Multi-agent systems

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Mobile robots based on subsumption architecture

ALLEN – room exploration

HERBERT – empty cans collection

TOTO – cognitive map building

METATOTO – navigation to a specified spot

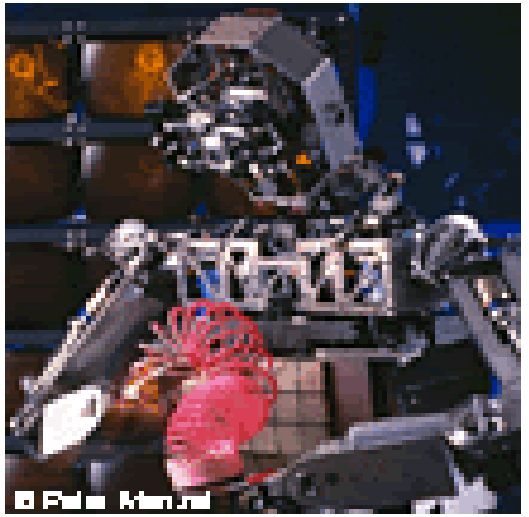
COG – humanoid robot for learning by imitation

Mobile robots based on subsumption architecture

ALLEN

HERBERT

TOTO



COG

Alternatives to subsumption architecture

- Fine-grained alternative (Rosenblatt, Payton)
  - It supports data fusion, but need same type of data
- Behavioral systems (Arkin)
  - We apply just suppression to output of the layer – the layer has just one module

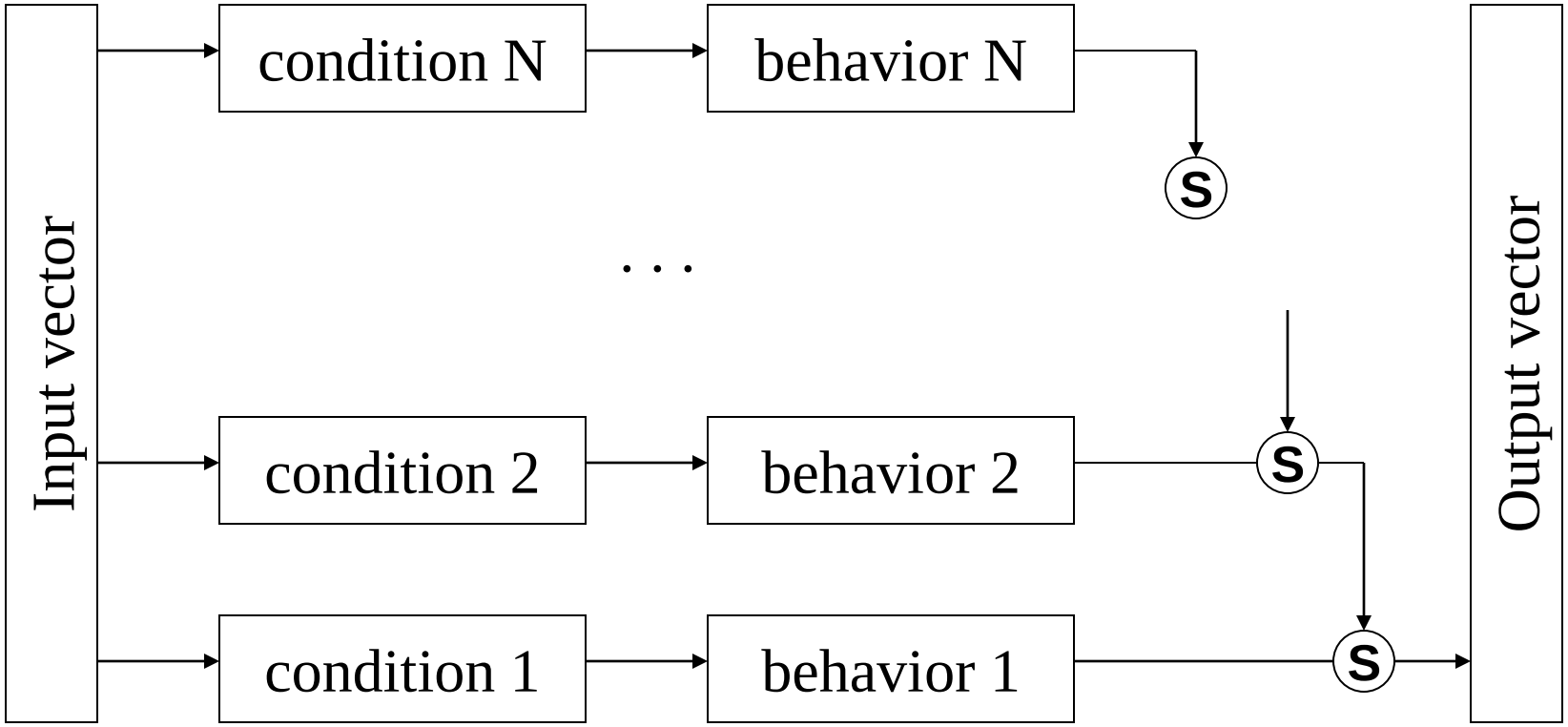
fine-grained architecture

- Similar to neural network
- One data type only: float <-1,1>
- Output from modules is synchronized in time to enable fusion of the output values (weighting, addition, normalization)
- Code in modules is very simple

