LAPORAN TUGAS KECIL I

IF2211 STRATEGI ALGORITMA

Penyelesaian ***Cyberpunk 2077 Breach Protocol*** dengan Algoritma Brute Force

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DAFTAR ISI

Bagian 1
ALGORITMA BRUTE FORCE

Algoritma *Brute Force* adalah algoritma yang dengan pendekatan yang lempang untuk mencari sebuah solusi dari suatu masalah, Algoritma ini bergantung pada kekuatan komputasi karena semakin banyak langkah yang dilakukan semakin besar pula komputasinya. Dalam penyelesaian ***Breach Protocol Cyberpunk 2077*** dengan pendekatan *Brute force*, algoritma yang digunakan adalah sebagai berikut:

- Misalkan ada sequence yang dibentuk dari token unik dan setiap sequence memiliki reward random.
  contoh *sequence*
  {{AB, CD, EF}, 20}
  {{87, G5, J8}, 30}
  {{B8, AB, CD, EF}, 50}
- Pada Matriks game akan ditelusuri semua jalurnya dengan maksimal token yang diambil dari matriks sebanyak buffer yang telah ditentukan yang ada.
- setiap token yang diambil dari matriks akan di-*compare* dengan *sequence* yang memiliki *reward*. Jika kombinasi dari token ada yang sama dengan *Sequence* maka *total prize* akan bertambah sebanyak nilai dari *reward sequence* tersebut.
- Setiap kombinasi yang memiliki total reward yang sama, tetapi memiliki langkah yang lebih sedikit, maka kombinasi yang diambil adalah kombinasi yang memiliki langkah yang lebih sedikit sehingga solusi menjadi lebih optimal.

Bagian 2
SOURCE CODE

Projek ini ditulis dalam Bahasa C++ dengan menggunakan library

1. iostream
2. string
3. limits
4. vector
5. algorithm
6. random
7. chrono
8. fstream
9. climits
10. sys/stat.h

Di dalam file *main.cpp* ada 2 jenis modul, pertama modul yang memang diperuntukkan algoritma *brute force* dan ada yang diperuntukkan sebagai *miscellaneous*

Algoritma *Brute Force*:

1. randomToken: fungsi untuk merandomize matriks dari token user
2. board: fungsi untuk generate matriks secara random
3. seqGenerator: fungsi untuk generate sequence secara random beserta reward
4. comparing: fungsi untuk membandingkan kombinasi dari token pada matriks dengan sequence
5. dfs: fungsi mencari kombinasi pada matriks

Miscellaneous:

1. isExist: fungsi untuk mengecek folder ada atau tidak
2. inputer: fungsi validasi input dalam main looping
3. inputInt: fungsi input yang diberikan message
4. file: fungsi menulis result pada file
5. saving: fungsi untuk menentukan menyimpan file atau tidak
6. isFound: fungsi yang menghasilkan keluaran dari algoritma *brute force*

