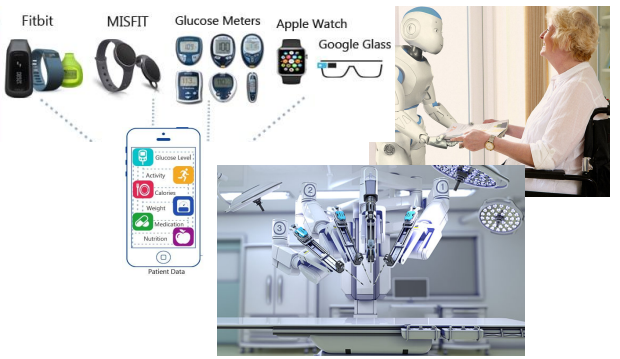
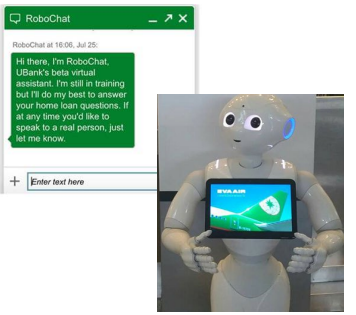
COMP30024 Artificial Intelligence

AI is Everywhere

Healthcare

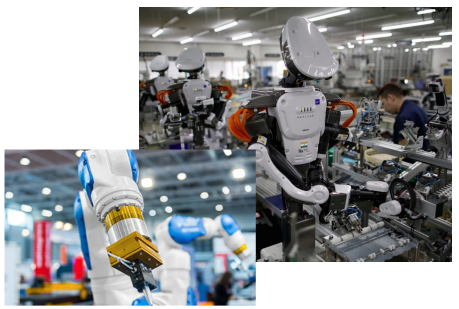


Customer Service



Transportation

Manufacturing



Gaming

Smart Homes

But AI has many risks and limitations,
both inherent in the technology, and how it is used

Our AI Team

♢ To contact lecturers: comp30024-lecturers@lists.unimelb.edu.au

♢ Lecturers: Prof. Chris Leckie (caleckie@unimelb.edu.au)
Dr. Wafa Johal (wafa.johal@unimelb.edu.au)

♢ Head tutor: Alex Zable

♢ Tutors: Ali Guler
Chenyuan Zhang
Lucas Fern
Patrick Gibbs
Rohan Hitchcock
Yifei Wang
Youran Zhou

About Me

♢ Research interests:
Machine Learning
Large-Scale Data Mining
Cyber Security
Telecommunications

♢ Industry research partners:
Telstra
Leidos
Northrop Grumman
AEMO

♢ Homepage:
https://findanexpert.unimelb.edu.au/profile/6335-christopher-leckie

General Information

- Text: *Artificial Intelligence: A Modern Approach*,
  Stuart Russell & Peter Norvig, 4th Edition, Pearson, 2021
  (earlier editions are fine)
- Lecture slides available on LMS, lectures recorded on Lecture Capture
- Subject LMS discussion board for student discussion
- Workshops (aka tutorials) are one hour and start week 2

Prerequisites

♢ Subjects:
COMP20003 Algorithms and Data Structures or
COMP20007 Design of Algorithms

♢ Skills:
Data structures & algorithms coding in Python
(This subject does not include programming language tuition)
Familiarity with formal mathematical notation
Basic understanding of differential calculus and probability theory helpful but not essential

Assessment

- Assessment: 70% exam, 30% project (programming project in Python)
- Requirements: 15/30 project hurdle, 35/70 exam hurdle, 50/100 overall
- Project: a single project in 2 parts
  Part A due 30th March. Part B due 11th May.
  (to be confirmed in project specification on subject LMS site)
- Project is to implement a game playing agent in Python
- You will work on the project in a team of two people
- We will discuss the project in more detail next lecture,
  and over the coming weeks

Who and Where

♢ Lectures:
Wednesdays 2.15–3.15 pm
Thursdays 10–11 am

♢ Tutorials: (per your registration)

♢ Feedback:
During/after lecture
Tutorial
Assignment feedback
Discussion board
Consultation sessions (to be announced)
General inquiries: comp30024-lecturers@lists.unimelb.edu.au

