Laporan Tugas Kecil 1 IF2211 Strategi Algoritma Semester II Tahun 2025/2026

Penyelesaian Permainan Queens Linkedin

Disusun Oleh

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A. DESKRIPSI ALGORITMA

Algoritma yang diimplementasikan untuk menyelesaikan masalah Queens ini adalah pendekatan Brute Force Exhaustive Search dengan Backtracking. Algoritma ini bekerja dengan cara mengeksplorasi ruang solusi secara sistematis untuk menempatkan N ratu pada papan berukuran N x N. Langkah-langkah detail algoritma adalah sebagai berikut:

1. **Inisialisasi & Identifikasi Region**: Program membaca papan permainan dan memetakan setiap sel ke dalam suatu kelompok warna (region). Hasilnya disimpan dalam struktur data dictionary atau hash map untuk akses cepat **O(1)** saat validasi.

2. **Pencarian Rekursif (*Row-by-Row*)**: Pencarian dimulai dari baris ke-0. Pada setiap baris, algoritma mencoba menempatkan ratu di setiap kolom (dari indeks 0 hingga N-1).

3. **Validasi Langkah (*Pruning*)**: Sebelum ratu ditempatkan secara permanen pada posisi (row, col), dilakukan pemeriksaan validasi terhadap tiga aturan utama :

    a. Aturan Baris & Kolom: Memastikan tidak ada ratu lain di baris atau kolom yang sama.

    b. Aturan Region Warna: Memastikan warna pada sel (row, col) belum ditempati oleh ratu lain yang sudah diletakkan sebelumnya.

    c. Aturan Ketetanggaaan (Neighbors): Memastikan ratu tidak bersentuhan dengan ratu lain secara vertikal, horizontal, maupun diagonal.

4. **Rekursi & *Backtracking***:

    a. Jika posisi valid, ratu akan ditempatkan dan fungsi memanggil dirinya sendiri secara rekursif untuk baris berikutnya (row + 1) .

    b. Jika fungsi rekursif mengembalikan True, berarti solusi ditemukan.

    c. Jika seluruh kolom pada baris tersebut telah dicoba dan tidak ada yang valid (atau panggilan rekursif mengembalikan False), algoritma akan melakukan *backtracking* dengan membatalkan penempatan ratu terakhir dan mencoba kolom berikutnya.

5. **Terminasi**: Algoritma berhenti ketika:

    a. Semua ratu berhasil ditempatkan (Solusi ditemukan).

    b. Seluruh kemungkinan pada baris awal telah dicoba (Tidak ada solusi).

B. SOURCE CODE

Algoritma yang dibangun menggunakan bahasa pemrograman python dengan modul-modul sebagai berikut:

1. **solver.py**

   Berisi kelas board_solver yang berisi fungsi-fungsi yang berguna untuk menyelesaikan masalah menggunakan strategi brute force, mulai dari mapping warna, validasi posisi, dan rekursifnya. Berikut adalah kodenya :

```
import time


class board_solver :
    def __init__(self, board:list[list[str]]):
        self.board = board
        self.n = len(board)
        self.solution = [[' ' for i in range(self.n)] for j in range(self.n)]
        self.iterations = 0
        self.start_time = 0
        self.execution_time = 0
        self.regions = self.color_regions()
        self.visualization_call = None

    # Mapping setiap warna ke posisi sel nya
    def color_regions(self) :
        regions = {}
        for i in range(self.n) :
            for j in range(self.n) :
                color = self.board[i][j]
                if color not in regions :
                    regions[color] = []
                regions[color].append((i,j))
        return regions

    # Cek setiap pasangan bidak apakah bertetangga
    def check_neighbor (self, row1: int, col1: int, row2: int, col2: int) :
        return abs(row1-row2) <= 1 and abs(col1-col2) <= 1 and (row1!=row2 or
col1!=col2)

    # Cek apakah posisi bidak valid
    def check_valid(self, row: int, col: int, placed_queens: list[tuple[int,int]]) :
        self.iterations +=1
        current_color = self.board[row][col]
        for qr, qc in placed_queens :
            if qr == row :
                return False
            elif qc == col :
                return False
            elif self.board[qr][qc] == current_color :
                return False
            elif self.check_neighbor(row,col,qr,qc) :
                return False
        return True

    # Pemasangan bidak secara rekursif
    def solver_recursive(self, row: int, placed_queens: list[tuple[int,int]]) :
        if row == self.n :
            return True

        for col in range(self.n) :
            if self.check_valid(row, col, placed_queens) :
                placed_queens.append((row,col))

                if self.visualization_call:
                    self.visualization_call(placed_queens, self.iterations)

                if self.solver_recursive(row+1, placed_queens) :
                    return True

                placed_queens.pop()

        return False

    # Fungsi utama untuk Solve
    def solve(self, visualization_call=None) :
        self.iterations = 0
        self.start_time = time.time()
        placed_queens = []
        self.visualization_call = visualization_call

        success = self.solver_recursive(0,placed_queens)
        self.execution_time = (time.time() - self.start_time) * 1000

        if success :
            for qr, qc in placed_queens:
                self.solution[qr][qc] = '#'

            for i in range (self.n) :
                for j in range (self.n) :
                    if self.solution[i][j]!='#' :
                        self.solution[i][j] = self.board[i][j]

        return success, self.solution, self.iterations, self.execution_time,
placed_queens
```

