University of Msila

FACULTY OF MATHEMATICS AND INFORMATICS

DEPARTMENT OF COMPUTER SCIENCE

Muti Agent Systems (MAS)

Outline

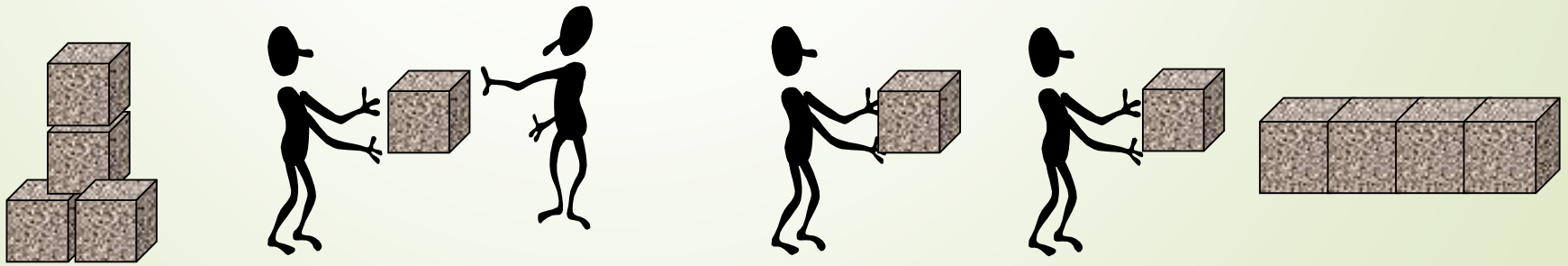
- Introduction
- DAI
- Agent concept
- Multi-agent systems

Introduction

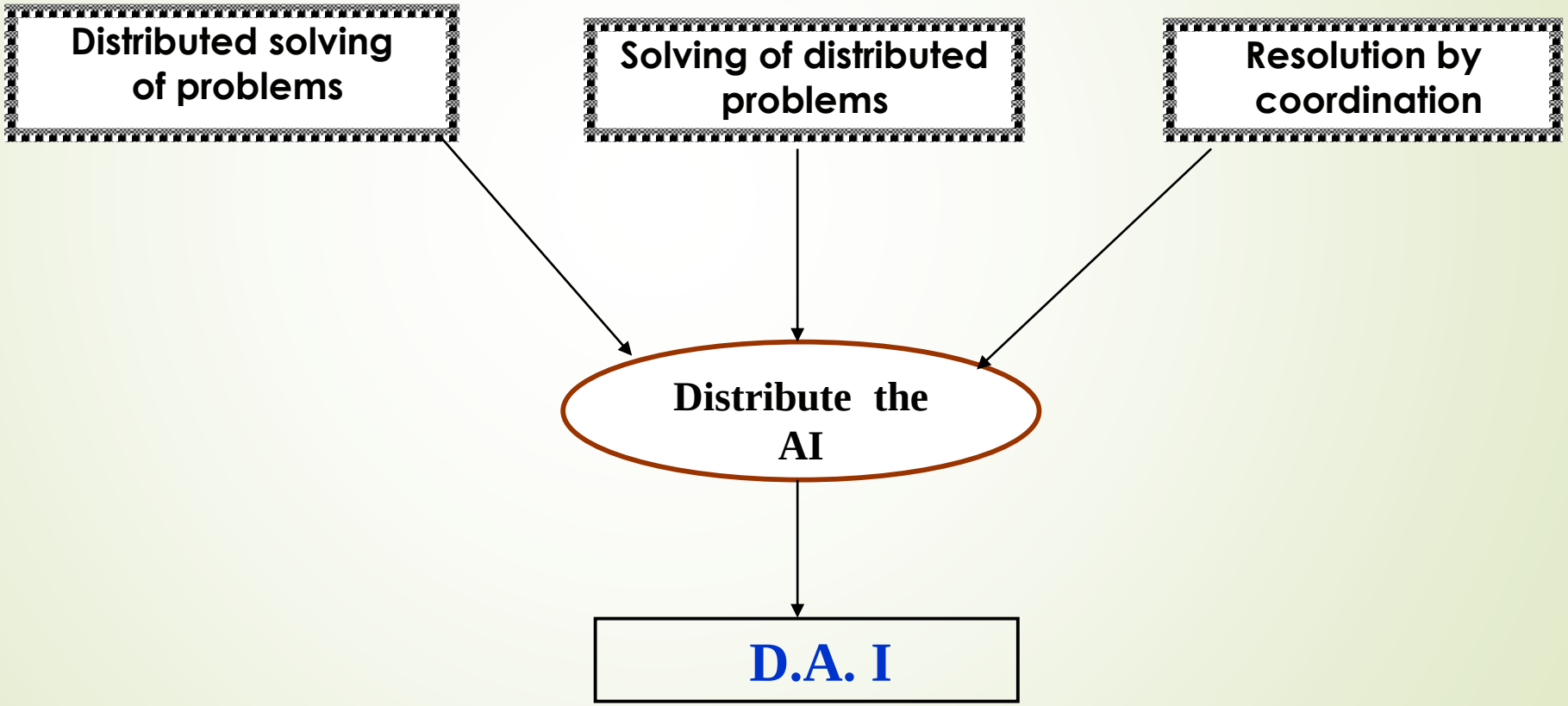
- A.I. is the science and engineering of building intelligent machines with calculable, intelligent, like human-behaviors:
- A machine can : Play chess, Talk, Translate text, Ride a bike, Bring breakfast to bed, Recognize a friend in a photo.
- **1970**: Creation of Distributed Artificial Intelligence
- A new AI: **Distributed AI**

