January 17, 2024 Notes

0.1 Typical Agent Architectures

- Simple reflex agent: uses condition-action rules
- Model-based reflex agent: keeps track of the unobserved parts of the environment by maintaining internal state:
  - "how the world works": state transition model
  - how percepts and environment is related: sensor model
- Goal-based reflex agent: maintains the models of the world and goals to select decisions (that lead to goal)
- Utility-based reflex agent: maintains the model of the world and utility function to select PREFERRED decisions (that lead to the best expected utility: avg (EU * p))

0.2 State and Transition Representations

- Atomic: state representation has NO internal structure
- Factored: state representation includes fixed attributes (which can have values)
- Structured: state representation includes objects and their relationships

0.3 Problem-Solving / Planning Agent

- Context / Problem:
  - correct action is NOT immediately obvious
  - a plan (a sequence of actions leading to a goal) may be necessary
- Solution / Agent:
  - come up with a computational process that will search for that plan
- Planning Agent:
  - uses factored or structured representations of states
  - uses searching algorithms

0.4 Defining Search Problem

- Define a set of possible states: State Space
- Specify Initial State
- Specify Goal State(s) (there can be multiple)
- Define a FINITE set of possible Actions for EACH state in the State Space
- Come up with a TRANSITION model which describes what each action does
- Specify the Action COST Function (a function that gives the cost of applying action a to state s)

0.5 Measuring Searching Performance

Search algorithms can be evaluated in four ways:

- Completeness: Is the algorithm guaranteed to find a solution when there is one, and to correctly report failure when there is not?
- Cost optimality: Does it find a solution with the lowest path cost of all solutions?
- Time complexity: How long goes it take to find a solution? (in seconds, actions, states, etc.)
- Space complexity: How much memory is needed to perform the search?

0.6 Informed Search and Heuristics

Informed search relies on domain-specific knowledge / hints that help locate the goal state.

$$h(n) = h(\text{State } n)$$
$$h(n) = n(\text{relevant information about State } n)$$

0.7 Romanian Roadtrip: Heuristics h(n)

For this particular problem, the heuristic function $h(n)$ is defined by a straight line (Euclidean) distance between two states (cities). As the crow flies in other words.

0.8 A* Algorithm: Evaluations Function

Calculate/obtain:

$$f(n) = g(\text{State}_n) + h(\text{State}_n)$$