2. **utils.py**

Berisi fungsi dan kelas yang berguna untuk visualisasi GUI dan menyimpan hasil baik text maupun gambar. Berikut adalah kodenya :

```
 import os
import tkinter as tk
from tkinter import filedialog, messagebox
```

```python
from PIL import Image, ImageDraw, ImageFont

color_palette = [
    '#FF6B6B',
    '#FFE66D',
    '#4ECDC4',
    '#95E1D3',
    '#A8E6CF',
    '#FFB6B9',
    '#C7CEEA',
    '#B4A7D6',
    '#FFDAC1',
    '#FF8B94',
    '#6C5CE7',
    '#00B894',
    '#FDCB6E',
    '#E17055',
    '#74B9FF',
    '#A29BFE',
    '#FD79A8',
    '#DCDDE1',
    '#00CEC9',
    '#FFEAA7',
    ]

# Fungsi untuk membaca file dan membangun papan
def read_file(filename: str) :
    if not os.path.exists(filename) :
        raise FileNotFoundError(f"File '{filename}' not found!")

    with open(filename, 'r') as f :
        lines = f.readlines()

    board = []
    for line in lines:
        line = line.strip()
        if line :
            board.append(list(line))

    if not board :
        raise ValueError('Board is empty!')

    n = len(board)
    for row in board :
        if len(row)!=n:
            raise ValueError("Board must be square (NxN)!")

    return board

# Fungsi untuk menyimpan solusi
def save_text(solution: list[list[str]], filename: str) :
    with open(filename, 'w') as f :
        for row in solution :
            f.write(''.join(row) + '\n')

# Fungsi untuk mengambil warna
def get_color(char: str, map: dict) :
    if char not in map :
        map[char] = len(map) % len(color_palette)

    return color_palette[map[char]]

# Fungsi untuk menyimpan gambar
def save_image(board: list[list[str]], queens: list[tuple[int,int]], filename: str,
cell_size: int=60):
    n = len(board)
    img_size = n*cell_size
    img = Image.new('RGB', (img_size, img_size), color="#000000")
    draw = ImageDraw.Draw(img)
    color_map = {}

    for i in range (n) :
        for j in range (n) :
            x1 = j*cell_size
            y1 = i*cell_size
            x2 = x1 + cell_size
            y2 = y1 + cell_size

            cell_color = get_color(board[i][j], color_map)
            draw.rectangle([x1, y1, x2, y2], fill=cell_color, outline='#34495E',
width=2)

    font = ImageFont.truetype("seguisym.ttf", int(cell_size * 0.5))
    for qr, qc in queens :
        x = qc*cell_size + cell_size//2
        y = qr*cell_size + cell_size//2

        crown = '♕'

        draw.text((x+2, y+2), crown, fill="#FFFEFE", font=font, anchor="mm" )
        draw.text((x, y), crown, fill="#000000", font=font, anchor="mm")

    try:
        img.save(filename, 'PNG')
        return True
    except Exception as e:
        print(f"Error saving image: {e}")
        return False

# Class untuk bonus GUI
class GUI :
    def __init__(self, board: list[list[str]], solver_call: callable):
        self.board = board
        self.n = len(board)
        self.solver_call = solver_call
        self.cell_size = min(60, 600//self.n)
        self.root = tk.Tk()
        self.root.title("Brute Force Algorithm for Queens Linkedin Problem")
        self.root.configure(bg='#2C3E50')

        self.color_map = {}
        self.canvas_frame = tk.Frame(self.root, bg='#2C3E50')
        self.canvas_frame.pack(pady=20)
        self.canvas = tk.Canvas(
            self.canvas_frame,
            width=self.n*self.cell_size,
            height=self.n*self.cell_size,
            bg='#34495E',
            highlightthickness=0)
        self.canvas.pack()

        self.info_frame = tk.Frame(self.root, bg='#2C3E50')
        self.info_frame.pack(pady=10)

        self.iteration_label = tk.Label(
            self.info_frame,
            text="Iteration: 0",
            font=('Arial', 14, 'bold'),
            bg='#2C3E50',
            fg='#ECF0F1')
        self.iteration_label.pack()

        self.time_label = tk.Label(
            self.info_frame,
            text="Time: 0 ms",
            font=('Arial', 12),
            bg='#2C3E50',
            fg='#BDC3C7'
        )
        self.time_label.pack()

        self.button_frame = tk.Frame(self.root, bg='#2C3E50')
        self.button_frame.pack(pady=10)

        self.solve_button = tk.Button(
            self.button_frame,
            text="Start",
            command=self.start_solving,
            font=('Arial', 12, 'bold'),
            bg='#27AE60',
            fg='white',
            padx=20,
            pady=10,
            relief=tk.RAISED,
            cursor='hand2'
        )
        self.solve_button.pack(side=tk.LEFT, padx=5)
```

```python
        self.save_image_button = tk.Button(
            self.button_frame,
            text="Save Image",
            command=self.save_as_image,
            font=('Arial', 12),
