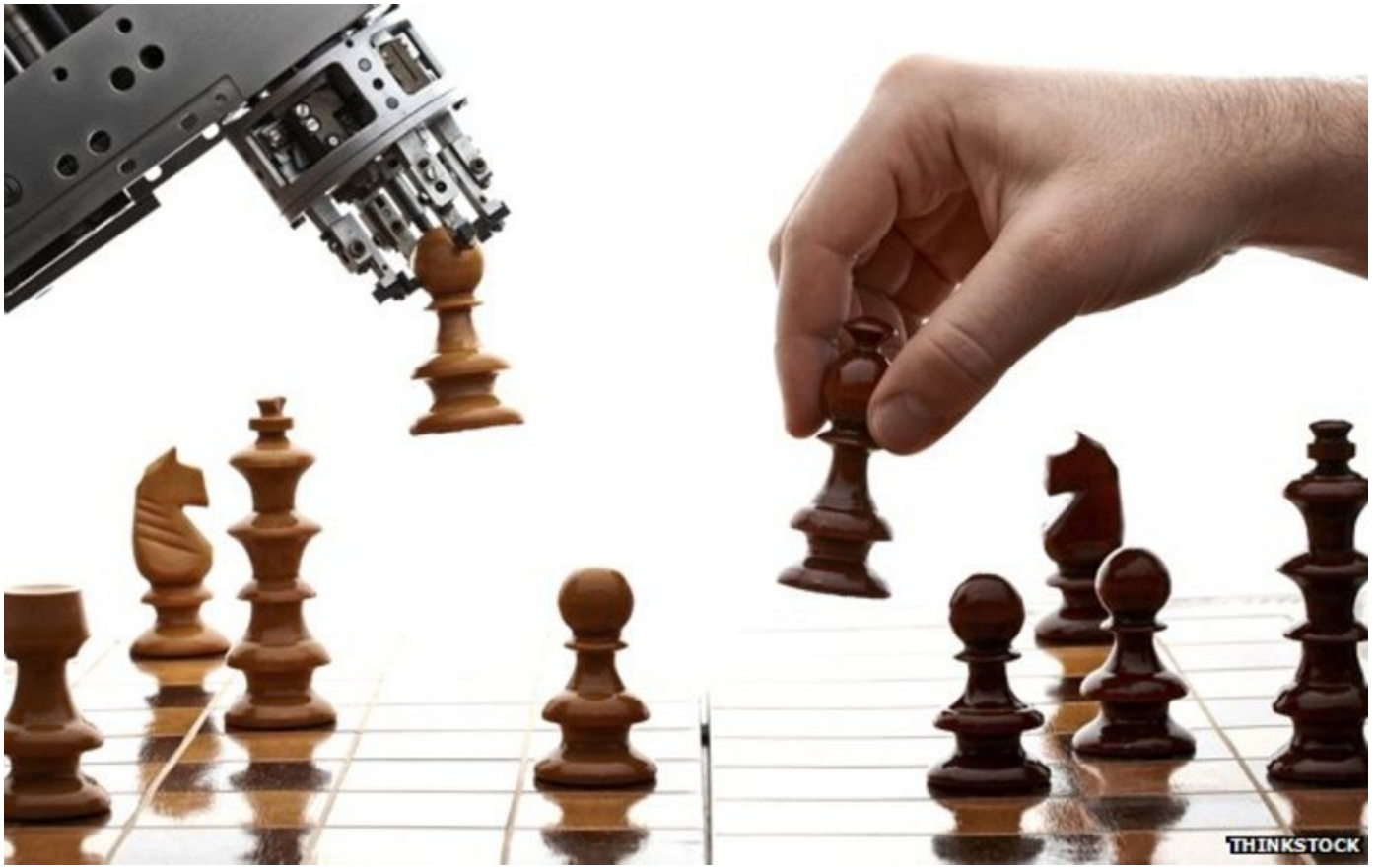


Introduction to Artificial Intelligence

COSC 4550 / COSC 5550

Professor Cheney

9/6/17

Homework Posted!

Interactions of AI and other fields?

Philosophy
(rationalism, induction, dualism, materialism)

Mathematics
(logic, computation, probability)

Economics
(utility, decision theory, game theory)

Linguistics
(natural language processing, symbolic representation)

Interactions of AI and other fields?

Neuroscience
(artificial neural networks, AI neuroscience)

Control Theory
(objective/loss functions, stable feedback loops)

Computer Engineering
(programmability, algorithmic efficiency)

Psychology
(cognitive science, behaviorism, shaping)

Philosophy
(rationalism, induction, dualism, materialism)

Mathematics
(logic, computation, probability)

Economics
(utility, decision theory, game theory)

Biophysics
(animal behavior, embodiment)

Mechanical Engineering
(robotics, kinematics, computer aided design)

Linguistics
(natural language processing, symbolic representation)

Interactions of AI and other fields?

