# 2. Agent Modelling

Course: Introduction to AI
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# Reminder

Model of Artificial Intelligence to emulate:

1. Human Thoughts
2. Human Actions
3. Rational Thoughts
4. Rational Actions

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4. **Rational Actions**
   - Operate autonomously, sense the environment, create, adapt and pursue goals in a way so as the maximise gains.

# Reminder

1. Human Thoughts
2. Human Actions
3. Rational Thoughts
4. **Rational Actions**
   - Operate autonomously, sense the environment, create, adapt and pursue goals in a way so as the maximise gains.
   - **John McCarthy wanted to name the area of enquiry *Computational Rationality* instead of *Artificial Intelligence***

# Autonomous agents

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# Autonomous agents

- The aim of AI is to create agents that can conduct autonomously in specified task environments.
- A task environment is characterised in terms of the following components:
  - **P**erformance measure
  - **E**nvironment description
  - **A**ctuators
  - **S**ensors

# Task environment - Performance measure

## Performance measure

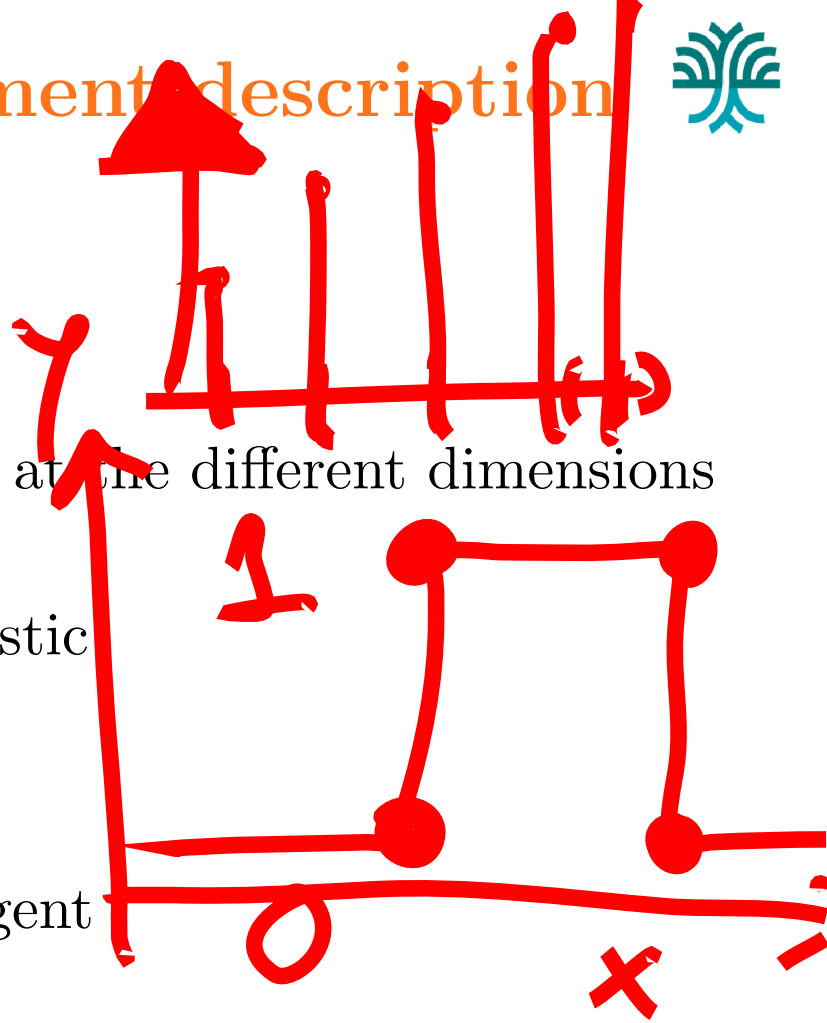
What is the measure of how well the agent is doing?

- Has the agent reached the goal state?
- Has the agents received the most rewards along the way?
- Has the agent arrived at goal without injury to self or others?

