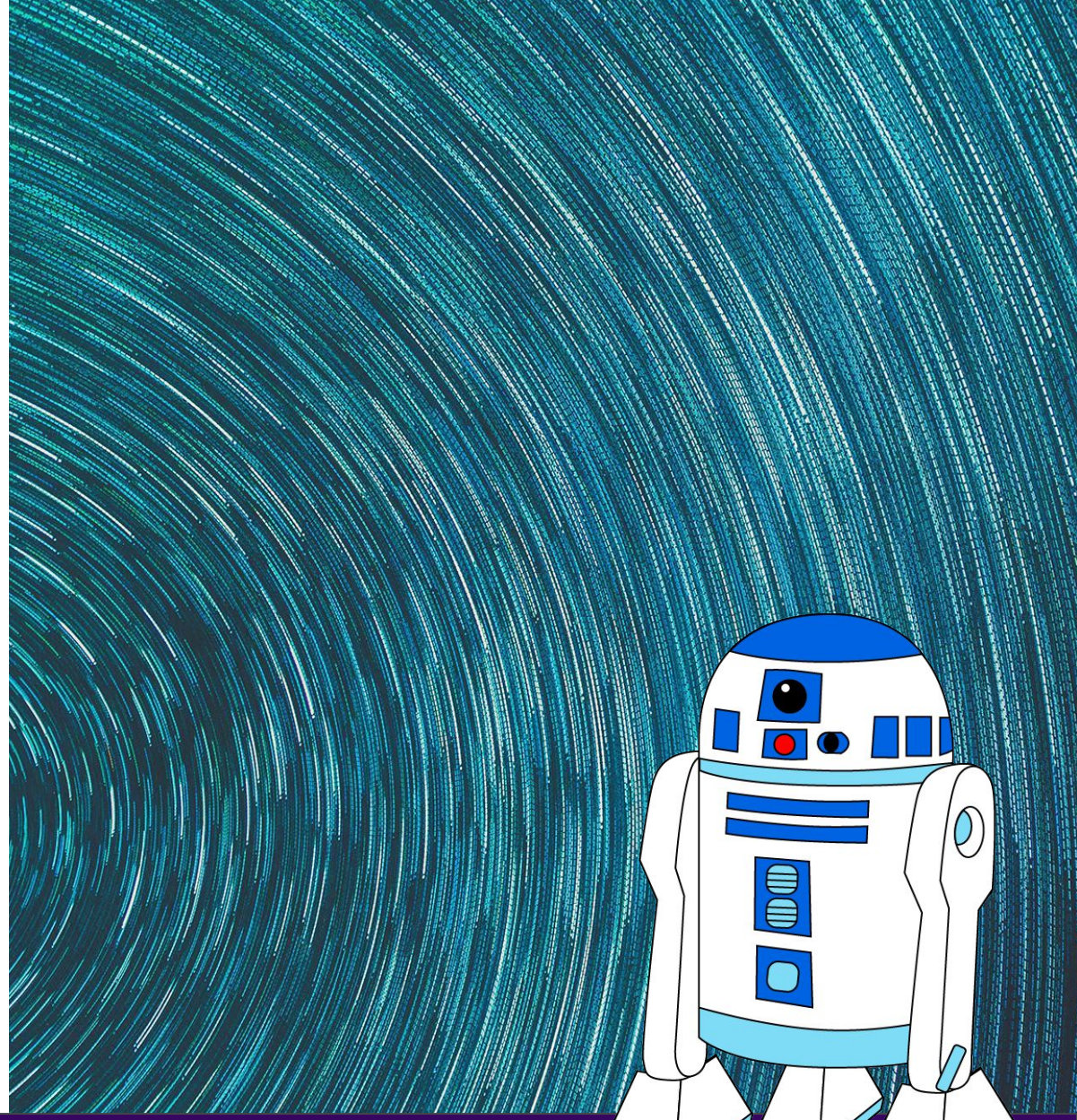
CIS 421/521:
ARTIFICIAL INTELLIGENCE

Task Environments



Penn Engineering
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Task environments

To design a rational agent we need to specify a *task environment*

- a problem specification for which the agent is a solution

PEAS: *to* specify a task environment

- ***P***erformance measure
- ***E***nvironment
- ***A***ctuators
- ***S***ensors

PEAS: Specifying an automated taxi driver

*P*erformance measure:

- ?

*E*nvironment:

- ?

*A*ctuators:

- ?

*S*ensors:

- ?

PEAS: Specifying an automated taxi driver

*P*erformance measure:

- safe, fast, legal, comfortable, maximize profits

*E*nvironment:

- roads, other traffic, pedestrians, customers

*A*ctuators:

- steering, accelerator, brake, signal, horn

*S*ensors:

- cameras, LiDAR, speedometer, GPS

https://www.today.com/video/amazon-adebuts-new-package-delivery-drone-61414981780

PEAS: Amazon Prime Air

*P*erformance measure:

- ?

*E*nvironment:

- ?

*A*ctuators:

- ?

*S*ensors:

- ?

