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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?

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

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

- \* 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

- \* 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).

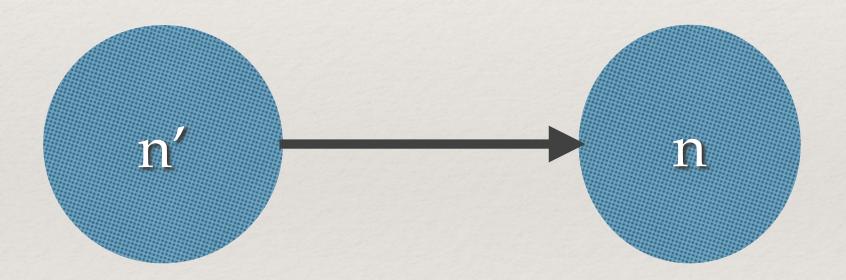
#### \* Cost Functions

- \* 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:

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

- \* 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')

\* '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 all 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

### Al Ethics Presentation

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

## Informed Search Assignment

\* Review the assignment