Level of detail for action selection of virtual humans

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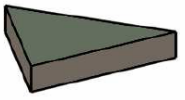
Level of detail

[MRE - Marsella et al., 2003]

- Virtual humans
- Computer graphics LOD
  - objects
  - agents: locomotion, gestures...





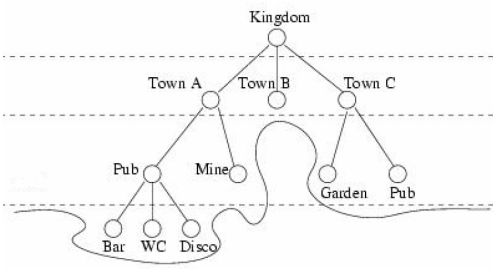
Outline

1. Level of detail – problem statement
2. Level of detail approach
3. Experiments
4. Future work

Problem statement I

- Can we apply level of detail for **action selection** and **space**?
- Computer games, educational app's
  - but not simulations!
  - time-critical, and yet hundreds of agents and tens of locations
- Unexplored
  - a "canyon" approach
  - a "see – not see" approach

Problem statement II



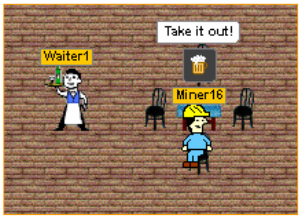
We want to simulate all places at least to some extent:

- partial simulation
- more important and partially important places
- keep information

a **MEMBRANE** metaphor

An approach

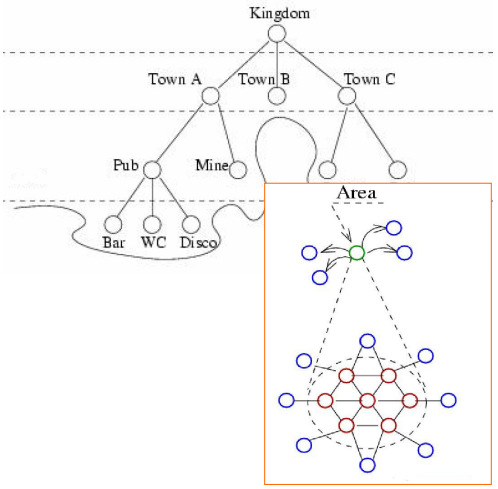
Project IVE



- A tool for investigating AI of virtual humans
- Abstraction for the purposes of high-level reasoning
  - grid world

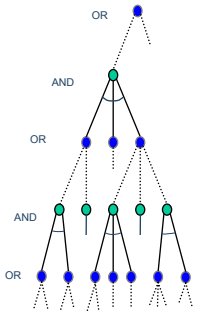
[IVE - Brom et al., 2006]

Space in IVE



- **Hierarchical** decomposition
- Places and areas
  - **discrete**
  - multigraphs
  - atomic places
- Various objects

Action selection in IVE



- **Hierarchical reactive planning**
- Fuzzy if-then rules

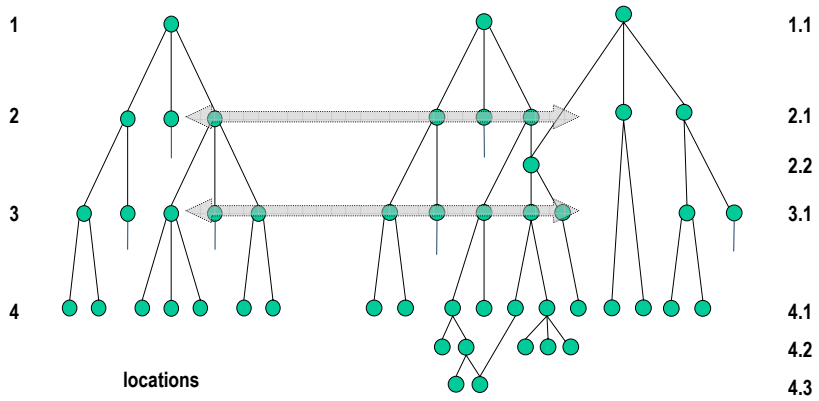
[Bratman, 1987]