PEAS: Specifying an Amazon delivery drone

*P*erformance measure:

maximize profits - minimize time - obey laws governing airspace restrictions - deliver package to right location - keep package in good condition - avoid accidents - reduce noise - preserve battery life

*E*nvironment:

- airspace - obstacles when airborne (other drones, birds, buildings, trees, utility poles) - obstacles when landing (pets, patio furniture, lawnmowers, people, cars) - weather - distances/route information between warehouse and destinations - position of houses, and spaces that are safe for drop-off- package weight

PEAS: Specifying an Amazon delivery drone

*A*ctuators:

- Propellers and flight control system- Payload actuators: E.g. Arm/basket/claw for picking up, dropping off packages- Lights or signals - Mechanism to announce/verify delivery- Device for delivering packages to customers

*S*ensors:

- GPS - radar/Lidar- altitude sensor- weather sensors (barometer, etc). - gyroscope- accelerometer- camera- rotor sensors- weight sensor to recognize package

The rational agent designer's goal

Goal of AI practitioner who designs rational agents:

given a *PEAS* task environment,

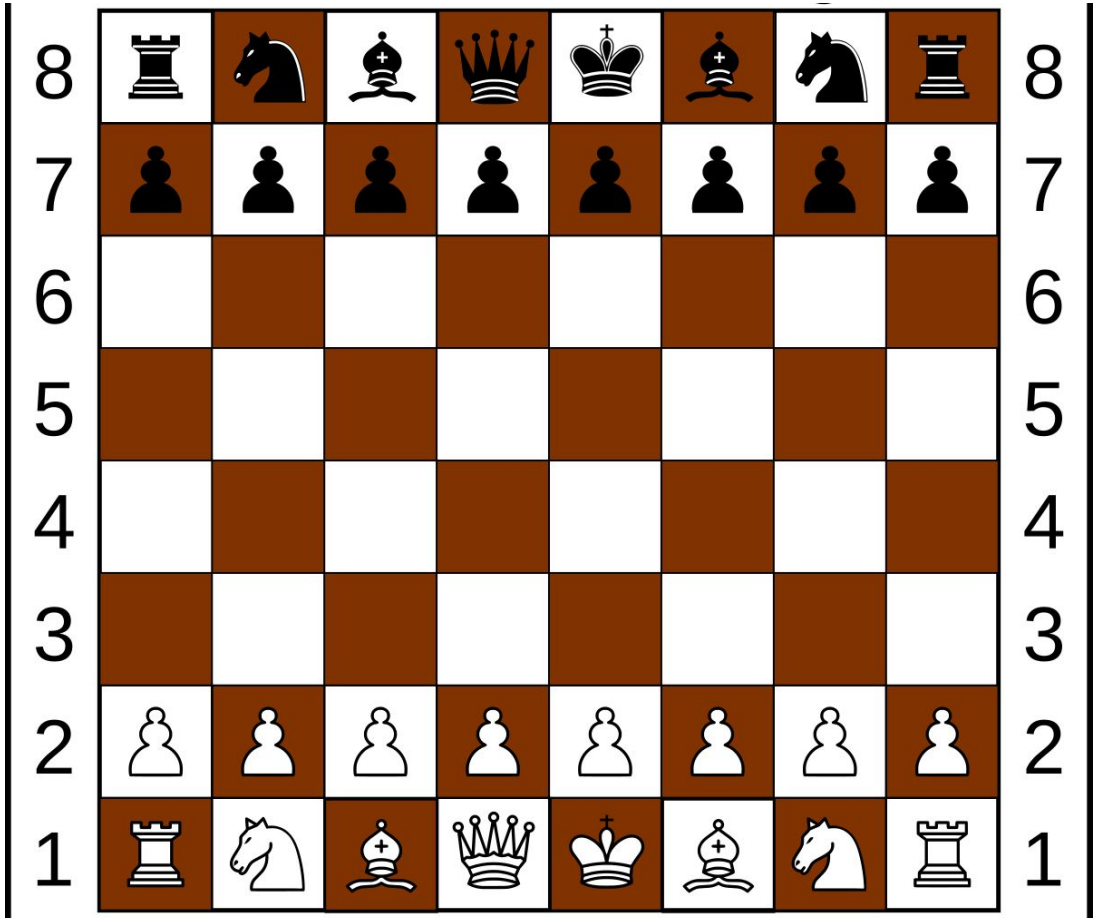
1. **Construct *agent function* f that maximizes the expected value of the performance measure,**

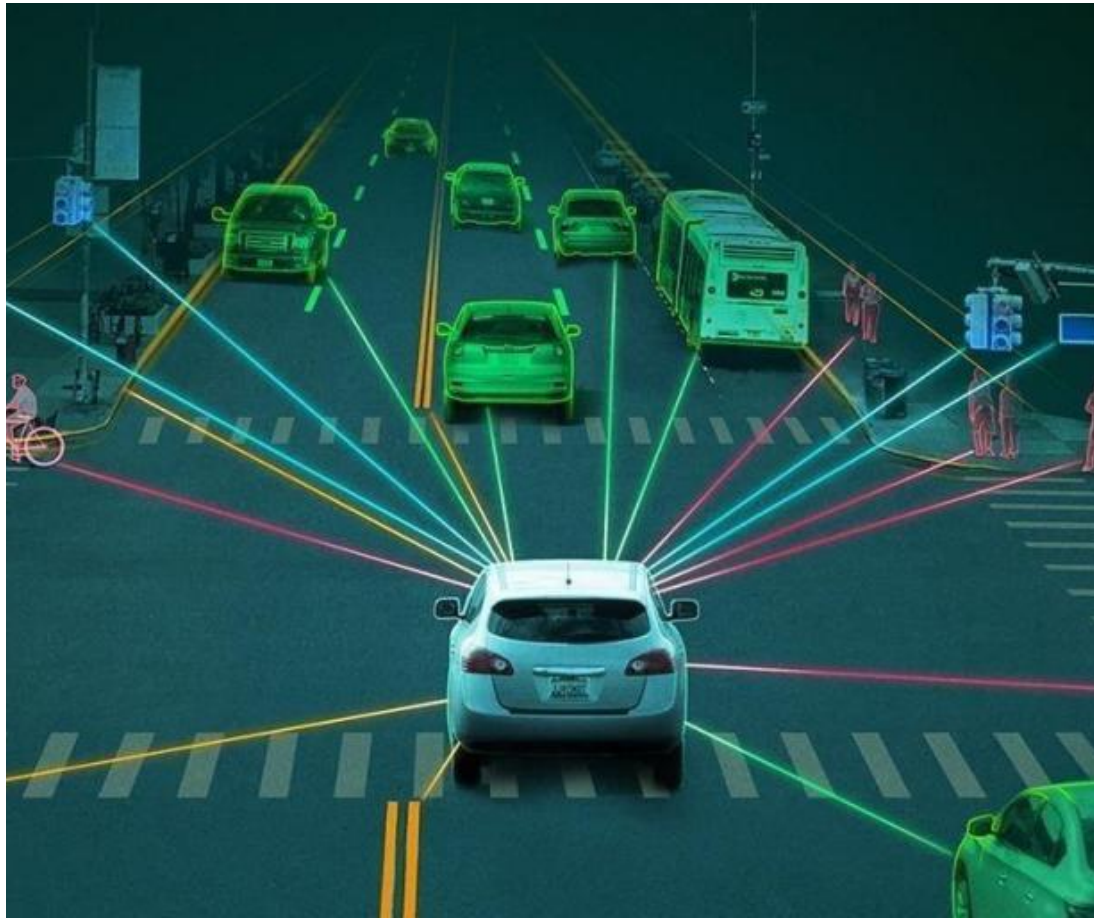
2. **Design an *agent program* that implements f on a particular architecture**

