

**Laporan Tugas Kecil 1 IF2211 Strategi Algoritma**  
**Semester II Tahun Akademik 2023/2024**

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



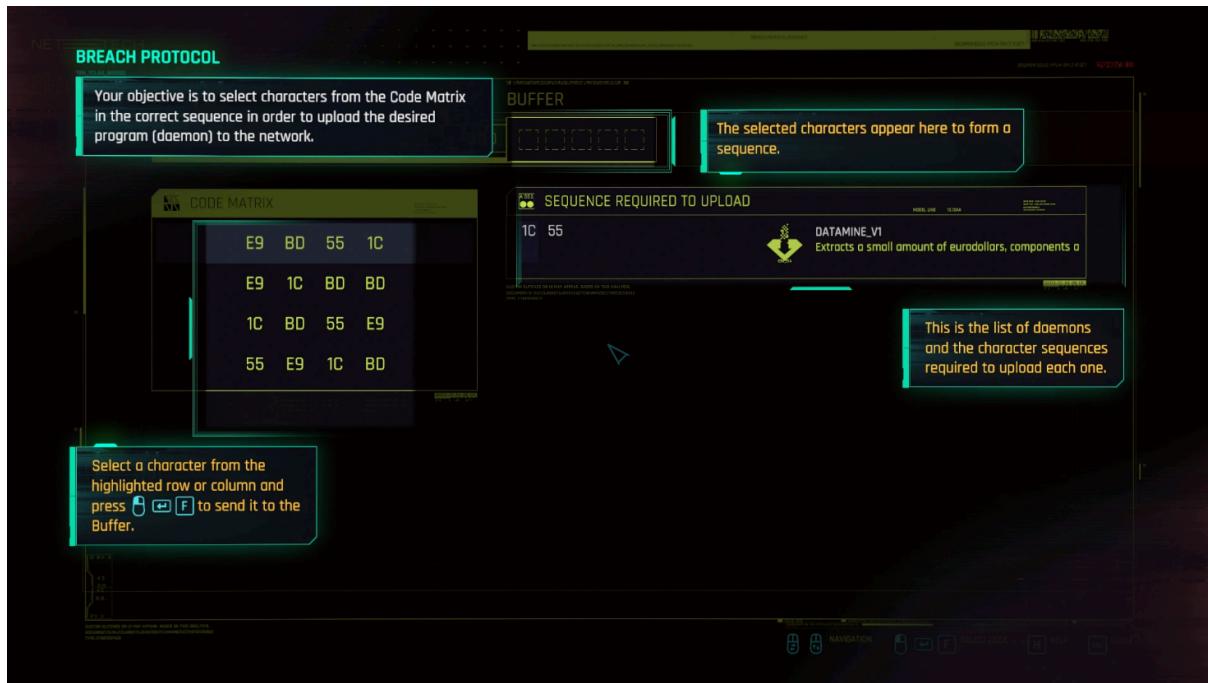
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# Daftar Isi

Daftar Isi.....	1
1. Deskripsi Tugas.....	2
2. Algoritma Bruteforce.....	3
3. Source Code.....	6
3.1 server.py.....	7
3.2 main.py.....	9
3.2 RF.py.....	10
3.3 Solution.py.....	11
4. How To Use.....	14
5. Test Case.....	16
5.1 Test Case 1.....	16
Input.....	16
Result.....	16
5.2 Test Case 2.....	17
Input.....	17
Result.....	17
5.3 Test Case 3.....	18
Input.....	18
Result.....	18
5.4 Test Case 4.....	19
Input.....	19
Result.....	19
5.5 Test Case 5.....	20
Input.....	20
Result.....	20
5.6 Test Case 6.....	21
Input.....	21
Result.....	21
GitHub.....	22
Poin-Poin Penting.....	22

# 1. Deskripsi Tugas



Gambar 1. Cyberpunk 2077 Breach Protocol  
( Sumber: <https://cyberpunk.fandom.com/wiki/Quickhacking> )

Cyberpunk 2077 Breach Protocol adalah minigame meretas pada permainan video Cyberpunk 2077. Minigame ini merupakan simulasi peretasan jaringan local dari ICE (Intrusion Countermeasures Electronics) pada permainan Cyberpunk 2077. Komponen pada permainan ini antara lain adalah:

1. Token – terdiri dari dua karakter alfanumerik seperti E9, BD, dan 55.
2. Matriks – terdiri atas token-token yang akan dipilih untuk menyusun urutan kode.
3. Sekuens – sebuah rangkaian token (dua atau lebih) yang harus dicocokkan.
4. Buffer – jumlah maksimal token yang dapat disusun secara sekuensial.

Aturan permainan Breach Protocol antara lain:

1. Pemain bergerak dengan pola horizontal, vertikal, horizontal, vertikal (bergantian) hingga semua sekuens berhasil dicocokkan atau buffer penuh.
2. Pemain memulai dengan memilih satu token pada posisi baris paling atas dari matriks.
3. Sekuens dicocokkan pada token-token yang berada di buffer.
4. Satu token pada buffer dapat digunakan pada lebih dari satu sekuens.
5. Setiap sekuens memiliki bobot hadiah atau reward yang variatif.
6. Sekuens memiliki panjang minimal berupa dua token.

