

Applications of AI

- Travelling Salesman
- Protein folding
- Artificial Language

Travelling Salesman Problem (TSP)

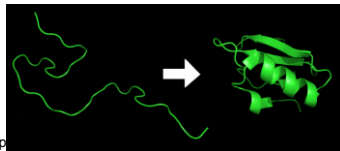
- Minimise total distance to visit all cities



To/From	Melbourne	Sydney	Brisbane	Perth
Melbourne		881km	1691km	3423km
Sydney	881km		926km	3942km
Brisbane	1691km	926km		4351km
Perth	3423km	3942km	4351km	

Protein Folding

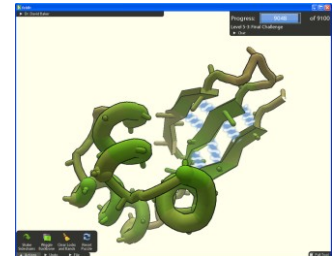
- Searching through the possible structures of the protein to find the lowest-energy solution
- Simulated annealing
- Stochastic local search
- Population based local search



<http://folding.stanford.edu/>
<http://www.biocomp.chem.uw.edu.p>

Protein Folding: Foldit

- Computer game to help solve the problem



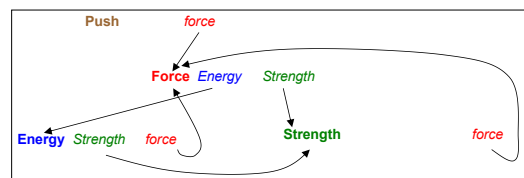
<http://fold.it/portal/>

Artificial Language

- How can agents understand and use language appropriately?
- What sort of concepts can agents form?
- What abilities do agents require to form these concepts?
- Can the agents learn new concepts and words?

Grounding Artificial Language

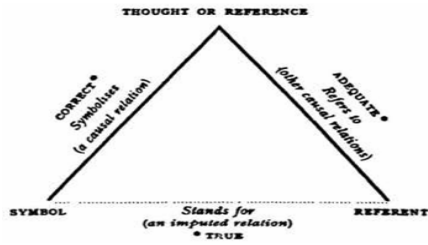
- Symbol Grounding Problem



From Figure 1 in Roy, D. (2005). Semiotic Schemas: A framework for grounding language in action and perception. *Artificial Intelligence*, 167(1-2), 170-205.

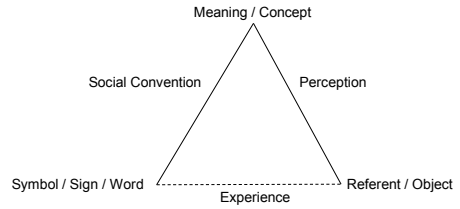
Grounding Artificial Language

- Semiotic Triangle



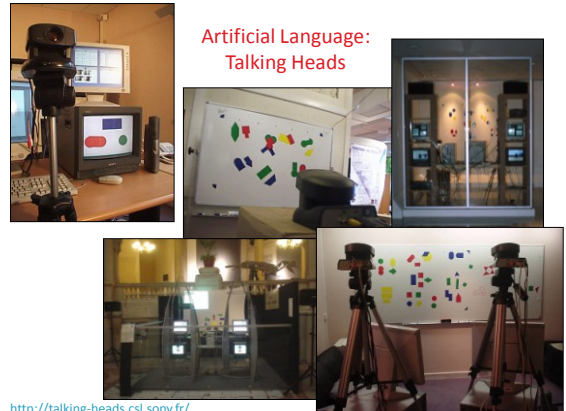
Ogden, C. K. and I. A. Richards, I. A. (1923). *The Meaning of Meaning: A Study of the Influence of Language Upon Thought and of the Science of Symbolism*. London: Routledge & Kegan Paul.

