Multi-agent systems
General overview

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Modular systems

- a complex system cannot not be monolithic, but modular
- how kind of modules we should use ?
- how organization of these modules we should use ?

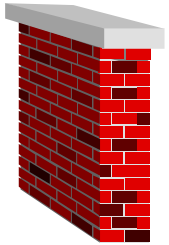
Transferring Real to Virtual

- The core of this problem resides in strategy how we transfer units of real world into computer (how we model real world)

- These strategies can be classified according to kind of activity which the transferred units exhibit

Types of activity

- passive unit

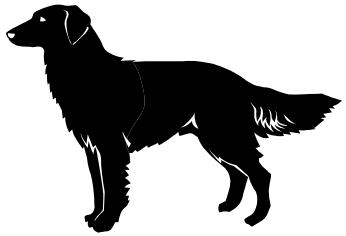


(record)

- reactive unit

(object)

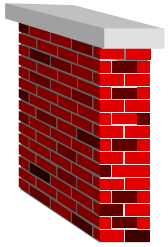
- proactive unit



(agent)

Types of activity

- simple and single units

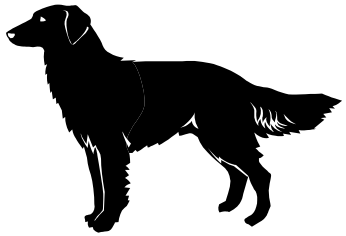


- structured programming

- units which have relations with others

- object-oriented programming

- units which have own behavior

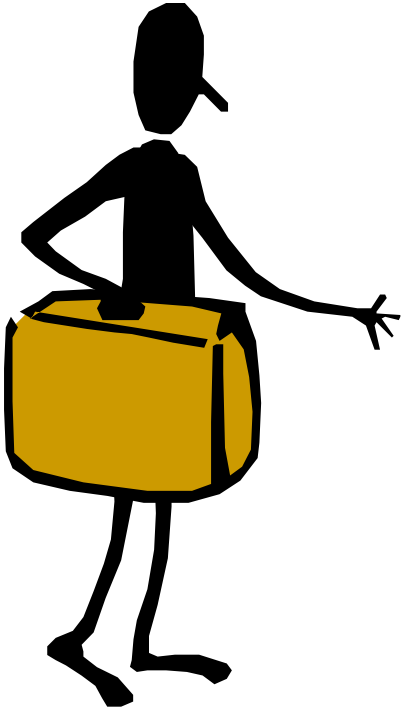


- agent-oriented programming

What is agent ?

- “Agent” is not a technology
- “Agent” is a metaphor only
- “Agent” defines just a framework for many various technologies which use the same metaphor

