CSE102: Data Structures and Algorithms, Winter' 17
Lab Assignment 3

Background

Efficiency of algorithms matters even for simple problems.
Fibonacci numbers have many applications in the theoretical as well as applied computer science. They are used in pseudo-random number generators, Fibonacci heap data structure, analyzing efficiency of Euclids algorithm etc. Fibonacci numbers are also found in natural patterns like flower petals.

Exercise

Let F(n) denote nth Fibonacci number. Consider a related computational problem whose input is an integer n and m=2014, and output is (F(n) mod m). Integer n can be any positive integer value up to 10^{18} .
In the course lecture, three algorithms for calculating Fibonacci numbers were discussed. The slides for the same are available on Backpack for reference, as Lecture 5 slides.
The first algorithm was iterative, the second algorithm was recursive and the third algorithm was based on repeated squaring to compute some power of matrix. You have to design and implement three algorithms Rfib, Ifib, and Clever-algo-Fib for the above problem by suitably employing each of these three algorithms respectively. The aim of this exercise is to see how efficiently these algorithms solve the problem in real time.
There are two parts of this exercise. In the first part you have to submit Java program for the three mentioned algorithms on Backpack deadline.
As the value of n increases, some of the above algorithms start taking too much time. The second part of this assignment is to make you realise the importance of having an algorithm which takes lesser time than the trivial implementation. You have to experimentally determine the largest possible value of input for each of algorithms Rfib, Ifib, Clever-algo-Fib for which you get the answer within 1 sec, 10 sec, 1 minute, 10 minutes. If you cannot find a value for a particular time, leave it as blank in the report. Also, plot the time taken by each of the algorithm(details of report and plot template would be shared in lab). You can plot using Excel.

To calculate runtime of code segment, add the following to your code:

```
long startTime = System.currentTimeMillis();

//invoke your fib method here

long endTime = System.currentTimeMillis();
int TimeElapsed= (endTime-startTime)/1000.0; //finds time in seconds
```

The table and graph has to be submitted as a short report, details of which would be shared in the lab.