

# Applications of AI

- Travelling Salesman
- Protein folding
- Artificial Language

# Travelling Salesman Problem (TSP)

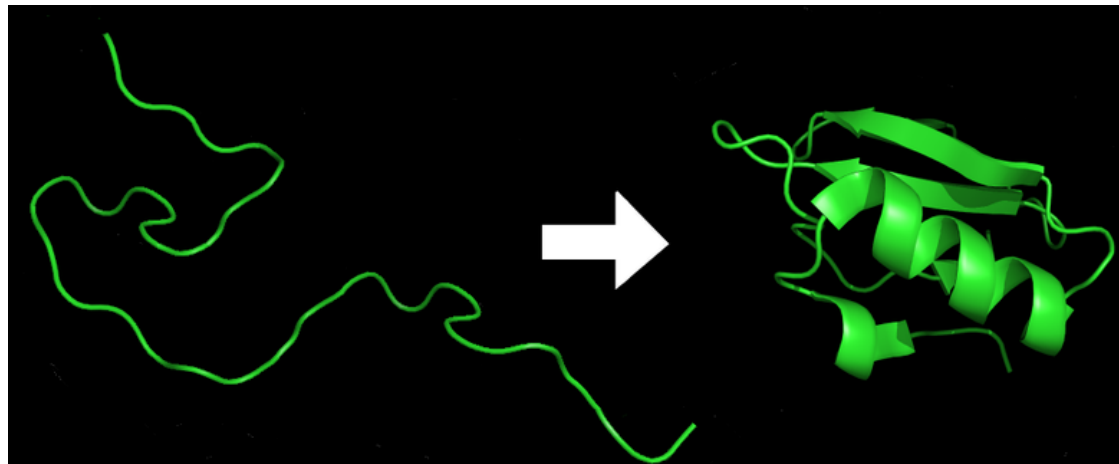
- Minimise total distance to visit all cities



