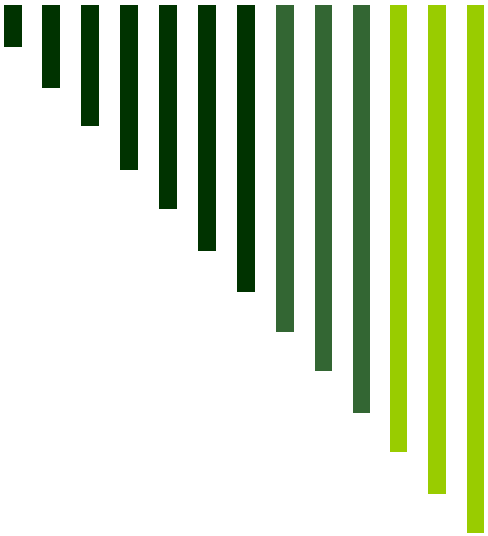


Intelligent virtual actors

Cyril Brom et al.

Charles University in Prague
Faculty of Mathematics and Physics
Dept. of Software and Computer Science Education

brom@ksvi.mff.cuni.cz

Outline

1. Intelligent virtual actors
2. Action selection
3. Useful metaphors:
   - Goals, Desires, Intentions
   - Affordances
4. Discussion

1. Virtual humans (a short intro)

EPFL, Virtual Reality Lab (c)

Virtual humans

- **Believability**, imitation, cheating,...
- Computer games,
  educational applications,
  therapies,
  virtual storytelling,
  film industry...

video

Computational modelling

- **Plausibility**, inspiration, falsifying,...

- Ethology

- Cognitive psychology

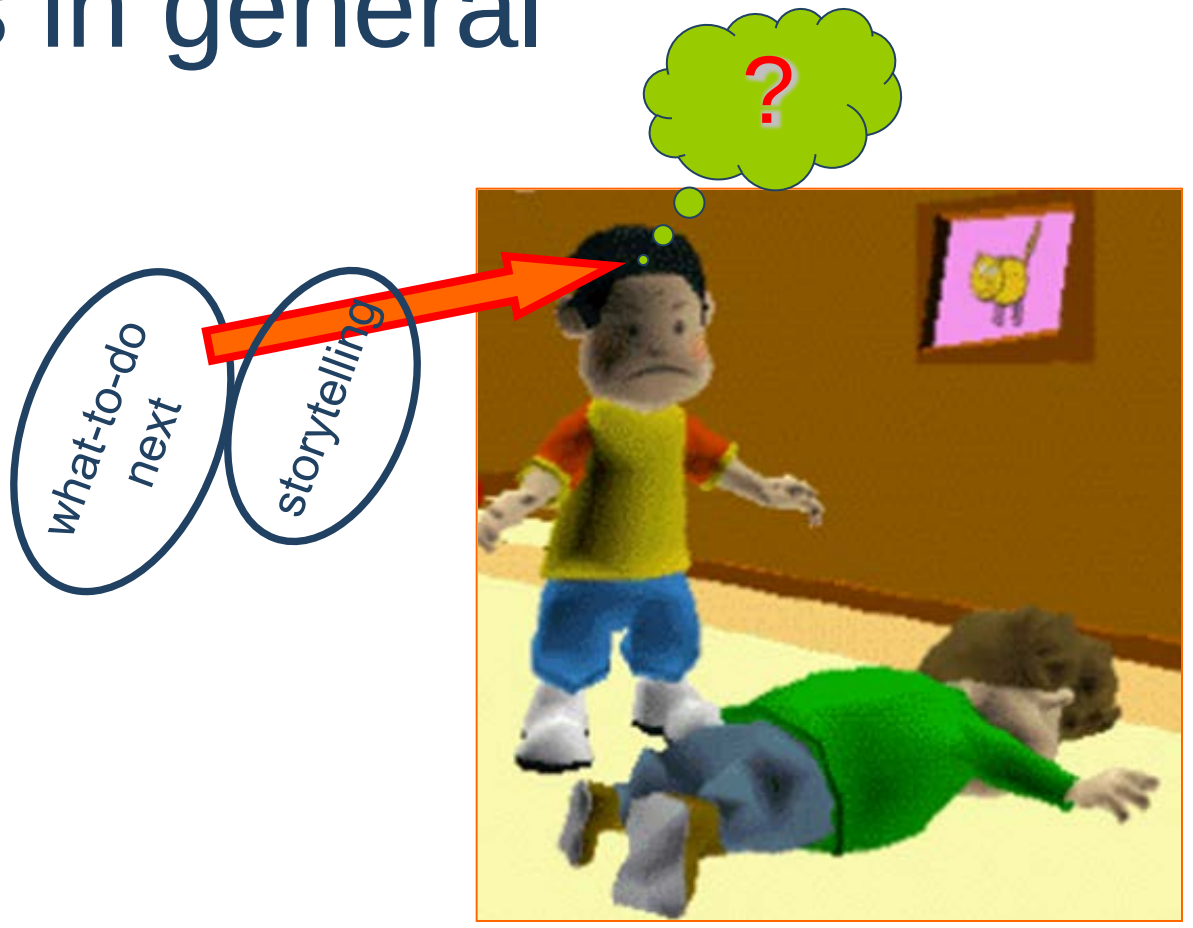
Netlogo

Issues in general

High-level reasoning
("AI")

Low-level reasoning
("AI", graphics)

Animation
(graphics, physics)



FearNot, Aylett et al., 2005-7

Issues in general

High-level reasoning
("AI")

Low-level reasoning
("AI", graphics)