abstract mathematical description

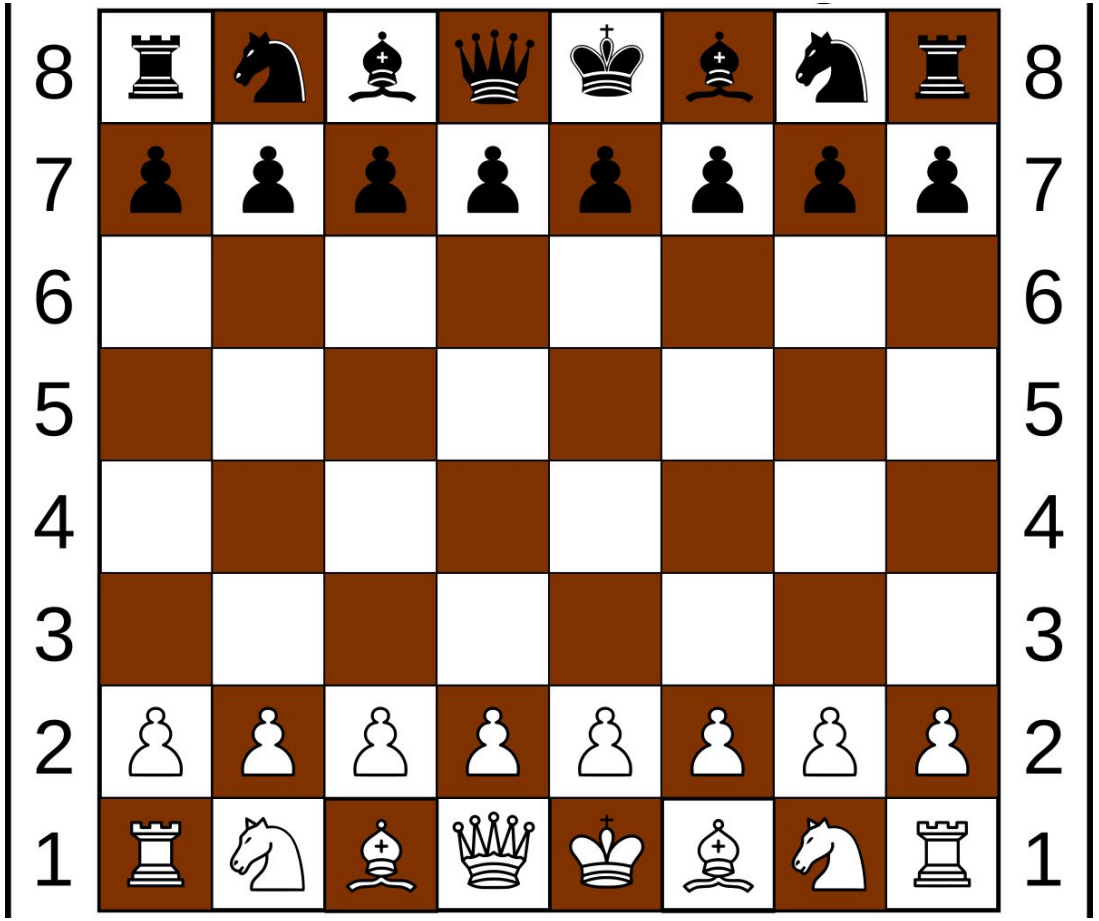
concrete implementation

Fully Observable v. Partially Observable

