**Ex 10: AVL Tree**

**PROGRAM:**

#include<stdio.h>

#include<stdlib.h>

struct node

{

int data;

struct node\* left;

struct node\* right;

int ht;

};

struct node\* root = NULL;

struct node\* create(int);

struct node\* insert(struct node\*, int);

struct node\* delete(struct node\*, int);

struct node\* search(struct node\*, int);

struct node\* rotate\_left(struct node\*);

struct node\* rotate\_right(struct node\*);

int balance\_factor(struct node\*);

int height(struct node\*);

void inorder(struct node\*);

void preorder(struct node\*);

void postorder(struct node\*);

int main()

{

int user\_choice, data;

char user\_continue = 'y';

struct node\* result = NULL;

while (user\_continue == 'y' || user\_continue == 'Y')

{

printf("\n\n------- AVL TREE --------\n");

printf("\n1. Insert");

printf("\n2. Delete");

printf("\n3. Search");

printf("\n4. Inorder");

printf("\n5. Preorder");

printf("\n6. Postorder");

printf("\n7. EXIT");

printf("\n\nEnter Your Choice: ");

scanf("%d", &user\_choice);

switch(user\_choice)

{

case 1:

printf("\nEnter data: ");

scanf("%d", &data);

root = insert(root, data);

break;

case 2:

printf("\nEnter data: ");

scanf("%d", &data);

root = delete(root, data);

break;

case 3:

printf("\nEnter data: ");

scanf("%d", &data);

result = search(root, data);

if (result == NULL)

{

printf("\nNode not found!");

}

else

{

printf("\n Node found");

}

break;

case 4:

inorder(root);

break;

case 5:

preorder(root);

break;

case 6:

postorder(root);

break;

case 7:

printf("\n\tProgram Terminated\n");

return 1;

default:

printf("\n\tInvalid Choice\n");

}

printf("\n\nDo you want to continue? ");

scanf(" %c", &user\_continue);

}

return 0;

}

struct node\* create(int data)

{

struct node\* new\_node = (struct node\*) malloc (sizeof(struct node));

if (new\_node == NULL)

{

printf("\nMemory can't be allocated\n");

return NULL;

}

new\_node->data = data;

new\_node->left = NULL;

new\_node->right = NULL;

return new\_node;

}

struct node\* rotate\_left(struct node\* root)

{

struct node\* right\_child = root->right;

root->right = right\_child->left;

right\_child->left = root;

root->ht = height(root);

right\_child->ht = height(right\_child);

return right\_child;

}

struct node\* rotate\_right(struct node\* root)

{

struct node\* left\_child = root->left;

root->left = left\_child->right;

left\_child->right = root;

root->ht = height(root);

left\_child->ht = height(left\_child);

return left\_child;

}

int balance\_factor(struct node\* root)

{

int lh, rh;

if (root == NULL)

return 0;

if (root->left == NULL)

lh = 0;

else

lh = 1 + root->left->ht;

if (root->right == NULL)

rh = 0;

else

rh = 1 + root->right->ht;

return lh - rh;

}

int height(struct node\* root)

{

int lh, rh;

if (root == NULL)

{

return 0;

}

if (root->left == NULL)

lh = 0;

else

lh = 1 + root->left->ht;

if (root->right == NULL)

rh = 0;

else

rh = 1 + root->right->ht;

if (lh > rh)

return (lh);

return (rh);

}

struct node\* insert(struct node\* root, int data)

{

if (root == NULL)

{

struct node\* new\_node = create(data);

if (new\_node == NULL)

{

return NULL;

}

root = new\_node;

}

else if (data > root->data)

{

root->right = insert(root->right, data);

if (balance\_factor(root) == -2)

{

if (data > root->right->data)

{

root = rotate\_left(root);

}

else

{

root->right = rotate\_right(root->right);

root = rotate\_left(root);

}

}

}

else

{

root->left = insert(root->left, data);

if (balance\_factor(root) == 2)

{

if (data < root->left->data)

{

root = rotate\_right(root);

}

else

{

root->left = rotate\_left(root->left);

root = rotate\_right(root);

}

}

}

root->ht = height(root);

return root;

}

struct node \* delete(struct node \*root, int x)

{

struct node \* temp = NULL;

if (root == NULL)

{

return NULL;

}

if (x > root->data)

{

root->right = delete(root->right, x);

if (balance\_factor(root) == 2)

{

if (balance\_factor(root->left) >= 0)

{

root = rotate\_right(root);

}

else

{

root->left = rotate\_left(root->left);

root = rotate\_right(root);

}

}

}

else if (x < root->data)

{

root->left = delete(root->left, x);

if (balance\_factor(root) == -2)

{

if (balance\_factor(root->right) <= 0)

{

root = rotate\_left(root);

}

else

{

root->right = rotate\_right(root->right);

root = rotate\_left(root);

}

}

}

else

{

if (root->right != NULL)

{

temp = root->right;

while (temp->left != NULL)

temp = temp->left;

root->data = temp->data;

root->right = delete(root->right, temp->data);

if (balance\_factor(root) == 2)

{

if (balance\_factor(root->left) >= 0)

{

root = rotate\_right(root);

}

else

{

root->left = rotate\_left(root->left);

root = rotate\_right(root);

}

}

}

else

{

return (root->left);

}

}

root->ht = height(root);

return (root);

}

struct node\* search(struct node\* root, int key)

{

if (root == NULL)

{

return NULL;

}

if(root->data == key)

{

return root;

}

if(key > root->data)

{

search(root->right, key);

}

else

{

search(root->left, key);

}

}

void inorder(struct node\* root)

{

if (root == NULL)

{

return;

}

inorder(root->left);

printf("%d ", root->data);

inorder(root->right);

}

void preorder(struct node\* root)

{

if (root == NULL)

{

return;

}

printf("%d ", root->data);

preorder(root->left);

preorder(root->right);

}

void postorder(struct node\* root)

{

if (root == NULL)

{

return;

}

postorder(root->left);

postorder(root->right);

printf("%d ", root->data

);

**OUTPUT:**

} 