Source Code-nya:

```cpp
#include <iostream>
#include <string>
#include <limits>
#include <vector>
#include <algorithm>
#include <random>
#include <chrono>
#include <fstream>
#include <climits>
#include <sys/stat.h>

using namespace std;
using namespace std::chrono;

int maxPrize = INT_MIN;
int minMove = INT_MAX;

struct Path{
    int row;
    int col;
};

struct Reward{
    vector<string> sequence;
    int prize;
};

struct PathVal{
    int row;
    int col;
    string finalToken;
};

vector<Path> globalPath;
vector<string> globalCurrPos;
vector<PathVal> finalePath;
```

```cpp
bool isExist(string name){
    struct stat buffer;
    return (stat(name.c_str(), &buffer) == 0);
}
```

```cpp
int inputer(int awal, int akhir){
    string input;
    while (true) {
        cout << ">> ";
        cin >> input;
        try {
            int number = stoi(input);

            if(number >= awal && number <= akhir){
                return number;
            }
            else{
                cout << "Input invalid, masukkan ulang" << endl;
            }
        }
        catch (invalid_argument const &e) {
            cout << "Invalid input, masukkan ulang dengan angka" << endl;
        }
    }
    cin.clear();
    cin.ignore(numeric_limits<streamsize>::max(), '\n');
    cin >> input;

    return -1;
}
```

```cpp
int inputInt(string msg){
    string input;
    while (true) {
        cout << msg;
        cin >> input;
        try {
            int number = stoi(input);

            if(number >= 0){
                return number;
            }
            else{
                cout << "Input invalid, masukkan ulang" << endl;
            }
        }
        catch (invalid_argument const &e) {
            cout << "Invalid input, masukkan ulang dengan angka" << endl;
        }
    }
    cin.clear();
    cin.ignore(numeric_limits<streamsize>::max(), '\n');
    cin >> input;

    return -1;
}
```

```cpp
string randomToken(vector<string> tokens){
    int index = 0 + (rand() % (tokens.size() - 1));
    return tokens[index];
}

vector<vector<string>> board(int cols, int rows, vector<string> token){
    vector<vector<string>> board;

    for(int i = 0; i < rows; i++){
        vector<string> temp;
        for(int j = 0; j < cols; j++){
            temp.push_back(randomToken(token));
        }
        board.push_back(temp);
    }
    return board;
}
```

```cpp
vector<Reward> seqGenerator(int maksSequence, vector<string> token, int jumlahSequence){
    int min = 2;
    vector<Reward> result;
    for(int i = 0; i < jumlahSequence; i++){
        vector<string> temp;
        random_device rd;
        mt19937 gen(rd());
        uniform_int_distribution<int> resultDis(0, token.size() - 1);
        uniform_int_distribution<int> resultLength(min, maksSequence);
        int length = resultLength(gen);
        for(int i = 0 ; i < length; i++){
            int index = resultDis(gen);
            temp.push_back(token[index]);
            // cout << gen << index << endl;
        }
        int value = 1 + (rand() % 100);
        result.push_back({temp, value});
    }
    return result;
}
```

```cpp
void comparing(vector<string>& currentCombination, vector<Reward>& matrix, vector<Path> path) {
    int point = 0;
    for (auto& reward : matrix) {
        vector<string>& combination = reward.sequence;

        auto it = search(currentCombination.begin(), currentCombination.end(), combination.begin(), combination.end());
        if (it != currentCombination.end()) {
            point += reward.prize;
            if(point > maxPrize){
                finalePath.clear();
                maxPrize = point;
                // minMove = depth;
                for(int i = 0; i < path.size(); i++){
                    finalePath.push_back({path[i].row, path[i].col, currentCombination[i]});
                }
            }
            if(point == maxPrize && path.size() < minMove){
                finalePath.clear();
                minMove = path.size();
                for(int i = 0; i < path.size(); i++){
                    finalePath.push_back({path[i].row, path[i].col, currentCombination[i]});
                }
            }
        }
    }
}
```

```cpp
void dfs(vector<vector<string>>& board, vector<Reward> base, vector<Path> path, vector<string> currentPos, int curRow, int curCol, int currDepth, int buffer, bool isHorizontal){
    int prizeTotal = 0;
    for(int i = 0; i < base.size(); i++){
        prizeTotal += base[i].prize;
    }
    if(prizeTotal == maxPrize){
        return;
    }

    if(curRow < 0 || curRow >= board.size() || curCol < 0 || curCol >= board[0].size()){
        return;
    }

    for(int i = 0; i < path.size(); i++){
        if(curRow == path[i].row && curCol == path[i].col){
            return;
        };
    }

    path.push_back({curRow, curCol});
    currentPos.push_back(board[curRow][curCol]);
    comparing(currentPos, base, path);

    if(currDepth == buffer){
        return;
    }

    if(isHorizontal){
        for(int i = 1; i < board.size(); i++){
            dfs(board, base, path, currentPos, curRow + i, curCol, currDepth + 1, buffer, false);
            dfs(board, base, path, currentPos, curRow - i, curCol, currDepth + 1, buffer, false);
        }
    }
    else{
        for(int i = 1; i < board[0].size();i++){
            dfs(board, base, path, currentPos, curRow, curCol + i, currDepth + 1, buffer, true);
            dfs(board, base, path, currentPos, curRow, curCol - i, currDepth + 1, buffer, true);
        }
    }
    path.pop_back();
    currentPos.pop_back();
}
```

```cpp
void file(string filename, auto duration){
    filename += ".txt";
    fstream savingData;
    savingData.open(filename, ios::out);

    savingData << maxPrize << endl;
    for(int i =0; i < finalePath.size(); i++){
        savingData << finalePath[i].finalToken << " ";
    }
    savingData << "\n";
    for(int i = 0; i < finalePath.size(); i++){
        savingData << "(" << finalePath[i].col + 1 << "," << finalePath[i].row + 1 << ")" << "\n";
    }

    savingData << "\n";
    savingData << duration << " ms";
    savingData.close();
}
```

```
void saving(auto duration){
    string fileName;
    string filePath;
    cout << "simpan hasil dalam bentuk file? (y/n) ";
    char choose;
    cin >> choose;
    while(choose != 'y' && choose != 'n' && choose != 'Y' && choose != 'N'){
        cout << "input invalid, masukkan ulang" << endl;
        cout << ">> ";
        cin >> choose;
    }
    if(choose == 'y' || choose == 'Y'){
        cout << "Masukkan nama file: ";
        filePath = "./test/";
        cin >> fileName;
        filePath += fileName;
        file(filePath, duration);
        cout << fileName << " telah tersimpan di folder test" << endl;
    }
}
```

```
void isFound(auto duration, vector<vector<string>> board){
    if(maxPrize == INT_MIN){
        maxPrize = 0;
    }
    if(minMove == INT_MAX){
        minMove = 0;
    }
    if(finalePath.size() != 0){
        cout << " _______  _____   __   __  .__   __.  _______  " << endl
        << "|   ____| /  __  \\  |  |  | |  \\ |  | |       \\ " << endl
        << "|  |__    |  |  |  | |  |  | |   \\|  | |  .---.  |" << endl
        << "|   __|   |  |  |  | |  |  | |  . `  | |  |   |  |" << endl
        << "|  |      |  `--'  | |  `--' | |  |\\   | |  '---'  |" << endl
        << "|__|       \\_____/   \\_____/  |__| \\__| |_______/ " << endl;

        cout << "Result" << endl;
        cout << "Matriks: " << endl;