            bg='#3498DB',
            fg='white',
            padx=20,
            pady=10,
            relief=tk.RAISED,
            cursor='hand2',
            state=tk.DISABLED
        )
        self.save_image_button.pack(side=tk.LEFT, padx=5)

        self.save_text_button = tk.Button(
            self.button_frame,
            text="Save Text",
            command=self.save_as_text,
            font=('Arial', 12),
            bg='#E67E22',
            fg='white',
            padx=20,
            pady=10,
            relief=tk.RAISED,
            cursor='hand2',
            state=tk.DISABLED
        )
        self.save_text_button.pack(side=tk.LEFT, padx=5)

        self.queens = []
        self.solution = None
        self.execution_time = 0
        self.draw_board()

    def draw_board(self, queens: list[tuple[int,int]]=None) :
        self.canvas.delete('all')

        for i in range (self.n) :
            for j in range (self.n) :
                x1 = j * self.cell_size
                y1 = i * self.cell_size
                x2 = x1 + self.cell_size
                y2 = y1 + self.cell_size

                cell_color = get_color(self.board[i][j], self.color_map)
                self.canvas.create_rectangle(
                    x1,y1,x2,y2,
                    fill=cell_color,
                    outline='#34495E',
                    width=2
                )
        if queens :
            for qr, qc in queens :
                x = qc * self.cell_size + self.cell_size // 2
                y = qr * self.cell_size + self.cell_size // 2

                self.canvas.create_text(
                    x, y,
                    text="♛",
                    font=('Arial', int(self.cell_size * 0.6)),
                    fill="#000000"
                )

        self.canvas.update()

    def visualization_call(self, placed_queens: list[tuple[int,int]], iterations:
int) :
        self.draw_board(placed_queens)
        self.iteration_label.config(text=f"Iteration: {iterations}")
        self.root.update()

    def start_solving(self) :
        self.solve_button.config(state=tk.DISABLED)
        self.iteration_label.config(text="Searching for a solution ...")
        self.time_label.config(text="Time: 0 ms")

        success, solution, iterations, exec_time, self.queens =
self.solver_call(self.visualization_call)

        self.solution = solution
        self.execution_time = exec_time

        if success:
            self.draw_board(self.queens)

            self.iteration_label.config(text=f"Solution Found! Iteration:
{iterations}")
            self.time_label.config(text=f"Time: {exec_time:.2f} ms")

            self.save_image_button.config(state=tk.NORMAL)
            self.save_text_button.config(state=tk.NORMAL)

            messagebox.showinfo(
                "Success",
                f"Solution Found!\n\nIteration: {iterations}\nTime: {exec_time:.2f}
ms"
            )
        else:
            self.iteration_label.config(text=f"No Solution. Iteration:
{iterations}")
            self.time_label.config(text=f"Time: {exec_time:.2f} ms")
            messagebox.showwarning(
                "No Solution",
                f"There is no valid solution for this board.\n\nIteration:
{iterations}\nTime: {exec_time:.2f} ms"
```

```
            )

        self.solve_button.config(state=tk.NORMAL)

    def save_as_image(self) :
        if not self.queens:
            messagebox.showwarning("Warning", "There is no solution to save!")
            return

        filename = filedialog.asksaveasfilename(
            defaultextension=".png",
            filetypes=[("PNG Image", "*.png"), ("All Files", "*.*")]
        )

        if filename:
            try :
                save_image(self.board, self.queens, filename, cell_size=80)
                messagebox.showinfo("Success", f"Image saved successfully 
to:\n{filename}")
            except Exception as e:
                messagebox.showerror("Error", f"Failed to save file: {e}")

    def save_as_text(self):
        if not self.solution:
            messagebox.showwarning("Warning", "There is no solution to save!")
            return

        filename = filedialog.asksaveasfilename(
            defaultextension=".txt",
            filetypes=[("Text File", "*.txt"), ("All Files", "*.*")]
        )

        if filename:
            try:
                save_text(self.solution, filename)
                messagebox.showinfo("Success", f"Solution saved successfully 
to:\n{filename}")
            except Exception as e:
                messagebox.showerror("Error", f"Failed to save file: {e}")

    def run(self):
        self.root.mainloop()
```