Value

**Figure:** Task Environment

# Task environment - Environment description



## Environment description

What is the environment type? Let's look at the different dimensions of variability.

- Deterministic ——— Stochastic
- Discrete ——— Continuous
- Episodic ——— Sequential
- Single agent ——— Multi agent
- Static ——— Dynamic
- Partially Observed ——— Fully Observed
- Known ——— Unknown

# Task environment - Environment description

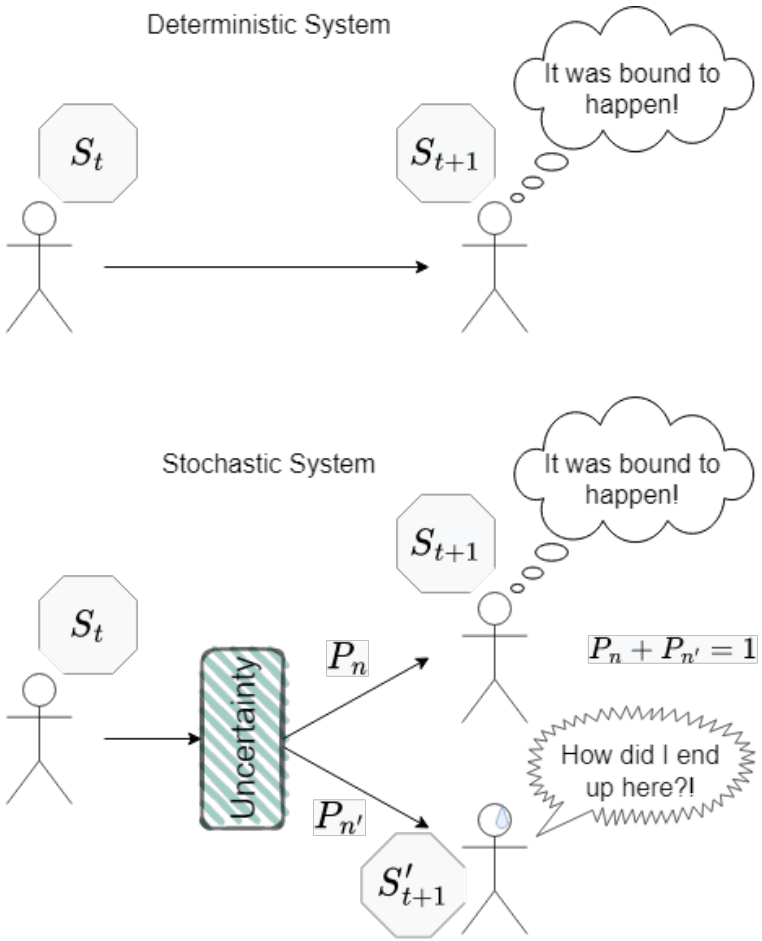



**Figure:** Deterministic vs. Stochastic

# Task environment - Environment description

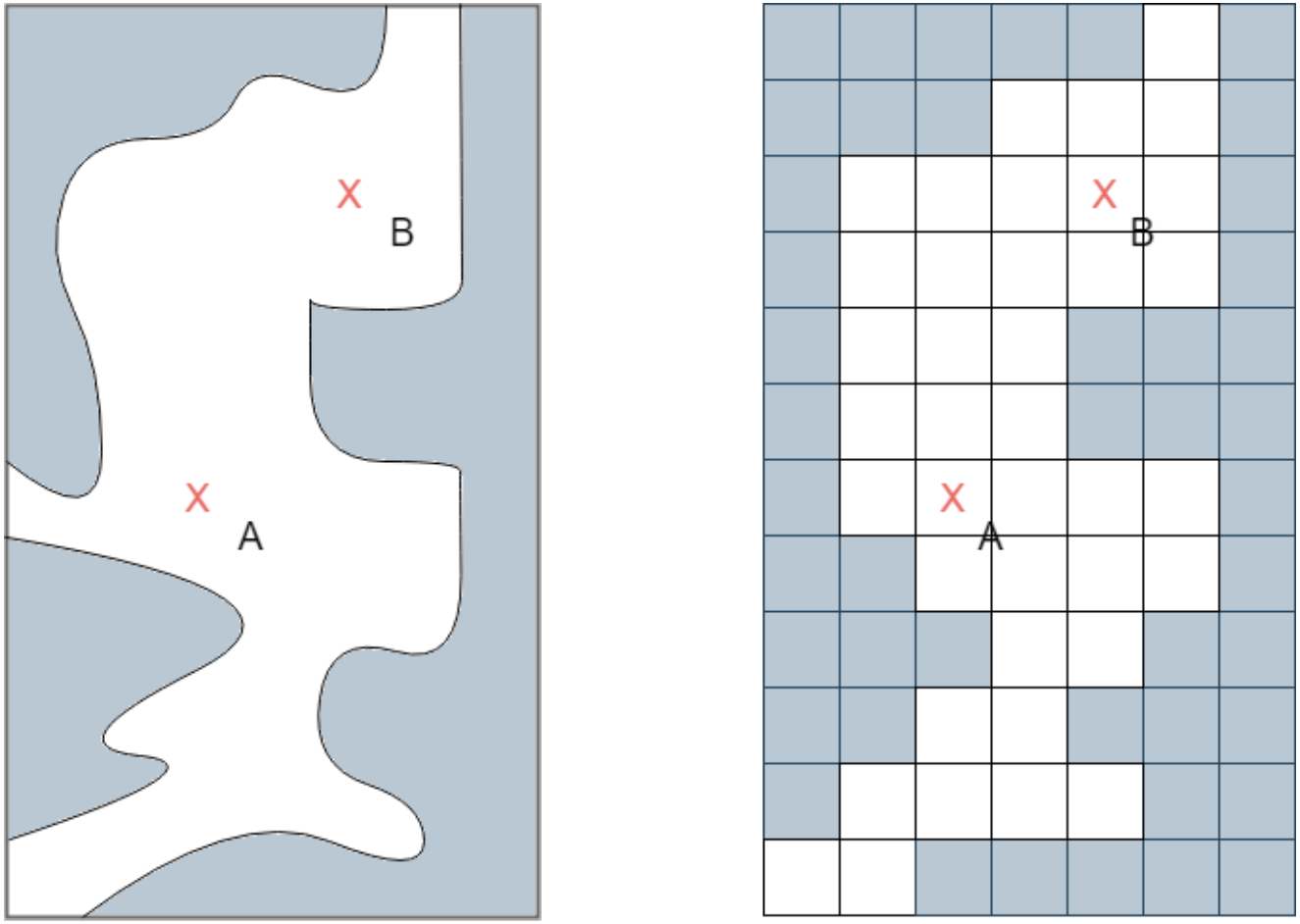



**Figure:** Continuous vs. Discrete

# Task environment - Environment description

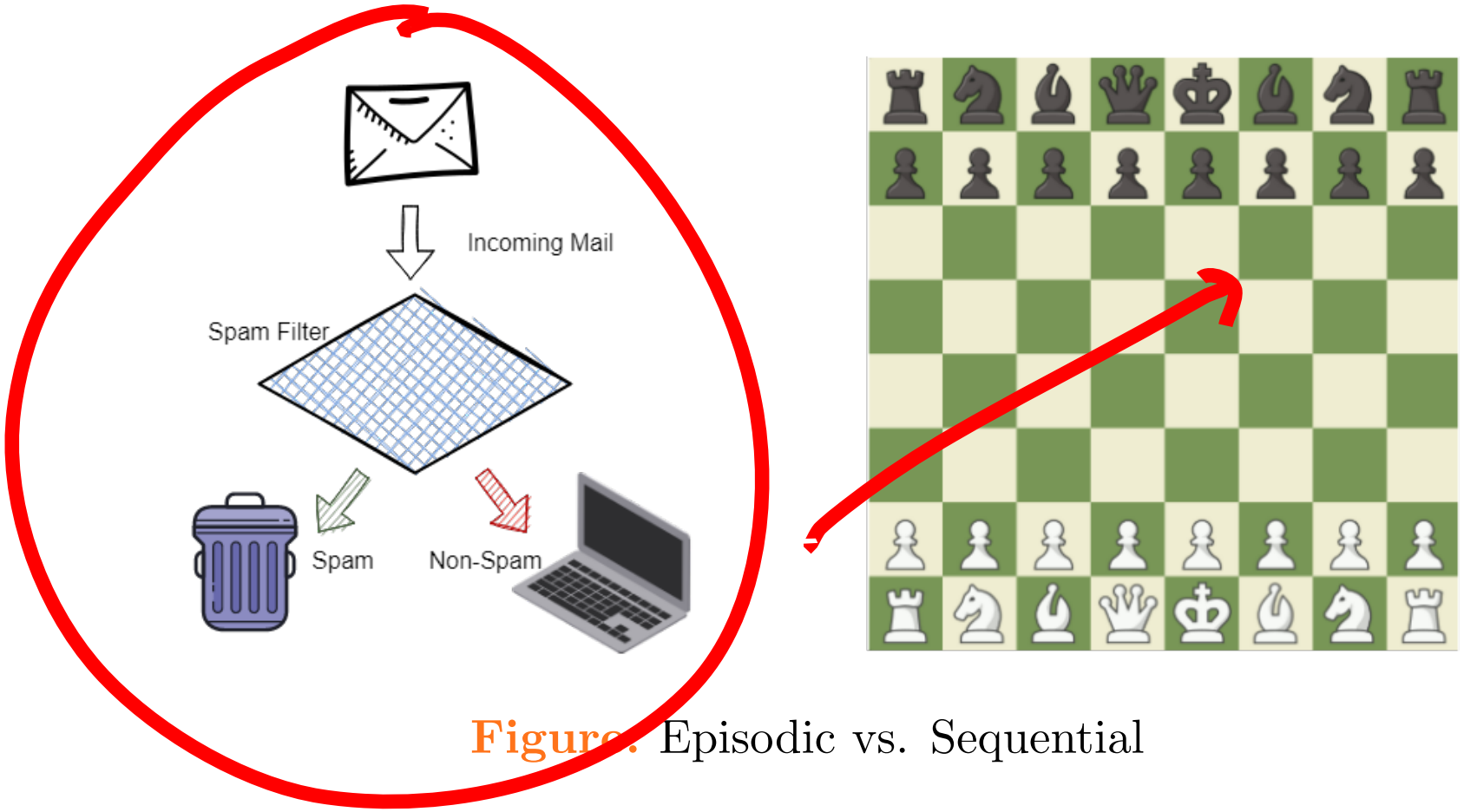



**Figure:** Episodic vs. Sequential

# Task environment - Environment description

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | 3 | | | 7 | | | | |
| 6 | | | 1 | 9 | 5 | | | |
| | 9 | 8 | | | | | 6 | |
| 8 | | | | 6 | | | | 3 |
| 4 | | | 8 | | 3 | | | 1 |
| 7 | | | | 2 | | | | 6 |
| | 6 | | | | | 2 | 8 | |
| | | | 4 | 1 | 9 | | | 5 |
| | | | | 8 | | | 7 | 9 |