Objective:

- Create a society of autonomous agents working together towards a global goal



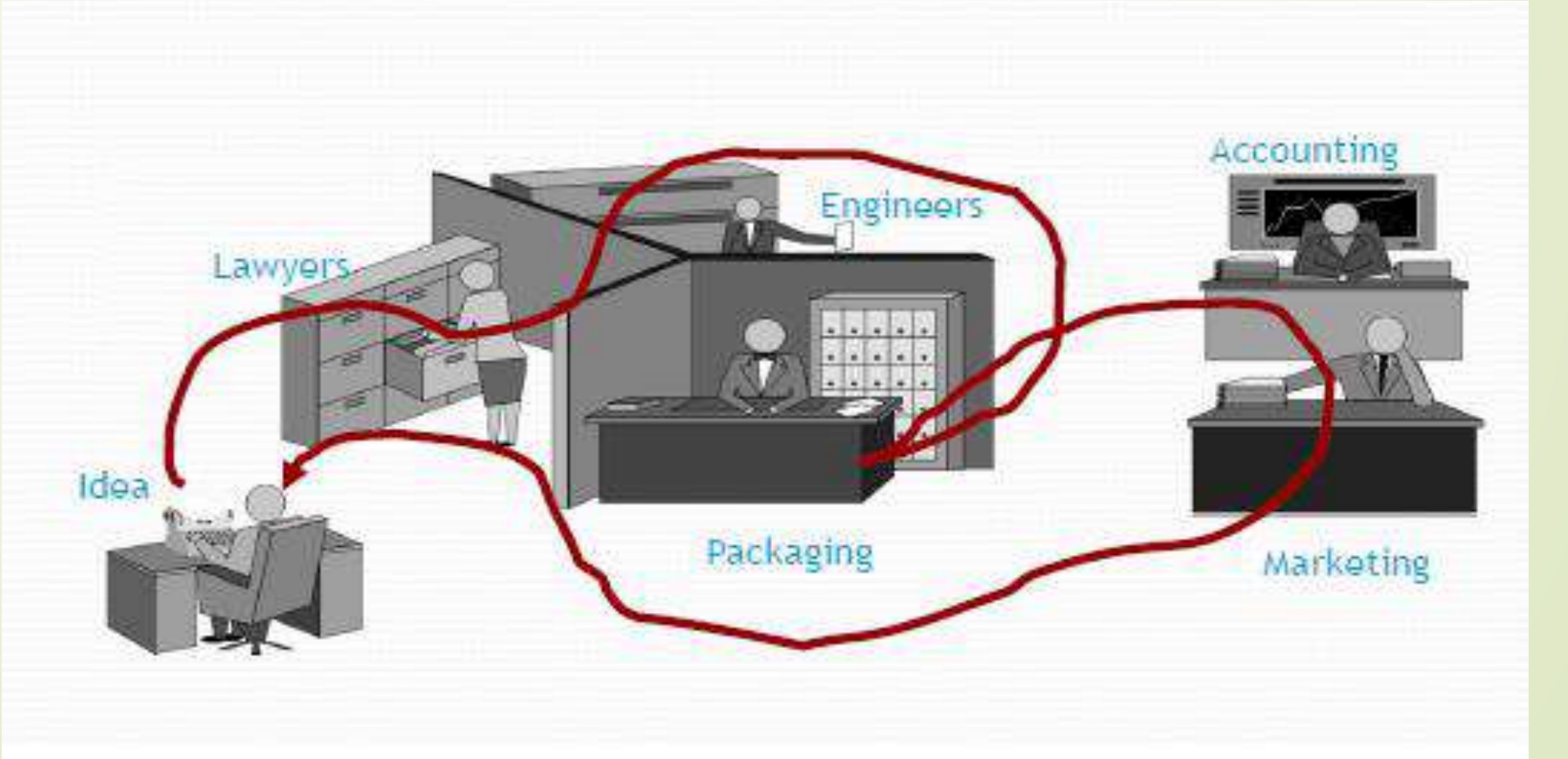
Introduction



DAI

- **Example:**

Functional distribution in human activities (such as product design, for example) : Decomposition of the problem according to specialties



DAI

- **Parallel Artificial Intelligence**
  - •Language and algorithm development for DAI
  - •Improving the performance of DAI systems by proposing concurrent languages and parallel architectures

- **Distributed Solving of Problems**
  - •Decomposition of a problem posed on a set of distributed, cooperating entities
  - •Knowledge sharing between entities
  - •Entities are generally dependent on one another.

- **Multi-Agent Systems**

Cooperate a set of proactive and relatively independent entities called "**agents**", endowed with intelligent behavior. with the aim of coordinating their goals and action plans to solve problems.