- AND-OR trees (BDI)
- High-level goals → Activities → Subgoals → Subactivities → ... → Atomic actions

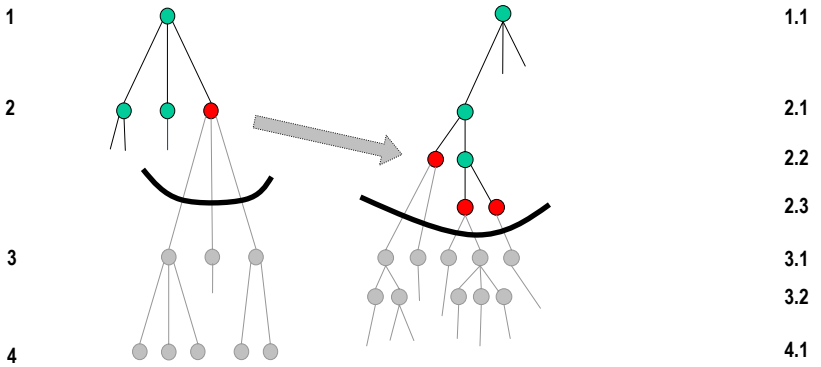
The "trick"

- virtual affordances

[Gibson, 1979]



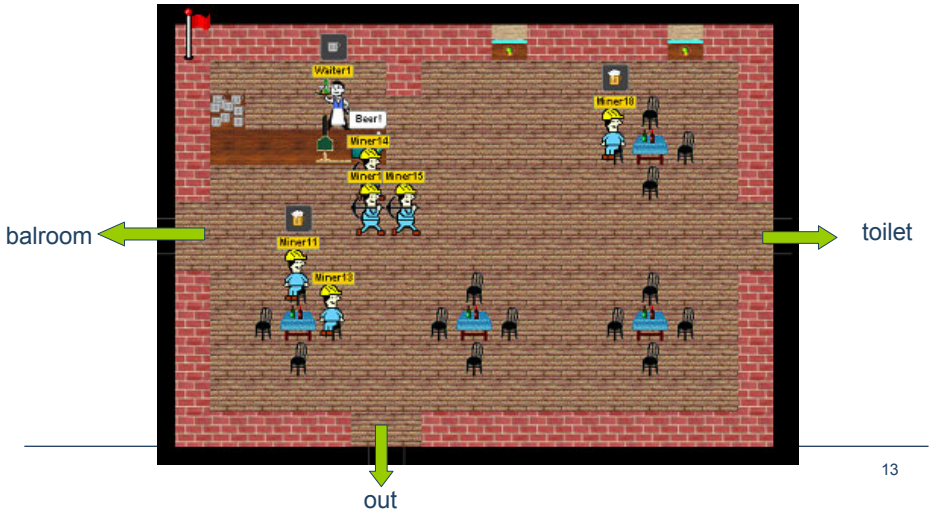
Low LOD



Simulation with a low LOD

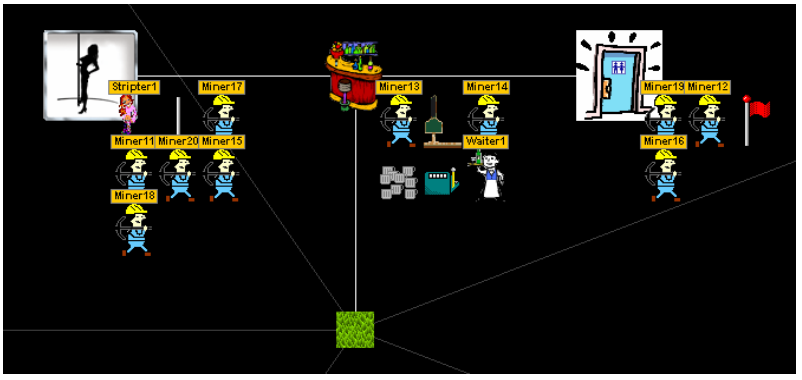
- Drinking (LOD 5 = maximum)
  - every minute drink a bit, until the glass is empty
- Drinking (LOD 4)
  - do 10 minutes nothing, then empty the glass
- **The result of the simulation might be different with a different LOD!**
  - the lower details only **approximates** the full detail