Syllabus

Topic	AIMA 2nd ed	3rd ed	4th ed
What is AI? (wk1)	Ch1	Ch1	Ch1
Intelligent Agents (wk1)	Ch2	Ch2	Ch2
Solving Problems by Searching (wk2)	Ch3	Ch3	Ch3
Informed Search Methods (wk3)	Ch4	Ch3	Ch3
Adversarial Search (wk4)	Ch6	Ch5	Ch6
Learning in Games (wk5)	notes	notes	notes
Feedback Quiz (wk6)	-	-	-
Advanced Topic (wk6)	-	-	-
Constraint Satisfaction (wk7)	Ch5	Ch7	Ch5
Making Collective Decisions (wk8)	Ch17	Ch17.6	Ch17.4
Uncertainty (wk9)	Ch13	Ch13	Ch12
Probabilistic Reasoning (wk10)	Ch14	Ch14	Ch13
Robotics (wk11)	Ch25	Ch25	Ch26
Revision and Tournament (wk12)	-	-	-

Week 1: What is AI?

Chapter 1

Outline

- ♢ Defining AI
- ♢ Tests for intelligence
- ♢ State of the art

Types of Intelligence

♢ The big question: How does the mind arise from the brain?

♢ How many different types of "intelligent" behaviour can you think of?

Four approaches to defining AI

- ♢ Thinking like a human
- ♢ Thinking rationally
- ♢ Acting like a human
- ♢ Acting rationally

Thinking like a human

Cognitive modelling: figure out how we think by *introspection* or *experimentation*

Self-awareness is important: "I think therefore I am"

Humans feel emotions and apparently don't always think (or act) rationally

Thinking rationally

The laws of thought:
eg "Socrates is a man. All men are mortal.
Therefore Socrates is mortal"

Codifying rational thinking started with Aristotle (at least in the West)

The study of *logic* has greatly influenced AI

Aspects of Intelligence

Abstract thinking and problem solving

Learning and memory

Language, communication

Intuition and creativity

Consciousness

Emotions

Surviving in a complex world

Adapting to new situations

Test for Intelligence: The Turing test

Proposed by Alan Turing in 1950

A human interrogates/converses with the computer via a teletype

The aim is for the computer to $imitate$ a human well enough to fool people

Turing thought a computer would pass this test by the end of the century

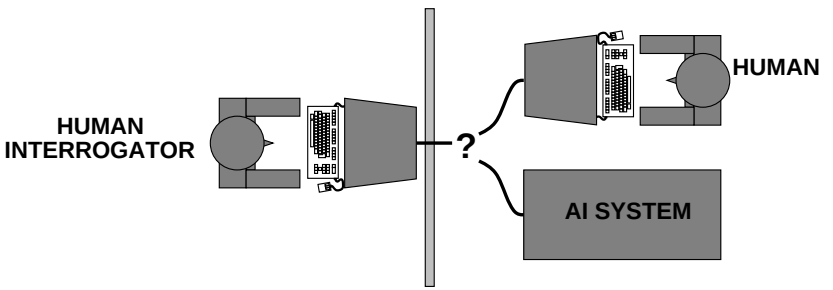
The Loebner Prize (Turing test) competition is held each year

The "total Turing test" allows physical objects to be passed to the machines as well as characters via the teletype

Acting humanly: The Turing test

Turing (1950) "Computing machinery and intelligence":

- "Can machines think?" $\longrightarrow$ "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game



- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language understanding, learning

Problem: Turing test is not *reproducible*, *constructive*, or amenable to *mathematical analysis*

Eliza Session

The earliest attempt was a system called Eliza (1966).

Eliza: What brought you here to see me today?

Visitor: Oh, nothing much. I'm feeling a bit tired, that's all.

Eliza: Why do you think you're feeling a bit tired?

Visitor: Well, I've been traveling a lot, and away from home.

Eliza: Tell me more about your family

Eliza Session

Visitor: The trouble is, my mother's ill.

Eliza: How long has she been ill?

...

Visitor: The trouble is, my mother's Irish.

Eliza: How long has she been Irish?

...

Visitor: The trouble is, my mother's poodle.

Eliza: How long has she been poodle?

Acting rationally

The rational agent: perform actions which will (most likely) achieve one's $goals$

Knowledge may not be perfect — we need to go beyond strict rational thought in general

The rational agent view is the basis of "Artificial Intelligence: A Modern Approach"

State of the art

Which of the following can be done at present?

