



United International University (UIU)
Dept. of Computer Science and Engineering (CSE)

Mid Exam

Year: 2025

Semester: Spring

Course Code: CSE 2217

Title: Data Structure and Algorithms II (BSDS)

Marks: 30

Time: 1 Hour 30 minutes

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

Answer all the questions. All questions are of values indicated on the right-hand margin.

1. (a) Suppose A problem X of size n can be divided into three subproblems each of size $n/4$; each of the problems can be solved recursively in time $T(n/4)$ respectively. The cost of dividing the problem and combining the results of the subproblems is $O(n \log n)$. **Formulate** the recurrence relation assuming $T(1) = O(1)$. [1.5]

- (b) Solve the following recurrence equation: $T(n) = 3T(n/3) + O(1)$, where $T(1) = O(1)$. [2.5]

- (c) Derive the exact-cost equation for the running time of the following function [3]
and show that the time complexity is $O(n \log n \log_3 n)$:

```
1  def funFunction(n):
2      sum = 0
3      i, k = n, 1
4      while (k < n):
5          for j in range(n//2, n+1):
6              while (i >= 1):
7                  sum += (i+j+k)
8                  i /= 5
9              k *= 2
10     print(sum)
```

2. (a) You are given a data file containing letters along with their corresponding frequency counts:

Letter	R	K	A	O	X	B	Z
Frequency	45	27	9	12	5	14	6

- i) Construct an optimal variable-length binary code using the Huffman coding algorithm and find the codeword for each letter. [2]
- ii) Encode the string "XOROB" using your Huffman codes and then decode it. Show the complete decoding process of your encoded string. [2]

b) You are a wildlife photographer planning an expedition to capture rare animals in the Amazon rainforest. Different species are most active during specific time windows each day:

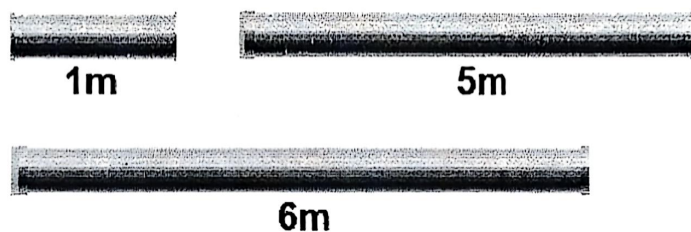
[4]

Animal	Activity Start Time	Activity End Time
Jaguar	5.30 AM	7.30 AM 3
Macaw	6.00 AM	7.00 AM 2
Poison Dart Frog	5.00 AM	6.00 AM 1
Howler Monkey	7.30 AM	11.30 AM 6
Anaconda	9.00 AM	10.00 AM 4
Capybara	12.00 AM	12.30 PM 7
Tiger	4.00 AM	11.00 AM 5

Using the activity selection algorithm, determine the maximum number of animals you can photograph without time conflicts, given that you can only be at one location at a time.

- 3 a) Imagine you need to make a 10 meter long pipe for your agricultural project. There are three types of small pipes available, which vary in length: 1 meter, 5 meters and 6 meters (See figure). Each type has an infinite amount of supplies, so you never run out of pipes. Now, there are many ways that you can make a 10 meter long pipe using these small pipes, but you want to use as few pipes as possible.

[4]



Using the **Dynamic Programming** method, find the minimum number of small pipes that you can use to make a 10 meter long pipe. Which pipes should we use? Describe your solution with a detailed calculation.

b) Suppose your wallet has capacity to hold only 8 grams of gold coins, and your best friend just offered you 4 gold coins from his own collection. The weights and the values of the coins are as follows: [5g, 4g, 6g, 3g] and [110\$, 100\$, 120\$, 90\$]. Using **Dynamic Programming**, determine which coins you should take so that your total gain is maximized. Keep in mind that you cannot carry more than 8 grams of gold coins.

[4]

- 4 a) Implement the divide and conquer technique to find the sum of all even numbers in the array {3, 4, 2, 1, 6, 11, 18}. Draw the recursion tree to demonstrate the steps involved in breaking down the array and calculating the sum. Provide the intermediate results at each level of recursion.

[3]

(b) You are given an array of temperatures recorded over a series of days on an island. [4]
Some days may have negative temperatures (freezing temperatures), while others may have positive temperatures. Your task is to find the consecutive days where the **sum of temperatures** is the **minimum**.

The temperatures recorded over the last 10 days are:

Temperatures = [3, -2, 5, -4, 6, -1, -2, 3, -5, 2]

Show the detailed simulation to find the result.