§CS 520: Assignment 1
Fast Trajectory Replanning

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Abstract

Heuristic search algorithms like A* can be adapted to solving path planning problems of directed goal and unknown environment In this report, we mainly discuss and evaluate three variants of A* algorithms, namely Repeated Forward A*, Repeated Backward A* and Adaptive A*. In the experiment, we first generate two sets of 50 random grid-based maps, where one follows the assignment requirement containing approximate 30% obstacles and 70% roads, and the other is the set of corridor-like mazes generated by DFS with randomly expanded nodes. Then we compare three algorithms by such evaluation indices as number of expanded nodes, number of explored nodes, total cost of steps, optimal cost of steps, etc. The result shows that 1) number of expanded nodes and explored nodes of Adaptive A* are respectively 23.86% and 19.35% less than those of Repeated Forward A*; 2) cost of steps for all three algorithms is pretty much the same. This indicates that Adaptive A* is greatly optimized in path replanning phase, while there is no significant improvement in actual moving phase. Finally, we discuss and calculate how to optimize data structures to store states as many as possible within only 4M memory. This is the practical problem in the situation where computational resources are rare and precious.

Part 0 Setup Environment

We simulate all path finding processes based on the frameworke of GridWorld[1], an AP case study project from collegeboard [1]. It provides graphical user interface based on Java AWT where visual objects can interact and perform customized actions in a two-dimensional grid map.

[1] https://www.collegeboard.org/

Part 1 Understanding the Methods

Part 2 The Effects of Ties

Part 3 Forward vs. Backward

Part 4 Heuristics in the Adaptive A*

Part 5 Heuristics in the Adaptive A*

Part 6 Memory Issues

References

[1] CollegeBoard. AP central gridworld case study. `http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/151155.html`. [Online; accessed 2-October-2015].

[2] Sven Koenig and Maxim Likhachev. Real-time adaptive a*. In *Proceedings of the fifth international joint conference on Autonomous agents and multiagent systems*, pages 281–288. ACM, 2006.

[3] Wikipedia. Maze generation algorithm — wikipedia, the free encyclopedia. `https://en.wikipedia.org/w/index.php?title=Maze_generation_algorithm&oldid=679876968`. [Online; accessed 4-October-2015].