- ♢ Play a decent game of table tennis
- ♢ Drive along a curving mountain road
- ♢ Drive down Brunswick St on a Saturday night
- ♢ Play a decent game of bridge
- ♢ Discover and prove a new mathematical theorem
- ♢ Write an intentionally funny story
- ♢ Give competent legal advice in a specialized area of law
- ♢ Translate spoken English into spoken Japanese in real time

State of the Art

Machine translation: try Google Translator
(`https://translate.google.com`)

Conversational agents: Apple's Siri, IBM's Watson for question answering

Robotic vehicles: Google self-driving car autonomous vehicle that can drive safely though traffic
(`https://www.google.com/selfdrivingcar/`)

Versatile robots: 2015 DARPA Robotics Challenge - mobile robot that can walk over rubble and operate power tools

Human action recognition: Microsoft Kinect

Summary

♢ Defining AI
  – Explain different approaches to defining AI

♢ Tests for intelligence
  – Describe the operation of the Turing test

♢ State of the art
  – Characterise the difficulty of different common tasks

What to do now:
  – Find a project partner
  – Brush up your Python
  – Tutorials start in Week 2

Week 1: Intelligent Agents

Chapter 2

Outline

- ♢ Agent model
- ♢ Agent types
- ♢ Environment types
- ♢ Summary

Intelligent agents

- ♢ chess/backgammon
- ♢ refinery controller
- ♢ medical diagnosis
- ♢ flight reservations
- ♢ walking on two legs
- ♢ taxi driver
- ♢ vacuum cleaning
- ♢ robocup soccer

The Agent Model

- **Percepts**/observations of the environment, made by *sensors*
- **Actions** which may affect the environment, made by *actuators*
- **Environment** in which the agent exists
- **Performance measure** of the desirability of environment states

Example: automated taxi

Percepts: video, accelerometers, gauges, engine sensors, keyboard, GPS, ...

Actions: steer, accelerate, brake, horn, speak/display, ...

Environment: city streets, freeways, traffic, pedestrians, weather, customers, ...

Performance measure: safety, reach destination, maximize profits, obey laws, passenger comfort, ...

Agents as functions

Agents can be evaluated empirically, sometimes analysed mathematically

Agent is a function from *percept sequences* to actions

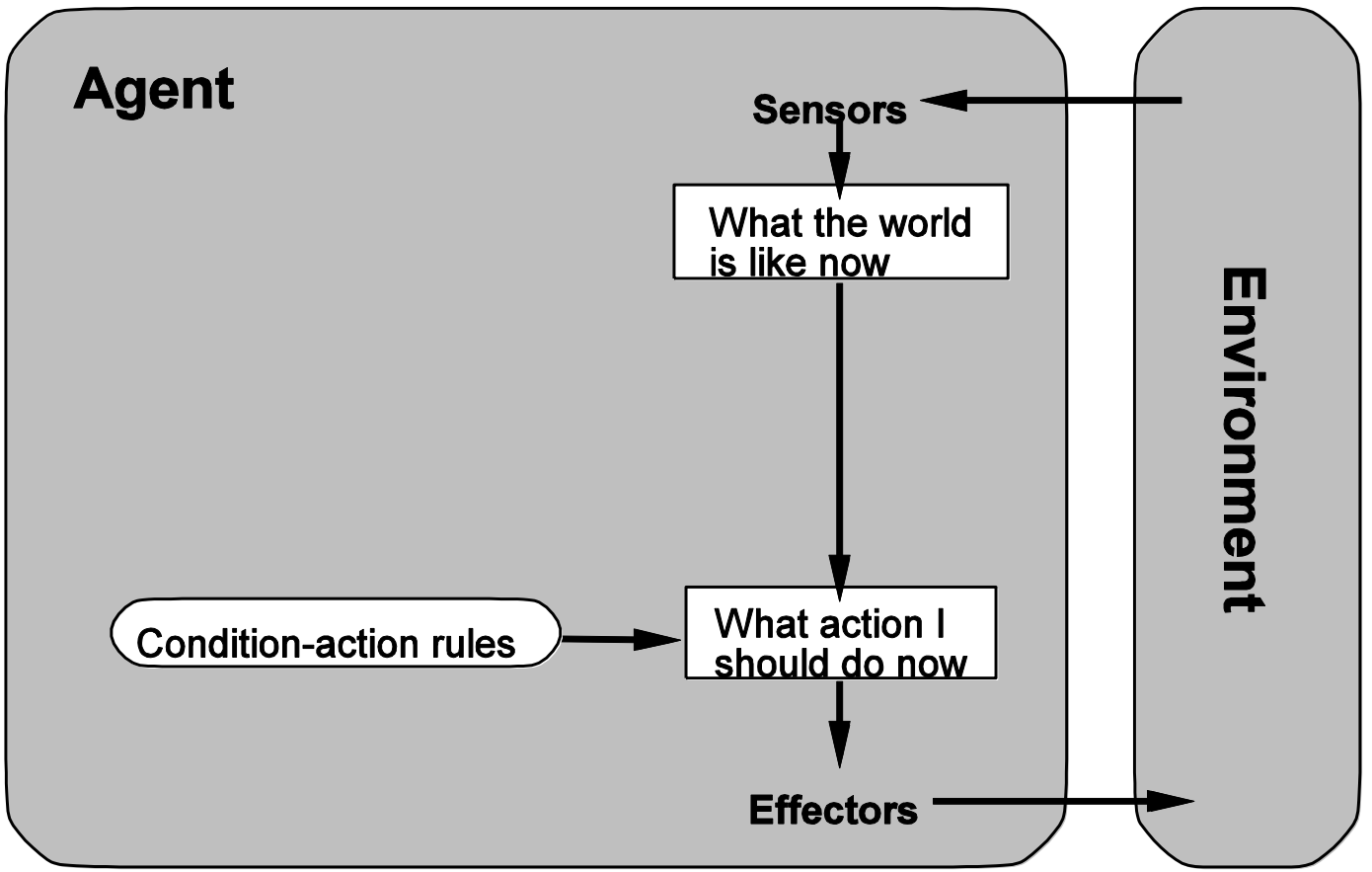
Ideal rational agent would pick actions which are expected to maximise its *performance measure* (based on the percept sequence and its built-in knowledge)

