

**PAC: A system for modelling  
agents with  
Personality And Cognition**

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# Why agents with personality/emotions

- education and training
- entertainment
- simulations
- complex systems

# Our focus

- What role do emotions and personality play in rational agents
- How do these aspects make individual agents and groups/societies more effective? More reactive? More flexible?
- How do these aspects interact with cognitive rational behaviour (beliefs, goals, plans, etc).

# Major international projects

- The OZ project - Joe Bates, woggle world, CMU
- Virtual Theatre - Barbara Hayes-Roth, Stanford
- Alive - Patti Maes; virtual reality, MIT
- Cognition and Affect - Aaron Sloman, University of Birmingham
- Jack project - Norman Baadler, University of Pennsylvania

# Aims of PAC system

- interactive environment for experimentation
- easy creation of worlds with objects
- ability to populate world with customized agents
- ability to easily modify agent emotions and personality
  - ✦ at creation time, and
  - ✦ at runtime
- graphical output

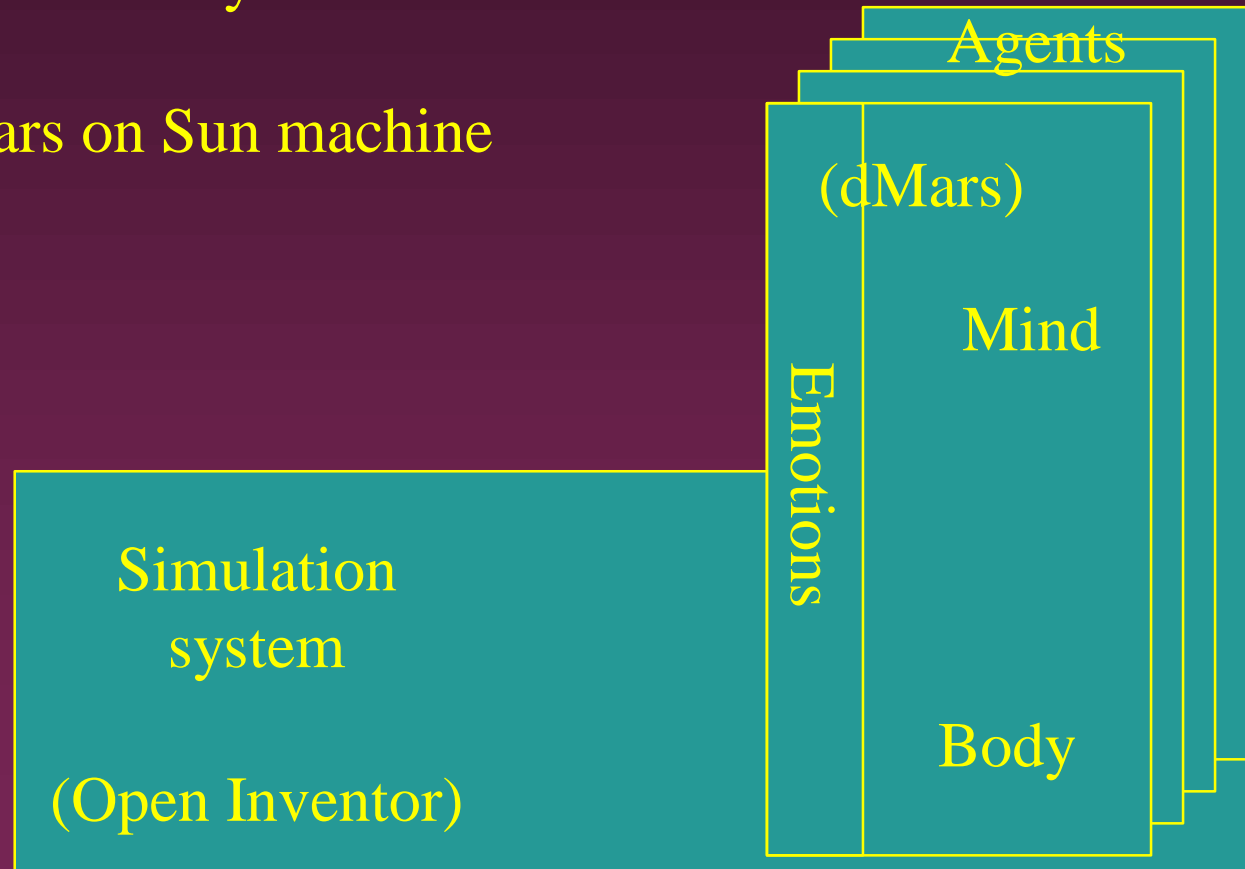
