

Contents

1	語法	
1.1	c++	
1.2	python	
2	Graph	
2.1	Bellman-Ford	
2.2	Dijkstra	
2.3	Floyd-Warshall	
2.4	SPFA	
2.5	smallTree	
3	Other	
3.1	KM	
3.2	LCS	
3.3	LIS	
3.4	merge	
3.5	Prime	
3.6	UVA12321	
3.7	Fire	

1 語法

1.1 c++

```

1 // c++ code
2 #include <bits/stdc++.h>
3 lower_bound(a, a + n, k); //最左邊 ≥ k 的位置
4 upper_bound(a, a + n, k); //最左邊 > k 的位置
5 upper_bound(a, a + n, k) - 1; //最右邊 ≤ k 的位置
6 lower_bound(a, a + n, k) - 1; //最右邊 < k 的位置
7 [lower_bound, upper_bound) //等於 k 的範圍
8 equal_range(a, a+n, k);
9
10 // 從小到大
11 priority_queue<int, vector<int>, greater<int>> > pq
12
13 insert(it, x) //向vector的任意迭代器it處插入一個元素x
14 erase(it) //刪除迭代器為it處的元素，erase(first, last)
15 //刪除一個區間[first, last)內的所有元素，時間複雜度均為O(N)
16
17 set
18 insert(x) //將x插入set中 O(log(n))
19 count(x) //回傳x是否存在於set中() O(log(n))
20 erase(x) //刪除在set中的x O(log(n))
21 clear() //刪除set中所有元素 O(n)
22 empty() //回傳是否為空 O(1)
23 size() //回傳共有幾個元素 O(1)
24
25 map
26 insert(x) //將x這個pair插入map中 O(log(n))
27 count(x) //回傳x這個key是否在map中 O(log(n))
28 erase(x) //刪除在map中key為x的 O(log(n))
29
30
31 #include <bits/stdc++.h>
32 using namespace std;
33
34 int main(){
35     set<int> s;
36     for(int i = 0; i < 10; i++){
37         s.insert(i);
38     }
39     cout << "lower bound: " << *s.lower_bound(5) <<
40         '\n'; // 5
41     cout << "upper bound: " << *s.upper_bound(5) <<
42         '\n'; // 6
43
44     if(s.lower_bound(20) == s.end()){
45         cout << "all elements are less than 20\n";
46     }
47 }

```

1.2 python

```

1 sorted((4,1,9,6),reverse=True)
2 fruits = ['apple', 'watermelon', 'pear', 'banana']
3 a = sorted(fruits, key = lambda x : len(x))
4 print(a)
5 # 輸出: ['pear', 'apple', 'banana', 'watermelon']
6 divmod(a,b)
7 把除數和餘數運算結果結合起來，
8 返回一個包含商和餘數的元組(a // b, a % b)
9
10 pow(base, exp[, mod])
11 >>> pow(38, -1, mod=97)
12 23
13 >>> 23 * 38 % 97 == 1
14 True
15
16 eof 寫法
17 try:
18     while True:
19         s = input()
20 except EOFError:
21     pass
22
23 eval(expression, globals=None, locals=None)
24
25
26 list(map(int, input().split()))
27 L.append(r)
28 my_list = ['This', 'is', 'a', 'string', 'in',
29            'Python']
30 my_string = " ".join(my_list)
31 #This is a string in Python
32 test = [[0 for j in range(m)] for i in range(n)]

```

2 Graph

2.1 Bellman-Ford

```

1 #include<iostream>
2 using namespace std;
3 const int INF = 1e9;
4 const int MAXN = 1000;
5 const int MAXM = 1000;
6 struct Edge {
7     int u;
8     int v;
9     int w;
10 };
11
12 int n, m;
13 Edge edges[MAXN];
14 int dis[MAXN];
15
16 // s是起點
17 bool bellman(int s) {
18     for (int i = 0; i < n; i++) {
19         dis[i] = INF;
20     }
21     dis[s] = 0;
22     bool relax;
23     // 做 n 輪
24     for (int i = 0; i < n; i++) {
25         relax = false;
26         for (int j = 0; j < m; j++) {
27             int u = edges[j].u;
28             int v = edges[j].v;
29             int w = edges[j].w;
30             if (dis[u] == INF) {
31                 continue;
32             }
33             if (dis[v] > dis[u] + w) {
34                 dis[v] = dis[u] + w;
35             }
36         }
37     }
38 }

```

```

35         relax = true;
36     }
37 }
38 if (!relax) {
39     break;
40 }
41 }
42 return relax;
43 }
44
45
46 int main(){
47 }
48 }

