INFO8006 Introduction to Artificial Intelligence

Exercises 1: Solving problems by searching

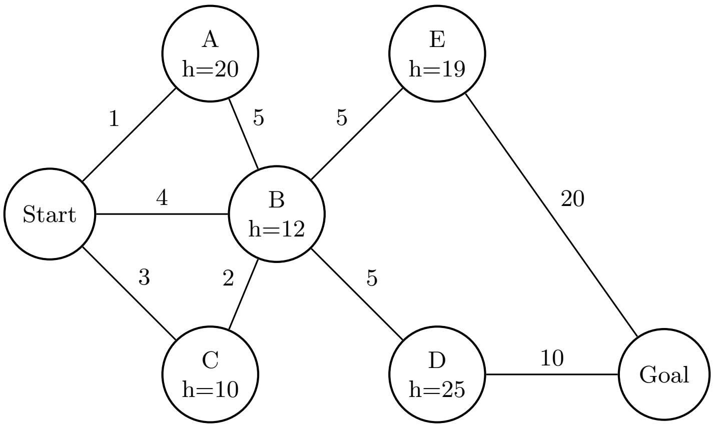
Objectives

At the end of this exercise session you should be able to:

- define rigorously what is a ”Search Problem”.
- theoretically analyse the algorithms to perform uninformed (Depth-first, Breadth-first, Uniform-cost) and informed (Greedy-search, A-star) search.
- apply each of these algorithms on any search problem defined in a fully observable and deterministic environment.

Exercises

(1) Search algorithms (≈ 35 min)

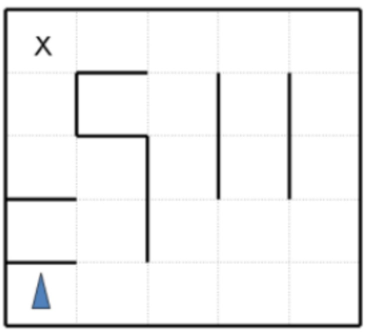


For each of the following search algorithms, give the order in which states are expanded as well as the final path returned by the algorithm. If two nodes are in competition to be expanded, the conflict is resolved by alphabetical order.

1. Depth-First
2. Breadth-First
3. Uniform-Cost
4. Greedy
5. A-Star (Is the heuristic admissible?)

(2) Maze Car (≈ 25 min)

Imagine a car-like agent that wishes to exit a maze like the one shown below:



The agent is directional and at all times faces some direction d $\in$ (N, S, E, W). With a single action, the agent can either move forward at an adjustable velocity v or turn. The turning actions are left and right, which change the agent's direction by 90 degrees. Turning is only permitted when the velocity is zero (and leaves it at zero). The moving actions are fast and slow. Fast increments the velocity by 1 and slow decrements the velocity by 1; in both cases the agent then moves a number of squares equal to its NEW adjusted velocity. Any action that would result in a collision with a wall crashes the agent and is illegal. Any action that would reduce v below 0 or above a maximum speed V_{max} is also illegal. The agent's goal is to find a plan which parks it (stationary) on the exit square using as few actions (time steps) as possible. As an example: if the agent shown were initially stationary, it might first turn to the east using (right), then move one square east using fast, then two more squares east using fast again. The agent will of course have to slow to turn.

- Quizz ($\approx$ 15 minutes):
  1. If the grid is M by N, what is the size of the state space? You should assume that all configurations are reachable from the start state.
  2. What is the maximum branching factor of this problem? You may assume that illegal actions are simply not returned by the successor function.
  3. Is the Manhattan distance from the agent's location to the exit's location admissible?
  4. If we used an inadmissible heuristic in A* tree search, could it change the completeness of the search?
  5. If we used an inadmissible heuristic in A* tree search, could it change the optimality of the search?
- Discussion (if time permits) ($\approx$ 10 minutes):
  1. State and justify a non-trivial admissible heuristic for this problem.
  2. Give a general advantage that an inadmissible heuristic might have over an admissible one.

Supplementary materials

`http://ai.berkeley.edu/sections/section_0_v55LOfoUUwiW1k6Nchnk3Dw6WQuTW8.pdf`
`http://ai.berkeley.edu/sections/section_1_0hzy6TFupb1Z3bckfRXdC5KYpsdZOE.pdf`