

University of Msila
FACULTY OF MATHEMATICS AND
INFORMATICS
DEPARTMENT OF COMPUTER
SCIENCE



Introduction to DAI and Multi Agent Systems (MAS)



Outline

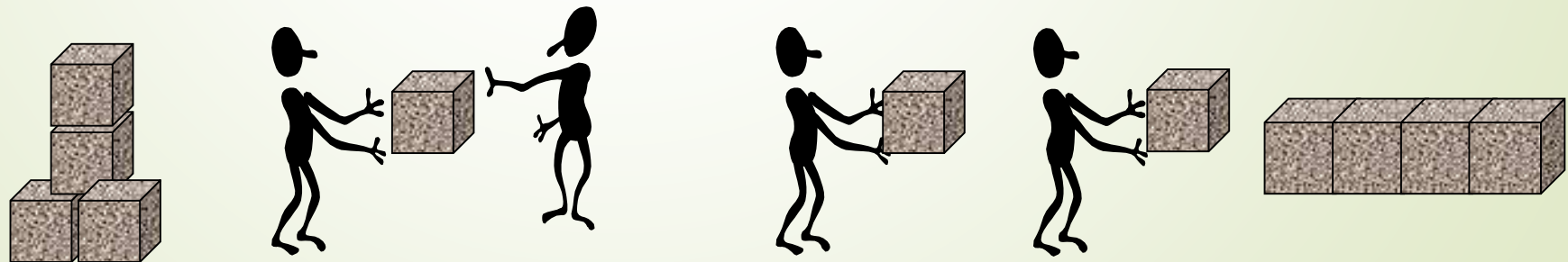
- Introduction
 - DAI
 - Agent concept
 - Multi-agent systems
- 

Introduction

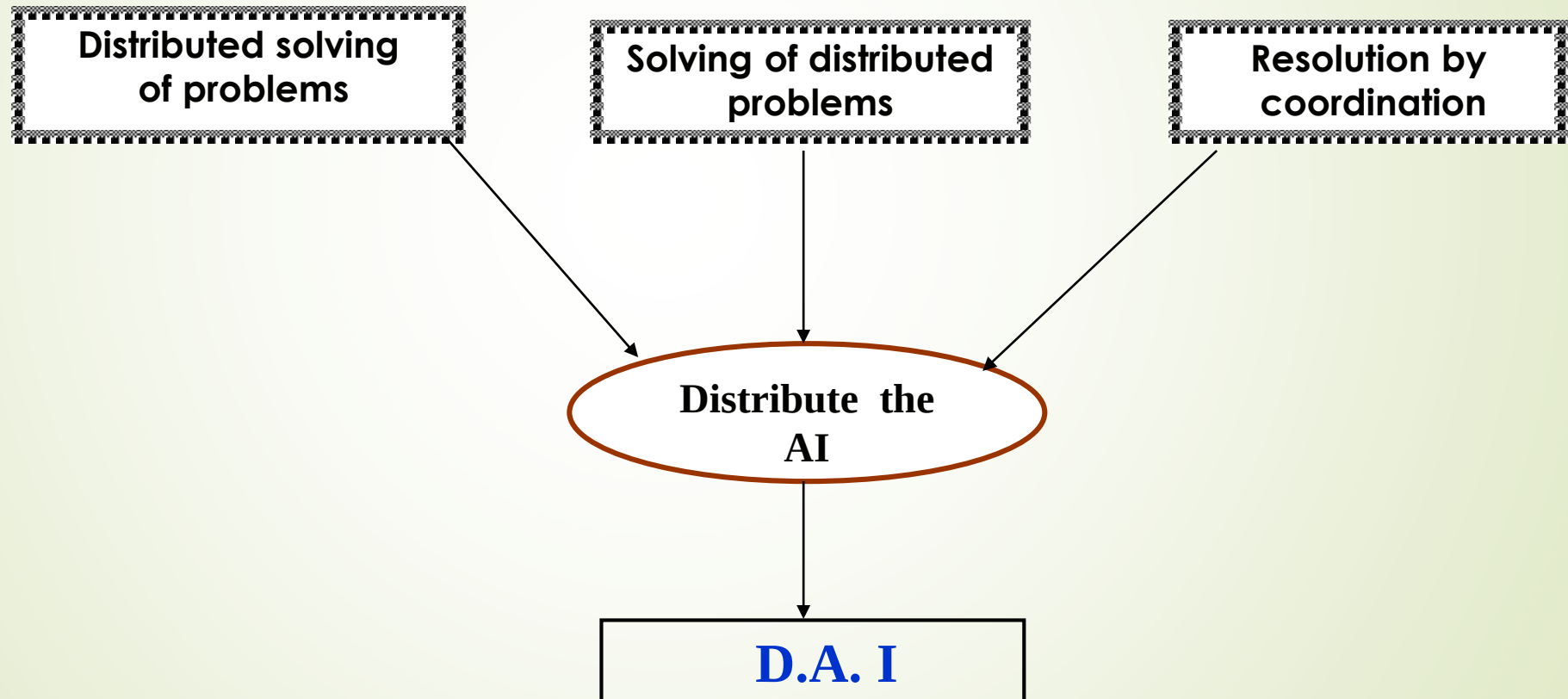
- A.I. is the science and engineering of building intelligent machines with calculable, intelligent, like human-behaviors:
- A machine can : Play chess, Talk, Translate text, Ride a bike, Bring breakfast to bed, Recognize a friend in a photo.
- **1970:** Creation of Distributed Artificial Intelligence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

