МОСКОВСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ
имени М.В. ЛОМОНОСОВА

ОЛИМПИАДНАЯ РАБОТА

Наименование олимпиады школьников: **«Ломоносов»**

Профиль олимпиады: **Информатика**

ФИО участника олимпиады: **Алексеев Станислав Михайлович**

Класс: **10 класс**

Технический балл: **92**

Дата проведения: **17 марта 2022 г.**

Результаты проверки:

Оценка участника строится из 3 частей:

1. оценка за задание - рассчитывается путем запуска тестов и определения правильности работы программы на тестах, до 100 баллов по каждой задаче;
2. дополнительные баллы за полностью правильное решение задания со 2 по 5 - в случае прохождения всех тестов по заданию к оценке прибавляется 55 баллов;
3. нормализация оценки - если полученная из пунктов 1 и 2 сумма баллов превышает 500, то итоговая оценка - 100, если не превышает 500, но превышает 400 - 99 баллов, если не превышает 400 - делится на 3.9 и округляется до целого.

Оценки за задания:

№	1	2	3	4	5
Оценка	100	94	100	8	0

Дополнительный балл: 55

Задание 1. Попытка 1.

```
from math import factorial


MAXLEN = 62


k, n = [int(input()) for _ in range(2)]
fac = [1] * MAXLEN
for i in range(1, MAXLEN):
    fac[i] = fac[i - 1] * i


numeric = set([str(x) for x in range(0, 10)])
alpha = set([chr(x) for x in range(ord("a"), ord("z") + 1)])
ALPHA = set([chr(x) for x in range(ord("A"), ord("Z") + 1)])



def to_int(i: str) -> int:
    if i in numeric:
        return int(i)
    elif i in alpha:
        return ord(i) - ord("a")
    else:
        return ord(i) - ord("A")



def parse(x: str) -> str:
```

```
    x = list(x[::-1])
    while len(x) > 1 and x[-1] == '0':
        x.pop()
    return ''.join(x)[::-1]



def calc(num: str) -> int:
    num = num[::-1]
    res = 0
    for i, j in enumerate(num):
        res += to_int(j) * fac[i]
    return res



nums_strs = [parse(input()) for _ in range(n)]
nums = list(map(calc, nums_strs))
for i, num in enumerate(nums):
    if num % fac[k] == 0:
        print(nums_strs[i])
        for j in range(i, n):
            if nums[j] == nums[i]:
                print(j + 1)
        exit(0)

print(-1)
```

Задание 1. Попытка 2.

```
from math import factorial


MAXLEN = 62


k, n = [int(input()) for _ in range(2)]
fac = [1] * MAXLEN
for i in range(1, MAXLEN):
    fac[i] = fac[i - 1] * i


numeric = set([str(x) for x in range(0, 10)])
alpha = set([chr(x) for x in range(ord("a"), ord("z") + 1)])
ALPHA = set([chr(x) for x in range(ord("A"), ord("Z") + 1)])



def to_int(i: str) -> int:
    if i in numeric:
        return int(i)
    elif i in alpha:
        return ord(i) - ord("a")
    else:
        return ord(i) - ord("A")



def parse(x: str) -> str:
```

```
    x = list(x[::-1])
    while len(x) > 1 and x[-1] == '0':
        x.pop()
    return ''.join(x)[::-1]



def calc(num: str) -> int:
    num = num[::-1]
    res = 0
    for i, j in enumerate(num):
        res += to_int(j) * fac[i]
    return res



nums_strs = [parse(input()) for _ in range(n)]
nums = list(map(calc, nums_strs))
nums.sort(reverse=True)
for i, num in enumerate(nums):
    if num % fac[k] == 0:
        print(nums_strs[i])
        for j in range(i, n):
            if nums[j] == nums[i]:
                print(j + 1)
        exit(0)
```

```
print(-1)
```

