Notebook - Maratona de Programação

Py tá O(N)

Contents

1 Strings

1.1 Kmp

```cpp
vector<int> prefix_function(string s) {
    int n = (int)s.length();
    vector<int> pi(n);
    for (int i = 1; i < n; i++) {
        int j = pi[i-1];
        while (j > 0 && s[i] != s[j])
            j = pi[j-1];
        if (s[i] == s[j])
            j++;
        pi[i] = j;
    }
    return pi;
}
```

1.2 Z-function

```cpp
vector<int> z_function(string s) {
    int n = (int) s.length();
    vector<int> z(n);
    for (int i = 1, l = 0, r = 0; i < n; ++i) {
        if (i <= r)
            z[i] = min (r - i + 1, z[i - l]);
        while (i + z[i] < n && s[z[i]] == s[i + z[i
    ]])
            ++z[i];
        if (i + z[i] - 1 > r)
            l = i, r = i + z[i] - 1;
    }
    return z;
}
```

2 Math

2.1 Sieve Of Eratosthenes

```cpp
int n;
vector<bool> is_prime(n+1, true);
is_prime[0] = is_prime[1] = false;
for (int i = 2; i <= n; i++) {
    if (is_prime[i] && (long long)i * i <= n) {
        for (int j = i * i; j <= n; j += i)
            is_prime[j] = false;
    }
}
```

3 ED

3.1 Dsu

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

using namespace std;

const int MAX = 1e6+17;

struct DSU {
    int n;
    vector<int> link, sizes;

    DSU(int n) {
        this->n = n;
        link.assign(n+1, 0);
        sizes.assign(n+1, 1);

        for (int i = 0; i <= n; i++)
            link[i] = i;
    }

    int find(int x) {
        while (x != link[x])
            x = link[x];

        return x;
    }

    bool same(int a, int b) {
        return find(a) == find(b);
    }

    void unite(int a, int b) {
        a = find(a);
        b = find(b);

        if (a == b) return;

        if (sizes[a] < sizes[b])
            swap(a, b);

        sizes[a] += sizes[b];
        link[b] = a;
    }

    int size(int x) {
        return sizes[x];
    }
};

int main() {
    ios::sync_with_stdio(false);
    cin.tie(NULL);

    int cities, roads; cin >> cities >> roads;
    vector<int> final_roads;
    int ans = 0;
    DSU dsu = DSU(cities);
    for (int i = 0, a, b; i < roads; i++) {
        cin >> a >> b;
        dsu.unite(a, b);
    }

    for (int i = 2; i <= cities; i++) {
        if (!dsu.same(1, i)) {
            ans++;
            final_roads.push_back(i);
            dsu.unite(1,i);
        }
    }

    cout << ans << '\n';
    for (auto e : final_roads) {
        cout << "1 " << e << '\n';
    }

}
```

4 Grafos

4.1 Kruskall

```cpp
vector<int> parent, rank;

void make_set(int v) {
    parent[v] = v;
    rank[v] = 0;
}

int find_set(int v) {
    if (v == parent[v])
        return v;
    return parent[v] = find_set(parent[v]);
}

void union_sets(int a, int b) {
    a = find_set(a);
    b = find_set(b);
    if (a != b) {
        if (rank[a] < rank[b])
            swap(a, b);
        parent[b] = a;
        if (rank[a] == rank[b])
            rank[a]++;
    }
}

struct Edge {
    int u, v, weight;
    bool operator<(Edge const& other) {
        return weight < other.weight;
    }
};

int n;
vector<Edge> edges;

int cost = 0;
vector<Edge> result;
parent.resize(n);
rank.resize(n);
for (int i = 0; i < n; i++)
    make_set(i);

sort(edges.begin(), edges.end());

for (Edge e : edges) {
    if (find_set(e.u) != find_set(e.v)) {
        cost += e.weight;
        result.push_back(e);
        union_sets(e.u, e.v);
    }
}
```

4.2 Dijkstra

```cpp
const int INF = 1000000000;
vector<vector<pair<int, int>>> adj;

void dijkstra(int s, vector<int> & d, vector<int> & p
    ) {
    int n = adj.size();
    d.assign(n, INF);
    p.assign(n, -1);

    d[s] = 0;
    set<pair<int, int>> q;
    q.insert({0, s});
    while (!q.empty()) {
        int v = q.begin()->second;
        q.erase(q.begin());

        for (auto edge : adj[v]) {
            int to = edge.first;
            int len = edge.second;

            if (d[v] + len < d[to]) {
                q.erase({d[to], to});
                d[to] = d[v] + len;
                p[to] = v;
                q.insert({d[to], to});
            }
        }
    }
}
```

4.3 Bellman Ford