Neuroscience
(artificial neural networks, AI neuroscience)

Social Sciences
(network science, sociology, anthropology)

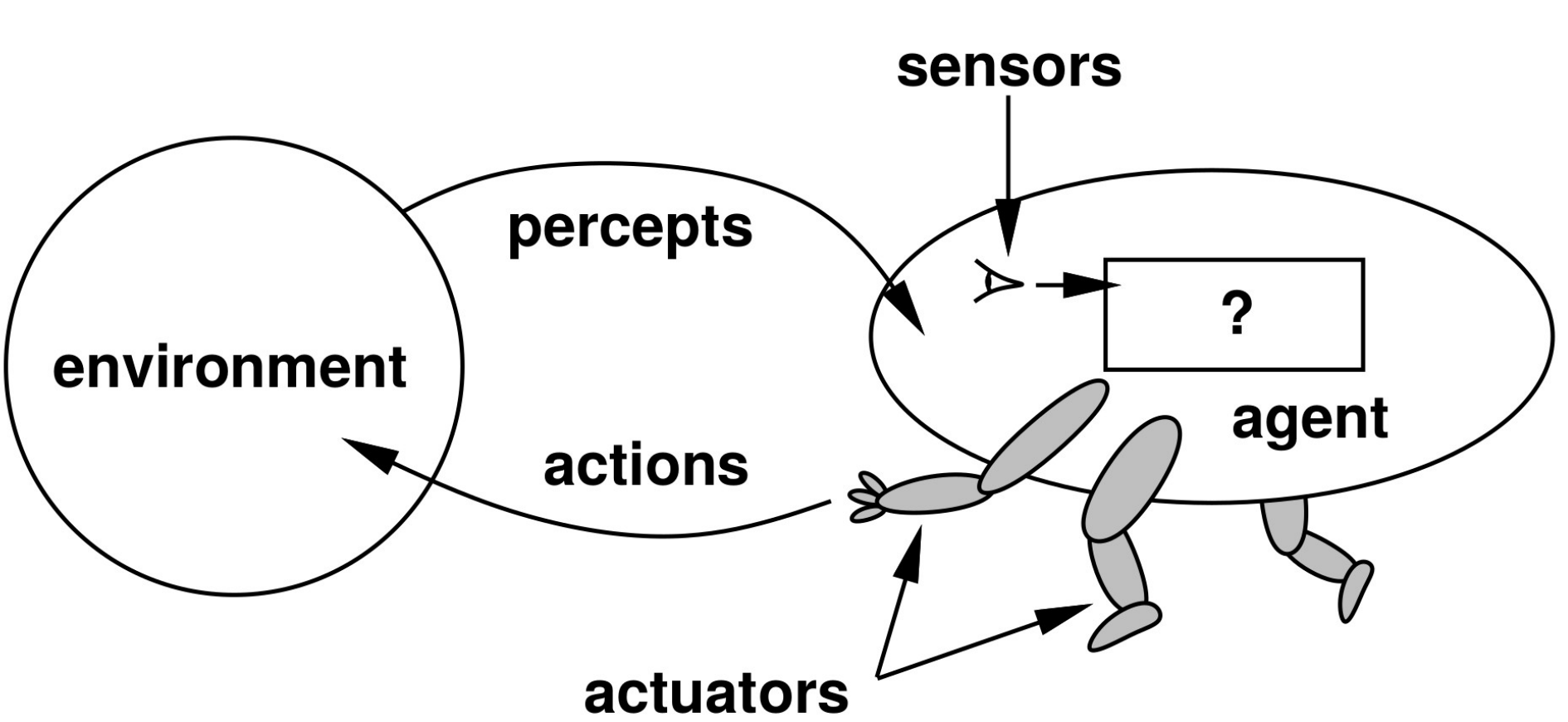
Natural Sciences
(astronomy, earth science, genomics)