Animation
(graphics, physics)

path-finding

obstacle avoidance

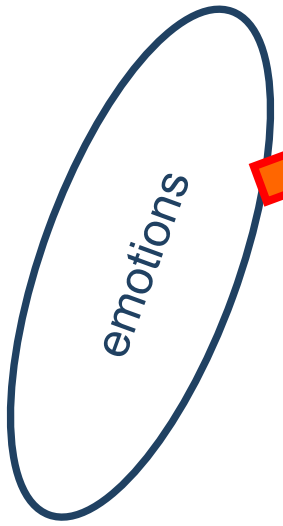
FearNot, Aylett et al., 2005-7

Issues in general

High-level reasoning
("AI")

Low-level reasoning
("AI", graphics)

Animation
(graphics, physics)



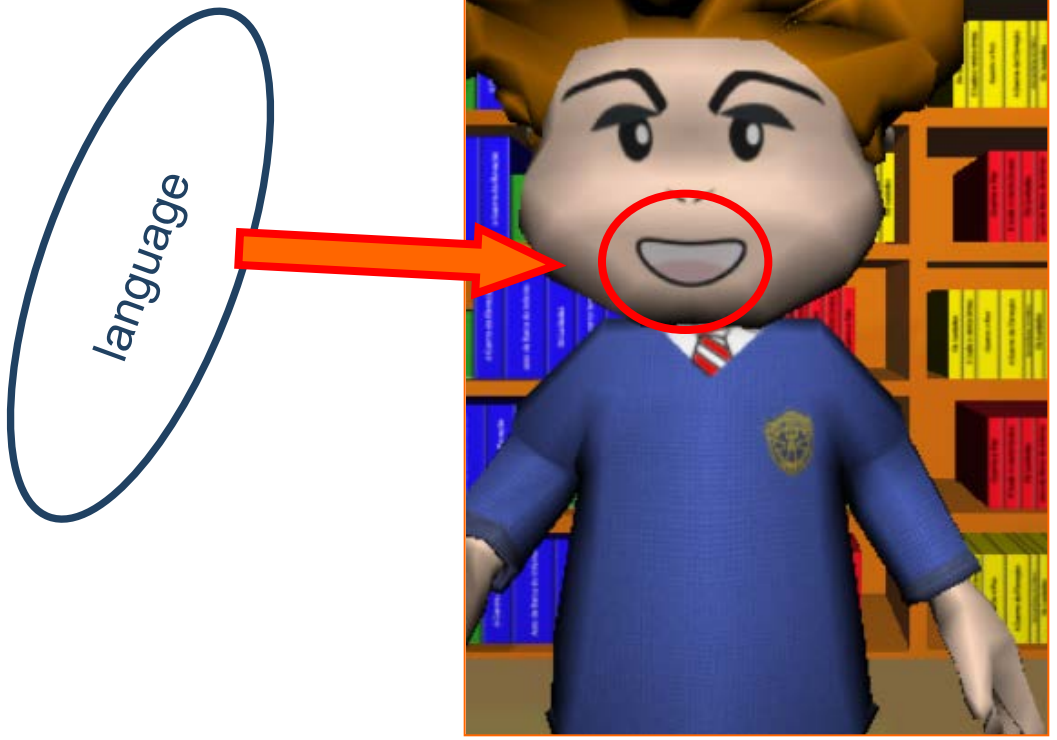
FearNot, Aylett et al., 2005-7

Issues in general

High-level reasoning
("AI")

Low-level reasoning
("AI", graphics)

Animation
(graphics, physics)