3. **main.py**

Berfungsi sebagai entry point. Pengguna akan diberikan pilihan untuk menjalankan program dalam mode CLI (Terminal) atau GUI. Berikut adalah kodenya :

```
import sys
from solver import board_solver
from utils import read_file, save_text, save_image, GUI
import tkinter as tk
from tkinter import filedialog
```

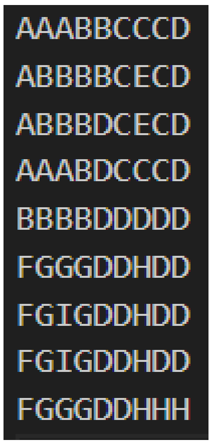
```python
# Fungsi untuk print papan
def print_board(board: list[list[str]]):
    for row in board:
        print(''.join(row))

# Fungsi untuk output berupa Command Line Interface (CLI)
def cli_mode():
    print()

    filename = input("Enter the input file name (Example: test1.txt): ").strip()

    try:
        print(f"\nRead the file : '{filename}'...")
        board = read_file(filename)
    except FileNotFoundError:
        print(f"Error: File '{filename}' not found!")
        return
    except ValueError as e:
        print(f"Error: {e}")
        return
    except Exception as e:
        print(f"Error: {e}")
        return

    print(f"\nBoard Size: {len(board)}x{len(board)}")
    print("\nInitial Board:")
    print_board(board)
    print()

    input("Press enter to continue...")

    solver = board_solver(board)

    # Fungsi untuk visualisas CLI
    def cli_visualization(placed_queens, iterations):
        print(f"\nIteration: {iterations}")

        temp_board = [row[:] for row in board]
        for qr, qc in placed_queens:
            temp_board[qr][qc] = '#'

        for row in temp_board:
            row_str = ""
            for cell in row:
                row_str += cell + " "
            print(row_str)

        print()

    print("\nSearching for solution...\n")
    success, solution, iterations, exec_time, queens =
solver.solve(cli_visualization)
```

```python
    print("Result :")
    print()

    if success:
        print("Solution Found!")
        print()
        print_board(solution)
        print()
        print(f"Execution Time: {exec_time:.2f} ms")
        print(f"Cases Reviewed: {iterations} cases")
        print()

        save_choice = input("Save the solution as text? (y/n): ").strip().lower()
        if save_choice in ['y', 'yes', 'ya']:
            output_filename = input("Output file name (Example: solution.txt): 
").strip()
            try:
                save_text(solution, output_filename)
                print(f"Solution saved successfully to '{output_filename}'")
