

Introduction to Robotics for cognitive science

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Web page of the subject

www.agentspace.org/kv



Biological motivation

- Brooks introduced “Cambrian” intelligence, e.g. snail Littorino



- We have many examples of intelligent behavior of animals
- And also many examples of failures

“Cambrian” intelligence

- Examples

- Goose treats phantom eggs by beak



- bees ostracize bee on which we drop oleic acid

- digger wasp mating behavior



mole cricket

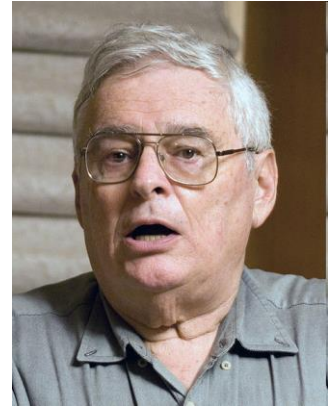
Mind modeling

- Can we model human mind in similar way than Cambrian intelligence of insects ?
- We will try to show that our intelligence is at least partially Cambrian
- Later we will look for non-Cambrian intelligence in our mind

**FINISHED FILES ARE THE RE-
SULT OF YEARS OF SCIENTIF-
IC STUDY COMBINED WITH THE
EXPERIENCE OF YEARS**

- How many dollars are in dozen ?
- And how many quarters ?

Fodor theory



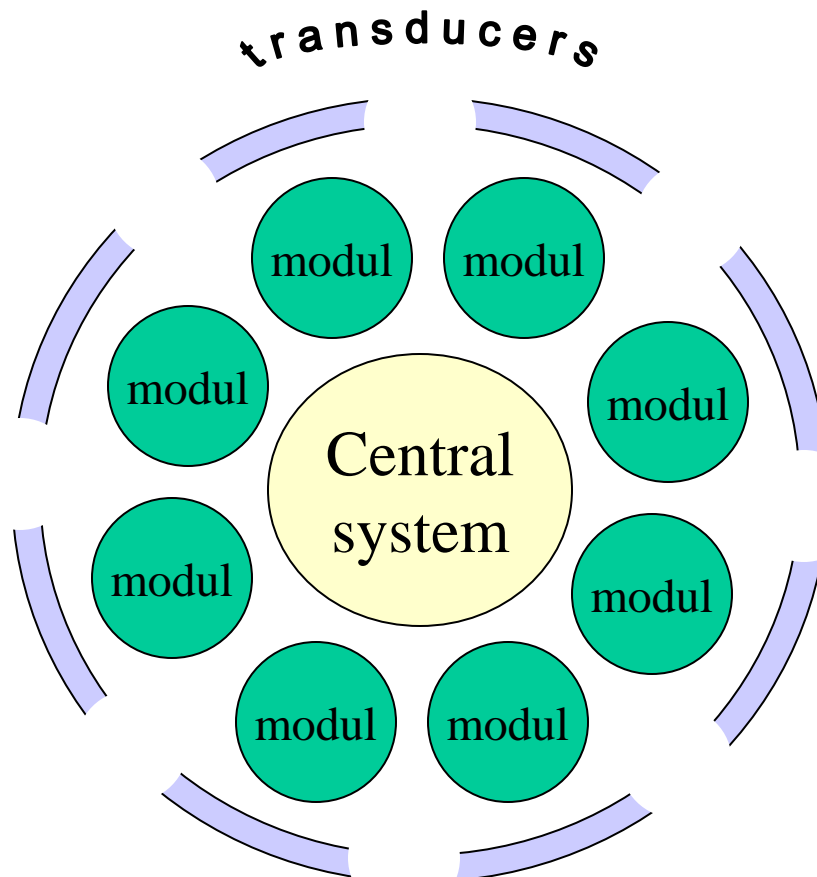
- Derived from rich set of brain injuries

Modules are mandatory

(not controlled by will)

Modules are domain specific

(they have certain function and it is anatomically localized)



Central system is holistic

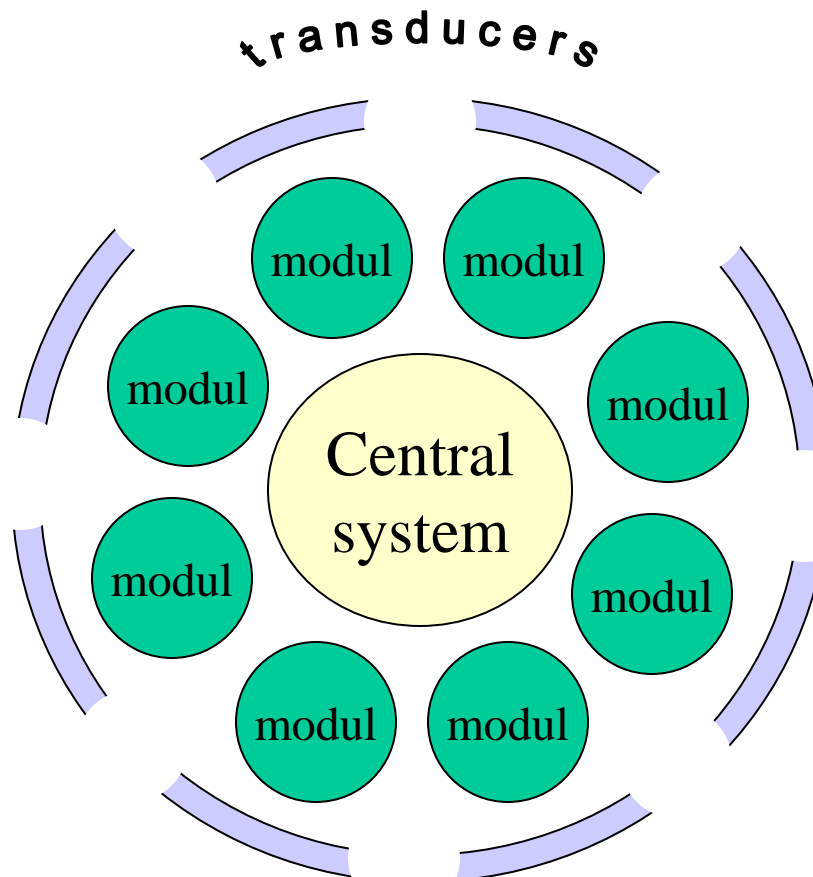
(it has not one function and it does work or not)