Concept of agent

- "An agent is a mechanical, biological or software system that interacts with its environment. Anne Nicole.
- For example:
- a printer can be seen as a mechanical agent that reacts to commands and produces actions in return.
- Plants, animals and humans are biological agents with greater autonomy, absorbing nutrients, breathing, transforming themselves and their environment.
- In Computer science: Software agents are autonomous programs, run on a machine, which perceive certain elements of their environment via input streams (keyboard, mouse, sensors) and act via their output streams (screen displays, physical machine control, process control).

Concept of agent

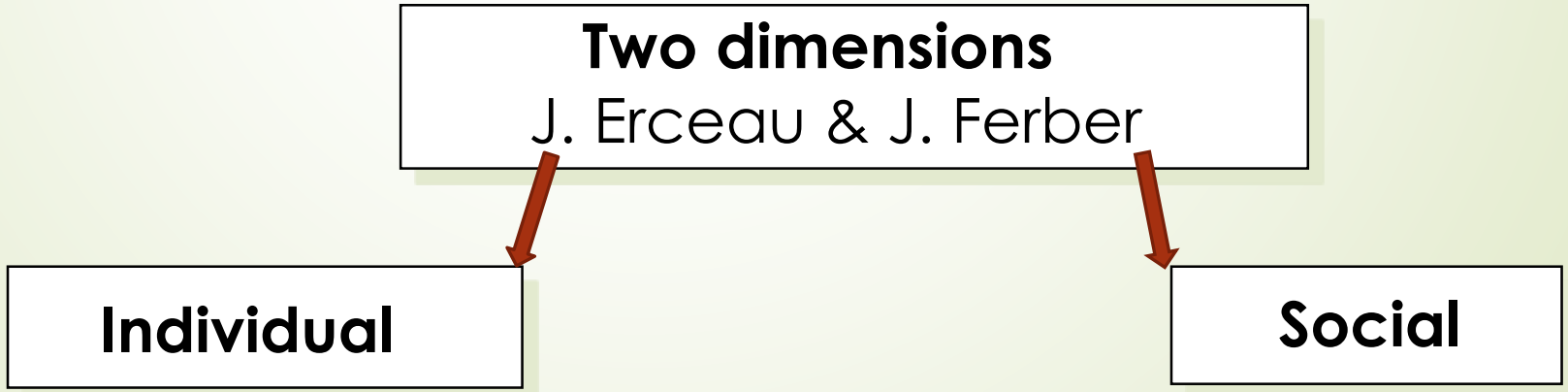
- **Definitions**
  - An agent is an entity (physical or abstract) characterized by :

    - Its autonomy in decision-making,
    - Its knowledge of itself and of others,
    - Its ability to act.

