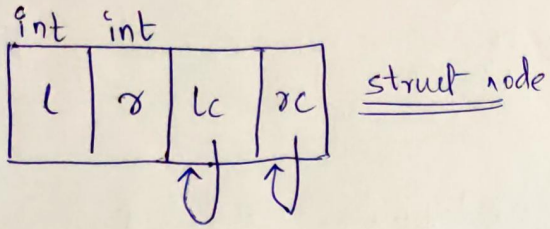
(★) E1 - 35

Structure and Diagram:-




```
struct node{
    int l=0;
    int r=0;
    bptr lc=NULL;
    bptr rc=NULL;
};
typedef struct node * bptr;
```

Algorithm:-

→ addRange() function:-

- If the given range doesnt already exist, it will create it.
- If given range is partially overlapping, it will just create a new node with unoverlapped ranges.
- If given range is completely overlapping, it will just return.

→ searchRange() function:-

- Almost similas to addRange function.
- If any part of range doesnt exist it returns false.

→ deleteRange():

- If given range is subset of range in current node, it splits current node into 2 nodes, excluding the range to be deleted.
- If given range is partially overlapping, delete the partial range in current node, and remaing range from children.

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## E1_35

Code:

```
#include<iostream>
using namespace std;
#define null NULL
typedef struct node * bptr;
struct node{
    int l=0,r=0;
    bptr lc=null,rc=null;
};
void addRange(bptr &t,int left,int right)
{
    if(!t){
        t=new node;
        t->l=left;
        t->r=right;
        return;
    }
    if(t->l<=left && right<=t->r)return;
    if(left<t->l && right<=t->r){
        if(right<t->l)addRange(t->lc,left,right);
        else addRange(t->lc,left,t->l);return;
    }
    if(t->l<=left && t->r<right){
        if(left>t->r)addRange(t->rc,left,right);
        else addRange(t->rc,t->r,right);return;
    }
    if(left<t->l && t->r<right){
        addRange(t->lc,left,t->l);
        addRange(t->rc,t->r,right);return;
    }
}
bool searchRange(bptr t,int left,int right){
    if(!t)return false;
    if(t->l<=left && right<=t->r)return true;
    if(left<t->l && right<=t->r){
        if(right<t->l)return searchRange(t->lc,left,right);
```

```
        return searchRange(t->lc,left,t->l);
    }
    if(t->l<=left && t->r<right){
        if(left>t->r)return searchRange(t->rc,left,right);
        return searchRange(t->rc,t->r,right);
    }
    if(left<t->l && t->r<right){
        return searchRange(t->lc,left,t->l) && searchRange(t->rc,t->r,right);
    }
    return false;
}
void deleteRange(bptr &t,int left,int right);
void delfull(bptr &t){
    if(!t->lc){t=t->rc;return;}
    else if(!t->rc){t=t->lc;return;}
    else{
        bptr lmax=t->lc;
        while(lmax->rc)lmax=lmax->rc;
        t->l=lmax->l;
        t->r=lmax->r;
        deleteRange(t->lc,lmax->l,lmax->r);
    }
}
void deleteRange(bptr &t,int left,int right){
    if(!t)return;
    if(t->l<=left && right<=t->r){
        if(t->l==left && t->r==right){
            delfull(t);return;
        }
        if(t->l==left){t->l=right;return;}
        if(t->r==right){t->r=left;return;}
        bptr temp = new node;
        temp->l=right;temp->r=t->r;
        temp->rc=t->rc;
        t->rc=temp;
        t->r=left;
        return;
    }
    if(right<t->l){deleteRange(t->lc,left,right);return;}
    if(left>t->r){deleteRange(t->rc,left,right);return;}
    if(left<t->l && right<t->r){
        deleteRange(t,t->l,right);
```

```
        deleteRange(t->lc,left,t->l);return;
    }
    if(left>t->l && right>t->r){
        deleteRange(t,left,t->r);
        deleteRange(t->lc,t->r,right);return;
    }
    if(left<t->l && right>t->r){
        deleteRange(t,t->l,t->r);
        deleteRange(t->lc,left,t->l);
        deleteRange(t->rc,t->r,right);return;
    }
}
int main()
{
    bptr t=null;
    addRange(t,10,20);
    deleteRange(t,14,16);
    if(searchRange(t,10,14))cout<<"true";else cout<<"false";cout<<endl;
    if(searchRange(t,13,15))cout<<"true";else cout<<"false";cout<<endl;
    if(searchRange(t,16,17))cout<<"true";else cout<<"false";cout<<endl;
}
```

Output:

```
PS C:\Users\Vishwas Gajawada\Desktop\c++ codes\
true
false
true
PS C:\Users\Vishwas Gajawada\Desktop\c++ codes\
```