        for(int i = 0; i < board.size(); i++){
            for(int j = 0; j < board[0].size(); j++){
                cout << board[i][j] << " ";
            }
            cout << endl;
        }
        for(int i = 0; i < finalePath.size(); i++){
            cout << finalePath[i].finalToken << " ";
        }
        cout << endl;
        for(int i = 0; i < finalePath.size(); i++){
            cout << "(" << finalePath[i].col + 1 << "," << finalePath[i].row + 1 << ")" << endl;
        }
    }
```

```
    else{
        cout << endl;
        cout << "##    ##  #######  ########    ########  #######  ##     ## ##    ## ########" << endl;
        cout << "###   ## ##     ##    ##       ##       ##     ## ##     ## ###   ## ##     ##" << endl;
        cout << "## ## ## ##     ##    ##       ######   ##     ## ##     ## ## ## ## ##     ##" << endl;
        cout << "##  #### ##     ##    ##       ##       ##     ## ##     ## ##  #### ##     ##" << endl;
        cout << "##    ##  #######     ##       ##        #######   #######  ##    ## ########" << endl;
        cout << endl;
    }
    cout << "Optimum reward: " << endl;
    cout << "total prize: " <<  maxPrize << endl;
    cout  << "minimum buffer taken: " << minMove << endl;

    cout << "\nExecution Time: " << duration.count() << " milliseconds" << endl;
    if(!finalePath.empty()){
        saving(duration.count());
    }
}
```

```cpp
int main(){
    cout<< "                __                          " << endl
        << " _       _____  / /________  ____ ___  ___ " << endl
        << "| | /| / / _ \\/ / ___/ __ \\/ __ `__ \\/ _ \\" << endl
        << "| |/ |/ /  __/ / /__/ /_/ / / / / / /  __/" << endl
        << "|__/|__/\\___/_/\\___/\\____/_/ /_/ /_/\\___/ " << endl;

    while(true){
        cout << "    ____                   __               " << endl
             << "   / __ )________  ____ ______/ /_            " << endl
             << "  / __  / ___/ _ \\/ __ `/ ___/ __ \\           " << endl
             << " / /_/ / /  /  __/ /_/ / /__/ / / /          " << endl
             << "/_____/_/   \\___/\\__,_/\\___/_/ /_/        __" << endl
             << "   / __ \\_________  / /_____  _________  / /" << endl
             << "  / /_/ / ___/ __ \\/ __/ __ \\/ ___/ __ \\/ / " << endl
             << " / ____/ /  / /_/ / /_/ /_/ / /__/ /_/ / /  " << endl
             << "/_/   /_/   \\____/\\__/\\____/\\___/\\____/_/   " << endl;
        //reset global variable
        cout << "choose input method: " << endl;
        globalCurrPos.clear();
        globalPath.clear();
        finalePath.clear();
        maxPrize = INT_MIN;
        minMove = INT_MAX;

        int jumlahTokenUnik, buffer, rowsMatriks, colsMatriks, jumlahSekuens, maksSekuens;
        vector<string> token;

        cout << "1. cli" << endl;
        cout << "2. file" << endl;
        cout << "3. quit" << endl;
        int input = inputer(1, 3);
```

```cpp
        if(input == 1){
            jumlahTokenUnik = inputInt("Masukkan jumlah token unik: ");
            buffer = inputInt("Masukkan jumlah buffer: ");
            rowsMatriks = inputInt("Masukkan jumlah baris matriks: ");
            colsMatriks = inputInt("Masukkan jumlah kolom matriks: ");
            jumlahSekuens = inputInt("Masukkan total sekuens: ");
            maksSekuens = inputInt("Masukkan jumlah maksimum sekuens: ");
            cout << "Masukkan token: ";
            for(int i = 0; i < jumlahTokenUnik; i++){
                string seq;
                cin >> seq;
                token.push_back(seq);
            }

            // generate sequence reward and matriks board
            vector<vector<string>> boardGame = board(rowsMatriks, colsMatriks, token);
            vector<Reward> rewardSequence = seqGenerator(maksSekuens, token, jumlahSekuens);

            // reward debug
            for(int i = 0; i < rewardSequence.size(); i++){
                cout << "{{";
                for(int j = 0 ; j < rewardSequence[i].sequence.size(); j++){
                    cout << rewardSequence[i].sequence[j];
                    if(j != rewardSequence[i].sequence.size() - 1){
                        cout << ",";
                    }
                }
                cout << "}, ";
                cout << rewardSequence[i].prize;
                cout << "}";
                cout << endl;
            }

            auto start = high_resolution_clock::now();
            // main execution
            vector<string> currentPos;
            vector<Path> path;
            for(int i = 0; i < colsMatriks; i++){
                dfs(boardGame, rewardSequence, path, currentPos, 0, i, 0, buffer, true);
            }
            auto stop = high_resolution_clock::now();
            auto duration = duration_cast<milliseconds>(stop - start);
            // result
            isFound(duration, boardGame);
        }
```

```
else if(input == 2){
    bool isValid = 1;
    vector<vector<string>> matriks;
    string line;
    string filePath = "test/";
    string fileName;
    vector<string> lines;
    fstream myData;

    cout << "Pastikan file ada di dalam folder test" << endl;
    cout << "tambahkan ekstensi file\ncontoh: data.txt\n";
    cout << "Masukkan nama file: ";
    cin >> fileName;
    filePath += fileName;
    while(!isExist(filePath)){
        cout << "file tidak ada di folder test" << endl;
        cout << "Masukkan nama file: ";
        cin >> fileName;
        filePath = "test/";
        filePath += fileName;
    }
    cout << "\n\nMemproses file "  << fileName << endl;

    myData.open(filePath);
    if(myData.is_open()){
        while(getline(myData, line)){
            lines.push_back(line);
        }
    }
    myData.close();
    try{
        buffer = stoi(lines[0]);
    }catch(const invalid_argument& e){
        cerr << "file tidak sesuai format: buffer bukanlah angka";
        isValid = 0;
    }
```

```
    try{
        rowsMatriks = stoi(tempString);
    }catch(const invalid_argument& e){
        cerr << "file tidak sesuai format: rowsMatriks bukanlah angka\n";
        isValid = 0;
    }
    tempString.clear();
    for(int i = lengthBreak + 1; i < lines[1].size(); i++){
        if(lines[1][i] == ' ' || lines[1][i] == '\r'){
            break;
        }
        tempString += (lines[1][i]);
    }

    try{
        colsMatriks = stoi(tempString);
        tempString.clear();
    }catch(const invalid_argument& e){
        cerr << "file tidak sesuai format: colsMatriks bukanlah angka\n";
        isValid = 0;
    }

    string myStr;
    vector<string> temp;
    if(rowsMatriks > lines.size()){
        cout << "file tidak sesuai format: rowMatriks terlalu banyak\n";
        isValid = 0;
    }

    if(isValid){
        for(int i = 2; i <= rowsMatriks + 1; i++){
            if(isValid){
                temp.clear();
                for(int j = 0; j < lines[i].size(); j++){
                    if(isValid){
                        if(lines[i][j] != ' '){
                            myStr.push_back(lines[i][j]);
                            if(myStr.back() == '\r'){
                                myStr.pop_back();
                            }
                        }
                        if(lines[i][j] == ' ' || j == lines[i].size() - 1){
                            if(myStr.size() != 2){
                                isValid = 0;
                                cout << "file tidak sesuai format: token matriks tidak sesuai" << endl;
                                break;
```

