MONASH University

INTELLIGENT AGENTS AND RATIONALITY

FIT3080

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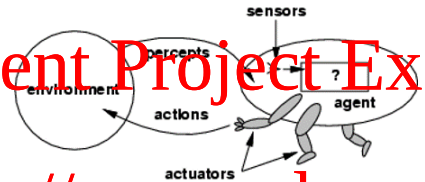
Outline

- Agents and environments
- Rationality
- PEAS (Performance measure, Environment, Actuators, Sensors)
- Environment types

Agents

- An agent is anything that can be viewed as perceiving its environment through sensors, and acting upon that environment through actuators
- Human agent:
  - eyes, ears and other organs for sensors
  - hands, legs, mouth and other body parts for actuators
- Robotic agent:
  - cameras and infrared range finders for sensors
  - various motors for actuators
- Software / virtual agent:
  - keyboard input, file input, receiving from network
  - screen, file output, sending to network

Agents and Environments

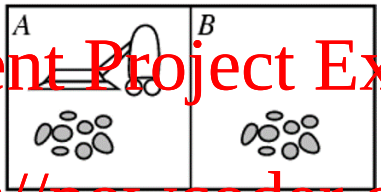


- The agent function f maps from percept histories $\mathcal{P}^\star$ to actions $\mathcal{A}$:

$$\mathrm{f}: \mathcal{P}^\star \rightarrow \mathcal{A}$$

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

Example: Vacuum-cleaner World and Agent



- Percepts: location and contents, e.g., [A, Dirty] or [B, Clean]
- Actions: Left, Right, Vacuum
- Program:

if status = Dirty **return** Vacuum
else if Location = A **return** Right
else if Location = B **return** Left

Rationality and Rational Agents

- Rationality depends on
  - Performance measure
  - The agent's prior knowledge of the environment
  - The actions that the agent can perform
  - The percept sequence to date
- Definition:

  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 the agent's built-in knowledge

Rational, Autonomous Agents

- Rationality is NOT omniscience
- Agents can perform actions to modify future percepts in order to obtain useful information
  - → exploration, learning
- An agent is autonomous if its behavior is determined by its own experience

Task Environment – PEAS

To design a rational agent, we must specify the Task Environment

- PEAS
  - Performance measure
  - Environment
  - Actuators
  - Sensors

PEAS – Automated Taxi example

- Performance measure
  - Safe, fast, legal, comfortable trip, minimize fuel consumption, maximize profit
- Environment
  - Road types, road contents, customers, operating conditions
- Actuators
  - Control over the car, interfaces for informing other vehicles and informing passengers
- Sensors
  - Cameras, sonar, speedometer, GPS, odometer, engine sensors, interface for receiving information from other vehicles and passengers (e.g., speech recognizer)

Performance measure considerations

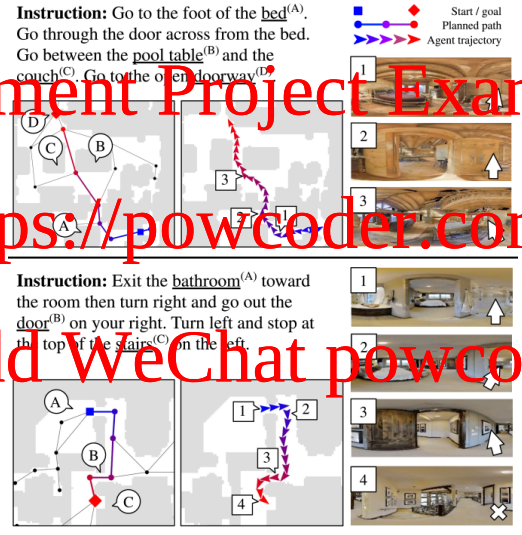
Rational agent:

- maximize *expected* performance measure, considering both now and the future.

Performance	Score
Safe	Every crash: -100 Arrives unharmed: +500
Fast	Every second -0.1
Legal	Every violation: -500
Comfortable	Every speed bump -10 Sudden turn, braking -50
Fuel consumption	Every liter -0.5

General rule: better to design performance measures according to what one actually wants, than according to how one thinks an agent should behave

PEAS Example: Vision-Language Navigation



Chen *et al.*, Topological Planning with Transformers for Vision-and-Language Navigation, CVPR 2021.

PEAS Example: Vision-Language Navigation

In break-out rooms,

- Check https://bringmeaspoon.org/ and the other links in this web-page (5 min)
- Discuss what you think PEAS should be in this problem (5 min)
- Afterwards, we will discuss the responses

Environment Types (I)

The environment type largely determines the agent design

- Fully (partially) observable – An agent's sensors give it access to the complete state of the environment at all times
- Known (unknown) – An agent knows the "laws" of the environment
- Single (multi) agent – An agent operating by itself in an environment
- Deterministic (stochastic) – The next state is completely determined by the current state and the action executed by the agent

Environment Types (II)

- Episodic (sequential) – The agent's experience is divided into atomic *episodes*. The next episode does NOT depend on previous actions
  - In each episode an agent perceives a percept and performs a single action
- Static (dynamic) – The environment is unchanged while an agent is deliberating
- Discrete (continuous) – Pertains to number of states, the way time is handled, and number of percepts and actions
  - E.g., a state may be continuous, but actions may be discrete

Next week:
Search algorithms