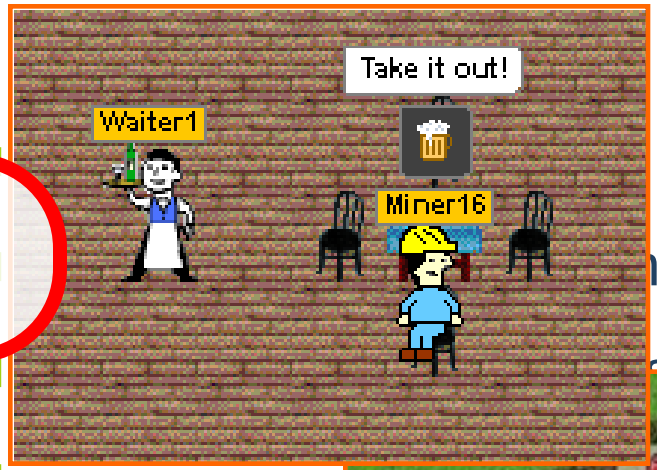


FearNot, Aylett et al., 2005-7

Our research

MFF UK

IVE



- n selection
- …

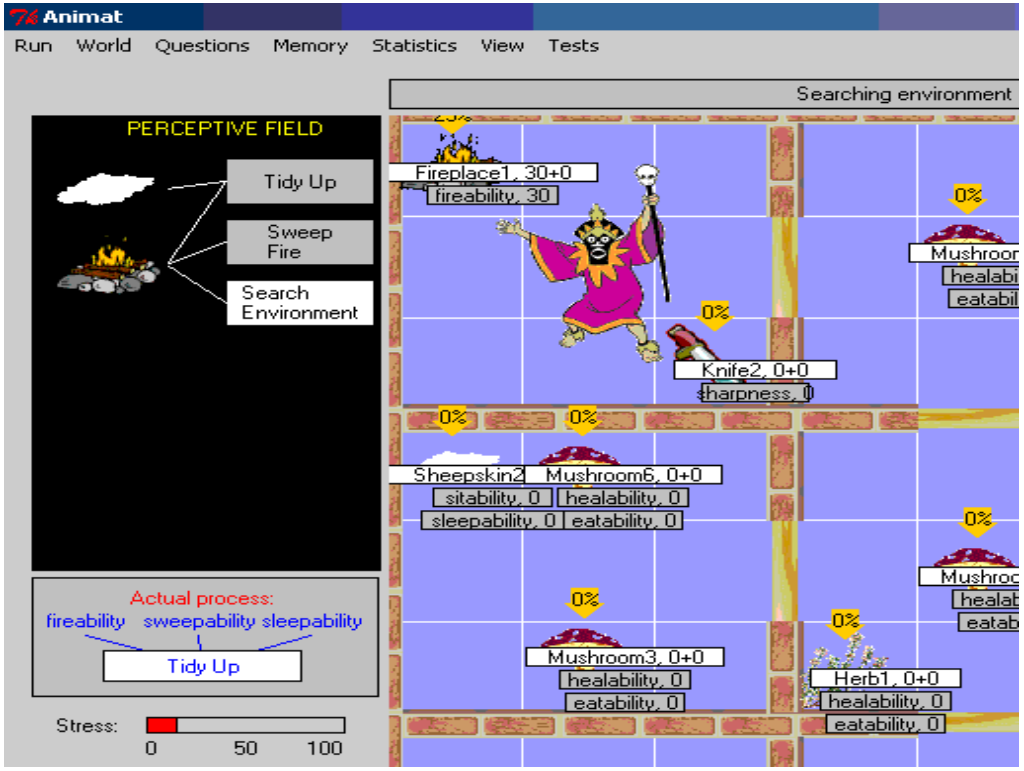
- PSÚ AV ČR
- PřF UK
- Ciant, Gene

ENTs

Unreal T.

Unreal Tournament
Epic (c)


Unreal T.



Episodic memory

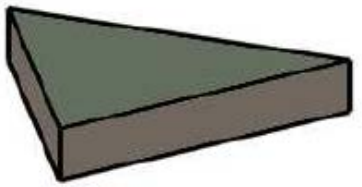
"I was doing SearchRandom for smokeability because of Smoke. I was doing go from room 1 to room 2 because of SearchRandom. I was doing look in environment because of SearchRandom. I was doing go from room 2 to room 5 because of SearchRandom. I was doing pick up Calumet1 because of Smoke. I was doing Smoke."

Level of detail
Problem statement

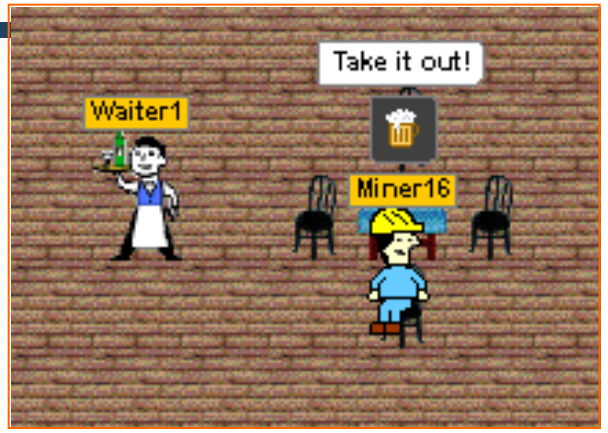
- Large words → **SPEED**
  - real-time, time-critical, and yet hundreds of actors and tens of locations

- Idea:
  - Cheating is ok provided the user perceives the right think
  - Can we apply level of detail for **high-level action selection** and **space**?





