RUTGERS

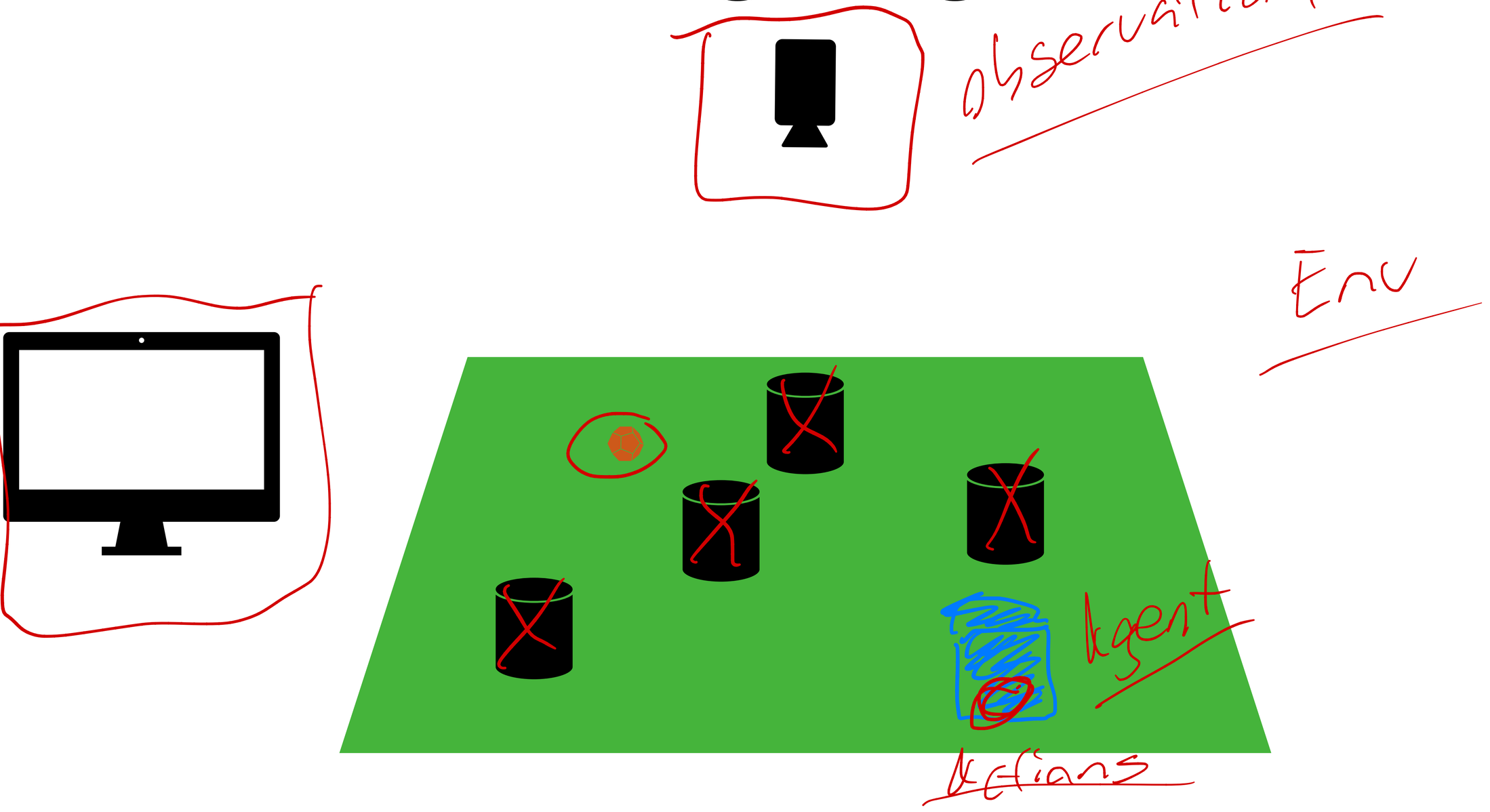
THE STATE UNIVERSITY
OF NEW JERSEY

Introduction to Artificial Intelligence

Intelligent Agents

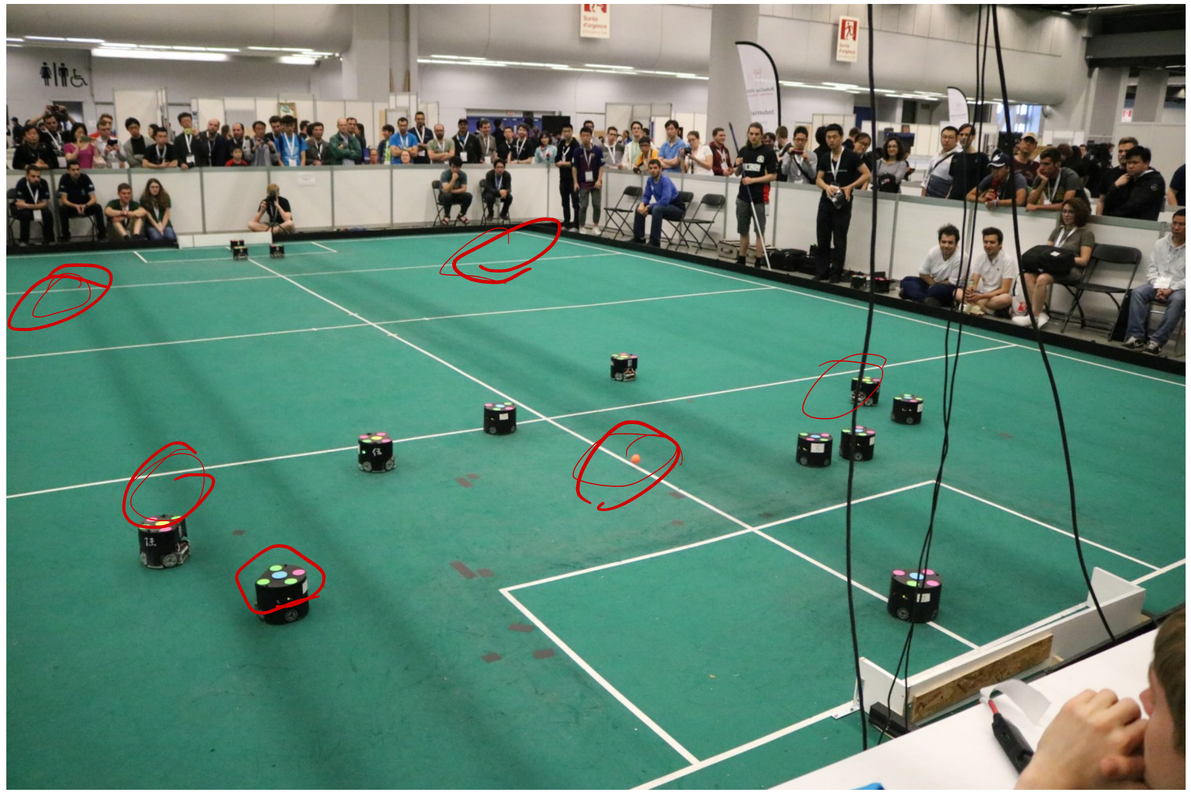
