ESO-207 Programming Assignment-1

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1 Table

The values of the constants used are as follows:
a = 51 : b = 61 : c = 71 : m = 81

Time taken to compute G(n) mod m (in seconds)	10^{-5}	10^{-4}	10^{-3}	10^{-2}	10^{-1}	1	10
Max value of n for recursive algorithm	13	18	23	28	32	37	42
Max value of n for iterative algorithm	410	4848	47600	479900	1200433	48001000	486000000
Max value of n for matrix method	1	$>10^{18}$	$>10^{18}$	$>10^{18}$	$>10^{18}$	$>10^{18}$	$>10^{18}$

2 Plots

1. Recursive Algorithm

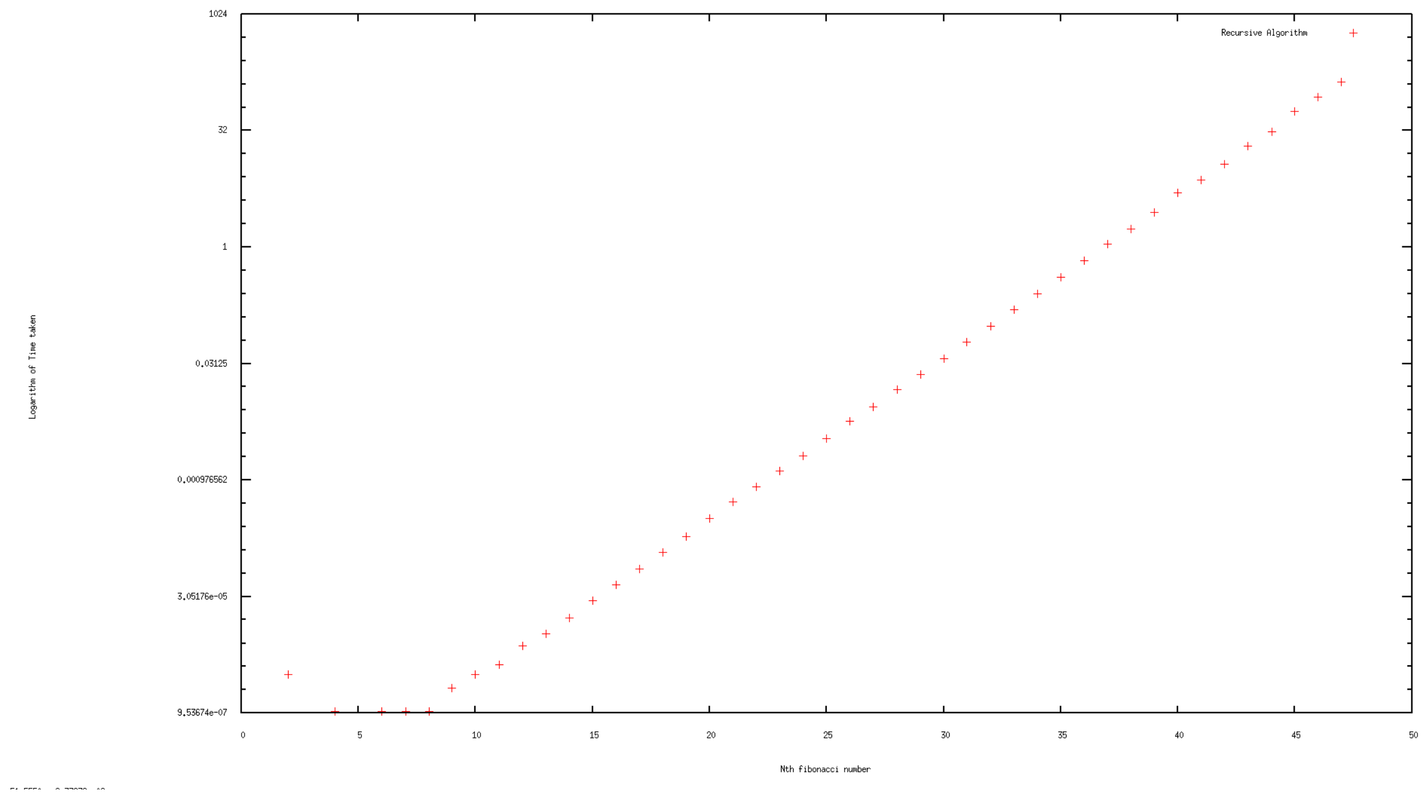

Figure 1: Plot of $log_2 t$ vs n for recursive algorithm

2. Iterative Algorithm

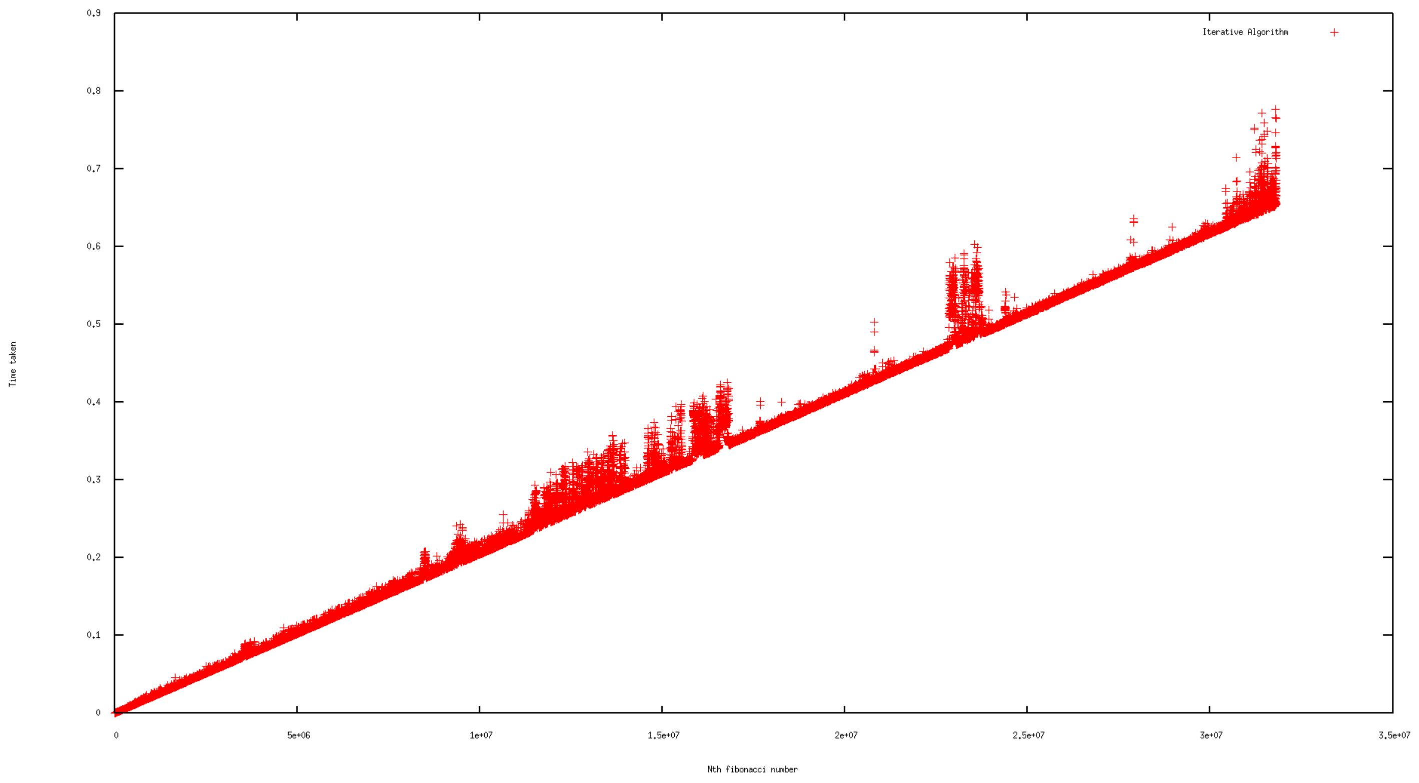

Figure 2: Plot of t vs n for iterative algorithm

3. Matrix-method

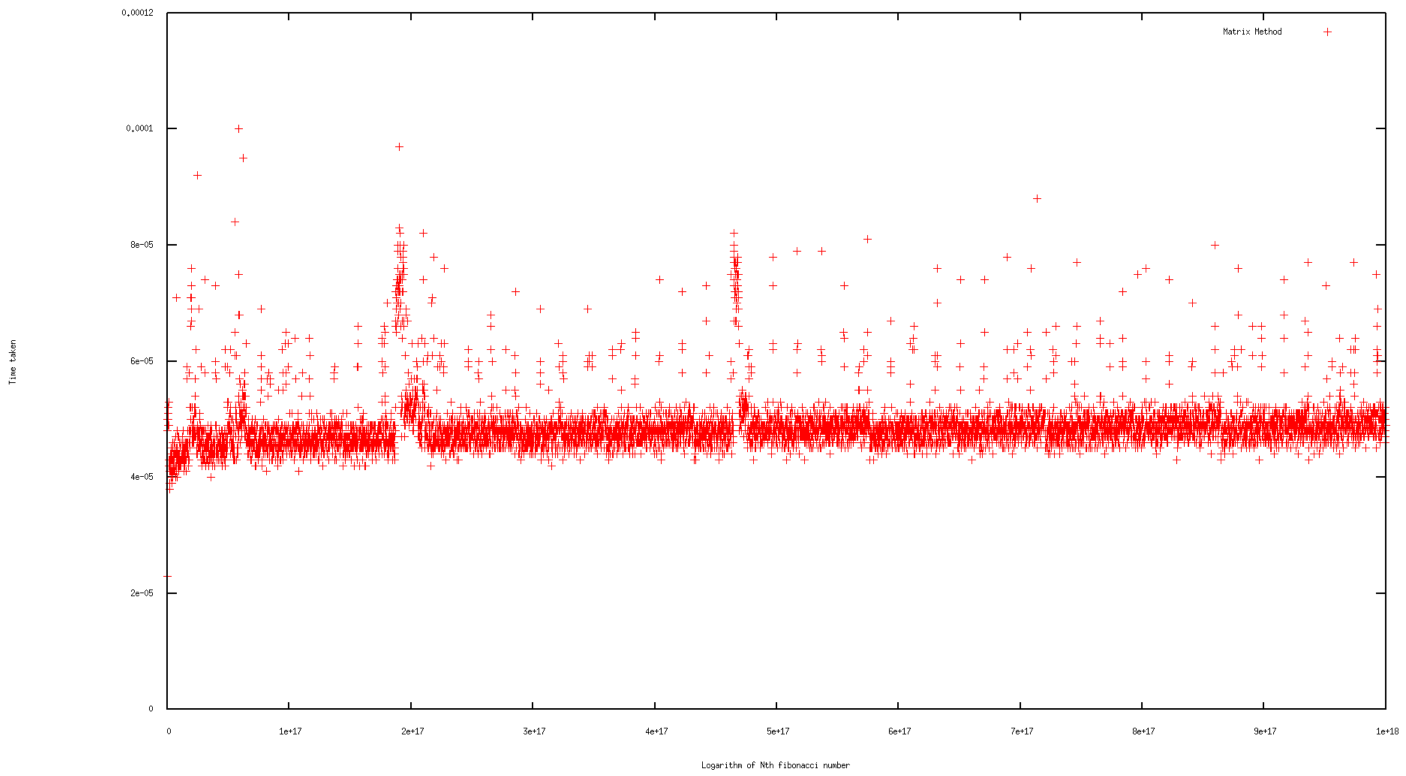