Level of detail

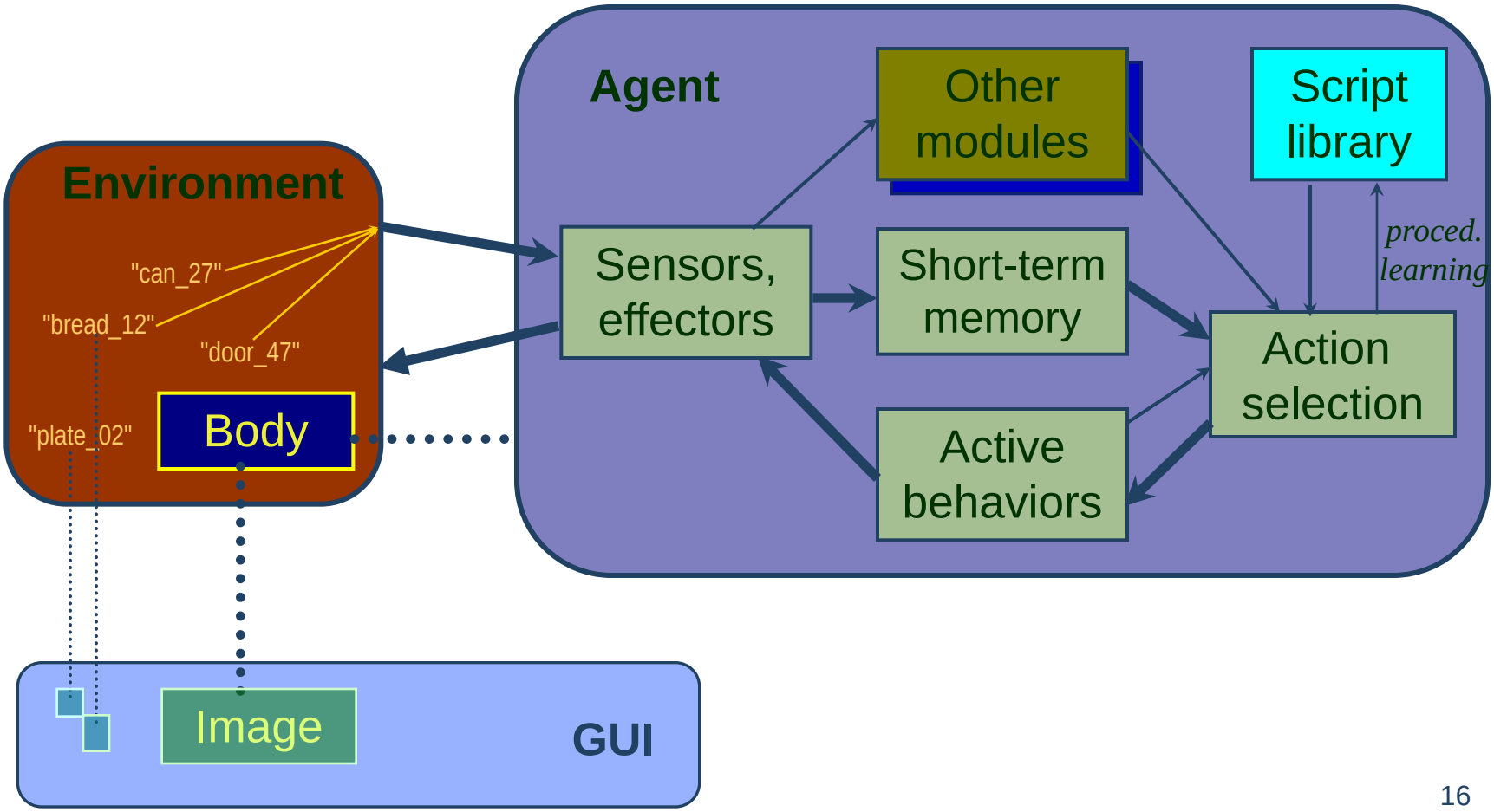


level of detail

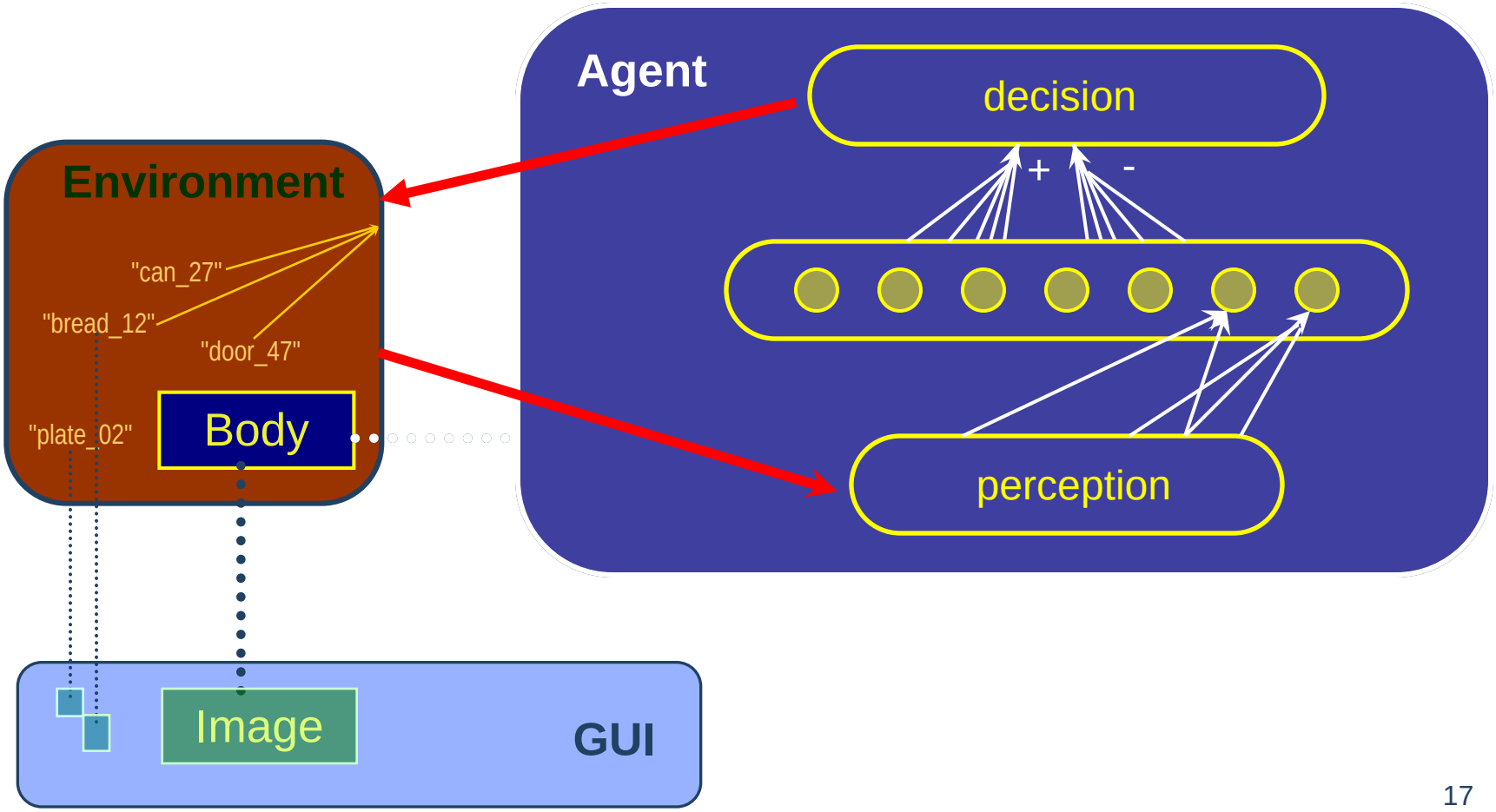
- Drinking (LOD 5 = maximum)
  - every minute drink a bit, until the glass is empty
- Drinking (LOD 4)
  - do 10 minutes nothing, then empty the glass
- Drinking (LOD 3)
  - do 30 minutes nothing for all the guys, then decrease the beer level in the barrel