Задание 1. Попытка 3.

```
from math import factorial


MAXLEN = 62


k, n = [int(input()) for _ in range(2)]
fac = [1] * MAXLEN
for i in range(1, MAXLEN):
    fac[i] = fac[i - 1] * i


numeric = set([str(x) for x in range(0, 10)])
alpha = set([chr(x) for x in range(ord("a"), ord("z") + 1)])
ALPHA = set([chr(x) for x in range(ord("A"), ord("Z") + 1)])



def to_int(i: str) -> int:
    if i in numeric:
        return int(i)
    elif i in alpha:
        return ord(i) - ord("a") + len(numeric)
    else:
        return ord(i) - ord("A") + len(alpha) + len(numeric)



def parse(x: str) -> str:
```

```
    x = list(x[::-1])
    while len(x) > 1 and x[-1] == '0':
        x.pop()
    return ''.join(x)[::-1]



def calc(num: str) -> int:
    num = num[::-1]
    res = 0
    for i, j in enumerate(num):
        res += to_int(j) * fac[i]
    return res



nums_strs = [parse(input()) for _ in range(n)]
nums = list(map(calc, nums_strs))
nums.sort(reverse=True)
for i, num in enumerate(nums):
    if num % fac[k] == 0:
        print(nums_strs[i])
        for j in range(i, n):
            if nums[j] == nums[i]:
                print(j + 1)
        exit(0)
```

```
print(-1)
```

Задание 1. Попытка 4.

```
from math import factorial


MAXLEN = 62


k, n = [int(input()) for _ in range(2)]
fac = [1] * MAXLEN
for i in range(1, MAXLEN):
    fac[i] = fac[i - 1] * i


numeric = set([str(x) for x in range(0, 10)])
alpha = set([chr(x) for x in range(ord("a"), ord("z") + 1)])
ALPHA = set([chr(x) for x in range(ord("A"), ord("Z") + 1)])



def to_int(i: str) -> int:
    if i in numeric:
        return int(i)
    elif i in alpha:
        return ord(i) - ord("a") + len(numeric)
    else:
        return ord(i) - ord("A") + len(alpha) + len(numeric)



def parse(x: str) -> str:
```

```
    x = list(x[::-1])
    while len(x) > 1 and x[-1] == '0':
        x.pop()
    return ''.join(x)[::-1]


def calc(num: str) -> int:
    num = num[::-1]
    res = 0
    for i, j in enumerate(num):
        res += to_int(j) * fac[i]
    return res


nums_strs = [parse(input()) for _ in range(n)]
nums = list(map(calc, nums_strs))

max_num = -1
max_pos = -1
for i, num in enumerate(nums):
    if num % fac[k] == 0 and max_num < num:
        max_num = num
        max_pos = i

if max_pos == -1:
```

```
    print(-1)
else:
    print(nums_strs[max_pos])
    for i in range(n):
        if nums[i] == max_num:
            print(i + 1)
```

Задание 1. Попытка 5.

```
from math import factorial


MAXLEN = 62


k, n = [int(input()) for _ in range(2)]
fac = [1] * MAXLEN
for i in range(1, MAXLEN):
    fac[i] = fac[i - 1] * i


numeric = set([str(x) for x in range(0, 10)])
alpha = set([chr(x) for x in range(ord("a"), ord("z") + 1)])
ALPHA = set([chr(x) for x in range(ord("A"), ord("Z") + 1)])



def to_int(i: str) -> int:
    if i in numeric:
        return int(i)
    elif i in alpha:
        return ord(i) - ord("a") + len(numeric)
    else:
        return ord(i) - ord("A") + len(alpha) + len(numeric)



def parse(x: str) -> str:
```

```
    x = list(x[::-1])
    while len(x) > 1 and x[-1] == '0':
        x.pop()
    return ''.join(x)[::-1]



def calc(num: str) -> int:
    num = num[::-1]
    res = 0
    for i, j in enumerate(num):
        res += to_int(j) * fac[i + 1]
    return res



nums_strs = [parse(input()) for _ in range(n)]
nums = list(map(calc, nums_strs))

max_num = -1
max_pos = -1
for i, num in enumerate(nums):
    if num % fac[k] == 0 and max_num < num:
        max_num = num
        max_pos = i

if max_pos == -1:
```

```
    print(-1)
else:
    print(nums_strs[max_pos])
    for i in range(n):
        if nums[i] == max_num:
            print(i + 1)
```