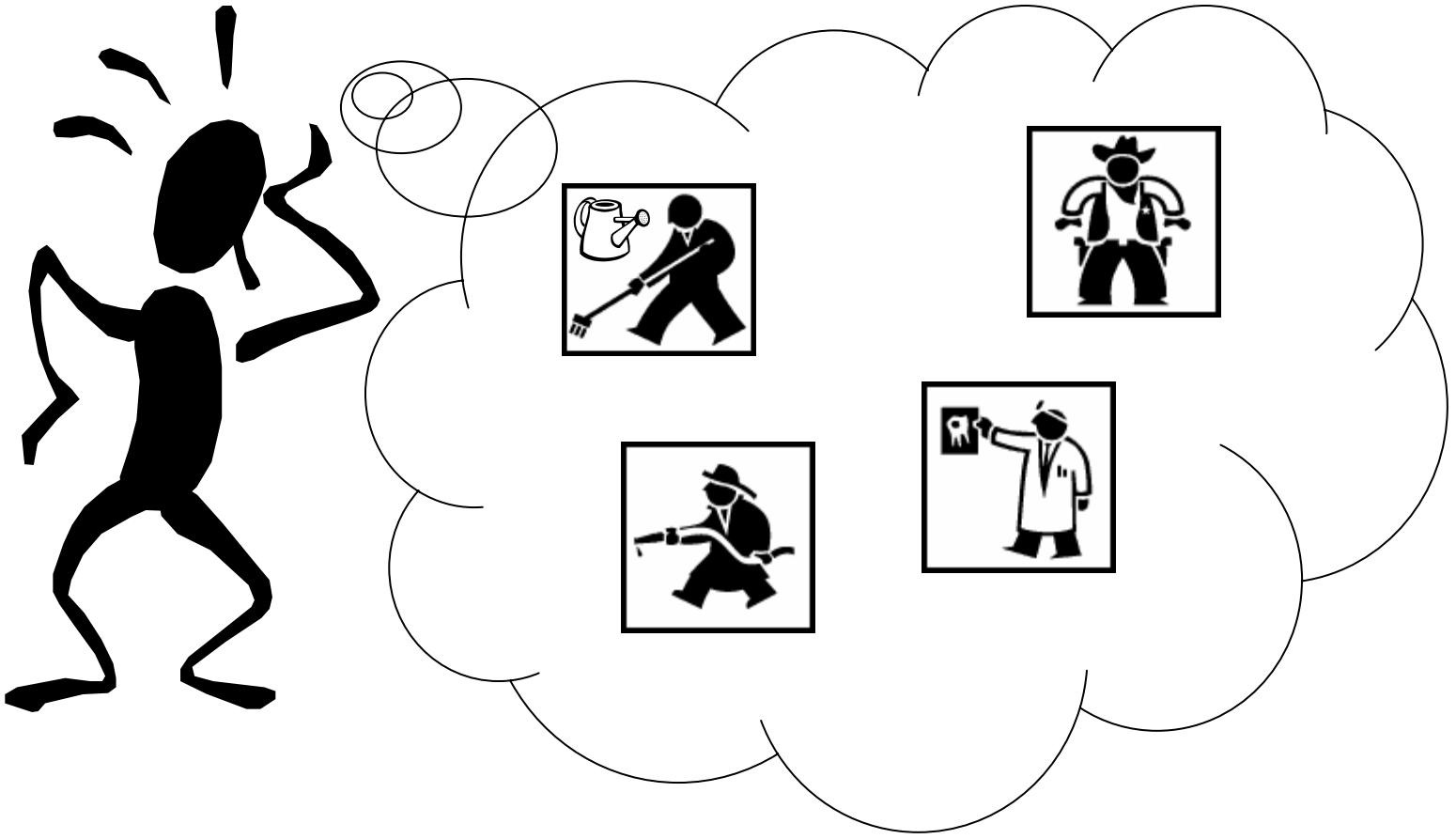
Agent metaphor



Agent is a deputy which represents a real unit - exhibiting an active behavior - in computer

Multi-agent system is a system which building units are agents

Sorry, the metaphor is too wide



Conference on agents = Tower of Babel

Agent platforms

Therefore various platforms try to specify smaller domains like:

- Intelligent agents
- Software agents
- Autonomous agents
- Mobile agents
- …many others

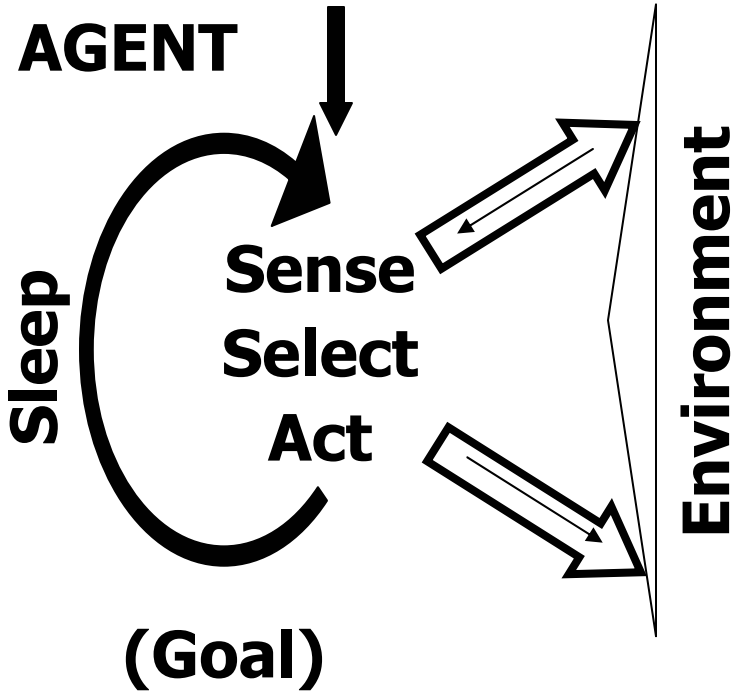
Even some researchers abandon word “agent” and use a replacement (e.g. resource)

