**Faculty of Computers and Artificial intelligence**

**Cairo University**

Midterm Exam

|  |  |  |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |
|  |  |

Q1 Using quick sort to sort the following data (5, 2, 4, 8, 0, 3, 1, 7) (5 points)

Show each steps by drawing the array after each operation.

Q2 Using recursion tree to solve (9 points)

1. T(n) = 4T(n/2) + n (3 points)
2. T(n) = 4T(n/4) + n0 (3 points**)**
3. T(n) = 2T(n/2) + n(3 points)

Q3 Prove that (9 points) Best case of quick sort = nlgn using recursion tree .

Q4 what is properties of Red Black tree and how can you get the maximum of tree and predecessor of any key, write a pseudo-code for these functions ? (4 points)

Q5 what is the time complexity T (n) of the nested loops below? For simplicity, you may assume that n is a power of 3. That is, n = 2k for some positive integer k. [4 points]

for (i = 1; i <= n; i++)

{

j = n2;

While (j > = 1)

{ < body of the while loop > //Needs Θ (1).

j = [j/2];

}

}

Q6 Given the following recursion function:-

F (n) = n when n >=0 and n <2

F (n) = F (n-1) + F (n-2) when n>=2

Solve this problem in three different ways such as what was explained in the lectures and determine what its complexity. And compute f(5) by each methods and show the steps of your answer.[9 points]