

# Design and Analysis of Algorithms Assignment - 8

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Batch : B-3

## Huffman Encoding

CODE :

```
#include<bits/stdc++.h>
using namespace std;
struct Node
{
    char data;
    int freq;
    Node* left;
    Node* right;
};

Node* createNode(char d,int f)
{
    Node* temp = new Node;
    temp->data = d;
    temp->freq = f;
    temp->left = NULL;
    temp->right = NULL;
    return temp;
}

void show(Node* root)
{
    if(root)
```

```

{
    show(root->left);

    cout<<root->freq<<" ";

    show(root->right);
}
}

void generateCodes(Node* root,string s)
{
    if(!root)
        return;

    if(root->data!='$')
        cout<<"\n\t\t"<<root->data<<" "<<s<<endl;

    generateCodes(root->left,s+'0');
    generateCodes(root->right,s+'1');
}

void hauffmanTree(vector<pair<char,int>> &v)
{
    priority_queue<Node*,vector<Node*>,greater<Node*>> p;

    for(int i=0;i<v.size();i++)
    {
        Node* temp = new Node;

        temp = createNode(v[i].first,v[i].second);

        p.push(temp);
    }

    Node *left,*right,*top;

    while(p.size()!=1)
    {
        left = p.top();

        p.pop();

        right = p.top();

        p.pop();

        top = new Node;

        top = createNode('$',left->freq+right->freq);

        top->left = left;

        top->right = right;

        p.push(top);
    }
}

```

```

    }

    cout<<"\n\tInorder traversal of Hauffman Tree is: ";

    show(p.top());

    cout<<endl<<"\n\tCodes of each character : "<<endl;

    generateCodes(p.top(),"\t");

    cout<<endl;
}

bool helper(pair<char,int> &p1,pair<char,int> &p2)
{
    return p1.second<p2.second;
}

int main()
{
    string s;

    cout<<"\n\tEnter the input string : ";

    cin>>s;

    unordered_map<char,int> m;

    for(int i=0;i<s.size();i++)

        m[s[i]]++;

    vector<pair<char,int>> v;

    for(auto i:m)

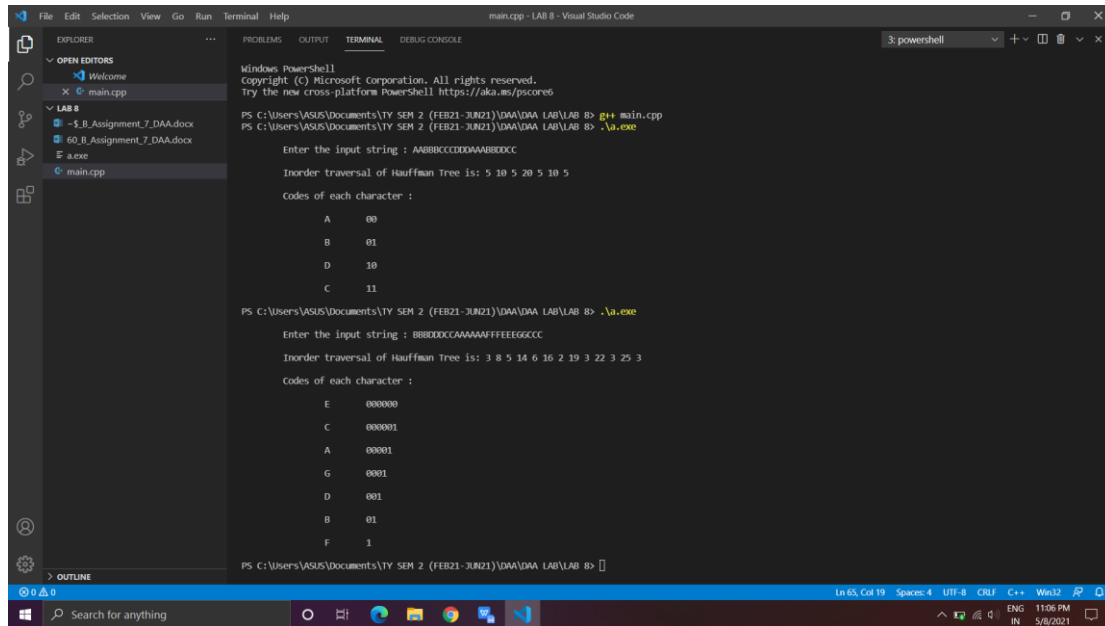
        v.push_back(i);

    sort(v.begin(),v.end(),helper);

    hauffmanTree(v);
}

```

O/P:



The screenshot shows a Visual Studio Code window with a terminal running a C++ program. The program constructs a Huffman tree and outputs the in-order traversal of the tree and the binary codes for each character. The first example uses the input string "AABBCCDDDDAAABDDCC" and the second example uses "BBBDDCCAAAAAFFFFEEGGCC".

```
Windows PowerShell
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Try the new cross-platform PowerShell https://aka.ms/powershell

PS C:\Users\ASUS\Documents\TY SEM 2 (FEB21-JUN21)\DAA\LAB\LAB 8> g++ main.cpp
PS C:\Users\ASUS\Documents\TY SEM 2 (FEB21-JUN21)\DAA\LAB\LAB 8> .\a.exe

Enter the input string : AABBCCDDDDAAABDDCC

Inorder traversal of Huffman Tree is: 5 10 5 20 5 10 5

Codes of each character :

A      00
B      01
D      10
C      11

PS C:\Users\ASUS\Documents\TY SEM 2 (FEB21-JUN21)\DAA\LAB\LAB 8> .\a.exe

Enter the input string : BBBDDCCAAAAAFFFFEEGGCC

Inorder traversal of Huffman Tree is: 3 8 5 14 6 16 2 19 3 22 3 25 3

Codes of each character :

E      000000
C      000001
A      00001
G      0001
D      001
B      01
F      1

PS C:\Users\ASUS\Documents\TY SEM 2 (FEB21-JUN21)\DAA\LAB\LAB 8>
```

Time Complexity:  $O(n \log n)$

Space Complexity:  $O(n)$