Behavioral systems

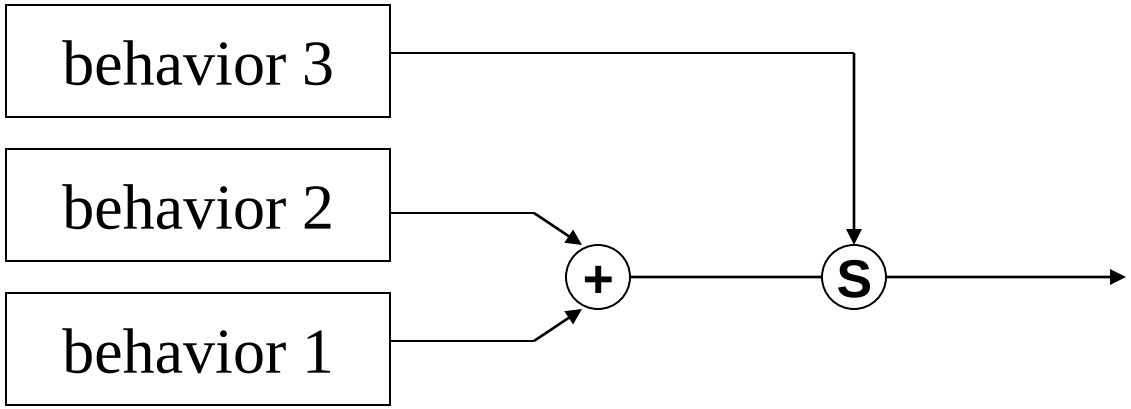
- Layer corresponds to only module which generate certain behavior
- Thus modules are linearly sortable by priority
- Each behavior has condition of applicability and it can suppress behaviors implemented by modules with lower priority

Behavioral systems



Hybrid system

- Each module has to output a variant of robot output vector
- Then also data fusion can be considered



Mind modeling

- Can we model human mind in similar way than neural control of insects ?
- We can try, fruitfulness od this approach is questionable. Anyway we can employ multi-agent approach to imagine several interesting mechanisms which are probably present in our mind

Fodor theory

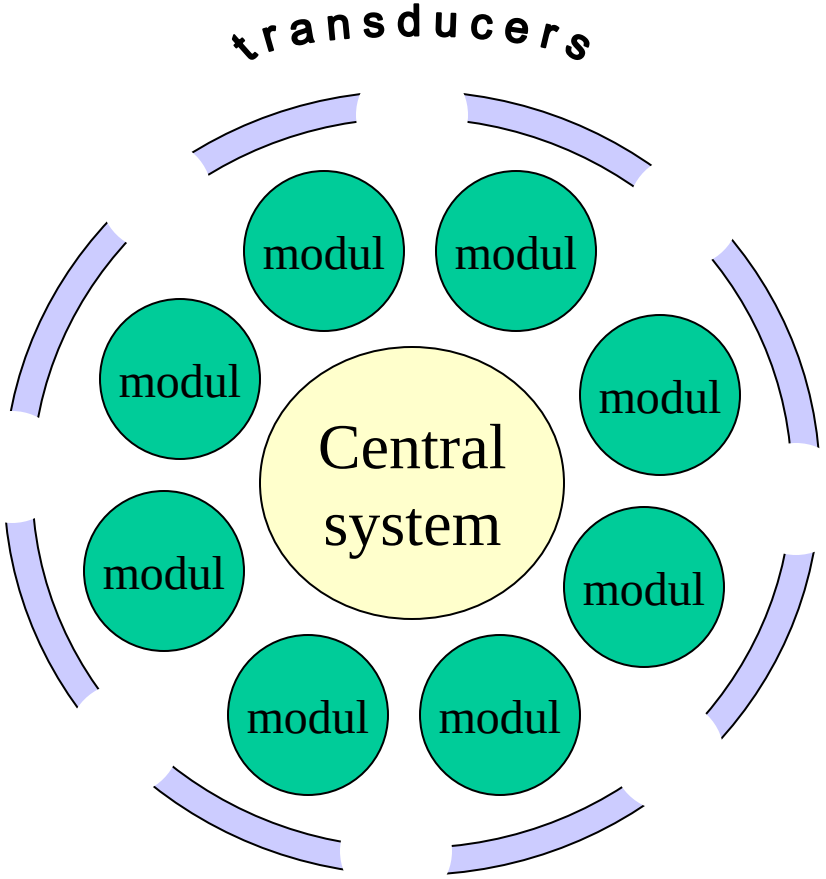
- Derived from rich set of brain injuries

Modules are mandatory

(not controlled by will)

Modules are domain specific

(they have certain function and it is anatomically localized)



