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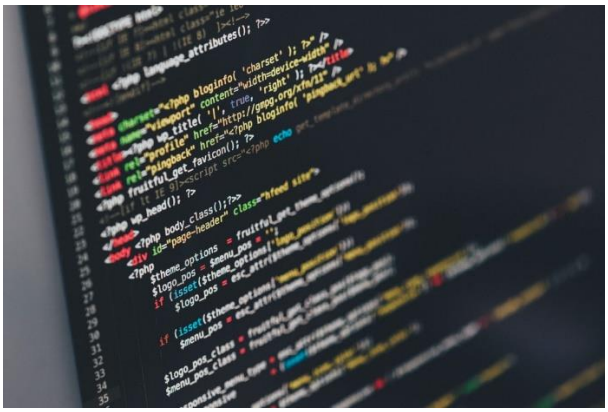
LAB REPORT

CSE2011 – DATA STRUCTURES AND ALGORITHMS LAB



(B.Tech. CSE Specialisation in Bioinformatics)

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Name:	**ALOK MATHUR**
Reg. No:	**20BCB0086**
Slot:	**L51+L52**
Faculty Name:	**SRIVANI A Ma'am**

VIT – A Place to Learn; A Chance to Grow

ASSIGNMENT 3

1. Write a program to perform the following operations:

   a) Create a binary search tree
   b) Insert an element into a binary search tree
   c) Deletion of an element(all the options)
   d) Sort the elements of the BST.
   e) Find the minimum and maximum element in the BST
   f) Find the kth minimum element in the BST

CODE

```
#include <stdio.h>
#include <iostream>
#include <string.h>

using namespace std;

struct node
{
    int data;
    struct node *left_child;
    struct node *right_child;
};

struct node *newNode(int n)
{
    struct node *node = new struct node;
    node->data = n;
    node->left_child = NULL;
    node->right_child = NULL;
};
struct node *find_minimum(struct node *root);

void inorder_traversal(struct node *p)
{
    if (p == NULL)
        return;
    inorder_traversal(p->left_child);
    cout << p->data << " ";
    inorder_traversal(p->right_child);
}

void preorder_traversal(struct node *p)
{
    if (p == NULL)
```

```
        return;
    cout << p->data << " ";
    preorder_traversal(p->left_child);
    preorder_traversal(p->right_child);
}

void postorder_traversal(struct node *p)
{
    if (p == NULL)
        return;
    postorder_traversal(p->left_child);
    postorder_traversal(p->right_child);
    cout << p->data << " ";
}

struct node *insert(struct node *root, int n)
{
    if (root == NULL)
    {
        return newNode(n); //Creating the main root node
    }
    else if (n > root->data)
    {
        root->right_child = insert(root->right_child, n);
    }
    else if (n < root->data)
    {
        root->left_child = insert(root->left_child, n);
    }
    return root;
}

struct node *del(struct node *root, int key)
{
    if (root == NULL)
        return root;

    if (key < root->data)
        root->left_child = del(root->left_child, key);

    else if (key > root->data)
        root->right_child = del(root->right_child, key);

    else
    {
        // node with only one child or no child
        if (root->left_child == NULL)
        {
```

```
            struct node *temp = root->right_child;
            free(root);
            return temp;
        }
        else if (root->right_child == NULL)
        {
            struct node *temp = root->left_child;
            free(root);
            return temp;
        }

        // node with two children:

        struct node *temp = find_minimum(root->right_child);
        // Copy the inorder
        root->data = temp->data;

        // Delete the inorder successor
        root->right_child = del(root->right_child, temp->data);
    }
    return root;
}

struct node *find_minimum(struct node *root)
{
    if (root == NULL)
        return NULL;
    else if (root->left_child != NULL)
        return find_minimum(root->left_child);
    return root;
}

struct node *max_element(struct node *root)
{
    struct node*temp=root;
    while(temp->right_child!=NULL)
        temp=temp->right_child;
    return temp;
}

int main()
{
    /* Let us create following BST
              50
           /     \
          30      70
         /  \    /  \
        20   40  60   80 */
```

```
    struct node *root = NULL;
    root = insert(root, 50);
    insert(root, 30);
    insert(root, 70);
    insert(root, 20);
    insert(root, 40);
    insert(root, 60);
    insert(root, 80);
    cout << "**BST**" << endl;
    int choice, x,k,a;
    struct node *t;
    struct node *temp;
    while (choice != 10)
    {
        cout << "Options available are:-" << endl;
        cout << "1.Insert an element into BST\n2.Deletion of Node\n3.Inorder T
raversal\n4.Preorder Traversal\n5.Postorder Traversal\n6.Minimum element\n7.Ma
ximum element\n8.Exit" << endl;
        cin >> choice;
        switch (choice)
        {
        case 1:
            cout << "Enter the number to be inserted" << endl;
            cin >> x;
            insert(root, x);
            break;
        case 2:
            cout << "Enter the element to be deleted " << endl;
            cin >> x;
            del(root, x);
            inorder_traversal(root);
            cout << "\n";
            break;
        case 3:
            inorder_traversal(root);
            cout << "\n";
            break;
        case 4:
            preorder_traversal(root);
            cout << "\n";
            break;
        case 5:
            postorder_traversal(root);
            cout << "\n";
            break;
        case 6:
            t = find_minimum(root);
            cout << t->data<<endl;
```

```
            break;
        case 7:
            temp = max_element(root);
            cout << temp->data<<endl;
            break;
        case 8:
            cout << "Exiting..." << endl;
            break;
        default:
            cout << "Invalid Input" << endl;
            break;
        }
    }
    return 1;
}
```