Agent definition

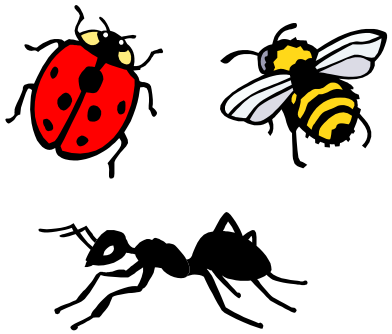
[modified definition by Jim Doran]

Agent is a process which constantly selects and performs actions upon perception of its environment, pursuing a goal.

Agent: form of code



Classification according to method of action selection



Agents

Reactive

They react: select an action because this is the action which is dedicated to be selected upon the current conditions

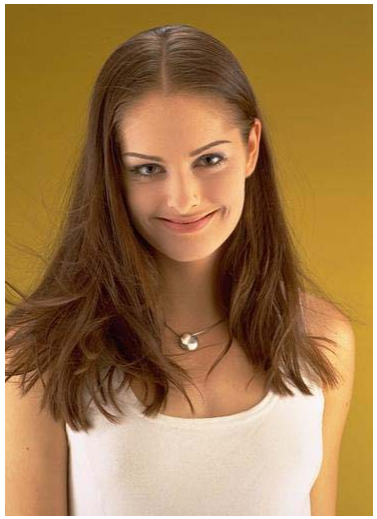
Deliberative

They decide: select an action because the estimated consequences of the action seem to be the best

Reactive selection

Deliberative selection

I am going to exam



Always going to exam, I dress a miniskirt

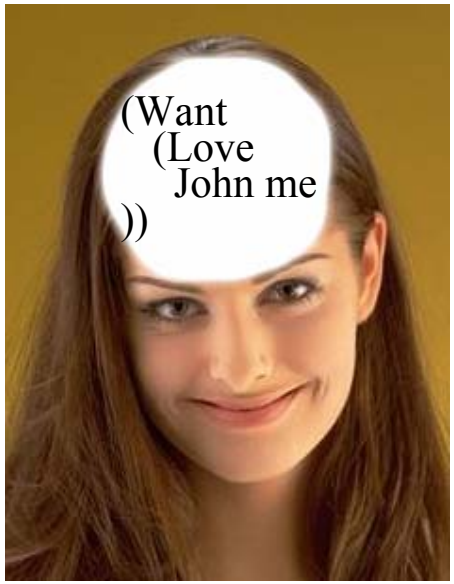
I'd like to pass the exam, but my skills are poor. I have a chance only if my professor pays attention to something else than my knowledge. He is a man and my hams are beauty. Therefore I'll dress a miniskirt

I'll dress a miniskirt

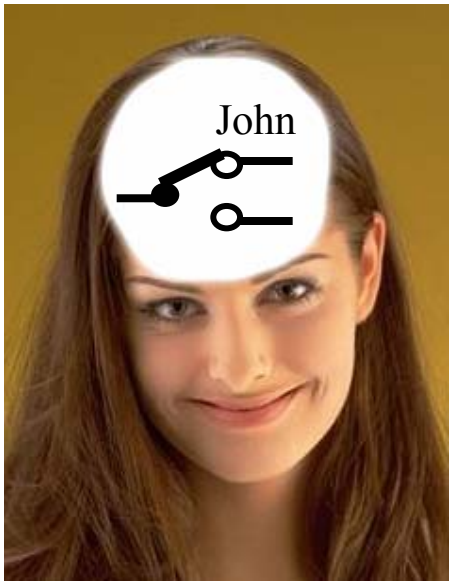
FASHION

LOGIC

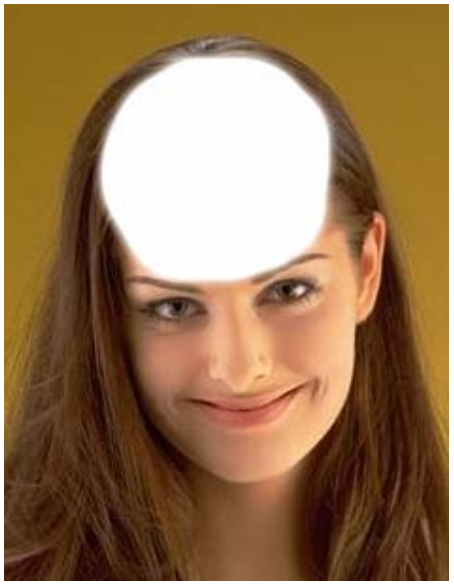
Internal state of agents



deliberative agent



reactive agent



purely reactive agent

How to achieve intelligence ?

