ARTIFICIAL INTELLIGENCE

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Indice

1 Introduction to the course

Professor's slides:
`../other/professor'sslidesPartI-Introductiontothecourse.pdf`

1.1 Informations

Professor Marco Colombetti WebEx's room link:
`https://politecnicomilano.webex.com/meet/marco.colombetti`

Stuart Russell, Peter Norvig (2010). Artificial Intelligence: A modern approach, 3rd edition, Prentice-Hall/Pearson:
`../other/Artificial_Intelligence_A_Modern.pdf`

Lessons informations:

POLITECNICO
MILANO 1863

Dear students,

welcome to the 2020-21 edition of Artificial Intelligence, Section M-Z (i.e., for students whose family name starts with a letter from M to Z, inclusive). The timetable of PoliMi courses will be somewhat complex this year; as far as this course is concerned, here is how it has been organized:

- on Friday mornings, from 8:15 (actually 8:30, as traditional) to 11:15 (actually around 11:00): online lessons using Cisco Webex
- on Friday afternoons, from 13:15 (actually 13:30) to 15:15 (actually 15:00): classroom lessons in room 20.S.1 (formerly EL.0).

Classroom lessons will be available in streaming and recorded; links to the videos will be then published on Beep. As you know, the classroom lessons will be accessible in-person to one team at a time, where by definition

- Team MZ-1 consists of all M-Z students with odd person number, and
- Team MZ-2 consists of all M-Z students with even person number.

Please note that **every week only one team will attend the two-hour classroom lesson from 13:30 to 15**; more precisely, Team MZ-1 will attend the lesson in the odd weeks (counting from the initial week of the course), and Team MZ-2 will attend the lesson in the even weeks. Below is a timetable presenting the turns for M-Z students:

Week	Date	Lesson	Exercise sessions
1	18.09	online for all, 8:30-11	room 20.S.1, team MZ-1, 13:30-15
2	25.09	online for all	room 20.S.1, team MZ-2, 13:30-15
3	09.10	online for all, 8:30-11	room 20.S.1, team MZ-1, 13:30-15
4	16.10	online for all	room 20.S.1, team MZ-2, 13:30-15
5	23.10	online for all, 8:30-11	room 20.S.1, team MZ-1, 13:30-15
6	30.10	online for all	room 20.S.1, team MZ-2, 13:30-15
7	13.11	online for all, 8:30-11	room 20.S.1, team MZ-1, 13:30-15
8	20.11	online for all	room 20.S.1, team MZ-2, 13:30-15
9	27.11	online for all, 8:30-11	room 20.S.1, team MZ-1, 13:30-15
10	04.12	online for all	room 20.S.1, team MZ-2, 13:30-15
11	11.12	online for all, 8:30-11	room 20.S.1, team MZ-1, 13:30-15
12	18.12	online for all	room 20.S.1, team MZ-2, 13:30-15

More details will be provided during the first online lesson.

See you soon,

Marco Colombetti

2 What is AI?

Professor's slides:
`../other/professor'sslides/PartII-WhatisAI.pdf`

Artificial Intelligence (AI) is an area of Computer Science and Engineering whose goal is to develop computational systems that can be considered intelligent in some meaningful way.

Since the beginning, the goal of AI has been to program digital computers in order to replicate aspects of human intelligence.
Of course, this presupposes that we know what we are talking about when we use the terms "intelligence", "intelligent", and so on.

So, what do we actually mean by "intelligence", "intelligent", etc.?
We have an intuitive understanding, but no rigorous definition that is universally accepted.

A possible interpretation of the term "intelligent" tends to identify it with the term "rational", which in turn is viewed under the rather restricted perspective that is typical of the economical sciences: being rational means being able to act in such a way that some utility function is maximised (or some cost function is minimised).

Under this view, the predicate "intelligent" may be applied:

- to an **agent**, that is, to a systems that we regard as capable of performing actions (persons, dogs, ..., maybe certain types of artificial systems);
- to a specific **action** perfromed by an agent (e.g., an intelligent answer);
- to the **result** or product of an action (e.g., an intelligent coffee machine).

If, as it seems reasonable, we opt for the first one, this implies that we are ready to regard a computer program as an **agent**.

3 Intelligent Agents

Professor's slides:
`../other/professor'sslides/PartIII-Intelligentagents.pdf`

3.1 Agent-Environment interaction

What is an agent? Intuitively, an **agent** is a system that is able to **act**.

In general, an agent performs an action on its **environment**: therefore, what we call an action is actually an **agent-environment interaction**. To give a more general idea of what an agent is, we shall first consider agents that have both a "mind" and a "body" (biological organisms, robots); a pure software agent can then be viewed as a special case, in which there is no "body" properly so called.

The interaction between an agent and its environment consists of two **streams of** physical **events**, one in **input** to the agent, the other one in **output**.