Objective:

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



Introduction





DAI

➤ Why distribute the A.I.?

The reasons for distributing artificial intelligence can be found in the following investigations:

➤ **Simplifying distributed IT applications**

▪ **Distributed solving of problems**

- A complex task is solved by a group of specialists with complementary skills,
- Expertise is distributed, but the domain is not,
- **Ex:** medical diagnostics, product design, pattern recognition...

▪ **Solving of Distributed problem**

- The domain is distributed,
- Analysis, identification and control of physically distributed systems,
- **Ex:** communication network control, road network control.

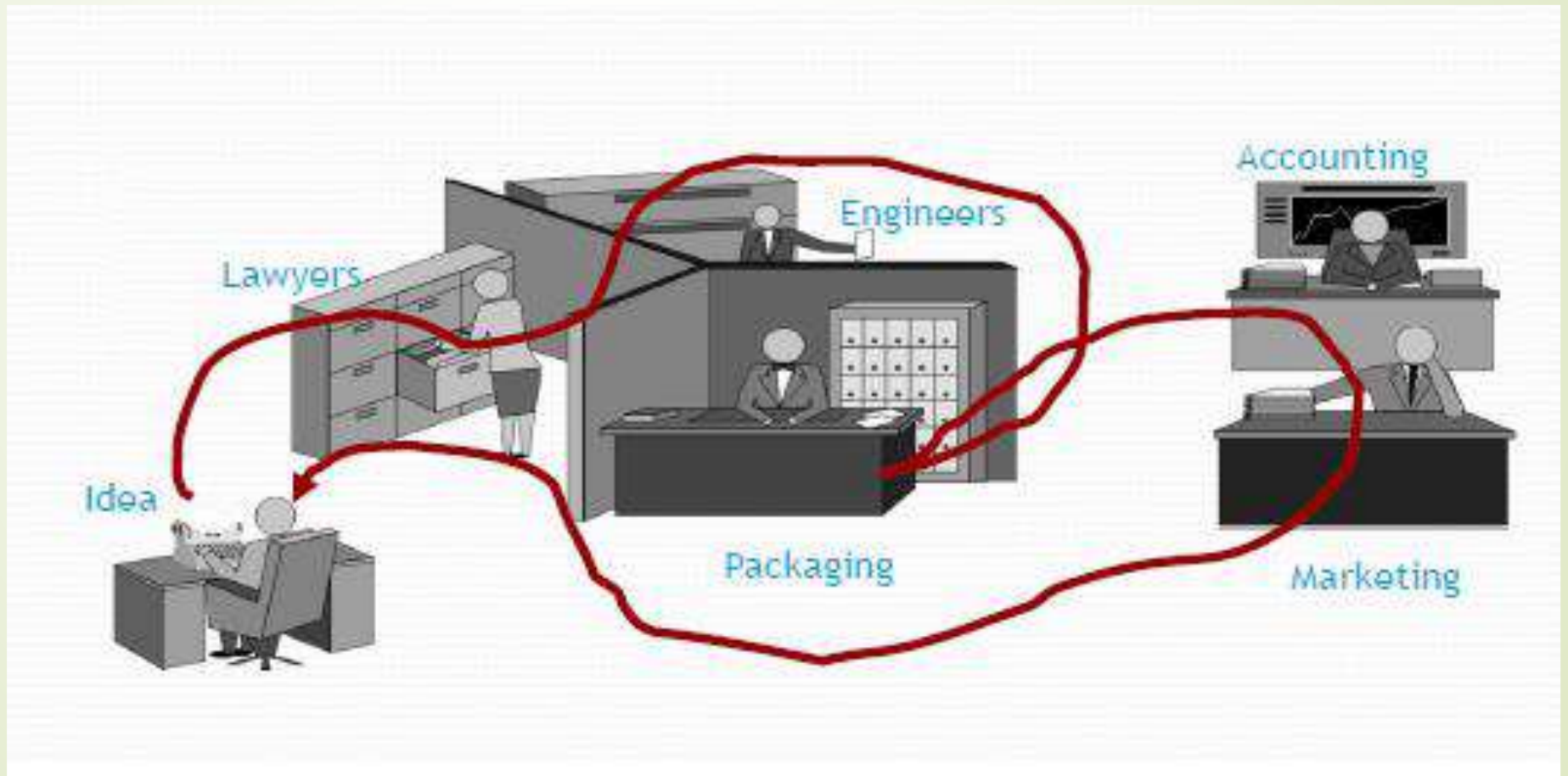
▪ **Coordinated problem solving**

- Expertise through coordination,
- **Ex:** assigning tasks in a workshop.
- Overcoming user interface problems,

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

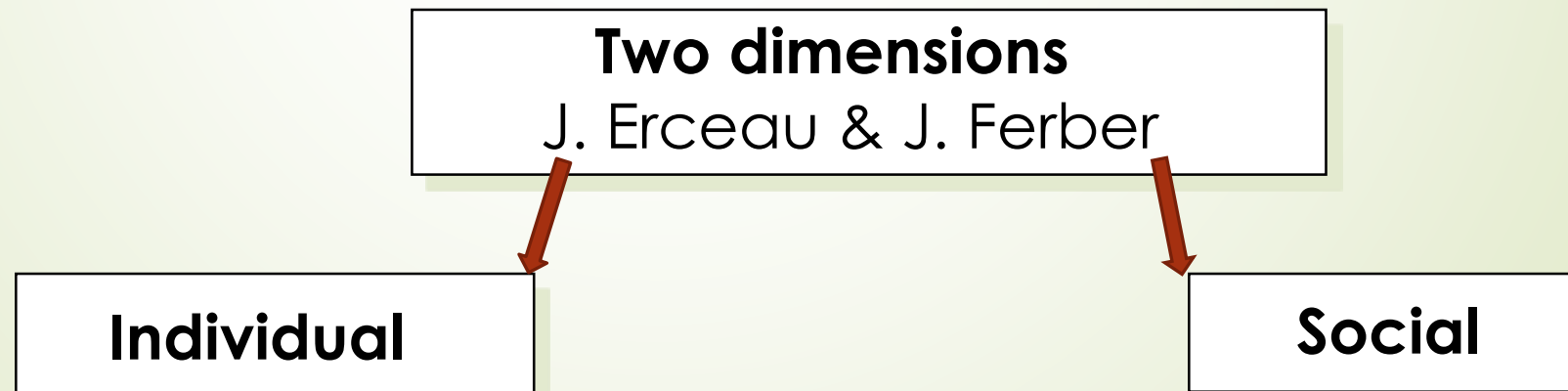
➤ An agent is an entity (physical or abstract) characterized by :

- 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.