Rational $\neq$ omniscient
Rational $\neq$ clairvoyant
Rational $\neq$ successful

Agent types

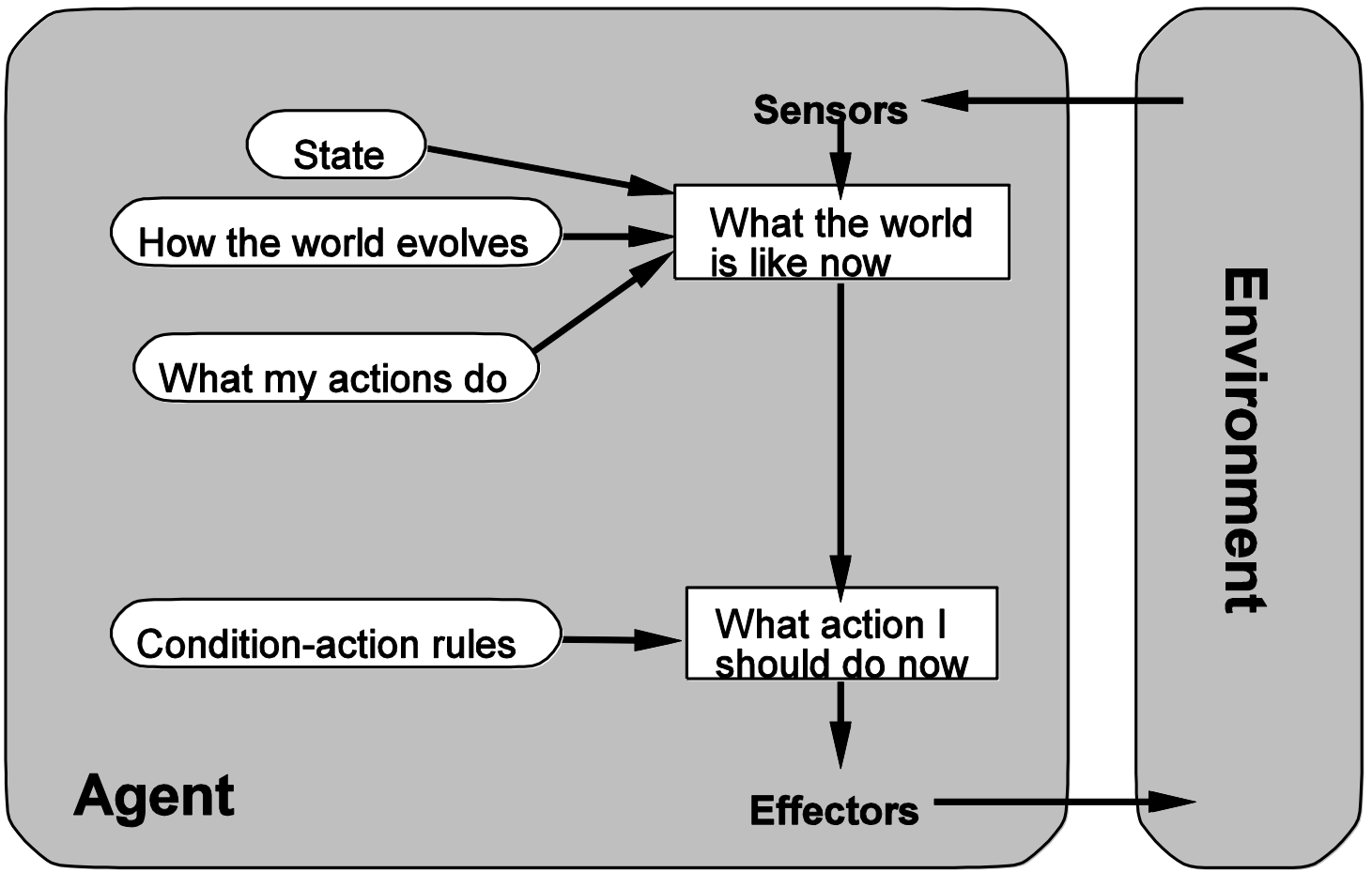
- ♢ simple reflex agents
- ♢ model-based reflex agents
- ♢ goal-based agents
- ♢ utility-based agents