    J. Ferber and G. Ghallab, 88

  - An agent: an intelligent entity, acting rationally and intentionally, according to according to its own goals and the current state of its knowledge.

    Y. Demazeau & J.P. Müller, 90



Concept of agent

- **Behavior**

Its behavior tends to satisfy its objectives, taking into account the resources and skills at its disposal, and depending on its perceptions, representations and the communications it receives.

- **Knowledge**

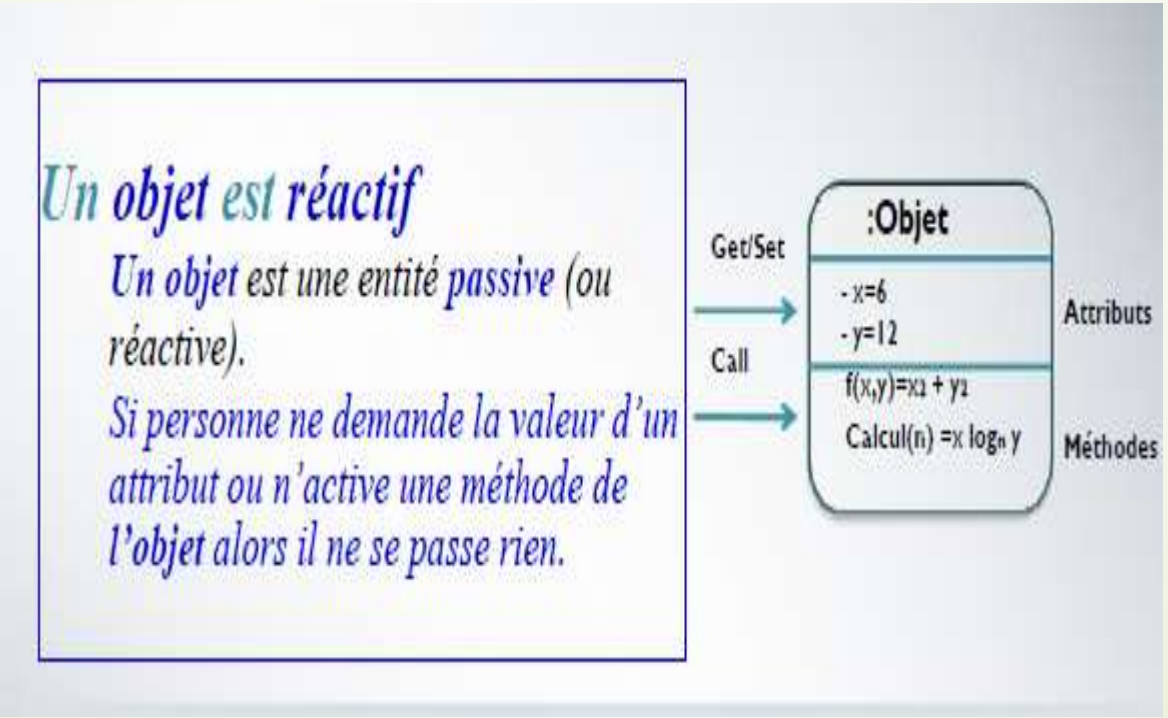
An agent has three types of knowledge:
- domain knowledge or expertise ;
- control knowledge or behavior ;
- communication and interaction knowledge

- **Agent characteristics**

- **Nature:** An agent can be a physical or virtual entity.
- **Autonomy:** An agent is more or less independent of the user, other agents and resources (CPU, memory, etc....).
- **Environment:** this is the space in which an agent will act; it can be reduced to the network made up of all the agents.
- **The objective:** an agent can pursue the overall system goal, satisfy its own objectives or even behave in a way that absolves itself of a survival function.
- **Perception:** of the environment by an agent.
- **Communication:** an agent has the ability to communicate with other agents.
- **Reasoning:** an agent may be linked to an expert system or other more or less complex reasoning mechanisms.