Fodor theory

- We do not know whether the idea of the central system is plausible, but we can model it:

Modules are represented by reactive agents

Interconnections among modules and central system are represented by global data blocks



Transducers represented by data blocks for sensor input and actuator output

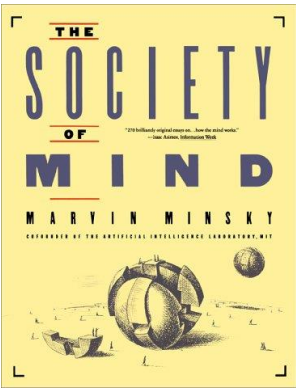
central system is represented by one deliberative agent

Fodor thesis

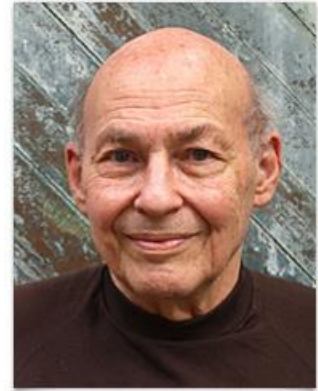
- Modules are domain-specific
- Modules are mandatory
- The central system has limited access to data from modules
- Modules have different speed of data processing
- Modules are informatively closed
- Modules have shallow output
- Modules have fixed neural architecture
- Modules have typical decay courses

Fodor thesis

- Denial of connectionism (subsymbolic) approach
- Preference of computation-symbolic approach
- Compliance with Newell – Simon hypothesis



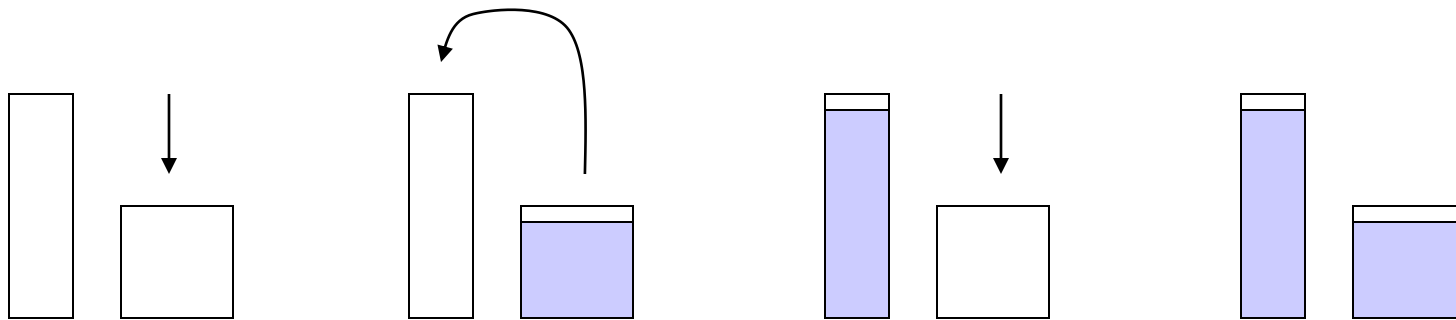
Minsky: Society of Mind



- Mind is a society of agents. How structures do the agents form ?
- Explaining of Piaget experiments
- No unique representation but a strategy how to put different representations into one system
- How to grant that proper agent is activated in the proper time to generate proper overall behavior of system ?

Piaget experiments

- Where is more of water ?



- 4-years old and younger child select one glass
- 5-years old and more child comprehends that there is the same amount of water

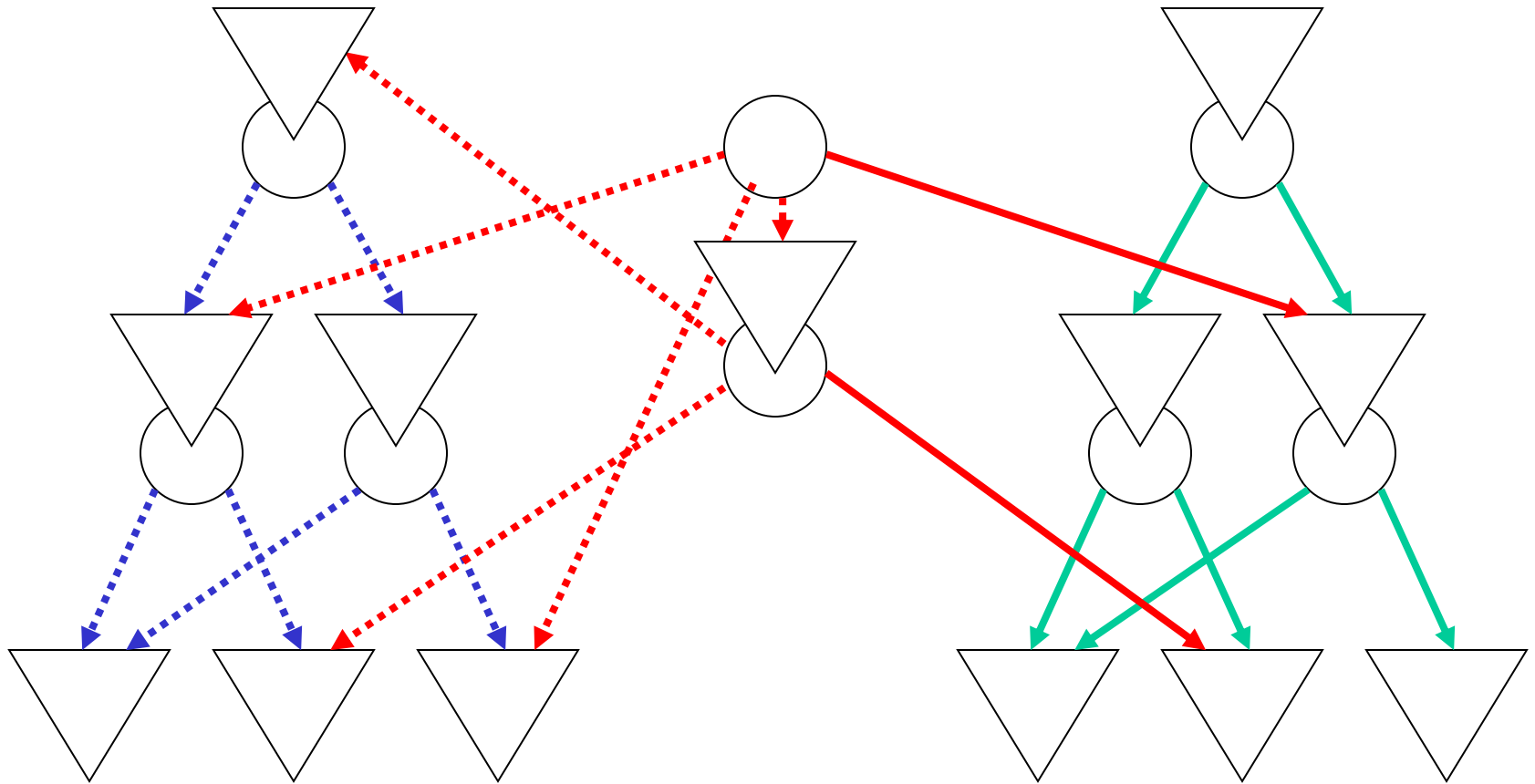
How does the structure in child brain evolve ?