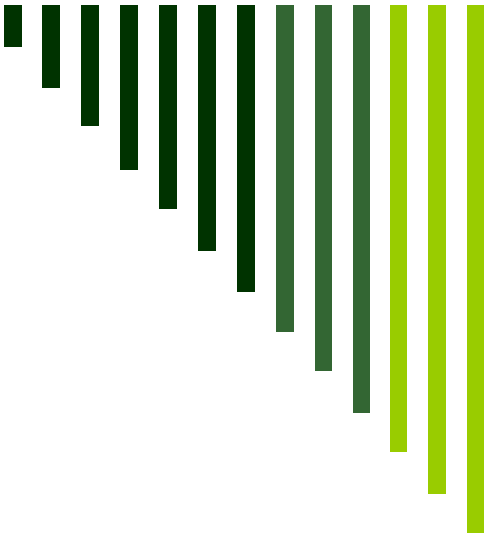
- **The results of the simulation may differ for different LODs!**
  - the lower details only **approximates** the full detail

Cognitive architecture



Cognitive architecture

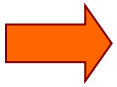




2. Action selection (reactive planning)

Action selection problem

- The problem of **"what to do next"**
  - representation of behaviour (procedural knowledge)
  - control algorithm
- Robotics, software agents, ...



Karel

real time applications

dynamic, unpredictable

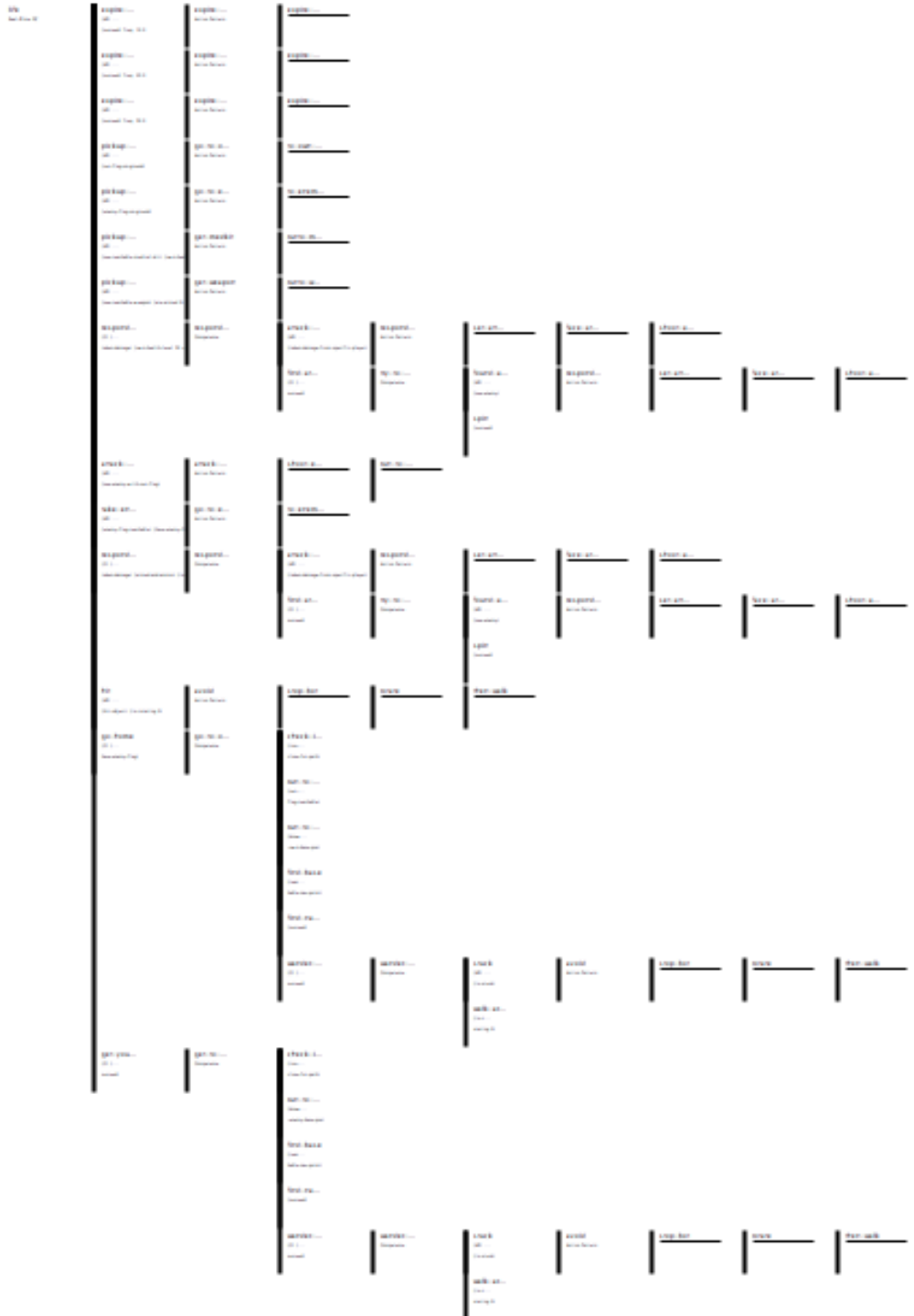
complex, human-like behavior

A possible approach

- Reactive rules with priorities

An NPC from a MMORPG in a shop:

```
1. if fire then flee
2. if attacked then defence
3. if a player asks and not aggressor then answer
4. if a player is near then pretend working
5. otherwise nothing
```