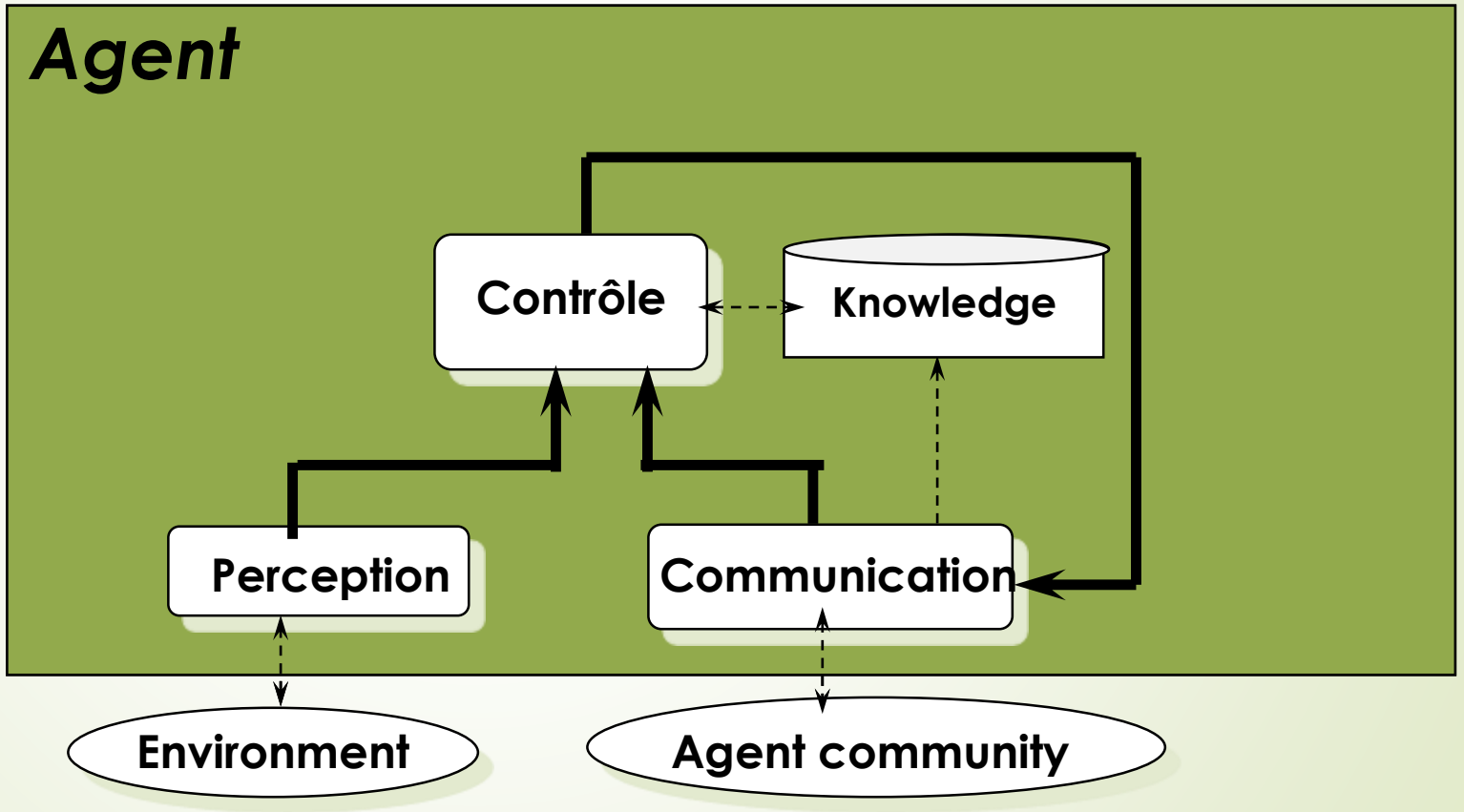
Agent versus Object

- **Autonomy**: agents have control over their actions, they can refuse to cooperate
- Agents are reactive, like objects, but also proactive.
- Agents are usually persistent, and have their own thread of control.