Simple reflex agents



THERE IS NO GOAL SET SAME AS SIMPLE FLEX AGENT, NO CONSIDERATION FOR CONSEQUENCES CAUSED BY ACTIONS.

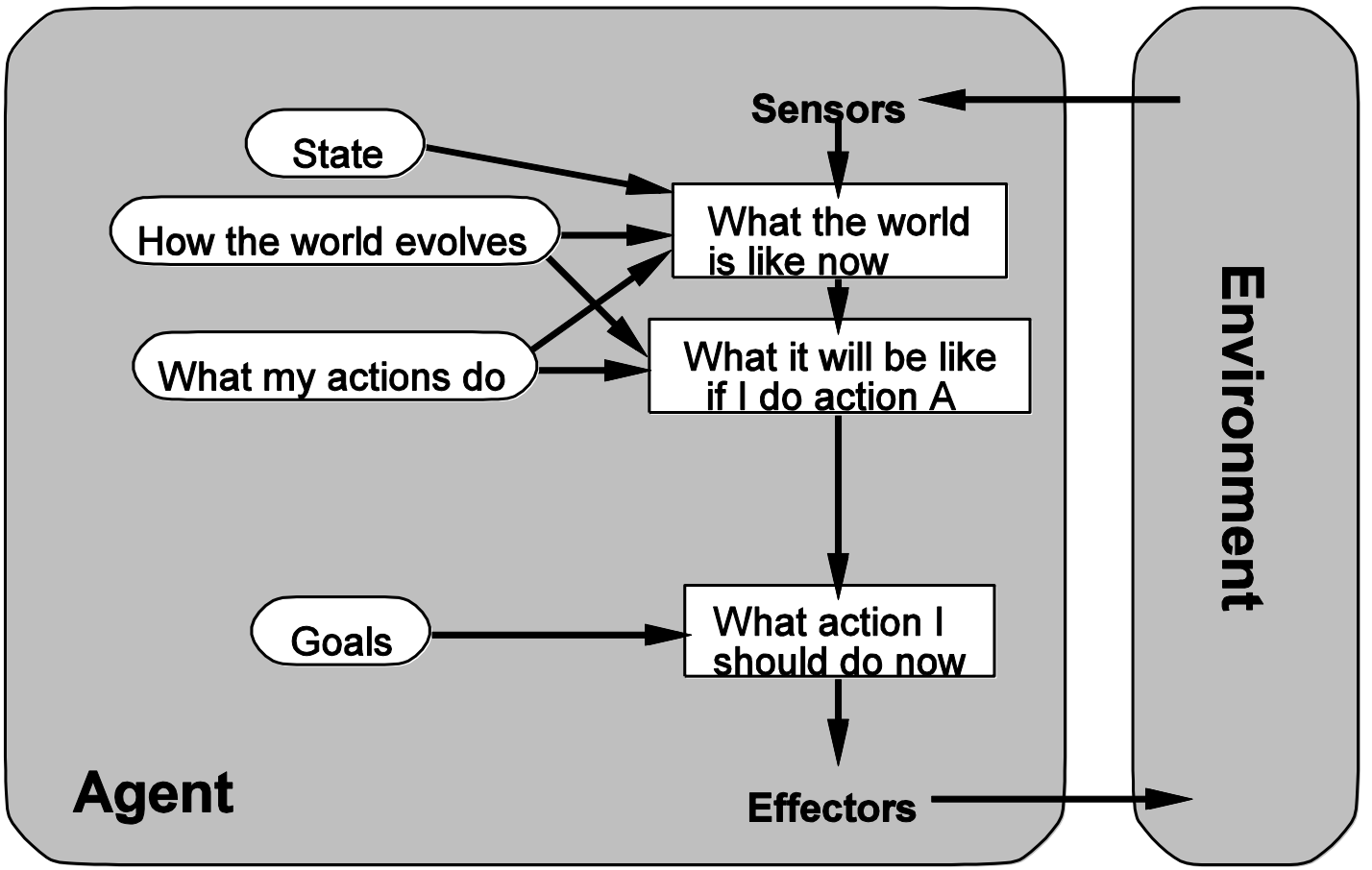
Model-based reflex agents