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

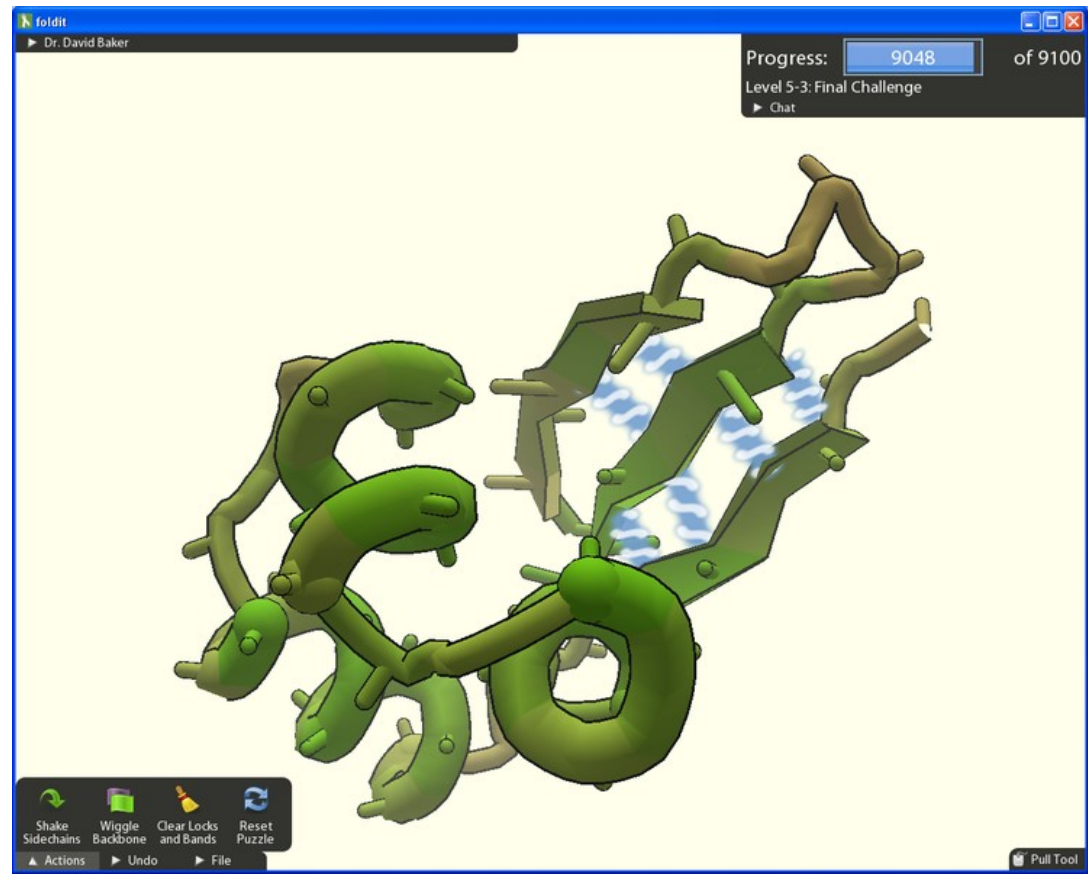
# Protein Folding

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



# Protein Folding: Foldit

- Computer game to help solve the problem