Edgar Granados

Intelligent Agent

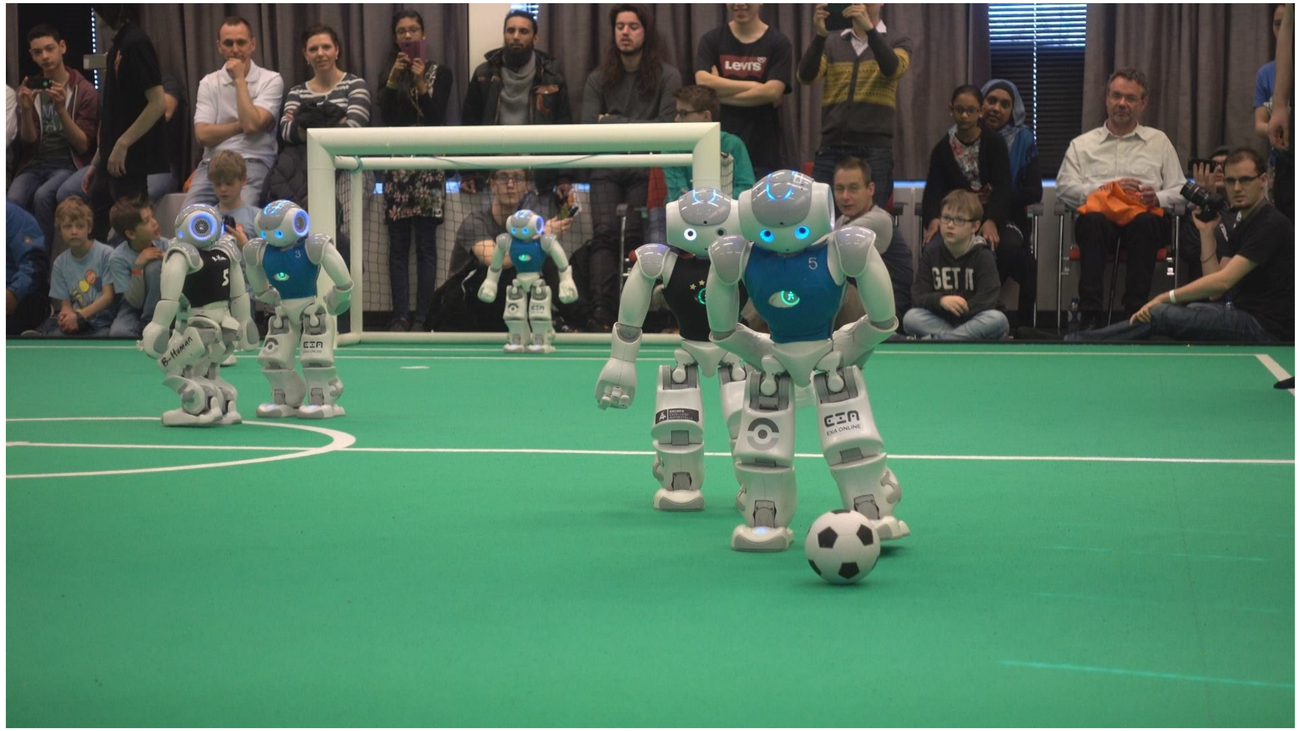


Intelligent Agent

Nao



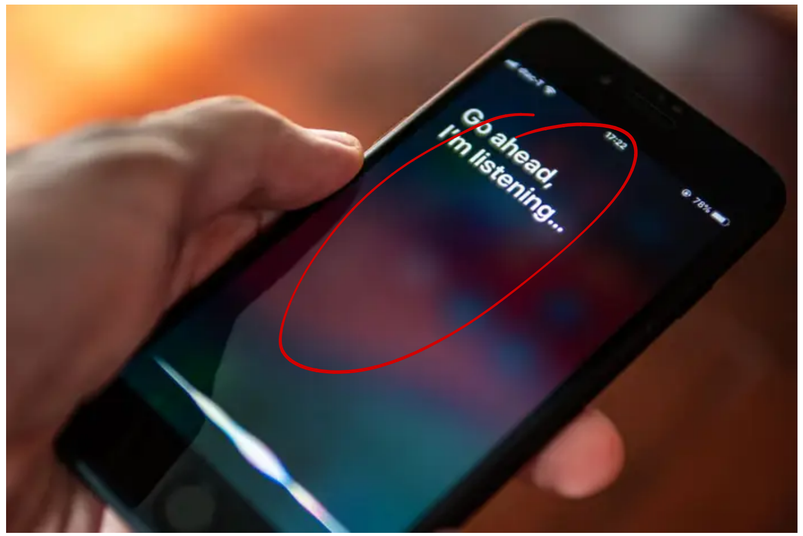
SSL

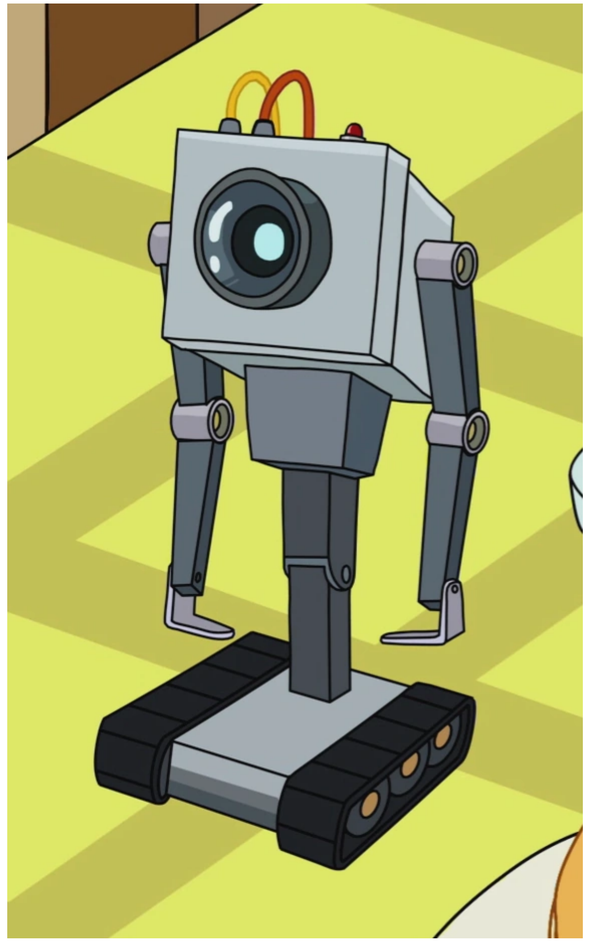


SPL

Intelligent Agent

- Choose actions based on previous actions and observations
- A function that maps history of actions and observations into actions



