

Definition:

- A problem-solving technique that utilizes heuristics (rules of thumb or educated guesses) to guide the search process towards a solution.
- Aims to find a good solution efficiently, but not necessarily the optimal one.

Types of Heuristic Search:

1. Direct Heuristic Search:

- Has knowledge of the goal state.
- Uses this knowledge to estimate the distance or cost to the goal.
- Examples:
 - A* Search: Combines cost to reach the node (g) and estimated cost to goal (h') to find the shortest path.
 - Greedy Best-First Search: Expands the node closest to the goal based on the heuristic.

2. Weak Heuristic Search (Uninformed Search):

- No additional information about the goal state.
- Explores the search space systematically.
- Examples:
 - Breadth-First Search (BFS): Explores layer by layer.
 - Uniform Cost Search (UCS): Expands the node with the lowest cost.
 - Depth-First Search (DFS): Explores as deeply as possible along each branch.
 - Iterative Deepening Depth-First Search (IDDFS): Combines DFS with iterative deepening.
 - Bidirectional Search: Searches from both the start and goal states

simultaneously.

Key Concepts:

- **Heuristic Function:** Estimates the cost to reach the goal from a given state.
- **Admissibility:** A heuristic is admissible if it never overestimates the actual cost to the goal.
- **Efficiency:** Heuristic search aims to find a good solution quickly.
- **Completeness:** A search algorithm is complete if it is guaranteed to find a solution if one exists.

Advantages of Heuristic Search:

- Can be more efficient than uninformed search.
- Can find good solutions even for complex problems.

Disadvantages of Heuristic Search:

- May not always find the optimal solution.
- The effectiveness depends heavily on the quality of the heuristic function.

Applications:

- Robotics
- Pathfinding and navigation
- Game playing
- Machine learning
- Optimization problems

References:

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