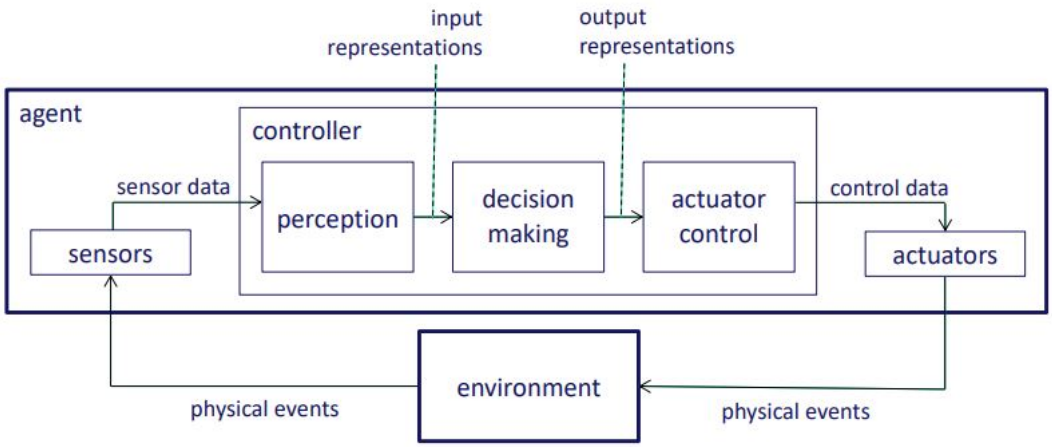
The function of an agent is to **control its environment**, in order to achieve certain **goals**.

At the interface with its environment, an agent has to:

- transform the input physical events into input data suitable for internal processing performed by what we can call the agent's **controller**;
- tranform the output data of internal processing into the output physical events.

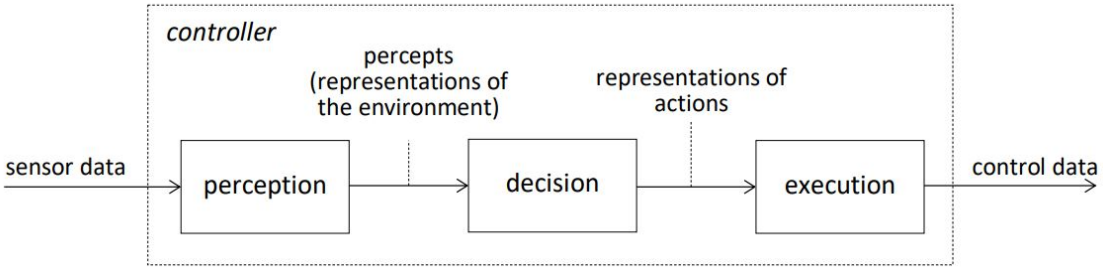
These operations are performed by two types of devices, called **transducers**:

- input transducers, called **sensors**;
- output transducers, called **actuators** or effectors.



The main function of the agent's **controller** is to **decide what to do** in order to fulfill the agent's goals, given the current state of the environment. Often, such decisions cannot be taken directly from an inspection of the sensor data; rather, the sensor data need first to be interpreted.
In general, **perception** is a process that transforms sensor data into higher-level representations of the current state of the environment, which are suitable inputs for the agent's decision module.
Symmetrically to the case of perception, such representations will have to be translated into **control data** to drive the actuators.

In this course we shall concentrate only on the decision module:



3.2 Agent classification

In view of our goals it is important to classify agents according to the complexity of their decision-making function.

A first distinction is between **reactive** and **proactive** agents. A purely reactive agent is an agent that decides what to do only on the basis of the state of the perceived state of its environment; in other words, such an agents simply reacts to elements of the current external (or internal) situation. A proactive agent, on the contrary, is also sensitive to the future, at least as far as this can be anticipated by the agent.

Purely reactive agents are often further classified in the two categories of simple reflex agent and model-based reflex agents, and proactive agents in the two categories of goal-based agents and utility-based agents.

Simple reflex agents

Simple reflex agents are agents whose decisions at time t are based on the agent's perceptions at time t.
Simple reflex agents are stateless and therefore have no memory of past perceptions and actions.

Model-based reflex agents

Many types of behaviours cannot be implemented by a simple reflex agent, because relevant information about the environment may not be currently accessible through the agent's sensors.
Model-based reflex agents maintain a model that represents aspect of the environment that are not currently accessible through the sensors.
In any case, an agent of this type is still reflex, in the sense that its next action will be completely determined by the current perceptions and the current model ot the environment

Goal-based agents

Reflex agents (either simple or model-based) are realised in such a way that they pursue some fixed goal.
A goal-based agent is an agent that can, within limits, select what goals to pursue and how to pursue them.