Concept of agent

- Agent architecture



Concept of agent

- **Agent knowledge**
  - Domain knowledge
  - Control knowledge
    - Intentions
    - Beliefs
    - Decisions
    - Rationalities
    - Commitments
  - **Communication knowledge**
    - Communication expertise
    - Messages

Concept of agent

- **Agent types**

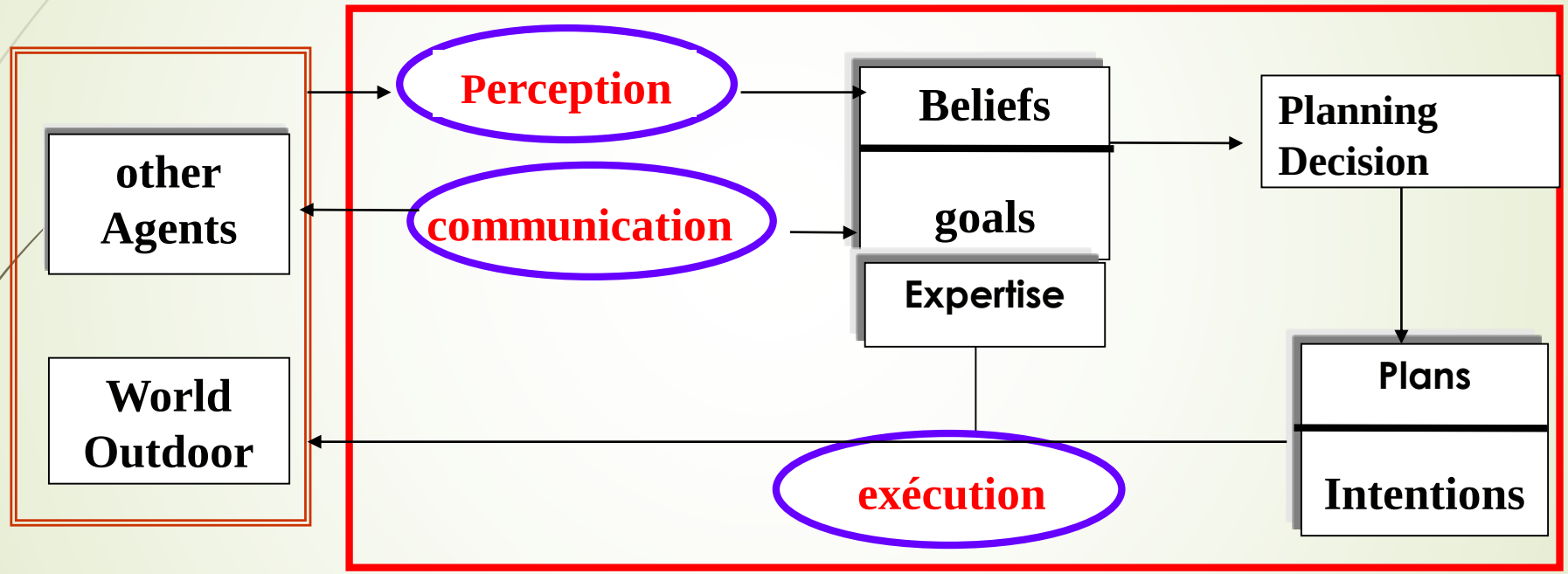
There are two types of agent: reactive and cognitive.

- **Cognitive agent**

- Cognitive agents have a symbolic representation of their environment and reasoning capabilities.
- Agents are immersed in an environment in which they interact. Hence their structure is built around three main functions: perceiving, deciding and acting.
- We can also mention some important sub-functions:
  - conflict detection,
  - belief revision,
  - cooperation (negotiation, coordination),
  - learning.

Concept of agent

- How a cognitive agent works



Concept of agent

- **Reactive Agent**
- It does not include reasoning; it acts according to a **stimulus/reaction** pattern to events produced as inputs.
- The "reactive" school, on the other hand, claims that it is not necessary for agents to be individually intelligent for the system to behave intelligently as a whole.

Example

rules *: règles condition-action*
percepts *: ensemble de percepts*
repeat
state := interpret_input(percept) ;
rule := match(state, rules) ;
execute*(rule[action]) ;*
forever

Concept of agent

- Difference between a Reactive Agent and a Cognitive Agent

Cognitive agent system	Reactive agent system
Explicit representation of the environment	No explicit representation
Can take its past into account	No history memory
Complex agent	Stimulus/reaction operation
Small number of agents	Large number of agents