Evaluation of a Modified Trémaux's Maze Solving Algorithm

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Introduction

- A maze is a common type of puzzle in which the solver attempts to find a path between two locations.
- Maze-solving algorithms have many practical applications, including manufacturing, home automation, traffic control, and rescue operations.[1]
- Some maze-solving algorithms are used when the entire maze layout can be seen.[1] This is like solving a maze printed on paper. Other algorithms do not use any prior knowledge of the maze[1]. This is more akin to solving a hedge maze.
- Trémaux's algorithm is of the latter variety and is a popular choice for real-world applications.
- This study compares Trémaux's algorithm to a modified version that makes use of the maze's exit location.

Algorithms

Trémaux's algorithm follows three rules:

- When entering a new junction, pick any new path.
- When entering a previously explored junction via a new path, turn around.
- When entering a previously explored junction via a previously explored path, pick a new path with the fewest number of marks.

The modified version of the algorithm adds an additional rule:

- When able to pick between multiple paths, attempt to pick a path that shortens the distance between the current coordinates and the exit coordinates.

Methods

Both algorithms were implemented in a Java simulation. 480 unique mazes were tested. These mazes have a trait called "Connectivity" which represents how much the walls of the maze are connected.[2] Each algorithm was run on each maze, and the median percent difference in total steps was obtained for each level of connectivity.

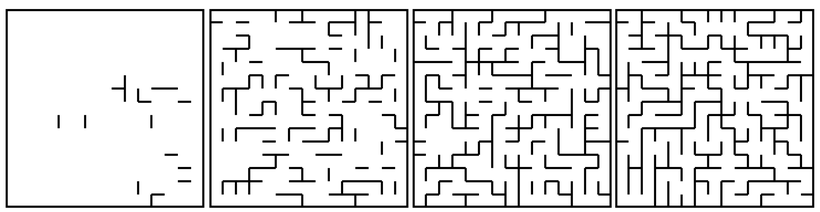
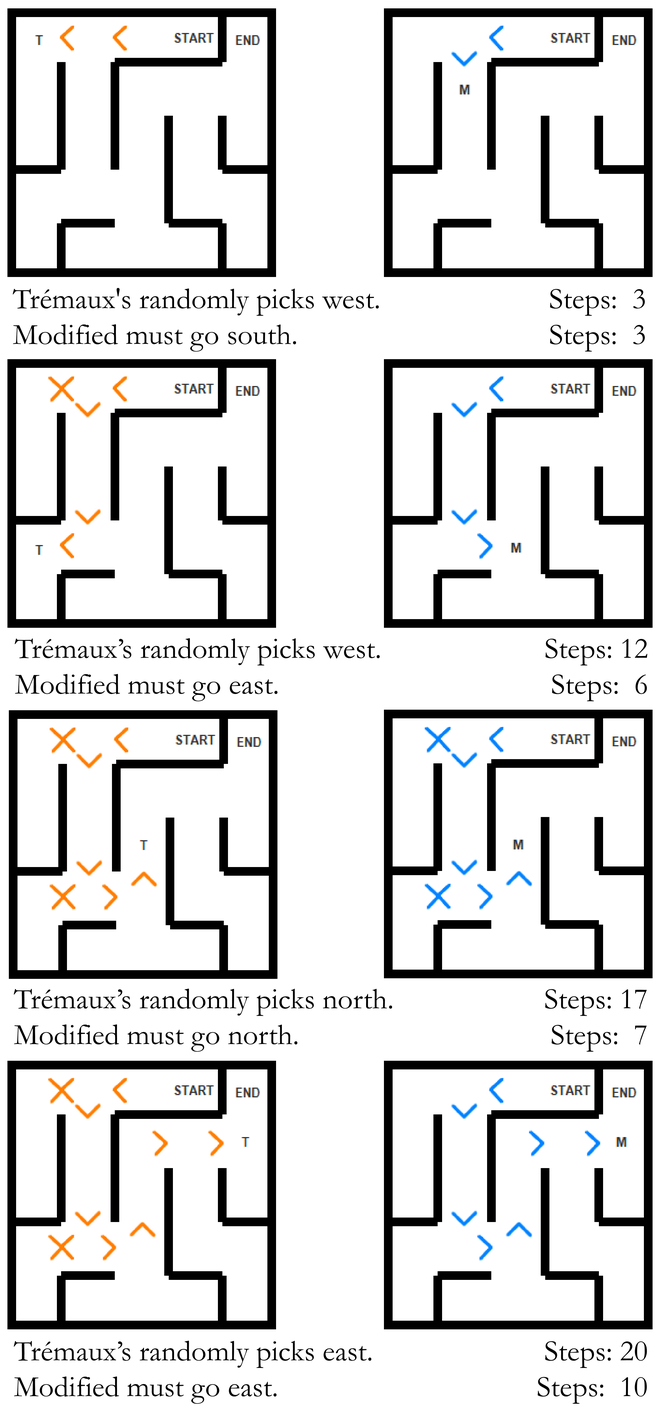


Figure 1: Mazes with the 4 different levels of connectivity
From left to right: 0, 30, 60, 100



If both end in one more step, Modified will have used 47.6% fewer steps.

Results

Table 1: The median percent difference in steps between the modified algorithm and Trémaux's algorithm.

Connectivity	Percent Difference
0	-95.2%
30	-81.8%
60	-57.9%
100	-53.1%

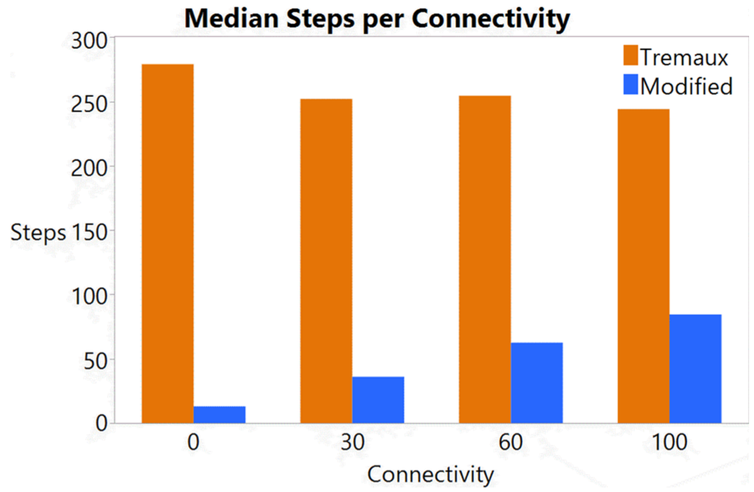


Figure 2: Median steps each algorithm took for mazes with different amounts of connectivity

Conclusion

- The modified algorithm solved the maze in fewer total steps on average for each level of connectivity.
- The modified algorithm did especially well in mazes where the walls are less thoroughly connected.

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References

[1] Alamri, Shatha, Shuruq Alshehri, Wejdan Alshehri, Hadeel Alamri, Ahad Alaklabi, and Tareq Alhmiedat. "Autonomous maze solving robotics: algorithms and systems." Int J Mech Eng Robot Res 10, no. 12 (2021): 668-675.

[2] Alaguna, Camilo, and Jonatan Gomez. "Maze benchmark for testing evolutionary algorithms." In Proceedings of the genetic and evolutionary computation conference companion, pp. 1321-1328. 2018.