009

THE OPEN UNIVERSITY OF SRI LANKA
BSc (IT) DEGREE PROGRAMME: LEVEL 04
NO BOOK TEST: 2023/2024
COU4303: ARTIFICIAL INTELLIGENCE

**DURATION: ONE HOUR** (1 HOUR)

**Date: 03.11.2024** **Time: 2.30 pm – 3.30 pm**

**Answer ALL Questions**

(1).

a) Briefly explain the following terms.

i. Agent.

ii. Percepts. (10 Marks)

b) State the **PEAS** descriptions of the following agents.

i. Robot Taxi Driver

ii. Windshield Wiper Agent

iii. Medical Diagnosis System (12 Marks)

c) Define what is meant by a **simple reflex agent**. (05 Marks)

d) What is the main difference between the **goal based reflex agent** and the **utility based reflex agent**? (08 Marks)

(2).

a) Briefly explain the following **task environment** types.

i. Episodic

ii. Deterministic

iii. Dynamic (15 Marks)

b) An AI system is to be developed to automatically detect dirt (e.g., dust) on glass surfaces of large buildings using drones where human access is impossible or costly.

i. Write a possible PEAS description (i.e., requirement specification) for this system.

ii. Comment on the type of environment that the drones would be operating in.

(20 Marks)

c) Indicate whether the following statements on TASK environment are True or False and explain the reason.

i. Vacuum cleaner agent is dynamic

ii. Chess with a clock is deterministic

iii. Crossword puzzle is partially observable (30 Marks)

2)

(a) State and briefly explain the two types of algorithm complexities.

(b) Consider the following algorithm.

```
j = n;
while (j >= 1){
      for I = 1 to n
            x = x + 1;
      j = j / 2;
}
```

Write the asymptotic notation for the number of times that the statement `x = x + 1` is executed.

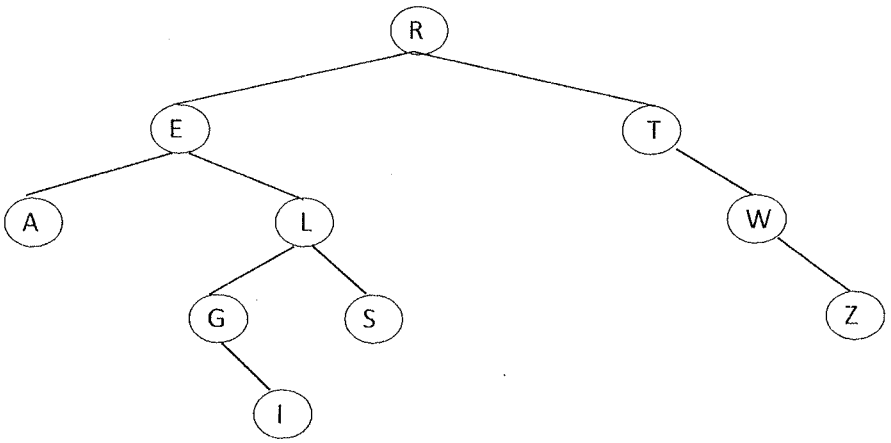
[4 marks]

3)

(a) Briefly explain what a binary search tree (BST) is, listing its properties.

(b) Is the following binary tree a BST?

(c) Justify your answer.




[5 marks]

4) Quicksort is a sorting algorithm that divides the given array into two parts based on a chosen value and then sorts each part separately using repeated calls to the sorting process.

(a) Explain what the pivot is.

(b) Briefly describe input and output parameters of the `quicksort()` method.

(c) Graphically show the steps of sorting the following dataset by using the quick sort algorithm.

| 10 | 7 | 2 | 9 | 1 | 5 |
|---|---|---|---|---|---|

(d) Analyze the worst-case behavior of quicksort and discuss possible ways of improving it.

