Introduction to Artificial Intelligence

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CMSC 170 – Introduction to AI
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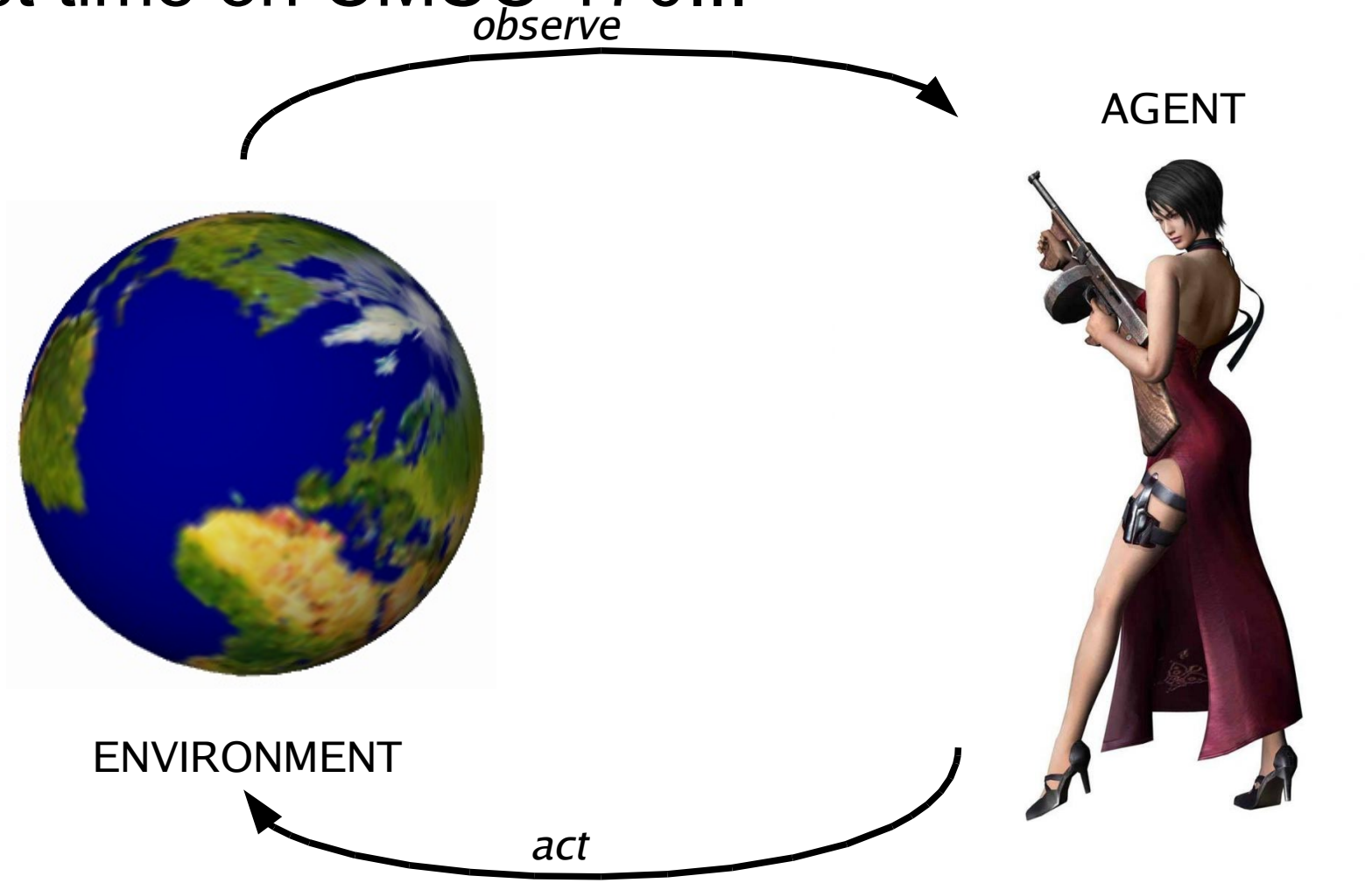
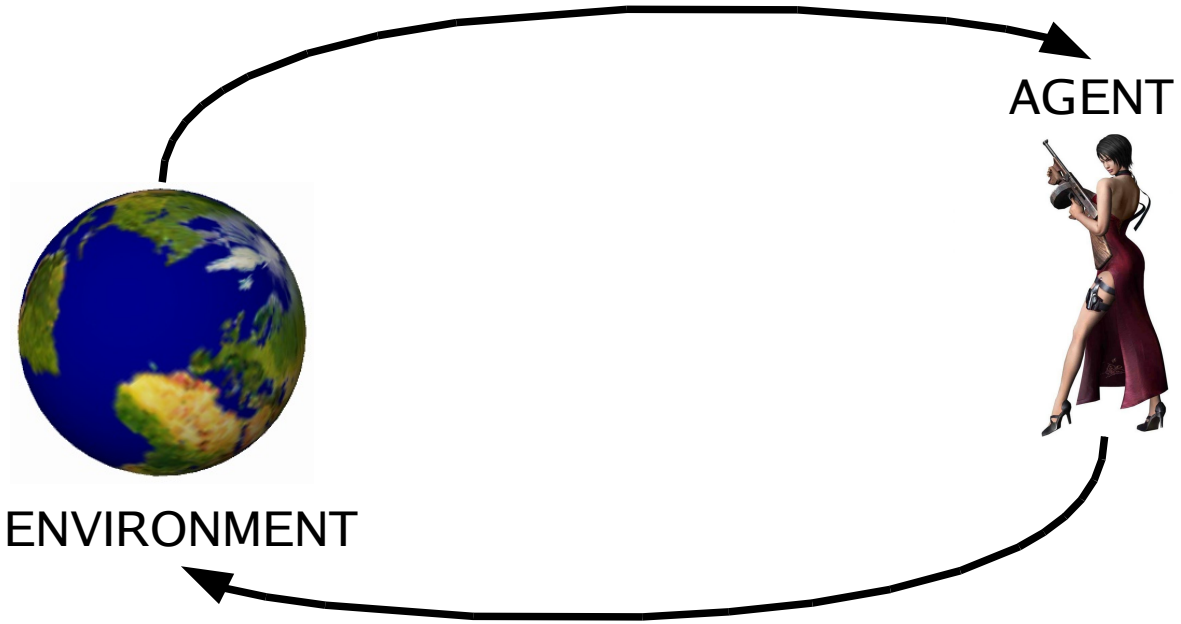
Agents + Environment