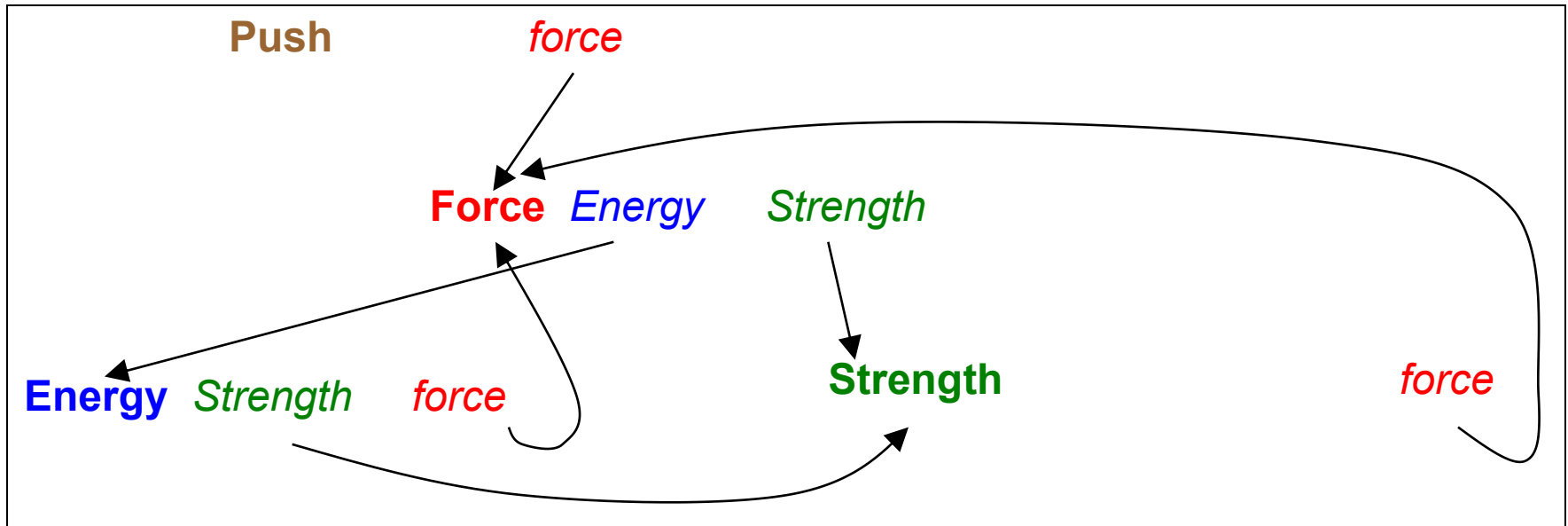


# Artificial Language

- 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

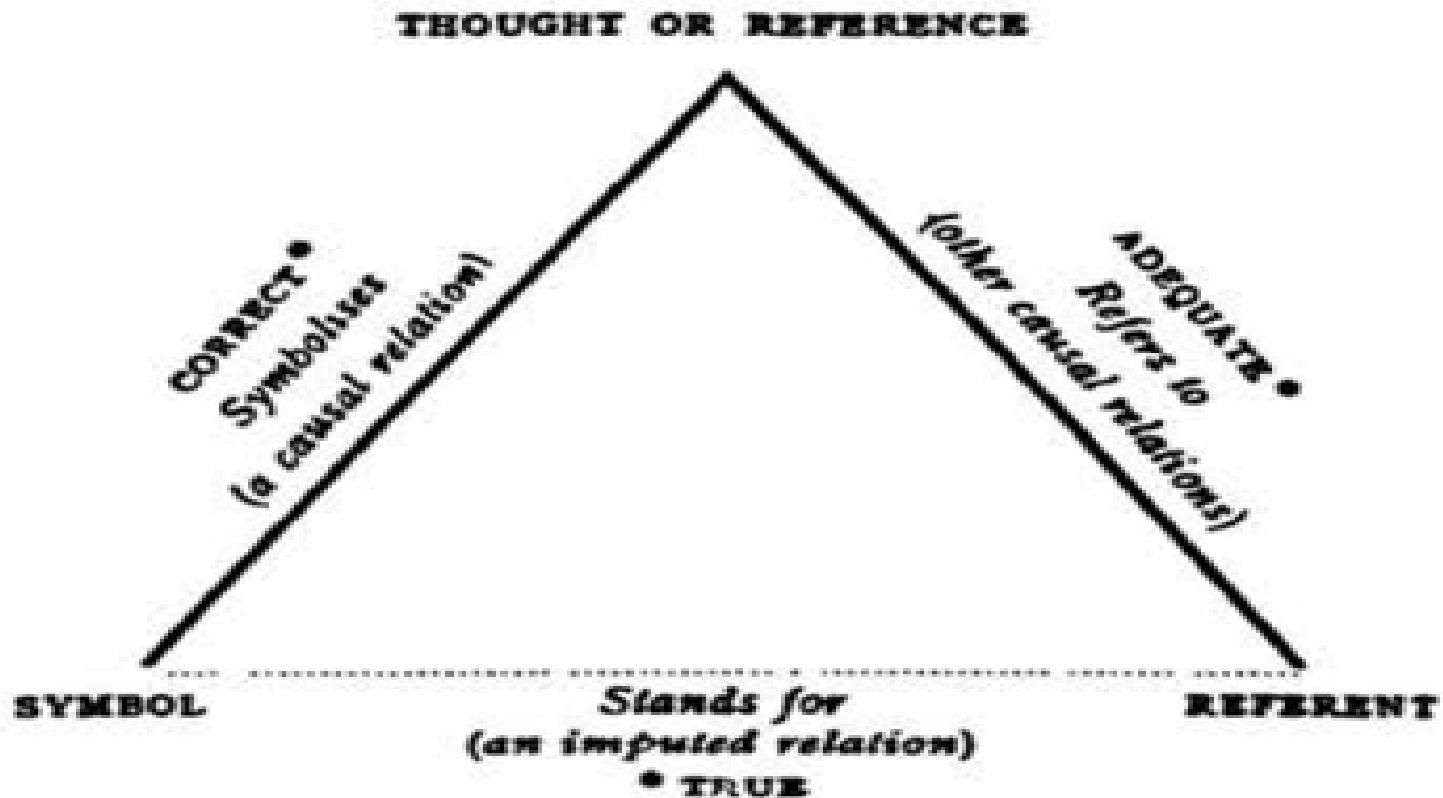
- Symbol Grounding Problem



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.

