Jolene Williams
October 16, 2025

Project goal/motivation

In completing this project, my goal is to incorporate my knowledge of Python
fundamentals that I learned from taking the Python Developer Course. I also hope to
gain a deeper understanding of pathfinding and graph traversal algorithms, as well as
data visualization and data analysis through the matplotlib and pandas libraries.

Project idea

Build and analyze different algorithms for solving 2D mazes and compare the efficiency
using data analysis.

Order of steps/tasks

- **(4 hours) Maze Generation** - use recursive backtracking and the random
  module to generate mazes with custom sizes and/or obstacles. Maze sizes and
  amount of runs for each algorithm are taken from a CSV file
- **(8 hours) Algorithms** - implement DFS, A*, and BFS algorithms. Each algorithm
  outputs a list of coordinates representing the shortest path for each maze
- **(4 hours) Data collection** - in a pandas DataFrame, for each algorithm, store
  the time to solve the maze, number of steps in each path, and the nodes(cells)
  visited. Use the time module to keep track of time
- **(4 hours) Data Analysis** - Analyze performance data of each algorithm
  - Pandas Dataframe
    - Columns - algorithm type, maze size, time, steps, nodes explored
    - Rows - different maze runs
  - For each algorithm, calculate mean/median/standard deviation for
    time,steps, nodes explored
- **(4 hours) Data visualization using matplotlib** - visualize the maze and paths
  taken by each algorithm
  - Plot/visualize calculations and show performance data comparisons with
    graphs for each algorithm
  - Animate each algorithm's pathfinding process when visualizing each path

- ○ Display maze grid with matplotlib (mark start/goal/solution path for each algorithm)
- **(3 hours) Test algorithms** with various maze sizes, ensure visualizations are correct

Programming knowledge outside of NCLab

- Some college/college courses - I have taken some CS courses at the University of Nevada, Reno for the B.S. of Computer Science and Engineering program. I have experience with college level programming projects with C/C++, JavaScript, Python, and HTML/CSS.
- I am moderately experienced with C/C++, JavaScript, Java, MATLAB, Visual Basic for Applications, Scheme, and HTML/CSS.

Libraries/modules used

- Matplotlib - used to visualize the maze and paths taken by each algorithm, visualize each algorithm's pathfinding process, and plot performance data
- Pandas - store performance data in Pandas DataFrames, statistical analysis for performance data
- Time module - track time for each algorithm path
- Random module - for maze generation

Operation System

Windows 11 Home 24H2

Resources/relevant links:

https://matplotlib.org/stable/tutorials/index.html

https://pandas.pydata.org/docs/

https://www.geeksforgeeks.org/dsa/a-search-algorithm/

https://www.geeksforgeeks.org/dsa/depth-first-search-or-dfs-for-a-graph/

https://www.geeksforgeeks.org/dsa/breadth-first-search-or-bfs-for-a-graph/