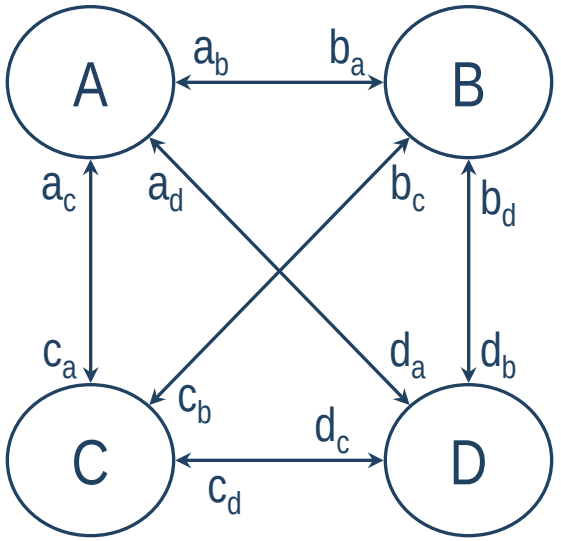
An example plan

Simple hierarchical reactive planning

[Partington & Bryson, 2005]

Other possibilities

- Finite state machines
- Other rules
  - Soar, fuzzy rules
- Petri Nets
- Any-time planning
- Free-flow hierarchies
- Neural Networks
  - the most problematic approach!



Psychology,
ethology,...

Abstractions

Conceptual metaphor
Abstract model
"black-box"

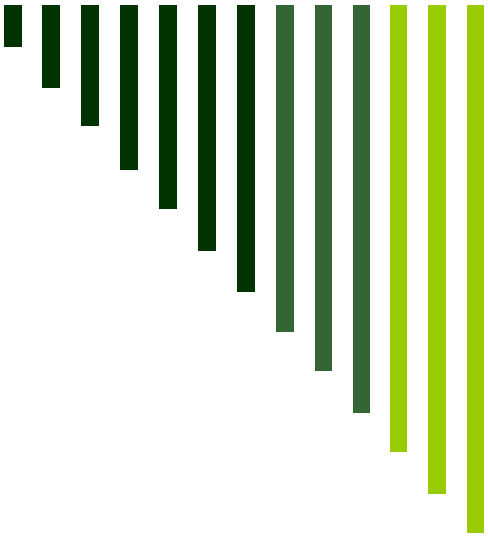
Artificial int.,
sw. engineering

Implementation metaph.
Software architecture
"gray-box"

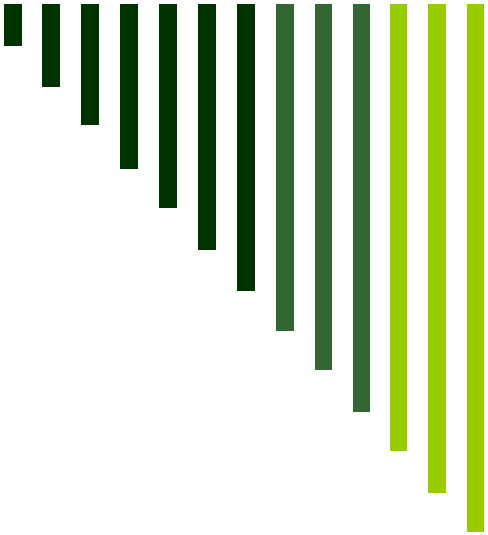
Useful metaphors

```
printf (...)
i++
c = a – b->d
```

Code metaphor
A particular language



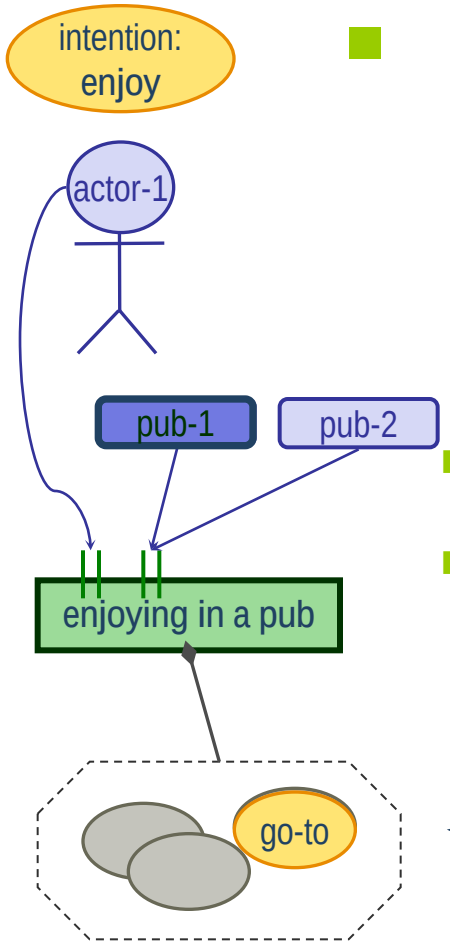
3. Useful black-box metaphors



3.1 Goals & intentions

(& joint-intentions & role-passing)