```

2.2 Dijkstra

```

1 #include<bits/stdc++.h>
2 using namespace std;
3 #define M 100005
4 #define INF 1e9
5 struct Edge{
6     int v, w;
7     Edge(int a, int b):v(a), w(b){};
8 };
9 struct node{
10     int u, dis;
11     node(){};
12     node(int a, int b):u(a), dis(b){};
13     bool operator<(const node &r)const{
14         return dis > r.dis;
15     }
16 };
17 int dis[M]; //距離
18 vector<Edge> G[M];
19 void init(){
20     fill(dis, dis+M, INF);
21     for(int i = 0; i < M; i++){
22         G[i].clear();
23     }
24 }
25 void dijkstra(int start){
26     dis[start] = 0;
27     priority_queue<node> pq;
28     pq.push(node(start, 0));
29     while(!pq.empty()){
30         node now = pq.top();
31         pq.pop();
32         if(now.dis > dis[now.u]) continue;
33         for(Edge i : G[now.u]){
34             if(dis[i.v] > now.dis + i.w){
35                 dis[i.v] = now.dis + i.w;
36                 pq.push(node(i.v, dis[i.v]));
37                 // printf("push(%d, %d)\n", i.v,
38                     //         dis[i.v]);
39             }
40         }
41     }
42 }
43 int main(){
44     int point, side;
45     cin >> point >> side;
46     init();
47     for(int i = 0; i < side; i++){
48         int s, t, w;
49         cin >> s >> t >> w;
50         G[s].push_back(Edge(t, w));
51         G[t].push_back(Edge(s, w));
52     }
53     dijkstra(1);
54     for(int i = 2; i <= point; i++){
55         cout << dis[i] << '\n';
56     }
57 }
58 }

```

2.3 Floyd-Warshall

```

1 #include<bits/stdc++.h>
2 using namespace std;
3 #define M 1005
4 #define INF 1e9
5
6 int dis[M][M];
7 // int G[M][M];
8 void init(int n){
9     for(int i = 0; i <= n; i++){
10         for(int j = 0; j <= n; j++){
11             dis[i][j] = INF;
12             if(i == j) dis[i][j] = 0;
13         }
14     }
15 }
16 void Floyd(int n){
17     for(int k = 1; k <= n; k++){
18         for(int i = 1; i <= n; i++){
19             for(int j = 1; j <= i; j++){
20                 dis[i][j] = min(dis[i][k]+dis[k][j],
21                                 dis[i][j]);
22             }
23         }
24     }
25 }
26 void printarr(int r, int c){
27     for(int i = 1; i <= r; i++){
28         for(int j = 1; j <= c; j++){
29             if(dis[i][j] == INF) cout << "INF ";
30             else cout << dis[i][j] << ' ';
31         }
32         cout << '\n';
33     }
34 }
35 int main(){
36     int point, side;
37     cin >> point >> side;
38     init(point);
39     for(int i = 0; i < side; i++){
40         int s, t, w;
41         cin >> s >> t >> w;
42         dis[s][t] = w;
43         dis[t][s] = w;
44     }
45     Floyd(point);
46     int Cas;
47     cin >> Cas;
48     while(Cas--){
49         int i, j;
50         cin >> i >> j;
51         cout << dis[i][j] << '\n';
52         // printarr(point, point);
53     }
54 }

```

2.4 SPFA

```

1 const int INF = 1e9;
2 const int MAXN = 1000;
3 struct Edge {
4     int v;
5     int w;
6 };
7 int n, m;
8 vector<Edge> G[MAXN]; //向量記圖
9 int dis[MAXN];
10 void SPFA(int s) {
11     // 記錄目前的點是否在 queue 中
12     bool inq[n];
13     for (int i = 0; i < n; i++) {
14         dis[i] = INF;

```

```

15     inq[i] = false;
16 }
17 dis[s] = 0;
18 inq[s] = true;
19 queue<int> q;
20 q.push(s);
21 while (!q.empty()) {
22     int u = q.front();
23     q.pop();
24     inq[u] = false;
25     for (Edge e : G[u]) {
26         if (dis[e.v] > dis[u] + e.w) {
27             dis[e.v] = dis[u] + e.w;
28             if (!inq[e.v]) {
29                 inq[e.v] = true;
30                 q.push(e.v);
31             }
32         }
33     }
34 }
35 }

```

38 Bellman Ford / SPFA 偵測負環

40 如果有一個點被放到 queue 裡面超過V次,那麼有負環
 41 最大負環為包含所有點的環,共有V條邊,被更新V次
 42 ,在極端的例子,被長度為1.2..3..V的路徑都
 43 被更新一次最短距離。

