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CIS 365 Artificial Intelligence

Informed Search

Week in Review

Blackboard Check-in

Artificial Intelligence Informed Search

Judea Pearl -Possible to teach effective Problem Solving Skills?

State Space Search

- Do we have to search through every possible state to find the state we are looking for?
- Can we use some ‘knowledge’ to help us determine which paths to search?

State Space Search

- Can we arrive at a quasi-optimal (instead of optimal) solution with a significant cost reduction?

State Space (Review)

- What is the state space for traveling to the coffee shop from class?

A* Algorithm

- Pathfinding and graph traversal algorithm that finds the shortest path from a starting node to a goal node in a weighted graph or grid.

A* Algorithm

- Heuristic Function h(n)
  - **Estimates the cost to reach the goal from the current node**

A* Algorithm

- Heuristic Function h(n)
  - **What are some examples of heuristic functions (as well as problems to apply them too!!!)**

A* Algorithm Group Exercise (10 minutes)

- Create a heuristic for each of the following:
  - Tic Tac Toe
  - Pathfinding to get to your next class
  - Which video game you should purchase
  - Potential Spouse

A* Algorithm

- Problem Representation:
  - The problem is typically represented as a graph where nodes represent states or locations, and edges represent connections between these states, each with an associated cost (or weight).

A* Algorithm

- Cost Functions
  - g(n): The cost of the path from the starting node to node n
  - h(n): A heuristic function that estimates the cost from node n to the goal node.
  - f(n): The total estimated cost of the cheapest path from the start node to the goal node passing through n:

$$f(n) = g(n) + h(n)$$

A* Algorithm

- Heuristic Function h(n)
  - **Estimates the cost to reach the goal from the current node**
  - ‘Admissable’ if it never overestimates the true cost to reach the goal. This ensures that A* finds the optimal path
  - ‘Consistent/Monotonic’ if for every node n and successor n’, the estimated cost of h(n) is no greater than the step cost from n to n’ plus h(n’)

A* Algorithm

- ‘Consistent/Monotonic’ if for every node n and successor n’, the estimated cost of h(n) is no greater than the step cost from n to n’ plus h(n’)

$$h(n) <= h(n') + cost(n',n)$$

Hill Climbing

- Initial State (can be chosen at random or assigned based on some prior knowledge
- Evaluation - current state is evaluated using an objective/heuristic function
- Generate Neighbors - generate neighbor states based on the current state
- Select the ‘best’ neighbor
- Move to the neighbor
- Repeat
- Termination: When the state of the neighbors generated isn’t better than the current state

Hill Climbing Types

- Simple Hill Climbing - Evaluates one neighbor at a time, moves to the first neighbor that improves the objective function
- Steepest-Ascent Hill Climbing - evaluates all neighbors, selects the one that provides the greatest improvement in the objective function
- Stochastic Hill Climbing - selects a random neighbor to move to, rather than the best one
- Random Restart Hill Climbing - randomly reset the starting point and perform the hill climbing algorithm

Hill Climbing Challenges

- Local Optima - can get stuck in a state where alll neighboring states do not improve the objective function even though a better solution exists in the space
- Plateaus - objective function may encounter a flat region where it doesn't change significantly
- Global Optima - no guarantee to find the global optima (similar to the local optima challenge)

Hill Climbing Applications

- Optimization Problems
- Pathfinding

Informed Search Algorithms

https://www.educative.io/answers/what-are-informed-search-algorithms

AI Course Project

- Break into your small group
- Discuss what types of topics you may be interested in
- Brainstorm what types of projects you would be interested in working on
  - Discuss with the instructor

AI Ethics Presentation

- Finish the signup sheet
- Ethical concerns involving NLP and LLM

Informed Search Assignment

- Review the assignment