            except Exception as e:
                print(f"Error saving file: {e}")

        image_choice = input("\nSave the solution as a PNG image? (y/n): 
").strip().lower()
        if image_choice in ['y', 'yes', 'ya']:
            image_filename = input("Image file name (Example: solution.png): 
").strip()
            try :
                save_image(board, queens, image_filename)
                print(f"Image saved successfully to '{image_filename}'")
            except Exception as e:
                print(f"Error saving file: {e}")
    else:
        print("There is no valid solution for this board")
        print()
        print(f"Execution Time: {exec_time:.2f} ms")
        print(f"Cases Reviewed: {iterations} cases")

    print()
    print("Finish.")

# Fungsi untuk output berupa GUI
def run_gui_mode():
    root = tk.Tk()
    root.withdraw()

    filename = filedialog.askopenfilename(
        title="Select Input File",
        filetypes=[("Text Files", "*.txt"), ("All Files", "*.*")]
    )

    if not filename:
        print("No files selected. Exit the program..")
        return

    try:
        board = read_file(filename)
    except Exception as e:
        root = tk.Tk()
        root.withdraw()
        from tkinter import messagebox
        messagebox.showerror(f"Error! Failed to read file:\n{e}")
        return

    root.destroy()

    solver = board_solver(board)

    def solve_visualization(visualization_call):
        return solver.solve(visualization_call)

    gui = GUI(board, solve_visualization)
    gui.run()

# Main Code untuk menjalankan
def main():
    print("--- Brute Force Algorithm for Queens Linkedin Problem ---")
    print()
    print("Select mode:")
    print("1. CLI Mode (Command Line Interface)")
    print("2. GUI Mode (Graphical User Interface)")
    print()

    choice = input("Your choice (1/2): ").strip()

    if choice == '1':
        cli_mode()
    elif choice == '2':
        run_gui_mode()
    else:
        print("Invalid selection!")
        sys.exit(1)


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

C. EKSPERIMEN

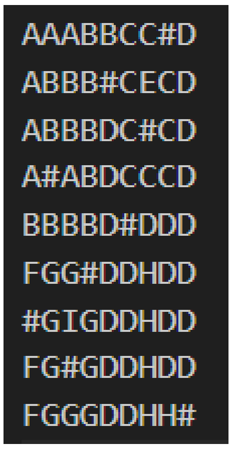
C.1 Test 1 :

Input :

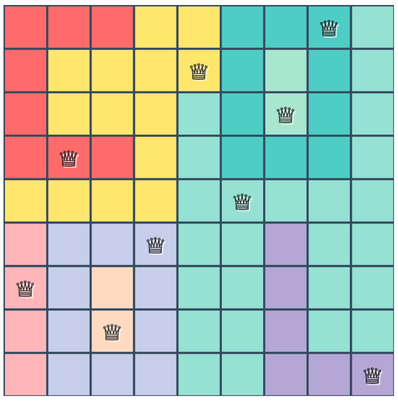


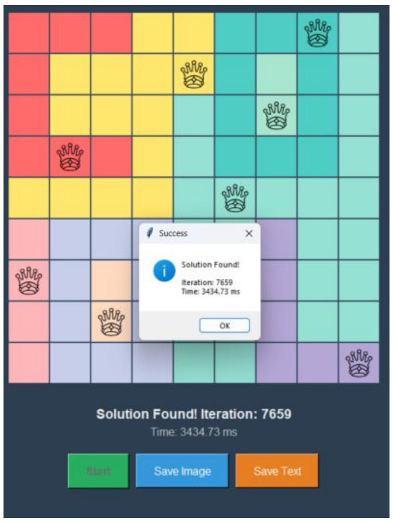
```
AAABBCCCD
ABBBBCECD
ABBBDCECD
AAABDCCCD
BBBBDDDDD
FGGGDDHDD
FGIGDDHDD
FGIGDDHDD
FGGGDDHHH
```

Output :



