Dr. B.C. Roy Engineering college

Topic: - uniform cost search

Name: Himadri Chandra

Roll: 12000122031

Department: Computer science & engineering

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Introduction: -

Uniform Cost Search (UCS) is an algorithm used in artificial intelligence and graph theory to find the least cost path from a starting node to a goal node.

The main goal of UCS is to ensure that the path found from the start to the goal has the smallest possible cost.

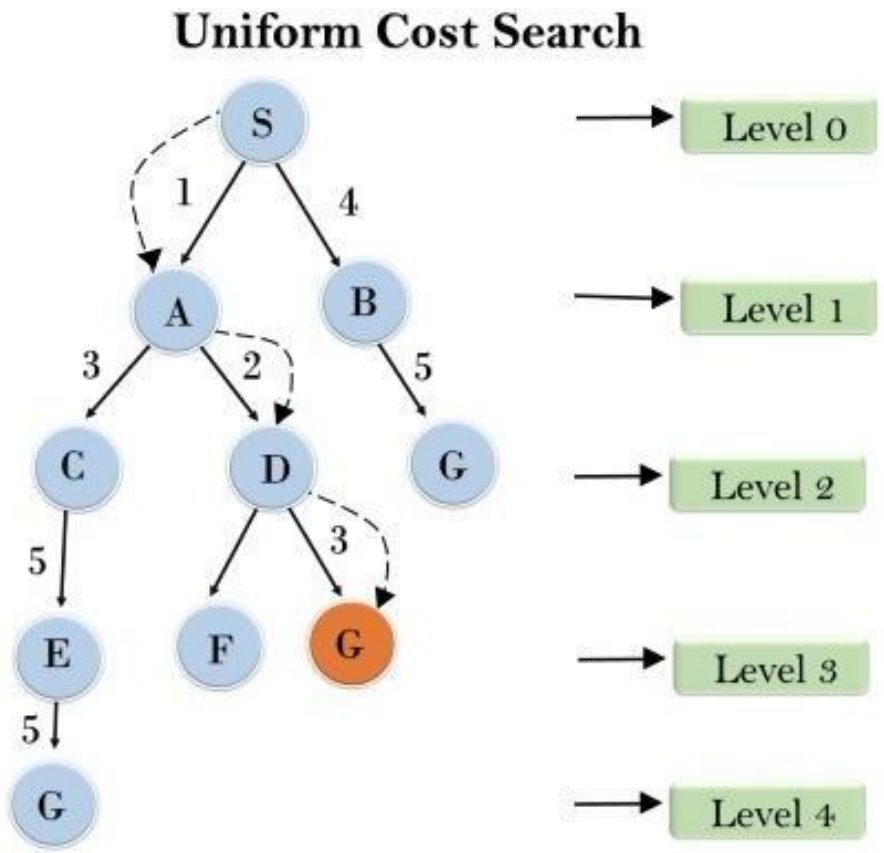
How UCS Works: -

Uniform Cost Search (UCS) is an algorithm used to find the least-cost path from a start node to a goal node in a graph where edges have associated costs. It is particularly useful when the costs vary and the goal is to find the cheapest path rather than the shortest path in terms of the number of edges.

UCS Algorithm Steps: -

- Initialize the priority queue with the start node, having a cost of 0. Repeat the following steps:
- Dequeue the node with the lowest cost.
- If the node is the goal, return the path and cost.
- For each neighboring node, calculate the cumulative cost an enqueue it.
- If a node has been reached with a lower cost, update the cost and re-enqueue it.

Example: -


Uniform Cost Search
S
A
B
C
D
G
E
F
G
G
1
4
3
2
5
5
3
5
Level 0
Level 1
Level 2
Level 3
Level 4

Applications of UCS: -

- **Robotics Path Planning: -** In robotics, UCS is used to determine the optimal path a robot should take to minimize the travel cost, which could be time, energy, or distance.
- **Puzzle Solving: -** UCS is effective in solving puzzles where each move has an associated cost, and the goal is to find the least cost solution.
- **Airline Route Optimization: -** UCS can optimize flight routes to minimize fuel consumption and travel time, considering factors like weather and air traffic.

Advantages and Disadvantages: -

Advantages: -

Optimality: Uniform Cost Search (UCS) is guaranteed to find the least cost path to the goal if a solution exists.

Completeness: UCS is complete, meaning it will find a solution if one exists, provided the graph has a finite number of nodes with non-negative edge costs.

Disadvantages: -

High Time and high space Complexity: The time complexity of UCS can be very high, particularly for graphs and UCS requires storing all the nodes in memory until the goal is found, leading to high space complexity.

Infinite Graphs: In cases where the graph is very large or infinite, UCS can be impractical due to its high time and space requirements.

Conclusion: -

Uniform Cost Search (UCS) is a fundamental algorithm in artificial intelligence for finding the least cost path in a weighted graph. By systematically exploring nodes based on cumulative cost, UCS ensures that the first solution found is optimal.

Reference: -

- Google

  https://www.javatpoint.com/ai-uninformed-search-algorithms
- ChatGPT

  https://chatgpt.com/c/e34c6079-eced-480e-b880-392c7a35a54b


Thank
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