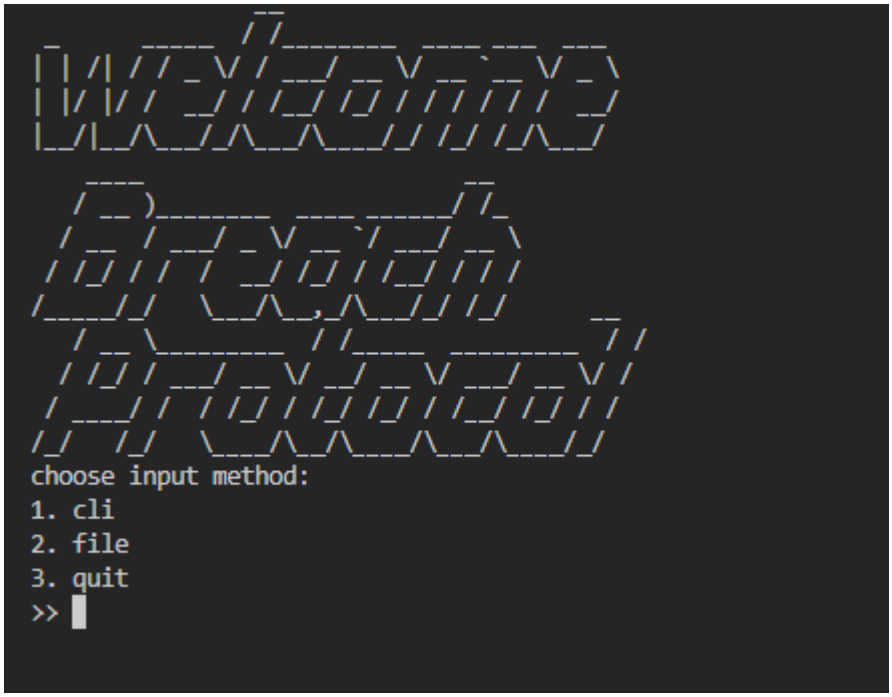
```
if(isValid){
    for(int i = 2; i <= rowsMatriks + 1; i++){
        if(isValid){
            temp.clear();
            for(int j = 0; j < lines[i].size(); j++){
                if(isValid){
                    if(lines[i][j] != ' '){
                        myStr.push_back(lines[i][j]);
                        if(myStr.back() == '\r'){
                            myStr.pop_back();
                        }
                    }
                    if(lines[i][j] == ' ' || j == lines[i].size() - 1){
                        if(myStr.size() != 2){
                            isValid = 0;
                            cout << "file tidak sesuai format: token matriks tidak sesuai" << endl;
                            break;
                        }
                        temp.push_back(myStr);
                        myStr.clear();
                    }
                }

            }
            matriks.push_back(temp);
            if(matriks[i-2].size() != colsMatriks){
                cout << "file tidak sesuai format: jumlah kolom tidak sesuai dengan input" << endl;
                isValid = 0;
                break;
            }
        }
    }
}
```

```
if(isValid){
    for(int f = rowsMatriks + 3; f < lines.size(); f++){
        Reward tempReward;
        //ini reward
        if(isValid){
            temp.clear();
            //ini sequence
            for(int j = 0; j < lines[f].size(); j++){
                if(lines[f][j] != ' '){
                    myStr.push_back(lines[f][j]);
                    if(myStr.back() == '\r'){
                        myStr.pop_back();
                    }
                }
                if(lines[f][j] == ' ' || j == lines[f].size() - 1){
                    if(myStr.size() != 2){
                        cout << "file tidak sesuai format: sequence token tidak berjumlah 2" << endl;
                        isValid = 0;
                    }
                    temp.push_back(myStr);
                    myStr.clear();
                }
            }
            tempReward.sequence = temp;

            f += 1;
            try{
                tempReward.prize = stoi(lines[f]);
            }
            catch(const invalid_argument& e){
                cerr << "file tidak sesuai format: baris matriks tidak sesuai dengan input" << endl;
                cerr << "file tidak sesuai format: reward sequence bukanlah angka" << endl;
                isValid = 0;
            }
            rewardSequence.push_back(tempReward);
        }
    }
}
```

```
            if(rewardSequence.size() != jumlahSekuens && isValid){
                cout << "file tidak sesuai format: jumlah sekuens tidak sesuai" << endl;
                isValid = 0;
            }

            if(isValid){
                // main execution
                auto start = high_resolution_clock::now();
                vector<string> currentPos;
                vector<Path> path;
                for(int i = 0; i < colsMatriks; i++){
                    dfs(matriks, rewardSequence, path, currentPos, 0, i, 0, buffer, true);
                }
                auto stop = high_resolution_clock::now();
                auto duration = duration_cast<milliseconds>(stop - start);
                isFound(duration, matriks, rewardSequence);

            }else{
                cout << "\ncek kesalahan satu per satu" << endl;
            }

            // result
        }
        else{
            break;
        }
    }
    return 0;
}
```