```cpp
struct edge
{
    int a, b, cost;
};

int n, m, v;
vector<edge> e;
const int INF = 1000000000;

void solve()
{
    vector<int> d (n, INF);
    d[v] = 0;
    for (int i=0; i<n-1; ++i)
        for (int j=0; j<m; ++j)
            if (d[e[j].a] < INF)
                d[e[j].b] = min (d[e[j].b], d[e[j].a]
 + e[j].cost);
}
```

4.4 Floyd Warshall

```cpp
for (int k = 0; k < n; ++k) {
    for (int i = 0; i < n; ++i) {
        for (int j = 0; j < n; ++j) {
            if (d[i][k] < INF && d[k][j] < INF)
                d[i][j] = min(d[i][j], d[i][k] + d[k
    ][j]);
        }
    }
}
```

4.5 Lca

```cpp
int n, l;
vector<vector<int>> adj;

int timer;
vector<int> tin, tout;
vector<vector<int>> up;

void dfs(int v, int p)
{
    tin[v] = ++timer;
    up[v][0] = p;
    for (int i = 1; i <= l; ++i)
        up[v][i] = up[up[v][i-1]][i-1];

    for (int u : adj[v]) {
        if (u != p)
            dfs(u, v);
    }

    tout[v] = ++timer;
}

bool is_ancestor(int u, int v)
{
    return tin[u] <= tin[v] && tout[u] >= tout[v];
}

int lca(int u, int v)
{
    if (is_ancestor(u, v))
        return u;
    if (is_ancestor(v, u))
        return v;
    for (int i = l; i >= 0; --i) {
        if (!is_ancestor(up[u][i], v))
            u = up[u][i];
    }
    return up[u][0];
}

void preprocess(int root) {
    tin.resize(n);
    tout.resize(n);
    timer = 0;
    l = ceil(log2(n));
    up.assign(n, vector<int>(l + 1));
    dfs(root, root);
}
```

5 Template

5.1 Template

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

using namespace std;

const int MAX = 2e5+17;

int main() {
    ios::sync_with_stdio(false);
    cin.tie(NULL);



    return 0;
}
```

6 Algoritmos

6.1 Binary Search Last True

```cpp
int last_true(int lo, int hi, function<bool(int)> f)
    {
    lo--;
    while (lo < hi) {
        int mid = lo + (hi - lo + 1) / 2;
        if (f(mid)) {
            lo = mid;
        } else {
            hi = mid - 1;
        }
    }
    return lo;
}
```

6.2 Kadane

```cpp
int ans = a[0], ans_l = 0, ans_r = 0;
int sum = 0, minus_pos = -1;

for (int r = 0; r < n; ++r) {
    sum += a[r];
    if (sum > ans) {
        ans = sum;
        ans_l = minus_pos + 1;
        ans_r = r;
    }
    if (sum < 0) {
        sum = 0;
        minus_pos = r;
    }
}
```

6.3 Binary Exponentiation

```cpp
long long power(long long a, long long b) {
    long long res = 1;
    while (b > 0) {
        if (b & 1)
            res = res * a;
        a = a * a;
        b >>= 1;
    }
    return res;
}
```

6.4 Delta-encoding

```cpp
#include <bits/stdc++.h>
using namespace std;

int main(){
    int n, q;
    cin >> n >> q;
    int [n];
    int delta[n+2];

    while(q--){
        int l, r, x;
        cin >> l >> r >> x;
        delta[l] += x;
        delta[r+1] -= x;
    }

    int curr = 0;
    for(int i=0; i < n; i++){
        curr += delta[i];
        v[i] = curr;
    }

    for(int i=0; i< n; i++){
        cout << v[i] << ' ';
    }
    cout << '\n';

    return 0;
}
```

6.5 Binary Search First True

```cpp
int first_true(int lo, int hi, function<bool(int)> f)
     {
    hi++;
    while (lo < hi) {
        int mid = lo + (hi - lo) / 2;
        if (f(mid)) {
            hi = mid;
        } else {
            lo = mid + 1;
        }
    }
    return lo;
}
```