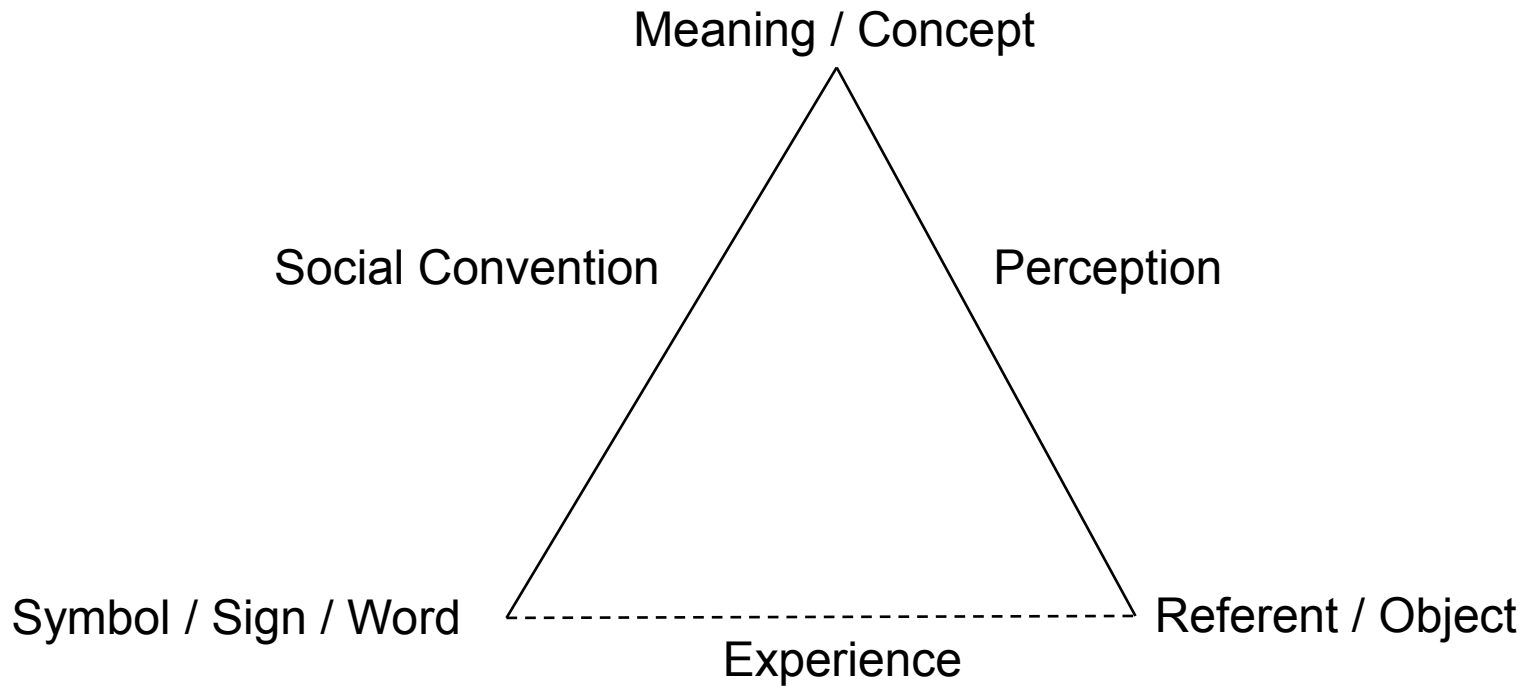
# Grounding Artificial Language

- 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.

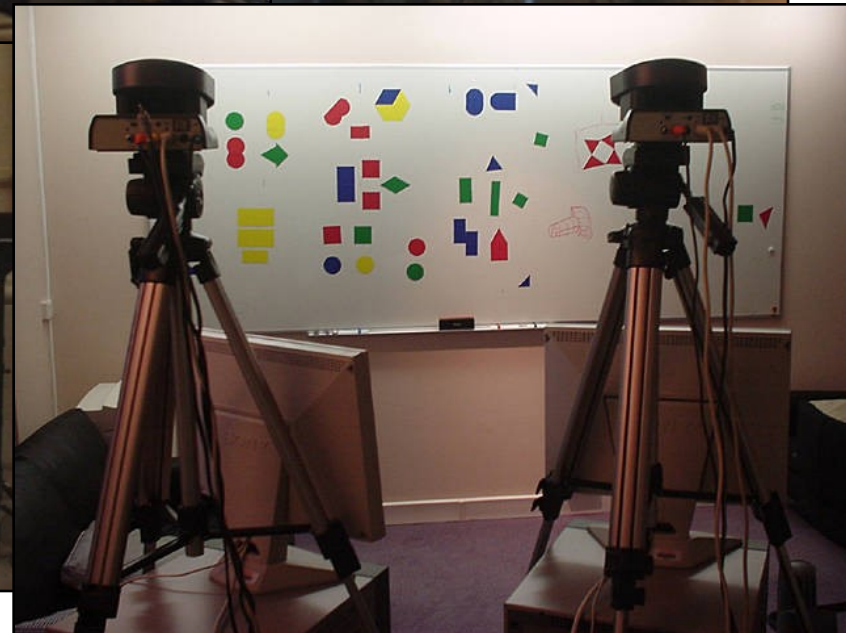
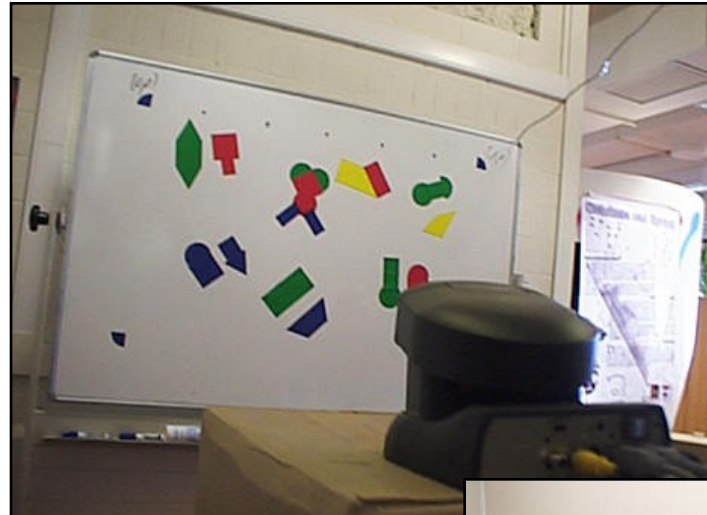
# Semiotic Triangle