Bagian 3

SCREENSHOT TEST



Input Keyboard

Input 1:

```
Masukkan jumlah token unik: 5
Masukkan jumlah buffer: 6
Masukkan jumlah baris matriks: 6
Masukkan jumlah kolom matriks: 6
Masukkan total sekuens: 4
Masukkan jumlah maksimum sekuens: 5
Token harus kombinasi 1 angka 1 huruf, 2 angka, atau 2 huruf
Contoh: A8, BG, 97
Masukkan token: AB CD 7F HG 8F
{{HG,8F,CD,HG,CD}, 91}
{{AB,HG,8F}, 30}
{{AB,8F,CD}, 71}
{{AB,8F}, 51}

##    ##  #######  ########    ########  #######  ##     ## ##    ## ########
###   ## ##     ##    ##       ##       ##     ## ##     ## ###   ## ##     ##
## ## ## ##     ##    ##       ######   ##     ## ##     ## ## ## ## ##     ##
##  #### ##     ##    ##       ##       ##     ## ##     ## ##  #### ##     ##
##    ##  #######     ##       ##        #######   #######  ##    ## ########

Optimum reward:
total prize: 0
minimum buffer taken: 0

Execution Time: 846 milliseconds
simpan hasil dalam bentuk file? (y/n) y
Masukkan nama file: result1k
result1k telah tersimpan di folder test
```

test > result1k.txt

```
1   0
2
3
4   846 ms
```

Input2:

```
Masukkan jumlah token unik: 7
Masukkan jumlah buffer: 6
Masukkan jumlah baris matriks: 6
Masukkan jumlah kolom matriks: 6
Masukkan total sekuens: 5
Masukkan jumlah maksimum sekuens: 6
Token harus kombinasi 1 angka 1 huruf, 2 angka, atau 2 huruf
Contoh: A8, BG, 97
Masukkan token: AB 7U 4R 6D 3E 9I OP
{{9I,3E,OP,7U,AB}, 9}
{{6D,AB,OP}, 45}
{{OP,AB,9I}, 10}
{{9I,9I,4R}, 90}
{{6D,3E,4R,7U}, 3}
 _______   ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__   |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|  |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |     |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|      \______/   \______/  |__| \__| |_______/

Result
Matriks:
6D AB 6D AB 3E 7U
AB 9I 7U AB 4R AB
4R 7U 9I 4R 7U AB
7U 9I 6D AB 9I 7U
3E 9I 4R 9I 6D 4R
9I 7U 4R 3E 6D 4R
Reward Sequence:
9I 3E OP 7U AB (9)
6D AB OP (45)
OP AB 9I (10)
9I 9I 4R (90)
6D 3E 4R 7U (3)
Token combination: 6D 3E 4R 7U 9I 9I 4R
(1,1)
(1,5)
(3,5)
(3,2)
(2,2)
(2,5)
(6,5)
Optimum reward:
total prize: 93
minimum buffer taken: 7
```

test > resultk2.txt

```
1   93
2   6D 3E 4R 7U 9I 9I 4R
3   (1,1)
4   (1,5)
5   (3,5)
6   (3,2)
7   (2,2)
8   (2,5)
9   (6,5)
10
11  1025 ms
```

Input 3:

```
Masukkan jumlah token unik: 4
Masukkan jumlah buffer: 6
Masukkan jumlah baris matriks: 7
Masukkan jumlah kolom matriks: 7
Masukkan total sekuens: 3
Masukkan jumlah maksimum sekuens: 4
Token harus kombinasi 1 angka 1 huruf, 2 angka, atau 2 huruf
Contoh: A8, BG, 97
Masukkan token: AB 76 D9 IF
{{76,76,76}, 75}
{{76,D9,IF,76}, 21}
{{76,AB,AB,D9}, 97}
 _______   ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__   |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|  |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |     |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|      \______/   \______/  |__| \__| |_______/

Result
Matriks:
AB D9 D9 AB 76 D9 76
D9 76 AB 76 76 76 AB
D9 76 AB 76 D9 AB AB
D9 D9 76 D9 D9 AB D9
76 D9 76 AB D9 AB D9
AB D9 76 D9 AB D9 D9
AB 76 AB D9 D9 76 D9
Reward Sequence:
76 76 76 (75)
76 D9 IF 76 (21)
76 AB AB D9 (97)
Token combination: 76 76 76 AB AB D9
(5,1)
(5,2)
(6,2)
(6,3)
(7,3)
(7,4)
Optimum reward:
total prize: 172
minimum buffer taken: 6

Execution Time: 2691 milliseconds
```

test > resultk3.txt

```
1   172
2   76 76 76 AB AB D9
3   (5,1)
4   (5,2)
5   (6,2)
6   (6,3)
7   (7,3)
8   (7,4)
9
10  2691 ms
```