# PAC System



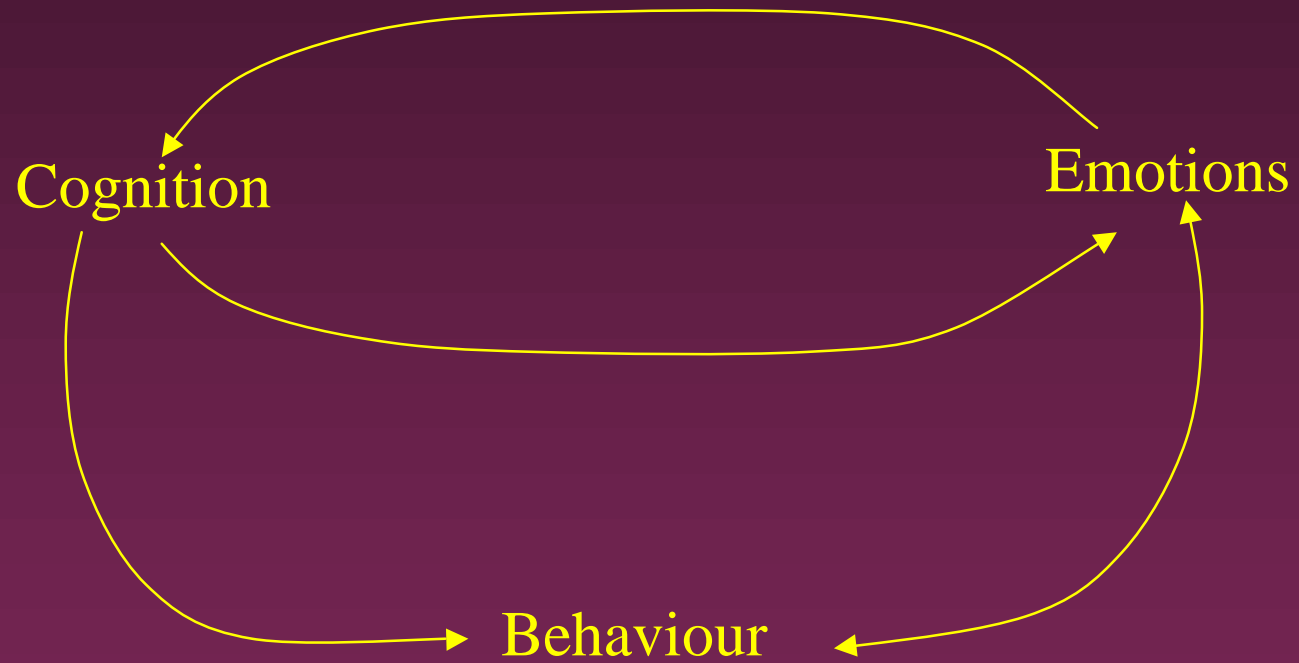
# System Architecture

Simulation system on SGI

dMars on Sun machine



# Emotional model



# Cognition influences emotion

- Goal(X) achieved -> happy(X)
  - Goal(X) failed -> sad(X)
  - Goal(X) achieved by (Y) -> grateful(X,Y)
  - Goal(X) thwarted by (Y) -> angry(X,Y)
  - Goal(Y) thwarted by (X) -> guilty(X)
  - **Expect** goal achieved -> hopeful
  - **Expect achieved** and goal failed(X)  
-> disappointed
- (e.g. Dyer, Ortony Clore and Collins, Bates)

# Emotion influences cognition

- As trigger or context condition of plans
  - ✦ angry at X, and X has food  
steal X's food
  - ✦ hungry, and X has food and angry at X  
steal X's food
- Adding or deleting goals
  - ✦ If X is grateful to Y, X may add goal to help Y
  - ✦ Motivational Concerns (details follow)
- Metaplans to reorder goal priorities
  - ✦ if fearful goal to stay near group has higher priority than explore goal

# Emotion (directly) influences behaviour

- Observable characteristics e.g.
  - ✦ facial expressions,
  - ✦ speed of movement,
  - ✦ posture ...
- Reflexive action e.g.
  - ✦ extreme fear -> flight/fight