Задание 1. Попытка 6.

```
from math import factorial


MAXLEN = 62


k, n = [int(input()) for _ in range(2)]
fac = [1] * MAXLEN
for i in range(1, MAXLEN):
    fac[i] = fac[i - 1] * i


numeric = set([str(x) for x in range(0, 10)])
alpha = set([chr(x) for x in range(ord("a"), ord("z") + 1)])
ALPHA = set([chr(x) for x in range(ord("A"), ord("Z") + 1)])



def to_int(i: str) -> int:
    if i in numeric:
        return int(i)
    elif i in alpha:
        return ord(i) - ord("a") + len(numeric)
    else:
        return ord(i) - ord("A") + len(alpha) + len(numeric)



def parse(x: str) -> str:
```

```
    x = list(x[::-1])
    while len(x) > 1 and x[-1] == '0':
        x.pop()
    return ''.join(x)[::-1]



def calc(num: str) -> int:
    num = num[::-1]
    res = 0
    for i, j in enumerate(num):
        res += to_int(j) * fac[i + 1]
    return res



nums_strs = [parse(input()) for _ in range(n)]
nums = list(map(calc, nums_strs))

max_num = -1
max_pos = -1
for i, num in enumerate(nums):
    if num % fac[k] == 0 and max_num < num:
        max_num = num
        max_pos = i

if max_pos == -1:
```

```
    print(-1)
else:
    print(nums_strs[max_pos])
    for i in range(n):
        if nums[i] == max_num:
            print(i + 1)
```

Задание 2. Попытка 1.

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

#define rep(i, a, b) for (int (i) = (a); (i) < (b); (i)++)
#define trav(a, x) for (auto& (a): (x))
#define all(x) (x).begin(), (x).end()
#define sz(x) (int)(x).size()
using ll = long long;
using pii = pair<int, int>;
using vi = vector<int>;

constexpr int MOD = 1e9 + 7; // 998244353

template<class T>
bool ckmin(T& a, const T& b) {
    return a > b && (a = b, true);
}

template<class T>
bool ckmax(T& a, const T& b) {
    return a < b && (a = b, true);
}

int to_int(char x) {
```

```
    if ('0' <= x && x <= '9') return x - '0';
    if ('a' <= x && x <= 'z') return x - 'a' + 10;
    return x - 'A' + 36;
}

char to_chr(int x) {
    if (x < 10) return (char)('0' + x);
    if (x < 36) return (char)('a' + x - 10);
    return (char)('A' + x - 36);
}

int main() {
    ios_base::sync_with_stdio(false);
    cin.tie(nullptr);

    int n;
    string s;

    while (cin >> n >> s) {
        priority_queue<int> q;
        trav(x, s) {
            if (isalnum(x))
                q.push(to_int(x));
        }
```

```
n = sz(q);

vector<int> res(61, -1);
int fst = 61 - min(n, 61), zero = fst;

function<bool(int)> update = [&](int i) {
    for (int j = i - 1; j >= zero; --j) {
        if (res[j] <= 61 - i) {
            res[i] = res[j];

            if (j == zero) {
                res[j] = 0;
                zero++;
                return true;
            }
            return update(j);
        }
    }
    return false;
};

rep(i, fst, 61) {
    while (!q.empty() && q.top() > 61 - i) q.pop();

    if (q.empty()) {
```

```
            if (!update(i)) {
                cout << "-1\n";
                goto nxt;
            }
        } else {
            res[i] = q.top();
            q.pop();
        }
    }