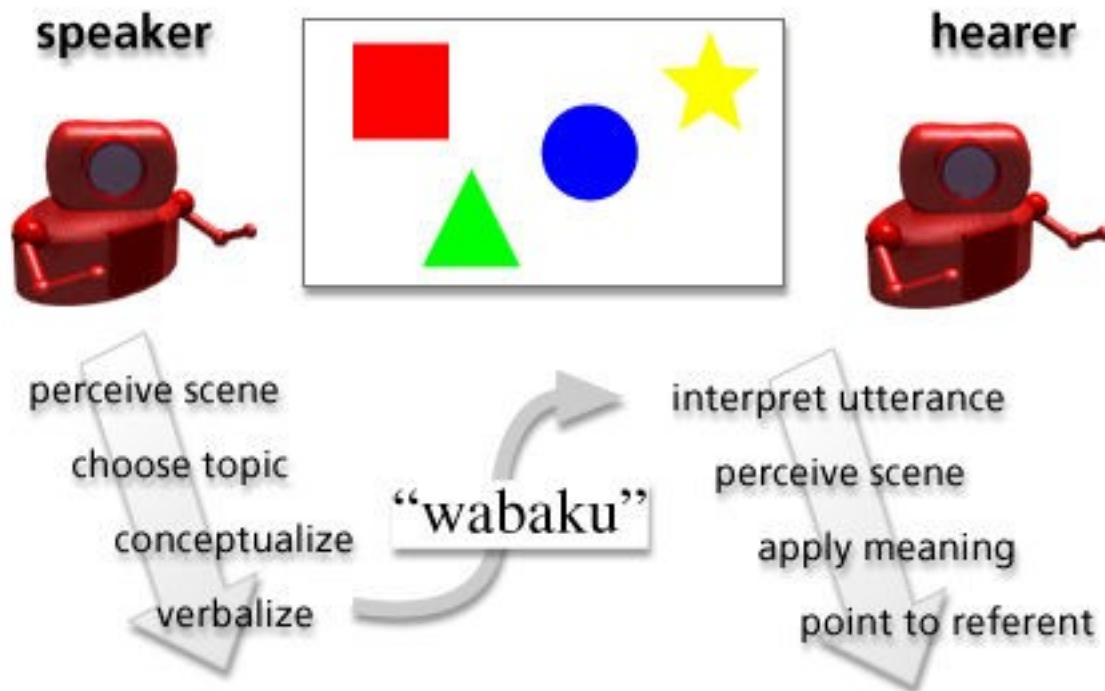
# Artificial Language in Robots

- Talking heads
- Lingodroids

# Artificial Language: Talking Heads

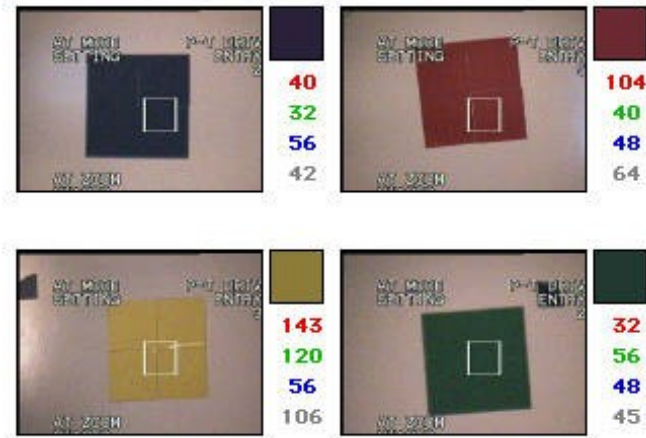


