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Repo - 3013 Advance Structures

Presentation 1 - A* Search Algorithm

1. Introduction

- **Topic**: A* Search Algorithm

- **Description**: A* is a popular informed search algorithem widely used in pathfinding and graph traversal know for finding the shorest efficiently.

- **Why is it intresting?**: It combines features of uniform-cost search and greedy best first search, providing optimallity and efficiency. It is widely implemented in real world scenarios like GPS navigation, game AI, and robotics.

2. Core Mechanics

- **High-Level Overview:**

  - Uses heuristics to guide the search towards the most promesing path.

  - Evalutaes nodes based on **f(n) = g(n) + h(n):**

    - **g(n):** Cost from start node to current node.
    - **h(n):** Estimated cost from current node to goal.

- **Edge Cases & Design Tradeoffs:**

  - Works optimally if heuristics is admissible (never overestimates the true cost).
  - Performance can degrade significantly if heuristics is poorly chosen.
  - Tradeoff between heuristic complexity and computational overhead.

3. Uses Cases/Imapct

- **Real-World Applications:**

  - GPS navigation and route finding.
  - Game development for NPC pathfinding.
  - Autonomous vehicle navigation systems.

- **Theorical Significance:**

  - Benchmark for development and testing heuristic - based search algorithems.
  - Bases for numerous advanced search strategies.

- **Comparison to Alternatives:**

  - Better performance compared to uninformed search (BFS, DFS).
  - More optimal than greedy algorithems due to comprehensive evaluation.

4. Conclusion

- **Key Points:**
  - A* efficiantly combines path cost nd heuristic to find optimal paths.
  - Proper heuristic selection is crucial for performance.