45 比較

46 Floyd: ,需要計算許多點對的距離。

47 Dijkstra: 沒有負邊且起點固定。

48 Bellman Ford / SPFA: 其他狀況。

2.5 smallTree

```

1 #include<bits/stdc++.h>
2 using namespace std;
3 #define M 100005
4 int tree[M] = {}; //parents
5 int r[M] = {};
6
7 struct Edge{
8     int s, t, w;
9     bool operator<(const Edge& r) const{
10         return w < r.w;
11     }
12 };
13
14 vector<Edge> G;
15
16 void init(int n){
17     for(int i = 0; i <= n; i++){
18         tree[i] = i;
19         r[i] = 1;
20     }
21 }
22 int Find(int n){
23     if(tree[n] == n) return n; //find root
24     return tree[n] = Find(tree[n]);
25 }
26
27 void Union(int a, int b){
28     a = Find(a);
29     b = Find(b);
30     if (a == b) return;
31     if (r[a] <= r[b]){
32         tree[a] = b; //a接b
33         r[b] += r[a];
34     }
35     else{
36         tree[b] = a; //b接a
37         r[a] += r[b];

```

```

38     }
39 }
40
41 int kruskal(){
42     int cost = 0, flag = 0, Space = 0;
43     for (auto it : G){
44         it.s = Find(it.s);
45         it.t = Find(it.t);
46         if (it.s == it.t){
47             if(Space) cout << ' ';
48             Space = 1;
49             flag = 1;
50             cout << it.w;
51             continue;
52         }
53         cost += it.w;
54         Union(it.s, it.t);
55     }
56     return flag;
57 }
58
59 int main(){
60     int point, side, Max = 0;
61     while(cin >> point >> side){
62         G.clear();
63         if(point+side == 0) break;
64         init(point);
65         for(int i = 0; i < side; i++){
66             Edge tmp;
67             cin >> tmp.s >> tmp.t >> tmp.w;
68             G.push_back(tmp);
69         }
70         sort(G.begin(), G.end());
71         if(!kruskal()){
72             cout << "forest";
73         }
74         cout << '\n';
75     }

```

3 Other

3.1 KM

```

1 // uva12083
2 #include<bits/stdc++.h>
3 using namespace std;
4
5 const int M = 500+5;
6 struct people{
7     int high;
8     char sex;
9     string music, sport;
10 };
11
12 vector<int> G[M];
13 people Class[M];
14 int used[M] = {0};
15 int Last[M] = {0};
16
17 bool Check(people a, people b){
18     if(abs(a.high-b.high) > 40) return true;
19     if(a.sex == b.sex) return true;
20     if(a.music != b.music) return true;
21     if(a.sport == b.sport) return true;
22     return false;
23 }
24
25 bool KM(int x){
26     for(int i = 0; i < G[x].size(); i++){
27         int v = G[x][i];
28         if(used[v]) continue;
29         used[v] = 1;
30         if(Last[v] == -1 || KM(Last[v])){
31             //v找到還沒配對的人或前一個v配對的人找到別人

```

```

31     Last[v] = x;
32     return true;
33 }
34 }
35 return false;
36 }
37
38 int Ans(int n){
39     int Max = 0;
40     memset(Last, -1, sizeof(Last));
41     for(int i = 0; i < n; i++){
42         memset(used, 0, sizeof(used));
43         if(KM(i)){
44             Max++;
45         }
46     }
47     return Max;
48 }
49
50 int main(){
51     int Cas;
52     cin >> Cas;
53     while(Cas--){
54         int n;
55         cin >> n;
56         for(int i = 0; i < n; i++){
57             G[i].clear();
58             cin >> Class[i].high >> Class[i].sex >>
                    Class[i].music >> Class[i].sport;
59         }
60         for(int i = 0; i < n; i++){
61             if(Class[i].sex == 'M') continue;
62             for(int j = 0; j < n; j++){
63                 if(i == j) continue;
64                 if(!Check(Class[i], Class[j])){
65                     G[i].push_back(j);
66                 }
67             }
68         }
69         int MaxPeople = n-Ans(n);
70         cout << MaxPeople << '\n';
71     }
72 }
73 }