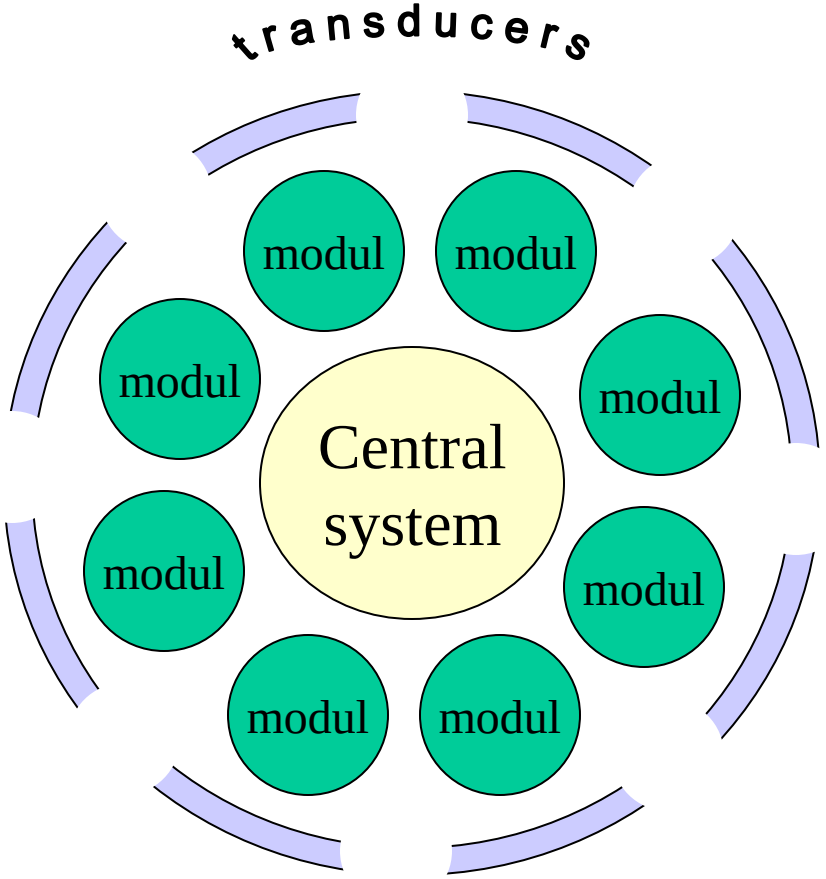
Central system is holistic

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

Fodor theory

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

Modules are represented by reactive agents



Transducers represented by data blocks for sensor input and actuator output

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

central system is represented by one deliberative agent

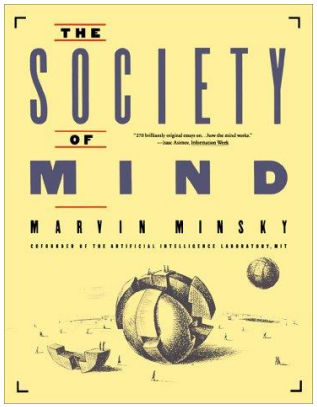
Fodor thesis

- Modules are domain-specific
- Moduls 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 haves typical decay courses

Fodor thesis

- Denial of connectionism (subsymbolic) approach
- Preference of computation-symbolic approach