[13 marks]

**Question 05**

1) For each of the following methods used to design algorithms, provide:
   (a) An example of a problem that can be solved using each method.
   (b) An example of an algorithm that uses each method to solve the problem mentioned in (a).

   i. Divide and conquer
   ii. Breadth-first search
   iii. Greedy algorithms
   iv. Dynamic programming

[8 marks]

2) The adjacency matrix of a directed graph is given below.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| A | 0 | 1 | 0 | 0 | 0 | 0 |
| B | 0 | 0 | 1 | 0 | 1 | 0 |
| C | 0 | 0 | 0 | 1 | 0 | 0 |
| D | 1 | 1 | 0 | 0 | 0 | 0 |
| E | 0 | 0 | 0 | 0 | 0 | 1 |
| F | 0 | 1 | 0 | 0 | 0 | 0 |

   (a) Draw the directed graph that corresponds to the above given adjacency matrix.
   (b) Write down the edges in the graph.
   (c) State, with reasons, whether the graph you have drawn is **strongly connected** or **weakly connected**.

[5 marks]

3) State whether the following statements are true or false.
   (a) The running time of the `treeSearch` algorithm is $O(n)$, where $n$ is the number of nodes in the binary search tree.
   (b) The successor of a node in a binary search tree can be found using its right subtree.
   (c) A sorted array can be obtained from a binary search tree by performing an inorder traversal.
   (d) In Red-Black trees all leaves are red.
   (e) An extended binary tree is a special type of binary tree where each node has either 0 or 2 children.

[5 marks]

4)

(a) Write a Java method to implement the bubble sort. Use the following method signature.

```
void bubbleSort(int data[], int n){}
```

where 'data[]' array has the elements to be sorted and 'n' gives the number of elements

(b) What is the running time of bubble sort in the worst-case scenario? Use Big O notation.

[7 marks]

## Question 06

1) If we want to create a binary tree whose nodes contain integer values, we can represent the nodes using instances of the following Java class.

```
/** binary tree node with integer node values */
public class Node {
    public int value; // value contained in this node
    public Node left; // left subtree
    public Node right; // right subtree
}
```

Complete the definition of the following method so it returns the **sum of the values** contained in nodes of the binary tree with root n. Use recursion to answer this question.

```
/* Return the sum of the values in a binary tree with
root n */

 public int sum(Node n) {

    // Complete the method here

}
```

[6 marks]

2)

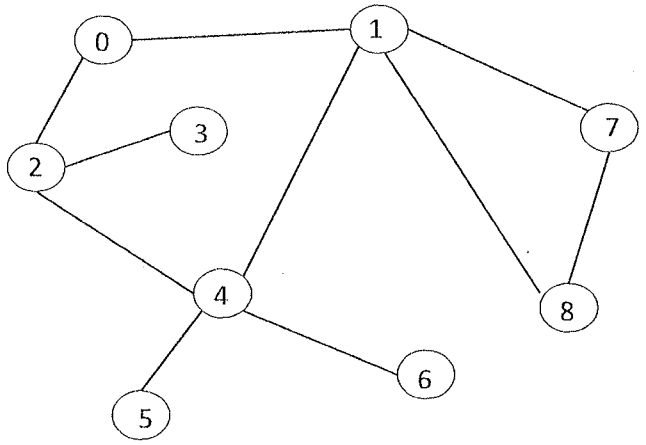
(a) What is the running time of the merge sort in the worst-case scenario? Use Big O notation.

(b) Graphically show the steps of sorting the following dataset by using the merge sort algorithm.

| 37 | 28 | 42 | 4 | 8 | 80 | 10 |
|---|---|---|---|---|---|---|

[8 marks]

3) For the following graph, use 0 as the starting node and determine the order in which the vertices are visited for:
   (a) Depth-First Traversal
   (b) Breadth-First Traversal




[5 marks]

4) Consider the following scenario.

*"Input/output buffer is an area of a computer memory used to temporarily store data and instructions transferred into and out of a computer, permitting several such transfers to take place simultaneously with processing of data. Instructions are processed according to the arrival time, and they are executed one by one."*

   (a) Which of the studied data structures would be most appropriate for the following task?
   (b) Briefly explain your answer.

[6 marks]