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**ЛАБОРАТОРНАЯ РАБОТА № \_4\_**

**ПО ДИСЦИПЛИНЕ «*Алгоритмы и структуры данных*»**

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1080. Map coloring

Algorithm :

+ Build a tree. Using DFS to color all the node of tree. If node u – color red, so all the node v, which connect to u will be colored blue. We can’t color the tree if two node connect each others has the same color.

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| #include <bits/stdc++.h>  using namespace std;  const int maxn = 110;  int dd[maxn][maxn];  int colour[maxn];  int n;  bool ok;  void DFS(int x) {  for (int i = 1; i <= n; i++)  if (dd[i][x] == 1 || dd[x][i] == 1) {  if (colour[i] == -1) {  colour[i] = 1 - colour[x];  DFS(i);  } else if (colour[x] == colour[i])  ok = false;  }  }  int main() {  cin >> n;  for (int i = 1; i <= n; i++)  for (int j = 1; j <= n; j++)  dd[i][j] = 0;  for (int i = 1; i <= n; i++) {  int x;  cin >> x;  while (x != 0) {  dd[i][x] = 1;  dd[x][i] = 1;  cin >> x;  }  }  ok = true;  for (int i = 1; i <= n; i++)  colour[i] = -1;  for (int i = 1; i <= n; i++) {  if (colour[i] == -1) {  colour[i] = 0;  DFS(i);  }  }  if (ok) {  for (int i = 1; i <= n; i++)  cout << colour[i];  } else  cout << -1;  } |

## 1160. Network

Algorithm : Using Kruskal to find mimimum tree in graph.

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| #include <iostream>  #include <algorithm>  #include <vector>  using namespace std;  const int maxn = 1000 + 10;  const int maxm = 15000 + 10;  int n, m;  int par[maxn];  bool dd[maxm];  struct edge {  int u, v, ts;  };  vector<edge> cable;  int anc(int p) {  if (par[p] == p)  return p;  else  return par[p] = anc(par[p]);  }  void join(int u, int v) { par[anc(u)] = anc(v); }  int myComp(edge tmp, edge \_tmp) { return tmp.ts < \_tmp.ts; }  void kruskal() {  int res = 0;  int count = 0;  int maxTS = 0;  sort(cable.begin(), cable.end(), myComp);  for (int i = 0; i <= m; i++)  dd[i] = false;  for (int i = 1; i <= n; i++)  par[i] = i;  int h = 0;  for (auto cab : cable) {  if (anc(cab.u) != anc(cab.v)) {  join(cab.u, cab.v);  dd[h] = true;  res += cab.ts;  if (cab.ts > maxTS)  maxTS = cab.ts;  count++;  }  h++;  }  cout << maxTS << endl;  cout << count << endl;  for (int i = 0; i < m; i++)  if (dd[i])  cout << cable[i].u << " " << cable[i].v << endl;  }  int main() {  cin >> n >> m;  for (int i = 0; i < m; i++) {  int x, y, z;  cin >> x >> y >> z;  edge tmp;  tmp.u = x;  tmp.v = y;  tmp.ts = z;  cable.push\_back(tmp);  }  kruskal();  } |

## 1450. Russian Pipelines

## The main idea is find the maximum path from S -> F. So we will find the minimum path with negative gas transfer.

## Using fordbellmanqueue.

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| #include <iostream>  #include <queue>  using namespace std;  #define X first  #define Y second  const int maxn = 500 + 10;  typedef pair<int, int> ii;  vector<ii> a[maxn];  int n, m;  int d[maxn];  bool inqueue[500 \* 500];  void bellman(int u) {  int i, v, uv;  queue<int> qu;  for (i = 1; i <= n; i++)  d[i] = 1000111000;  d[u] = 0;  qu.push(u);  inqueue[u] = true;  while (qu.size()) {  u = qu.front();  inqueue[u] = false;  qu.pop();  for (i = 0; v = a[u][i].Y; i++) {  uv = a[u][i].X;  if (d[v] > d[u] + uv) {  d[v] = d[u] + uv;  if (!inqueue[v]) {  qu.push(v);  inqueue[v] = true;  }  }  }  }  }  main() {  int p, q, w, i, u, v;  cin >> n >> m;  while (m--) {  cin >> p >> q >> w;  w = 0 - w;  a[p].push\_back(ii(w, q));  }  cin >> u >> v;  for (i = 1; i <= n; i++)  a[i].push\_back(ii(0, 0));  bellman(u);  if (d[v] != 1000111000)  cout << 0 - d[v];  else  cout << "No solution";  } |

## 1806. Mobile Telegraphs

## The main idea is find minimum cost path from the first fighter to the last fighter.

## We will create a graph, which show link each others. We have edge, each of them will have cost to tranfer information from one to other.

