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COURSE CODE: CSE2003

SLOT: L27 + L28

DATA STRUCTURES AND ALGORITHMS

DIGITAL ASSIGNMENT – 5

1. Menu driven C program to create binary search tree. Perform insertion and deletion operations. Display the contents of BST using preorder, inorder and postorder traversal.

PSEUDOCODE:

```
struct tree
{
int info
struct tree *left
struct tree *right
};
struct tree *insert(struct tree *,int)
void inorder(struct tree *)
void postorder(struct tree *)
void preorder(struct tree *)
struct tree *delet(struct tree *,int)
int main()
{
struct tree *root
int choice, item,item_no
root = NULL
do
```

```
{
do
{
printf("\n\t 1. Insert in Binary Tree  ")
printf("\n\t 2. Delete from Binary Tree ")
printf("\n\t 3. Inorder traversal of Binary tree")
printf("\n\t 4. Postorder traversal of Binary tree")
printf("\n\t 5. Preorder traversal of Binary tree")
printf("\n\t 6. Exit ")
printf("\n\t Enter choice : ")
scanf(" %d",&choice)
if(choice<1 || choice>7)
printf("\n Invalid choice - try again")
}while (choice<1 || choice>6)

switch(choice)
{
case 1:
printf("\n Enter new element: ")
scanf("%d", &item)
root= insert(root,item)
printf("\n root is %d",root->info)
printf("\n Inorder traversal of binary tree is : ")
inorder(root)
printf("\n Preorder traversal of binary tree is : ")
preorder(root)
printf("\n Postorder traversal of binary tree is : ")
   postorder(root)
   printf("\n")
   break
   case 2:
```

```
printf("\n Enter the element to be deleted : ")
scanf(" %d",&item_no)
root=delet(root,item_no)
printf("\n Inorder traversal of binary tree is : ")
inorder(root)
printf("\n Preorder traversal of binary tree is : ")
preorder(root)
printf("\n Postorder traversal of binary tree is : ")
postorder(root)
printf("\n")
break
case 3:
printf("\n Inorder traversal of binary tree is : ")
inorder(root)
break
case 4:
 printf("\n Postorder traversal of binary tree is : ")
 postorder(root)
 break
 case 5:
 printf("\n Preorder traversal of binary tree is : ")
 preorder(root)
   break
   default:
   printf("\n End of program ")
   }
   }
   while(choice !=6)
   return(0)
  }
  struct tree *insert(struct tree *root, int x)
```

```
    {
    if(!root)
    {
    root=(struct tree*)malloc(sizeof(struct tree))
    root->info = x
    root->left = NULL
    root->right = NULL
    return(root)
     }
     if(root->info > x)
      root->left = insert(root->left,x)
     else
     {
     if(root->info < x)
     root->right = insert(root->right,x)
     }
     return(root)
}
void inorder(struct tree *root)
{
if(root != NULL)
{
inorder(root->left)
printf(" %d",root->info)
inorder(root->right)
}
return;
}
void postorder(struct tree *root)
{
if(root != NULL)
```

```
{
postorder(root->left)
postorder(root->right)
printf(" %d",root->info)
}
return
}
void preorder(struct tree *root
{
if(root != NULL)
{
printf(" %d",root->info)
preorder(root->left)
preorder(root->right)
}
return
}
struct tree *delet(struct tree *ptr,int x)
{
struct tree *p1,*p2
if(!ptr)
{
printf("\n Node not found ")
return(ptr)
}
else
{
if(ptr->info < x)
{
ptr->right = delet(ptr->right,x);
/*return(ptr);*/
```

```
}
else if (ptr->info >x)
{
ptr->left=delet(ptr->left,x)
return ptr
}
else
{
if(ptr->info == x)
 {
if(ptr->left == ptr->right)
{
free(ptr)
return(NULL)
}
else if(ptr->left==NULL)

{
p1=ptr->right
free(ptr)
return p1
}
else if(ptr->right==NULL)
{
p1=ptr->left
free(ptr)
return p1
}
else
{
p1=ptr->right
```

```
p2=ptr->right
while(p1->left != NULL)
p1=p1->left
p1->left=ptr->left
free(ptr)
return p2
}
}


}


}
return(ptr)
}
```