Last time on CMSC 170...



Agents + Environment

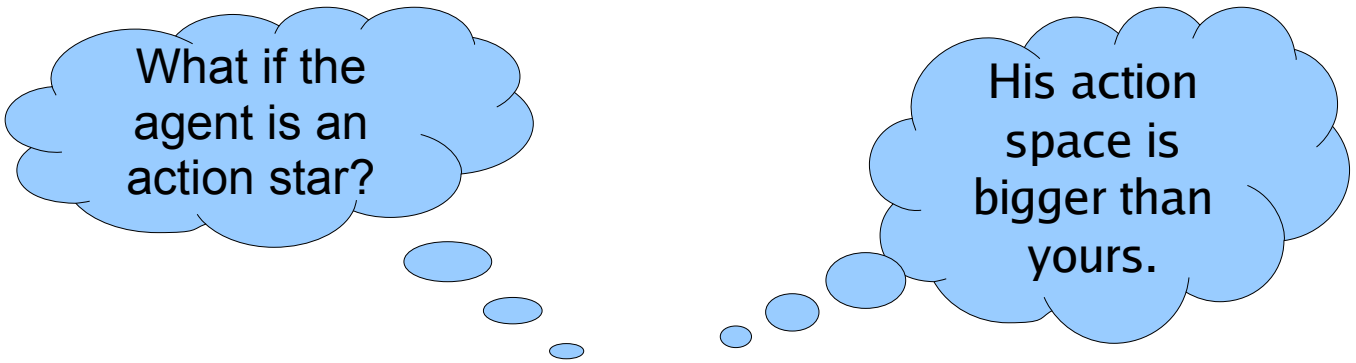
Percept Space = all possible observations