# Artificial Language: Talking Heads

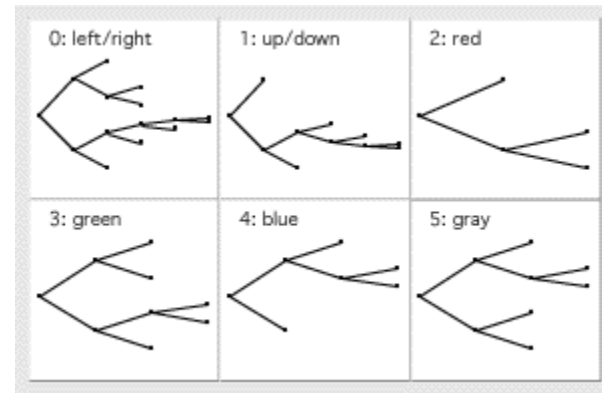


# Artificial Language: Talking Heads

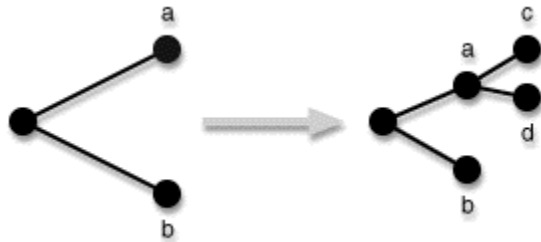
## 1. Perception



## 2. Categorisation