```
AAABBCC#D
ABBB#CECD
ABBBDC#CD
A#ABDCCCD
BBBBD#DDD
FGG#DDHDD
#GIGDDHDD
FG#GDDHDD
FGGGDDHH#
```





Success

Solution Found!

Iteration: 7659
Time: 3434.73 ms

Solution Found! Iteration: 7659

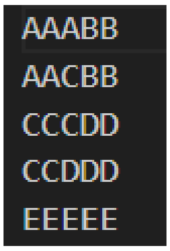
Time: 3434.73 ms

Execution Time: 423.64 ms

Cases Reviewed: 7659 cases

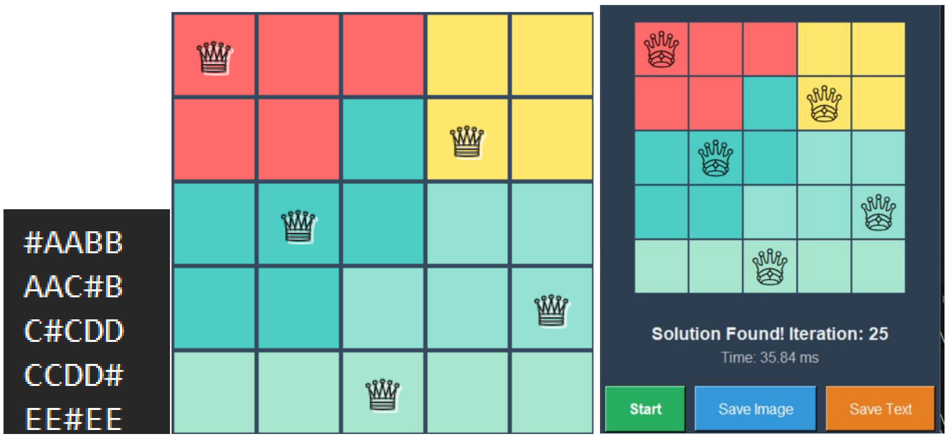
C.2 Test 2 :

Input :



```
AAABB
AACBB
CCCDD
CCDDD
EEEEE
```

Output :



```
#AABB
AAC#B
C#CDD
CCDD#
EE#EE
```

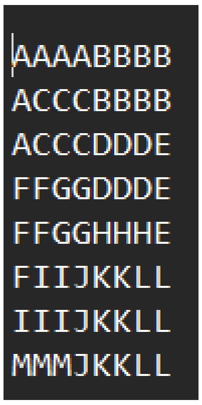
Solution Found! Iteration: 25
Time: 35.84 ms

Execution Time: 3.01 ms

Cases Reviewed: 25 cases

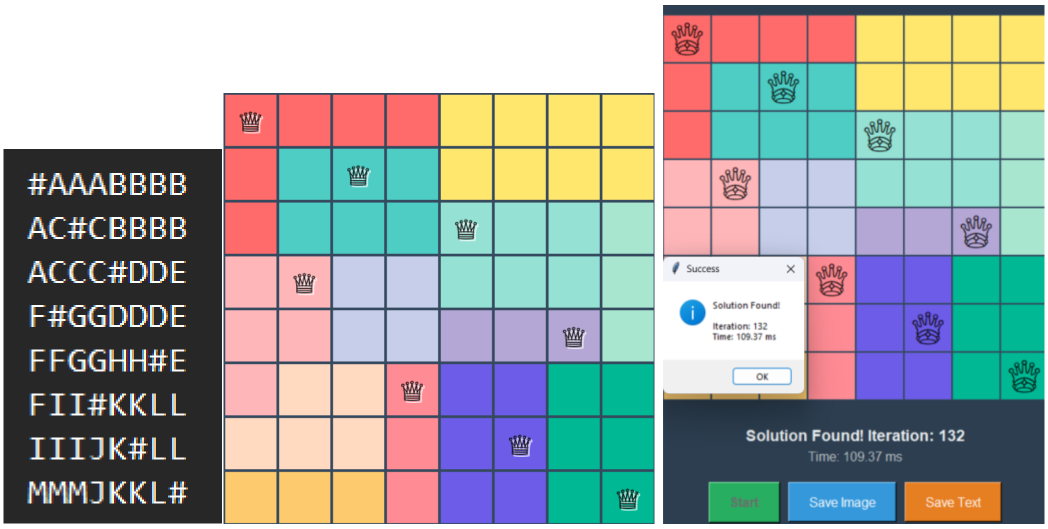
C.3 Test 3 :

Input :



```
AAAABBBB
ACCCBBBB
ACCCDDDE
FFGGDDDE
FFGGHHHE
FIIJKKLL
IIIJKKLL
MMMJKKLL
```

Output :