Input 4:

```
Masukkan jumlah token unik: 6
Masukkan jumlah buffer: 7
Masukkan jumlah baris matriks: 6
Masukkan jumlah kolom matriks: 6
Masukkan total sekuens: 5
Masukkan jumlah maksimum sekuens: 6
Token harus kombinasi 1 angka 1 huruf, 2 angka, atau 2 huruf
Contoh: A8, BG, 97
Masukkan token: AB FG HU 7Y 8U IF
{{AB,IF,8U,AB,HU}, 94}
{{IF,8U,7Y,AB,HU,AB}, 57}
{{HU,7Y,AB,7Y}, 12}
{{HU,8U,IF,AB}, 43}
{{8U,7Y,IF}, 30}
 _______  ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__   |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|  |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |     |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|      \______/   \______/  |__| \__| |_______/

Result
Matriks:
7Y FG HU AB 7Y AB
FG HU 8U FG HU HU
AB 8U 7Y FG AB FG
HU FG FG 7Y HU 8U
HU AB HU 7Y HU AB
8U HU HU 7Y 8U HU
Reward Sequence:
AB IF 8U AB HU (94)
IF 8U 7Y AB HU AB (57)
HU 7Y AB 7Y (12)
HU 8U IF AB (43)
8U 7Y IF (30)
Token combination: HU 7Y AB 7Y
(3,1)
(3,3)
(5,3)
(5,1)
Optimum reward:
total prize: 12
minimum buffer taken: 4

Execution Time: 7364 milliseconds
```

test > resultk4.txt

```
1  12
2  HU 7Y AB 7Y
3  (3,1)
4  (3,3)
5  (5,3)
6  (5,1)
7
8  7364 ms
```

Input 5:

```
Masukkan jumlah token unik: 8
Masukkan jumlah buffer: 8
Masukkan jumlah baris matriks: 8
Masukkan jumlah kolom matriks: 8
Masukkan total sekuens: 7
Masukkan jumlah maksimum sekuens: 6
Token harus kombinasi 1 angka 1 huruf, 2 angka, atau 2 huruf
Contoh: A8, BG, 97
Masukkan token: 6F TU YD HD H8 43 A4 K9
{{6F,K9,6F}, 89}
{{K9,K9,TU,6F,A4,H8}, 7}
{{YD,YD,43,6F,TU,A4}, 41}
{{YD,K9,A4,A4,YD}, 43}
{{6F,K9,A4}, 65}
{{H8,H8,43,YD}, 49}
{{H8,K9,A4,TU,6F,43}, 47}
 _______  ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__   |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|  |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |     |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|      \______/   \______/  |__| \__| |_______/

Result
Matriks:
A4 TU A4 43 HD YD 43 6F
43 A4 6F 43 A4 A4 6F TU
A4 6F H8 H8 YD YD HD A4
43 A4 43 43 A4 TU TU 43
TU YD 6F H8 43 6F H8 HD
HD H8 H8 YD 43 YD 6F H8
TU TU H8 TU 6F H8 HD 6F
TU H8 43 TU HD H8 6F TU
Reward Sequence:
6F K9 6F (89)
K9 K9 TU 6F A4 H8 (7)
YD YD 43 6F TU A4 (41)
YD K9 A4 A4 YD (43)
6F K9 A4 (65)
H8 H8 43 YD (49)
H8 K9 A4 TU 6F 43 (47)
Token combination: A4 H8 H8 43 YD
(3,1)
(3,3)
(4,3)
(4,1)
(6,1)
Optimum reward:
total prize: 49
minimum buffer taken: 5
```

test > resultk5.txt

```
1   49
2   A4 H8 H8 43 YD
3   (3,1)
4   (3,3)
5   (4,3)
6   (4,1)
7   (6,1)
8
9   959981 ms
```

Input 6:

```
Masukkan jumlah token unik: 6
Masukkan jumlah buffer: 6
Masukkan jumlah baris matriks: 8
Masukkan jumlah kolom matriks: 8
Masukkan total sekuens: 4
Masukkan jumlah maksimum sekuens: 6
Token harus kombinasi 1 angka 1 huruf, 2 angka, atau 2 hurufContoh: A8, BG, 97
Masukkan token: 7K 8F AA BH FK LK
{{FK,FK,AA}, 89}
{{FK,8F,AA,7K,FK,LK}, 7}
{{7K,FK,7K,AA}, 41}
{{BH,8F}, 43}
 _______   ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__    |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|   |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |      |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|       \______/   \______/  |__| \__| |_______/

Result
Matriks:
8F AA FK 7K FK FK BH BH
AA FK 7K 7K 8F AA 8F 8F
7K AA AA 8F 8F FK AA BH
AA AA 8F 8F BH 7K AA 8F
8F BH FK AA AA FK 7K FK
BH 8F AA BH BH FK 8F 8F
BH BH AA FK AA AA AA FK
BH 8F FK BH 8F 7K 7K AA
Reward Sequence:
FK FK AA (89)
FK 8F AA 7K FK LK (7)
7K FK 7K AA (41)
BH 8F (43)
Token combination: FK FK AA BH 8F
(3,1)
(3,5)
(4,5)
(4,6)
(2,6)
Optimum reward:
total prize: 132
minimum buffer taken: 5

Execution Time: 9338 milliseconds
```

