**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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