**oHomework 5**

Problem 5.1

a.

All four method to compute Fibonacci numbers have been implemented in c++ file “5\_1a.cpp”.

b.

The runtime is measured for all the methods using chrono standard library. To make the program stop after a certain amount of time, I have a while (1) loop that either stops when the max time has been reached or when all elements till n is executed in the loop. An example of the implementation is shown below (for naïve recursive method).

A screenshot of a cell phone

Description automatically generated

A table with the time taken for each method is made in a four different data files “naive.txt”, “bottom.txt”, “closed.txt”, “closed.txt”, and “matrix.txt” for naïve recursive method, bottom up method, closed form method, and matrix representation method respectively. The file should be created after the program “5\_1b.cpp” is compiled and executed.

c.

For the same value of n, all four methods might not return the same Fibonacci number! This is because, as the value of n gets larger and closer to infinity, the Closed Form approach contain floating-point errors. We use the equation involving the terms and as a double values, then subtract neg from pos, compute the power of the term to n, then finally divide the term by the square root of 5! This value may round off certain terms based on the property and size of the data type “double”, which may give possible errors.

A close up of a logo

Description automatically generated

d.

The graph has been plotted using gnuplot. To get the graph, one must type “gnuplot plot.plt” into the terminal.

We can see from the graph that …..

Problem 5.2

a.