CODE:

```
#include<stdio.h>
#include<conio.h>

struct tree {
        int info;
        struct tree *left;
        struct tree *right;
};
struct tree *insert(struct tree *,int);
void inorder(struct tree *);
void postorder(struct tree *);
void preorder(struct tree *);
struct tree *delet(struct tree *,int);
int main()
{
```

```
        struct tree *root;
        int choice, item,item_no;
        root = NULL;
        /* rear  = NULL;*/
        do
{
                do
                {
                        printf("\n\t 1. Insert in Binary Tree  ");
                        printf("\n\t 2. Delete from Binary Tree ");
                        printf("\n\t 3. Inorder traversal of Binary tree");
                        printf("\n\t 4. Postorder traversal of Binary tree");
                        printf("\n\t 5. Preorder traversal of Binary tree");
                        printf("\n\t 6. Exit ");
                        printf("\n\t Enter choice : ");
                        scanf(" %d",&choice);
                        if(choice<1 || choice>7)
                            printf("\n Invalid choice - try again");
                }while (choice<1 || choice>6);

                switch(choice)
                {
                        case 1:
         printf("\n Enter new element: ");
         scanf("%d", &item);
         root= insert(root,item);
         printf("\n root is %d",root->info);
         printf("\n Inorder traversal of binary tree is : ");
         inorder(root);
         printf("\n Preorder traversal of binary tree is : ");
         preorder(root);
```

```
printf("\n Postorder traversal of binary tree is : ");
postorder(root);
printf("\n");
break;
                case 2:
printf("\n Enter the element to be deleted : ");
scanf(" %d",&item_no);
root=delet(root,item_no);
printf("\n Inorder traversal of binary tree is : ");
inorder(root);
printf("\n Preorder traversal of binary tree is : ");
preorder(root);
printf("\n Postorder traversal of binary tree is : ");
postorder(root);
printf("\n");
break;
                case 3:
printf("\n Inorder traversal of binary tree is : ");
inorder(root);
break;
                case 4:
                        printf("\n Postorder traversal of binary tree is : ");
postorder(root);
break;
                case 5:
printf("\n Preorder traversal of binary tree is : ");
preorder(root);
break;
                default:
printf("\n End of program ");
        }
```

```
                /* end of switch */
        }
        while(choice !=6);
        return(0);
}
struct tree *insert(struct tree *root, int x)
{
        if(!root)
   {
                root=(struct tree*)malloc(sizeof(struct tree));
                root->info = x;
                root->left = NULL;
                root->right = NULL;
                return(root);
        }
        if(root->info > x)
            root->left = insert(root->left,x);
   else
   {
                if(root->info < x)
                        root->right = insert(root->right,x);
        }
        return(root);
}


void inorder(struct tree *root)
{
        if(root != NULL)
   {
                inorder(root->left);
```

```
                printf(" %d",root->info);
                inorder(root->right);
        }
        return;
}
void postorder(struct tree *root)
{
        if(root != NULL)
   {
                postorder(root->left);
                postorder(root->right);
                printf(" %d",root->info);
        }
        return;
}
void preorder(struct tree *root)
{
        if(root != NULL)
   {
                printf(" %d",root->info);
                preorder(root->left);
                preorder(root->right);
        }
        return;
}
/* FUNCTION TO DELETE A NODE FROM A BINARY TREE */
struct tree *delet(struct tree *ptr,int x)
{
        struct tree *p1,*p2;
        if(!ptr)
   {
```

```
                printf("\n Node not found ");
                return(ptr);
        }
        else
{
                if(ptr->info < x)
                {
                        ptr->right = delet(ptr->right,x);
                        /*return(ptr);*/
                }
   else if (ptr->info >x)
                {
                        ptr->left=delet(ptr->left,x);
                        return ptr;
                }
                else
                /* no. 2 else */
                {
                        if(ptr->info == x)
                        /* no. 2 if */ {
                                if(ptr->left == ptr->right)
                                /*i.e., a leaf node*/
                                {
                                        free(ptr);
                                        return(NULL);
                                }
                                else if(ptr->left==NULL)
                                /* a right subtree */
                                {
                                        p1=ptr->right;
                                        free(ptr);
```

```
                                        return p1;
                                }
                                else if(ptr->right==NULL)
                                /* a left subtree */
                                {
                                        p1=ptr->left;
                                        free(ptr);
                                        return p1;
                                }
                                 else
        {
                                        p1=ptr->right;
                                        p2=ptr->right;
                                        while(p1->left != NULL)
                                                p1=p1->left;
                                        p1->left=ptr->left;
                                        free(ptr);
                                        return p2;
                                }
                        }
                        /*end of no. 2 if */
                }
                /* end of no. 2 else */
                /* check which path to search for a given no. */
        }
        return(ptr);
}
```

