

## Homework 5

### Problem 5.1 Fibonacci Numbers

b) In the table there are shown different  $n$  values and the corresponding time values in which each method is performed. The time taken by naïve recursion method grows exponentially with the input so even for a simple input like  $n = 100$ , it will take years. The time complexity for bottom-up approach and matrix representation is  $\Theta(n)$  and  $\Theta(\lg n)$  respectively. Closed-form method is the fastest of them four, hence we see that the time values are 0 even though the value can be as big as 100000.

Value of $n$	Naïve recursion	Bottom up	Closed-form	Matrix
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
5	0	0	0	0
7	0	0	0	0
10	0	0	0	0
17	0	0	0	0
25	0	0	0	0
40	1138	0	0	0
52	(very large)	0	0	0
75	(very large)	0	0	0
100	(very large)	0	0	0
350	(very large)	0	0	0
500	(very large)	0	0	0
1000	(very large)	0	0	0
5000	(very large)	0	0	1000
10000	(very large)	1000	0	5000
50000	(very large)	4000	0	42000
100000	(very large)	19000	0	118000

c) Naïve recursion method, bottom-up method and matrix representation method return the same Fibonacci number for the same  $n$ . The number returned by Closed-form method differs a bit for same  $n$  as the other methods due to rounding the number. Hence as the  $n$  grows, the returned number might not be as precise.