## 2. Algoritma Bruteforce

Pada laporan ini, algoritma yang digunakan oleh penulis adalah bruteforce (*exhaustive search*). Berikut langkah-langkah penyelesaian

1. *Generate* semua kemungkinan pola token sesuai dengan panjang buffer. Metode yang digunakan adalah pemilihan secara selang-seling horizontal-vertikal.
2. Pola selalu dimulai dari lokasi (1,1) kiri-atas. Jika *cell* belum pernah dikunjungi maka pilih *cell* tersebut. Setelah memilih sebuah *cell* pada koordinat (a, 0), dengan a adalah rentang dari 0 hingga lebar matriks, dilanjutkan dengan memilih *cell* pada koordinat (a, b), dengan nilai b adalah rentang dari 0 hingga tinggi matriks, syaratnya yakni *cell* belum pernah dikunjungi. Misal, buffer berukuran 6 maka akan dibuat pola sebagai berikut.

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

1

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

2

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

3

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

4

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

5

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

6

Gambar 2. Proses Pembentukan Pola “7A 55 7A 55 E9 1C”  
( Sumber: Arsip Pribadi )

Menghasilkan “7A 55 7A 55 E9 1C” lalu

**1**

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

**2**

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

**3**

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

**4**

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

**5**

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

**6**

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

Gambar 3. Proses Pembentukan Pola “7A 55 7A 55 E9 1C”  
 ( Sumber: Arsip Pribadi )

Menghasilkan pola “7A 55 7A 55 E9 1C”. hingga pola terakhir yaitu,

**1**

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

**2**

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

**3**

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

**4**

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

**5**

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

**6**

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

Gambar 4. Proses Pembentukan Pola “55 7A 55 1C 1C BD”  
 ( Sumber: Arsip Pribadi )

Yang menghasilkan pola “55 7A 55 1C 1C BD” dengan syarat **sel matriks (token) yang sudah di pilih, tidak dapat dipilih kembali.**

Disini, disimpan titik koordinat setiap token yang dipilih, dan *string* hasilnya dalam *array*.

3. Kemudian, dilakukan pengecekan *sequences* dengan himpunan solusi. Dengan cara mencari apakah *substring* dari solusi mengandung *sequences* yang ingin dicari.
4. Dengan meng-iterasi semua himpunan solusi, dilakukan pencatatan maksimum skor yang mungkin didapatkan. Jika maksimum skor ditemukan, maka catat juga *string* solusi dan titik koordinat setiap token yang dipilih.

### 3. Source Code

Penulis membagi file menjadi 4 file yakni server.py, main.py, RF.py, Solution.py. Struktur folder sebagai berikut

```
/Tucill_13522039  
.  
├── LICENSE  
├── README.md  
├── bin  
├── doc  
│   └── Tucill_K1_13522039_Edbert Eddyson Gunawan.pdf  
└── src  
    ├── RF.py  
    ├── Solution.py  
    ├── main.py  
    ├── server.py  
    ├── templates  
    │   ├── index.html  
    │   └── solution.html  
    └── test.py  
test  
├── solution-21.txt  
├── solution-generated-empty.txt  
├── solution-generated1.txt  
├── solution-haha.txt  
├── solution-test1.txt  
├── solution-test2.txt  
└── test1.txt  
    └── test2.txt
```