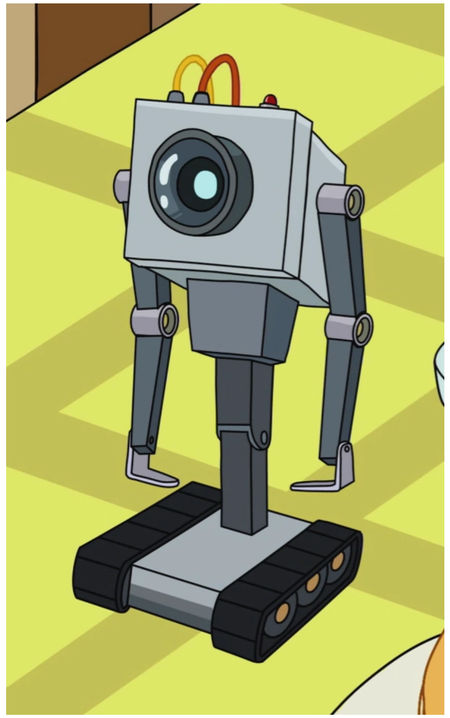


Intelligent Agent

Simple example: Pass the butter

A

Away from Butter



Obs: {location, Pass?}

Actions: {Move, Stay}

Percept Seq	Action
[A, Pass]	Move
[A, Not Pass]	Stay
[B, Pass]	Move
[B, Not Pass]	Stay
[A, Pass], [A, Pass]	Move
[A, Pass], [B, Pass]	Move
(...)	

B

Butter

Intelligent Agent

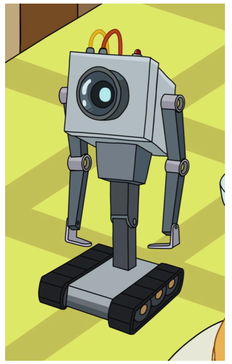
Simple example: Pass the butter

- Is rational?
- Is it working correctly?

Rational: **Performance** is Maximal

Not a single definition of *performance*!

Away from Butter



Butter

- Reward when action done correctly
- Reward when action done correctly AND penalize for energy used