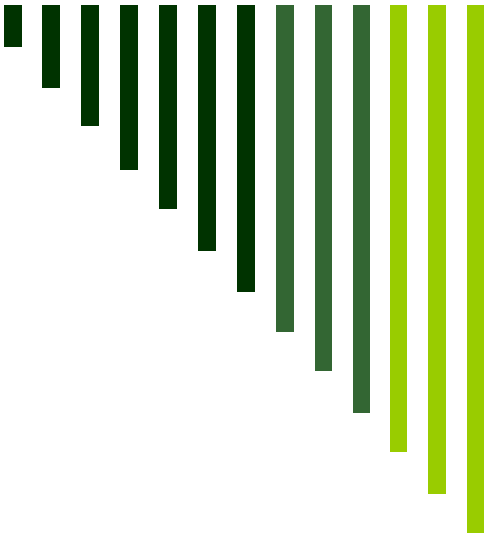
Behavioural representation



- To describe possible behaviour in terms of **desires** (goals) that an actor can commit itself to (i.e. **intentions**) and of **activities** that can accomplish the intentions
  - practical reasoning, BDI [Bratman, 1987]
  - easy to understand

something like

fuzzy if-then rules



3.2 Affordances

Affordances

[Brom et al., 2006, GSM]

- Actors perceive its world in the terms of environmental **possibilities**
  - theory of affordances [Gibson, 1979]
    - "...the affordances of the environment are what it **offers** the animal, what it provides or **furnishes**."

- "sittable" & "throwable" instead of "chair"
- "sittable" for a human, "jumpable" for a dog

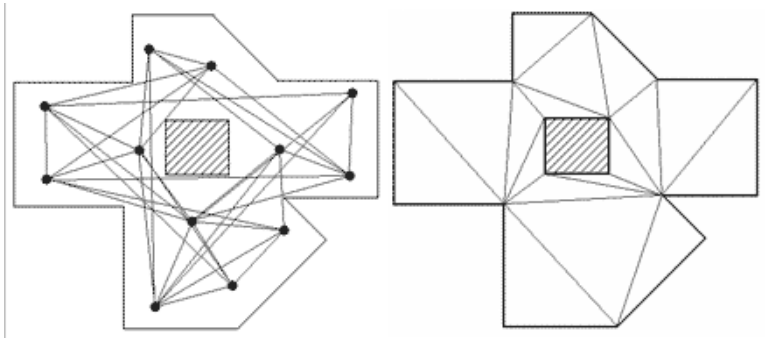
Affordances technically

Distributed representation

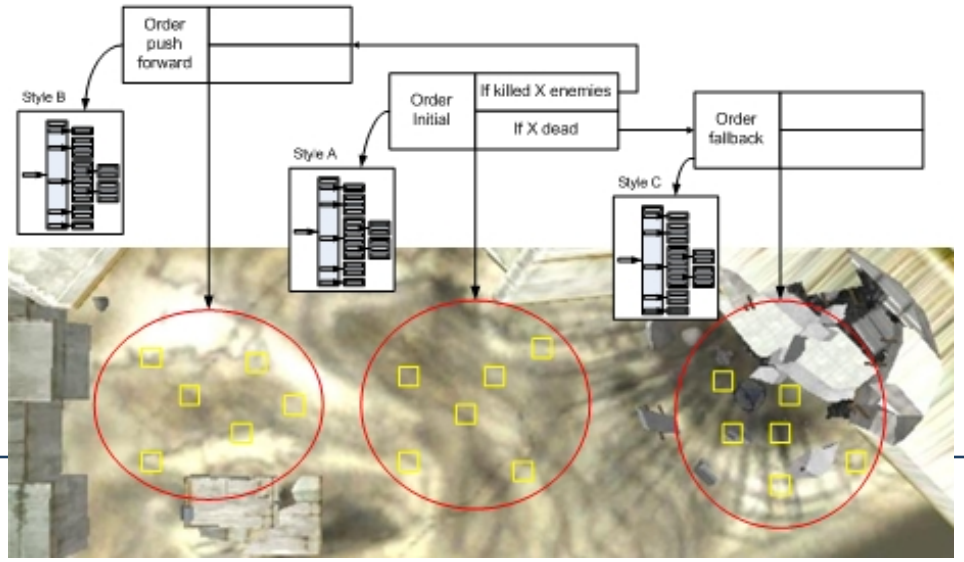
- Intelligence "in the environment"
- Smart objects [Kallmann, Thalmann, 1998]
- Semantic marks [e.g. Isla, 2005]

Affordances in space representation

- way-points
- surrounding information
- navigation mesh
- other cues



[Gemrot, 2006] (c)



[Isla, 2005] (c)