```
#AAABBBB
AC#CBBBB
ACCC#DDE
F#GGDDDE
FFGGHH#E
FII#KKLL
IIIJK#LL
MMMJKKL#
```

Success

Solution Found!
Iteration: 132
Time: 109.37 ms

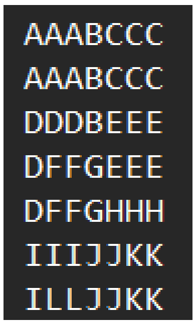
Solution Found! Iteration: 132
Time: 109.37 ms

Execution Time: 13.03 ms

Cases Reviewed: 132 cases

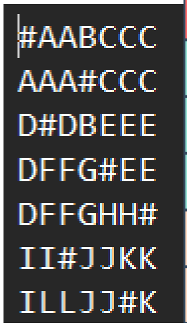
C.4 Test 4 :

Input :

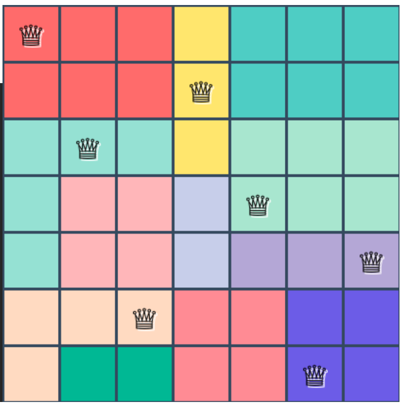


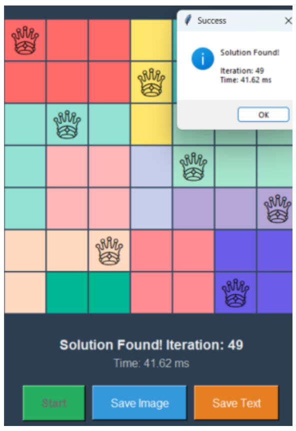
```
AAABCCC
AAABCCC
DDDBEEE
DFFGEEE
DFFGHHH
IIIJJKK
ILLJJKK
```

Output :



```
#AABCCC
AAA#CCC
D#DBEEE
DFFG#EE
DFFGHH#
II#JJKK
ILLJJ#K
```





Success

Solution Found!

Iteration: 49
Time: 41.62 ms

OK

Solution Found! Iteration: 49

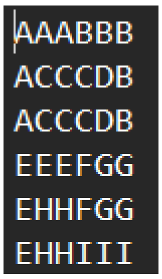
Time: 41.62 ms

Execution Time: 4.00 ms

Cases Reviewed: 49 cases

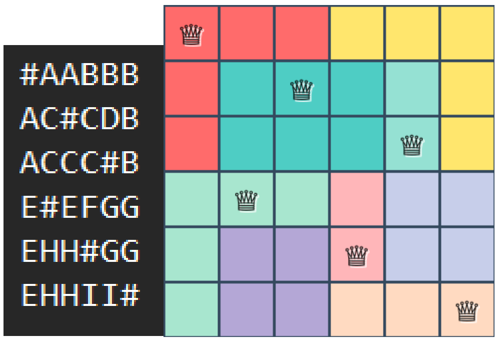
C.5 Test 5 :

Input :

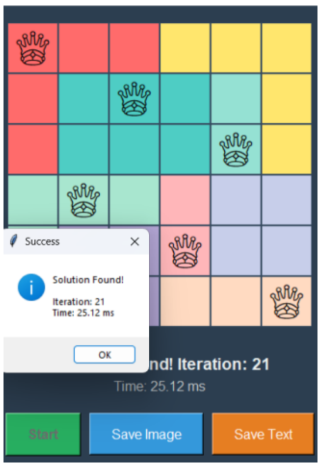


```
AAABBB
ACCCDB
ACCCDB
EEEFGG
EHHFGG
EHHIII
```

Output :



```
#AABBB
AC#CDB
ACCC#B
E#EFGG
EHH#GG
EHHII#
```



Success

Solution Found!

Iteration: 21
Time: 25.12 ms

OK

nd! Iteration: 21
Time: 25.12 ms

Execution Time: 2.14 ms

Cases Reviewed: 21 cases

LAMPIRAN

Link repository github: https://github.com/Benth48/Tucil1_10122043

Tugas ini disusun sepenuhnya tanpa bantuan kecerdasan buatan (Generative AI), melainkan hasil pemikiran dan analisis mandiri.

[illegible]

Beni Lesmana

No	Poin	Ya	Tidak
1	Program berhasil di kompilasi tanpa kesalahan	✓	
2	Program berhasil di jalankan	✓	
3	Solusi yang diberikan program benar dan mematuhi aturan permainan	✓	
4	Program dapat membaca masukan berkas .txt serta menyimpan solusi dalam berkas .txt	✓	
5	Program memiliki Graphical User Interface (GUI)	✓	
6	Program dapat menyimpan solusi dalam bentuk file gambar	✓	