Karl Hu Josefsson

Written Answers - Assignment 2

Algorithm	Time Complexity	Space Complexity	Complete?	Optimal?
BFS	O(b^(d+1)	O(b^(d+1)	yes	yes
UCS	O(b^1+⌈C∗/ϵ⌉) (from Russel Norvig)	O(b^1+⌈C∗/ϵ⌉) (from Russel Norvig)	yes	yes
DFS	O(b^n)	O(bn)	Yes in finite spaces	no
DLS	O(b^l)	O(bl)	Yes if depth limit is set to at least the shallowest solution	no
IDS	O(b^d)	O(bd)	yes	Yes if all actions have the same cost
A*	O(b^h*)	O(b^h*)	yes	yes

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2. Note: All data gathered after tool actions initiated

Mission complete:

BFS: 41 states generated

DFS: 22 states generated

DLS: 33 states generated

Sub completes:

Move_to_sample_goal {

BFS: 5 states generated

DFS: 6 states generated

DLS: 6 states generated

}

Remove_sample_goal

BFS: 8 states generated

DFS: 16 states generated

DLS: 10 states generated

}

return_to_charger_goal {

BFS: 30 states generated

DFS: 11 states generated

DLS: 11 states generated

}

Total States: BFS -> 43, DFS -> 33, DLS -> 27

Depth-Limited Search (DLS) generates the fewest states when the problem is broken into subproblems because the depth limit stops the search from going too deep, focusing only on what's needed to reach each subgoal.

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3.

Mars Graph Structure: (made the font smaller to fit the page)

1,1: 2,1 1,2
2,1: 1,1
1,2: 1,1 1,3
1,3: 1,2 1,4
1,4: 1,3 1,5
1,5: 1,4 1,6
1,6: 1,5 1,7
1,7: 1,6 2,7
2,7: 1,7 3,7
3,7: 3,6 2,7
3,4: 3,5 4,4
3,5: 3,4 3,6
4,4: 3,4 5,4
3,6: 3,5 3,7
5,4: 5,5 5,3 4,4
4,8: 5,8
5,8: 4,8 6,8
5,1: 6,1 5,2
6,1: 5,1
5,2: 5,1 5,3
5,3: 5,2 5,4
5,5: 5,4 6,5
6,5: 5,5 6,6
6,8: 6,7 5,8
6,6: 6,5 7,6 6,7
7,6: 6,6 8,6
6,7: 6,6 6,8
8,6: 8,5 8,7 7,6
8,3: 8,4
8,4: 8,3 8,5
8,5: 8,4 8,6
8,7: 8,6 8,8
8,8: 8,7

A* Search Results:

Path found: 8,8 -> 8,7 -> 8,6 -> 7,6 -> 6,6 -> 6,5 -> 5,5 -> 5,4 -> 4,4 -> 3,4 -> 3,5 -> 3,6 -> 3,7 ->

2,7 -> 1,7 -> 1,6 -> 1,5 -> 1,4 -> 1,3 -> 1,2 -> 1,1

States generated: 62

Uniform Cost Search Results:

Path found: 8,8 -> 8,7 -> 8,6 -> 7,6 -> 6,6 -> 6,5 -> 5,5 -> 5,4 -> 4,4 -> 3,4 -> 3,5 -> 3,6 -> 3,7 ->

2,7 -> 1,7 -> 1,6 -> 1,5 -> 1,4 -> 1,3 -> 1,2 -> 1,1

States generated: 63

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5.

a) The engineering advances that made Deep Blue successful include the creation of custom chess chips, a detailed evaluation system, and an effective parallel search approach. These chess chips were built to quickly process specific chess moves, analyzing millions of possible positions every second. The evaluation system used thousands of factors to judge the quality of each chess position. The parallel search approach allowed Deep Blue to examine different possibilities at the same time, boosting the depth and speed of its decision-making.

b) The key is AlphaZero being much more efficient. It looks at fewer positions on the board, but each one is analyzed with a deep understanding of the game's strategy, thanks to its use of a neural network and a smarter search method called MCTS. Stockfish, on the other hand, looks at many more positions but with less focus on strategy for each one. This difference in how they search and analyze the game gives AlphaZero a big advantage, letting it perform better than the brute-force method that Stockfish uses, even with much less computing power.