Example - LOD 5



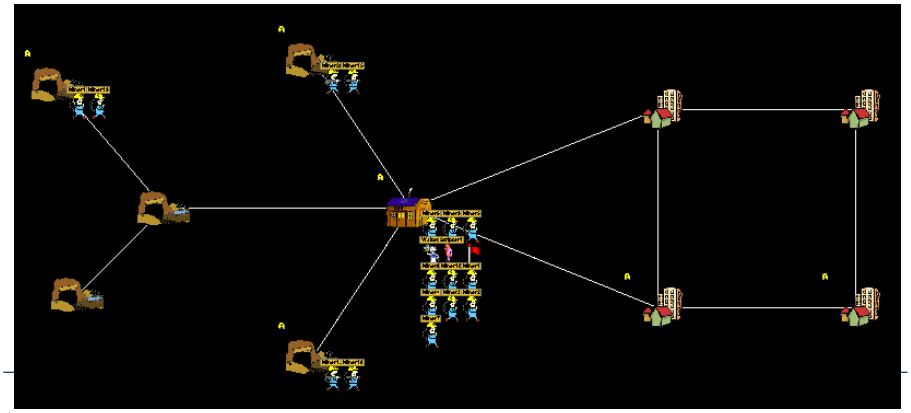
Example - LOD 4

- drinking the whole glass at once



Example - LOD 3

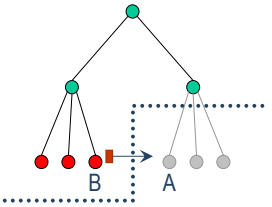
- drinking "from the barrel"
- the glasses have ceased to exist



The experiments

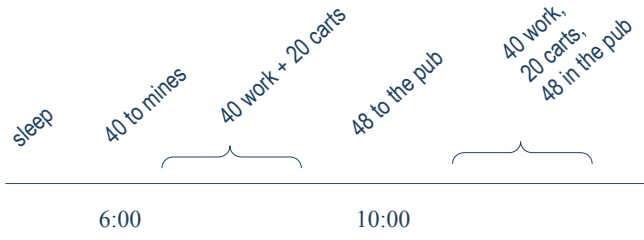
The experiment – the questions

1. **Is it useful at all?**
   - the processor load: LOD 4 < LOD 5
   - the hypothesis: due to less rules during LOD 4
2. **Is the partial simulation useful?**
   - the hypothesis: the “crater approach” helps to keep **reshaping** overhead in control during the change of a centre of attention
3. Other...



The experiments – the setting

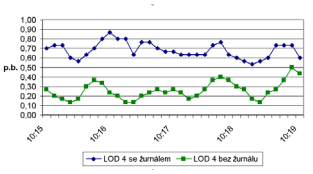
- 5 levels of detail
- 108 agents
- 5000 rules



1 – Is it useful at all?

What happens at 10.15?

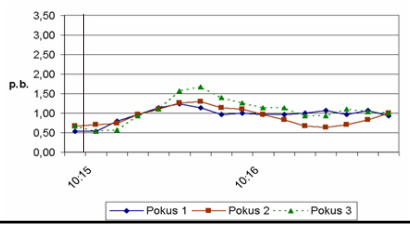
- Everyone works or enjoys himself
- LOD 4:
  - about 2500 rules
  - **0,2 – 0,5 p.**
- LOD 5
  - about 5000 rules
  - **6 - 8 p.**
- **Conclusion: useful**, but not only the number of the rules is important (the number of objects?)

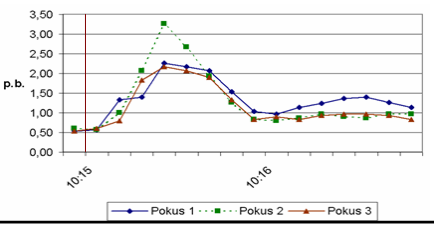


2 – Is the partial simulation useful?