    rep(i, zero, 61) {
        cout << to_chr(res[i]);
    }
    cout << '\n';
    nxt:
    continue;
  }
}
```

Задание 2. Попытка 2.

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

#define rep(i, a, b) for (int (i) = (a); (i) < (b); (i)++)
#define trav(a, x) for (auto& (a): (x))
#define all(x) (x).begin(), (x).end()
#define sz(x) (int)(x).size()
using ll = long long;
using pii = pair<int, int>;
using vi = vector<int>;

constexpr int MOD = 1e9 + 7; // 998244353

template<class T>
bool ckmin(T& a, const T& b) {
    return a > b && (a = b, true);
}

template<class T>
bool ckmax(T& a, const T& b) {
    return a < b && (a = b, true);
}

int to_int(char x) {
```

```
    if ('0' <= x && x <= '9') return x - '0';
    if ('a' <= x && x <= 'z') return x - 'a' + 10;
    return x - 'A' + 36;
}

char to_chr(int x) {
    if (x < 10) return (char)('0' + x);
    if (x < 36) return (char)('a' + x - 10);
    return (char)('A' + x - 36);
}

int main() {
    ios_base::sync_with_stdio(false);
    cin.tie(nullptr);

    int n;
    string s;

    while (cin >> n >> s) {
        priority_queue<int> q;
        trav(x, s) {
            if (isalnum(x))
                q.push(to_int(x));
        }
```

```
n = sz(q);


vector<int> res(61, -1);
int fst = 61 - min(n, 61), zero = fst;


function<bool(int, int)> update = [&](int i, int iter) {
    for (int j = i - 1; j >= zero; --j) {
        if (res[j] <= 61 - i) {
            res[i] = res[j];


            if (j == zero) {
                res[j] = 0;
                zero++;
                return true;
            }
            return update(j, iter + 1);
        }
    }
    if (!iter) return false;
    else {
        zero = i + 1;
        return true;
    }
};
```

```
rep(i, fst, 61) {
    while (!q.empty() && q.top() > 61 - i) q.pop();

    if (q.empty()) {
        if (!update(i, 0)) {
            cout << "-1\n";
            goto nxt;
        }
    } else {
        res[i] = q.top();
        q.pop();
    }
}

if (zero >= 61) {
    cout << "-1\n";
    goto nxt;
}

rep(i, zero, 61) {
    cout << to_chr(res[i]);
}
cout << '\n';
nxt:
continue;
```

```
    }
}
```

Задание 3. Попытка 1.

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

#define rep(i, a, b) for (int (i) = (a); (i) < (b); (i)++)
#define trav(a, x) for (auto& (a): (x))
#define all(x) (x).begin(), (x).end()
#define sz(x) (int)(x).size()
using ll = long long;
using pii = pair<int, int>;
using vi = vector<int>;

constexpr int MOD = 1e9 + 7; // 998244353

template<class T>
bool ckmin(T& a, const T& b) {
    return a > b && (a = b, true);
}

template<class T>
bool ckmax(T& a, const T& b) {
    return a < b && (a = b, true);
}

int ha(vi a) {
```

```
    constexpr int P = 239;
    int res = 0;
    for (auto en: a) {
        res = (1LL * res * P + en + 1) % MOD;
    }
    return res;
}

struct edge {
    int v, u, type;

    bool operator<(const edge& oth) const {
        if (v != oth.v) return v < oth.v;
        if (u != oth.u) return u < oth.u;
        return type < oth.type;
    }
};

vector<vi> has, banu, band;
set<edge> now;
int cnt = 0, n;

set<set<edge>> ans;

void dfs(int v, int side, int type) {
```

```
if (cnt == 0) {
    ans.insert(now);
}

rep(i, -1, 2) {
    int u = v + i;
    if (u < 0 || u >= n) continue;
    if (side == 0) {
        if (type == 0 && has[v][u] && !banu[v][u]) {
            banu[v][u] = 1;
            cnt--;
            now.insert({v, u, 0});
            dfs(u, 1, 1);
            now.erase({v, u, 0});
            cnt++;
            banu[v][u] = 0;
        } else if (type == 1 && !has[v][u] && !band[v][u]) {
            band[v][u] = 1;
            now.insert({v, u, 1});
            dfs(u, 1, 0);
            now.erase({v, u, 1});
            band[v][u] = 0;
        }
    } else {
        if (type == 0 && has[u][v] && !banu[u][v]) {
```

