C++ Tres Caballeros Collatz Conjecture

Time required: 90 minutes

- Comment each line of code as shown in the tutorials and other code examples.
- Follow all directions carefully and accurately.
- Think of the directions as minimum requirements.

Pseudocode

1. Write pseudocode or TODO for the exercise
2. Submit with the assignment

Scenario

In 1937, a German mathematician named Lothar Collatz formulated an intriguing hypothesis (it remains unproven) which can be described in the following way:

1. Take any non-negative and non-zero integer number and name it c0;
2. If it's even, evaluate a new c0 as c0 // 2 (Integer division)
3. Otherwise, if it's odd, evaluate a new c0 as (3 × c0) + 1
4. If c0 ≠ 1, skip to step 2.

The hypothesis says that regardless of the initial value of c0, it will always go to 1.

It's an extremely complex task to use a computer to prove the hypothesis for any natural number (it may even require artificial intelligence), but you can use Python, Java, and C++ to check some individual numbers. Maybe you'll even find the one which would disprove the hypothesis.

Return a Vector from a Method

Returning a Vector from a method is just a little different than returning a regular variable. The difference is how you declare the return data type.

long long is an integer data type with enough room to calculate big, big numbers.

Return data type: **std::vector<long long>**

Method name: **CalculateCollatz()**

Parameter: **long long num**

Here is a sample signature vector method with a **long long** parameter, and a **vector** return.

```
public:
    std::vector<long long> CalculateCollatz(long long num)
```

Requirements

1. Create a program in C++.
2. Create an OOP file with a collatz calculation method. You do not have to create the class as a separate file, you can create the class in the main file.
    a. This class method will take a **long long** data type as an argument. A long long is a really big int.
    b. The class method will calculate the sequence and store it in a vector.
    c. The vector will be returned to the main method.
3. Input will take place in the main application.
4. Display will take place in the main application.
5. Ask the user to enter a natural number.
6. Calculate the Collatz sequence.
7. Display the input and output as shown.
8. Ask the user if they wish to continue or exit.

Example runs:

```
Enter a number: 15
46 23 70 35 106 53 160 80 40 20 10 5 16 8 4 2 1
Steps: 17
```

```
Enter a number: 16
8 4 2 1
Steps: 4
```

```
Enter a number: 1023
3070 1535 4606 2303 6910 3455 10366 5183 15550 7775 23326 11663 3499
0 17495 52486 26243 78730 39365 118096 59048 29524 14762 7381 22144
11072 5536 2768 1384 692 346 173 520 260 130 65 196 98 49 148 74 37
112 56 28 14 7 22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
Steps: 62
```

Challenge

Which starting number, under one million, produces the longest chain?

Assignment Submission

1. Attach the pseudocode.
2. Attach the program files.
3. Attach screenshots showing the successful operation of the program.
4. Submit in Blackboard.