

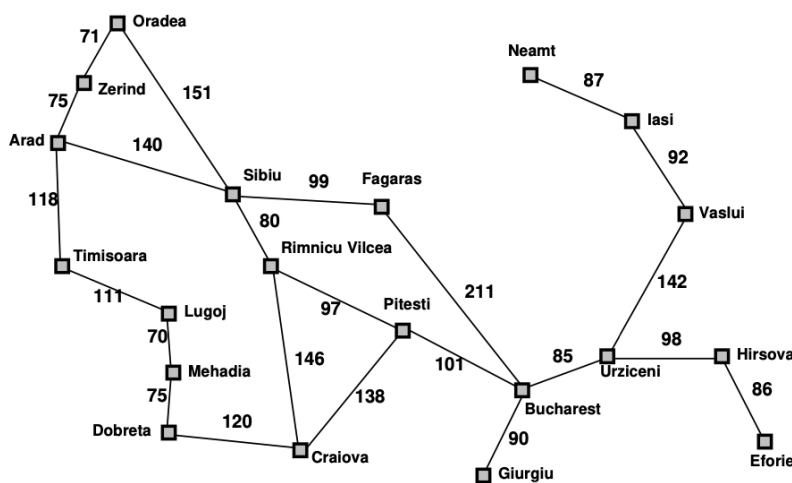


Tutorial: Heuristic Path Search



Activity 1: Path Search Algorithms on a Graph

For the route from Arad to Bucharest, what order are nodes in the state space expanded for each of the following algorithms when searching for the shortest path between Arad and Bucharest? Where there is a choice of nodes, take the first one by alphabetical ordering. Make sure you understand the key properties of the different algorithms, as listed below.



Straight-line distance to Bucharest

| | |
|----------------|-----|
| Arad | 366 |
| Bucharest | 0 |
| Craiova | 160 |
| Dobreta | 242 |
| Eforie | 161 |
| Fagaras | 178 |
| Giurgiu | 77 |
| Hirsova | 151 |
| Iasi | 226 |
| Lugoj | 244 |
| Mehadia | 241 |
| Neamt | 234 |
| Oradea | 380 |
| Pitesti | 98 |
| Rimnicu Vilcea | 193 |
| Sibiu | 253 |
| Timisoara | 329 |
| Urziceni | 80 |
| Vaslui | 199 |
| Zerind | 374 |

1. Greedy best-first search (efficient, not guaranteed optimal solution)
2. A* search with straight-line distance heuristic (space inefficient, guaranteed optimal solution)

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→ (Ex 3.22, R&N) Prove each of the following statements, or give a counterexample:

- 1 Breadth First Search is a special case of Uniform Cost Search.
- 2 Breadth First Search, Depth First Search and Uniform Cost Search are special cases of best-first search.
- 3 Uniform Cost Search is a special case of A* Search.

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Activity 3: Heuristic Path Algorithm

→ (Ex 3.28, R&N) The **heuristic path algorithm** is a best-first search in which the objective function is:

$$f(n) = (2 - w)g(n) + wh(n), \quad \text{where } 0 \leq w \leq 2.$$

What kind of search does this perform when $w = 0$? when $w = 1$? when $w = 2$?

For what values of w is this algorithm complete? For what values of w is it optimal, assuming $h()$ is admissible?



Activity: 4 Understanding Informed Search Algorithms with Mazes





→ Discuss your findings and insights from the 'Fun with Mazes' activity. Compare your findings and discuss any discrepancies.


- (a) an environment for which Bidirectional Search would find a solution faster than Breadth First Search.
- (b) an environment for which Greedy Search takes much longer than A* Search.
- (c) an environment for which Greedy Search produces a path that is much longer than the optimal path.
- (d) an environment for which A* Search with the Euclidean Distance heuristic takes much longer than with the Manhattan Distance heuristic.
- (e) an environment that is interesting for some other reason.

 Anna Trofimova (<https://www.openlearning.com/u/atrofimova>) – a month ago

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