# Cognition influences behaviour

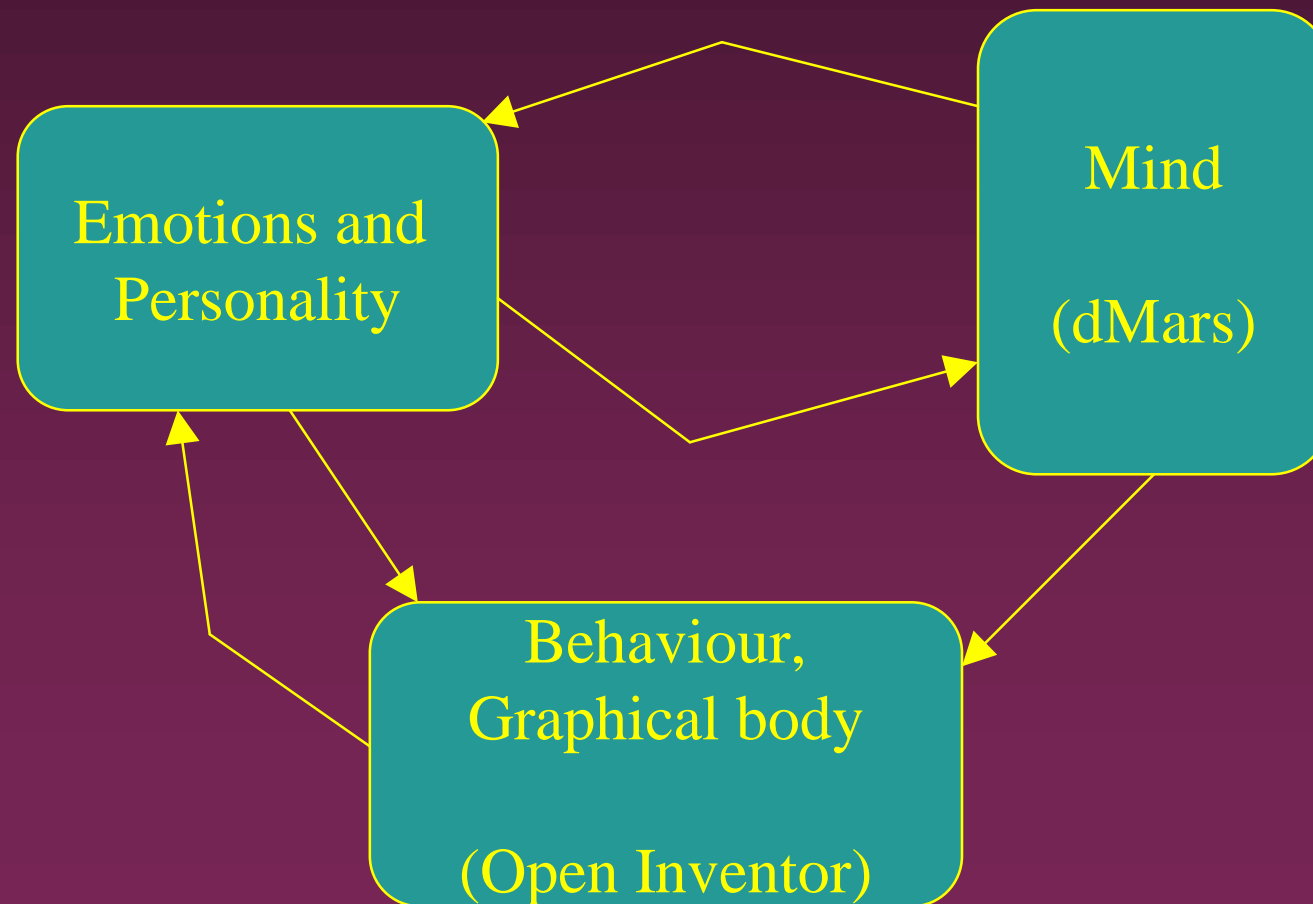
- Standard mechanisms of BDI style agents
  - ✦ plans,
  - ✦ beliefs
  - ✦ plan selection
  - ✦ plan abort
  - ✦ ...
- PAC uses dMars as the cognitive engine which activates simulator behaviours

# Motivational Concerns

- Equivalent to “major goal”, “permanent goal”, maintenance goal, motive
- Emotions are part of “concern realisation system”: recognition of threats and opportunities with respect to motivational concerns.
- Examples: survival, stimulation, family harmony, etc.
- Threats or opportunities lead to emotions, which in turn lead to actions (via goals).