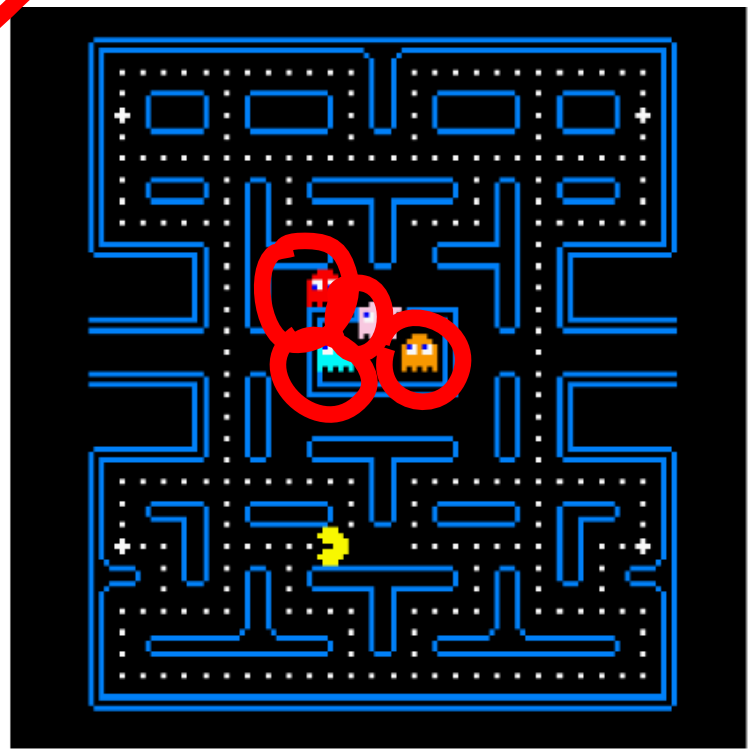


**Figure:** Single vs. Multi agent

# Task environment - Environment description

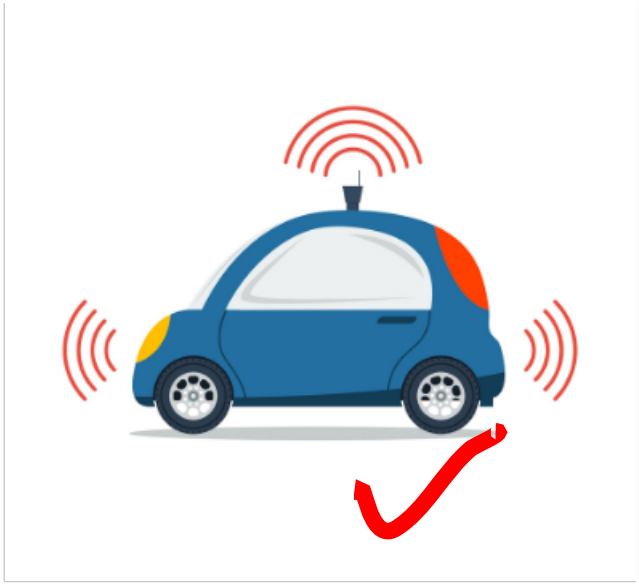



**Figure:** Static vs. Dynamic

# Task environment - Environment description

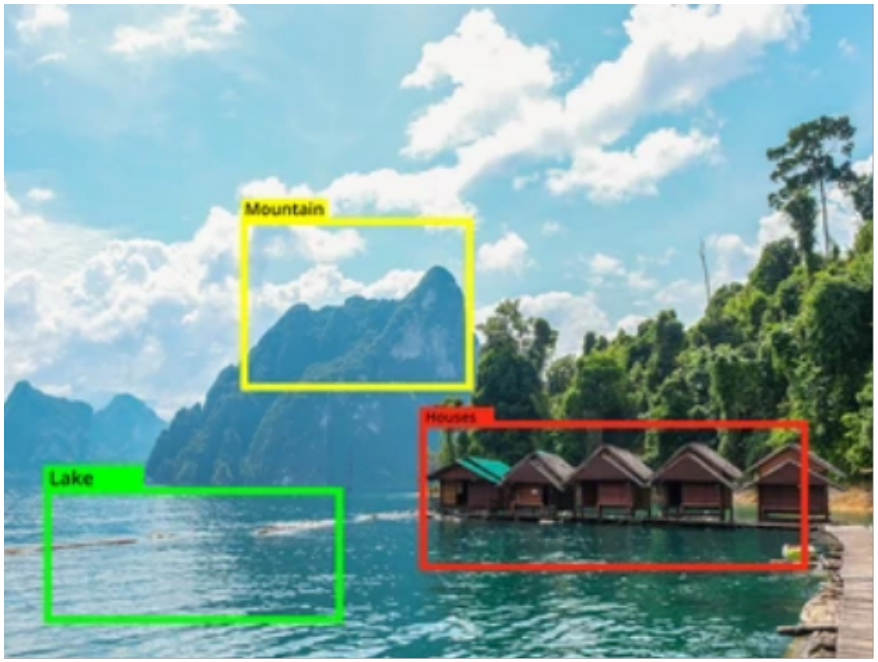
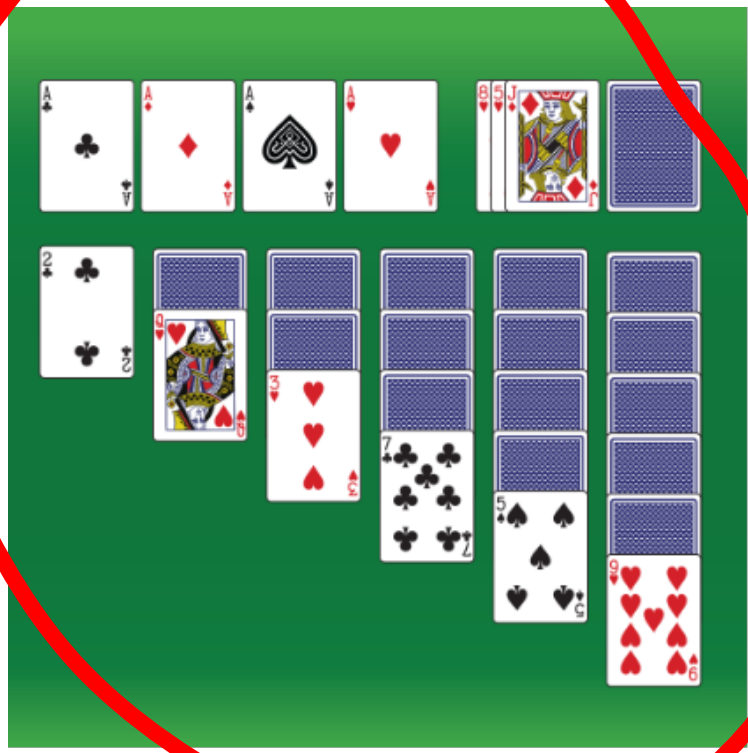