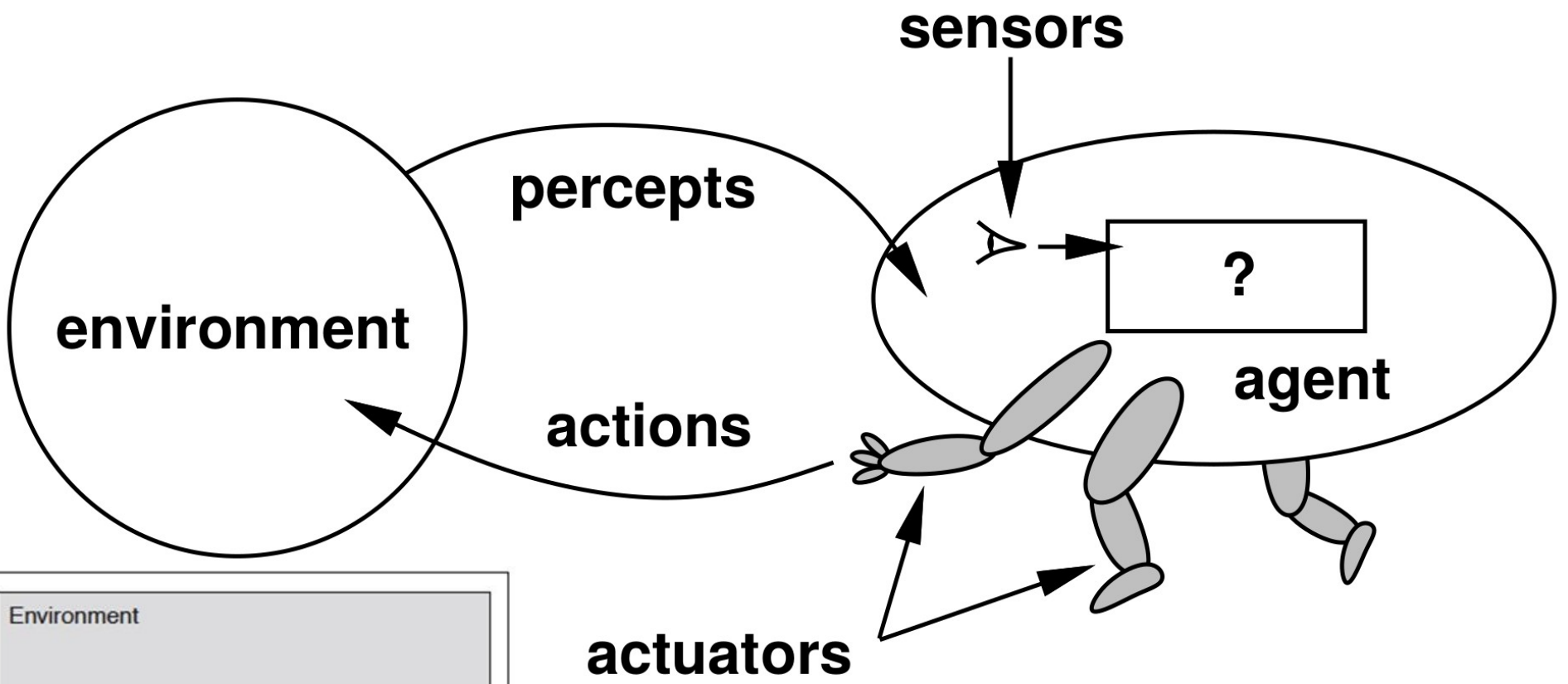
Control Theory
(objective/loss functions, stable feedback loops)

Computer Engineering
(programmability, algorithmic efficiency)

Psychology
(cognitive science, behaviorism, shaping)

What's an Agent?


sensors
percepts
environment
?
agent
actions
actuators



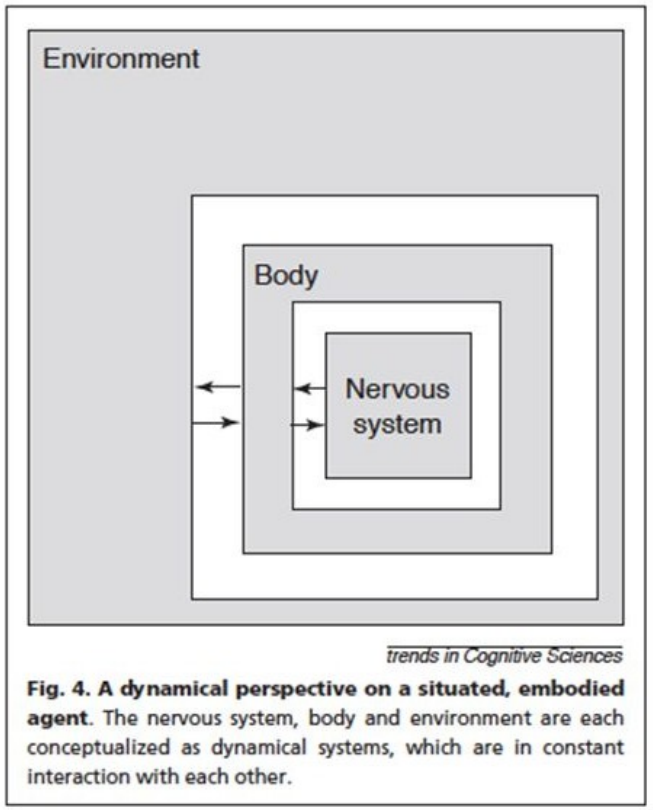


Fig. 4. A dynamical perspective on a situated, embodied agent. The nervous system, body and environment are each conceptualized as dynamical systems, which are in constant interaction with each other.

