What is AI?

- **Russell and Norvig** view definitions of AI fall into four categories:
  - Systems that think like humans.
  - Systems that act like humans.
  - Systems that think rationally.
  - Systems that act rationally.

🎓 Just understand each type of them and explain in your own words

What is AI?

Thinking Humanly	**Thinking Rationally**
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985) "The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990) "The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998) "AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Figure 1.1 Some definitions of artificial intelligence, organized into four categories.

Agents and Environments

- An **agent** is anything that can be viewed as *perceiving* its environment through sensors and *acting* upon that environment through actuators.
- Human agent has:
  - Eyes, ears, and other organs for sensors;
  - Hands, legs, mouth, and other body parts for actuators.
- Robotic agent has:
  - Cameras and infrared range finders for sensors;
  - Various motors for actuators.
- Software agent:
  - Receives keystrokes, file contents, and network packets as inputs;
  - Displays on screen, writes files, and sends net packets as outputs.

☞ agent = architecture + program

Rational Agents

- Need to distinguish between rationality and ***omniscience***
  - An omniscient agent (all-knowing with infinite knowledge) knows the actual outcome of its actions, and can act accordingly.
  - But omniscience is impossible in reality.
- Rationality is not the same as ***perfection***
  - Rationality maximizes expected performance, while perfection maximizes actual performance.
- Agents, to be rational, can perform actions to obtain useful information in order to modify future percepts (information gathering, exploration).
- A rational agent should be ***autonomous***
  - Its behavior is determined by its own experience (with ability to learn and adapt its prior knowledge).

- The **task environment** of any agent includes:
  1. Performance measure.
  2. Environment.
  3. Actuators.
  4. Sensors.
- For the acronymically minded, we call this the **PEAS** (**P**erformance, **E**nvironment, **A**ctuators, **S**ensors) description.

PEAS of Taxi Driver

- The task environment of designing an automated taxi driver:
  - Performance measure: Safe, fast, legal, comfortable trip, maximize profits.
  - Environment: Roads, other traffic, pedestrians, customers.
  - Actuators: Steering wheel, accelerator, brake, signal, horn.
  - Sensors: Cameras, sonar, speedometer, odometer, GPS, engine sensors, keyboard

Properties of Task Environments

- The task environments can be categorized according to number of dimensions:
  - **Fully observable** (vs. **partially observable**): An agent's sensors give it access to the complete state of the environment at each point in time.
  - **Single agent** (vs. **multi-agent**): An agent operating by itself in an environment.
  - **Deterministic** (vs. **stochastic**): 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 task environment, the agent's experience is divided into atomic episodes – each episode consists of the agent percept and then performing a single action.

Properties of Task Environments

- The task environments can be categorized according to number of dimensions:
  - **Dynamic** vs. **static**: If the environment can change while an agent is deliberating, then we say the environment is dynamic for that agent; otherwise, it is static.
  - **Discrete** (vs. **continuous**): A limited number of distinct, clearly defined percepts and actions.
  - **Known** (vs. **unknown**): The rules of the game, or physics/dynamics of the environment are known to the agent.
- These properties of various task environments determine the appropriate agent design and the applicable technique for agent implementation.

Properties of Task Environments

	Chess with a clock	Chess without a clock	Taxi driving
Fully observable	Yes	Yes	No
Single agent	No	No	No
Deterministic	Strategic	Strategic	No
Episodic	No	No	No
Static	Semi	Yes	No
Discrete	Yes	Yes	No
Known	Yes	Yes	Yes

- The hardest case is *partially observable*, *multi-agent*, *stochastic*, *sequential*, *dynamic*, *continuous*, and *unknown*.

Skeleton Agent

function SKELETON-AGENT (*percept*) **returns** *action*

static: *memory*

memory ← UPDATE-MEMORY(*memory, percept*)

action ← CHOOSE-BEST-ACTION(*memory*)

memory ← UPDATE-MEMORY(*memory, action*)

return *action*