- Compliance with Newell – Simon hypothesis

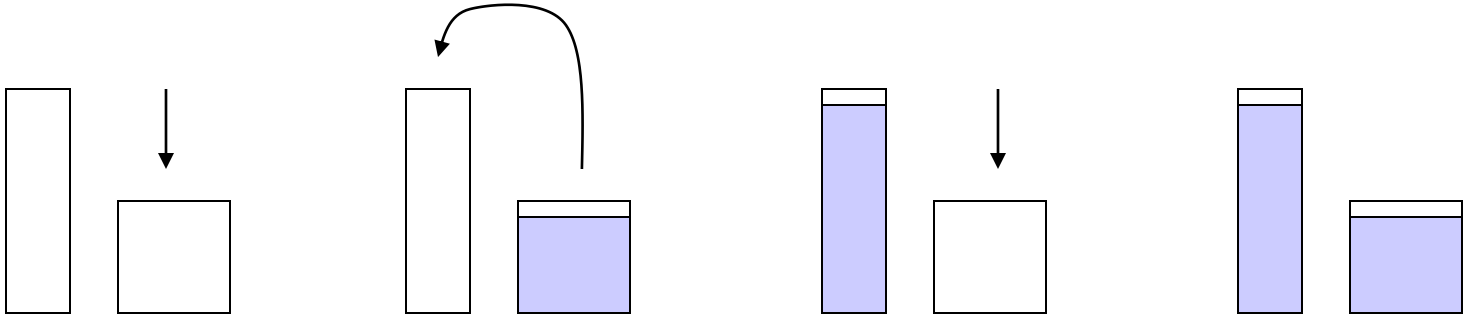


Minsky society of mind

- 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

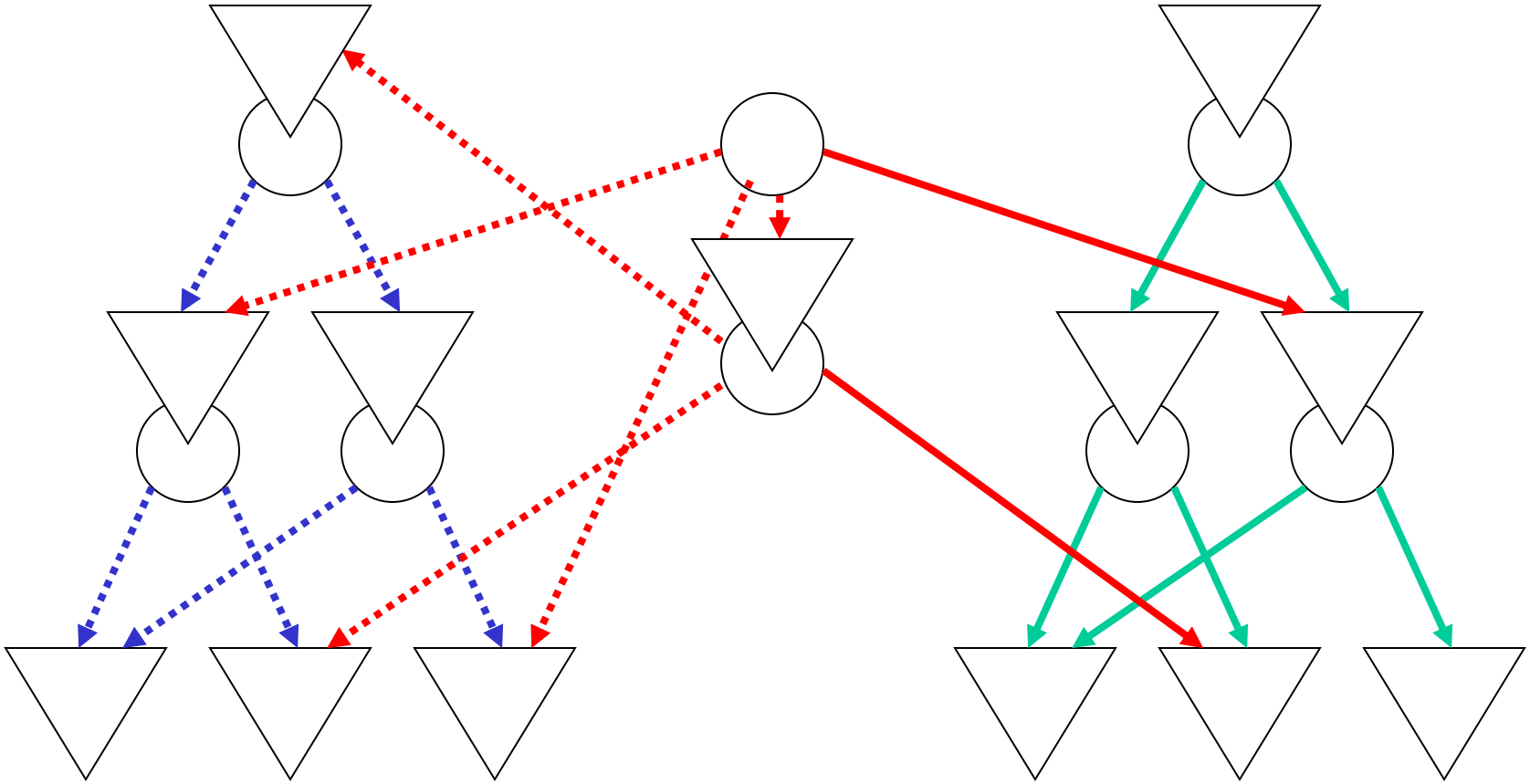
How does the structure in child brain evolve ?