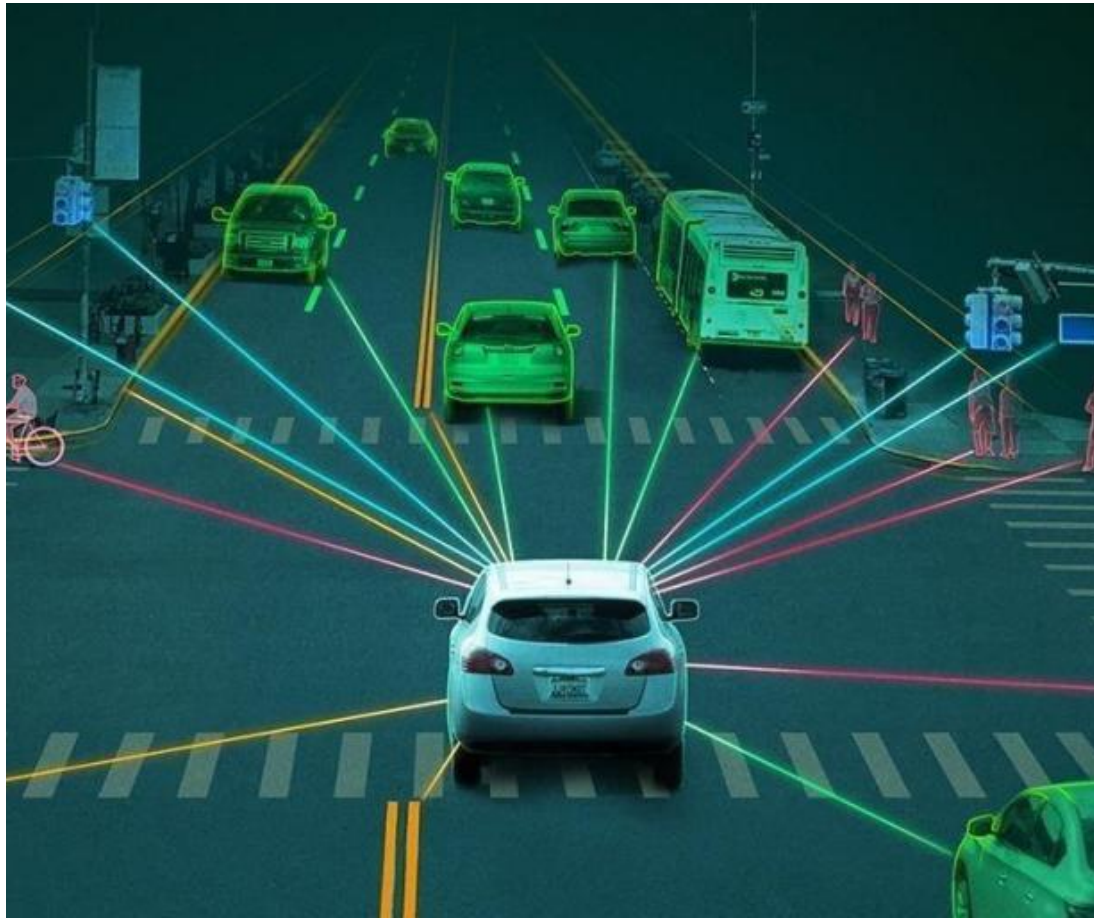




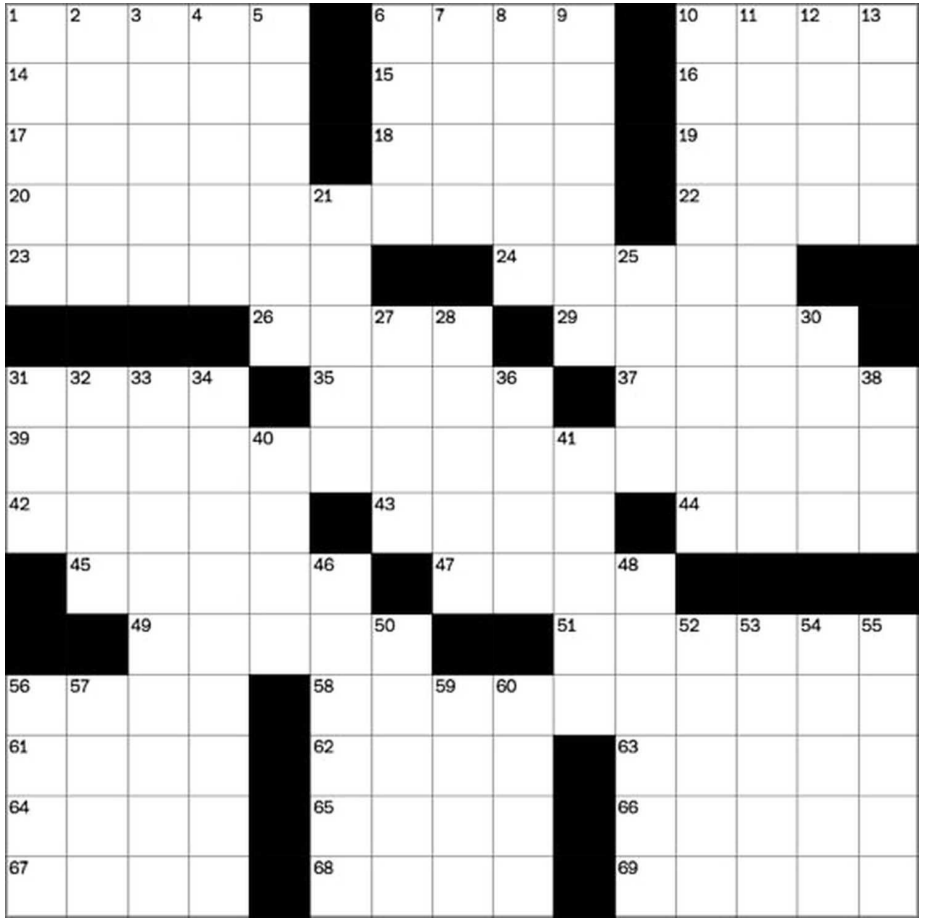
Deterministic v. Nondeterministic v. Stochastic