### 3.1 server.py

```
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from flask import Flask, render_template, request, url_for, flash
import os
import numpy as np
import json

import main
import Solution

m_obj = None
sol = None

app = Flask(__name__)

abs_path = os.path.dirname(os.path.dirname(os.path.abspath(__file__)))

@app.route('/')
def hello():
    return render_template("index.html")

@app.route('/save-file', methods=['POST'])
def saveFile():
    result_file = sol.saveToFile(request.form.get('filename'))
    return json.dumps({'success':True, 'fname': result_file}), 200, {'ContentType':'application/json'}

@app.route('/solve', methods=['POST'])
def solve():
    global sol, m_obj

    m_obj = main.App()
    if "auto-generate" in request.form:
        print("go to auto generate")
        m_obj.rf.choice = 2
        arr = ['buffer-size', 'token-size', 'token-id', 'matrix-col', 'matrix-row', 'seq-id', 'seq-len', 'seq-min', 'seq-max']

        for x in arr:
            if x not in request.form:
                flash(f'{x} is required!')

    buffer_size = int(request.form['buffer-size'])
    token_size = int(request.form['token-size'])
    token = np.array(request.form['token-id'].split(' '))
    token = token[token != '']
    matrix_size = (int(request.form['matrix-row']), int(request.form['matrix-col']))
    seq_size = int(request.form['seq-id'])
    seq_len = int(request.form['seq-len'])
    min_score = int(request.form['seq-min'])
    max_score = int(request.form['seq-max'])

    print("buffer size:", buffer_size)
    m_obj.rf.generate_problem(buffer_size, matrix_size, token_size, token, seq_size, seq_len, min_score,
    max_score)
    print("buffer size:", m_obj.rf.buffer_size)
    sol = Solution.Solution(m_obj.rf.matrix_size, m_obj.rf.sequence, m_obj.rf.matrix, m_obj.rf.buffer_size)
    print("maximum depth:", sol.max_depth)
    sol.main()

    elif "submit" in request.form:
        arr = ['buffer-size', 'matrix', 'seq-score']
        for x in arr:
            if x not in request.form:
                flash(f'{x} is required!')

        m_obj.rf.buffer_size = int(request.form['buffer-size'])
        matrix = request.form['matrix'].split('\n')
        m_obj.rf.matrix = list(map(lambda x: [y for y in x.strip('\r').split(' ') if y], matrix))
        # matrix = matrix[matrix != '']
        m_obj.rf.sequence = []
        seq_score = request.form['seq-score'].split('\n')
        for i in range(len(seq_score) // 2):
            seq, val = seq_score[2*i].strip('\r'), int(seq_score[1 + i*2].strip('\r'))
            m_obj.rf.sequence.append(([y for y in seq.split(' ') if y], val))
        m_obj.rf.sequence_size = len(m_obj.rf.sequence)

        m_obj.rf.matrix_size = [len(m_obj.rf.matrix), len(m_obj.rf.matrix[0])]
        sol = Solution.Solution(m_obj.rf.matrix_size, m_obj.rf.sequence, m_obj.rf.matrix, m_obj.rf.buffer_size)
        sol.main()
```

```

        }

    elif "file-solve" in request.form:
        if "file-name" not in request.form:
            flash("filename is required!")

        filename = request.form['file-name']
        m_obj.rf.read_file(filename)

        sol = Solution.Solution(m_obj.rf.matrix_size, m_obj.rf.sequence, m_obj.rf.matrix, m_obj.rf.buffer_size)
        sol.main()

    between = []

    for i in range(len(sol.max_coor)-1):
        a, b = sol.max_coor[i], sol.max_coor[i+1]

        if(a[0] == b[0]):
            start_col = min(a[1], b[1])
            end_col = max(a[1], b[1])

            for j in range(start_col, end_col+1):
                between.append((a[0], j))
        elif(a[1] == b[1]):
            start_r = min(a[0], b[0])
            end_r = max(a[0], b[0])

            for j in range(start_r, end_r):
                between.append((j, a[1]))

    return render_template('solution.html', matrix=m_obj.rf.matrix, sequence=m_obj.rf.sequence,
                           matrix_size=m_obj.rf.matrix_size, max_score=sol.max_score, coordinates=sol.max_coor,
                           exec_time=round(sol.time_elapsed * 1000, 2), len_coor=len(sol.max_coor), between=between)

if __name__ == "__main__":
    app.run(debug=True)

```

## 3.2 main.py

```
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# libraries
from colorama import Style, Fore

# external files
import RF
import Solution

class Util:
    def __init__(self):
        pass

    def showBanner(self):
        print("Make Sure Your Input File is in test folder!")

class App:
    def __init__(self):
        self.rf = RF.RF()
        self.ut = Util()
        self.sol = None

    def main(self):
        self.rf.input_prompt()
        if(self.rf.choice == 3):
            self.exit_program()
        elif(self.rf.choice == 1):
            self.rf.read_file()
        elif(self.rf.choice == 2):
            self.rf.generate_auto()

        self.sol = Solution.Solution(self.rf.matrix_size, self.rf.sequence, self.rf.matrix, self.rf.buffer_size)
        self.sol.main()

        choice = input("Apakah anda ingin menyimpan solusi? (y/n)\n> ")

        if(choice == 'y'):
            fname = input("Masukkan nama file\n> ")
            self.sol.saveToFile(fname)

    def exit_program(self):
        exit(0)

if __name__ == "__main__":
    App().main()
```

