



S.E.E. S.P.O.T.

Single Entry and Exit, Strategic Positioning Over Time

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The Idea:

Setting: A burning building

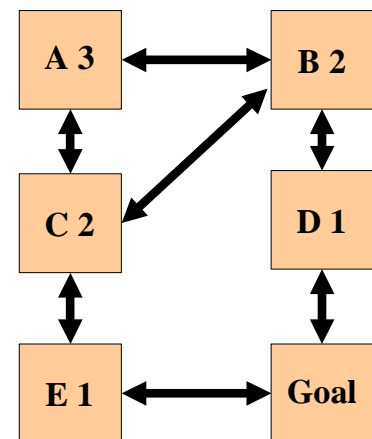
Problem: Someone is trapped inside. It is no longer safe for humans to attempt a rescue.

Complication: Beams and furniture collapse, blocking paths, while walls open to create new ones. The room layout is constantly changing.

The Solution: Send in a robot rescue team that uses the D* algorithm. D* (read “dee-star”), an algorithm developed by Anthony Stentz of Carnegie Mellon University. It can plan a path from one point to another and, should an obstacle be encountered, re-plan based on that information.

How D* Works – Searching a Graph

- 1) Each square represents a space roughly the size of the robot - a “step” it could take.
- 2) A plan is formed by comparing the sum of estimated distance to goal and total steps taken from start to current position for each possible next step.
- 3) The path is followed until a new obstacle is encountered. Another plan is formed to avoid the obstacle and get the system back “on track”. This cycle continues until the goal is found or all paths have been tried.



Choosing the next step from B:

$$A = 3 + 1 = 4$$

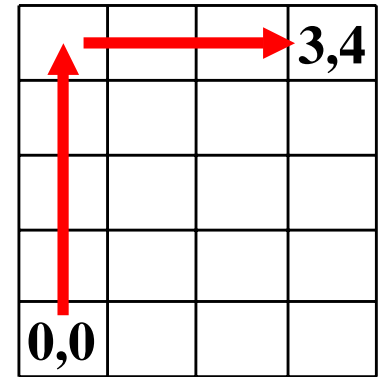
$$C = 2 + 1 = 3$$

$$\underline{D} = 1 + 1 = 2$$

How D* Works - Admissibility

An “admissible” algorithm never overestimates the distance to the goal. If this estimate calculation never returns an answer too high, the path found using that estimate is guaranteed to be optimal.

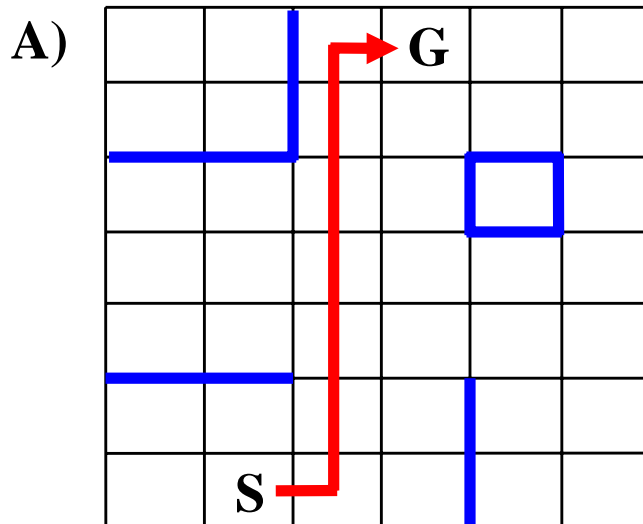
S.E.E. S.P.O.T.’s estimate of distance to the goal is a simple one. It uses the distance, assuming no obstacles, on our 4-connected search grid.



$$4-0 = 4, 3-0 = 3$$

$$\text{Est. Distance} = 7$$

How D* Works - Local Re-planning



Legend:

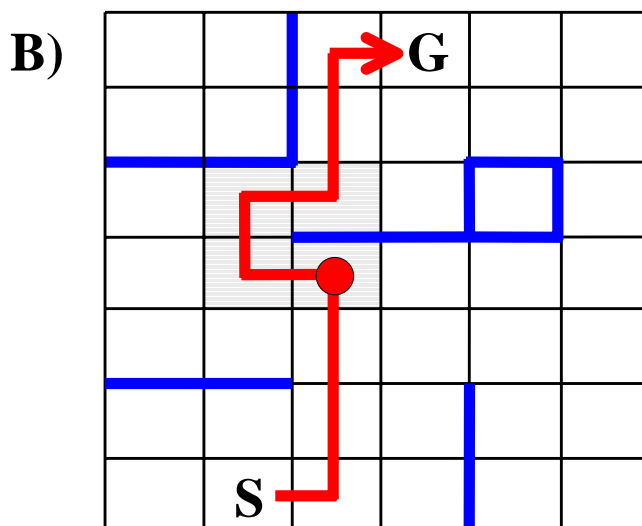
G - Goal State

S - Start State

■ - Optimal Path

■ - Obstacle

A) One possible optimal path, planning around the known obstacles.



B) The re-planned path, after a new obstacle is encountered when the robot reaches ●.

Note that only the shaded area needs to be re-planned. Once the local problem has been navigated around, D* resumes the original plan.