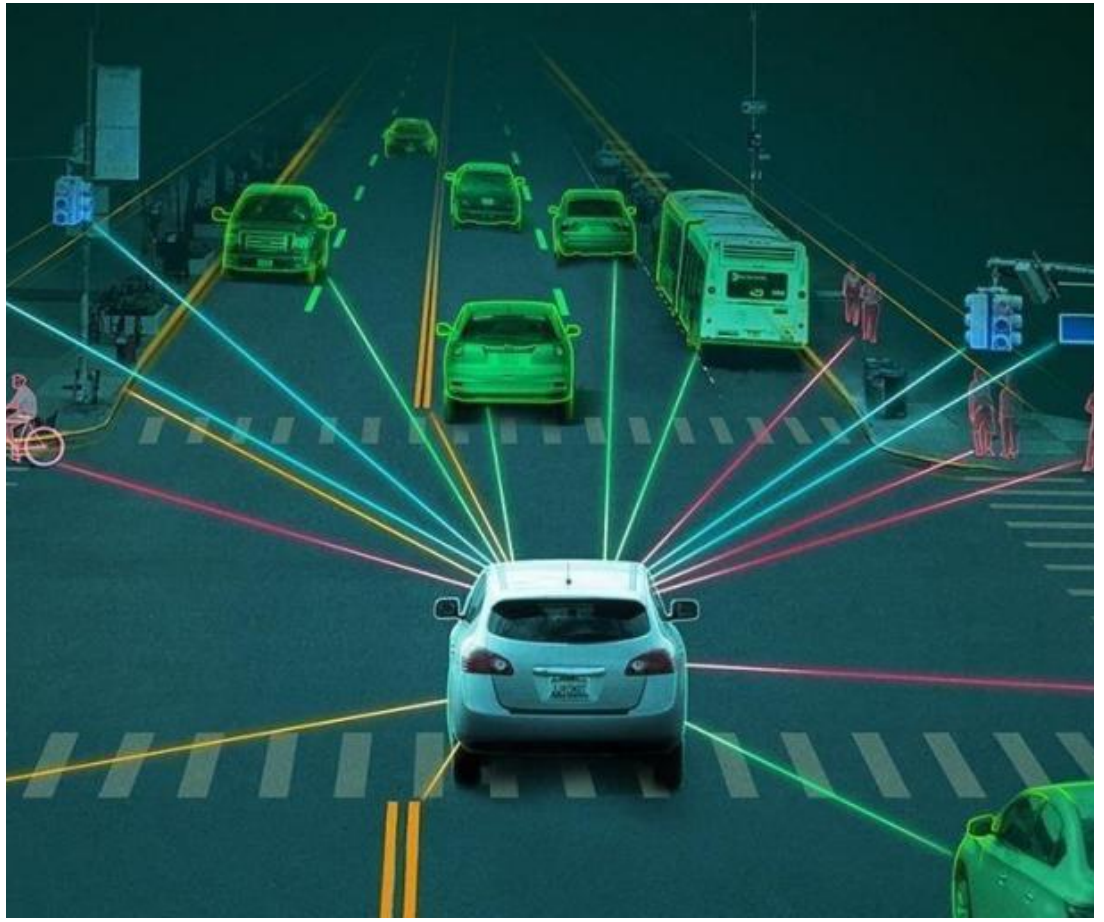


Episodic v. Sequential

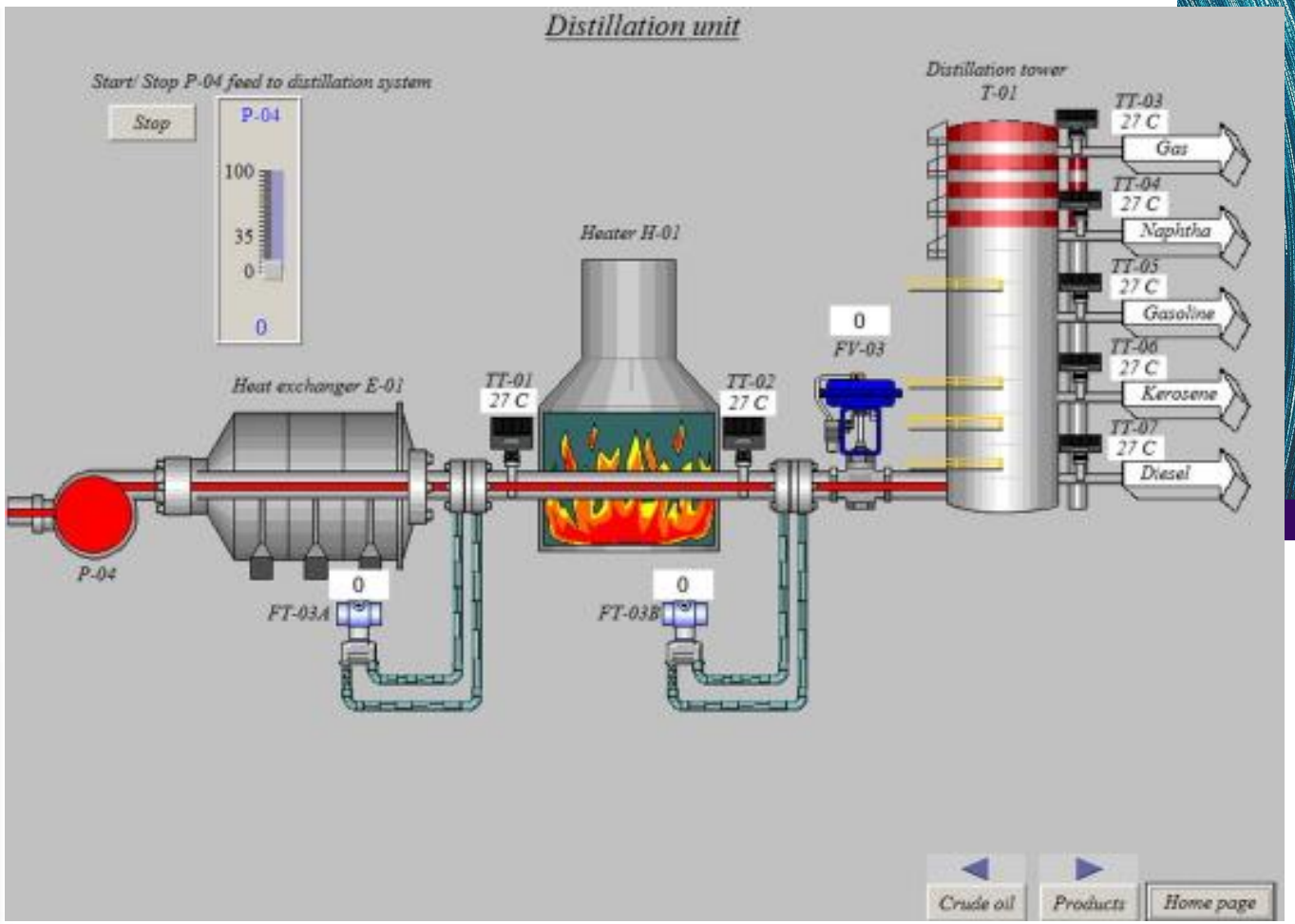


Static v. Dynamic

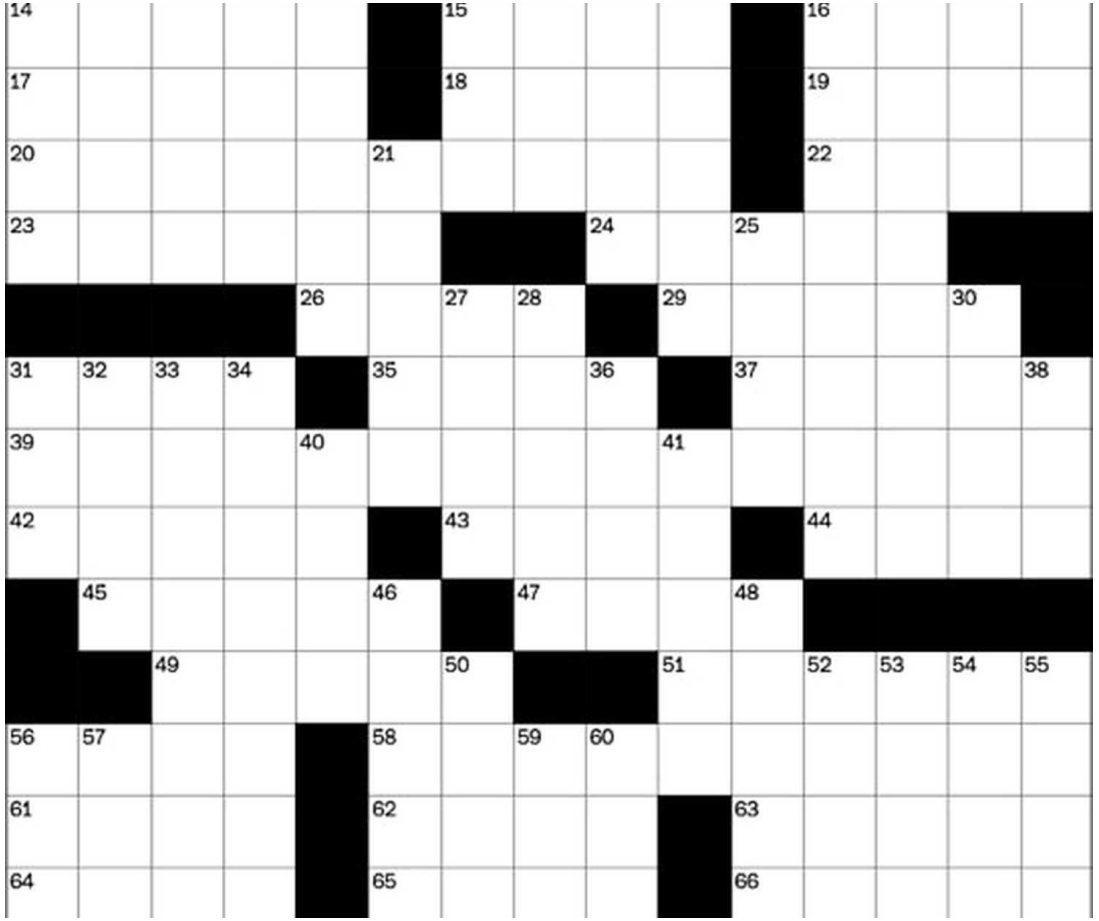


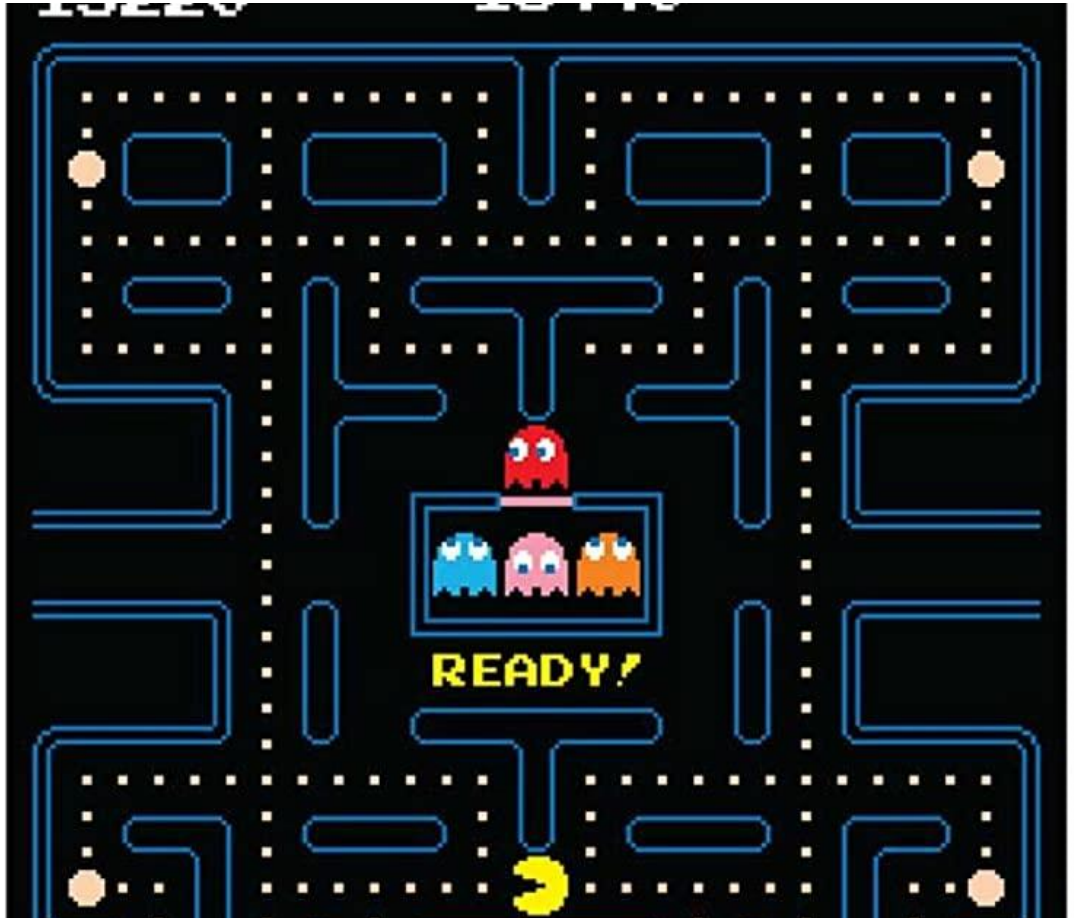


Discrete v. Continuous



Single Agent v. Multi Agent





When should something be considered an agent?

If we're talking about a self driving taxi, when should we consider something part of the environment versus another agent?

For instance, a telephone pole is part of the environment, but a car might be another agent.

When something behavior can best be described as having its own performance measure, then we should consider it to be an agent.

Examples

Task Environment	Observable	Agents	Deterministic	Episodic	Static	Discrete
Crossword puzzle	Fully	Single	Deterministic	Sequential	Static	Discrete
Chess with a clock	Fully	Multi	Deterministic	Sequential	Semi	Discrete
Poker	Partially	Multi	Stochastic	Sequential	Static	Discrete
Backgammon	Fully	Multi	Stochastic	Sequential	Static	Discrete
Taxi driving	Partially	Multi	Stochastic	Sequential	Dynamic	Continuous
Medical diagnosis	Partially	Single	Stochastic	Sequential	Dynamic	Continuous
Image analysis	Fully	Single	Deterministic	Episodic	Semi	Continuous
Part-picking robot	Partially	Single	Stochastic	Episodic	Dynamic	Continuous
Refinery controller	Partially	Single	Stochastic	Sequential	Dynamic	Continuous
Interactive English tutor	Partially	Multi	Stochastic	Sequential	Dynamic	Discrete