PKA model

P = perception

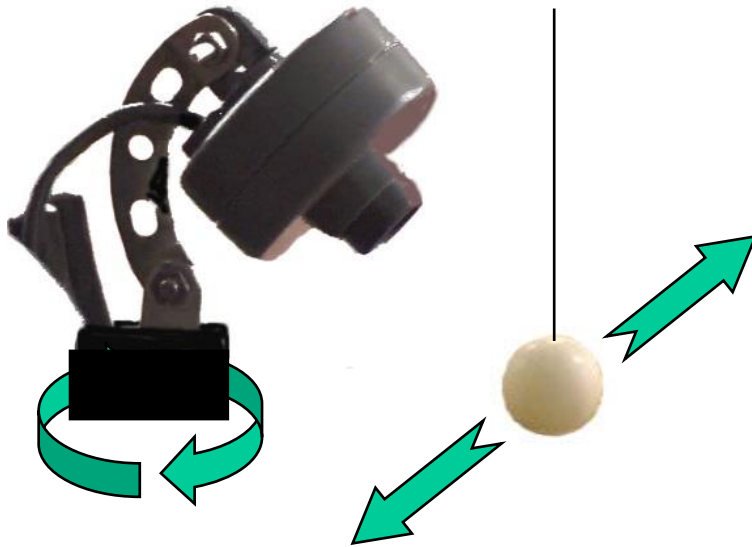
K = knowledge

A = action

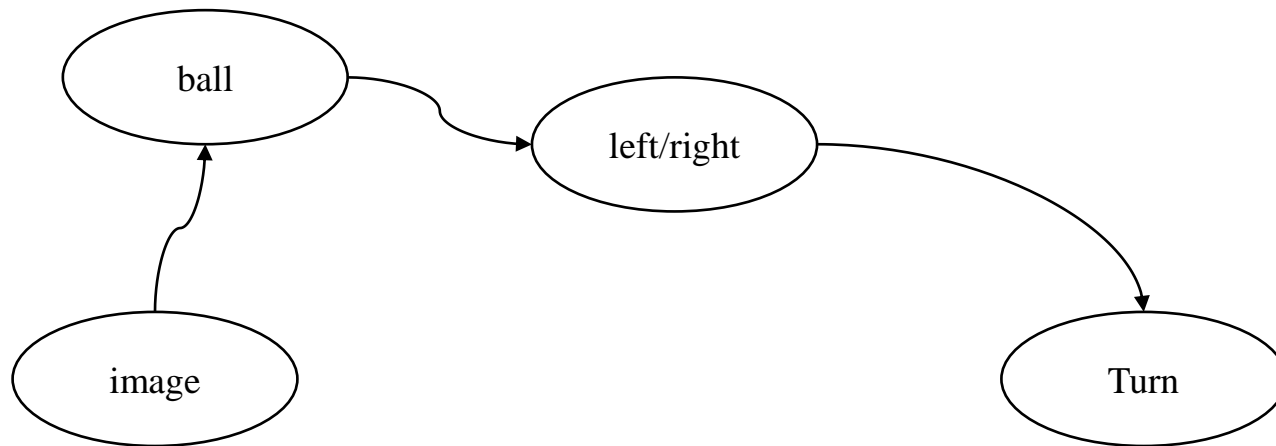


Example

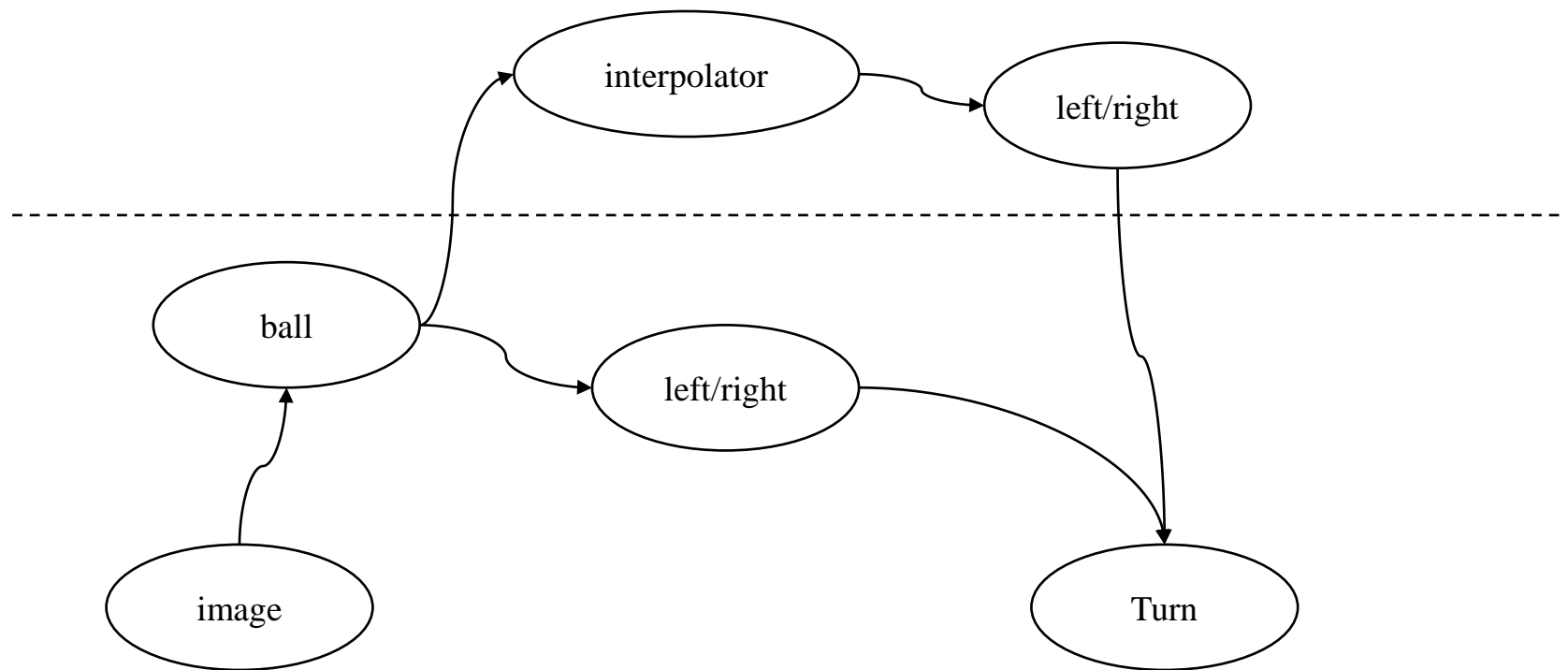
- Robot following ball



- We get image taken by camera, we recognize a circle on the image, if it is on left we turn to left, if it is on right we turn to right
- Minsky would organize such system to the following Agents:



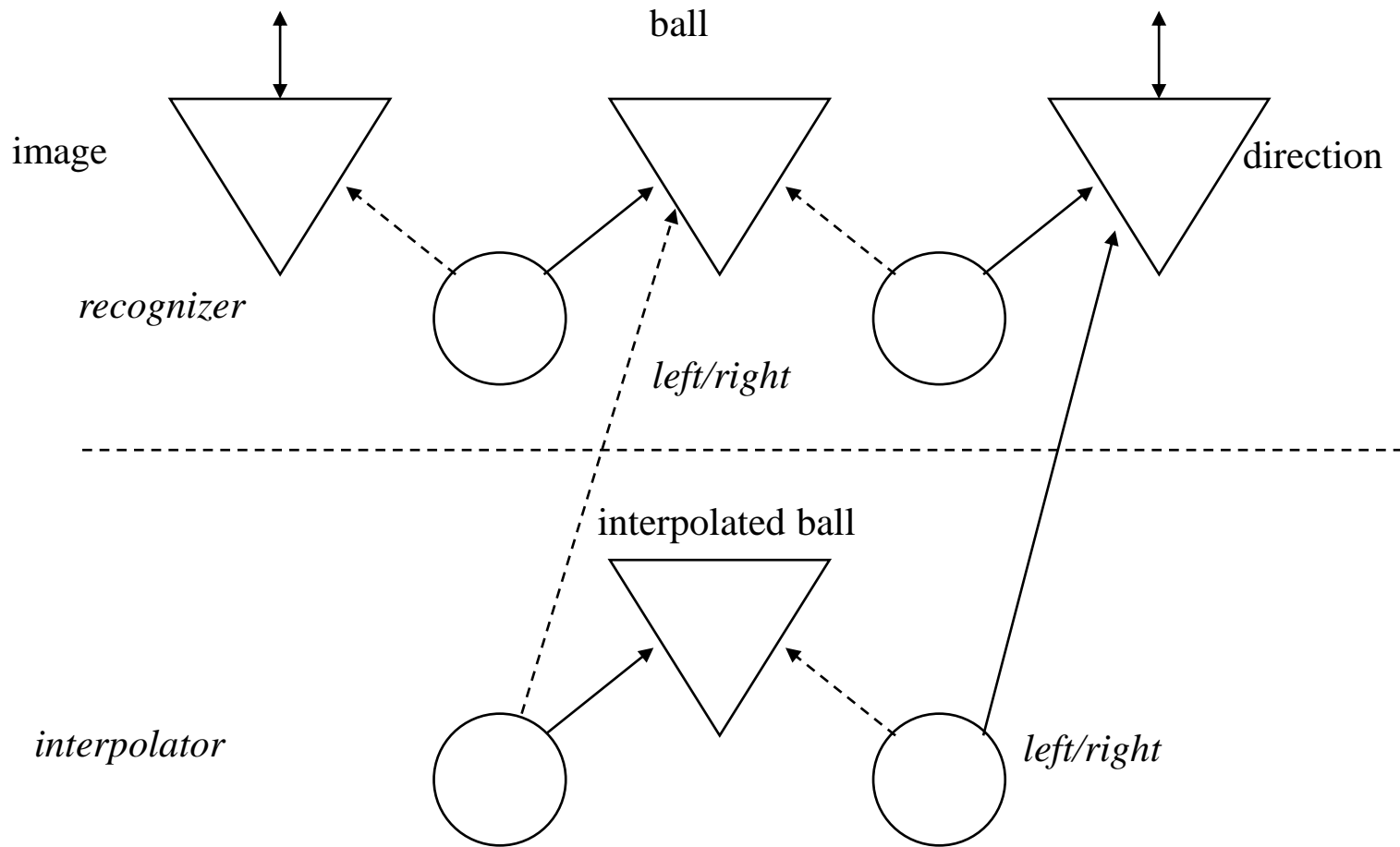
- When we like to follow also ball moving behind an occlusion, we add two additional agents



Implementation

- There is no standard implementation of Minsky model
- We can employ for that our *agent-space architecture*
- Agents corresponds to agents, connections among agents are implemented as named data on a blackboard (called *Space*)
- Minsky was not dealing too much with details like integration of outputs of original agents and new added agents. Thus we employ Brook's solution for this.