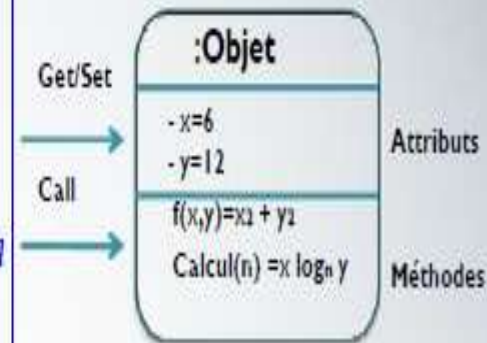
Agent versus Object

- **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.

Un objet est réactif

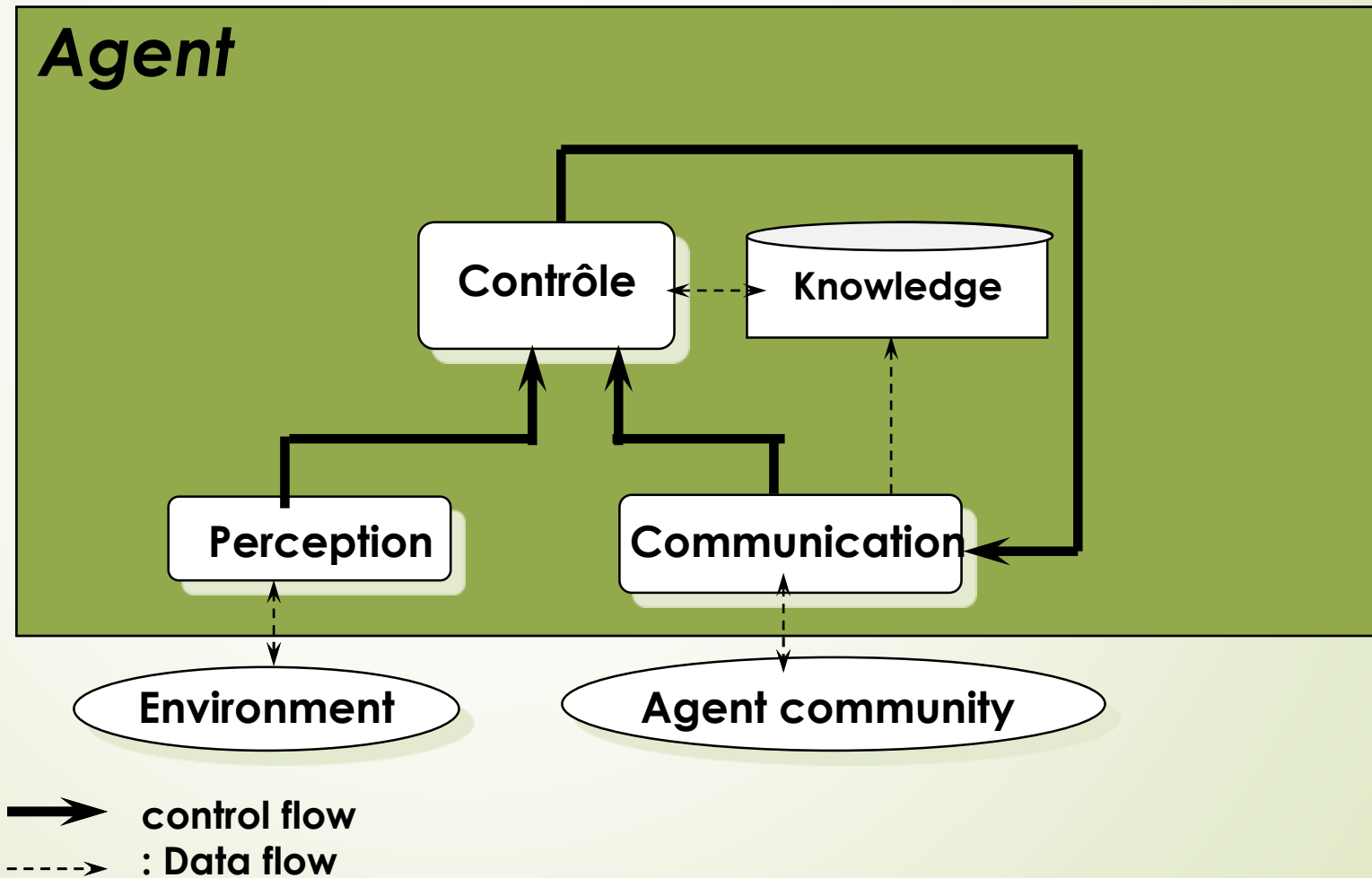
Un objet est une entité passive (ou réactive).

