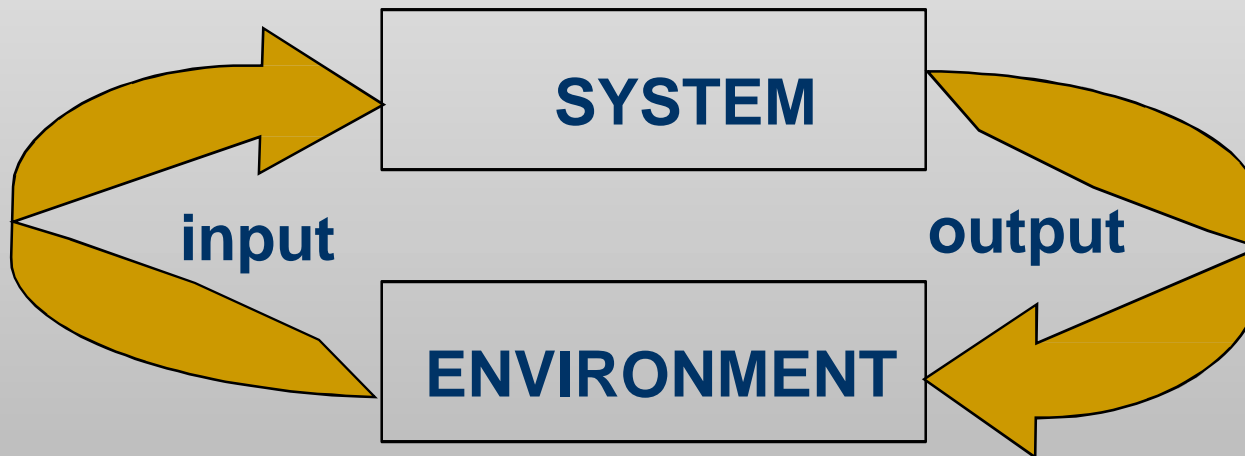# Agent Communication

Autonomous agents

- **An agent is a computer system capable of autonomous action** *in some environment* **in order to meet its design objectives**

input   **SYSTEM**   output

ENVIRONMENT

BDI agents – basic algorithm

BDI-interpreter
- (B,D,I):= Initialize-state();
- While true do
  - Update(B,D, I); // perceptions may update beliefs, desires and intentions (ex. Once fulfilled, an intention is dropped)
  - Options:= option-generator(B,D,I);
  - Selected-options:=deliberate(B,D,I);
  - Update-intentions(Selected-options,I);
  - Plan:=Planing(I,B);
  - Execute(Plan);
  - Get-new-perceptions();
- End While

Summary

- **An agent is a computer system capable of flexible autonomous action in some environment.**
- **Situatedness: peceiving the environment via sensors and being abble to affect the environment via effectors**
- **Autonomy: capability of action without intervention, and control over internal state**
- **Flexibility:**
  - **Responsiveness: respond in a timely fashion to change in the environment**
  - **Pro-activity: actions which go beyond simple response to stimulus**
  - **Sociability: ability to interact with other agents and humans for mutual benefit**

Agent Communication

- **Designing MAS:**
  - **Agent design**
  - **Sociaety design**
- **In this lecture, we cover *macro-aspects* of intelligent agent technology: issues relating to the agent *society*, rather than the individual**
- **Adress the sociability of the agent**

Outline of the presentation

- **Introduction:**
  - **What is cooperation?**
  - **Cooperative *versus* non-cooperative encounters**
- **Early systems:**
  - **Methode invocation**
  - **The blackboard architecture**
- ***Agent Communication Languages (ACL):***
  - **KQML & KIF;**
  - **FIPA ACL**
- **Protocols and agent conversations:**
  - **The contract net protocol**
  - **Argumentation**
  - **Negotiation protocols: Bargaining and Interest based negotiation (IBN)**

Working Together

- **Cooperation is:** the practice of working in common with mutually agreed-upon goals and possibly methods, instead of working separately in competition, and in which the success of one is dependent and contingent upon the success of another.
    - E.g. I can't play a quintet alone!
- **When agents are working together, it is important to make a distinction between:**
    - *Benevolent agents*
    - *Self-interested agents: it does not mean that they want to cause harm to other agents or that they care only about themselves. It means that it follows its interest as represented by a utility function (representing the agent preferences)*

Benevolent Agents

- If we "own" the whole system, or are in a cooperative environment, we can design agents that help each other whenever asked (if possible)

- In this case, we can assume agents are *benevolent*: others best interest is their best interest

- Problem-solving in benevolent systems is called *cooperative distributed problem solving* (CDPS)

- *Benevolence simplifies the system design task enormously!*

Self-Interested Agents

- If agents represent individuals or organizations, (the more general case), then we cannot make the benevolence assumption

- Agents will be assumed to act to further their own interests, possibly at expense of others

- Potential for *conflict.*

- *E.g. Competitive environment (sport, war, ...)*

- May complicate the design task enormously

Task Sharing and Result Sharing

- **Two main modes of cooperative problem solving:**
  - *Task sharing*: **components of a task are distributed to various agents**
  - *Result sharing*: **information (partial results, etc.) is distributed**
- **Both benevolent and self-interested agents have to work together and need to cooperate.**
- **Cooperation requires coordination**
- **Coordination of multiple independent autonomous agent require communication (of some sort).**
- *E.g. Lifting a table*
- *E.g. I can't play a quintet with the others if I can't ear them!*