- With Agent-Space we can implement Minsky's idea as follows:

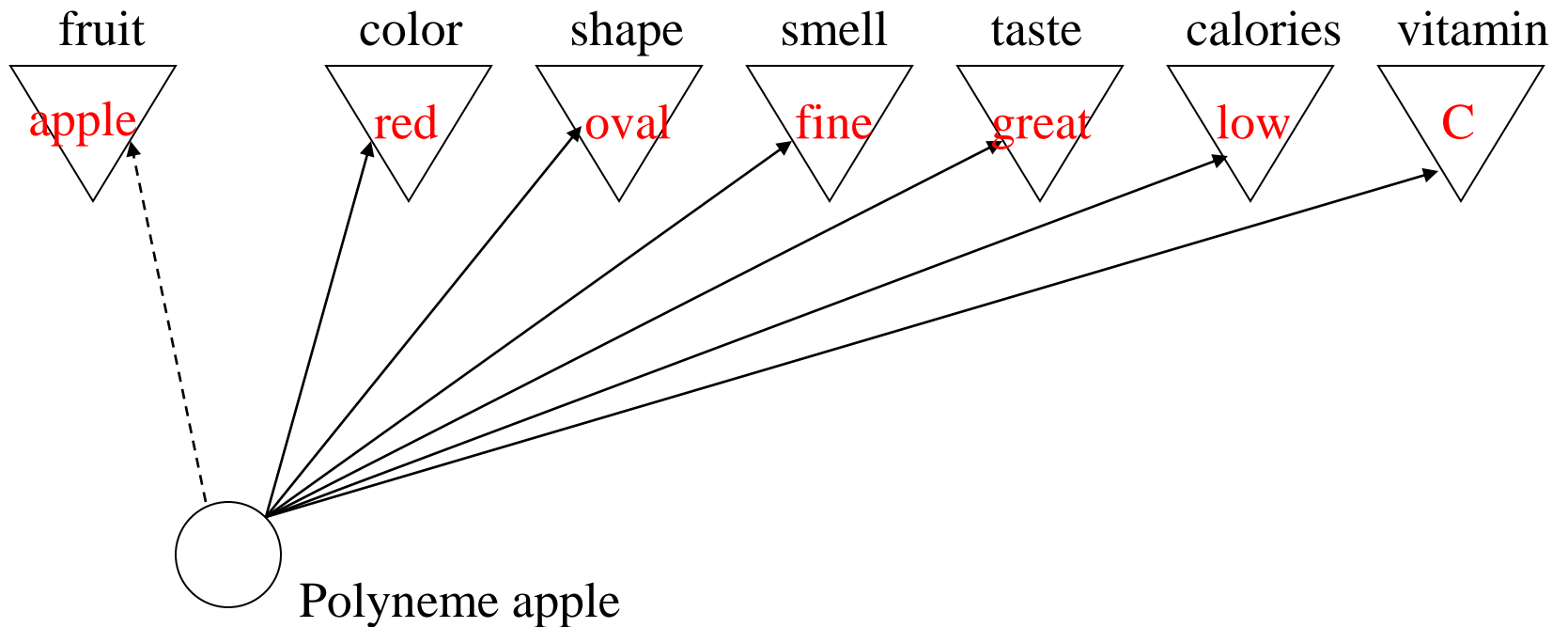


Structures

- Polynemes
- Melanemes
- Pronoms
- Scripts
- Frames
- Memorizers
- Recognizers
- a further, all together 18 structures

