

```

1:  /*
2:      Name: Krushkal Algorithm
3:      Author: Sounish Nath
4:      Date: 17-09-20 18:23
5:      Description: To find minimal spanning tree from Graph
6:  */
7:
8:  #include <bits/stdc++.h>
9:  using namespace std ;
10: typedef long long ll ;
11:
12: unordered_map<char, char> parent ; // check whos' parent
13: struct Edge{
14:     int cost ;
15:     char u, v ;
16:     Edge(char uu, char vv, int c) : cost(c), u(uu), v(vv) { }
17: };
18:
19: struct Graph {
20:     vector<char> vertices ;
21:     vector<Edge> edges ;
22: };
23:
24: struct Dset {
25:     void makeset(char u) {
26:         parent[u] = u ;
27:     }
28:     char find(char u) {
29:         if(parent[u] == u){
30:             return u ;
31:         }
32:         return find(parent[u]) ;
33:     }
34:     void unionn(char u, char v){
35:         char x = find(u) ;
36:         char y = find(v) ;
37:         parent[x] = y ;
38:     }
39: };
40:
41: void krushhkal_algorithm(Graph &g) {
42:     Dset dset ;
43:     sort(g.edges.begin(), g.edges.end(), [&](Edge a, Edge b) {
44:         return a.cost < b.cost ;
45:     }) ;
46:     for(auto &&vertex : g.vertices){
47:         dset.makeset(vertex) ;
48:     }
49:     vector<Edge> a ;
50:     for(auto &&edge : g.edges) {

```

```

51:         char x = dset.find(edge.u) ;
52:         char y = dset.find(edge.v) ;
53:         if(x != y){
54:             a.push_back(edge) ;
55:             dset.unionn(x, y) ;
56:         }
57:     }
58:     int mincost = 0 ;
59:     cout << "going paths: \n" ;
60:     for(auto &&edge : a) {
61:         mincost += edge.cost ;
62:         cout << edge.u << " ---> " << edge.v << endl ;
63:     }
64:     cout << "minimum cost: " << mincost << endl ;
65: }
66:
67: int main() {
68:     srand(time(NULL)) ;
69:     ios::sync_with_stdio(0), cin.tie(0), cout.tie(0);
70:
71:     char t[]{'a', 'b', 'c', 'd', 'e', 'f'};
72:
73:     Graph g ;
74:     g.vertices = vector<char>(t, t+ sizeof(t)/sizeof(t[0])) ;
75:     g.edges.push_back(Edge('a', 'b', 2)) ;
76:     g.edges.push_back(Edge('b', 'd', 2)) ;
77:     g.edges.push_back(Edge('c', 'e', 7)) ;
78:     g.edges.push_back(Edge('f', 'a', 10)) ;
79:     g.edges.push_back(Edge('e', 'e', 1)) ;
80:     g.edges.push_back(Edge('d', 'f', 6)) ;
81:     g.edges.push_back(Edge('d', 'c', 9)) ;
82:
83:     krushhkal_algorithm(g) ;
84:
85:
86: }
87:

```