Agent architectures
**Designing intelligent agents**

- An agent is defined by its *agent function* $f()$ that maps a sequence of perceptions to an action.
Rational agent

- It would be useful to design agent functions that make agents rational, namely that make them do the “right thing”
- How can rationality of an agent be defined?

For every possible sequence of perceptions, a rational agent chooses the action that maximizes the expected value of its performance measure, given its knowledge up to that moment.
Perception sequence and available knowledge

- The perception sequence represents the available knowledge of an agent about its environment.
- From the standpoint of an agent, its environment can be:
  - Completely/partially observable
  - Static/dynamic
  - Discrete/continuous
  - Single agent/multiagent
Actions

- Through actions an agent can change the state of its environment.
- From the standpoint of an agent, its environment can be:
  - Deterministic/stochastic.
Performance measure

- The performance measure is the criterion for evaluating the success of the behavior of an agent.
- The performance measure is defined by the designer.
What a rational agent does?

Rational agent

For every possible sequence of perceptions, a rational agent chooses the action that maximizes the expected value of its performance measure, given its knowledge up to that moment.

- A rational agent is not omniscient
- A rational agent is not clairvoyant
- A rational agent can explore to acquire new information, can learn, ...
From agent functions to agent programs

- A designer develops an *agent program* that implements an agent function
- An agent program has the current perception $p(t)$ as input
  - An agent program can store the previous perceptions $p(0), p(1), \ldots, p(t-1)$
- An agent program has an action $a(t)$ as output
Structure of agent programs

- Agent programs can be classified in four basic types:
  - Simple reflex agents
  - Reflex agents with state
  - Goal-based agents
  - Utility-based agents
- All these types of agent can also learn
Simple reflex agents

AGENT

what the world is like now

condition-action rules

what action to do now

effectors

sensors
Examples of simple reflex agents

First versions of Roomba

Neural networks
Reflex agents with state

AGENT

state
environment model
action model
condition-action rules

what the world is like now
sensors

what action to do now
effectors
Examples of reflex agents with state

Dyson 360 Eye
Goal-based agents

AGENT

state

environment model

action model

goals

what the world is like now

sensors

what the world will be like if I do action a

effectors

what action to do now
Examples of goal-based agents

Action (movement) planning
Utility-based agents

- **AGENT**
  - state
  - environment model
  - action model
  - utility

- sensors
  - what the world is like now

- action model
  - what the world will be like if I do action a

- utility
  - “happiness” in that state

- effectors
  - what action to do now
Examples of utility-based agents

Decision on the best action (movement)
Learning agents

- All the agents presented before can improve their performance with learning.
- Every component of the decisional process of an agent can be modified in order to perform better.
Examples of learning agents