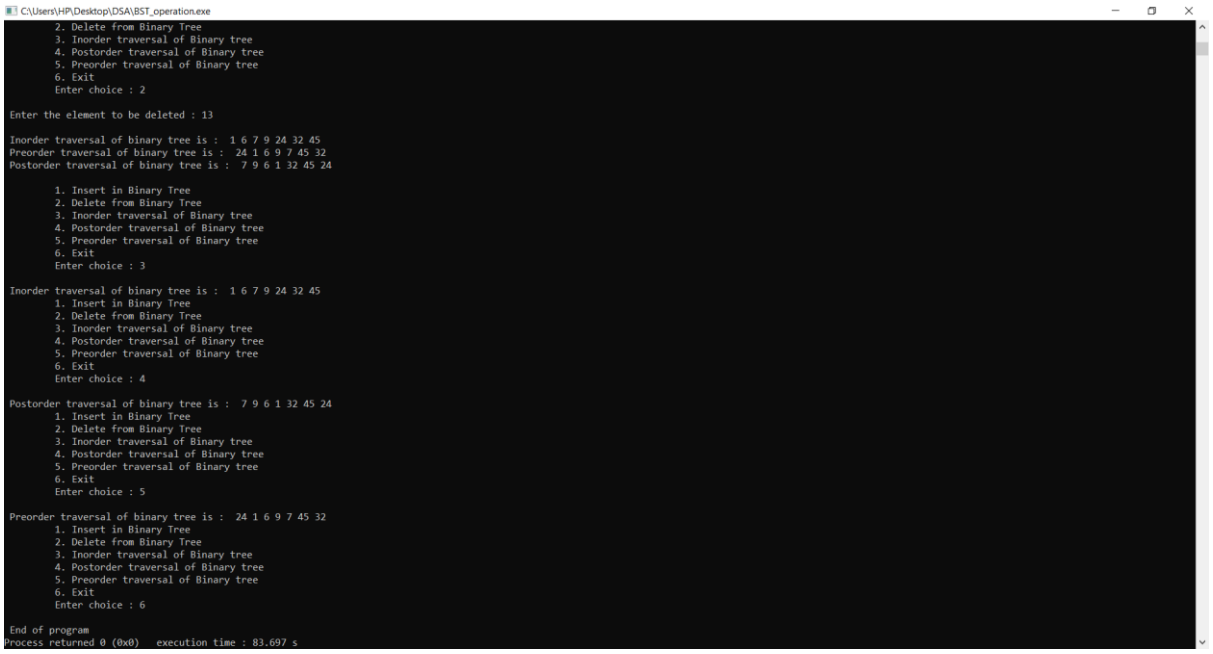
C:\Users\HP\Desktop\DSA\BST_operation.exe

```
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 1

Enter new element: 32

root is 13
Inorder traversal of binary tree is :  1 6 9 13 24 32 45
Preorder traversal of binary tree is :  13 1 6 9 24 45 32
Postorder traversal of binary tree is :  9 6 1 32 45 24 13

        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 1

Enter new element: 7

root is 13
Inorder traversal of binary tree is :  1 6 7 9 13 24 32 45
Preorder traversal of binary tree is :  13 1 6 9 7 24 45 32
Postorder traversal of binary tree is :  7 9 6 1 32 45 24 13

        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 1

Enter new element: 45

root is 13
Inorder traversal of binary tree is :  1 6 7 9 13 24 32 45
Preorder traversal of binary tree is :  13 1 6 9 7 24 45 32
Postorder traversal of binary tree is :  7 9 6 1 32 45 24 13

        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 2
```

C:\Users\HP\Desktop\DSA\BST_operation.exe

```
        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 1

Enter new element: 13

root is 13
Inorder traversal of binary tree is :  13
Preorder traversal of binary tree is :  13
Postorder traversal of binary tree is :  13

        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 1

Enter new element: 24

root is 13
Inorder traversal of binary tree is :  13 24
Preorder traversal of binary tree is :  13 24
Postorder traversal of binary tree is :  24 13

        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
        5. Preorder traversal of Binary tree
        6. Exit
        Enter choice : 1

Enter new element: 1

root is 13
Inorder traversal of binary tree is :  1 13 24
Preorder traversal of binary tree is :  13 1 24
Postorder traversal of binary tree is :  1 24 13

        1. Insert in Binary Tree
        2. Delete from Binary Tree
        3. Inorder traversal of Binary tree
        4. Postorder traversal of Binary tree
```