naplnit objekt vodou

vypít obsah objektu v ruce

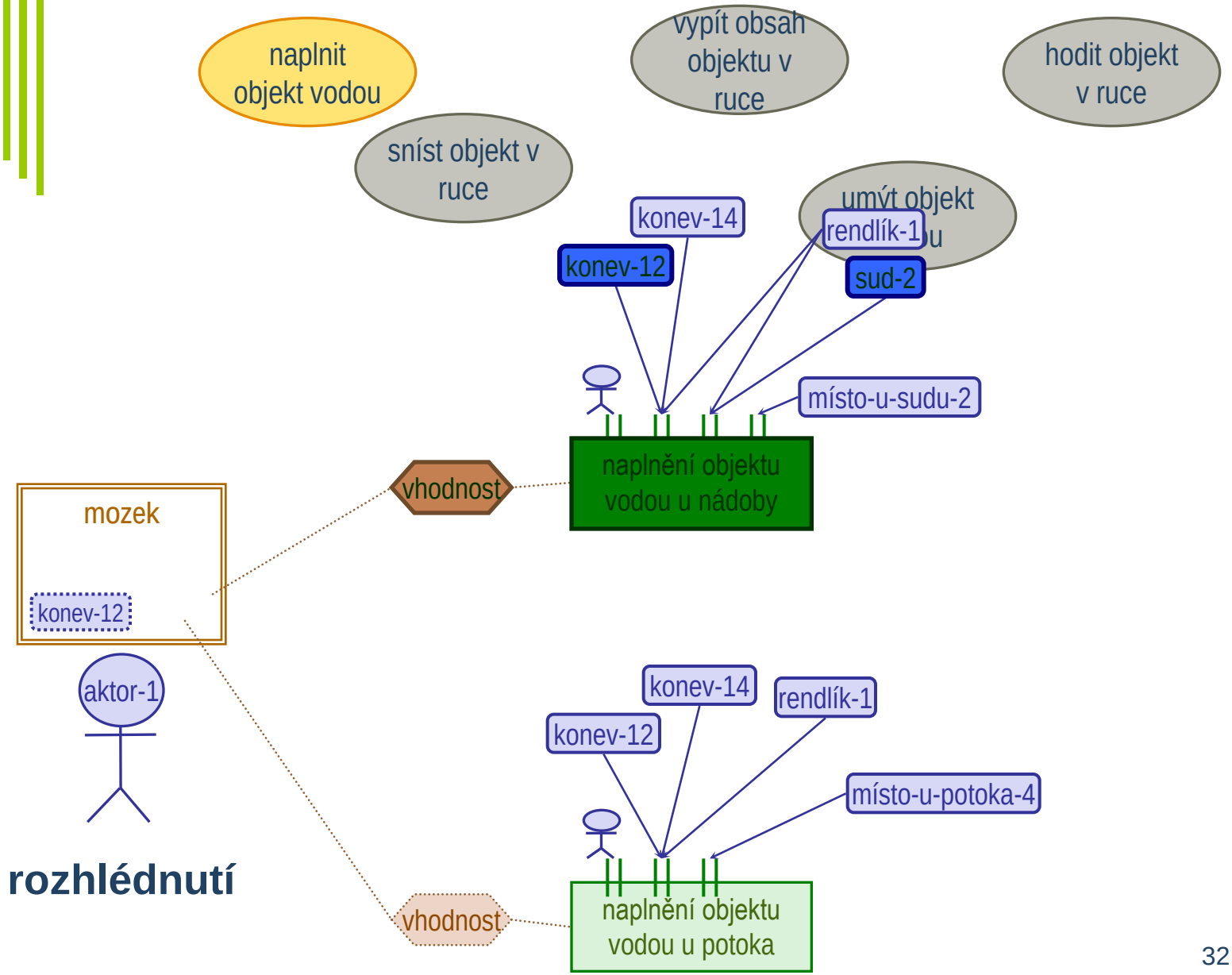
hodit objekt v ruce

sníst objekt v ruce

umýt objekt vodou

mozek

aktor-1

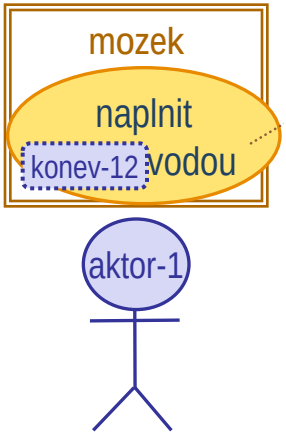


rozhlédnutí

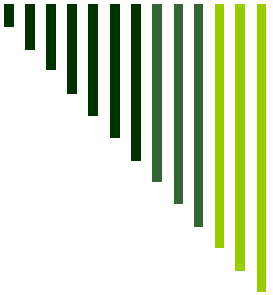
sud-2

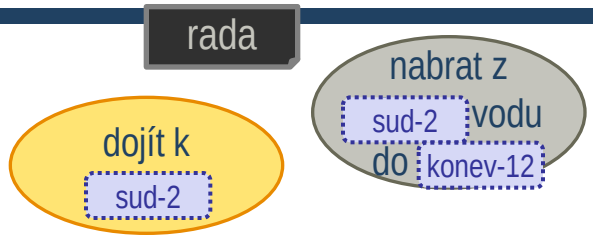
sud-2

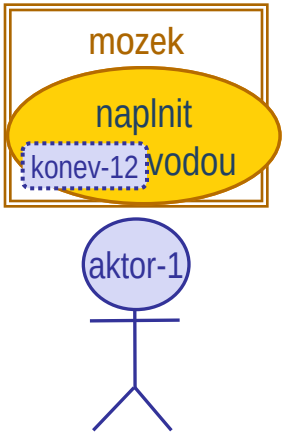
konev-12



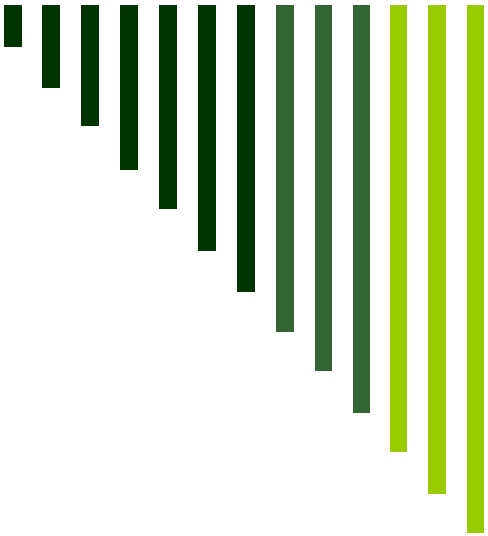
rozhodnutí







rozhlédnutí



4. Conclusion