PKA model

P = perception

K = knowledge

A = action

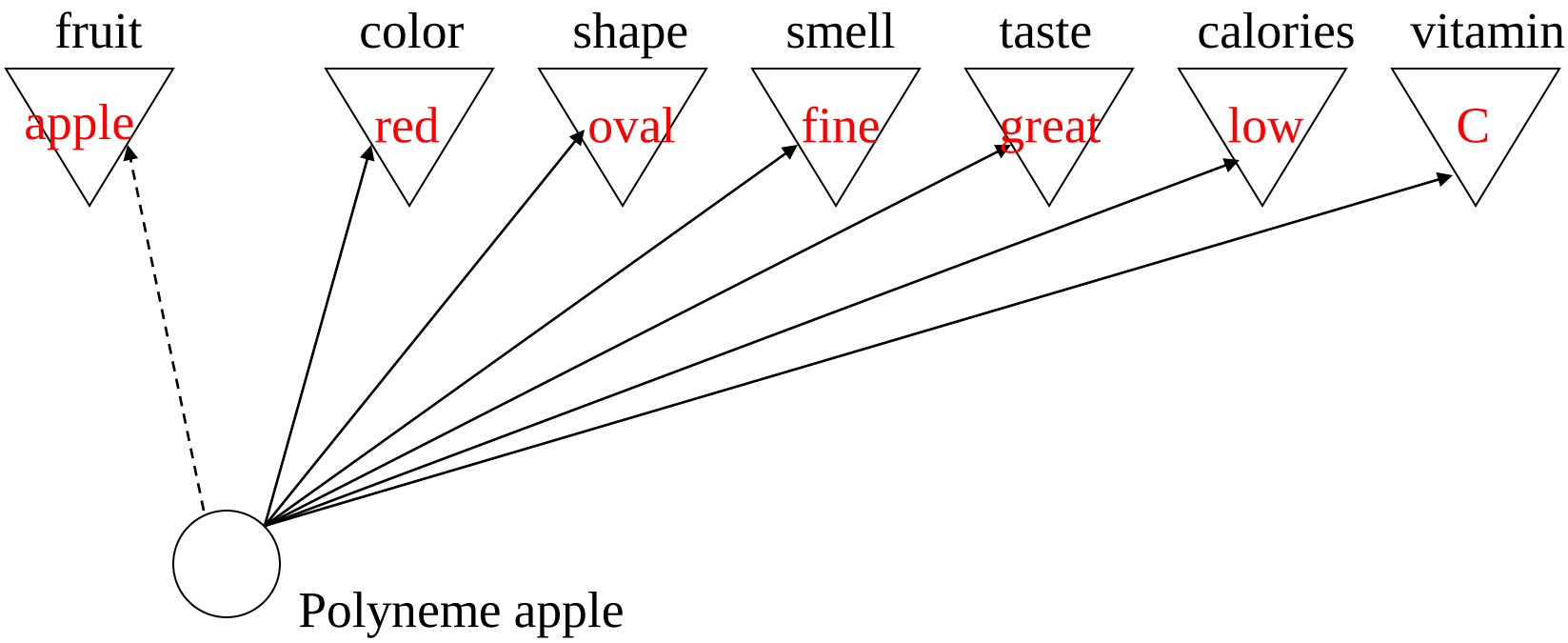


Structures

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

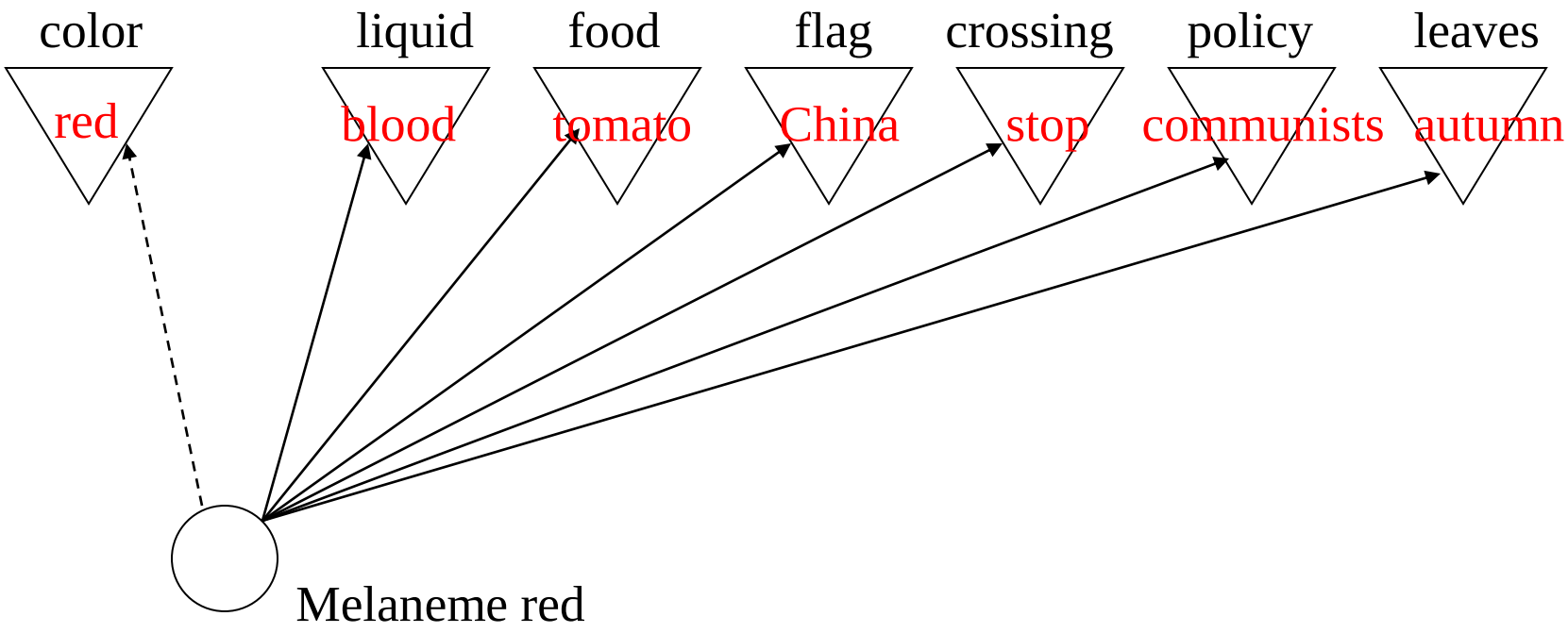
Polynemes

- stimulus activates its attributes