Measuring the reshaping overhead:

- LOD 4 → LOD in a pub increased to 5
- LOD 4, but a pub at LOD 3 → LOD in this pub increased to 5
- **Conclusion:** it really helps to keep the overall **overhead in control** by distributing it in time





Conclusion

- **"Canyon/approach"** to **LOD AI** and **space** is a useful technique for **entertainment** and **educational** simulations featuring large virtual environments inhabited by large number of complex human/animal-like agents
- Future works
  - episodic memory
  - emotions, social relations...
  - what to do with the objects during expansion
  - optimizing
- Speculative:
  - can LOD be used in human prospective planning during "what-happen-if" simulations?

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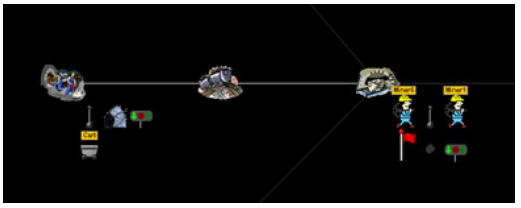
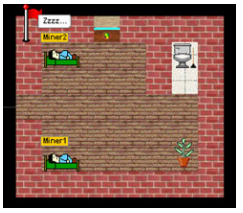
Questions?

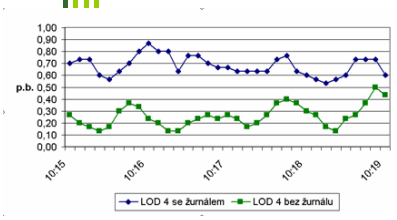
Expansion/contraction

- What to do during expansion/contraction?
  - where to place objects?
  - how to expand an already running activity?