Si personne ne demande la valeur d'un attribut ou n'active une méthode de l'objet alors il ne se passe rien.



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

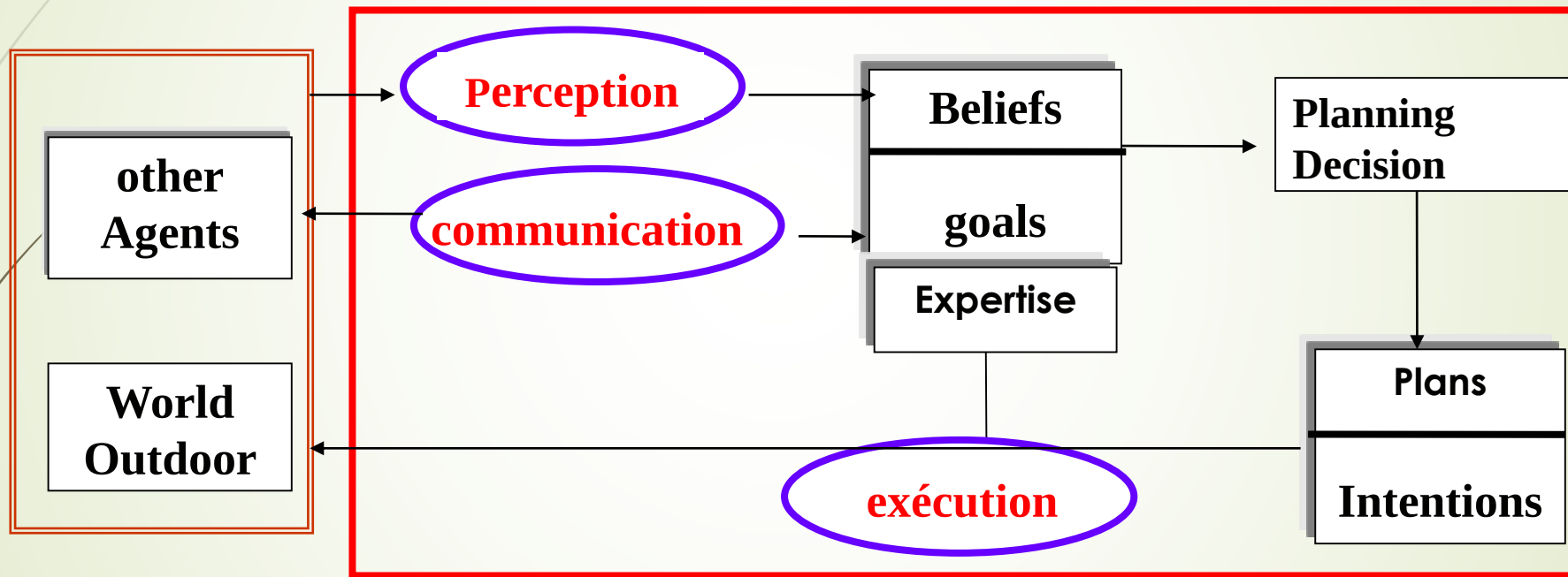
There are two types of agent: reactive and cognitive.

➤ 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