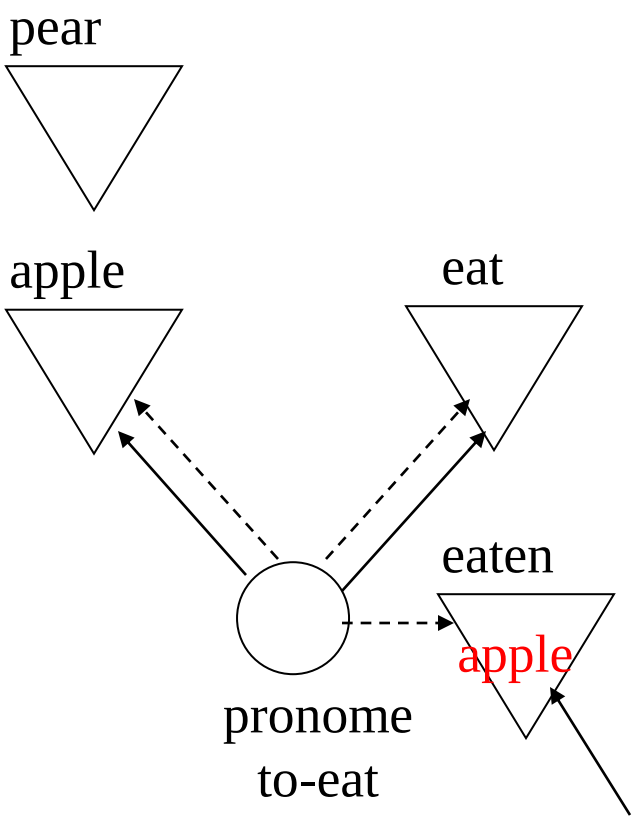


Melanemes

- stimulus activates objects which have it as attribute



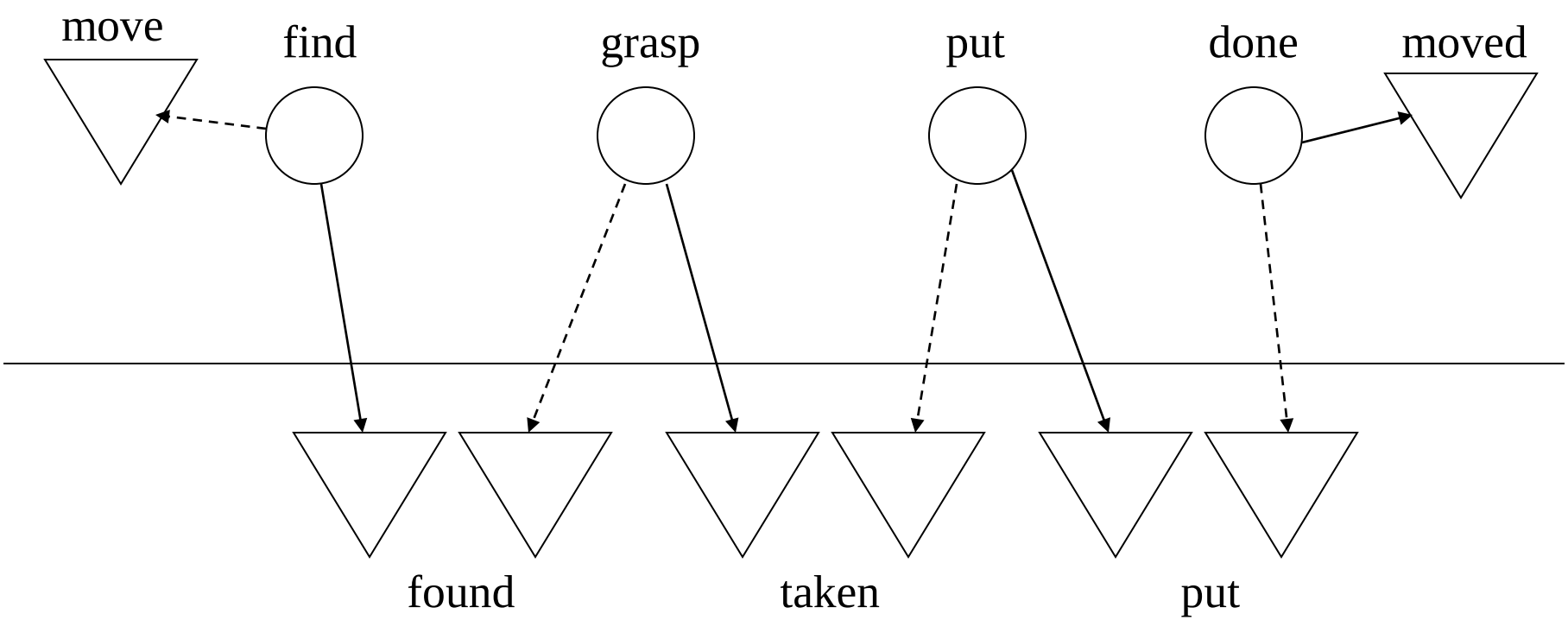
Pronomes



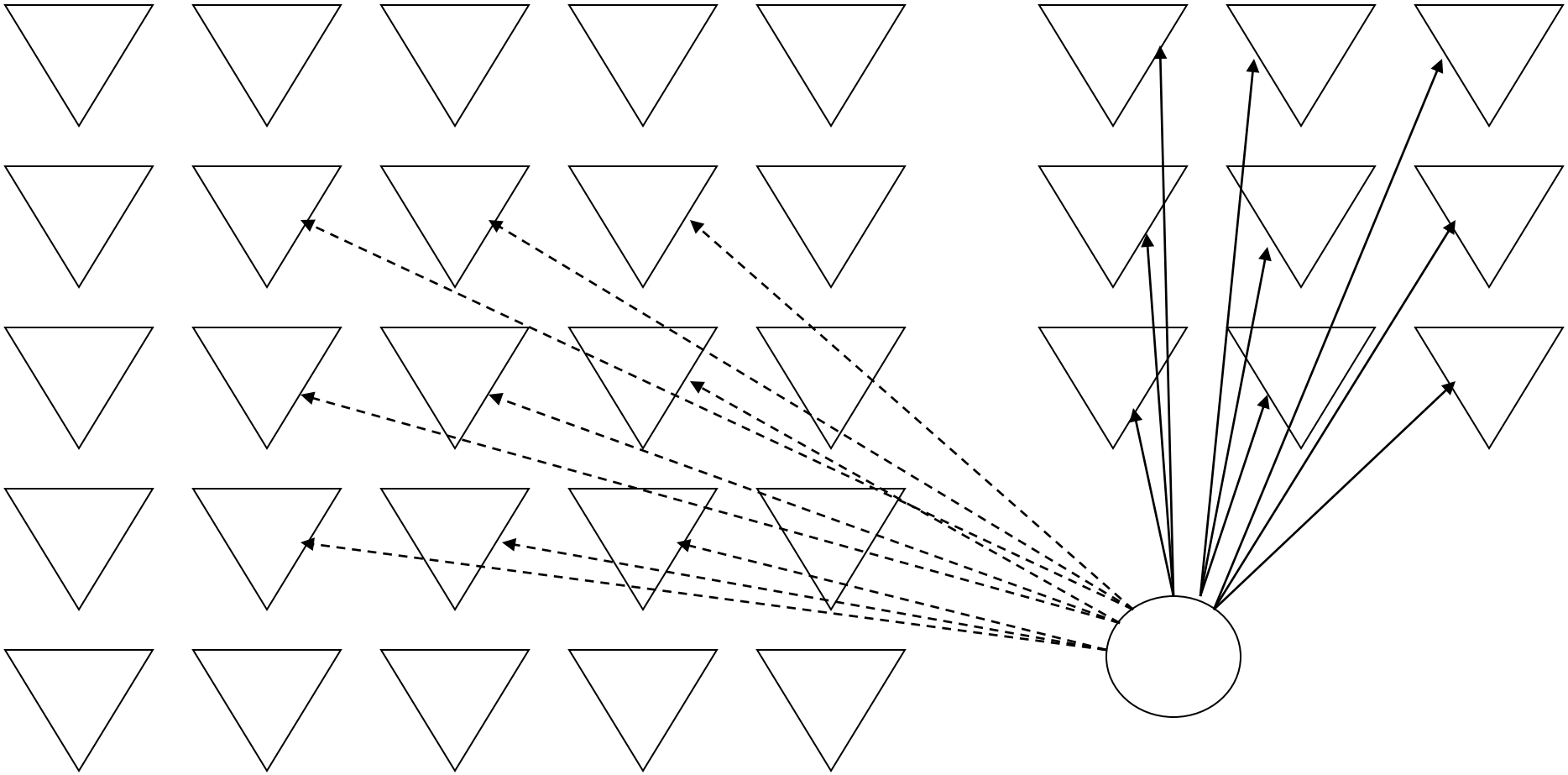
• enables manipulate variable objects