Input file

Input: data.txt

```
Masukkan nama file: data.txt


Memproses file data.txt
 _______  ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__    |  |  |  |  |  |  | |   \|  | |  .--.  |
|   __|   |  |  |  |  |  |  | |  . `  | |  |  |  |
|  |      |  `--'  |  |  `--' | |  |\   | |  '--'  |
|__|       \______/   \______/  |__| \__| |_______/

Result
Matriks:
7A 55 E9 E9 1C 55
55 7A 1C 7A E9 55
55 1C 1C 55 E9 BD
BD 1C 7A 1C 55 BD
BD 55 BD 7A 1C 1C
1C 55 55 7A 55 7A
Reward Sequence:
BD E9 1C (15)
BD 7A BD (20)
BD 1C BD 55 (30)
Token combination: 7A BD 7A BD 1C BD 55
(1,1)
(1,4)
(3,4)
(3,5)
(6,5)
(6,4)
(5,4)
Optimum reward:
total prize: 50
minimum buffer taken: 7
```

result7.txt U | main.cpp M | result.txt U | result2.txt U | README.md M

test > result.txt

```
1   50
2   7A BD 7A BD 1C BD 55
3   (1,1)
4   (1,4)
5   (3,4)
6   (3,5)
7   (6,5)
8   (6,4)
9   (5,4)
10
11  4306 ms
```

Input: data2.txt

```
Masukkan nama file: data2.txt


Memproses file data2.txt
 _______  ______    __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__    |  |  |  |  |  |  | |   \|  | |  .--.  |
|   __|   |  |  |  |  |  |  | |  . `  | |  |  |  |
|  |      |  `--'  |  |  `--' | |  |\   | |  '--'  |
|__|       \______/    \______/  |__| \__| |_______/

Result
Matriks:
42 69 69 AD BE AA AA
42 DE CC CC BE 42 42
AD BE EF 69 CC DE EF
CC 42 EF BE BE EF CC
42 CC AD EF AD 42 DE
EF CC DE 42 42 AA CC
BE AA AA BE CC 69 69
Reward Sequence:
DE 69 AA AD (87)
42 BE 42 EF AA (16)
AD DE 42 DE DE EF (52)
AD DE 42 AD CC (86)
EF AA AA (30)
Token combination: 42 AD DE 69 AA AD
(1,1)
(1,3)
(6,3)
(6,7)
(3,7)
(3,5)
Optimum reward:
total prize: 87
minimum buffer taken: 6

Execution Time: 29151 milliseconds
simpan hasil dalam bentuk file? (y/n) y
Masukkan nama file: result2
result2 telah tersimpan di folder test
```

result7.txt U | main.cpp M | result2.txt U | README.md M

test > result2.txt

```
1   87
2   42 AD DE 69 AA AD
3   (1,1)
4   (1,3)
5   (6,3)
6   (6,7)
7   (3,7)
8   (3,5)
9
10  27416 ms
```

input: data3.txt

```
Masukkan nama file: data3.txt


Memproses file data3.txt
 _______  ______   __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__   |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|  |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |     |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|      \______/   \______/  |__| \__| |_______/

Result
Matriks:
69 42 00 69 00 EF
BE AD BE AD EF 42
42 42 DE 69 EF AD
BE 69 DE BE AD 42
BE 42 EF BE BE DE
00 00 00 EF 00 BE
Reward Sequence:
AD 69 42 69 BE (17)
69 AD DE AD (100)
42 AD 00 (97)
DE EF AD 00 42 (3)
Token combination: EF 42 AD 00
(6,1)
(6,2)
(2,2)
(2,6)
Optimum reward:
total prize: 97
minimum buffer taken: 4

Execution Time: 4493 milliseconds
simpan hasil dalam bentuk file? (y/n) y
Masukkan nama file: result3
result3 telah tersimpan di folder test
```

test > result3.txt

```
1   97
2   EF 42 AD 00
3   (6,1)
4   (6,2)
5   (2,2)
6   (2,6)
7
8   4493 ms
```

input: data4.txt

```
Masukkan nama file: data4.txt


Memproses file data4.txt
 _______  ______   __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__    |  |  |  | |  |  |  | |   \|  | |  .--.  |
|   __|   |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |      |  `--'  | |  `--'  | |  |\   | |  '--'  |
|__|       \______/   \______/  |__| \__| |_______/

Result
Matriks:
UF DO A9 B3 74 J1
DD 7Y DB L4 QD 8A
BG 61 W7 QN TJ 91
C8 UO T0 PA UA D4
CQ 11 R2 DQ KN CF
98 IQ TL AX 9I 8E
Reward Sequence:
AB UO AB UO AB (59)
UF 7Y 9I 9I (6)
BG UF (-50)
UF AB (92)
9I 9I 7Y BG (3)
Token combination: DO 61 BG UF
(2,1)
(2,3)
(1,3)
(1,1)
Optimum reward:
total prize: 0
minimum buffer taken: 4
```