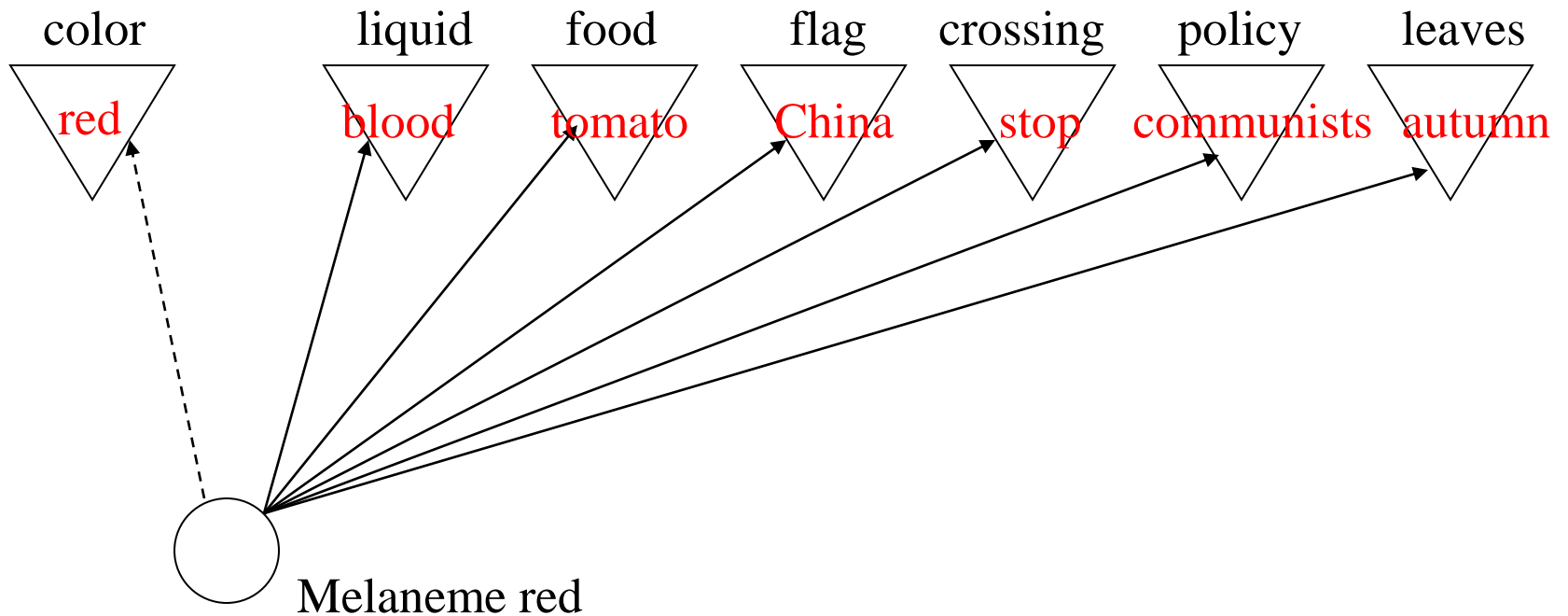
Polynemes

- stimulus activates its attributes

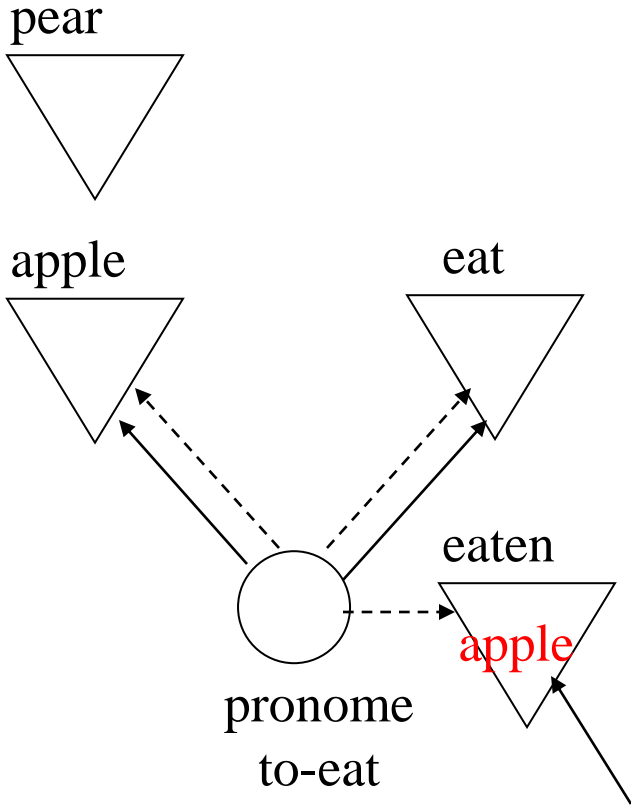


Melanemes

- stimulus activates objects which have it as attribute



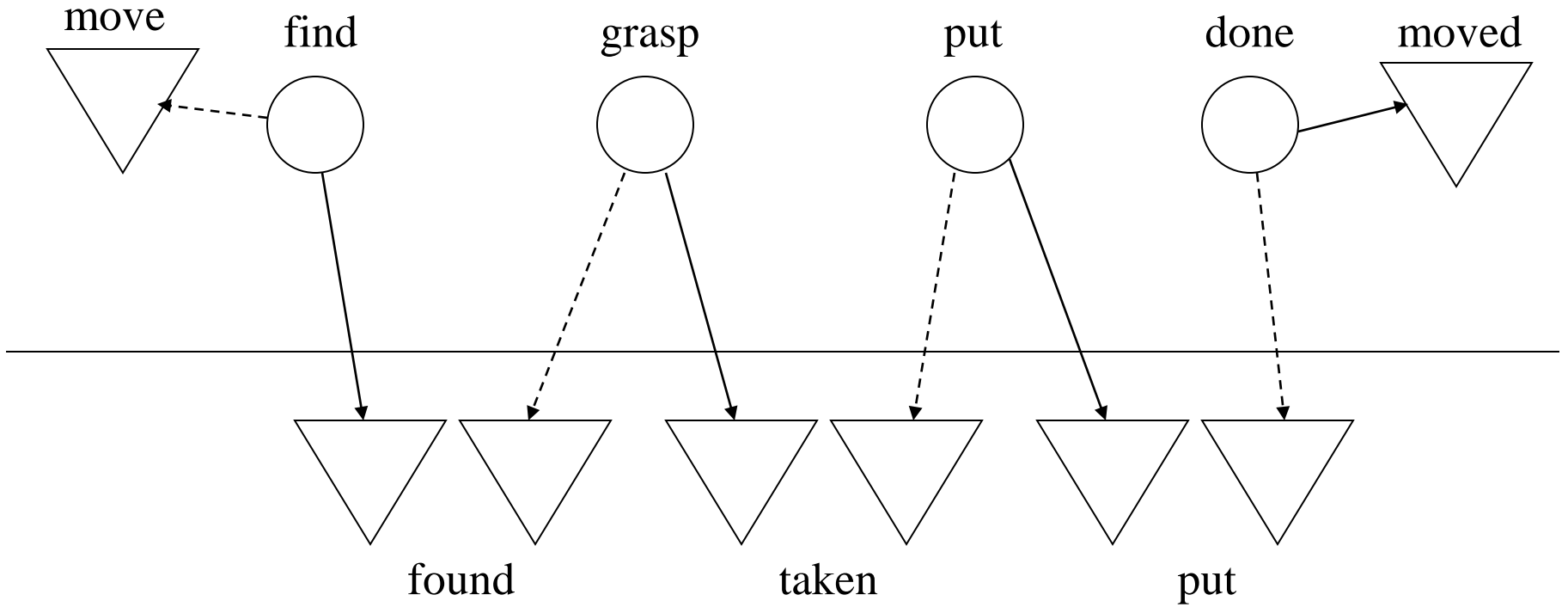
Pronomes



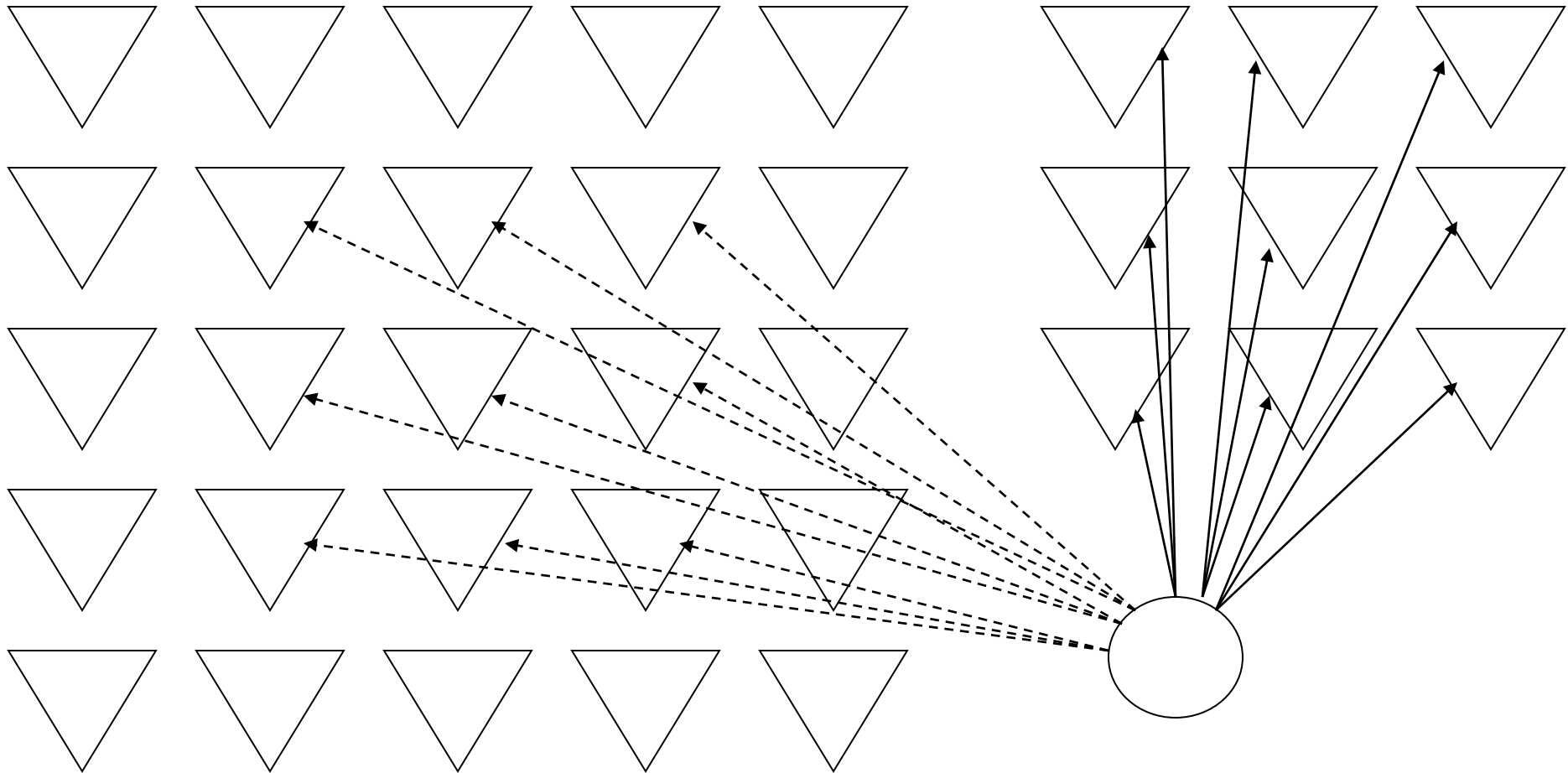
- enables manipulate variable objects

Scripts

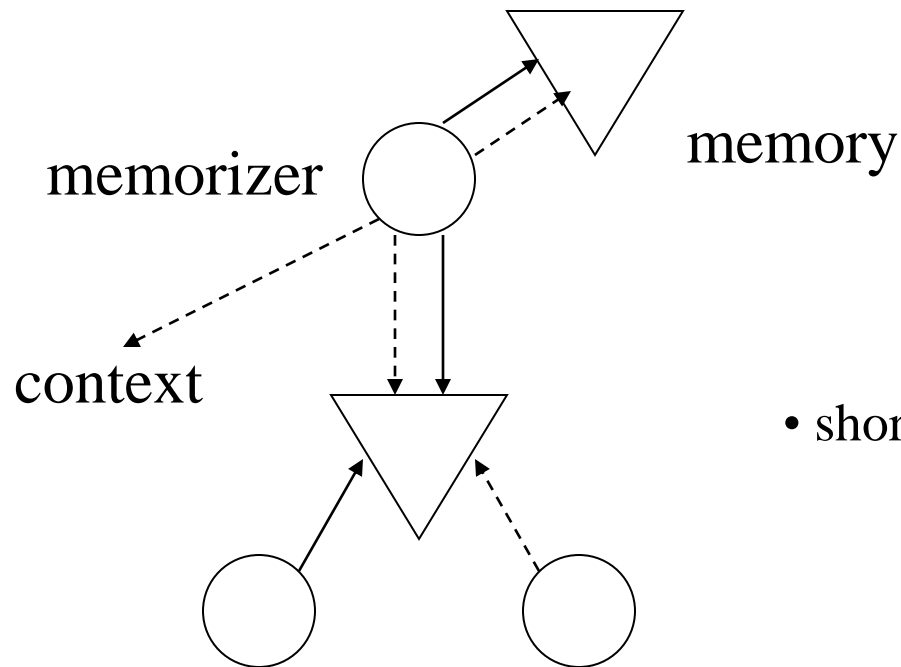
