Information Theory and Coding (ITC)

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Classwork

Q.1 Shannon Fano Coding (in cpp)

```
#include <bits/stdc++.h>
using namespace std;
#include<chrono>
#define ll long long
#define pb push_back
#define f first
#define s second
typedef vector<int> vi;
typedef vector<vector<int>> vvi;
typedef vector<ll> vll;

struct shanon{
    string symb;
    float pro;
    string code;
};
void sort_shanon(vector<shanon>& nodes){
    sort(begin(nodes),end(nodes),[&](shanon& a,shanon& b){
        return a.pro>b.pro;
    });
}
void solve(vector<shanon>& nodes,int l,int h){
    if(l>=h){
        return;
    }
    float tot_pro=0,split_pro=0;
    for(int i=l;i<=h;i++){
        tot_pro+=nodes[i].pro;
    }
```

```
    int mid=l;
    while(mid<h && (split_pro+nodes[mid].pro)*2<=tot_pro){
        mid++;
        split_pro+=nodes[mid].pro;
    }
    for(int i=l;i<=mid;i++){
        nodes[i].code+="0";
    }
    for(int i=mid+1;i<=h;i++){
        nodes[i].code+="1";
    }
    //Divide and conquer the two sub-arrays
    solve(nodes,l,mid);
    solve(nodes,mid+1,h);
}
void jarur_hoga() {
    cout<<"Welcome to Shanon Fanon Coding tutorial:"<<endl;
    int n;
    cout<<"Enter No. of symbols: ";
    cin>>n;
    vector<shanon>nodes(n);
    cout<<"Please Enter the symbols below:"<<endl;
    for(int i=0;i<n;i++){
        cout<<"Enter symbol "<<i+1<<" ";
        cin>>nodes[i].symb;
    }
    cout<<"Please Enter the Probabilities of respective symbols below:"<<endl;
    for(int i=0;i<n;i++){
        cout<<"Enter probability of Symbol "<<nodes[i].symb<<" ";
        cin>>nodes[i].pro;
    }
    cout<<"Input entered sucessfully!!"<<endl;
    cout<<"Waiting for the Shanon codes to be calculated"<<endl;
    auto start=chrono::high_resolution_clock::now();
    sort_shanon(nodes);
    solve(nodes,0,n-1);
    for(int i=0;i<n;i++){
        cout<<"Code for Symbol"<<nodes[i].symb<<" is:"<<nodes[i].code<<" "<<endl;
    }
    cout<<endl;
```

```
    auto end=chrono::high_resolution_clock::now();
    auto duration=chrono::duration_cast<chrono::milliseconds>(end-start);
    cout<<"Time taken to calculate the shanonn fano code is:
"<<duration.count()<<"ms\n";

}
int main() {
    bool has_mult_tcs=false;
    int t;
    if(has_mult_tcs){
        cin>>t;
    }
    else{
        t=1;
    }
    while(t--){
        jarur_hoga();
    }
    return 0;
}

```

Output

```
Welcome to Shanon Fanon Coding tutorial:
Enter No. of symbols: 5
Please Enter the symbols below:
Enter symbol 1 A
Enter symbol 2 B
Enter symbol 3 C
Enter symbol 4 D
Enter symbol 5 E
Please Enter the Probabilities of respective symbols below:
Enter probability of Symbol A 0.22
Enter probability of Symbol B 0.28
Enter probability of Symbol C 0.15
Enter probability of Symbol D 0.30
Enter probability of Symbol E 0.05
Input entered sucessfully!!
Waiting for the Shanon codes to be calculated
Code for SymbolD is:00
Code for SymbolB is:01
Code for SymbolA is:10
Code for SymbolC is:110
Code for SymbolE is:111

Time taken to calculate the shanonn fano code is: 0ms
```

[Note: Code was run on programmiz (online compiler)]