

Homework #5

Due: 10/28

1. [100 points]

In mathematics, there is a longstanding conjecture, known as the Collatz conjecture, which is based on this sequence of values of n :

```
given any positive integer  $n$ ,
while  $n \neq 1$ ,
  if  $n$  is even
     $n \leftarrow \lfloor \frac{n}{2} \rfloor$ 
  otherwise
     $n \leftarrow 3n + 1$ 
```

The conjecture is that for every given initial n , the sequence will end in 1. In fact, if $n > 2$, it will end in the sequence $\{4, 2, 1\}$.

To quote the famous mathematician Paul Erdos: “Mathematics is not yet ready for such problems.” Nevertheless, it doesn’t hurt to try it out.

Write a MIPS program to allow the user to try out the conjecture. The user will enter an initial n as the first argument on the command line, e.g.:

```
$ ./collatz 42
```

To get that argument (`argv[1]` in C or C++) from the command line, remember that `main()` follows the MIPS convention for arguments and that there’s a function `atoi()` in the standard C library that converts its `char *` argument to an `int`.

Use unsigned arithmetic. Print out n (one value per line with no extra text or spaces) on each iteration of the loop. Print an error message on standard output if the argument is missing or if there is more than one argument.

Be sure to stop the program and print an error message if the unsigned value of $3n + 1$ cannot be represented in 32 bits, since that would be an error in the calculation. How would you test for this?