```
                banu[u][v] = 1;
                cnt--;
                now.insert({u, v, 0});
                dfs(u, 0, 1);
                now.erase({u, v, 0});
                cnt++;
                banu[u][v] = 0;
            } else if (type == 1 && !has[u][v] && !band[u][v]) {
                band[u][v] = 1;
                now.insert({u, v, 1});
                dfs(u, 0, 0);
                now.erase({u, v, 1});
                band[u][v] = 0;
            }
        }
    }
}

int main() {
    cin.tie(nullptr)->sync_with_stdio(false);
    cin >> n;
    has.resize(n, vi(n));
    banu.resize(n, vi(n));
    band.resize(n, vi(n));
```

```
    cin.ignore();
    string now;
    for (getline(cin, now); getline(cin, now), now != "END";) {
        stringstream ss(now);

        int v, u;
        ss >> v >> u;
        --v, --u;
        has[v][u] = 1;
        cnt++;
    }

    rep(i, 0, n) {
        rep(side, 0, 2) {
            rep(type, 0, 2) {
                dfs(i, side, type);
            }
        }
    }

    cout << sz(ans) << '\n';
}
```

Задание 4. Попытка 1.

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

#define FOR(i, a, b) for (int (i) = (a); (i) < (b); (i)++)
#define F0R(i, a) FOR(i, 0, a)
#define ROF(i, a, b) for (int (i) = (b)-1; (i) >= (a); (i)--)
#define R0F(i, a) ROF(i, 0, a)
#define trav(a, x) for (auto& (a): (x))
#define all(x) (x).begin(), (x).end()
#define sz(x) (int)(x).size()
using ll = long long;
using pii = pair<int, int>;
using vi = vector<int>;

constexpr int MOD = 1e9 + 7; // 998244353

template<class T>
bool ckmin(T& a, const T& b) {
    return a > b && (a = b, true);
}

template<class T>
bool ckmax(T& a, const T& b) {
    return a < b && (a = b, true);
```

```
}

pair<int, vi> global_mc(vector<vi> wei) {
    int N = sz(wei);
    vi par(N);
    iota(all(par), 0);
    pair<int, vi> bes = {INT_MAX, vi{}};
    R0F(phase, N) {
        vi w = wei[0];
        int lst = 0;
        vector<bool> add(N, true);
        FOR(i, 1, N) if (par[i] == i) add[i] = false;
        F0R(i, phase) {
            int k = -1;
            FOR(j, 1, N) if (!add[j] && (k == -1 || w[j] > w[k])) k = j;
            if (i + 1 == phase) {
                if (w[k] < bes.first) {
                    bes = {w[k], {}};
                    F0R(j, N) if (par[j] == k) bes.second.push_back(j);
                }
                F0R(j, N) wei[lst][j] += wei[k][j], wei[j][lst] = wei[lst][j];
                F0R(j, N) if (par[j] == k) par[j] = lst;
            } else {
                F0R(j, N) w[j] += wei[k][j];
                add[lst = k] = true;
```

```
            }
        }
    }
    return bes;
}

constexpr int INF = 1e9;

int main() {
    ios_base::sync_with_stdio(false);
    cin.tie(nullptr);

    int n, m;
    cin >> n >> m;
    vector<vi> wei(n, vi(n, INF));

    F0R(i, n) wei[i][i] = 0;
    F0R(i, m) {
        int v, u;
        cin >> v >> u;
        --v, --u;

        if (v == u) continue;

        if (wei[v][u] == INF) {
```

```
            wei[v][u] = 1;
            wei[u][v] = 1;
        } else {
            wei[v][u]++;
            wei[u][v]++;
        }
    }

    auto ans = global_mc(wei);
    cout << ans.first << '\n';
    vector<bool> left(n);
    trav(x, ans.second) left[x] = true;

    F0R(i, n) {
        FOR(j, i + 1, n) {
            if (left[i] ^ left[j] && wei[i][j] < INF) {
                F0R(c, wei[i][j])
                    cout << i + 1 << ' ' << j + 1 << '\n';
            }
        }
    }
}
```

Задание 4. Попытка 2.