OUTPUT

```
**BST**
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
1
Enter the number to be inserted
10
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
1
Enter the number to be inserted
90
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
3
10 20 30 40 50 60 70 80 90
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
2
Enter the element to be deleted
50
10 20 30 40 60 70 80 90
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
2
Enter the element to be deleted
10
20 30 40 60 70 80 90
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
2
Enter the element to be deleted
60
20 30 40 70 80 90
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
4
70 30 20 40 80 90
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
5
20 40 30 90 80 70
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
6
20
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
7
90
```

```
Options available are:-
1.Insert an element into BST
2.Deletion of Node
3.Inorder Traversal
4.Preorder Traversal
5.Postorder Traversal
6.Minimum element
7.Maximum element
8.Exit
8
Exiting...
```

2. Consider a postfix expression, construct the expression tree, and traverse the tree using . Other possible traversals and display the corresponding expressions.

CODE

```
#include <iostream>
using namespace std;
struct n
{
    char d;
    n *l;
    n *r;
};
char pf[50];
int top = -1;
n *a[50];
int r(char inputch)
{
    if (inputch == '+' || inputch == '-' || inputch == '*' || inputch == '/')
        return (-1);
    else if (inputch >= 'A' || inputch <= 'Z')
        return (1);
    else if (inputch >= 'a' || inputch <= 'z')
        return (1);
    else
        return (-100);
}
void push(n *tree)
{
    top++;
    a[top] = tree;
}
n *pop()
{
    top--;
    return (a[top + 1]);
}
void construct_expression_tree(char *suffix)
{
    char s;
    n *newl, *p1, *p2;
    int flag;
    s = suffix[0];
    for (int i = 1; s != 0; i++)
    {
        flag = r(s);
        if (flag == 1)
```

```
        {
            newl = new n;
            newl->d = s;
            newl->l = NULL;
            newl->r = NULL;
            push(newl);
        }
        else
        {
            p1 = pop();
            p2 = pop();
            newl = new n;
            newl->d = s;
            newl->l = p2;
            newl->r = p1;
            push(newl);
        }
        s = suffix[i];
    }
}
void preOrder(n *tree)
{
    if (tree != NULL)
    {
        cout << tree->d;
        preOrder(tree->l);
        preOrder(tree->r);
    }
}
void inOrder(n *tree)
{
    if (tree != NULL)
    {
        inOrder(tree->l);
        cout << tree->d;
        inOrder(tree->r);
    }
}
void postOrder(n *tree)
{
    if (tree != NULL)
    {
        postOrder(tree->l);
        postOrder(tree->r);
        cout << tree->d;
    }
}
int main(int argc, char **argv)
```

```
{
    cout << "Enter Postfix Expression : ";
    cin >> pf;
    construct_expression_tree(pf);
    cout << "\nIn-Order Traversal : ";
    inOrder(a[0]);
    cout << "\nPre-Order Traversal : ";
    preOrder(a[0]);
    cout << "\nPost-Order Traversal : ";
    postOrder(a[0]);
    return 0;
}
```

OUTPUT

```
PS E:\VIT Semester\Winter Semester 2020\DSA\Lab\Module 4\Assignment 3\
 Q2expressionTree.cpp -o Q2expressionTree } ; if ($?) { .\Q2expressior
Enter Postfix Expression : AB+C*DE-/

In-Order Traversal : A+B*C/D-E
Pre-Order Traversal : /*+ABC-DE
Post-Order Traversal : AB+C*DE-/
PS E:\VIT Semester\Winter Semester 2020\DSA\Lab\Module 4\Assignment 3\
```

3. Write a program that takes the details of mobile phone (model name, year, camera resolution, RAM , memory card size and Operating system) and sort the mobile phones in ascending order based on their RAM size using insertion sort.