Semiotic Triangle



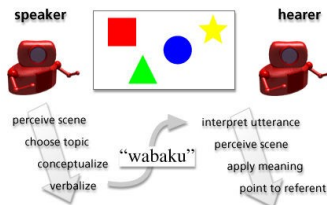
Artificial Language in Robots

- Talking heads
- Lingodroids



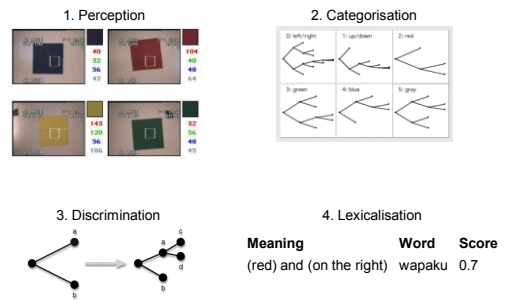
<http://talking-heads.csl.sony.fr/>

Artificial Language: Talking Heads



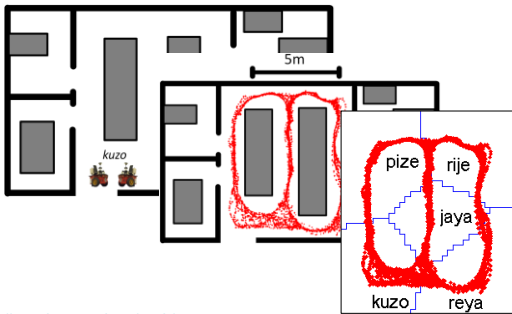
<http://talking-heads.csl.sony.fr/>

Artificial Language: Talking Heads



<http://talking-heads.csl.sony.fr/>

Artificial Language: Lingodroids



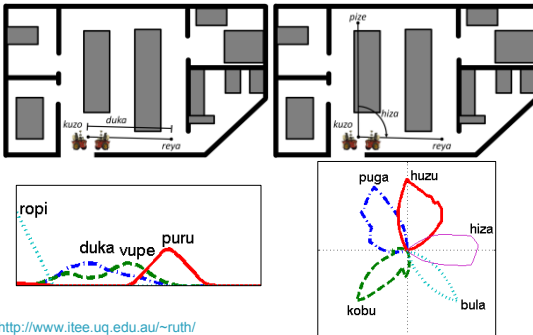
<http://www.itee.uq.edu.au/~ruth/>

Artificial Language: Lingodroids



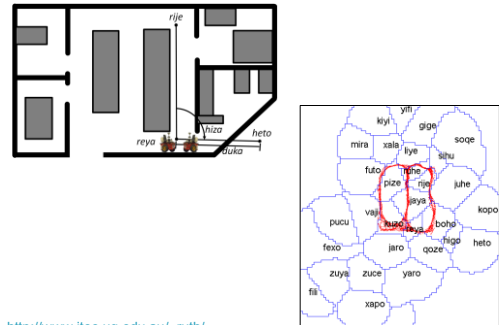
<http://www.itee.uq.edu.au/~ruth/>

Artificial Language: Lingodroids



<http://www.itee.uq.edu.au/~ruth/>

Artificial Language: Lingodroids



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Artificial Language Labs

- Artificial Intelligence Laboratory @ the Vrije Universiteit Brussel
<http://arti.vub.ac.be/index.html>
- ECAgents: Embodied and Communicating Agents
<http://ecagents.istc.cnr.it/>
- Cognitive Machines @ the MIT Media lab
<http://www.media.mit.edu/cogmac/>
- Language Evolution and Computation Research Unit @ the University of Edinburgh
<http://www.ling.ed.ac.uk/lec/>

Further Reading

- Symbol Grounding, Embodied Cognition, Language
- Searle, J. R. (1980). Mind, brains, and programs. *Behavioral and Brain Sciences*, 3(3), 417-457.
- Harnad, S. (1990). The symbol grounding problem. *Physica D: Nonlinear Phenomena*, 42, 335-346.
- Varela, F. J., Thompson, E., & Rosch, E. (1991). *The Embodied Mind*. Cambridge, Massachusetts: The MIT Press.
- Steels, L. (2008). The symbol grounding problem has been solved. So what's next? In M. De Vega, A. M. Glenberg & A. C. Graesser (Eds.), *Symbols and Embodiment: Debates on meaning and cognition* (pp. 223-244). New York: Oxford University Press.