Institute of Computer Technology

B. Tech. Computer Science and Engineering

Sub: DS

Course Code: 2CSE302

Practical – 15

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Sem - 3

Branch: CS

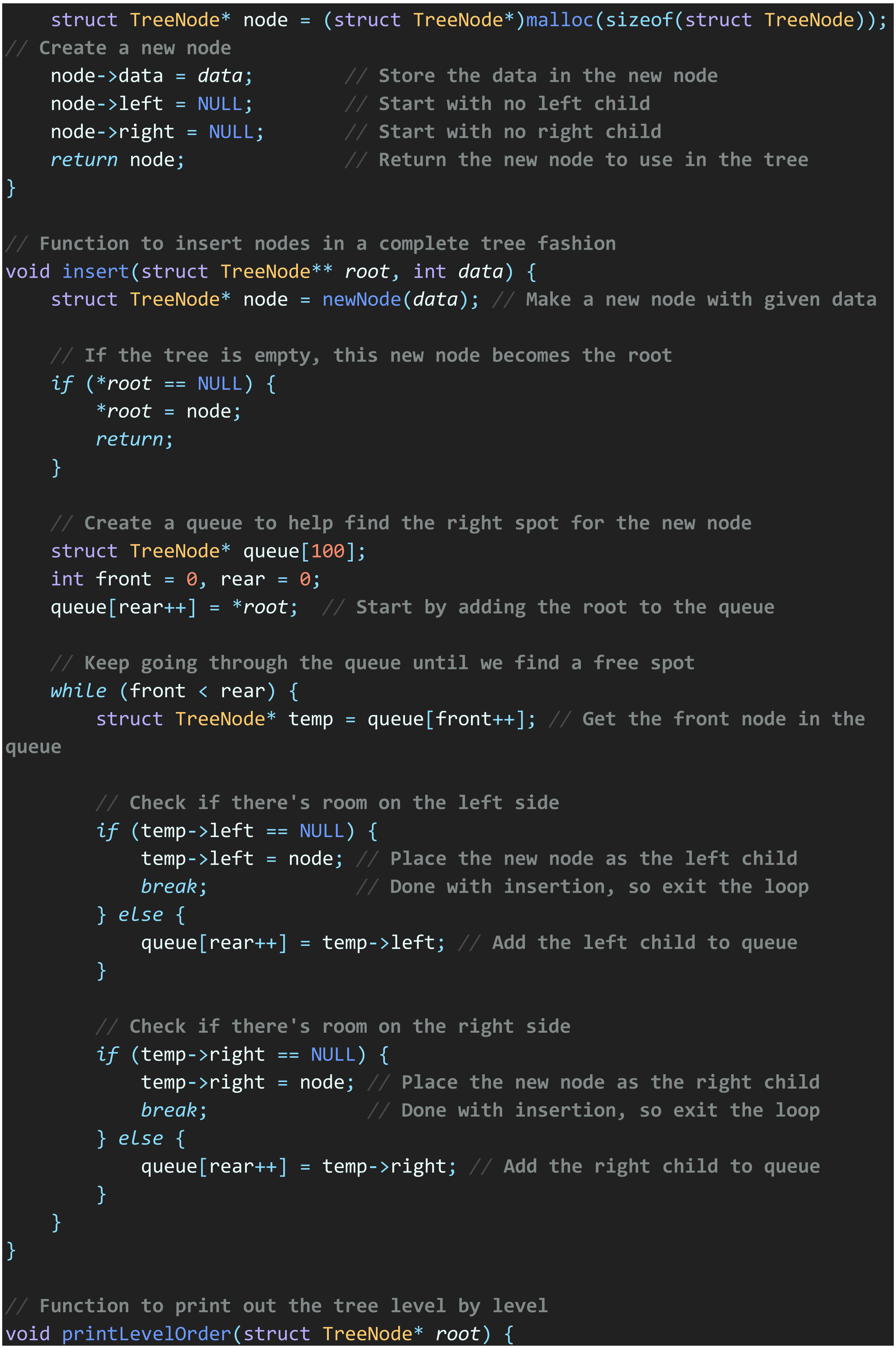
Class: A

Batch: 32

Problem Definition-1: Imagine you have a larger binary tree representing a company organizational structure, and within it, you want to check if there a smaller binary tree that represents a specific department. Your tasked with determining if the department tree is indeed a part of the larger organizational tree. To solve this, you use a C program that performs a recursive search, checking if there is a matching subtree within the larger tree. If found, the program confirms the presence of the department tree within the organizational structure..

