CSCI 5511: Artificial Intelligence I
Course Project Proposal

Team members

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Goal

Pathfinding is a typical search problem in robotics and computer strategy games. Pathfinding seeks the shortest distance between two places on a map. We propose to use informed search methods, with a particular emphasis on A* search, in our research to locate paths with lowest costs using the Minneapolis map. This real world example would benefit people who want to navigate around Minneapolis and have different user needs rather than the only criteria of shortest time using Google Maps.

Problem Statement

A* search is well-known for its guarantee of optimal solution given good admissible heuristics, and determining a heuristic has been crucial to optimizing the A* search algorithm. Our work will investigate, experiment and analyze several admissible heuristics on A* search and its implications on the optimal solution. In addition, we also take into consideration user needs when we come up with different heuristics.

Previous work

Many earlier works with various search methods are present. The path finding problem can be extended to any location given the map and coordinate data are available. One interesting way of imagining is the roads in nations where people drive on the right versus countries where people drive on the left. Previous work inspired us to consider user needs for developing heuristics based on many such other observations and information.

Approach

Analyzing and understanding the data is an important aspect of solving the problem. We intend to understand our Minneapolis map and come up with initial rules of cost allocation. We then intend to build upon other knowledge like free right hand turns versus left hand turns, intersections and one-way streets. We plan on running the A* search algorithm with a good heuristic and keep improving it as we go. Later methods would include its performance comparison with other informed search algorithms if time permits. To conclude, there would be at least three different heuristics:

1. Initial rules of costs (trivial heuristic)
2. Costs that align with real life scenario (real-life heuristic)
    a. For example, we would consider right turn, left turn, stop sign
3. Costs that satisfy specific user needs
    a. Tourism heuristic (sight-seeing heuristic)
    b. Other potential heuristics

Tools and Software

We intend on using python as our coding language as it is easy to use and a lot of help is available on the Internet. We also plan to utilize the aima-python package as our reference and starting point to build and tweak the code as per our project's need.

Evaluation Metrics

Evaluation of various distance calculation metrics like manhattan, euclidean and diagonal could be done. A comparison in terms of time, complexity, node expansion, path-length and path-nodes of various algorithms is also in our consideration to evaluate. If we are able to run the A* search algorithm with concurrency, a performance comparison in terms of runtime could be performed.

References

Belhaous, S., Baroud, S., Chokri, S., Hidila, Z., Naji, A., & Mestari, M. (2019, October). Parallel implementation of A* search algorithm for road network. In *2019 Third International Conference on Intelligent Computing in Data Sciences (ICDS)* (pp. 1-7). IEEE.

Foead, D., Ghifari, A., Kusuma, M. B., Hanafiah, N., & Gunawan, E. (2021). A systematic literature review of A* pathfinding. *Procedia Computer Science*, *179*, 507-514.

Liu, T., & Zhang, J. (2022). An improved path planning algorithm based on fuel consumption. *The Journal of Supercomputing*, 1-31.

Martell, V., & Sandberg, A. (2016). Performance Evaluation of A* Algorithms.