[Beer 2000]

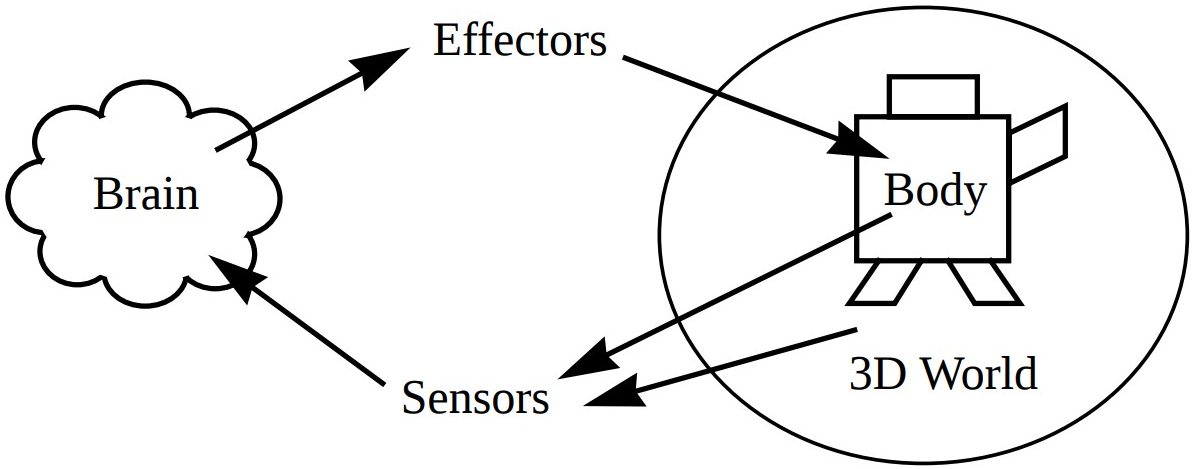
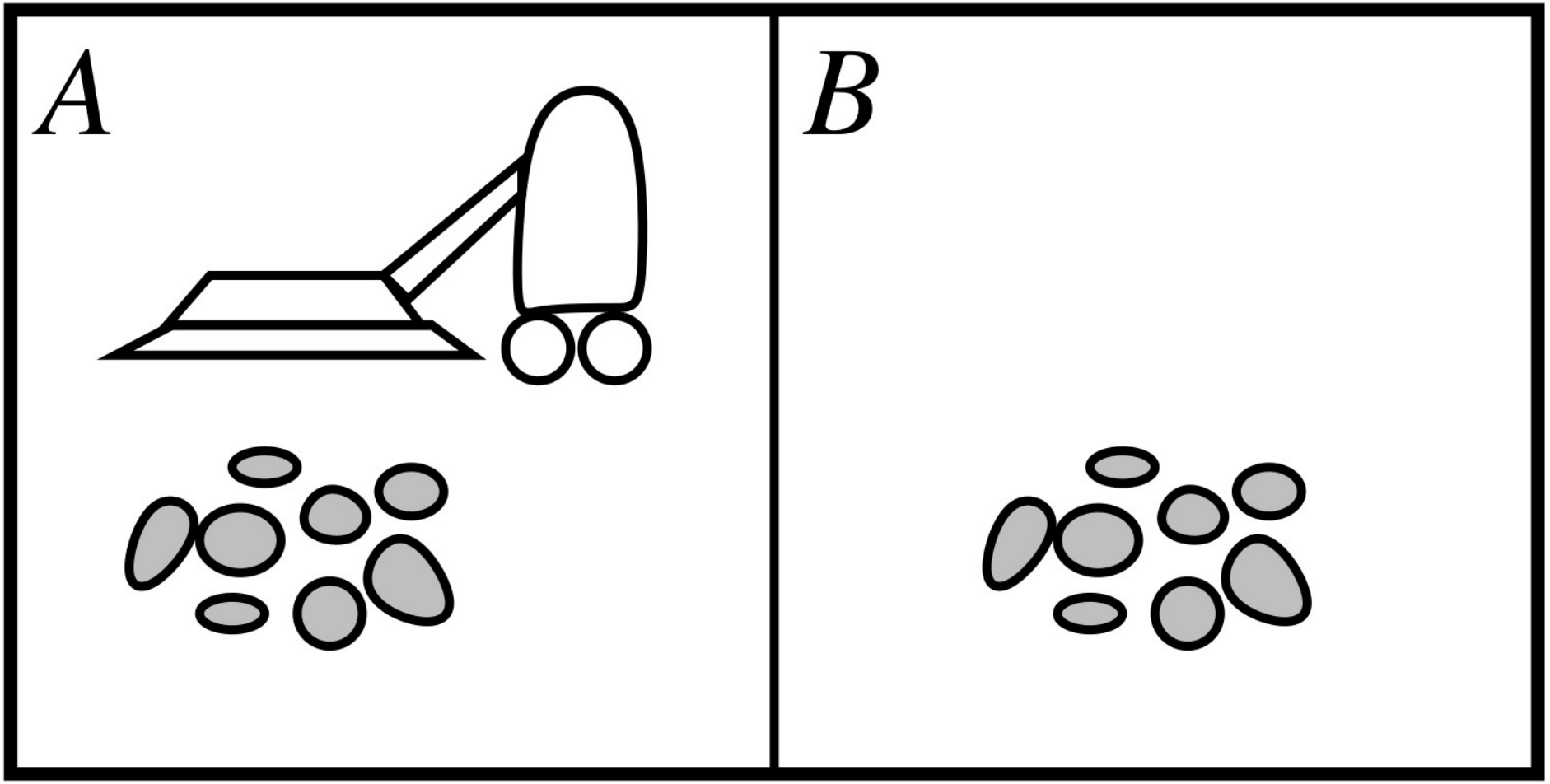


Figure 2: The cycle of effects between brain, body and world.