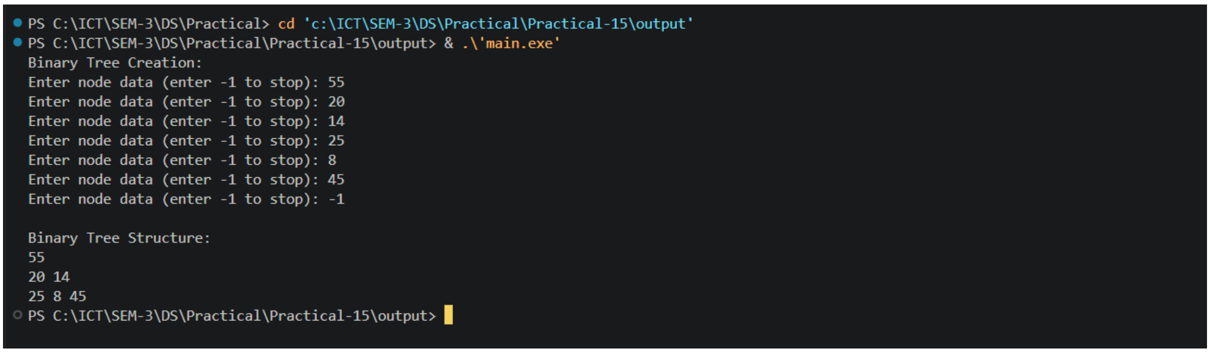
Code:

```
#include <stdio.h>
#include <stdlib.h>

// Define the structure for each tree node
struct TreeNode {
    int data;                   // Holds the value of the node
    struct TreeNode* left;      // Points to the left child node
    struct TreeNode* right;     // Points to the right child node
};

// Function to make a new node with given data
struct TreeNode* newNode(int data) {
```



```
    struct TreeNode* node = (struct TreeNode*)malloc(sizeof(struct TreeNode));
// Create a new node
    node->data = data;        // Store the data in the new node
    node->left = NULL;        // Start with no left child
    node->right = NULL;       // Start with no right child
    return node;              // Return the new node to use in the tree
}

// Function to insert nodes in a complete tree fashion
void insert(struct TreeNode** root, int data) {
    struct TreeNode* node = newNode(data); // Make a new node with given data

    // If the tree is empty, this new node becomes the root
    if (*root == NULL) {
        *root = node;
        return;
    }

    // Create a queue to help find the right spot for the new node
    struct TreeNode* queue[100];
    int front = 0, rear = 0;
    queue[rear++] = *root;  // Start by adding the root to the queue

    // Keep going through the queue until we find a free spot
    while (front < rear) {
        struct TreeNode* temp = queue[front++]; // Get the front node in the
queue

        // Check if there's room on the left side
        if (temp->left == NULL) {
            temp->left = node; // Place the new node as the left child
            break;             // Done with insertion, so exit the loop
        } else {
            queue[rear++] = temp->left; // Add the left child to queue
        }

        // Check if there's room on the right side
        if (temp->right == NULL) {
            temp->right = node; // Place the new node as the right child
            break;              // Done with insertion, so exit the loop
        } else {
            queue[rear++] = temp->right; // Add the right child to queue
        }
    }
}

// Function to print out the tree level by level
void printLevelOrder(struct TreeNode* root) {
    // If the tree is empty, say so
    if (root == NULL) {
        printf("The tree is empty.\n");
        return;
    }

    // Set up a queue to help us print each level
    struct TreeNode* queue[100];
    int front = 0, rear = 0;
    queue[rear++] = root;  // Start with the root in the queue

    printf("Binary Tree Structure:\n");

    // Go through each level of the tree
    while (front < rear) {
        int levelSize = rear - front; // Nodes in the current level

        // Print all nodes in this level
        for (int i = 0; i < levelSize; i++) {
            struct TreeNode* temp = queue[front++]; // Get node from the front
            printf("%d ", temp->data);             // Print the node's data

            // Add the left child to the queue if it exists
            if (temp->left != NULL) queue[rear++] = temp->left;

            // Add the right child to the queue if it exists
            if (temp->right != NULL) queue[rear++] = temp->right;
        }
        printf("\n"); // Go to a new line after each level
    }
}

int main() {
    struct TreeNode* root = NULL; // Start with an empty tree
    int data;

    printf("Binary Tree Creation:\n");

    // Get user input to build the tree
    while (1) {
        printf("Enter node data (enter -1 to stop): ");
        scanf("%d", &data);     // Read the data from the user
        if (data == -1) break;  // Stop if the user enters -1
        insert(&root, data);    // Add the data to the tree
    }

    // Display the tree level by level
    printf("\n");
    printLevelOrder(root);

    return 0;
}
```

Output:



```
● PS C:\ICT\SEM-3\DS\Practical> cd 'c:\ICT\SEM-3\DS\Practical\Practical-15\output'
● PS C:\ICT\SEM-3\DS\Practical\Practical-15\output> & .\'main.exe'
  Binary Tree Creation:
  Enter node data (enter -1 to stop): 55
  Enter node data (enter -1 to stop): 20
  Enter node data (enter -1 to stop): 14
  Enter node data (enter -1 to stop): 25
  Enter node data (enter -1 to stop): 8
  Enter node data (enter -1 to stop): 45
  Enter node data (enter -1 to stop): -1

  Binary Tree Structure:
  55
  20 14
  25 8 45
○ PS C:\ICT\SEM-3\DS\Practical\Practical-15\output> 
```