THERE IS AN INTERNAL STATE MODEL.

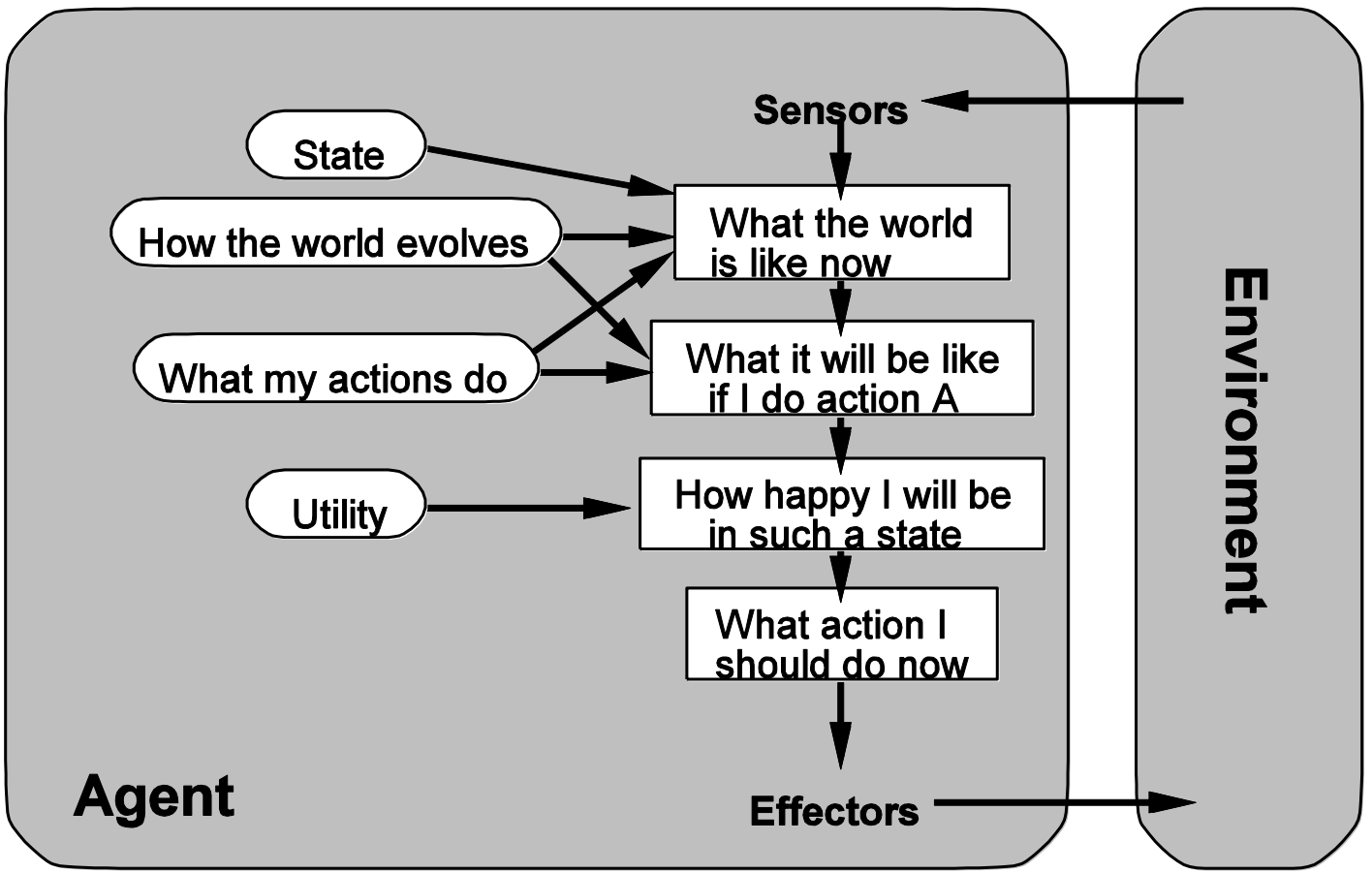
THERE IS NO GOAL SET SAME AS SIMPLE FLEX AGENT, NO CONSIDERATION FOR CONSEQUENCES CAUSED BY ACTIONS.