## 3.2 RF.py

```
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import random
import numpy as np
import os

class RF:
    def __init__(self):
        self.fname = ''
        self.buffer_size = 0
        self.matrix_size = None
        self.matrix = []
        self.sequence_size = 0
        self.sequence = []
        self.choice = 0

        self.abs_path = os.path.dirname(os.path.dirname(os.path.abspath(__file__)))

    def input_prompt(self):
        choice = input("Apakah Anda ingin generate otomatis? (y/n)\n> ")
        if(choice == 'n'):
            self.choice = 1
        elif(choice == 'y'):
            self.choice = 2
        else:
            self.choice = 3

    def showBanner(self):
        print("Make Sure Your Input File is in test folder!")

    def generate_auto(self):
        token_n = input("Masukkan jumlah token\n> ")
        token = np.array(input("Masukkan token\n> ").split(' '))
        token = token[token != '']
        buffer_size = int(input("Masukkan ukuran buffer\n> "))
        matrix_size = list(map(lambda x: int(x), input("Masukkan ukuran matriks (col row)\n> ").split(' ')))
        matrix_size = matrix_size[::-1]
        seq_size = int(input("Masukkan banyak sequence\n> "))
        seq_len = int(input("Masukkan maksimum panjang sequence\n> "))

        # self.generate_problem(buffer_size, matrix_size, seq_size, token_n, token, seq_len)

    def generate_problem(self, buffer_size, matrix_size, token_n, token, seq_size, seq_len, min_score, max_score):
        self.buffer_size = buffer_size
        self.matrix_size = matrix_size
        self.sequence_size = seq_size

        self.matrix = np.random.randint(0, token_n, size=(matrix_size[0], matrix_size[1]))
        self.matrix = token[self.matrix]
        print(self.matrix)

        rand_seq_size = np.random.randint(2, seq_len+1, size=(seq_size))

        self.sequence = []

        for x in rand_seq_size:
            self.sequence.append((list(token[(np.random.randint(0, token_n, size=x))]), random.randint(min_score, max_score)))

        for x in self.sequence:
            print(" ".join(x[0]), "|", x[1])

    def read_file(self, fname):
        self.fname = self.abs_path + "/test/" + fname
        f = open(self.fname, 'r')
        f = f.read()
        f = f.split('\n')
        f[:] = [x for x in f if x.strip('\n')]

        # assign values
        self.buffer_size = int(f[0])
        self.matrix_size = list(map(lambda x: int(x), f[1].split(' ')))
        self.matrix_size = self.matrix_size[::-1]
        self.matrix = list(map(lambda x: x.split(' '), f[2+2+self.matrix_size[0]]))
        self.sequence_size = int(f[2+self.matrix_size[0]])
        for i in range(self.sequence_size):
            seq, val = f[2+self.matrix_size[0] + 1 + 2 * i], f[2+self.matrix_size[0] + 2 + 2 * i]
            self.sequence.append((seq.split(' '), int(val)))
```

### 3.3 Solution.py

```
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import numpy as np
import time
import multiprocessing
import os

class Solution:
    def __init__(self, matrix_size, sequence, matrix, buffer_size):
        self.row = matrix_size[0]
        self.col = matrix_size[1]
        self.sequence = sequence
        self.matrix = matrix
        self.ans_pool = []
        self.max_depth = buffer_size
        self.max_score = 0
        self.max_coor = []
        self.time_elapsed = 0
        self.abs_path = os.path.dirname(os.path.dirname(os.path.abspath(__file__)))

    print("max depth dari dalam:", self.max_depth)
    if(buffer_size > sum([len(x[0]) for x in sequence])):
        self.max_depth = sum([x[1] for x in sequence])

    def main(self):
        visited = np.zeros((self.row, self.col))

        start_t = time.time()
        self.brute_force(0, 0, True, "", 0, [], visited)
        self.check_ans()
        end_t = time.time()

        self.time_elapsed = end_t - start_t

        self.show_banner()
        self.show_answer()

    def brute_force(self, row, col, b, ans, depth, coor, visited):
        if (depth == self.max_depth): # basis max depth
            # print("called")
            self.ans_pool.append((ans, coor))
            return
        elif (depth > self.max_depth):
            return

        if (b): # b = True -> Horizontal
            for j in range(self.col):
                visited2 = np.copy(visited)
                if(visited2[row][j] == 0):
                    visited2[row][j] = 1
                    ans2 = ans + self.matrix[row][j] + " "
                    self.brute_force(row, j, not b, ans2, depth+1, [*coor, (row, j)], visited2)
        else: # b = False -> Vertical
            for i in range(self.row):
                visited2 = np.copy(visited)
                if(visited2[i][col] == 0):
                    visited2[i][col] = 1
                    ans2 = ans + self.matrix[i][col] + " "
                    self.brute_force(i, col, not b, ans2, depth+1, [*coor, (i, col)], visited2)

    def printMatrix(self, visited):
        for x in list(map(lambda x: " ".join(str(x)), visited)):
            print(x)
        print("=====")
```

```

def check_ans(self):
    print("check_ans called")
    max_score = float('-inf')
    max_coor = []
    # print(self.ans_pool)
    for x in self.ans_pool:
        isExist = False
        temp_score = 0
        for i in range(len(self.sequence)):
            s = ".join(self.sequence[i][0])"
            # print(s, " | ", x)
            if s in x[0]:
                # print(s, " | ", x)
                temp_score += self.sequence[i][1]
                isExist = True

        # print(temp_score)
        if(temp_score > max_score and isExist):
            max_score = temp_score
            max_coor = x[1]
    if(max_score == float('-inf')):
        self.max_score = 0
    else:
        self.max_score = max_score
    self.max_coor = max_coor

def show_banner(self):
    print("====")
    print("|           SOLUTION           |")
    print("====")

def show_answer(self):
    print("Max score:\t", self.max_score)
    print("Sequence:\t", " ".join(list(map(lambda x: self.matrix[x[0]][x[1]], self.max_coor))))
    print("Coordinates:\n", "\n".join(list(map(lambda x: "("+str(x[1]+1)+", "+str(x[0]+1)+")", self.max_coor))))
    print("Time elapsed:\t", round(self.time_elapsed * 1000, 2), "ms")

def saveToFile(self, fname):
    fname = self.abs_path + "/test/solution-" + fname #"solution-test1.txt"
    f = open(fname, "w")

    f.write("=====\n")
    f.write("|           SOLUTION           |\n")
    f.write("=====\n")
    f.write("Max score:\t{}\n".format(self.max_score))
    f.write("Sequence:\t{}\n".format(" ".join(list(map(lambda x: self.matrix[x[0]][x[1]], self.max_coor)))))
    f.write("Coordinates:\n{}\n".format("\n".join(list(map(lambda x: "("+str(x[1]+1)+", "+str(x[0]+1)+")", self.max_coor))))
    f.write("Time elapsed:\t{} ms".format(round(self.time_elapsed*1000, 2)))

    print(f"File saved in {fname}")

    return fname