```

3.2 LCS

```

1 int n1 = s1.size(), n2 = s2.size();
2 int dp[N][N] = {};
3 for (int i = 1; i <= n1; ++i)
4 {
5     for (int j = 1; j <= n2; ++j)
6     {
7         if (s1[i - 1] == s2[j - 1])
8             dp[i][j] = dp[i - 1][j - 1] + 1;
9         else
10            dp[i][j] = max(dp[i - 1][j], dp[i][j - 1]);
11     }
12 }
13 }
14 }
15 #include<bits/stdc++.h>
16 using namespace std;
17
18 int dp[1005][1005] = {0};
19
20 int main(){
21     string a, b;
22     while(getline(cin, a) && getline(cin, b)){
23         memset(dp, 0, sizeof(dp));
24         int asize = a.size(), bsize = b.size();
25         for(int i = 1; i <= asize; i++){
26             for(int j = 1; j <= bsize; j++){
27                 if(a[i-1] == b[j-1]){
28                     dp[i][j] = dp[i-1][j-1] + 1;

```

```

29         }
30         else dp[i][j] = max(dp[i-1][j],
                    dp[i][j-1]);
31     }
32 }
33 cout << dp[asize][bsize] << '\n';
34 }
35 }
36 }
37
38 int n1 = s1.size(), n2 = s2.size();
39 int dp[2][N] = {};
40 for (int i = 1; i <= n1; i++)
41 {
42     int cur = i % 2;
43     int old = 1 - cur;
44     for (int j = 1; j <= n2; ++j)
45     {
46         if (s1[i - 1] == s2[j - 1])
47             dp[cur][j] = dp[old][j - 1] + 1;
48         else
49             dp[cur][j] = max(dp[old][j], dp[cur][j - 1]);
50     }
51 }
52 }

```

3.3 LIS

```

1 #include<bits/stdc++.h>
2 using namespace std;
3 // 前後兩次LIS
4 int main(){
5     int n;
6     while(cin >> n){
7         int arr[10005] = {0};
8         int dp[10005] = {0};
9         int dp2[10005] = {0};
10        int Max = -1;
11        for(int i = 0; i < n; i++){
12            cin >> arr[i];
13        }
14        for(int i = 0; i < n; i++){
15            dp[i] = 1;
16            for(int j = 0; j < i; j++){
17                if(arr[i] > arr[j]){
18                    dp[i] = max(dp[i], dp[j]+1);
19                }
20            }
21        }
22        for(int i = n-1; i >= 0; i--){
23            dp2[i] = 1;
24            for(int j = n-1; j > i; j--){
25                if(arr[i] > arr[j]){
26                    dp2[i] = max(dp2[i], dp2[j]+1);
27                }
28            }
29        }
30        // for(int i = 0; i < n; i++){
31        //     cout << arr[i] << ":\n"[i == n-1];
32        // }
33        // for(int i = 0; i < n; i++){
34        //     cout << dp[i] << ":\n"[i == n-1];
35        // }
36        // for(int i = 0; i < n; i++){
37        //     cout << dp2[i] << ":\n"[i == n-1];
38        // }
39        int lds = 0, lis = 0;
40        for(int i = 0; i < n; i++){
41            Max = max(Max, min(dp[i], dp2[i]));
42        }
43        cout << 2*Max-1 << '\n';
44    }
45 }
46 }

```

3.4 merge

```

1 #include<bits/stdc++.h>
2 using namespace std;
3
4 #define M 100010
5 // int cnt = 0;
6 void printarr(int arr[],int l,int r){
7     for(int i=l;i<=r;i++){
8         printf(" %d",arr[i]);
9     }
10    puts("");
11 }
12
13 int merge(int arr[], int l, int r, int mid){
14     int L = l, R = mid+1;
15     int tmpLen = r-l+1, tmpi = 0;
16     int tmp[M]={0};
17     int cnt = 0;
18     while(L <= mid && R <= r){
19         if(arr[L]<=arr[R]){
20             tmp[tmpi]=arr[L];
21             L++;
22         }
23         else{
24             tmp[tmpi]=arr[R];
25             cnt += mid-L+1;
26             R++;
27         }
28         tmpi++;
29     }
30     if(L>mid){
31         while(R<=r){
32             tmp[tmpi]=arr[R];
33             R++;
34             tmpi++;
35         }
36     }
37     else{
38         while(L<=mid){
39             tmp[tmpi]=arr[L];
40             L++;
41             tmpi++;
42         }
43     }
44     //L>mid&&R>r才可以全部跑過
45     L=l;
46     for (tmpi=0; tmpi<tmpLen; tmpi++) {
47         arr[L] = tmp[tmpi];
48         L++;
49     }
50
51     // printf("%d %d %d:",l,mid,r);
52     // printarr(arr,l,r);
53     return cnt;
54 }
55
56 int mergeSort(int arr[],int l,int r){
57     if(r <= l) return 0;
58     int mid=(l+r)/2;
59     int cnt = 0;
60     cnt += mergeSort(arr, l, mid);
61     cnt += mergeSort(arr, mid+1, r);
62     cnt += merge(arr, l, r, mid);
63     return cnt;
64 }
65
66 int main(){
67     int n;
68     while(cin >> n){
69         if(n == 0) break;
70         int arr[M] = {0};
71         for(int i = 0; i < n; i++){
72             cin >> arr[i];
73         }
74         if(mergeSort(arr, 0, n-1)%2) cout << "Marcelo\n";
75         else cout << "Carlos\n";