**Figure:** Fully vs. Partially observed

# Task environment - Environment description



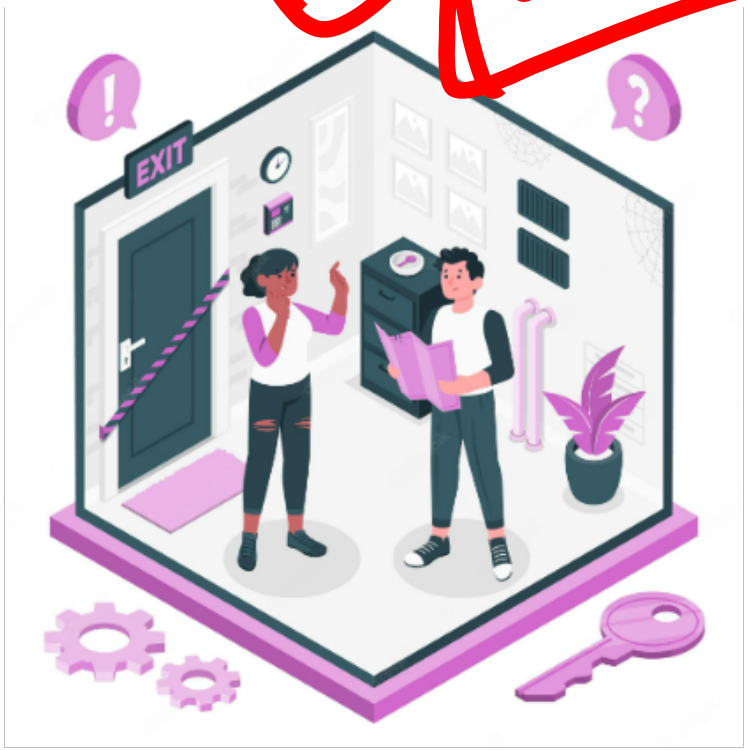


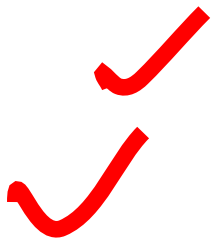

**Figure:** Known vs. Unknown

# Task environment: Actuators

**Actuators**

The actions that the agent can perform in the space

- Can the agent move an arm?
- Can the agent walk?



# Task environment: Sensors

**Sensors**

How much and what of the environment can the agent observe/sense?

- Can the agent see behind walls?
- Can the agent perceive the intention of fellow driver on the road?