- perform a sequence of steps



Frames



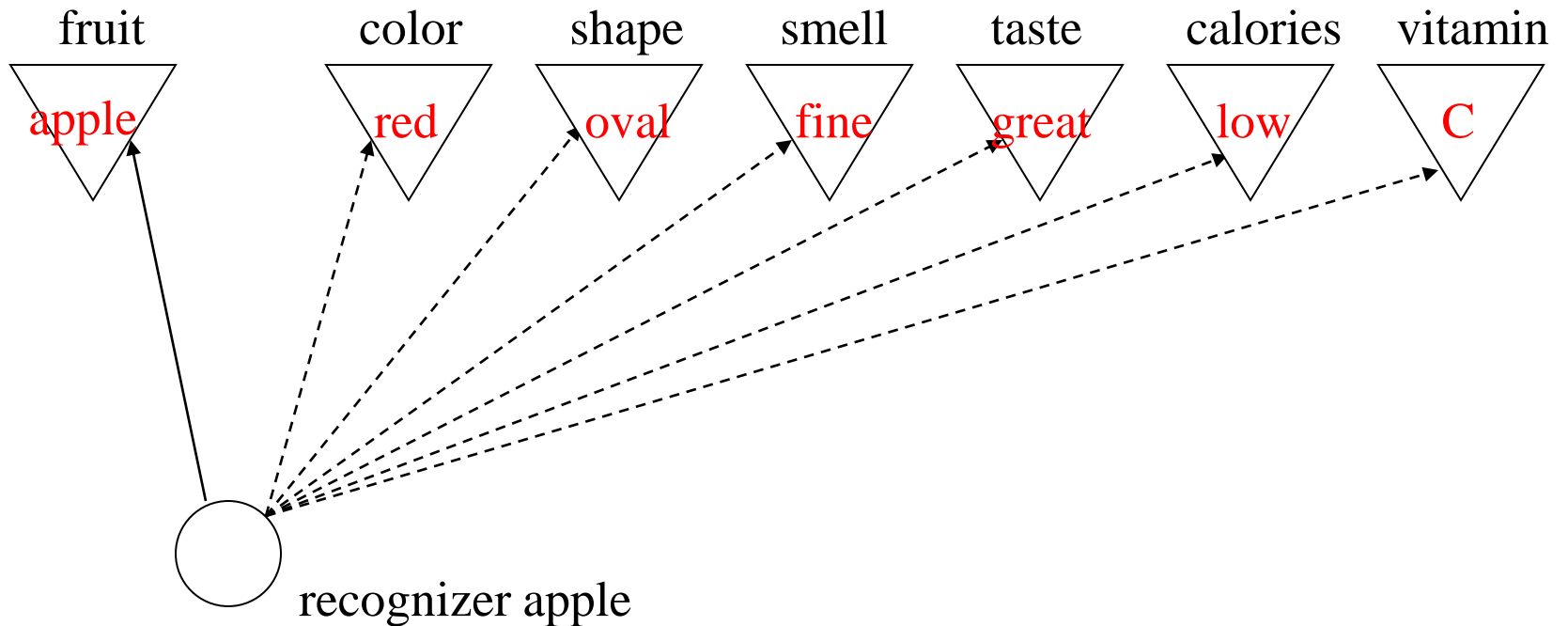
Memorizer



- shortcut in thinking

Recognizer

- opposite polyneme



And further ...

- all together Minsky has described 18 types of agent structures, so called agentures
- (btw. later Minsky used the term “resource“ instead of the term “agent”)

Another example: self
recognition in mirror