Action Space = all possible actions

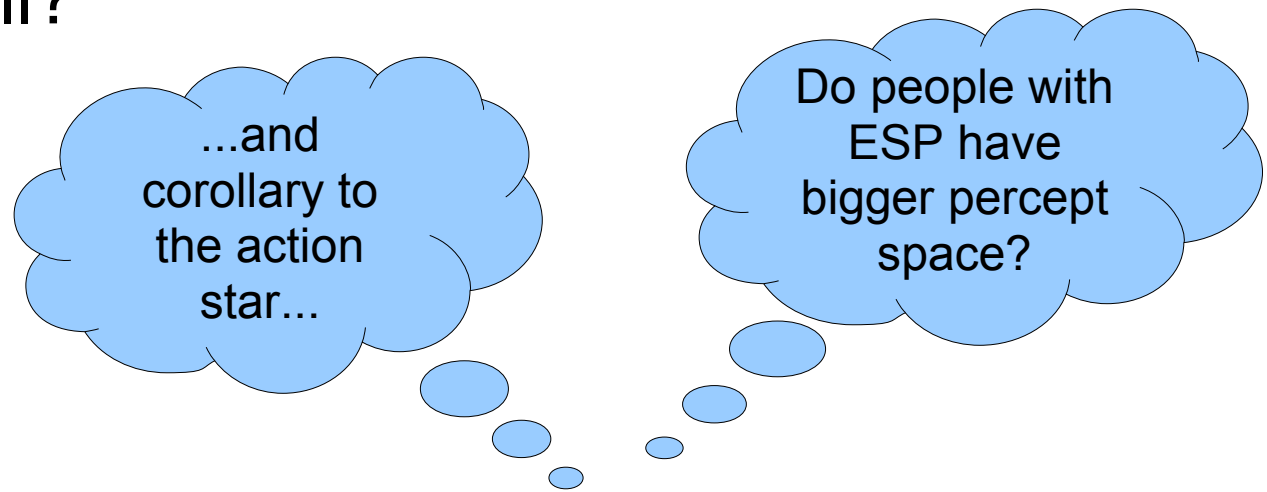
World Model

- **A** – Action space
  - Contains all possible actions that the agent can do
  - Could be continuous
  - Could be high-dimensional
  - Think of yourself as an agent,
    - What are the possible actions that you can do?
    - All actions that you can do belong to this space.



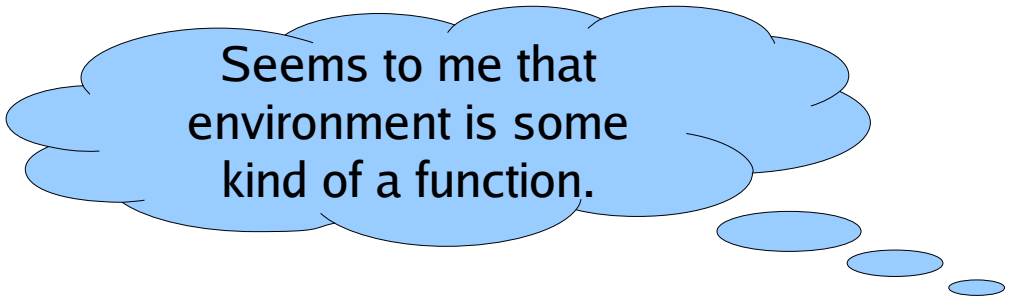
World Model

- A – Action space
- **P** – Percept space
  - What are all the things that the agent can perceive in the world?
  - Could be continuous
  - Example: what is the temperature in this lecture hall?



World Model

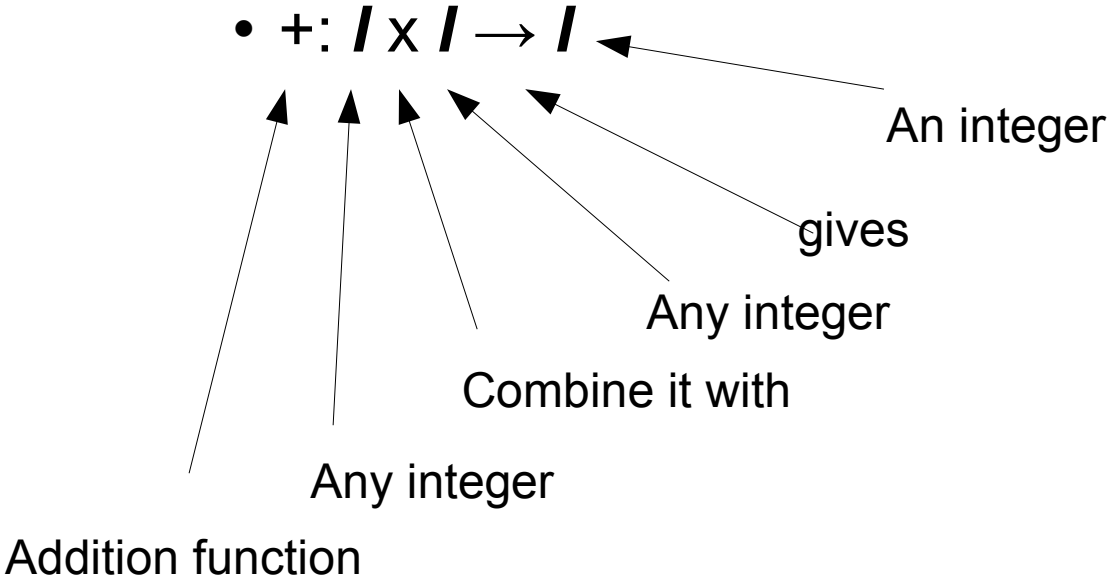
- A – Action space
- P – Percept space
- **E** – The environment: **A*** → **P**
  - In order for the agent to describe the problem, we need the environment
  - Maps strings of actions into percepts
  - Some new action that the agent does to the environment, the environment generates a percept