Scripts

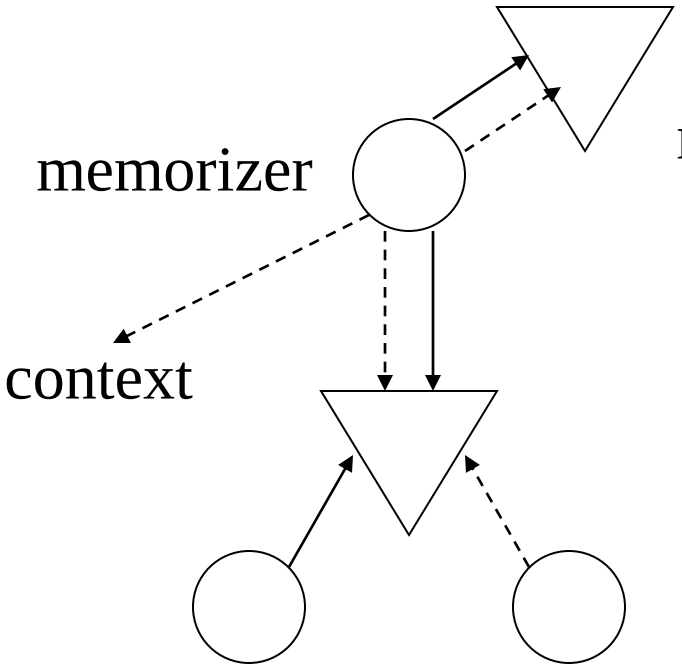
- perform a sequence of steps



Frames



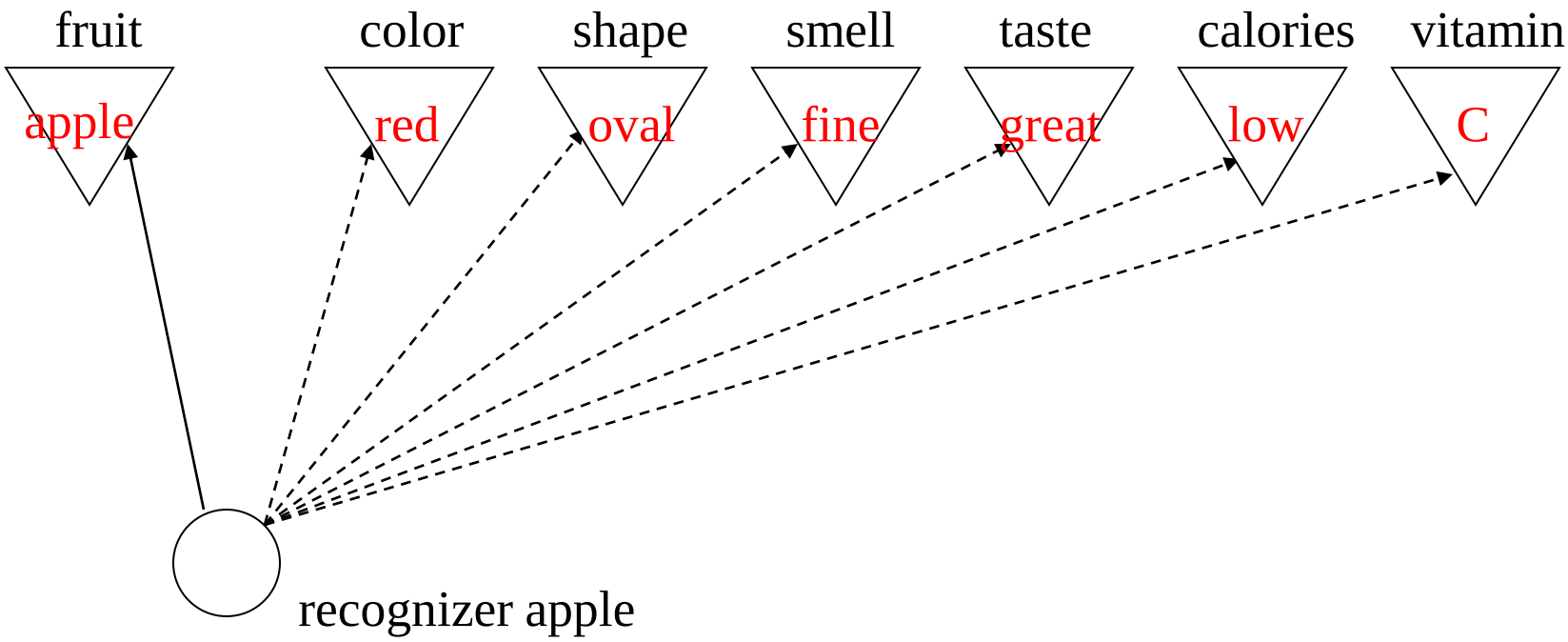
Memorizer



- shortcut in thinking

Recognizer

- opposite polyneme



And further ...

