CS150-01 Lab 4

Number Sequences

Date Assigned: Tuesday, September 21, 2004

Date Due: Tuesday, September 29, 2004

Points: 15

Objectives

This assignment requires the use of both the `if` selection structure and the `while` repetition structure.

Problem statement

There exists in mathematics an algorithm to generate a sequence of numbes. Start with an integer n. If n is even, divide by 2, but if n is odd, multiply by 3 and add 1. Repeat this process with the new value of n, terminating when $n = 1$.

As an example, if $n = 22$, the following sequence will be generated:

```
22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
```

Write a program that will output the sequence that follows this algorithm. You should ask the user to enter the value of n.

Sample output

```
              The 3n + 1 Problem

Enter a whole decimal number:  22
The sequence is:
22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
```

Steps for software development

1. First, we need to understand the program requirements. What needs to be calculated? Is there any additional information that we need?

2. Next, we need a program analysis. Answering the following questions will help guide you through the process.

   (a) What is the input to your program? What units will it be in?

   (b) What is the output to your program? What units will it be in?

   (c) Is there any data that will be internal to your program?

   (d) What are the calculations needed for your program?

3. What is the algorithm to solve this problem? Here you should describe in English the steps for solving the program. This is the place where you decide the specifics of your program. For example, if you need to use the `if` selection structure or the `while` repetition structure.

4. Create a new project in Visual Studio .NET. You should name your project "04SequencePUNetId", where PUNetId is your own id. I would name my project "04Sequencekhoj0332". While working on a project, it should be located on the current computer you are working on (i.e. the desktop). Once you have completed developing, you should copy the project folder onto Turing.

5. Write the code that will solve the problem. Make sure that you add comments to the code as you type and that your code follows the coding standards

6. How can you verify that your program works correctly? What numbers would you use to test the program.

Optional extension

Once you have completed all of the above, have a go at trying to expand the capabilities of your program.

As well as figuring out the sequence of numbers that follow the algorithm for a given input value n, you should display a count of the numbers in the sequence.

```
                    The 3n + 1 Problem

      Enter a whole decimal number:   22
      The sequence is:
      22 11 34 17 52 26 13 40 20 10 5 16 8 4 2 1
      There are 16 numbers in this sequence
```

What to turn in

When you have completed writing the program and you have verified that it works correctly, you will need to show it to the instructor or the TA.

Once you have done this you will submit the project for grading. You submit your program by placing a copy of the project folder in the "CS150-01 Lab" folder on Turing. Make sure that you also place a copy of the project folder in your own folder on Turing.

To receive full credit for this lab project, your program must be in the "CS150-01 Lab" folder by 8am on Tuesday, September 29.