CODE

```
#include <stdio.h>
#include <iostream>
#include <string.h>

using namespace std;

struct phone{
    char model[100];
    int year;
    float cam;
    int ram;
    int mem;
    char os[100];
}s[10];

void insertion_sort(struct phone p[],int n)
{
    int i,key,j;
    for(i=1;i<n;i++)
    {
        key=p[i].ram;
        j=i-1;
        while(j>=0 && p[j].ram>key)
        {
            p[j+1].ram=p[j].ram;
            j--;
        }
        p[j+1].ram=key;
    }
}

int main()
{
    int i,n;
    cout<<"Pls enter Number of mobile phones"<<endl;
    cin>>n;
    for(i=0;i<n;i++)
    {
        cout<<"Pls enter the model of phone"<<" number "<<i+1<<endl;
        cin>>s[i].model;
        cout<<"Pls enter the year of phone"<<" number "<<i+1<<endl;
```

```
        cin>>s[i].year;
        cout<<"Pls enter the camera resoluton of phone"<<" number "<<i+1<<endl
;
        cin>>s[i].cam;
        cout<<"Pls enter the RAM of phone"<<" number "<<i+1<<endl;
        cin>>s[i].ram;
        cout<<"Pls enter the memory of phone"<<" number "<<i+1<<endl;
        cin>>s[i].mem;
        cout<<"Pls enter the OS of phone"<<" number "<<i+1<<endl;
        cin>>s[i].os;
    }
    insertion_sort(s,n);
    cout<<"\n";
    cout<<"\n";
    for(i=0;i<n;i++)
    {
        cout<<s[i].year<<endl;
        cout<<s[i].model<<endl;
        cout<<s[i].cam<<endl;
        cout<<s[i].ram<<endl;
        cout<<s[i].mem<<endl;
        cout<<s[i].os<<endl;
        cout<<"\n";
    }
    return 1;
}
```

OUTPUT

```
PS E:\VIT Semester\Winter Semester 2020\DSA\Lab\Module 4\Assignmen
ctice\" ; if ($?) { g++ Q3InsertionSort.cpp -o Q3InsertionSort } ;
Pls enter Number of mobile phones
3
Pls enter the model of phone number 1
onePlus2
Pls enter the year of phone number 1
2021
Pls enter the camera resoluton of phone number 1
18
Pls enter the RAM of phone number 1
22
Pls enter the memory of phone number 1
128
Pls enter the OS of phone number 1
O2
```

```
Pls enter the model of phone number 2
Samsung
Pls enter the year of phone number 2
2018
Pls enter the camera resoluton of phone number 2
19
Pls enter the RAM of phone number 2
8
Pls enter the memory of phone number 2
100
Pls enter the OS of phone number 2
SUI
```

```
Pls enter the model of phone number 3
MI
Pls enter the year of phone number 3
2010
Pls enter the camera resoluton of phone number 3
10
Pls enter the RAM of phone number 3
11
Pls enter the memory of phone number 3
32
Pls enter the OS of phone number 3
MIUI
```

```
2021
onePlus2
18
8
128
O2

2018
Samsung
19
11
100
SUI

2010
MI
10
22
32
MIUI
```

4. Write a program that takes the details of a patient (hospital number, patient name, age, token number, height, , weight, reason(disease) and sort the patients in ascending order based on their token number using quick sort.

CODE

```
#include <stdio.h>
#include <iostream>
#include <string.h>

using namespace std;

struct patient
{
   int hn;
   char name[200];
   int age;
   int tn;
   float height;
   float weight;
   char dis[200];
};

void quicksort(struct patient s[], int first, int last)
{
   int i, j, pivot;
   patient temp;

   if (first < last)
   {
      pivot = first;
      i = first;
      j = last;

      while (i < j)
      {
         while (s[i].tn <= s[pivot].tn && i < last)
            i++;
         while (s[j].tn > s[pivot].tn)
            j--;
         if (i < j)
         {
            temp = s[i];
            s[i] = s[j];
            s[j] = temp;
```

```
         }
      }

      temp = s[pivot];
      s[pivot] = s[j];
      s[j] = temp;
      quicksort(s, first, j - 1);
      quicksort(s, j + 1, last);
   }
}

int main()
{
   patient s[10];
   int choice, n,i;
   cout << "***Quick Sort Application***" << endl;
   cout << "Number of patients\n";
   cin >> n;
   for(i=0;i<n;i++)
   {
      cin>>s[i].hn>>s[i].name>>s[i].age>>s[i].tn>>s[i].height>>s[i].weight>>s[
i].dis;
   }
   quicksort(s,0,n-1);
   cout<<"\n";
   cout<<"\n";
   for(i=0;i<n;i++)
   {
      cout<<s[i].hn<<endl;
      cout<<s[i].name<<endl;
      cout<<s[i].age<<endl;
      cout<<s[i].tn<<endl;
      cout<<s[i].height<<endl;
      cout<<s[i].weight<<endl;
      cout<<s[i].dis<<endl;
      cout<<"\n";
   }
   return 1;
}
```

OUTPUT

```
PS E:\VIT Semester\Winter Semester 2020\DSA\Lab\
 Q4quickSort.cpp -o Q4quickSort } ; if ($?) { .\
***Quick Sort Application***
Number of patients
3
1001
Alok
19
69
6.0
90
Fever
```

```
1001
BKM
52
12
5.56
80.2
Stomach
```

```
1001
RM
50
42
5.4
80
Headache
```

```
 Q4quickSort.cpp -o Q4quickSort } ; if ($?) { .\Q4quickSort
***Quick Sort Application***
Number of patients
3
1001
Alok
19
69
6.0
90
Fever
1001
BKM
52
12
5.56
80.2
Stomach
1001
RM
50
42
5.4
80
Headache
```

Sorted According to Token Number

```
1001
BKM
52
12
5.56
80.2
Stomach

1001
RM
50
42
5.4
80
Headache

1001
Alok
19
69
6
90
Fever
```