Task Environments

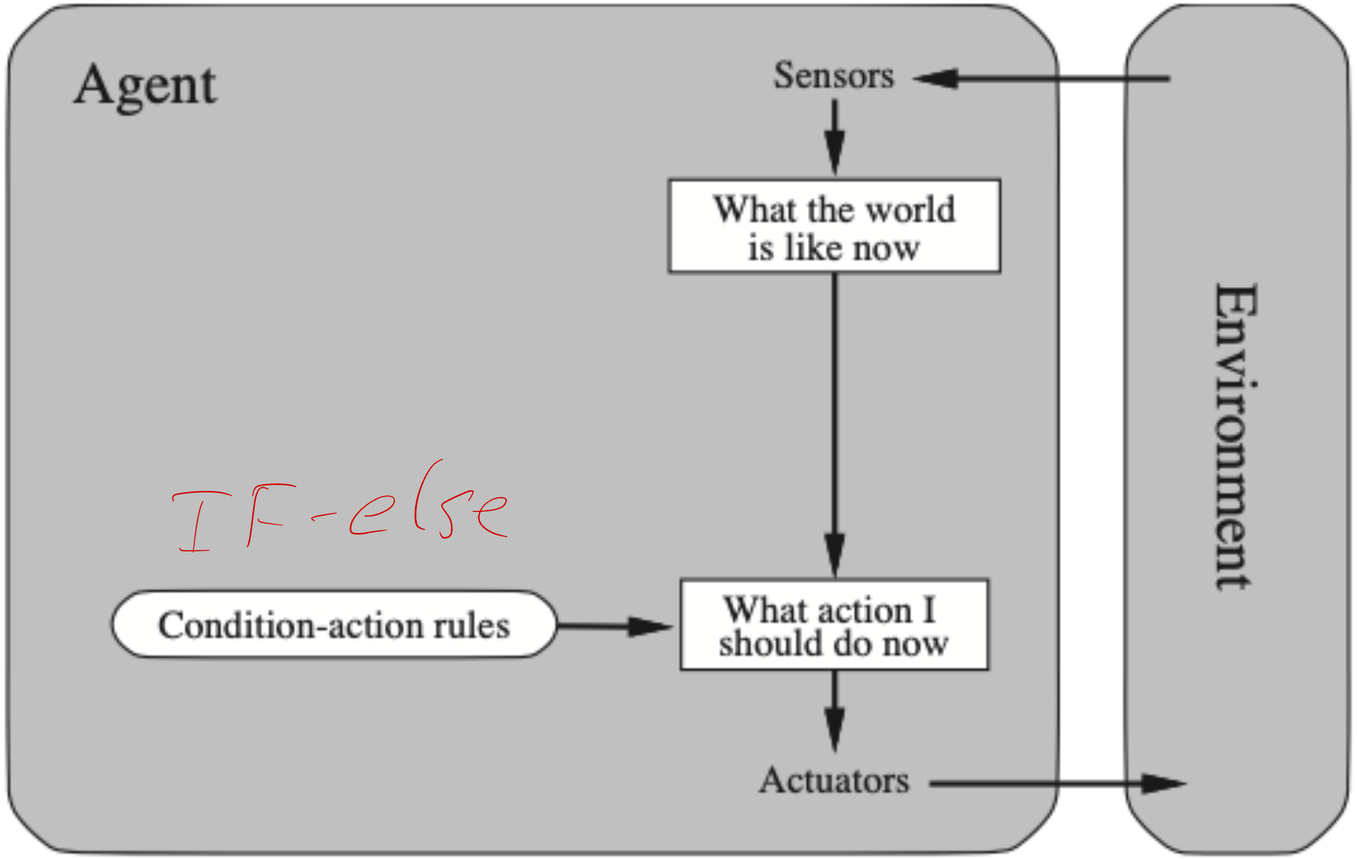
Properties

Performance, Environment, Actuator, Sensors PEAS

- Observability: Full vs Partial
- Number: Single vs Multi
- Deterministic vs Stochastic
- Episodic vs Sequential
- Discrete vs Continuous
- Known vs Unknown