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

#define FOR(i, a, b) for (int (i) = (a); (i) < (b); (i)++)
#define F0R(i, a) FOR(i, 0, a)
#define ROF(i, a, b) for (int (i) = (b)-1; (i) >= (a); (i)--)
#define R0F(i, a) ROF(i, 0, a)
#define trav(a, x) for (auto& (a): (x))
#define all(x) (x).begin(), (x).end()
#define sz(x) (int)(x).size()
using ll = long long;
using pii = pair<int, int>;
using vi = vector<int>;

constexpr int MOD = 1e9 + 7; // 998244353

template<class T>
bool ckmin(T& a, const T& b) {
    return a > b && (a = b, true);
}

template<class T>
bool ckmax(T& a, const T& b) {
    return a < b && (a = b, true);
```

```
}

pair<int, vi> global_mc(vector<vi> wei) {
    int N = sz(wei);
    vi par(N);
    iota(all(par), 0);
    pair<int, vi> bes = {INT_MAX, vi{}};
    R0F(phase, N) {
        vi w = wei[0];
        int lst = 0;
        vector<bool> add(N, true);
        FOR(i, 1, N) if (par[i] == i) add[i] = false;
        F0R(i, phase) {
            int k = -1;
            FOR(j, 1, N) if (!add[j] && (k == -1 || w[j] > w[k])) k = j;
            if (i + 1 == phase) {
                if (w[k] < bes.first) {
                    bes = {w[k], {}};
                    F0R(j, N) if (par[j] == k) bes.second.push_back(j);
                }
                F0R(j, N) wei[lst][j] += wei[k][j], wei[j][lst] = wei[lst][j];
                F0R(j, N) if (par[j] == k) par[j] = lst;
            } else {
                F0R(j, N) w[j] += wei[k][j];
                add[lst = k] = true;
```

```
            }
        }
    }
    return bes;
}

constexpr int INF = 1e9;

int main() {
    ios_base::sync_with_stdio(false);
    cin.tie(nullptr);

    int n, m;
    cin >> n >> m;
    vector<vi> wei(n, vi(n, INF));

    F0R(i, n) wei[i][i] = 0;
    F0R(i, m) {
        int v, u;
        cin >> v >> u;
        --v, --u;

        if (v == u) continue;

        if (wei[v][u] == INF) {
```

```
        wei[v][u] = 1;
        wei[u][v] = 1;
    } else {
        wei[v][u]++;
        wei[u][v]++;
    }
}

vector<char> used(n, 0);
function<void(int)> dfs = [&](int v) {
    used[v] = 1;
    F0R(i, n) {
        if (wei[v][i] != INF && !used[i]) dfs(i);
    }
};

dfs(0);

if (count(all(used), 0)) {
    cout << "0\n";
    return 0;
}

auto ans = global_mc(wei);
cout << ans.first << '\n';
```

```
    vector<bool> left(n);
    trav(x, ans.second) left[x] = true;

    F0R(i, n) {
        FOR(j, i + 1, n) {
            if (left[i] ^ left[j]) {
                cout << i + 1 << ' ' << j + 1 << '\n';
            }
        }
    }
}
```

Задание 5. Попытка 1.

```
a, b, c, d = map(int, input().split())

print(abs(a - c) + abs(b - d))
```

Задание 5. Попытка 2.

```
a, b, c, d = map(int, input().split())


f1 = abs(a - c)

f2 = abs(b - c)


ans = 0

ans += 2 * (f1 // 2) + (f1 + 1) // 2


ans += f2


print(ans)
```

Задание 5. Попытка 3.

```
a, b, c, d = map(int, input().split())


f1 = abs(a - c)
f2 = abs(b - d)


ans = 0
ans += 2 * (f1 // 2) + (f1 + 1) // 2


ans += f2


print(ans)
```

Задание 5. Попытка 4.

```
a, b, c, d = map(int, input().split())


f1 = abs(a - c)
f2 = abs(b - d)


ans = 0
ans += 2 * (f1 // 2) + (f1 + 1) // 2


ans += f2


print(ans + 1)
```