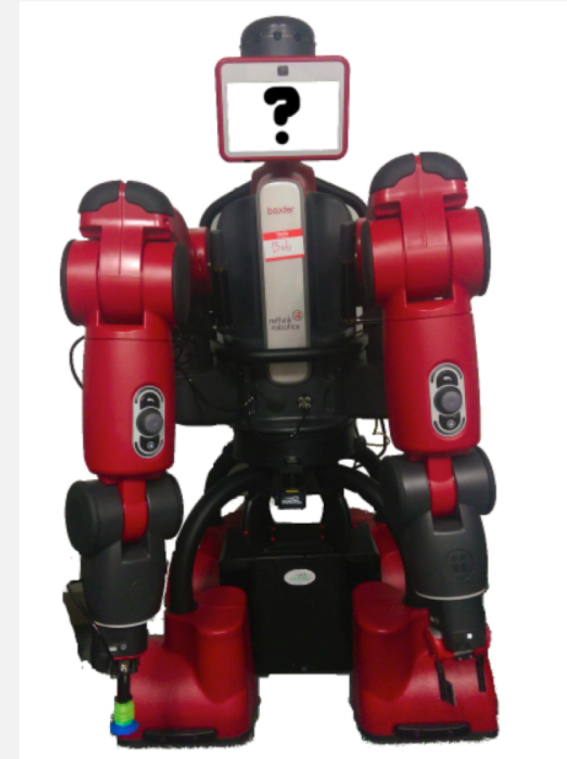


AI'S MISSING REAL-WORLD CONNECTION, AND ITS ESSENTIAL AND MULTIFACETED ROLES

Authors: Justin Brody, Timothy C. Clausner, Don Perlis, **David Sekora**

SOMETIMES, THINGS GO WRONG

- Competition robot hits fence, doesn't realize anything is wrong because wheels are still spinning;
- Robot voice command demo creates infinite loop of robot talking to itself because it doesn't know it is talking;
- Lunar probe lost contact with Earth after series of malfunctions, could have been prevented if it knew facing receiver towards Earth was a priority.



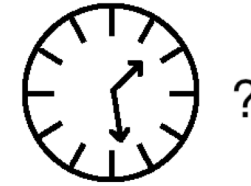
CURRENT APPROACH: AD-HOC SOLUTIONS

- Can solve any particular failure.
 - Example: Hardcode probe navigation system to always force it to face Earth.
- Inflexible – can only handle problems we anticipate/observe.
- Can't anticipate all possible problems – examples on previous slide demonstrate this!

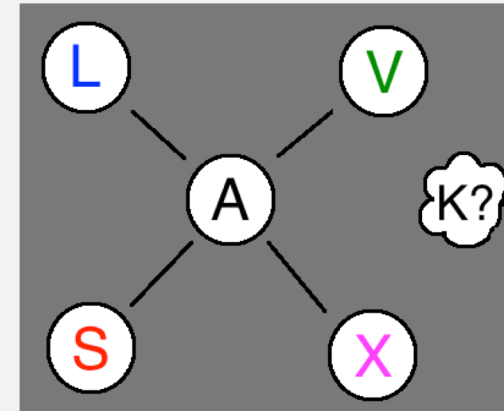
APPEARANCE-REALITY DISTINCTION + SELF-AWARENESS

- Appearance-Reality Distinction: knowledge is internal to a reasoning system, but is about information external to the system.
- Internal-external connection is key! The problems mentioned earlier, and many others, could be solved if systems understand their connection to the world.
- Useful for:
 - Anomaly detection
 - General learning
 - Scene interpretation
 - Explanation

OUR APPROACH: MCL



- MCL – Meta-Cognitive Loop
 - General strategies for resolving a wide variety of problems
- ALMA – Active Logic Machine
 - Active Logic - time-situated extension of first-order logic.
 - Reasoning systems and logics historically ignore time constraints - even a “temporal logic” system, while it reasons *about* time, does not reason *in* time.
 - Includes a notion of “now”, as well as an internal clock. Facts are tagged with timestamps, improves context/attention.



NEXT STEPS: SPATIAL REASONING

- Time was a natural first step – “time passes, and sometimes things change” is fundamental to working in the real world.
- Space seems similarly important, but is more complicated:
 - We have a notion of “now”, should we also have “here”? What would that look like?
 - Can we tag facts with spatial data to improve context/attention?
 - Space is 3-dimensional, not linear.
 - An agent can change space, but not time.
- Currently exploring: physics simulator + machine learning assistance.

THANKS! QUESTIONS?

FURTHER READING

- Brody, J., Perlis, D., and Shamwell, J.. "Who's Talking-Efference Copy and a Robot's Sense of Agency." 2015 AAAI Fall Symposium Series. 2015.
- Clausner, T.C. (2005). Image schema paradoxes: Implications for cognitive semantics. In B. Hampe & in collaboration with J. E. Grady (Eds.), From Perception to Meaning: Image Schemas in Cognitive Linguistics. (pp. 93-110). Berlin; New York: Mouton de Gruyter.
- Clausner, T.C., Palmer, E., Brown, C., Bates, C., & Kellman, P.J. (2009). Conceptualization of perceptual cues guided by metaphor, perception, and imagined perspective. Psychonomic Society: 50th Annual Meeting, 14, 102. Boston, MA.
- Palmer, E.M, Brown, C.M., Bates, C.F., Kellman, P.J. & Clausner, T.C. (2009). Perceptual affordances and imagined viewpoints modulate visual search in air traffic control displays. Proceedings of the 53rd Annual Meeting of the Human Factors and Ergonomics Society. 53(17).
- Perlis, D (1991). Putting ones foot in ones head - part I: Why. Noûs 25 (4):435-55.
- Perlis, D (1994). Putting ones foot in ones head - part II: How. In Eric Dietrich (ed.), Thinking Computers and Virtual Persons. Academic Press. pp. 435-455.
- Perlis, D. (2016). Five dimensions of reasoning in the wild. Proceedings of the Thirtieth AAAI Conference on Artificial Intelligence, pp. 4152-4156.
- Perlis, D., Brody, J., Kraus, S., Miller, M. (2017). The internal reasoning of robots. Proceedings of the Thirteenth International Symposium on Commonsense Reasoning.
- Sekora D., Barham, S., Brody, J., Perlis, D. (2017). Anatomy of a Task: Towards a Tentative Taxonomy of the Mind. AAAI Fall Symposium on a Standard Model of the Mind.