Agents

“Weak”

Intelligence is got only due to interaction among agents

↓

“New” Artificial Intelligence (emergent synthesis)

“Strong”

Intelligence is got also due to intelligent (GOFAI) component inside agents

↓

Distributed Artificial Intelligence

Agent and its goal

For any agent, there must be an answer for question:

“What this agent do ?”

Modeling the world, agent is a unit which has a goal

Goal

expressed implicitly

designer knows,
data does not contain

expressed explicitly

data contain the goal

system which navigates a car to a particular destination has an explicit goal

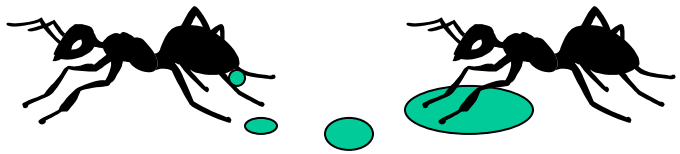
a pure transformation of color image to B/W image has an implicit goal

BUT! E.g. a neuron is not an agent because of missing goal

Communication among agents

direct - by agent name or address

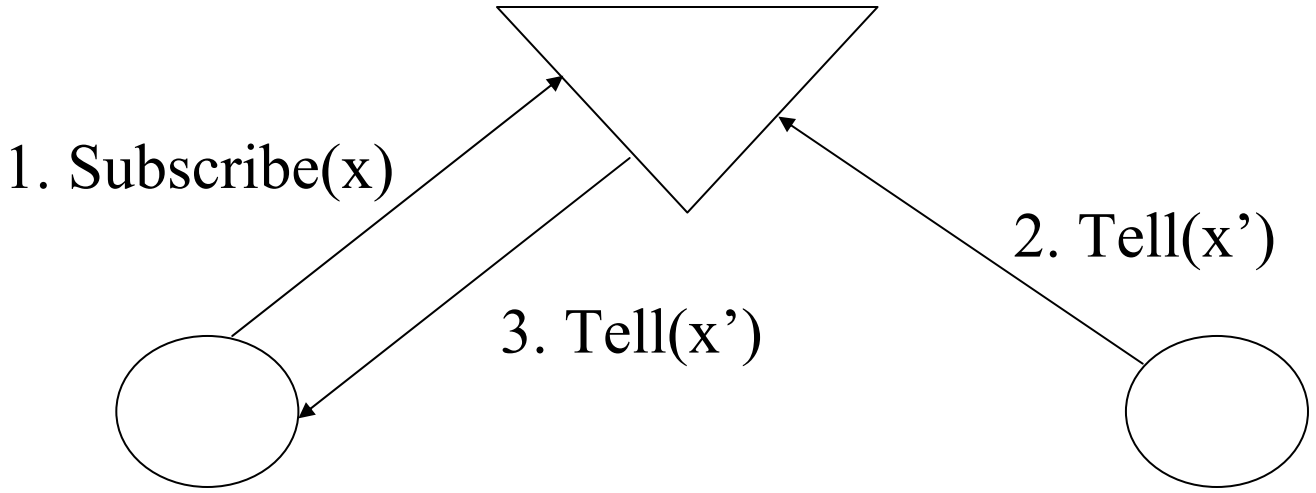
indirect – through another entity representing environment (**space**, mediator, facilitator, metaagent, …)



special case: stigmergic communication

Communication scenarios

- Communication protocol is based on “speech acts”



Communicated data

- binary data (buffers) 0A 00 00 00
- typed data Integer 10
- semi-structured data <age> 10 </age>
- structured data <age value="10" />

(ontological problem)

Implementation of agents

- concurrent programming: over inter-process communication
- object-oriented programming: objects running own thread
- network programming: as a middleware
- component programming: as a run-time component

Standards and tools

- KQML
- KIF
- FIPA ACL
- BDI
- Aglets
- JADE

BUT! Mainly proprietary solutions

Thank you for your attention !

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