

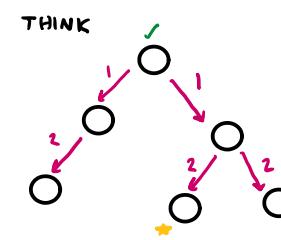
Lab #2

Tuesday, April 9, 2024 9:51 AM

#1

A. Summarize Findings

- Breadth-First Search (BFS) → moves in a spiral motion from the start node until hitting the target node; moving layer by layer through all the nodes
 - Random: Duration = 1ms, Length = 15 blocks
 - Recursive Division: Duration = 1ms, Length = 9 blocks
 - Recursive Division Vertical Skew: Duration = 1ms, Length = 9 blocks
 - Recursive Division Horizontal Skew: Duration = 1ms, Length = 39 blocks
 - Simple Spiral: Duration = 1ms, Length = 17 blocks



- Depth-First Search (DFS) → starts from first node and traverses like a tree until it finds the end node traversing back to the start

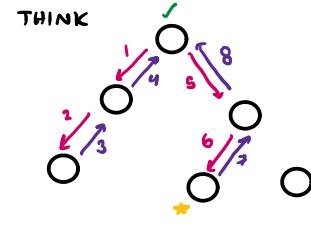
-Random: Duration = 1ms, Length = 253 blocks

-Recursive Division: Duration = 1ms, Length = 33 blocks

-Recursive Division Vertical Skew: Duration = 1ms, Length = 45 blocks

-Recursive Division Horizontal Skew: Duration = 1ms, Length = 47 blocks

-Simple Spiral: Duration = 1ms, Length = 19 blocks



(takes a lot longer time)

- Dijkstra → blast formation; goes from start node and calculates the closest unvisited node to it, expanding outwards till goal node is found

-Random: Duration = 3ms, Length = 13 blocks

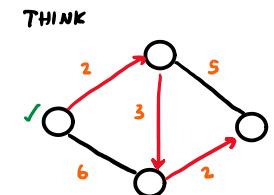
till goal node is found

-Recursive Division: Duration = 1ms, Length = 29 blocks

-Recursive Division Vertical Skew: Duration = 1ms, Length = 37 blocks

-Recursive Division Horizontal Skew: Duration = 2ms, Length = 41 blocks

-Simple Spiral: Duration = 1ms, Length = 17 blocks



- A* → just like dijkstra's, but gives priority to certain nodes (making it faster)

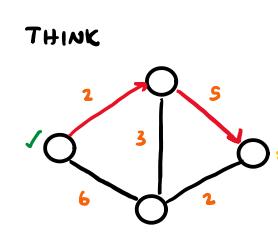
-Random: Duration = 6ms, Length = 13 blocks

-Recursive Division: Duration = 3ms, Length = 29 blocks

-Recursive Division Vertical Skew: Duration = 3ms, Length = 33 blocks

-Recursive Division Horizontal Skew: Duration = 1ms, Length = 11 blocks

-Simple Spiral: Duration = 1ms, Length = 17 blocks



B. Best / Worst Rankings

-Random:

Best = A*
Worst = DFS

-Recursive Division:

Best = A* or Dijkstra
Worst = DFS

-Recursive Division Vertical Skew:

Best = A*
Worst = DFS

-Recursive Division Horizontal Skew:

Best = A*
Worst = DFS

-Simple Spiral:

Best = A*, Dijkstra or BFS
Worst = DFS

★ DFS is worst overall because, depending on the walls set up, it will endlessly get trapped and have to recount its steps.

A* is generally the best because it efficiently finds the shortest path to the goal, taking into account the costs.

- #2 a) The size of the state space would be $M \times N \times 4 \times (V_{max} + 1)$.

If all configurations are reachable from the state start, then for each square/cell there are $1 + V_{max}$ velocities the agent could move before reaching the max (+1 for 0 velocity). We also multiply by 4 since there are 4 different directions the agent could move/turn (N, E, S, W).

- b) The Manhattan distance from the agent's location to the exit's location is NOT valid/accepted/admissible because although the distance is calculated, it does not take into account turning direction of the agent (nor the velocity).

- Manhattan Distance: measures the distance between two points on a grid-based map by summing the absolute differences (sum the absolute value of their distances)

- #3 a)

Search Alg	A-B-0-6	A-C-0-6	A-B-C-D-F-6
DFS	✓	✓	✓
BFS	✓	✓	✓
UCS	✓	✓	✗
A* h ¹	✓	✓	✗
A* h ²	✗	✓	✓

* Definitions

- Consistent: the cost of reaching the goal is never greater than the cost of getting to a neighbor + the estimated cost of getting to the goal from the neighbor

- Inconsistent: the cost of reaching the goal can be greater

- Admissible: never overestimates the cost to reach the goal (always less or equal to the actual cost)

- b) (i) # ≤ 2 b/c the shortest path cost B → b = 2 (any higher ≠ admissible)

(ii) # ≤ 2 (same reason as above)

(iii) # ≥ 4.5 ≤ 7