# Task environment: Interaction of Components

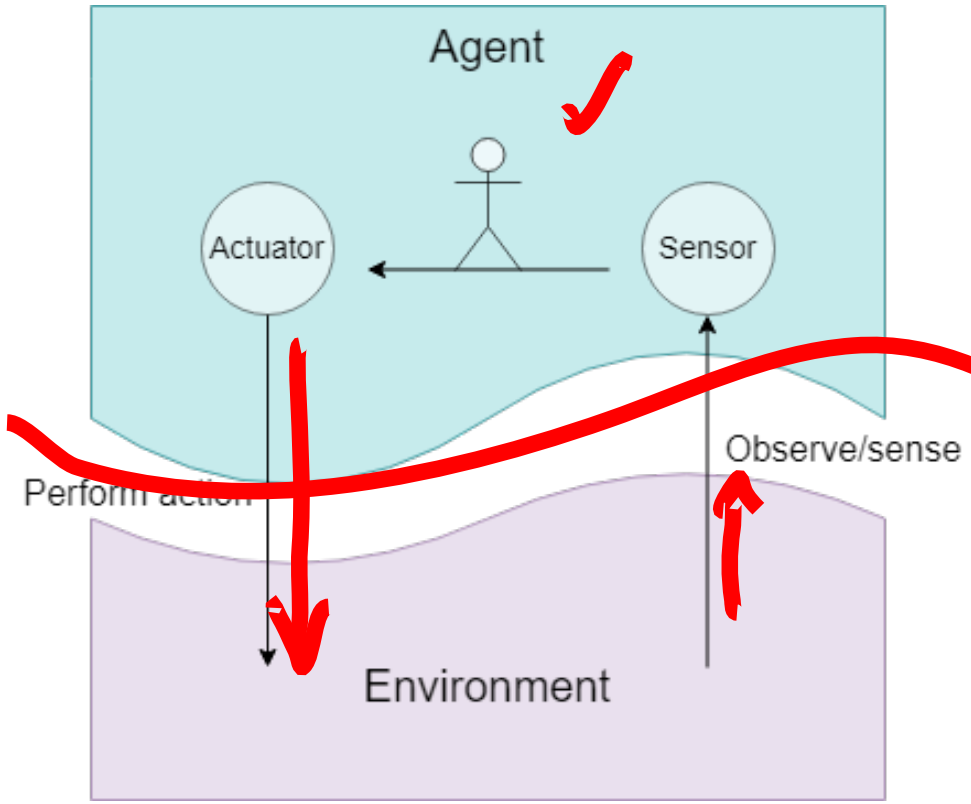
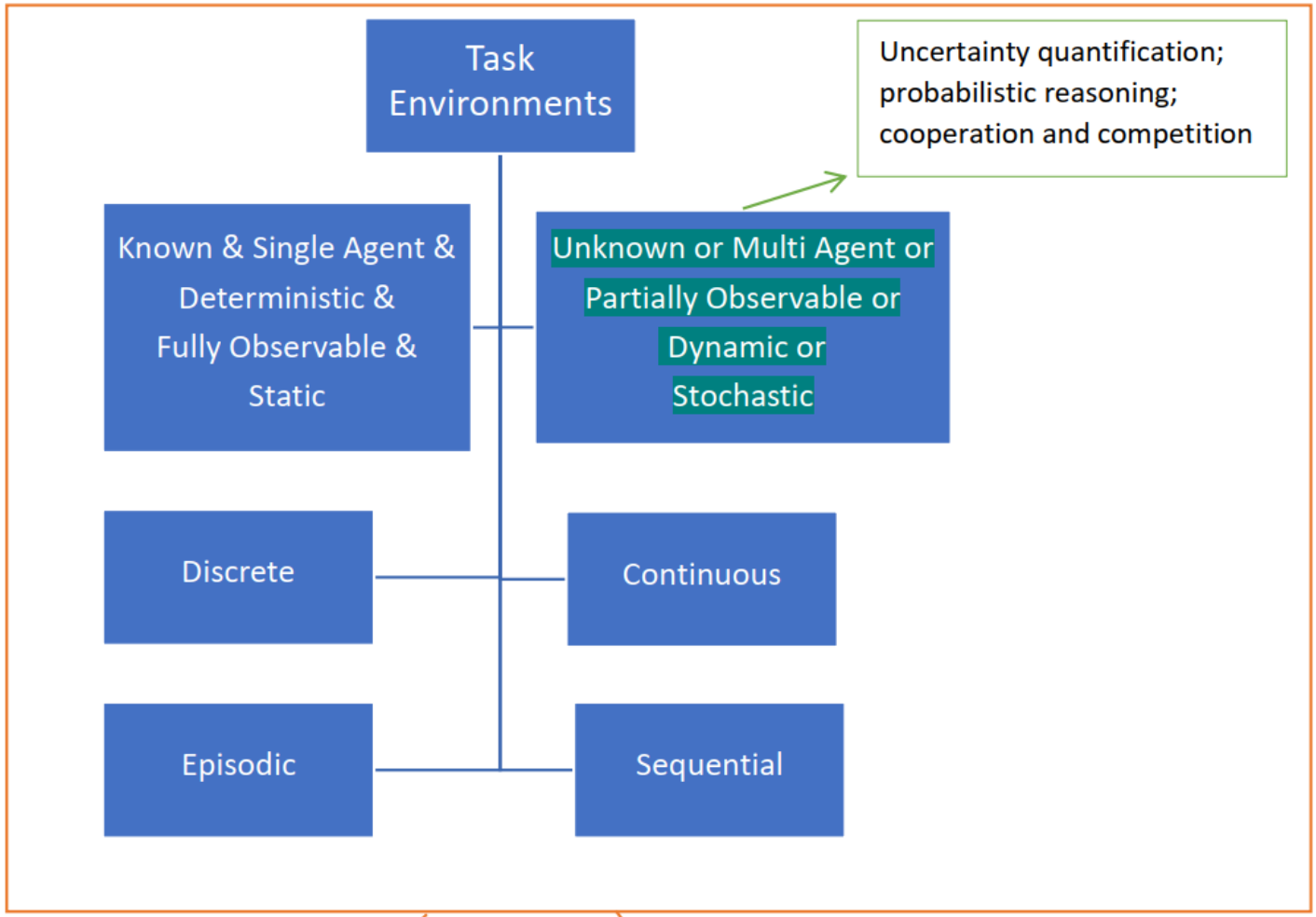



**Figure:** Constraints on observations and actions affect the description/nature of the environment.

# Types of Environments: A Taxonomy




**Problem-solving agent**

(Efficient, Special-purpose search algorithms)

**Planned agent**

(General-purpose algorithms i.e. knowledge representation and reasoning)

# Overview

1. **Reminder**
   - Computational Rationality
2. **Autonomous agents**
3. **Task environments**
   - Performance measure
   - Environment description
   - Actuators
   - Sensors
4. **Types of Environments: A Taxonomy**