 to reach 1
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The fascinating thing about this problem is that no one has yet been able to prove that it always stops. The number of steps in the process can certainly get very large. How many steps, for example, does your program take when  $n$  is 27?