Notes, Chapter 2

Agents and Environments

- An agent is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators

- Agents include humans, robots, vehicles, etc

- The agent function maps from percept histories to actions $f : P^* \to A$

- The agent program runs on the physical architecture to produce f
  $agent = architecture + program$

The goal of AI then is to link the percepts of the environment to actions that it can take.

Rationality

- A **rational agent** does the right thing, but what does it mean to do the right thing?

- A **performance measure** to evaluate the behavior of the agent in an environment

  - One point per square cleaned up in time T?
  - One point per clear square per time step, minus one per move?

- A rational agent chooses whichever action maximizes the expected value of the performane measure given the percept sequence to date.

- What is rational at any given time depends on four things:

  1. The performance measure that defines the criterion of success
  2. The agent's prior knowledge of the environment
  3. The actions that the agent can perform
  4. The agent's percept sequence to date

Definition of a Rational Agent

For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure given the evidence provided by the percept sequence, and whatever built-in knowledge the agent has.

The Nature of Environments / Task Environments (PEAS)

To design a rational agent, we must specify the task environment:

- Performance measure

- Environment

- Actuators

- Sensors

PEAS - Example - Automated Taxi

- Performance Measure: Profit, Safety, Destination (minimal path), Comfort

- Environment: US streets/freeways, traffic, weather

- Actuators: Steering, Accelerator, Brake, Horn, Speakers/Display, etc

- Sensors: Cameras, Accelerometers, Engine Sensors, GPS, etc

Properties of Task Environments

- Fully Observable vs Partially Observable

- Single-agent vs Multi-agent

  - Competitive vs Cooperative environment

- Deterministic vs Nondeterministic

  - In deterministic environments, the next state of the environment is completely determined by the current state and the action executed by the agent

- Episodic vs Sequential

  - In an episodic environment, the agen'ts experience is divided into atomic episodes. In each episode, the agent receives a percept and then performs a single action. The next episode does not depend on the action taken in the previous ones.

  - In a sequential environment, the current decisions could affect the future decisions.

- Static vs Dynamic: a dynamic environment can be changed for the agent

- Discrete vs Continuous: Able to process a snapshot vs ongoing inputs

Task Environment	Self-Driving Taxi	Crossword
Observable	Partially	Fully
Agents	Multi	Single
Deterministic	No	Yes
Episodic/Sequential	Sequential	Sequential
Static/Dynamic	Dynamic	Static
Continuous/Discrete	Continuous	Discrete

0.1 Agent Types

Any type of agent can have a learning model added to it.

0.1.1 Simple Reflex Agents

This agent type selects actions based on the currect percept, ignoring the rest of the percept history.

0.1.2 Model-based reflex agents

This agent maintains some sort of internal state that depends on the percept history. This is to handle partial observability to let the agent keep track of the part of the world it cannot see now.

0.1.3 Goal-based Agents

This type keeps track of the world state as well as a set of goals it is trying to achieve and chooses an action that will (eventually) leadd to the achievements of its goals.

0.1.4 Utility-based Agents

This type can be used wwhen there are conflicting goals. It uses a model of the world, along with a utility function that measures its performance among the states of the world. Then it chooses the action that maximizes the expected utility. Goal based agents and utility-based agents are more flexible than simple reflex and model-based reflex agents. Why?