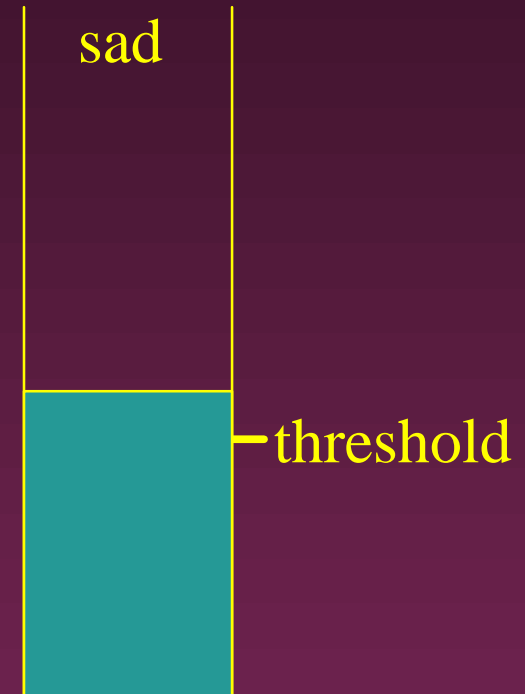
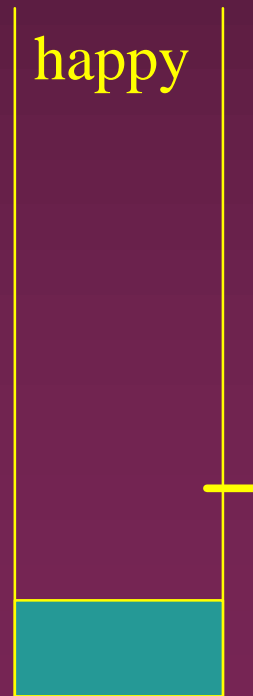
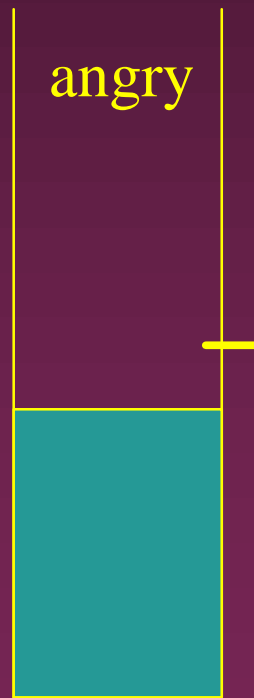
# Agent Architecture