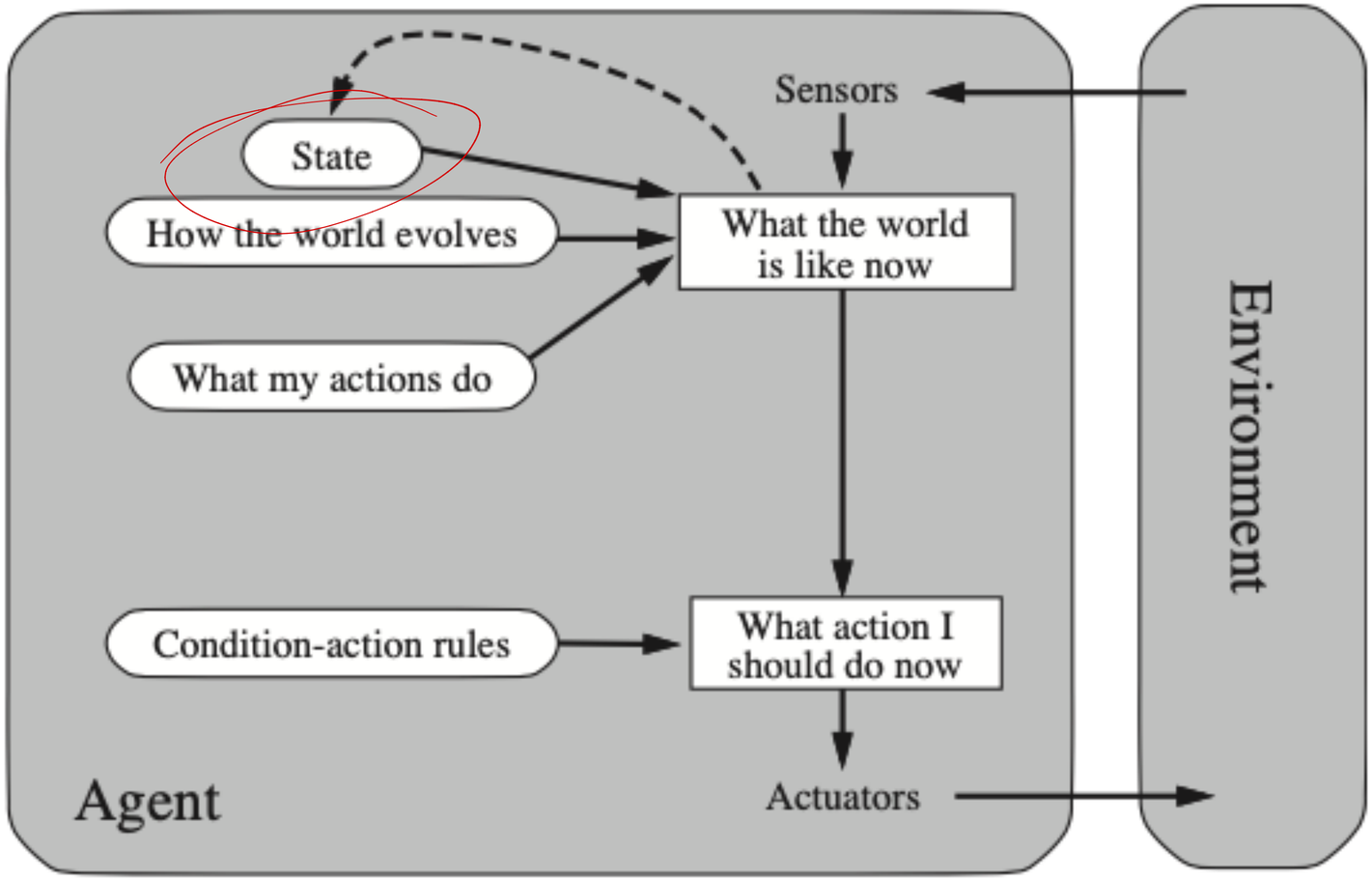
Types of Agents

Simple Reflex Agent



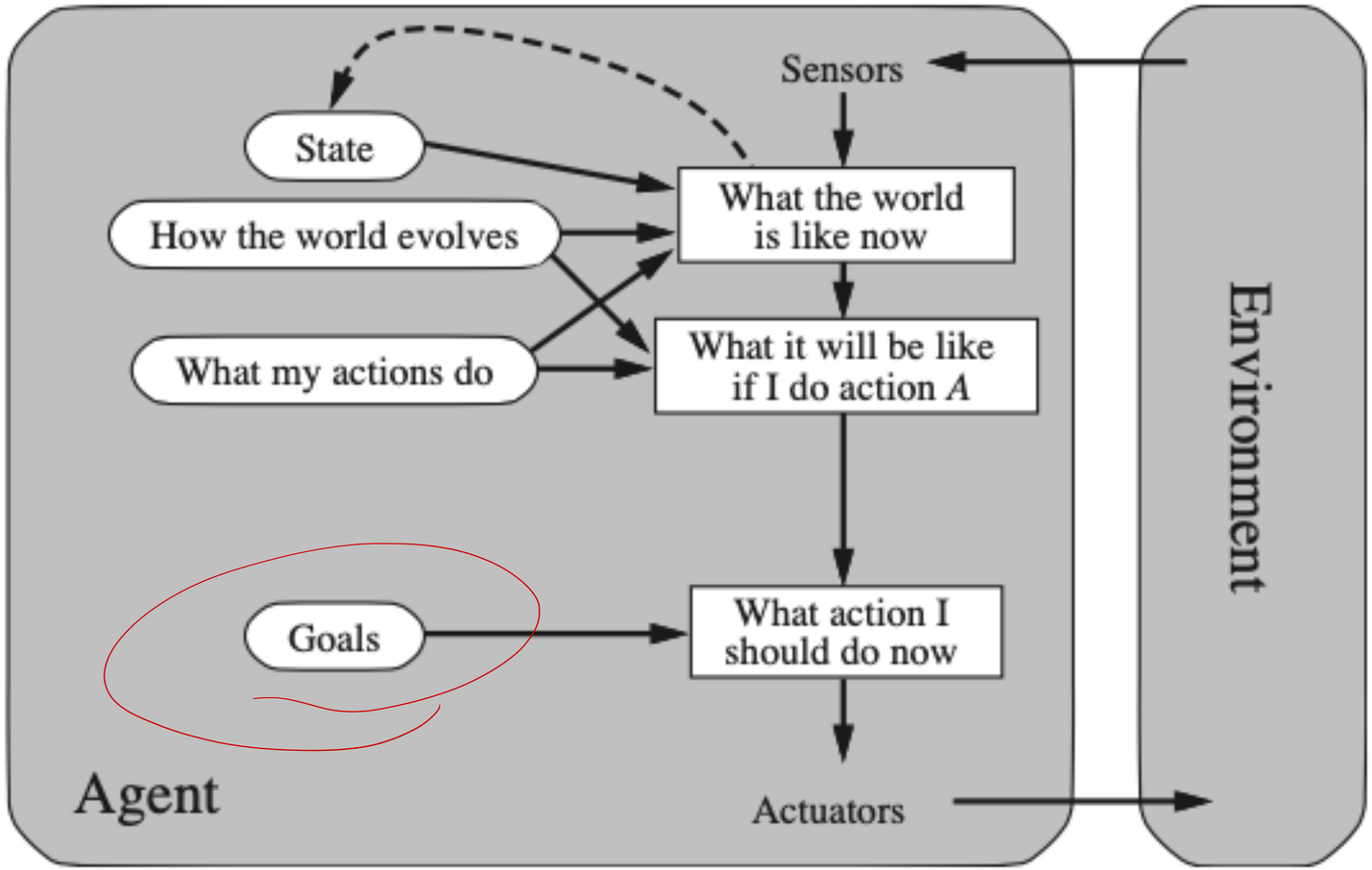
Types of Agents

Model-based Reflex Agent



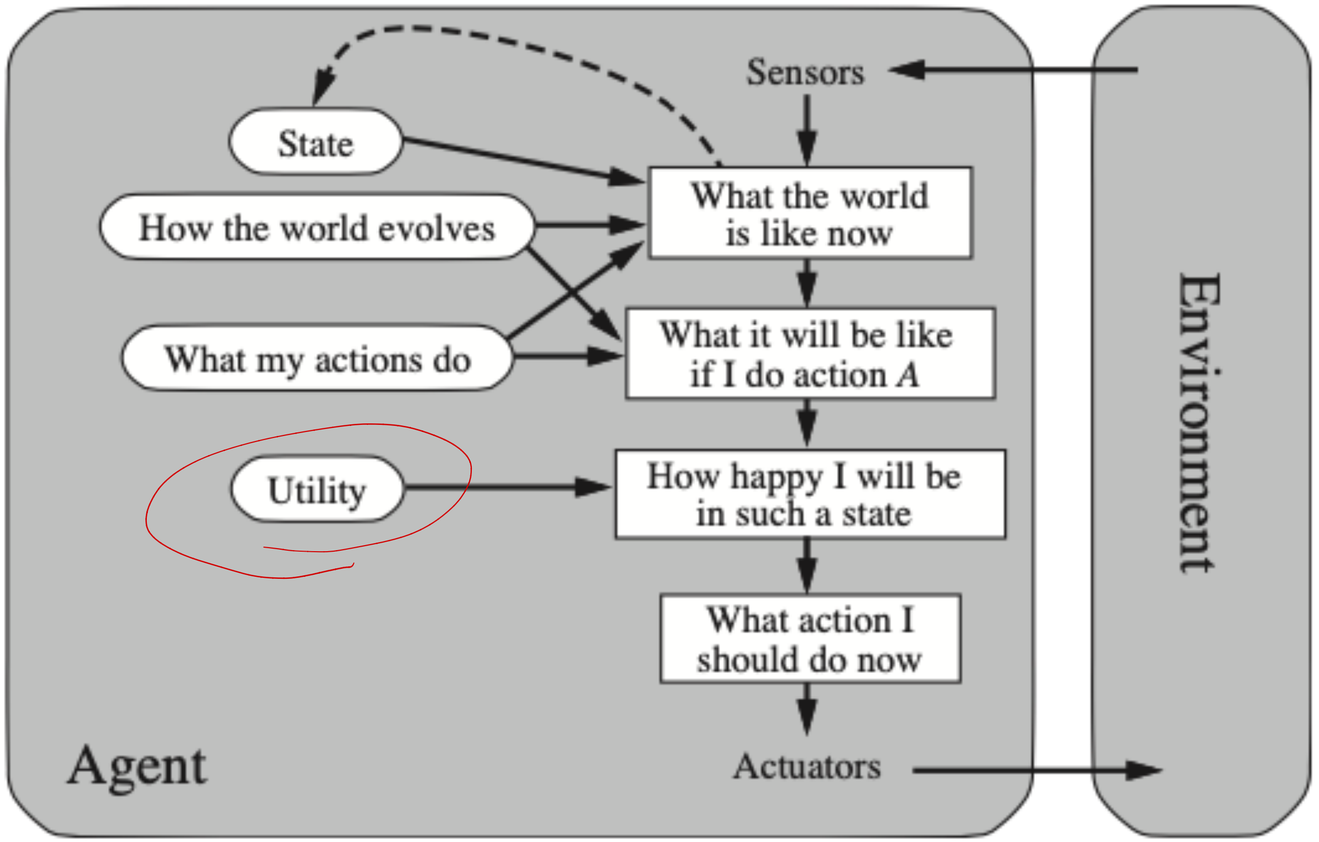
Types of Agents

Goal-based Reflex Agent



Types of Agents

Utility-based Reflex Agent



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Introduction to Artificial Intelligence

A Well-Defined Problem

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A Well-Defined Problem

- **States**: Set of possible situations/configurations/positions
- **Initial State**: Where the agent starts
- **Goal State(s)**: A function could be used
- **Actions**: Set of everything an agent can do to change its current state
- **Transition model**: The effect of applying the action
- **Cost**: A function that assigns a numeric value to the action taken