```

```

76     }
77
78 }

```

3.5 Prime

```

1 #include<bits/stdc++.h>
2 using namespace std;
3 #define M 10000
4 #define sq int(sqrt(double(M+5)));
5 bool prime[sq];
6 int main(){
7     memset(prime, true, sizeof(prime));
8     prime[0] = prime[1] = false;
9     for(int i = 2; i <= sq; i++){
10         if(prime[i]){
11             for(int j = i*i; j <= sq; j+=i){
12                 prime[j] = false;
13             }
14         }
15     }
16 }

```

3.6 UVA12321

```

1 #include<bits/stdc++.h>
2 using namespace std;
3 struct node{
4     int l, r;
5     node(){};
6     node(int l, int r):l(l), r(r){};
7     bool operator<(const node &a)const{
8         return l < a.l;
9     }
10 }
11
12 node gas[100005];
13 int main(){
14     int L, G;
15     while(cin >> L >> G){
16         if(L == 0 && G == 0) break;
17         for(int i = 0; i < G; i++){
18             int a, b;
19             cin >> a >> b;
20             gas[i].l = a-b;
21             gas[i].r = a+b;
22         }
23         sort(gas, gas+G);
24         int ans = G, lcover = 0, rcover = 0, i = 0;
25         while(L > lcover){
26             rcover = lcover;
27             for(; i < G && gas[i].l <= lcover; i++){
28                 if(gas[i].r > rcover) rcover = gas[i].r;
29             }
30             if(lcover == rcover) break;
31             lcover = rcover;
32             ans--;
33         }
34         if(lcover < L) cout << "-1\n";
35         else cout << ans << '\n';
36     }
37 }
38 // 天然氣

```

3.7 Fire

```

1 #include<bits/stdc++.h>
2 using namespace std;
3
4 #define M 1005

```

```

5
6 int arr[M][M] = {0};
7 int movei[4]={1,0,-1,0};
8 int movej[4]={0,1,0,-1};
9
10 struct point{
11     int I, J, n;
12     point(){};
13     point(int I, int J, int n):I(I), J(J), n(n){};
14 };
15
16 int main(){
17     int Cas;
18     cin >> Cas;
19     while(Cas--){
20         memset(arr, 0, sizeof(arr));
21         queue<point> walk;
22         queue<point> fire;
23         int r, c;
24         cin >> r >> c;
25         for(int i = 0; i < r; i++){
26             for(int j = 0; j < c; j++){
27                 char tmp;
28                 cin >> tmp;
29                 if(tmp == '#') arr[i][j] = -1;
30                 if(tmp == 'F'){
31                     arr[i][j] = 1;
32                     fire.push(point(i, j, 0));
33                 }
34                 if(tmp == 'J'){
35                     arr[i][j] = 2;
36                     walk.push(point(i, j, 0));
37                 }
38             }
39         }
40         int ans = 0;
41         while(!walk.empty()){
42             point now = walk.front();
43             walk.pop();
44             if(now.I == r-1 || now.I == 0 || now.J == c-1
45                || now.J == 0){
46                 ans = now.n+1;
47                 break;
48             }
49             while(fire.front().n == now.n){
50                 point tmp = fire.front();
51                 fire.pop();
52                 for(int i = 0; i < 4; i++){
53                     int tmpi = tmp.I+movei[i];
54                     int tmpj = tmp.J+movej[i];
55                     if(tmpi < r && tmpi >= 0 && tmpj < c &&
56                        tmpj >= 0){
57                         if(arr[tmpi][tmpj] == 0){
58                             arr[tmpi][tmpj] = 1;
59                             fire.push(point(tmpi, tmpj, tmp.n+1));
60                         }
61                     }
62                 }
63             }
64             for(int i = 0; i < 4; i++){
65                 int tmpi = now.I+movei[i];
66                 int tmpj = now.J+movej[i];
67                 if(tmpi < r && tmpi >= 0 && tmpj < c && tmpj
68                    >= 0){
69                     if(arr[tmpi][tmpj] == 0){
70                         walk.push(point(tmpi, tmpj, now.n+1));
71                     }
72                 }
73             }
74         }
75     }

```