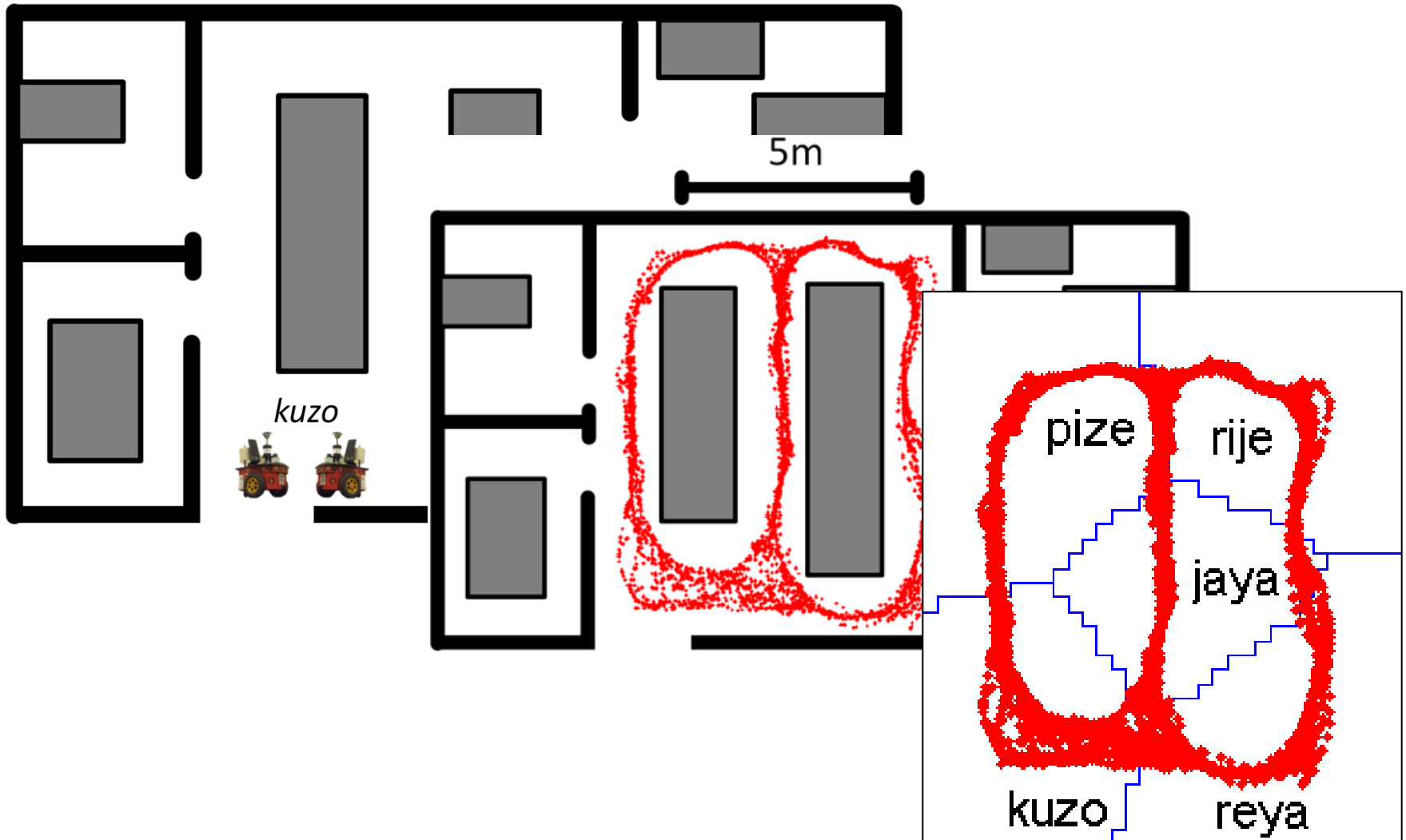
## 3. Discrimination



## 4. Lexicalisation

Meaning	Word	Score
(red) and (on the right)	wapaku	0.7

# Artificial Language: Lingodroids