Dot Mirror Test



Human is not passing the test before age of 18 months

Animals at the mirror



- Just ape, elephant, dolphin, orc, magpie can pass the test

Mechanisms

- proprioception



- mirroring



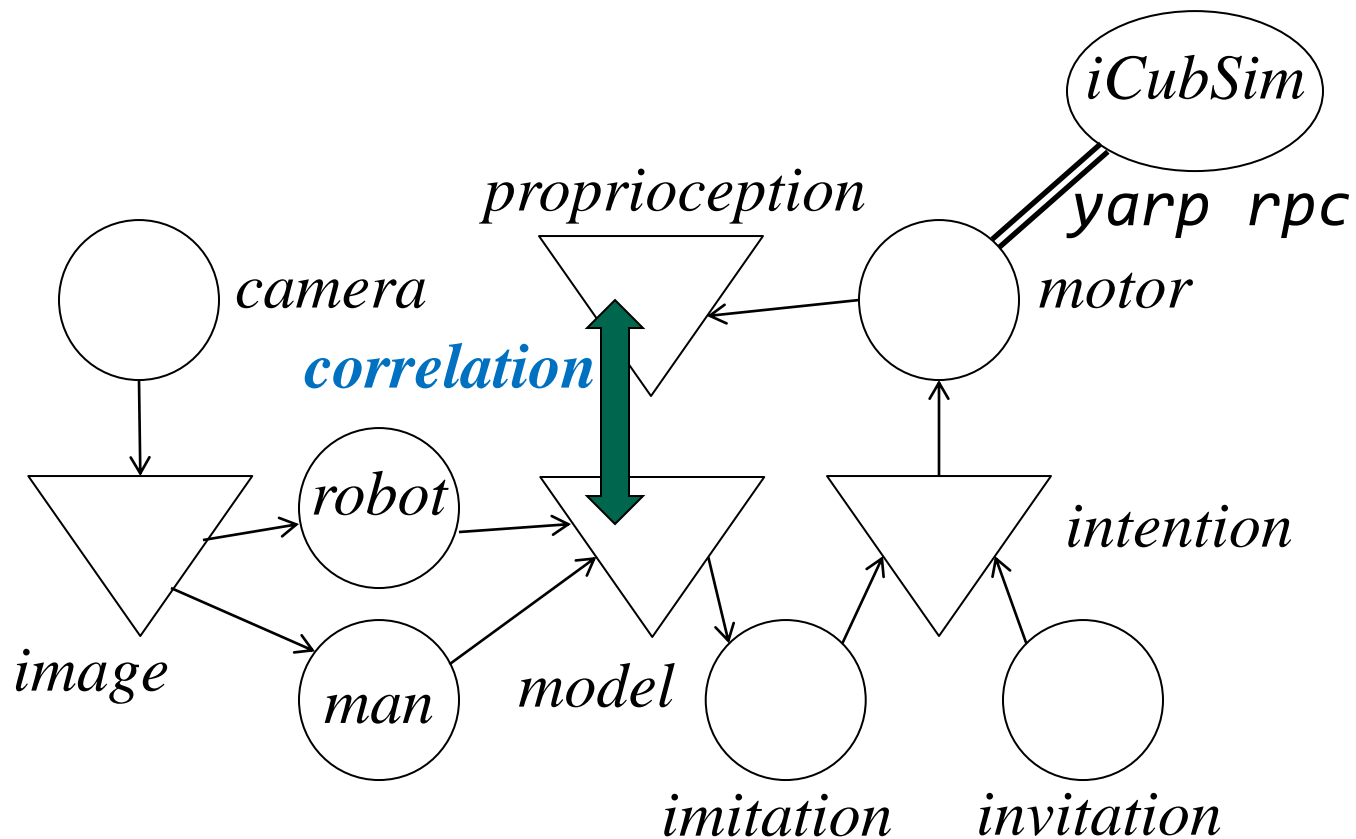
- Imitation



- social modeling



Control structure of the self-recognition



iCubSim at the mirror



<https://youtu.be/57bpNYZNNSA>