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

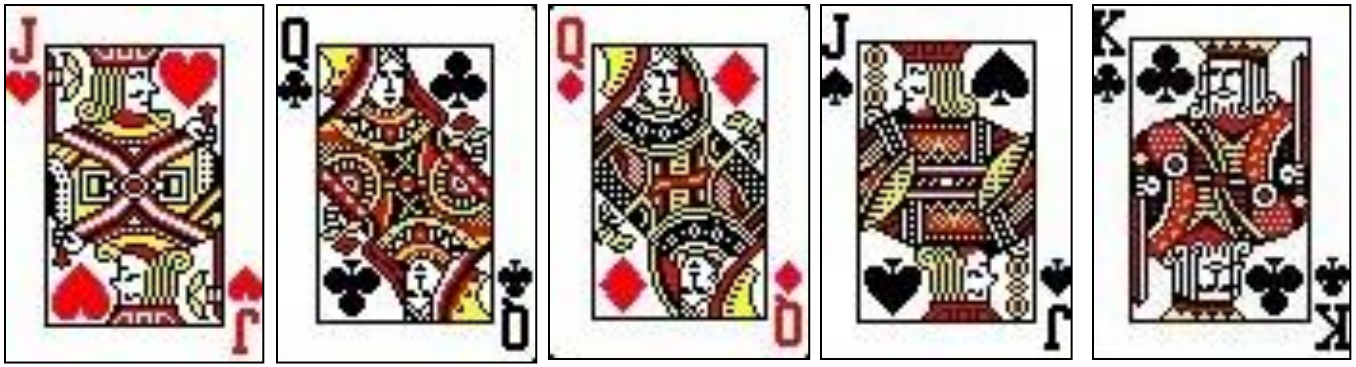
How can we employ Minsky structures for modelling ?

- It is too big job to model whole mind
- We can model a part

- If mind has such organization as Minsky supposed, it would be not perfect!
  Yes, it is not.
- We can verify our model on mind failures

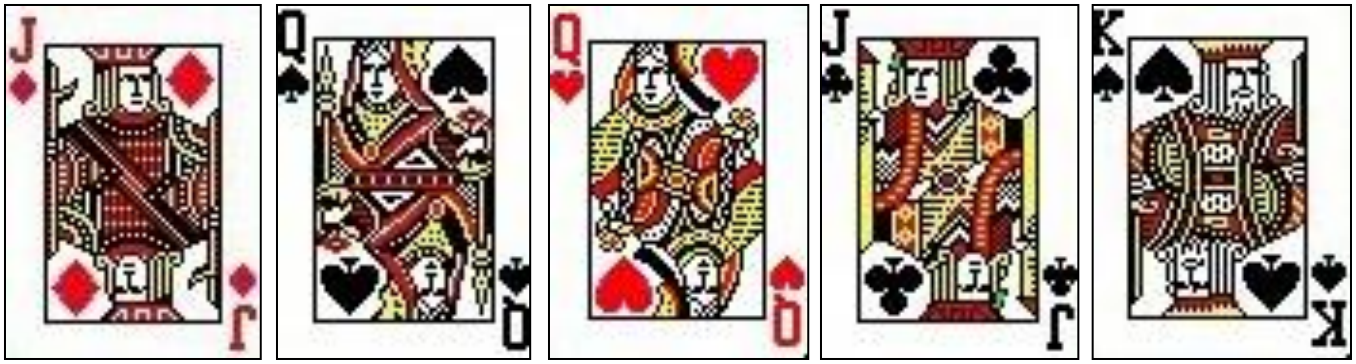
- How many dollars are in dozen ?
- And how many quarters ?

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



Select one card and look on it per one minute

Abracadabra ...



Your card has left !

Failures of animal behavior

- Example of situatedness of recognizer

  - Goose treats phantom eggs by beak

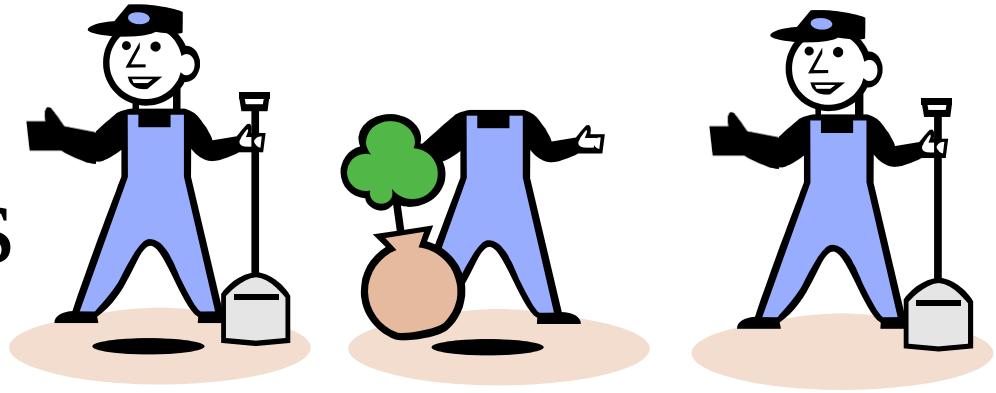
  - bees ostracize bee on which we drop oleic acid

- Example of embedded script
  - Digger wasp mating behavior

Features of Mind

- Mind has no universal “world” model
- Representations in mind does not correspond to a consistent theory
- (Godel, Turing, Penrose, Wiedermann)

Mind does not handle exceptions



- Mind works like these three men planting trees: the first one is digging a hole, the second one is putting a seedling there and the third is digging the plant in. Imagine that the second one fails. What will happen?