Figure 3: Plot of t vs $log_2 n$ for the matrix-method

- All the three plots are almost linear in shape with little positive deviations in each plot. These deviations are a result of various noise factors relating to the state of processors and the system. Also the graph of matrix-method is almost a constant small value advocating it's high efficiency.

3 Analysis and Conclusion of results

Here we can observe that each of the graphs are linear, and since the graph of recursive algorithm and matrix method have logarithmic scales on y and x axis respectively the Time Complexities of the various algorithms are as follows:

Recursive Algorithm	:	O(2^n)
Iterative Algorithm	:	O(n)
Matrix-method	:	O(log_2n)

With matrix-method being the fastest followed by iterative algorithm and the recursive algorithm being the slowest. The recursive algorithm is inefficient because it calculates the fibonacci numbers less than the n^{th} fibonacci number more than once, while the iterative algorithm does this only once. Hence, due to the redundency in the recursive algorithm it takes much more time than other algorithms. On the other hand the matrix-method calculates the matrices corresponding to fibonacci numbers less than n^{th} fibonacci number in jumps, with each number increasing by a factor of 2. Hence unlike the recursive and iterative algorithm the matrix-method does not calculate all fibonacci numbers less than the n^{th} fibonacci number, instead it calculates only log_2n of them hence has a much greater efficiency than the rest of the 2 algorithms.

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