[Sims 1994]

Vacuum Cleaning Robots!



Percepts: location, content (e.g. [A, Dirty] or [B, Clean])

Actions: left, right, suck, nothing

What's the shortest program that guarantees success?
(with no sensor data)

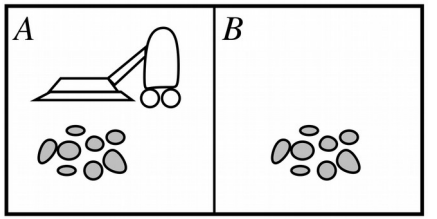
Left, suck, right, suck

(or: right, suck, left, suck)

always 4 actions

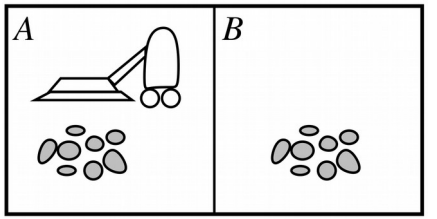
What's the shortest program that guarantees success?
(with sensor data!)

Percepts	***Action***
[A, Clean]	
[A, Dirty]	
[B, Clean]	
[B, Dirty]	



What's the shortest program that guarantees success?
(with sensor data!)

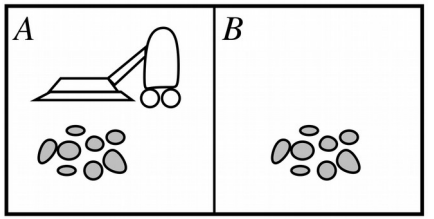
Percepts	***Action***
[A, Clean]	Right
[A, Dirty]	Suck
[B, Clean]	Left
[B, Dirty]	Suck



1, 2, 3, or 4 actions
(depending on environment)

What's the shortest program that guarantees success?
(with sensor data!)

Percepts	***Action***
[A, Clean]	Right
[A, Dirty]	Suck
[B, Clean]	Left
[B, Dirty]	Suck



1, 2, or 3 actions
(depending on environment)

What's the shortest program that guarantees success? (with sensor data!)

```
function REFLEX-VACUUM-AGENT( [location,status]) returns an action
    if status = Dirty then return Suck
    else if location = A then return Right
    else if location = B then return Left
```

What's the shortest program that guarantees success?

(what if we knew there was exactly
one dirty square in the environment?)

Now we need to store information
about past environmental states too!

What's the shortest program that guarantees success?

(what if we didn't know if each
action would be successful?)

maximize expected utility!

Vacuum Cleaning Robot in your Homework...

Percepts:

Sensor	Access	Description
GPS	getPosition()	Returns the current position of the robot as the pair *(x, y)*.
Compass	getDirection()	Returns the direction of the robot as a string from Directions (see game.py).
Wall sensor	rightWallSensor, leftWallSensor, frontWallSensor, backWallSensor	Returns the distance (in squares) to the first wall detected in the indicated direction.
Dust sensor	rightDustSensor, leftDustSensor, frontDustSensor	Returns the dust concentration in the indicated direction.

Actions:

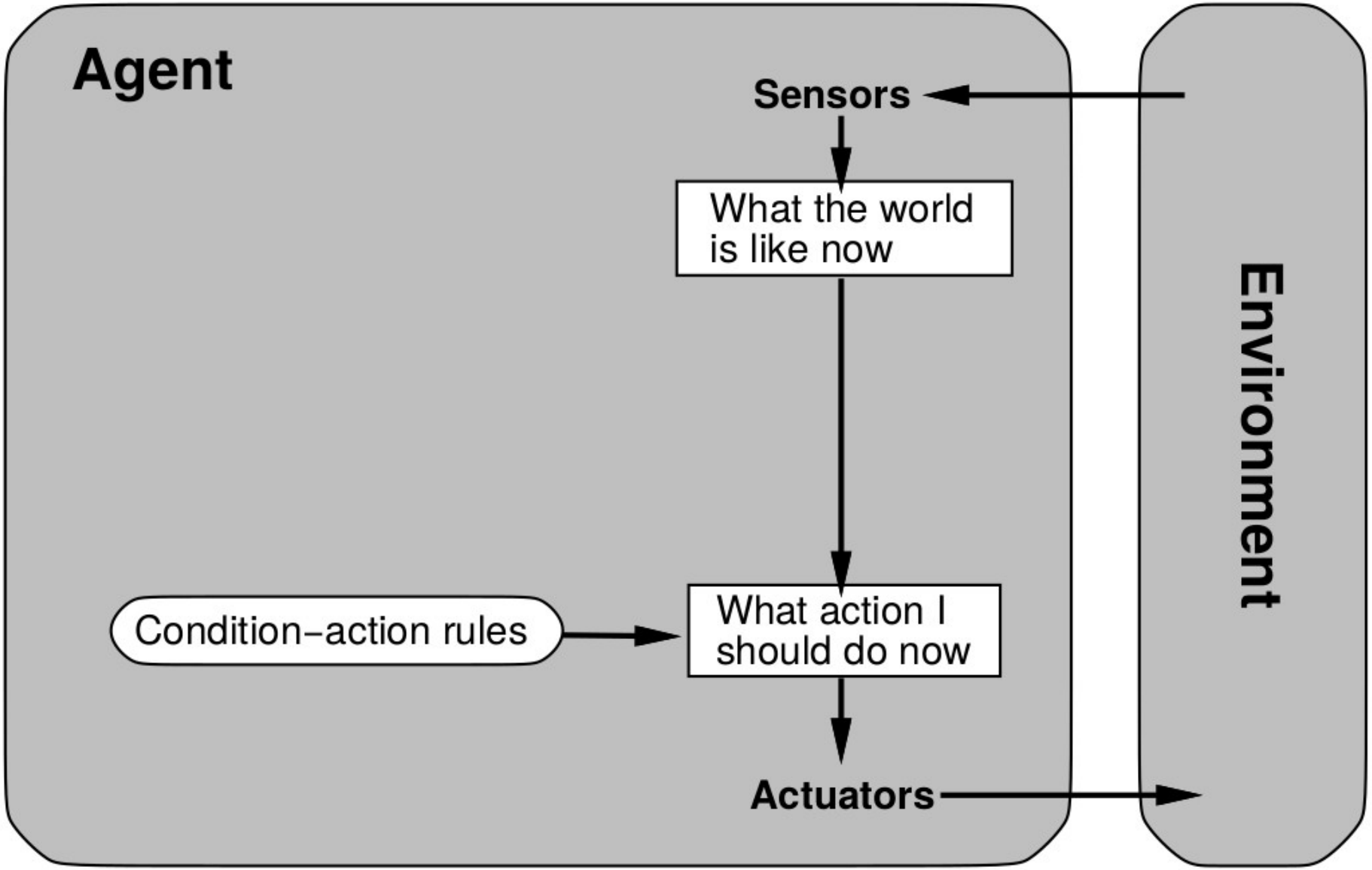
Action	Description
TURN_LEFT	Turns the robot left by 90 degrees.
TURN_RIGHT	Turns the robot right by 90 degrees.
TURN_AND_MOVE_LEFT	Turns the robot left by 90 degrees and moves forward one square.
TURN_AND_MOVE_RIGHT	Turns the robot right by 90 degrees and moves forward one square.
FORWARD	Moves the robot forward one square.
STOP	The robot does not move or turn.

Vacuum Cleaning Robot in your Homework...

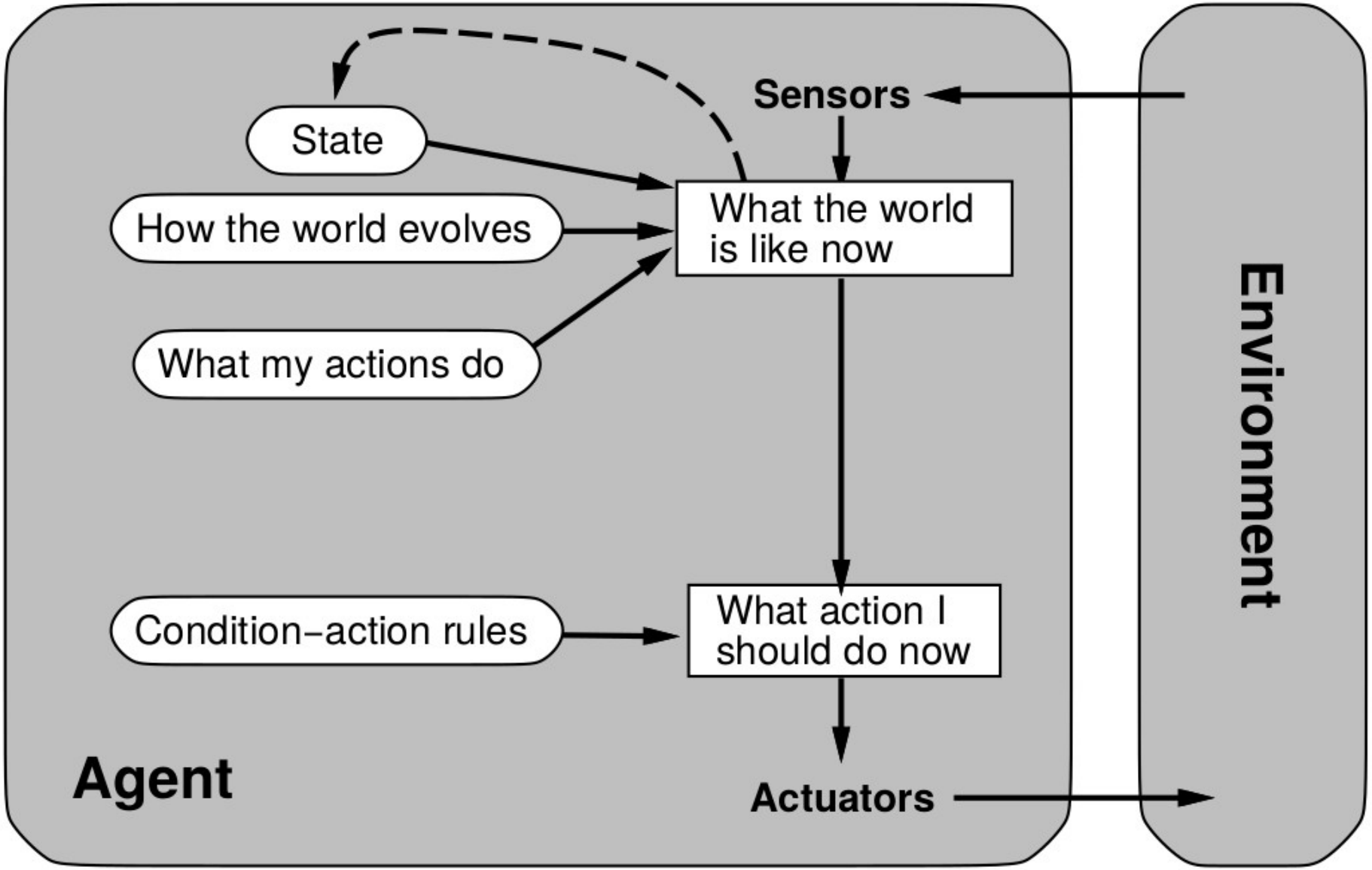
Programs… ?