```

## 4. How To Use

Berikut merupakan langkah-langkah untuk menjalankan program.

1. Clone repository dari github. Kemudian masuk ke dalam folder root.
2. Setelah itu jalankan perintah `python3 src/server.py` atau `python src/server.py` sesuaikan dengan komputer masing-masing. Berikut tampilan program berhasil di run pada komputer penulis berturut-turut WSL Ubuntu, VSCode Terminal, Command Prompt.

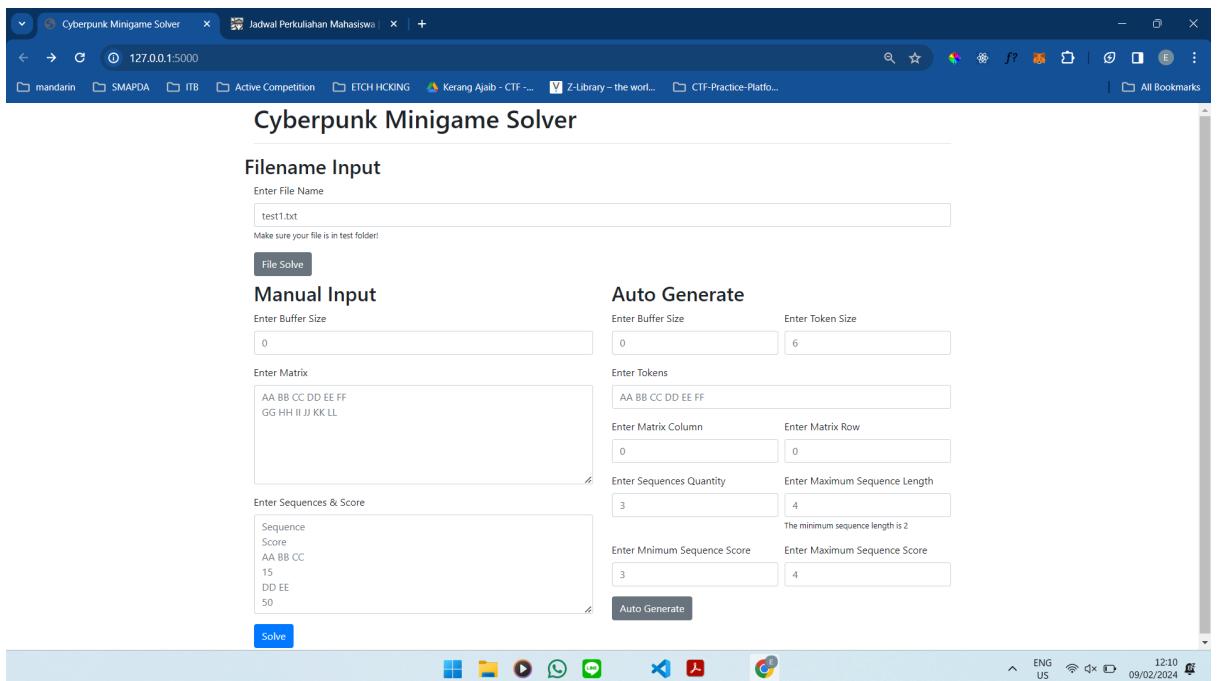
The image contains three screenshots of terminal windows showing the execution of a Python Flask application:

- WSL Ubuntu Terminal:** Shows the command `nexus@LAPTOP-M2BSGL6K:/mnt/c/Users/Asus Tuf Gaming/Documents/Github Desktop/Tucili_13522039$ python3 src/server.py` being run. The output shows the Flask app is serving on port 5000, but it is a development server and should not be used in production.
- VSCode Terminal:** Shows the command `python -u "c:/Users/Asus Tuf Gaming/Documents/Github Desktop/Tucili_13522039/src\server.py"` being run. The output is identical to the WSL terminal.
- Windows Command Prompt:** Shows the command `C:\Users\Asus Tuf Gaming\Documents\Github Desktop\Tucili_13522039>python src/server.py` being run. The output is identical to the others.