C:\Users\HP\Desktop\DSA\BST_operation.exe
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 1
Enter new element: 6
root is 13
Inorder traversal of binary tree is : 1 6 13 24
Preorder traversal of binary tree is : 13 1 6 24
Postorder traversal of binary tree is : 6 1 24 13
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 1
Enter new element: 9
root is 13
Inorder traversal of binary tree is : 1 6 9 13 24
Preorder traversal of binary tree is : 13 1 6 9 24
Postorder traversal of binary tree is : 9 6 1 24 13
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 1
Enter new element: 45
root is 13
Inorder traversal of binary tree is : 1 6 9 13 24 45
Preorder traversal of binary tree is : 13 1 6 9 24 45
Postorder traversal of binary tree is : 9 6 1 45 24 13
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree


C:\Users\HP\Desktop\DSA\BST_operation.exe
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 2
Enter the element to be deleted : 13
Inorder traversal of binary tree is : 1 6 7 9 24 32 45
Preorder traversal of binary tree is : 24 1 6 9 7 45 32
Postorder traversal of binary tree is : 7 9 6 1 32 45 24
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 3
Inorder traversal of binary tree is : 1 6 7 9 24 32 45
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 4
Postorder traversal of binary tree is : 7 9 6 1 32 45 24
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 5
Preorder traversal of binary tree is : 24 1 6 9 7 45 32
1. Insert in Binary Tree
2. Delete from Binary Tree
3. Inorder traversal of Binary tree
4. Postorder traversal of Binary tree
5. Preorder traversal of Binary tree
6. Exit
Enter choice : 6
End of program
Process returned 0 (0x0) execution time : 83.697 s

2. Implement C program to perform sorting of n numbers using heap sort technique.

PSEUDOCODE:

```
void heapify(int arr[])
{
 int i,n
 n=arr[0]
 for(i=n/2;i>=1;i--)
 adjust(arr,i)
 }

void adjust(int arr[],int i)
{
int j,temp,n,k=1
n=arr[0]
while(2*i<=n && k==1)
{
 j=2*i
 if(j+1<=n && arr[j+1] > arr[j])
 j=j+1

 if( arr[j] < arr[i])
  k=0
  else
  {
  temp=arr[i]
  arr[i]=arr[j]
  arr[j]=temp
   i=j
   }
```

```
  }
  }


int main()
{
 int arr[100],n,temp,last
 printf("Number of Elements you want in array: ")
 scanf("%d",&n)
 printf("Enter Elements in array:\n")
 for(int i=1;i<=n;i++)
 scanf("%d",&arr[i])
 arr[0]=n
 heapify(arr)
 while(arr[0] > 1)
 {
 last=arr[0]
 temp=arr[1]
  arr[1]=arr[last]
  arr[last]=temp
  arr[0]--
  adjust(arr,1)
  }

  printf("Sorted Array \n")
  for(int i=1;i<=n;i++)
  printf("%d ",arr[i])
  }
```

CODE:

```
#include<stdio.h>
#include <conio.h>
```

```
void heapify(int arr[])
{
   int i,n;
   n=arr[0];
   for(i=n/2;i>=1;i--)
   adjust(arr,i);
}

void adjust(int arr[],int i)
{
   int j,temp,n,k=1;
   n=arr[0];
   while(2*i<=n && k==1)
   {
     j=2*i;
     if(j+1<=n && arr[j+1] > arr[j])
        j=j+1;

     if( arr[j] < arr[i])
        k=0;
     else
     {
        temp=arr[i];
        arr[i]=arr[j];
        arr[j]=temp;
        i=j;
      }
    }
}
```

```
int main()
{
   int arr[100],n,temp,last;
   printf("Number of Elements you want in array: ");
   scanf("%d",&n);
   printf("Enter Elements in array:\n");
   for(int i=1;i<=n;i++)
      scanf("%d",&arr[i]);
   arr[0]=n;
   heapify(arr);
   while(arr[0] > 1)
   {
      last=arr[0];
      temp=arr[1];
      arr[1]=arr[last];
      arr[last]=temp;
      arr[0]--;
      adjust(arr,1);
   }

   printf("Sorted Array \n");
   for(int i=1;i<=n;i++)
   printf("%d ",arr[i]);
   getch();
   return 0;
}
```


C:\Users\HP\Desktop\DSA\Heapsort.exe
Number of Elements you want in array: 10
Enter Elements in array:
12
23
43
1
9
3
45
76
51
64
Sorted Array
1 3 9 12 23 43 45 51 64 76