Scientific Computing

Fitchburg State University
Department of Mathematics
HW #2

September 14, 2016

The following problems should be done in julia. Type up the code you used to find your results and answer all questions. Submit your homework via Blackboard by using any program you want and submitting the PDF version of it. This assignment should be submitted no later than 11:59pm on September 21, 2014.

1. Using your notes from class or those posted, combine the following functions in a single file:

   all_factors : a function that returns all factors of a given positive integer.

   is_prime : a function that returns true if a positive integer is prime or false if it is not.

   next_prime : a function that returns the next larger prime number bigger than the input positive integer.

   list_primes : a function that returns an array (list) of primes between two given inputs.

   is_perfect : a function that returns true if a positive integer is perfect or false if it is not.

   next_perfect : a function that returns the next perfect number larger than a given positive integer.

   Note: load the file with the `include` command and make sure your functions work. You do not need to save any of the output.

   You should provide a text version of your file. Upload this with your assignment.

   Lastly, this file will eventually be turned into a module and we will build some unit tests for this.

2. The following tests your functions above and you should use the functions that you wrote instead of any packages for this problem.

   (a) Print out all prime numbers less than 1000.

   (b) Determine the amount of time to find the smallest prime number bigger than 1000.

   (c) Find all perfect numbers less than 10,000.

   (d) Determine the amount of time to find the smallest perfect number bigger than 1000.

3. A **Mersenne Prime** is a prime number of the form $2^k - 1$ where k is also prime.

   (a) Find the first 6 Mersenne Prime numbers.

   (b) What is the largest value of k such that $2^k - 1$ is a valid 64-bit integer? Find the largest Mersenne Prime that can be written as a 64-bit integer. (Hint: use the `isprime` function in the `Primes` package.)

   (c) Find the smallest Mersenne Prime with $k > 1000$. Hint: use your `prime_list` function to find primes in the correct range and make sure that you `isprime` function in the `Primes` package as well as `BigInt`s.