Homework 1: Search

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Artificial Intelligence 6601

August 22, 2013

1 Three City Problem

In the three city problem you want to visit three cities. The order of your visit does not matter. So the goal is to find a path through these three cities. In this assignment we will search a real street map of atlanta.

In the attachment you will find a map in open street map format (osm) and a script to parse it into a street graph. Furthermore you will find a breadth first search implementation. So you can start coding your own searches right away. However, if you do not like python and you want to do it on your own, go ahead. We accept solutions in: C, C++, Java, Python, Ruby, Lisp, Prolog. If you want to use something else talk to us first. The book's webpage contains helpful code snippets for multiple languages, too.

2 Tridirectional Search

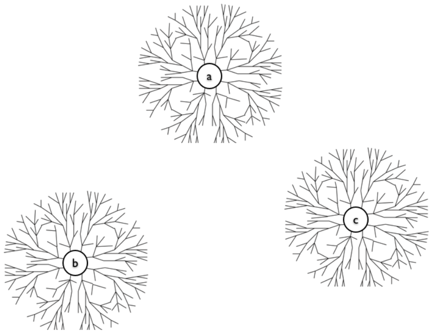

Figure 1: Tridirectional Search

Implementation of different searches (40 %)

1) Uniform Cost Search

Implement Uniform Cost Search. As a distance function use the straight line distance between the adjacent nodes.

2) Uniform Cost Search Three City Problem

Use Uniform cost search to solve three city problem. Describe how many searches were necessary. Shortly describe if Uniform Cost Search is complete and/or optimal.

3) Bidirectional Search Three City Problem

Implement Bidirectional Search and solve three city problem. Implement all searches using Uniform Cost Search. Describe how many searches were necessary, too. Shortly describe if Bidirectional Search is complete and/or optimal.

4) Tridirectional Search Three City Problem

Implement Tridirectional search. In Bidirectional search you start from the start and the goal state. In our case you start from all three cities. Implement all searches using Uniform Cost Search. Test your solution on the provided graph. Write a paragraph about your design choices. Also describe if Tridirectional Search is complete and/or optimal.

5) Experiments

With your implementations compare the number of nodes touched when you perform three separate Uniform Cost Searches and the number of nodes expanded with Bidirectional Search and Tridirectional Search. Therefore, run a search for multiple starting conditions (pick three cities at random at least 100 times and for each run all your search methods). Count the number of nodes expanded for both. Write a paragraph about your results and explain your observations as well as your experimental setup. Also discuss the relation to the theoretical bounds using O notation. Report the number of nodes touched for Bidirectional and Tridirectional Search and report the difference to Uniform Cost Search. Graph the numbers on avg. saved.

Late Submission (Sep. 2nd 9:35am grading is 50% on the above and 50% on this additional work)

Repeat your experiment comparing Triddirectional search and A*. Therefore you have to implement A* too. Write a paragraph about your results and explain your observations as well as your experimental setup.