test > result4.txt

```
1   0
2   DO 61 BG UF
3   (2,1)
4   (2,3)
5   (1,3)
6   (1,1)
7
8   5192 ms
```

input: data5.txt

```
Masukkan nama file: data5.txt


Memproses file data5.txt
 _______  ______   __    __  .__   __.  _______
|   ____| /  __  \ |  |  |  | |  \ |  | |   ____|
|  |__   |  |  |  ||  |  |  | |   \|  | |  |__
|   __|  |  |  |  ||  |  |  | |  . `  | |   __|
|  |     |  `--'  ||  `--'  | |  |\   | |  |____
|__|      \______/  \______/  |__| \__| |_______|

Result
Matriks:
AB Y4 HS UI YK HT
PF PN 7Q 30 RO E9
KU XW QN BI BI X4
UF 7U BF 2L L7 L7
TS J9 AX L7 BL PM
4B E6 0A 4E 44 E9
Reward Sequence:
AB GH AB J9 J9 KU (91)
UF UF J9 KU GH (30)
AB J9 UF J9 UF L7 (71)
KU AB (-100)
J9 UF GH (7)
Token combination: Y4 XW KU AB
(2,1)
(2,3)
(1,3)
(1,1)
Optimum reward:
total prize: 0
minimum buffer taken: 4

Execution Time: 23447 milliseconds
```

test > result5.txt

```
1   0
2   Y4 XW KU AB
3   (2,1)
4   (2,3)
5   (1,3)
6   (1,1)
7
8   23447 ms
```

input: data6.txt

```
Masukkan nama file: data6.txt


Memproses file data6.txt
 _______  ______   __    __  .__   __.  _______
|   ____| /  __  \  |  |  |  | |  \ |  | |       \
|  |__    |  |  | | |  |  |  | |   \|  | |  .--.  |
|   __|   |  |  | | |  |  |  | |  . `  | |  |  |  |
|  |      | `--'  | | `--'  | |  |\   | |  '--'  |
|__|       \______/   \______/  |__| \__| |_______/

Result
Matriks:
K9 D7 0F 7B 7B 15 7B J8
FF K9 0F FF 7B D7 7B K9
0F 7B 15 00 FF FF 15 15
0F FF J8 J8 D7 15 J8 K9
J8 0F K9 0F 15 7B D7 J8
00 K9 0F 00 0F FF 7B J8
J8 D7 K9 K9 00 00 15 FF
7B 00 7B 0F 7B 15 00 15
Reward Sequence:
J8 FF 15 J8 K9 (50)
K9 K9 00 7B 7B (30)
15 7B J8 K9 7B 7B (34)
15 FF D7 D7 (5)
K9 15 FF J8 7B FF (90)
D7 FF K9 (32)
Token combination: D7 FF K9 J8 FF 15 J8 K9
(2,1)
(2,4)
(8,4)
(8,6)
(6,6)
(6,4)
(4,4)
(4,7)
Optimum reward:
total prize: 82
minimum buffer taken: 8

Execution Time: 90897 milliseconds
simpan hasil dalam bentuk file? (y/n) y
Masukkan nama file: result6
result6 telah tersimpan di folder test
```

test > result6.txt

```
1   82
2   D7 FF K9 J8 FF 15 J8 K9
3   (2,1)
4   (2,4)
5   (8,4)
6   (8,6)
7   (6,6)
8   (6,4)
9   (4,4)
10  (4,7)
11
12  90897 ms
```

Input: data7.txt

```
| |  .--.  |
|   __|  |  |  |  | |  |  |  | |  . `  | |  |  |  |
|  |     |  `--'  |  |  `--'  |  |  |\   |  |  '--'  |
|__|      \_____/   \_____/   |__| \__|  |_____/

Result
Matriks:
K9 D7 0F 7B 7B 15 7B J8
FF K9 0F FF 7B D7 7B K9
0F 7B 15 00 FF FF 15 15
0F FF J8 J8 D7 15 J8 K9
J8 0F K9 0F 15 7B D7 J8
00 K9 0F 00 0F FF 7B J8
J8 D7 K9 K9 00 00 15 FF
7B 00 7B 0F 7B 15 00 15
D7 FF K9 J8 FF 15 J8 K9
(2,1)
(2,4)
(8,4)
(8,6)
(6,6)
(6,4)
(4,4)
(4,7)
Optimum reward:
total prize: 88
minimum buffer taken: 8

Execution Time: 606981 milliseconds
simpan hasil dalam bentuk file? (y/n) y
Masukkan nama file: result7
result7 telah tersimpan di folder test
```

result7.txt U × | main.cpp M | README.md M ●

test > result7.txt

```
1   88
2   D7 FF K9 J8 FF 15 J8 K9
3   (2,1)
4   (2,4)
5   (8,4)
6   (8,6)
7   (6,6)
8   (6,4)
9   (4,4)
10  (4,7)
11
12  606981 ms
```

Link Repository

Link repository github
https://github.com/Indraswara/Tucil1_13522119

Checklist

poin	Ya	Tidak
1. Program berhasil dikompilasi tanpa kesalahan	✓	
2. Program berhasil dijalankan	✓	
3. Program dapat membaca masukan berkas .txt	✓	
4. Program dapat menghasilkan masukan secara acak	✓	
5. Solusi yang diberikan program optimal	✓	
6. Program dapat menyimpan solusi dalam berkas .txt	✓	
7. Program memiliki GUI		✓