Gambar 5. Menjalankan Program Berturut-turut WSL Ubuntu, VSCode Terminal, Command Prompt

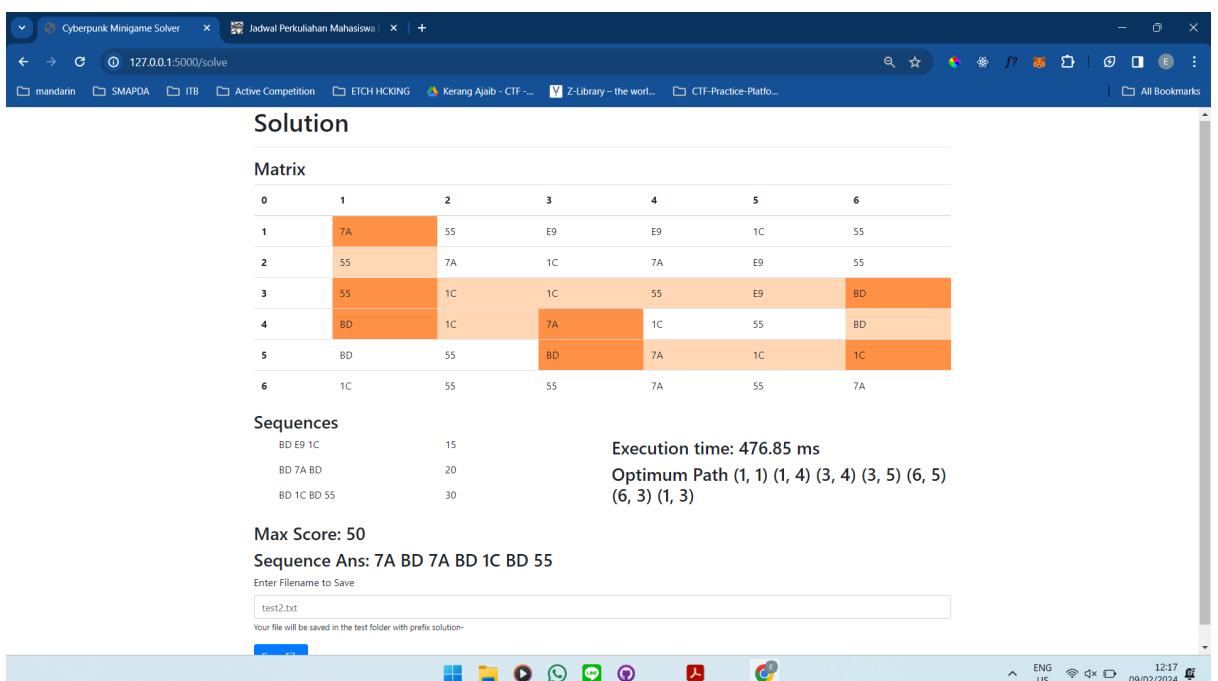
( Sumber: Arsip Pribadi )

3. Setelah server dijalankan maka akan diberikan tampilan GUI dalam bentuk website sebagai berikut.



Gambar 6. Tampilan GUI Solver  
( Sumber: Arsip Pribadi )

4. Terdapat 3 cara untuk menerima masukan, yakni dengan file.txt, ketik secara manual, dan otomatis inisiasi. **Untuk input dengan file, pastikan file.txt berada didalam folder test sebelum menekan tombol file solve.**
5. Setelah input dan tekan tombol, akan di redirect ke halaman baru dan ditampilkan solusi.



Gambar 7. Tampilan GUI Solusi  
( Sumber: Arsip Pribadi )

6. Setelah solusi didapatkan, maka kita dapat menyimpan solusi dengan input nama file lalu tekan tombol save.

## 5. Test Case

### 5.1 Test Case 1

#### Input

File berada didalam folder test.

```
test > test1.txt
1 7
2 6 6
3 7A 55 E9 E9 1C 55
4 55 7A 1C 7A E9 55
5 55 1C 1C 55 E9 BD
6 BD 1C 7A 1C 55 BD
7 BD 55 BD 7A 1C 1C
8 1C 55 55 7A 55 7A
9 3
10 BD E9 1C
11 15
12 BD 7A BD
13 20
14 BD 1C BD 55
15 30
```

## Cyberpunk Minigame Solver

### Filename Input

Enter File Name

test1.txt

Make sure your file is in test folder!

File Solve

#### Result

Jadwal Perkuliahan Mahasiswa

Active Competition

ETCH HOKING Kerang Ajib - CTF - Z-Library - the world... CTF-Practice-Platform...