## How we can create graph? Normally, we use loop to find 2 telegraph cost how many to transfer. But it will execute around 50000\*50000\*10 operations. It ‘s so big. So now, with each telegraphs, we will make all of numbers, which can be created from the original. With each created number, we will find out them in list of numbers. So it maybe execute 50000\*9\*10\*log2(50000) . It ‘s smaller .

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| #include <iostream>  #include <algorithm>  #include <vector>  #include <queue>  #include <map>  #include <iterator>  using namespace std;  const int maxn = 50000 + 10;  typedef pair<int, int> ii;  int n;  int dd[10];  int d[maxn];  bool inqueue[maxn];  int trace[maxn];  string arr[maxn];  vector<ii> ts[maxn];  map<long long, int> tele;  int find\_tele(long long x) {  if (tele.find(x) != tele.end())  return tele.find(x)->second;  return -1;  }  long long pow(int x, int y) {  long long res = 1;  for (int i = 0; i < y; i++)  res \*= (long long)x;  return res;  }  void change\_one\_number(long long x, int position) {  // cout << x << " " << position << endl;  int pos[10];  long long \_x = x;  for (int i = 9; i >= 0; i--) {  int c = \_x % 10;  \_x /= 10;  pos[i] = c;  }  for (int i = 0; i < 10; i++) {  // cout << pos[i]<< endl;  for (int j = 1; j < pos[i]; j++) {  long long tmp = x - pow(10, 9 - i) \* (long long)(pos[i] - j);  int x\_change = find\_tele(tmp);  if (x\_change == -1)  continue;  // cout << position << " " << x\_change << endl;  ts[position].push\_back(ii(dd[i], x\_change));  ts[x\_change].push\_back(ii(dd[i], position));  }  // cout << "bigger" << endl;  for (int j = pos[i] + 1; j < 10; j++) {  long long tmp = x + pow(10, 9 - i) \* (long long)(j - pos[i]);  int x\_change = find\_tele(tmp);  if (x\_change == -1)  continue;  // cout << position << " " << x\_change << endl;  ts[position].push\_back(ii(dd[i], x\_change));  ts[x\_change].push\_back(ii(dd[i], position));  }  // cout << "smaller" << endl;  }  }  void change\_two\_number(long long x, int position) {  // cout << x << " " << position << endl;  int pos[10];  long long \_x = x;  for (int i = 9; i >= 0; i--) {  int c = \_x % 10;  \_x /= 10;  pos[i] = c;  }  for (int i = 0; i < 10; i++) {  for (int j = i + 1; j < 10; j++) {  if (pos[i] == pos[j])  continue;  long long tmp = x;  if (pos[i] < pos[j]) {  tmp += pow(10, 9 - i) \* (pos[j] - pos[i]);  tmp -= pow(10, 9 - j) \* (pos[j] - pos[i]);  } else {  tmp -= pow(10, 9 - i) \* (pos[i] - pos[j]);  tmp += pow(10, 9 - j) \* (pos[i] - pos[j]);  }  int x\_change = find\_tele(tmp);  if (x\_change == -1)  continue;  // cout << position << " " << x\_change << endl;  ts[position].push\_back(ii(dd[i], x\_change));  ts[x\_change].push\_back(ii(dd[i], position));  }  }  }  void init() {  for (auto i : tele) {  change\_one\_number(i.first, i.second);  change\_two\_number(i.first, i.second);  }  }  void bellman(int u) {  int i, v, uv;  queue<int> qu;  for (int i = 0; i <= n; i++)  trace[i] = i;  for (i = 0; i <= n; i++)  d[i] = 1000111000;  d[u] = 0;  qu.push(u);  inqueue[u] = true;  while (qu.size()) {  u = qu.front();  inqueue[u] = false;  qu.pop();  for (i = 0; v = ts[u][i].second; i++) {  uv = ts[u][i].first;  if (d[v] > d[u] + uv) {  d[v] = d[u] + uv;  trace[v] = u;  if (!inqueue[v]) {  qu.push(v);  inqueue[v] = true;  }  }  }  }  }  void try\_trace() {  int tr[maxn];  int sl = 0;  int x = n;  while (x != 1) {  tr[sl] = x;  sl++;  x = trace[x];  }  tr[sl] = 1;  cout << ++sl << endl;  for (int i = sl - 1; i >= 0; i--) {  cout << tr[i] << " ";  }  }  int main() {  cin >> n;  for (int i = 0; i < 10; i++)  cin >> dd[i];  long long tmp;  for (int i = 1; i <= n; i++) {  cin >> tmp;  tele.insert(pair<long long, int>(tmp, i));  }  init();  for (int i = 1; i <= n; i++)  ts[i].push\_back(ii(0, 0));  bellman(1);  if (d[n] != 1000111000) {  cout << d[n] << endl;  try\_trace();  } else  cout << -1;  } |