United International University (UIU)

Dept. of Computer Science & Engineering (CSE)
Mid Exam   Year: 2021   Trimester: Summer
Course: CSE 2217/CSI 227 Data Structure and Algorithms II,
Total Marks: 20, Time: 1 hour, Upload & Download: 15 min

(Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules)

There are THREE questions. Answer all of them. Figures in the right-hand margin indicate full marks.

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1. a) What does it mean when we say that an algorithm X is asymptotically more efficient than Y?   [1]

   b) Prove that divide and conquer method will give maximum sum subarray in *O(nlogn)* time when *n>1*   [2]

   c) Suppose you have to choose among two algorithms to solve a problem: [2]
      o Algorithm X solves an instance of size n by recursively solving four instances of size n/2, and then combining their solutions in time O(n).
      o Algorithm Y solves an instance of size n by recursively solving four instances of size 3n, and then combining their solutions in time O(1).
   Which one is preferable, and why?

   d) Analyze the time complexity of the following algorithm and express in big-O notation: [2]

```
func eatChips(int bowlOfChips) {

        Println("Have some chips!")

        for chips := 0; chips <= bowlOfChips; chips++ {

                // dip chips

        }

        Println("No more chips.")

    }

func pizzaDelivery(int boxesDelivered) {

        Println("Pizza is here!")

        for pizzaBox := 0; pizzaBox <= boxesDelivered; pizzaBox++ {

                // open box
```

```
for pizza := 0; pizza <= pizzaBox; pizza++ {

    // slice pizza

    for slice := 0; slice <= pizza; slice++ {

        // eat slice of pizza

    }

    }

}

Println("Pizza is gone.")

}
```

2. a) Find an optimal solution to the 0/1 knapsack instance of n = 4, W = 5, (v1, v2, v3, v4) = (50,   [3+2]
    30, 35, 60), and (w1, w2, w3, w4) = (2, 2, 1, 3).
    Also find the optimal solution considering the fractional knapsack problem for the same instance.

    b) Consider the following five symbols present in a file along with their frequencies: [2+1]

a	b	c	d	e
3	1	1	3	2

   Construct the tree for finding codes from the Huffman encoding algorithm and write the optimal
   encoding codes for each symbol. **You must show the tree constructed by the algorithm and
   for each intermediate constructed node mention the creation sequence number.** For
   example, if you form a node t with a and b at first mention 1 beside the node t and then if form a
   node s with c and d next mention 2 beside the node s.

3. a) Discuss how the problem of computing the Fibonacci sequence demonstrates overlapping   [2]
    subproblems. Also, discuss how dynamic programming helps optimizing the computation.

    b) How can you detect cycle in a directed graph using DFS?   [1]

    c) Maloins are used as coins in the Maliceland for daily transactions. In its monetary system,   [2]
    Maliceland has the following coins available: {1, 7, 12, 25}. Show an example of an amount
    where the greedy strategy for the Coin-Change problem does not provide an optimal solution.