A little review of notation

Function: Input → Output

- Example: integer addition function



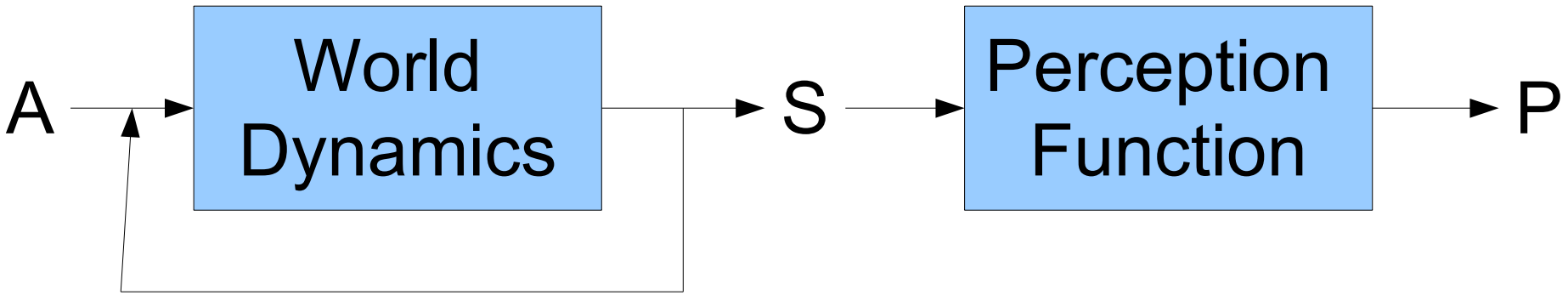
E: A* → P

Closure property

World Model

- Alternatively,
  - **S** – internal state (may not be visible to agent)
    - **E** might have **S** that is not visible to agent
  - We can describe how E works via two functions:
    - Perception function: **S** → **P**
      - Says what percepts the agent will receive as a function of the current state of the environment
    - World dynamics: **S** x **A** → **S**
      - Says what the next state will be, given the previous state and the action of the agent

World Model



World Model

- So far,
  - We have no value judgments
  - We're describing a set of worlds that the agent has to work in
  - We also have to say what the agent should do: what constitute a bad or good behavior
  - We need a utility function
- **U** – Utility function: $\mathbf{S} \rightarrow \mathfrak{R}$ (or $\mathbf{S}^* \rightarrow \mathfrak{R}$)

World Model

- **U** – Utility function: $\mathbf{S} \rightarrow \Re$ (or $\mathbf{S}^* \rightarrow \Re$)
  - Mapping from states of the world to real values
  - Or sequences of states to real values
  - It is meant to say...

Agents, these are the states of the world and this is how valuable they are from your perspective.

This indirectly tells the agent what you want to do.

World Model

- Now, our problem (as AI designers)
  - Is to build an agent (or software)...
  - ... in such a way as to get a lot of utility
  - Basically an optimization problem
- The agent design problem: Find $\mathbf{P}^* \rightarrow \mathbf{A}$
  - Mapping of sequences of percepts to action
  - Maximizes the utility of the resulting sequence of states (each action maps from one state to the next)

Rationality

A **rational** agent takes actions it believes will achieve its goals.

Assume I don't want to get wet, so I bring an umbrella. Is that rational?

Depends on the weather forecast

Depends whether I heard it.

Depends if I believe it

Action: bring umbrella

Belief: It will rain according to forecast

Goals: not to get wet.

Rationality

Rationality ≠ omniscience

- Assume that the most recent forecast is it will rain
- I did not hear to it
- I did not bring my umbrella
- Is that rational?
- Yes, since I did not known about the recent forecast

Rationality

Rationality ≠ success

- Suppose the most recent forecast is it will not rain
- I brought my umbrella
- I used it to defend myself against an attack
- Is that rational?
- No, although successful, it was done for wrong reason

Questions?

Email to <jppabico@uplb.edu.ph> for:

Questions requiring detailed answers

Proposals for research collaboration

Soft computing and machine learning

HPC/scheduling and dynamic load balancing

Wireless adhoc networks

Computer security and forensics

Information visualization

http://www.ics.uplb.edu.ph/jppabico