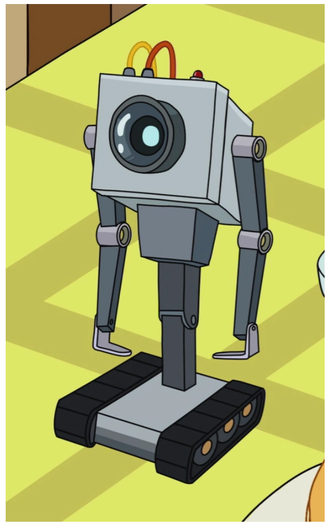
goal_func(s) = d(s, PH) < 0.5

$$\text{Total Cost}(seq) = \sum_{i=0}^{I} cost(A_i)$$

A Well-Defined Problem

Pass the Butter Robot

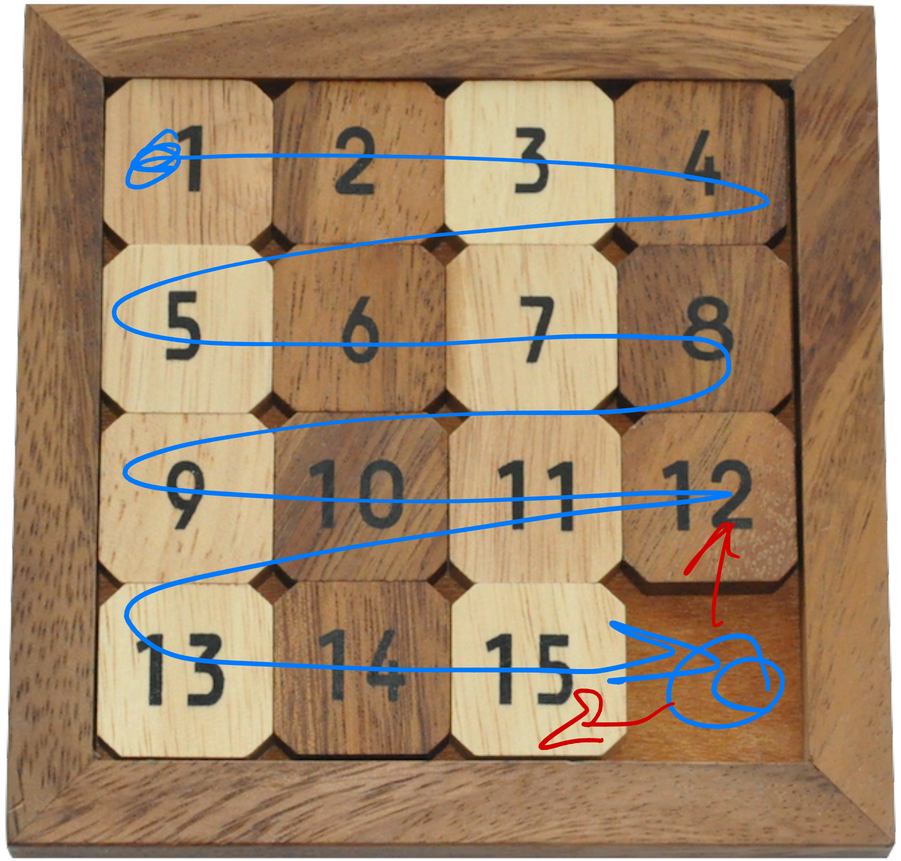
- **States:** [A, B]
- **Initial State:** A | B
- **Goal State(s):** Pass the Butter
- **Actions:** Pass, Stay
- **Transition model:** Det.
- **Cost:** 1
  - Battery Usage



A Well-Defined Problem

Sliding-Block Puzzle

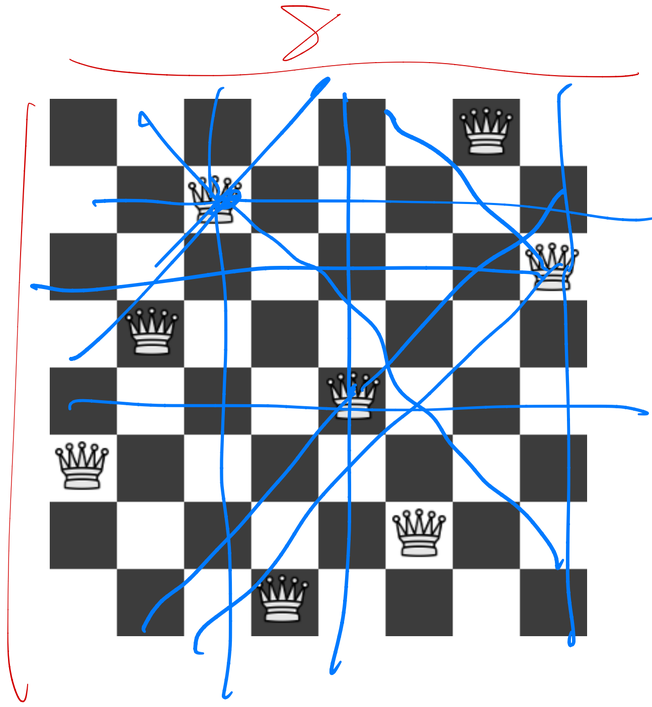
- **States:** 16!
- **Initial State** Any
- **Goal State(s):** (1, 2, ..., 15, ␣)
- **Actions:** R, L, U, D
- **Transition model:** Det
- **Cost:** 1 per action



A Well-Defined Problem

Eight Queen Problem

- **States:** $64 \times 63 \times 62 \times \dots \times 57$
- **Initial State:** Empty Board
- **Goal State(s):** 8 placed Queens Not facing each other
- **Actions:** Put a Queen
- **Transition model:** Det
- **Cost:** 1, 0



A Well-Defined Problem

Donald Knuth's Conjecture

Starting at 3, any integer can be reached by iterating factorial, sqrt and floor

Example: $\left\lfloor \sqrt{\sqrt{(3!)!}} \right\rfloor = 5$

- **States**:
- **Initial State**: 3
- **Goal State(s)**: a given number
- **Actions**: ! √ ⌊ ⌋
- **Transition model**: Det
- **Cost**: 1