Types of Agents

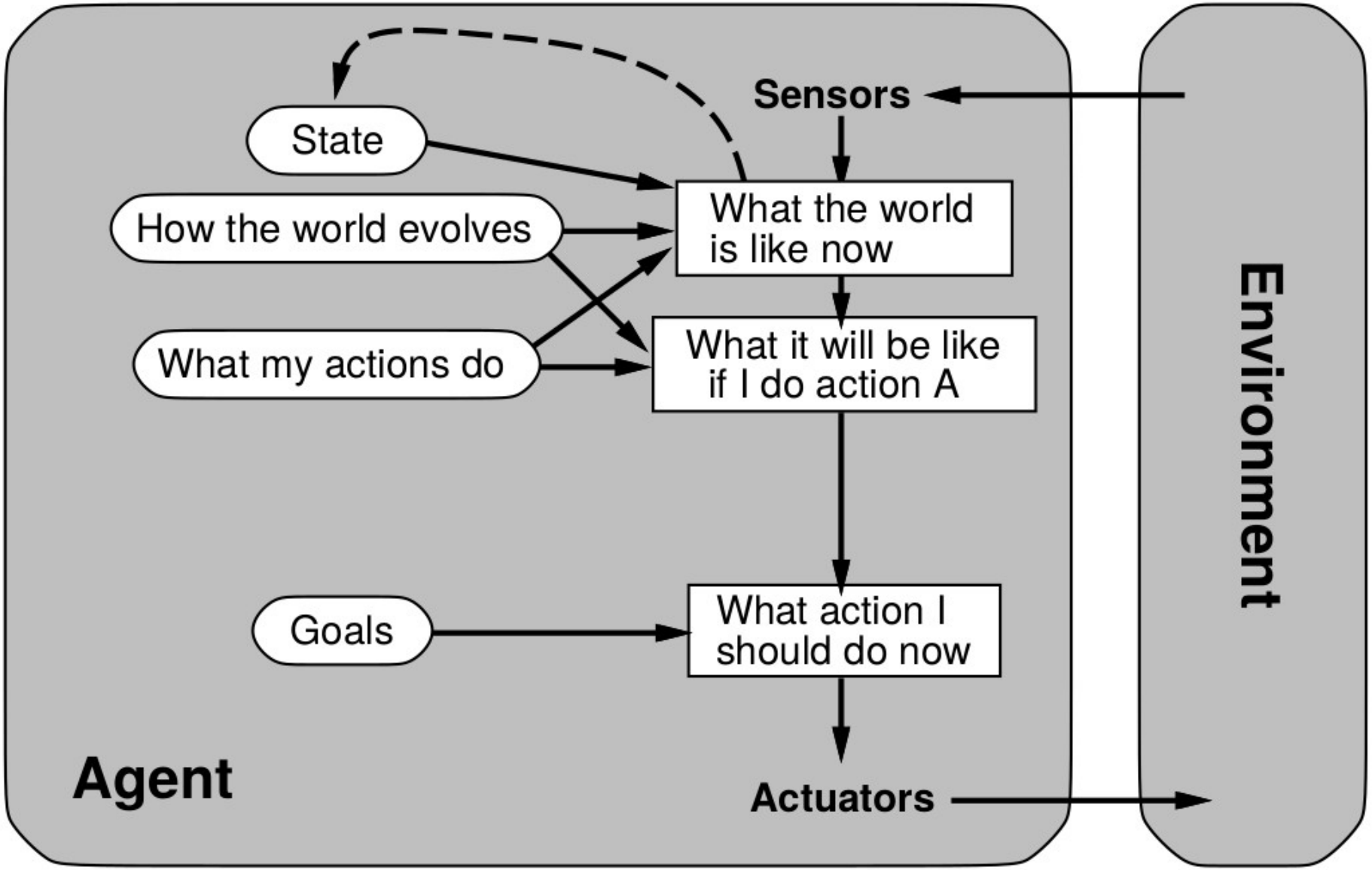
Simple reflex agents



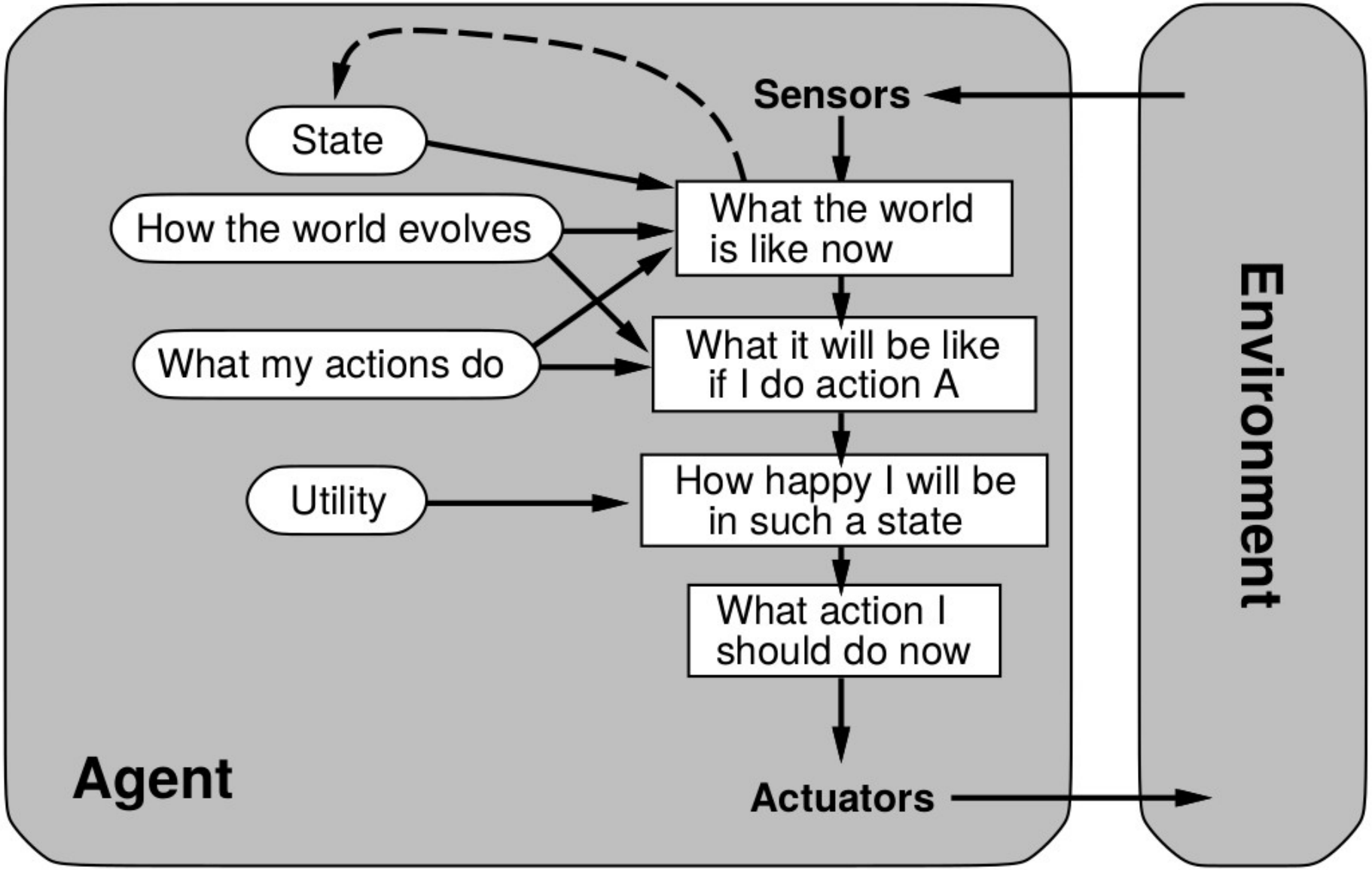
Reflex agents with state



Goal-based agents



Utility-based agents



What to consider when designing an agent

Performance Measure
Environment
Actuators
Sensors

Performance Measure

Environment

Actuators

Sensors

often difficult in practice!

perverse instantiation

(“you get what you ask for”)

Performance Measure

Environment

Actuators

Sensors

observability?

stochastic?

multi-agent?

episodic?

dynamic?

known dynamics?

Performance Measure

Environment

Actuators

Sensors

discrete?

biased?

Summary

(1) AI interfaces with many other disciplines

(2) agents perform sensorimotor interactions with their environments

(3) more complex types of agents consider more about their environment to make more informed decisions (but have the cost of learning more!)

(4) be careful when you design a performance measure (or decide what environment your agent will live in)