

 <p>الجامعة المصرية اليابانية للعلوم والتكنولوجيا <b>E-JUST</b> Egypt - Japan University of Science and Technology エジプト日本科学技術大学</p>	<b>Assignment 2: Spring 2021</b>
Department	Computer Science and Engineering
Submission due	Tue, Apr 6th, 2021 by 9:30am
Date	31/03/2021
Course Title	CSE 326: Analysis and Design of Algorithms
Instructor	Prof. Walid Gomaa
Allowed Equipment	

**Answer all of the following questions**

1. What is the asymptotic complexity of an algorithm with runtime  $T(n, n)$  defined by the following recurrence equation?

$$T(x, y) = \begin{cases} T(x, c) = \Theta(x) & \text{for } c \leq 2 \\ T(c, y) = \Theta(y) & \text{for } c \leq 2 \\ T(x, y) = T(\frac{x}{2}, \frac{y}{2}) + \Theta(x + y) & \text{otherwise} \end{cases} \quad (1)$$

2. For each of the following recurrences, give an expression for the runtime  $T(n)$  if the recurrence can be solved with the Master Theorem. Otherwise, indicate that the Master Theorem does not apply.

- (a)  $T(n) = 3T(n/2) + n^2$
- (b)  $T(n) = 4T(n/2) + n^2$
- (c)  $T(n) = T(n/2) + 2^n$
- (d)  $T(n) = 2^n T(n/2) + n^n$
- (e)  $T(n) = 16T(n/4) + n$
- (f)  $T(n) = 2T(n/2) + n/\log n$
- (g)  $T(n) = 2T(n/4) + n^{0.51}$
- (h)  $T(n) = 0.5T(n/2) + 1/n$
- (i)  $T(n) = 16T(n/4) + n!$
- (j)  $T(n) = \sqrt{2}T(n/2) + \log n$
- (k)  $T(n) = 6T(n/3) + n^2 \log n$
- (l)  $T(n) = 4T(n/2) + n/\log n$
- (m)  $T(n) = 64T(n/8) - n^2 \log n$
- (n)  $T(n) = 7T(n/3) + n^2$
- (o)  $T(n) = 4T(n/2) + \log n$
- (p)  $T(n) = T(n/2) + n(2 - \cos n)$

3. What is the asymptotic complexity of an algorithm with runtime  $T(n, n)$  defined by the following recurrence equation?

$$\begin{cases} T(x, c) = \Theta(x) & \text{for } c \leq 2 \\ T(x, y) = S(x, y/2) + \Theta(x) \\ S(c, y) = \Theta(y) & \text{for } c \leq 2 \\ S(x, y) = T(x/2, y) + \Theta(y) \end{cases} \quad (2)$$

4. Solve the following recurrences:

(a)

$$T(n) = 2T(\lfloor \sqrt{n} \rfloor) + \log n \quad \text{with } T(1) = \Theta(1) \quad (3)$$

(b)

$$T(n) = T(n/3) + T(2n/3) + \mathcal{O}(n) \quad (4)$$