ASSIGNMENT

1)A program P reads in 500 integers in the range [0..100] representing the scores of 500 students. It then prints the frequency of each score above 50. What would be the best way for P to store the frequencies?

To efficiently store the frequencies of scores above 50 for the 500 integers in the range [0..100], you can use an array of size 51. Here's a breakdown of the approach:

1.Array Initialization: Create an array called frequency with 51 elements, where each index corresponds to scores from 51 to 100. For example:

- frequency[0] represents the count of the score 51,
- frequency[1] represents the count of the score 52,
- ...
- frequency[49] represents the count of the score 100.

2.Input and Counting: As you read each score, if the score is greater than 50, increment the corresponding index in the frequency array. You can calculate the index as score - 51.

3.Output: After processing all scores, iterate through the frequency array and print the count for each score from 51 to 100.

2)Consider a standard Circular Queue q; implementation (which has the same condition for Queue Full and Queue Empty) whose size is 11 and the elements of the queue are q[0], q[1], q[2].....,q[10]. The front and rear pointers are initialized to point at q[2] . In which position will the ninth element be added?

Given that the queue has a size of 11 and both the front and rear pointers start at q[2], let's track the positions as elements are added: Initially:

Front = 2

Rear = 2

When the first element is added, the rear pointer moves to q[3].

For the second element, the rear pointer moves to q[4].

For the third element, it moves to q[5].

For the fourth element, it moves to q[6].

For the fifth element, it moves to q[7].

For the sixth element, it moves to q[8].

For the seventh element, it moves to q[9].

For the eighth element, it moves to q[10].

For the ninth element, it will wrap around to q[0] since q[10] is the last position.

Thus, the ninth element will be added at position q[0].

3) Write a C Program to implement Red Black Tree ?

```
#include <stdio.h> #include <stdlib.h>
typedef enum { RED, BLACK } Color;
typedef struct Node {     int data;
Color color;     struct Node *left,
*right, *parent;
} Node;
Node *root = NULL;
// Function prototypes
Node *createNode(int data); void
rotateLeft(Node *&root, Node *&pt); void
rotateRight(Node *&root, Node *&pt); void
```

```
fixViolation(Node *&root, Node *&pt); void
insert(const int &data); void inorder(Node
*root); void printTree(Node *root, int
space);

int main() {
insert(7);     insert(3);
insert(18);
insert(10);
insert(22);
insert(8);
insert(11);
insert(26);

   printf("Inorder Traversal of Created Tree:\n");
inorder(root);

   printf("\nTree Structure:\n");
printTree(root, 0);

   return 0;
}

Node *createNode(int data) {
```

```
    Node *newNode = (Node *)malloc(sizeof(Node));     newNode-
>data = data;     newNode->color = RED;     newNode->left =
newNode->right = newNode->parent = NULL;     return newNode;
}

void rotateLeft(Node *&root, Node *&pt) {
Node *pt_y = pt->right;     pt->right = pt_y-
>left;

    if (pt->right != NULL)         pt->right-
>parent = pt;

    pt_y->parent = pt->parent;

    if (pt->parent == NULL)
root = pt_y;     else if (pt == pt-
>parent->left)         pt->parent-
>left = pt_y;     else         pt-
>parent->right = pt_y;     pt_y-
>left = pt;     pt->parent = pt_y;
}

void rotateRight(Node *&root, Node *&pt) {
Node *pt_y = pt->left;     pt->left = pt_y-
>right;
```

```
    if (pt->left != NULL)         pt->left-
>parent = pt;

    pt_y->parent = pt->parent;

    if (pt->parent == NULL)
root = pt_y;      else if (pt == pt-
>parent->left)        pt->parent-
>left = pt_y;     else         pt-
>parent->right = pt_y;

    pt_y->right = pt;     pt-
>parent = pt_y;
}

void fixViolation(Node *&root, Node *&pt) {
    Node *pt_parent = NULL;
    Node *pt_grandparent = NULL;

    while ((pt != root) && (pt->color == RED) && (pt->parent->color
== RED)) {
        pt_parent = pt->parent;
pt_grandparent = pt->parent->parent;
```

```
        if (pt_parent == pt_grandparent->left) {
Node *pt_uncle = pt_grandparent->right;

            if (pt_uncle != NULL && pt_uncle->color == RED) {
pt_grandparent->color = RED;                pt_parent->color =
BLACK;                pt_uncle->color = BLACK;                pt
= pt_grandparent;
            } else {                if (pt ==
pt_parent->right) {
rotateLeft(root, pt_parent);
pt = pt_parent;                    pt_parent =
pt->parent;
                }
                rotateRight(root, pt_grandparent);
Color temp = pt_parent->color;
pt_parent->color = pt_grandparent->color;
pt_grandparent->color = temp;                pt =
pt_parent;
            }
        } else {
            Node *pt_uncle = pt_grandparent->left;

            if ((pt_uncle != NULL) && (pt_uncle->color == RED)) {
pt_grandparent->color = RED;                pt_parent->color =
```

```
BLACK;                  pt_uncle->color = BLACK;                  pt =
pt_grandparent;
            } else {                  if (pt ==
pt_parent->left) {
rotateRight(root, pt_parent);
pt = pt_parent;                      pt_parent =
pt->parent;
                }
                rotateLeft(root, pt_grandparent);
Color temp = pt_parent->color;                  pt_parent-
>color = pt_grandparent->color;
pt_grandparent->color = temp;                  pt =
pt_parent;
            }
        }
    }
    root->color = BLACK;
}

void insert(const int &data) {
Node *pt = createNode(data);
root = bstInsert(root, pt);
fixViolation(root, pt);
}
```

```
Node *bstInsert(Node *root, Node *pt) {
if (root == NULL)         return pt;

   if (pt->data < root->data) {         root-
>left = bstInsert(root->left, pt);         root-
>left->parent = root;     } else if (pt->data >
root->data) {         root->right =
bstInsert(root->right, pt);         root->right-
>parent = root;
   }

   return root;
}

void inorder(Node *root) {
if (root == NULL)
      return;     inorder(root-
>left);     printf("%d ", root-
>data);     inorder(root->right);
}

void printTree(Node *root, int space) {     if (root == NULL)
return;    space += 10;     printTree(root->right, space);
printf("\n");     for (int i = 10; i < space; i++) printf(" ");
printf("%d(%s)\n", root->data, root->color == RED ? "RED" :
```

```
"BLACK");
    printTree(root->left, space);
}
```

Explanation

Node Structure: Each node contains data, color (RED or BLACK), pointers to left and right children, and a parent pointer.

Insertion:The insert function creates a new node and uses bstInsert to insert it into the tree. After insertion, fixViolation is called to restore the Red-Black properties.

Rotations: The rotateLeft and rotateRight functions perform tree rotations, which are essential to maintain balance.

Fix Violations: The fixViolation function ensures that the tree adheres to the Red-Black properties after insertion.

Traversal and Display: The inorder function performs an in-order traversal, and printTree visualizes the tree structure.

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