

## Assignment No. 9

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### Programme:

```
#include<iostream>

using namespace std;

class node
{
public:
    string key;
    string meaning;
    node *left;
    node *right;
};

class AVL
{
    node *root;
public:
    AVL()
    {
        root=NULL;
    }

    void create();

    node* insert(node *cur,node *temp);

    node* balance(node *temp);

    int dif(node *temp);
```

```

int height(node *temp);

int maximum(int a,int b);


node* LL(node *par);
node* RR(node *par);
node* LR(node *par);
node* RL(node *par);


void ascending(node *temp);

node* delete_n(node *root,string key1);

void deleten();


node* extractmin(node *t);

void descending(node *temp);

void display();

bool search(node *cur,string key1);

void search_value();

};

```

```

void AVL::create()
{
    char answer;
    node *temp;
    do
    {
        temp=new node();
        cout<<endl<<"Enter keyword:\t";
        cin>>temp->key;
        cout<<"Enter meaning:\t";
        cin>>temp->meaning;
        temp->left=temp->right=NULL;

        root=insert(root,temp);
    }
    while(answer!='n');
}

```

```

        cout<<endl<<"Add another word? (y/n):\t";
        cin>>answer;
    }
    while(answer=='y' || answer=='Y');
}

```

```

node* AVL::insert(node *cur,node *temp)
{
    if(cur==NULL)
    {
        return temp;
    }
    if(temp->key<cur->key)
    {
        cur->left=insert(cur->left,temp);
        cur=balance(cur);
    }
    else if(temp->key>cur->key)
    {
        cur->right=insert(cur->right,temp);
        cur=balance(cur);
    }
    return cur;
}

```

```

node* AVL::balance(node *temp)
{
    int bal;
    bal=dif(temp);

    if(bal>=2)
    {

```

```

        if(dif(temp->left)<0)
            temp=LR(temp);
        else
            temp=LL(temp);
    }
    else if(bal<=-2)
    {
        if(dif(temp->right)<0)
            temp=RR(temp);
        else
            temp=RL(temp);
    }
    return temp;
}

```

```

int AVL::dif(node *temp)
{
    int l,r;
    l=height(temp->left);
    r=height(temp->right);
    return(l-r);
}

```

```

int AVL::height(node *temp)
{
    if(temp==NULL)
        return(-1);
    else
        return(max(height(temp->left),height(temp->right))+1);
}

```

```

int AVL::maximum(int a,int b)
{

```

```
if(a>b)
    return a;
else
    return b;
}
```

```
node* AVL::LL(node *par)
{
    node *temp,*temp1;
    temp=par->left;
    temp1=temp->right;
    temp->right=par;
    par->left=temp1;
    return temp;
}
```

```
node* AVL::RR(node *par)
{
    node *temp,*temp1;
    temp=par->right;
    temp1=temp->left;
    temp->left=par;
    par->right=temp1;
    return temp;
}
```

```
node* AVL::LR(node *par)
{
    par->left=RR(par->left);
    return(LL(par));
}
```

```
node* AVL::RL(node *par)
```

```

{
    par->right=LL(par->right);
    return(RR(par));
}

```

```

void AVL::ascending(node *temp)
{
    if(temp!=NULL)
    {
        ascending(temp->left);
        cout<<"\n\t"<<temp->key<<" : "<<temp->meaning;
        ascending(temp->right);
    }
}

```

```

void AVL::descending(node *temp)
{
    if(temp!=NULL)
    {
        descending(temp->right);
        cout<<"\n\t"<<temp->key<<" : "<<temp->meaning;
        descending(temp->left);
    }
}

```

```

void AVL::display()
{
    cout<<endl<<"Keywords in ascending order:\t";
    ascending(root);
    cout<<endl<<"Keywords in descending order:\t";
    descending(root);
}

```

```

bool AVL::search(node *cur,string key1)
{
    if(cur)
    {
        if(cur->key==key1)
            return true;
        if(cur->key>key1)
            return search(cur->left,key1);
        else
            return search(cur->right,key1);
    }
    return false;
}

```

```

void AVL::search_value()
{
    string key2;
    cout<<endl<<"Keyword to search:\t";
    cin>>key2;
    if(search(root,key2))
        cout<<endl<<"Keyword exists in AVL tree.";
    else
        cout<<endl<<"Keyword does not exist in AVL tree.";
}

```

```

node* AVL::delete_n(node* cur,string key1)
{
    if ( !cur)
        return cur;
    if ( key1 < cur->key )
        cur->left = delete_n(cur->left, key1);

    else if( key1 > cur->key )

```

```
cur->right = delete_n(cur->right, key1);
```

```
else
```

```
{
```

```
    node *l = cur->left;
```

```
    node *r = cur->right;
```

```
    delete cur;
```

```
    if ( !r )
```

```
        return l;
```

```
    node *m=r;
```

```
    while(m->left)
```

```
        m=m->left;
```

```
    m->right = extractmin(r);
```

```
    m->left = l;
```

```
    return balance(m);
```

```
}
```

```
return balance(cur);
```

```
}
```

```
node* AVL::extractmin(node *t)
```

```
{
```

```
    if ( !t->left )
```

```
        return t->right;
```

```
    t->left = extractmin(t->left);
```

```
    return balance(t);
```

```
}
```

```
void AVL::deleten()
```

```
{
```

```
    string key;
```

```
    cout<<endl<<"Keyword to delete:\t";
```

```
    cin>>key;
```



```

    root=delete_n(root,key);
}

int main()
{
    char c;
    int ch;
    AVL a;
    do
    {
        cout<<endl<<"--- MAIN MENU ---";
        cout<<endl<<"1 -> Insert keyword";
        cout<<endl<<"2 -> Display AVL tree";
        cout<<endl<<"3 -> Search a keyword";
        cout<<endl<<"4 -> Delete a keyword";
        cout<<endl<<"Choose an option (1-4):\t";
        cin>>ch;
        switch(ch)
        {
            case 1 : a.create();
                break;
            case 2 : a.display();
                break;
            case 3 : a.search_value();
                break;
            case 4 : a.deleten();
                break;
            default : cout<<endl<<"Please choose a valid option (1-4).";
        }
        cout<<endl<<"Would you like to continue? (y/n):\t";
        cin>>c;
    }
    while(c=='y' || c=='Y');
}

```

```

        cout<<"\n\n// END OF CODE\n\n";

return 0;

}

```

## Output:

```

--- MAIN MENU ---
1 -> Insert keyword
2 -> Display AVL tree
3 -> Search a keyword
4 -> Delete a keyword
Choose an option (1-4): 1

Enter keyword: 10
Enter meaning: first

Add another word? (y/n): y

Enter keyword: 11
Enter meaning: second

Add another word? (y/n): y

Enter keyword: 12
Enter meaning: third

Add another word? (y/n): n

Would you like to continue? (y/n): y

--- MAIN MENU ---
1 -> Insert keyword
2 -> Display AVL tree
3 -> Search a keyword
4 -> Delete a keyword
Choose an option (1-4): 2

Keywords in ascending order:
10 : first
11 : second
12 : third

Keywords in descending order:
12 : third

```