Problem Solving and Search

Andrea Danyluk

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Announcements

- Progamming Assignment 0: Python Tutorial
  - Due tomorrow at 11pm
- Assignment 1: Search
  - Will be posted on Friday
- Office Hours
  - Mon 1-3pm, Tues 1-2pm, Wed 11am-noon

Today's Lecture

- Finish Uninformed search
  - Breadth-first
  - Depth-first and variants
  - Uniform-cost search ← New
- Informed (Heuristic) search
  - Greedy best-first

Evaluating Search Strategies

- Completeness
  - Is the strategy guaranteed to find a solution when there is one?
- Optimality
  - Does the strategy find the highest-quality solution when there are several solutions?
- Time Complexity
  - How long does it take (in the worst case) to find a solution?
- Space Complexity
  - How much memory is required (in the worst case)?

Evaluating BFS

- Complete?
  - Yes (if the number of possible actions is finite)
- Optimal?
  - Not in general. When is it optimal?
    - When costs of all actions are the same
- Time Complexity?
  - How do we measure it?
- Space Complexity?

Time and Space Complexity

Let

- b = branching factor (i.e., max number of successors)
- m = maximum depth of the search tree
- d = depth of shallowest solution

For BFS

Time: $O(b^d)$ If we check for goal as we generate a node! Not if we check as we get ready to expand!

Space: $O(b^d)$

Evaluating DFS

- Complete?
  - Not in general
  - Yes if state space is finite and we modify tree search to account for loops
- Optimal?
  - No
- Time Complexity?
  - $O(b^m)$
- Space Complexity?
  - $O(mb)$

Depth-Limited DFS?

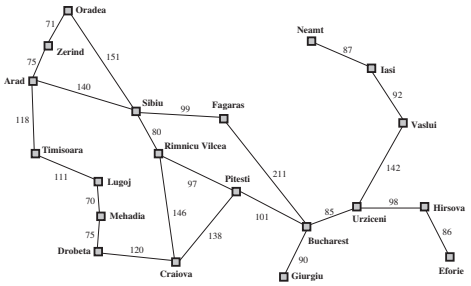
Let ℓ be the depth limit

- Complete?
  - No
- Optimal?
  - No
- Time Complexity?
  - $O(b^\ell)$
- Space Complexity?
  - $O(b\ell)$

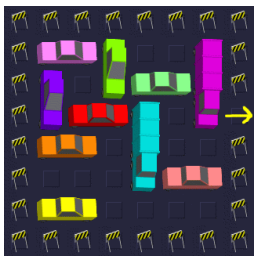
Iterative Deepening?

- Complete?
  - Yes (if b is finite)
- Optimal?
  - Yes (if costs of all actions are the same)
- Time Complexity?
  - $O(b^d)$
- Space Complexity?
  - $O(bd)$

Costs on Actions

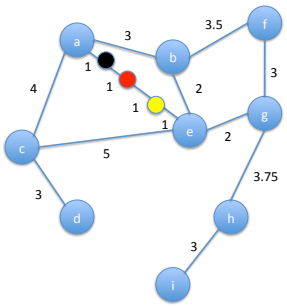


Costs on Actions



Cost of moving a truck = 2x the cost of moving a car that isn't a sports car.
Cost of moving a sports car is 4x the cost of moving any other vehicle.

Uniform Cost Search



Similar to another algorithm you know?

Fringe is a Priority Queue

Priority = cost so far