Goal-based agents



IN GOAL-BASED AGENT, THERE IS ONLY 1 GOAL AND AN AGENT WLL CONSIDER WHICH ACTION SHOULD BE TAKEN

Utility-based agents



FOR THE UTILITY BASED AGENT, THERE ARE MANY GOALS AND THE UTILITY IS GONNA CONSIDER DIFFERENT GOALS TO DECIDE WHICH ACTION TO TAKE,ITS CONSEQUENCES .

Environment types

Environments may or may not be

♢ **Observable:** percept contains all relevant information about the world

♢ **Deterministic:** current state of the world uniquely determines the next

♢ **Episodic:** only the current (or recent) percept is relevant,
and short-term actions do not have long-term consequences

♢ **Static:** environment doesn't change while the agent is deliberating

♢ **Discrete:** finite number of possible percepts/actions

OBSERVABLE / PARTIAL OBSERVABLE

For Example, a driver drive a truck. In this environment, while driving there are some blind spots such as like a person behind a truck that a driver cannot see (accidents..)

PARTIAL OBSERVABLE

DETERMINISTIC / STOCHASTIC

- IF I INCREASES THE SPEED OF THE CAR -> I'LL DRIVE FASTER (DETER)

IF I ROLL A DICE, I dont know a result certainly STOCHASTIC

EPISODIC/SEQUENTIAL

I SAW A MOTO CYCLE BEFORE AND WHERE IS IT NOW, IS IT IN FRONT OF MY TRUCK OR IN THE BLIND SPOTS SEQUENTIAL

DISCRETE/CONTINOUS

WHY U FLY ON THE PLANS, U NEED TO OBSERVE CAREFULLY COZ UR EVIRONMENT CHANGES AS OTHER PLANS ARE FLYING AS WELL DYNAMIC

STATIC / DYNAMIC

WHEN U PLAY CHESS, U MAKE A MOVE -> UR CHESS BOARD DOES NOT MOVE STATIC

Environment types

	Solitaire	Backgammon	Internet shopping	Taxi
Observable				
Deterministic				
Episodic				
Static				
Discrete				

The environment type largely determines the agent design

The real world is (of course) partially-observable, stochastic, sequential, dynamic, continuous

Environment types

	Solitaire	Backgammon	Internet shopping	Taxi
Observable	Yes	Yes	No	No
Deterministic	Yes	No	Partly	No
Episodic	No	No	No	No
Static	Yes	Yes	Semi	No
Discrete	Yes	Yes	Yes	No

The environment type largely determines the agent design

The real world is (of course) partially-observable, stochastic, sequential, dynamic, continuous

Summary

♢ Agent model
– characterise requirements for an agent in terms of its percepts, actions, environment and performance measure

♢ Agent types
– choose and justify choice of agent type for a given problem

♢ Environment types
– characterise the environment for a given problem