The Hardest Environment

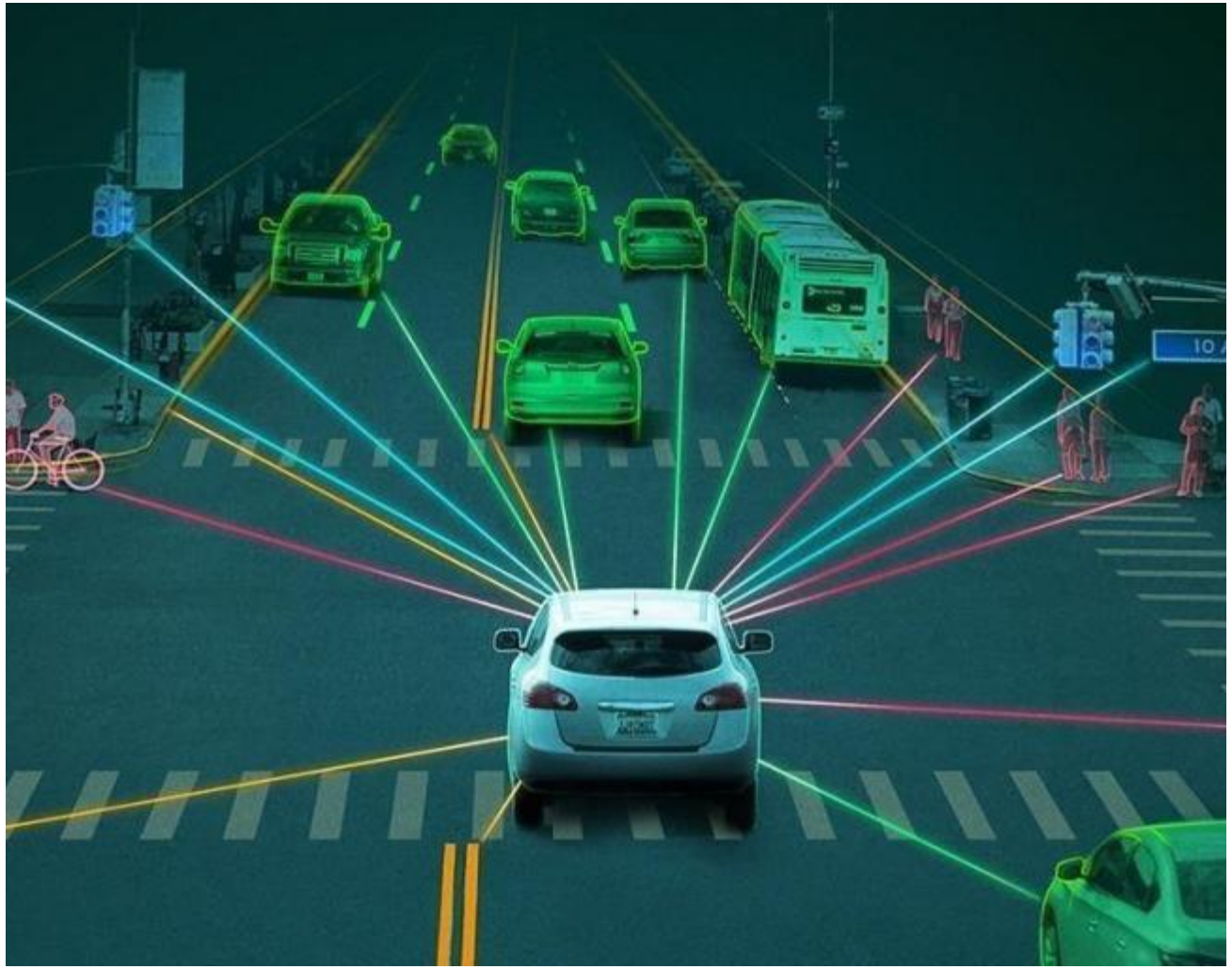
The hardest case is

Continuous

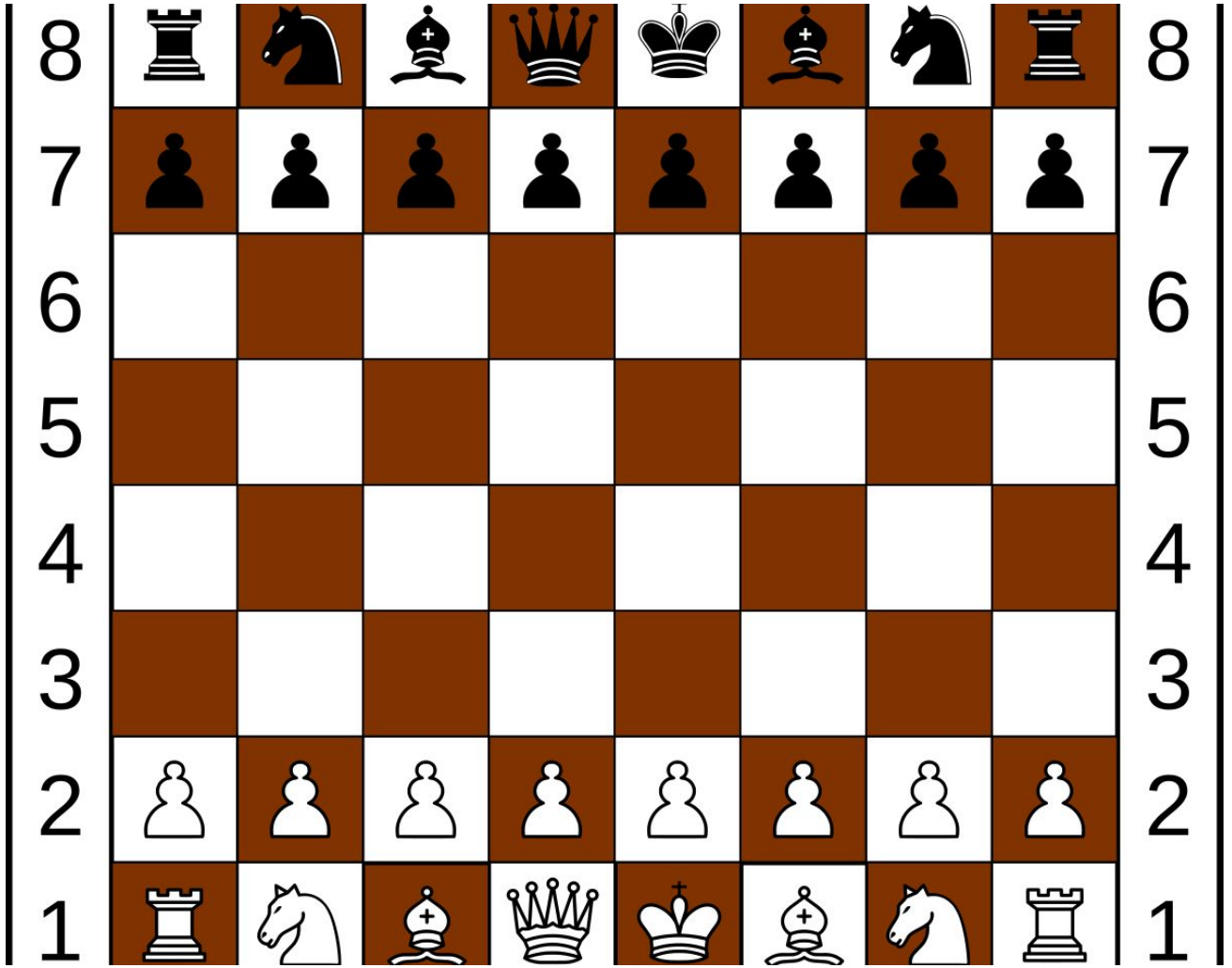
Partially Observable

Stochastic

Multiagent



Environment Restrictions for Now

We will assume environment is

- ***Static***
- ***Fully Observable***
- ***Deterministic***
- ***Discrete***