Lab 11

- Jainil Trivedi (CE166)

AIM: Implement basic compression Techniques

Implement Arithmetic Coding and Decoding.

```
#include<bits/stdc++.h>


using namespace std;

typedef struct node{
    double prob, range_from, range_to;
}node;

double encoding(unordered_map<char,node> arr, string s)
{
    double low = 0.0,high = 1.0, dif = 1.0;
    cout << "Symbol\tLow_v\tHigh_v\tdiff\n";
    for(int i = 0; i < s.length(); i++)
    {
        char c = s[i];
        high = low + dif * arr[c].range_to;
        low = low + dif * arr[c].range_from;
        dif = high - low;
        cout<<c<<"\t"<<low<<"\t"<<high<<"\t"<<dif<<endl;
    }
    cout<<low<<endl;
    return low;
}

string decoding(unordered_map<char,node> arr, double code, int len )
{
    char ch;
    string text= "";
    int j=0;
    unordered_map<char, node>:: iterator it;
    cout<<"Code\tOutput\tRangeFrom\tRangeTo\n";
    while(j<len){
        cout<<code<<"\t";
        for(it= arr.begin(); it!=arr.end(); it++){
```

```
            char i= (*it).first;
            if(arr[i].range_from<= code && code< arr[i].range_to){
                ch= i;
                code= (code-arr[i].range_from)/(arr[i].range_to-
arr[i].range_from);
                break;
            }
        }
        cout<<ch<<"\t"<<arr[ch].range_from<<"\t\t"<<arr[ch].range_to<<endl;
        text+= ch;
        j++;
    }
    return text;
}


int main()
{
    int n;
    cout<<"Enter no. of characters\n";
    cin>>n;
     /*
        n=9
        Y 0.1
        E 0.2
        R 0.1
        G 0.1
        N 0.1
        M 0.1
        A 0.1
        F 0.1
        C 0.1
    */
    unordered_map<char, node> arr;

    vector<char> ar;
    double range_from= 0;
    cout<<"Enter probabilities:\n";
    for(int i=0; i<n; i++){
        char ch;
        cin>>ch;
        ar.push_back(ch);
        cin>>arr[ch].prob;
        arr[ch].range_from= range_from;
        arr[ch].range_to= range_from+ arr[ch].prob;
```

```
        range_from= arr[ch].range_to;
    }
    cout<<"Symbol\tProb\tRangeFrom\tRangeTo\n";
    for(int i=0;i<n;i++)
    {
        cout<<ar[i]<<"\t";
        char ch=ar[i];
        cout<<arr[ch].prob<<"\t"<<arr[ch].range_from<<"\t\t"<<arr[ch].range_to<<e
ndl;
    }
    string s;
    cout<<"Enter text: ";
    cin>>s;
    double code=encoding(arr,s);
    cout<<"Code Generated is: "<<code<<endl;
    string d=decoding(arr,code,s.size());
    cout<<"Decoded Text: "<<d<<endl;

}
```

OUTPUT:

```
Enter text: france
Symbol  Low_v   High_v  diff
f       0.8     0.9     0.1
r       0.83    0.84    0.01
a       0.837   0.838   0.001
n       0.8375  0.8376  0.0001
c       0.83759 0.8376  1e-005
e       0.837591        0.837593        2e-006
0.837591
Code Generated is: 0.837591
Code    Output  RangeFrom       RangeTo
0.837591        f       0.8             0.9
0.37591 r       0.3             0.4
0.7591  a       0.7             0.8
0.591   n       0.5             0.6
0.91    c       0.9             1
0.1     e       0.1             0.3
Decoded Text: france
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\
```

```
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\IP\PDFs\CE166JAINILTRIVEDILAB11> ./a
Enter no. of characters
9
Enter probabilities:
y 0.1
e 0.2
r 0.1
g 0.1
n 0.1
m 0.1
a 0.1
f 0.1
c 0.1
Symbol  Prob  RangeFrom   RangeTo
y       0.1     0             0.1
e       0.2     0.1           0.3
f       0.1     0.8           0.9
c       0.1     0.9           1
Enter text: german
```

```
Enter text: german
Symbol  Low_v   High_v  diff
g       0.4     0.5     0.1
e       0.41    0.43    0.02
r       0.416   0.418   0.002
m       0.4172  0.4174  0.0002
a       0.41734 0.41736 2e-005
n       0.41735 0.417352        2e-006
0.41735
Code Generated is: 0.41735
Code    Output  RangeFrom       RangeTo
0.41735 g       0.4             0.5
0.1735  e       0.1             0.3
0.3675  r       0.3             0.4
0.675   m       0.6             0.7
0.75    a       0.7             0.8
0.5     n       0.5             0.6
Decoded Text: german
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\IP\PDFs\CE166JAINILTRIVEDILAB11>
```

2. Implement Huffman Coding and Decoding

```cpp
#include <bits/stdc++.h>
using namespace std;
class Node
{
public:
    int val;
    string symbol;
    Node *left, *right;
    bool isleaf = true;
    Node(int v, string sym)
    {
        symbol = sym;
        val = v;
        left = right = NULL;
    }
};
void print(Node *node, string curr){
    if (node == NULL)
        return;
```

```
    if (node->isleaf)
    {
        cout << node->symbol << " " << curr << endl;
        return;
    }

    print(node->left, curr + "0");

    print(node->right, curr + "1");
};
int main()
{
    map<string, int> freq;
    int total;
    cin >> total;
    map<char, string> codes;
    for (int i = 0; i < total; i++)
    {
        string sym;
        int fre;
        cin >> sym >> fre;
        freq[sym] = fre;
    }
    auto lambda_cmp = [](Node *a, Node *b)
    { return a->val > b->val; };

    priority_queue<Node *, vector<Node *>, decltype(lambda_cmp)> pq(lambda_cmp);
    for (auto it : freq)
    {
        string sym = it.first;
        int freq = it.second;
        // cout<<sym<<" "<<freq<<endl;
        Node *newnode = new Node(freq, sym);
        pq.push(newnode);
    }
    while (pq.size() > 1)
    {
        Node *min1 = pq.top();
        pq.pop();
        Node *min2 = pq.top();
        pq.pop();
        Node *newtop = new Node(min1->val + min2->val, min2->symbol + min1->
symbol);
        newtop->left = min2;
        newtop->right = min1;
```

```
        newtop->isleaf = false;
        pq.push(newtop);
    }
    auto root = pq.top();
    cout<<"Encoding is:\n";
    print(root, "");
    return 0;
}
```

OUTPUT:

```
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\IP\PDFs\CE166JAINILTRIVEDILAB11> ./a
5
A 30
B 30
C 15
A 30
B 30
C 15
D 15
E 10
Encoding is:
A 00
B 01
C 100
E 101
D 11
```

```
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\IP\PDFs\CE166JAINILTRIVEDILAB11> g++ hufman.cpp
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\IP\PDFs\CE166JAINILTRIVEDILAB11> ./a
5
a 30
b 30
c 15
d 10
e 5
Encoding is:
a 00
b 01
d 100
e 101
c 11
PS C:\Users\Jainil\Desktop\Jainil\College\Sem-7\IP\PDFs\CE166JAINILTRIVEDILAB11>
```