

Fundamentals of computer science 1
Theory – Mid Term exam -- MOCK

Name (block letters):

Student ID:

I hereby undertake to respect the regulations described in the Honor Code.

Signature:

(1) You have two algorithms, say A₁ and A₂, which take a number of steps t₁(n) and t₂(n) respectively to solve the same problem of size n:

$$t_1(n) = 2 n^3$$

$$t_2(n) = 8 n^2$$

For which value of n would you switch from one algorithm to the other in order to keep the running time minimum?

(2) Given: $f(n) = 2 n^{3/2} + n^2 + n \lg n$. Is $f(n) = \Theta(n^2)$? Derive the answer.

(3) Given the recurrence: $T(n) = 9 T\left(\frac{n}{3}\right) + n^2$. Is $T(n) = \Theta(n^2 \lg n)$?

Discuss the result by applying the master theorem.

(4) Describe the **binary search** algorithm. Write the recurrence equation for the running time and show that $T(n) = \Theta(\lg n)$.

(5) Define Breadth First Search algorithm for exploring connected components of a graph.

(6) For any graph $G(V, E)$ prove:

(I) $\sum_{v \in V} d(v) = 2 |E|$ where $d(v)$ is the degree of the vertex.

(II) The number of vertices of odd degree is even.

(7) Write the pseudo-code for the Insertion Sort algorithm