6.034

Representing Knowledge

Redux

Randall Davis

REPRESENTATION

What good are symbols?

- Communication

- Knowledge
  - Transmission
    - Education
  - Accumulation
    - Civilization

Ideas

☆ Symbols, symbolic reasoning
Enable talking about / thinking about things in their absence.

6.034

Architectures:

Putting it all Together

Randall Davis

To Date…

- Problem solving methods
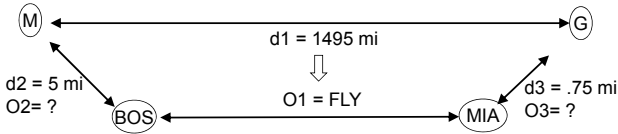- Representations
- Models of learning

- Architectures
  - GPS
  - SOAR
  - Subsumption
  - Society of Mind, multiplicities as key
  - The value of stories

GPS: The General Problem Solver

- Newell and Simon, 1969, CMU
- Basic model: means–ends analysis
  - What's my current situation?
  - What would I like my situation to be?
  - What operation can I carry out that reduces the difference?

GPS: The General Problem Solver

Current situation: MIT
Desired situation: Grandma's house (Miami)
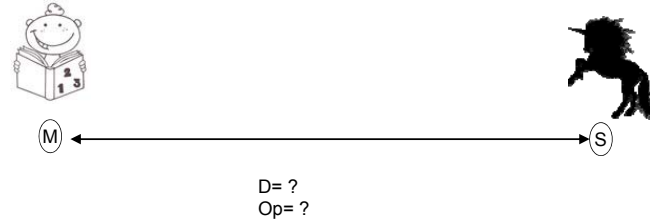Difference: 1495 mi
What op reduces that difference?

M
d1 = 1495 mi
⇩
O1 = FLY
G
d2 = 5 mi
O2= ?
BOS
MIA
d3 = .75 mi
O3= ?

GPS: Operator/Difference Table

Diff/Op	Auto	Plane	Bicycle	Walk
>1000 mi			x	x
100 – 1000			x	x
1 – 100	x			
<1 mi	x	x	x	

- How broadly applicable is this architecture?

- Why the desire for generality?

GPS In the Real world

D= ?
Op= ?

GPS and Predictions

- Within ten years…
- "a digital computer will discover an important mathematical theorem"
- "a computer will be as smart as a person"

We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.
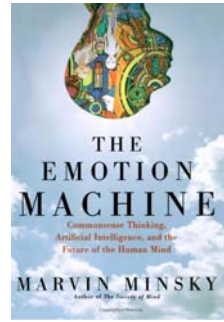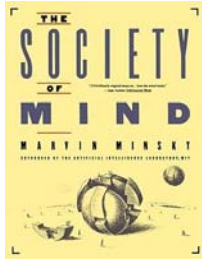
Roy Amara, Inst. for the Future

SOAR

LONG TERM MEMORY

RULES, ASSERTIONS

⇕

SHORT TERM MEMORY

ASSERTIONS

⇕

PERCEPTION
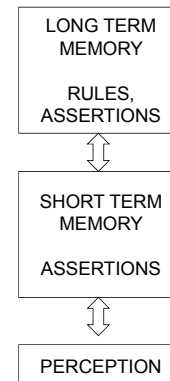
1) LTM and STM
2) Rules and assertions
3) Problem spaces
4) Universal subgoaling: a way out of any impasse or uncertainty
5) The physical symbol system hypothesis: *a symbolic system is necessary for general intelligence*

Society of Mind, Emotion Machine

Suitcase words: intelligence, emotion…
Multiplicities are necessary

Society of Mind, Emotion Machine

- How problem solving/thinking might be done in levels
- *Joan is part way across the street on the way to deliver her finished report. While thinking about what to say at the meeting, she hear a sound, turns her head, and sees a quickly oncoming car. Uncertain whether to cross or retreat, but uneasy about being late, she decides to sprint across the street. Later she remembers her knee had been injured and reflects on the impulsive decision to sprint. "If my knee had failed I could have been killed – and what would my friends have thought of me?"*

Levels in cognition

- Models of self and others
  - what friends will think
- Self-reflecting (self-modeling)
  - arriving late
- Reflective thinking
  - reflects on impulsive decision
- Deliberative thinking
  - decides to sprint
- Learned reactions
  - dealing with autos
- Instinctive reactions
  - hears sound… turns head

Rod Brooks' Alternative View

- Motivation: slow progress in robotics
- How do you get around a dark room?
- Maybe
  - we don't need a painstaking model and plan
  - we don't need a world model at all
  - *reaction* is enough
- The Creature Hypothesis: The bottom level is the hard part; after that it's easy
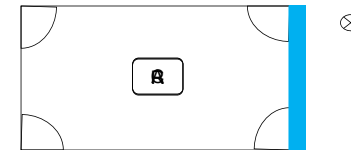
The Subsumption Architecture

Traditional

| V | R | A |

EXPLORE

WANDER

AVOID
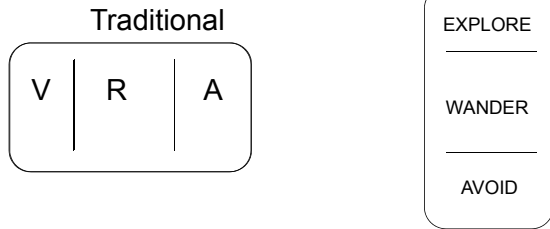
Genghis

Representations… We don't need no stinkin representations[1]

[1] Misquoted from The Treasure of the Sierra Madre

Subsumption Today

Genesis

- Rat: Equiprobably to appropriate corners
- Child: Equiprobably to appropriate corners
- Adult: Equiprobably to appropriate corners
- Blue wall
  - Adults: now only one corner
  - Child > ~5 years – only one corner
  - Rats, young child: no difference
  - Adults with language interference? Can't tell stories!