### Solution

**Matrix**

	1	2	3	4	5	6
1	7A	55	E9	E9	1C	55
2	55	7A	1C	7A	E9	55
3	55	1C	1C	55	E9	BD
4	BD	1C	7A	1C	55	BD
5	BD	55	BD	7A	1C	1C
6	1C	55	55	7A	55	7A

**Sequences**

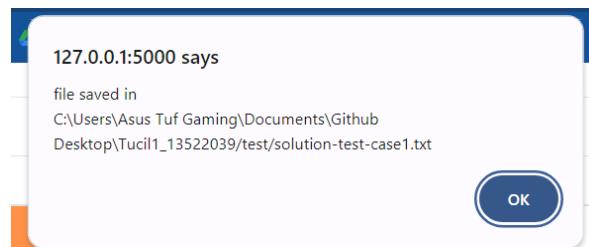
BD E9 1C	15
BD 7A BD	20
BD 1C BD 55	30

Max Score: 50  
Sequence Ans: 7A BD 7A BD 1C BD 55

Enter Filename to Save: test2.txt

Your file will be saved in the test folder with prefix solution-

```
test > solution-test-case1.txt
1 =====
2 | SOLUTION |
3 =====
4 Max score: 50
5 Sequence: 7A BD 7A BD 1C BD 55
6 Coordinates:
7 (1, 1)
8 [(1, 4)]
9 (3, 4)
10 (3, 5)
11 (6, 5)
12 (6, 3)
13 (1, 3)
14 Time elapsed: 373.75 ms
```



## 5.2 Test Case 2

### Input

Generate Otomatis

#### Auto Generate

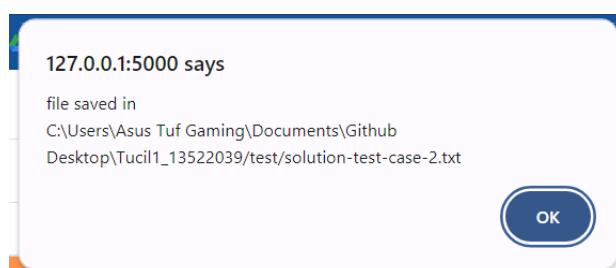
Enter Buffer Size	Enter Token Size
7	5
Enter Tokens	
AA BB CC DD EE	
Enter Matrix Column	Enter Matrix Row
8	5
Enter Sequences Quantity	Enter Maximum Sequence Length
4	6
The minimum sequence length is 2	
Enter Minimum Sequence Score	Enter Maximum Sequence Score
0	100
<input type="button" value="Auto Generate"/>	

### Result

The screenshot shows a software interface with the following components:

- Solution**: A section containing:
  - Matrix**: An 8x5 grid of tokens (AA, BB, CC, DD, EE). Row 1: BB, CC, AA, EE, EE. Row 2: CC, AA, EE, EE, BB. Row 3: BB, BB, BB, DD, AA. Row 4: BB, DD, DD, EE, DD. Row 5: DD, AA, AA, BB, EE.
  - Sequences**: A table of sequences and their scores:

Sequence	Score
BB EE EE	43
CC BB DD	48
EE AA EE CC	63
AA EE	25
  - Execution time: 765.8 ms**
  - Optimum Path**: (2, 1) (2, 3) (4, 3) (4, 1) (3, 1) (3, 2) (1, 2)
  - Max Score: 136**
  - Sequence Ans:** CC BB DD EE AA EE CC
- test > solution-test-case-2.txt**: A terminal window showing the output of the generated solution file. It includes:
  - ===== SOLUTION =====
  - Max score: 136
  - Sequence: CC BB DD EE AA EE CC
  - Coordinates:
    - (2, 1)
    - (2, 3)
    - (4, 3)
    - (4, 1)
    - (3, 1)
    - (3, 2)
    - (1, 2)
  - Time elapsed: 765.8 ms



## 5.3 Test Case 3

### Input

Ketik Manual

#### Manual Input

Enter Buffer Size

Enter Matrix

```
BD 1C BD 1C BD 1C
55 7A 55 7A 55 7A
E9 FF E9 FF E9 FF
BD 1C BD 1C BD 1C
55 7A 55 7A 55 7A
E9 FF E9 FF E9 FF
```

Enter Sequences & Score

```
1C FF
10
1C FF E9
20
7A 1C FF E9
30
```

**Solve**

### Result

**Solution**

**Matrix**

0	1	2	3	4	5	6
1	BD	1C	BD	1C	BD	1C
2	55	7A	55	7A	55	7A
3	E9	FF	E9	FF	E9	FF
4	BD	1C	BD	1C	BD	1C
5	55	7A	55	7A	55	7A
6	E9	FF	E9	FF	E9	FF

**Sequences**

1C FF	10
1C FF E9	20
7A 1C FF E9	30

Execution time: 91.56 ms  
Optimum Path (1, 1) (1, 4) (2, 4) (2, 3) (1, 3)  
(1, 2)