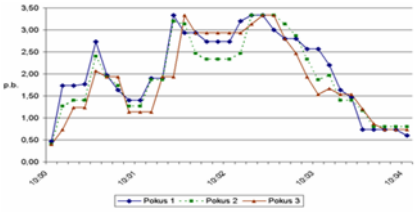




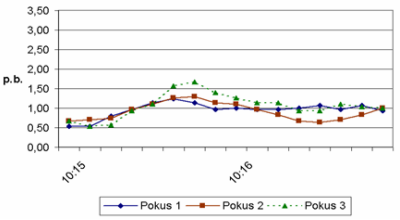
Other experiments



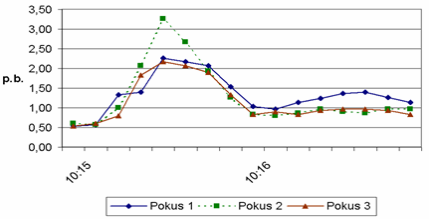
LOD 4



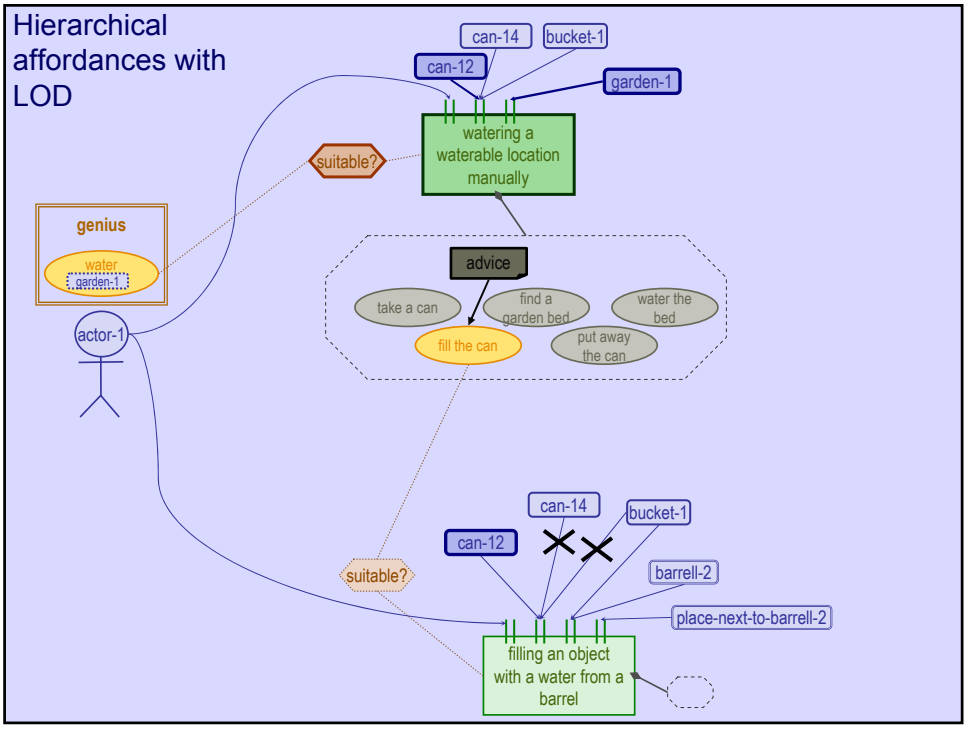
LOD 4 – going to the pubs

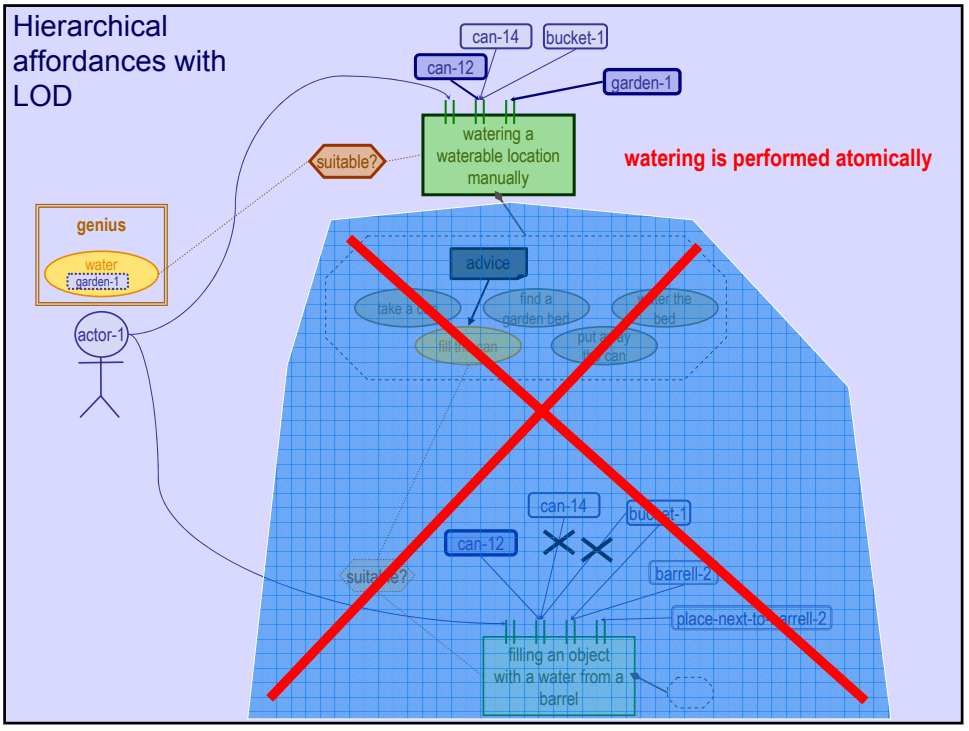


a pub: LOD 4 → LOD 5



a pub: LOD 3 → LOD 5


Hierarchical affordances with LOD
can-14
bucket-1
can-12
garden-1
watering a waterable location manually
suitable?
genius
water
garden-1
actor-1
advice
take a can
find a garden bed
water the bed
fill the can
put away the can
can-14
bucket-1
can-12
barrell-2
suitable?
place-next-to-barrell-2
filling an object with a water from a barrel


Hierarchical affordances with LOD
can-14
bucket-1
can-12
garden-1
watering a waterable location manually
watering is performed atomically
suitable?
genius
water
garden-1
actor-1
advice
take a can
find a garden bed
water the bed
fill the can
put away the can
can-14
bucket-1
can-12
barrell-2
suitable?
place-next-to-barrell-2
filling an object with a water from a barrel