Mind + Body + Emotions



# Emotion representation

emotional  
thermometers



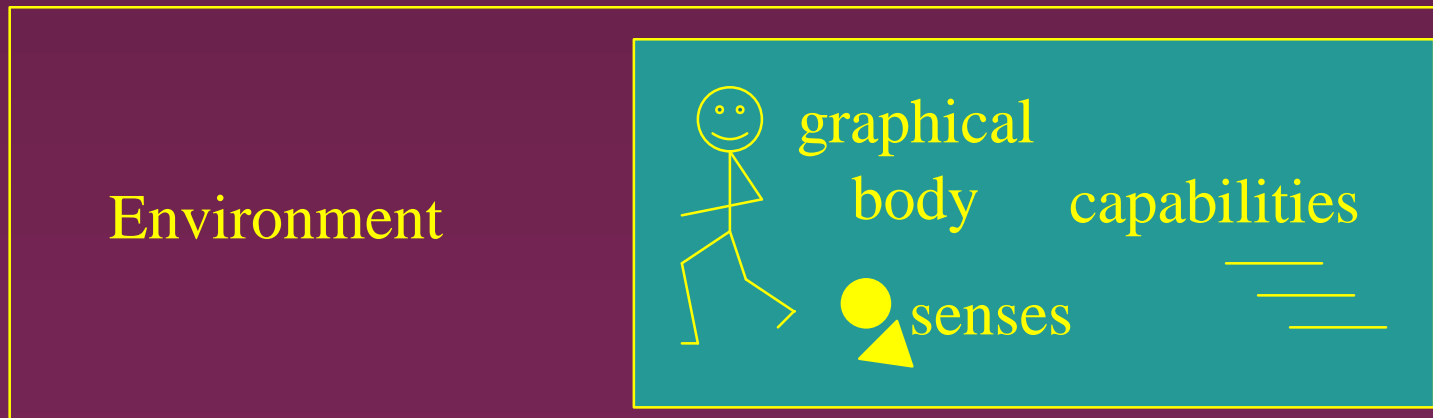
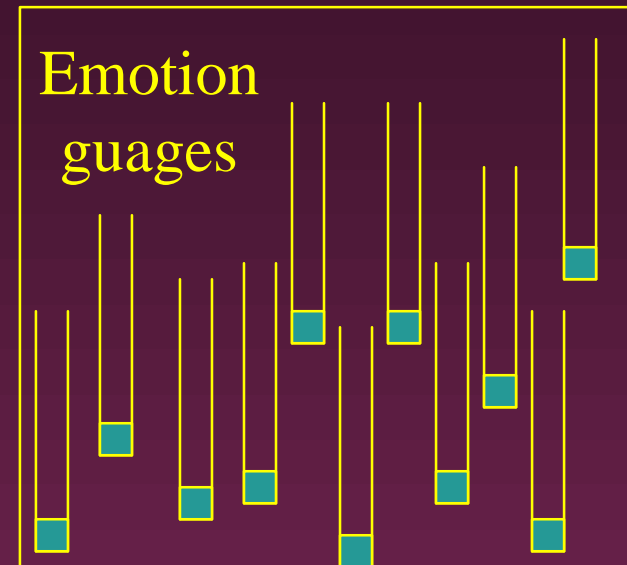
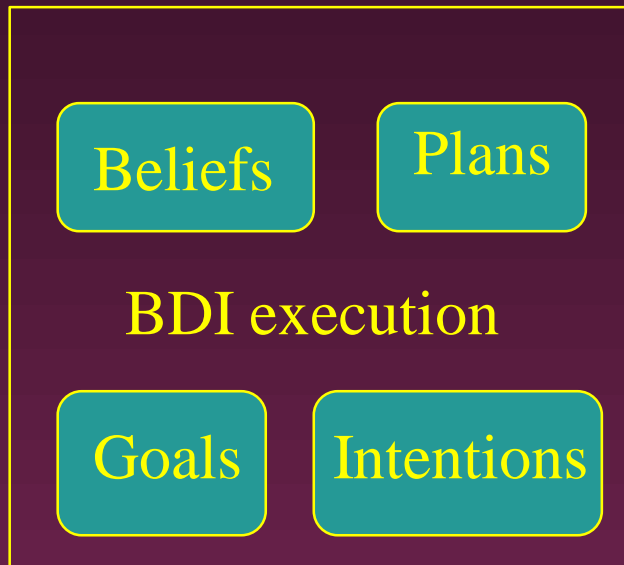
increase  
decrease  
function

A vertical double-headed arrow pointing both up and down, located to the left of the text 'increase decrease function'.

# Use of motivational concerns

- Application specific
- we only had a few
- require significant coding to watch for threats and opportunities

# Agent architecture internals



# Three projects

- Max and Fido
  - ✦ 2 dogs, 1 timid, 1 aggressive, food, bowls
- Sheepdog project
  - ✦ 2 dogs, sheep, 3 gates
- Lamp project (Luxor Jr)
  - ✦ parent and child lamp, ball, obstacles

# Lamp project: background

- Luxo Jr animation by Pixar
  - ✦ very engaging
  - ✦ appeared to have personalities
  - ✦ hand crafted
- Can we automatically generate something similar if we have a model of emotions and personality?

# Lamp project: details

- motivational concerns:
  - ✦ parental concern (parent)
  - ✦ stimulation (child)
  - ✦ safety (both)
- Emotions
  - ✦ happy
  - ✦ sad
  - ✦ angry
  - ✦ bored

# Lamp project details:

- scenario:
  - ✦ world with sparse objects
  - ✦ occasional random ball appears
- plans and actions
  - ✦ wander around
  - ✦ ball playing
  - ✦ walk
  - ✦ run

# Lamp project: conclusions

- Motivational concerns surprisingly effective in generating interesting behaviour
- Rich and engaging scenarios despite very limited options
- Complexity of result with simple input
  - ✦ emotions helped provide variation and complexity

# Summary

- Emotions and personality in agents interesting for a variety of reasons
- Some simple emotional models and use in PAC
- These simple constructs able to generate engaging and interesting agents
- (Graphics layer a major headache)