Max Score: 30  
Sequence Ans: BD BD 1C FF E9 55

Enter Filename to Save

Your file will be saved in the test folder with prefix solution-

Desktop 2

13:16 09/02/2024

## 5.4 Test Case 4

### Input

**Auto Generate**

Enter Buffer Size: 7      Enter Token Size: 5

Enter Tokens: AA BB CC DD EE

Enter Matrix Column: 10      Enter Matrix Row: 4

Enter Sequences Quantity: 4      Enter Maximum Sequence Length: 6  
The minimum sequence length is 2

Enter Minimum Sequence Score: -100      Enter Maximum Sequence Score: 0

**Auto Generate**

### Result

**Solution**

**Matrix**

0	1	2	3	4	5	6	7	8	9	10
1	DD	EE	EE	DD	BB	CC	CC	BB	DD	CC
2	CC	CC	CC	EE	CC	BB	AA	AA	AA	AA
3	DD	EE	BB	CC	DD	CC	BB	BB	BB	CC
4	BB	DD	AA	BB	EE	BB	AA	EE	AA	DD

**Sequences**

BB DD DD DD DD DD	-82
EE CC EE	-72
AA EE EE AA	-40
CC EE DD BB	-26

**Execution time: 1174.58 ms**  
**Optimum Path (1, 1) (1, 2) (2, 2) (2, 1) (4, 1) (4, 4) (1, 4)**

**Max Score: -26**  
**Sequence Ans: DD CC CC EE DD BB BB**

Enter filename to Save: test2.txt  
Your file will be saved in the test folder with prefix solution-

**Save File**

## 5.5 Test Case 5

### Input

**Auto Generate**

Enter Buffer Size <input type="text" value="7"/>	Enter Token Size <input type="text" value="5"/>
Enter Tokens <input type="text" value="AA BB CC DD EE"/>	
Enter Matrix Column <input type="text" value="1"/>	Enter Matrix Row <input type="text" value="1"/>
Enter Sequences Quantity <input type="text" value="4"/>	Enter Maximum Sequence Length <input type="text" value="6"/> The minimum sequence length is 2
Enter Minimum Sequence Score <input type="text" value="-100"/>	Enter Maximum Sequence Score <input type="text" value="0"/>
<input type="button" value="Auto Generate"/>	

### Result

**Solution**

**Matrix**

0	1
1	DD

**Sequences**

EE DD CC DD	-2
EE AA	-73
AA BB BB	-95
AA DD BB BB	-9

Execution time: 0.0 ms  
Optimum Path

**Max Score: 0**  
**Sequence Ans:**  
Enter Filename to Save  
  
Your file will be saved in the test folder with prefix solution-

## 5.6 Test Case 6

### Input

#### Auto Generate

Enter Buffer Size <input type="text" value="7"/>	Enter Token Size <input type="text" value="5"/>
Enter Tokens <input type="text" value="AA BB CC DD EE"/>	
Enter Matrix Column <input type="text" value="7"/>	Enter Matrix Row <input type="text" value="7"/>
Enter Sequences Quantity <input type="text" value="4"/>	Enter Maximum Sequence Length <input type="text" value="6"/> The minimum sequence length is 2
Enter Minimum Sequence Score <input type="text" value="-100"/>	Enter Maximum Sequence Score <input type="text" value="100"/>
<input type="button" value="Auto Generate"/>	

### Result

**Solution**

**Matrix**

0	1	2	3	4	5	6	7
1	BB	CC	BB	DD	AA	CC	CC
2	BB	EE	BB	CC	AA	DD	EE
3	DD	BB	EE	DD	BB	BB	DD
4	AA	EE	CC	EE	BB	BB	BB
5	CC	DD	CC	CC	DD	DD	EE
6	DD	BB	CC	CC	CC	DD	BB
7	BB	AA	EE	CC	EE	CC	BB

**Sequences**

AA CC BB	-13
CC EE AA DD CC	-85
DD DD	-63
EE AA CC	-95

**Execution time: 2222.7 ms**  
**Optimum Path (1, 1) (1, 2) (2, 2) (2, 1) (5, 1)  
(5, 6) (2, 6)**

**Max Score: -13**  
**Sequence Ans: BB BB EE CC AA CC BB**

# GitHub

Kode dapat diakses pada laman [https://github.com/WazeAzure/Tucil1\\_13522039](https://github.com/WazeAzure/Tucil1_13522039)

Jika tidak dapat diakses, mohon kontak penulis di LINE yenyenhu atau TEAMS.

## Poin-Poin Penting

No	Poin	Ya	Tidak
1.	Program berhasil dikompilasi tanpa kesalahan	V	
2.	Program berhasil dijalankan	V	
3.	Program dapat membaca masukan berkas .txt	V	
4.	Program dapat menghasilkan masukan secara acak	V	
5.	Solusi yang diberikan program optimal	V	
6.	Program dapat menyimpan solusi dalam berkas .txt	V	
7.	Program memiliki GUI	V	