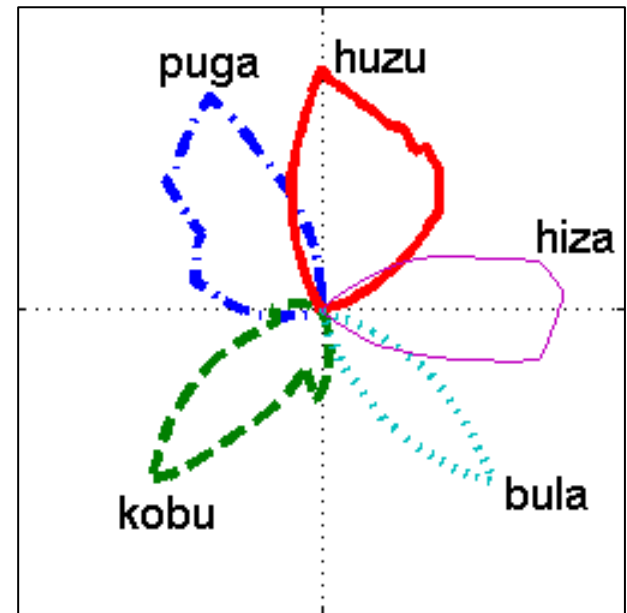
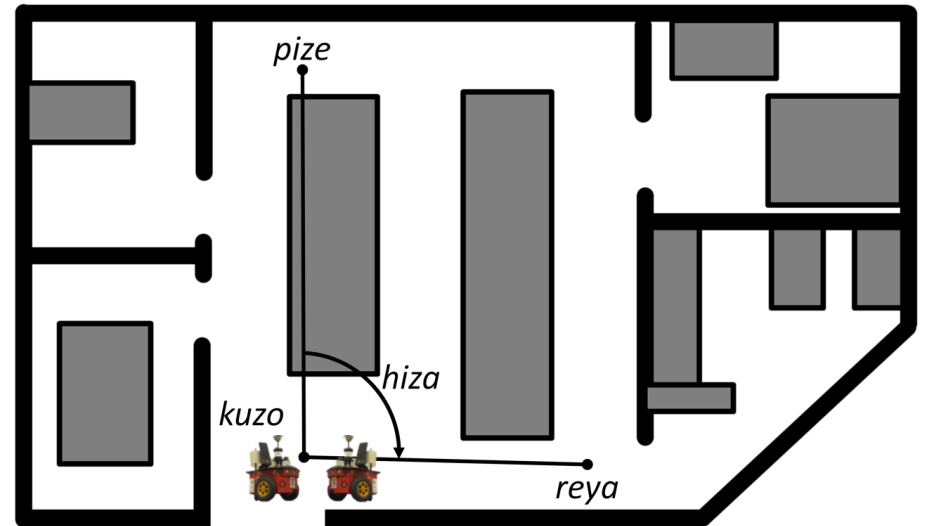
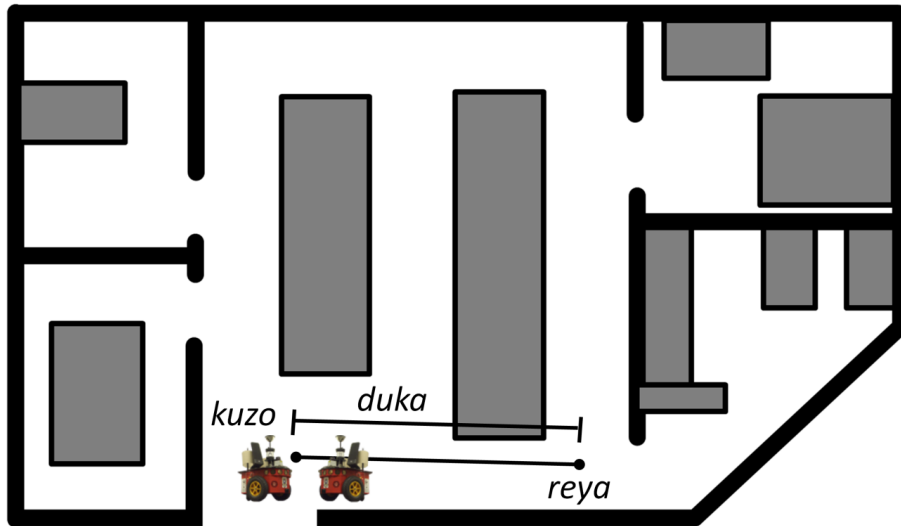


# Artificial Language: Lingodroids

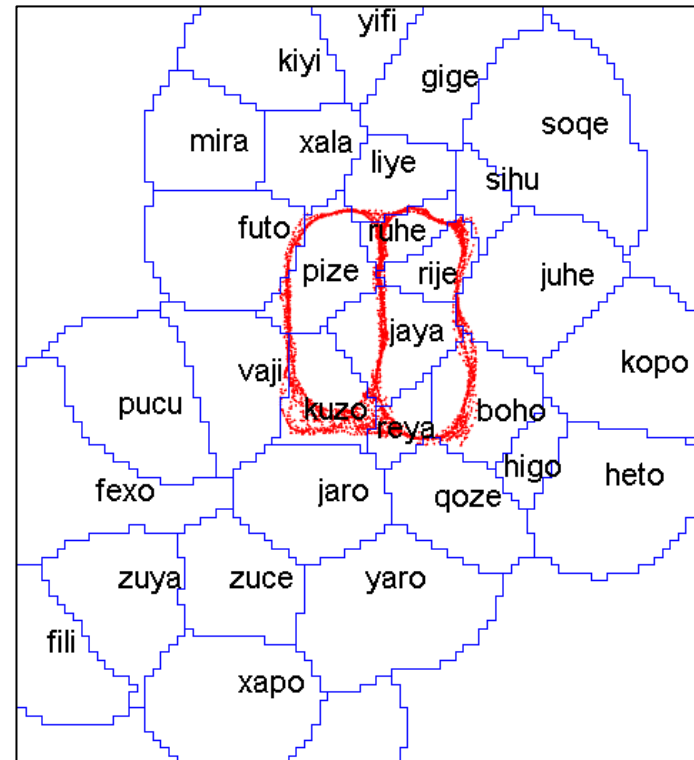
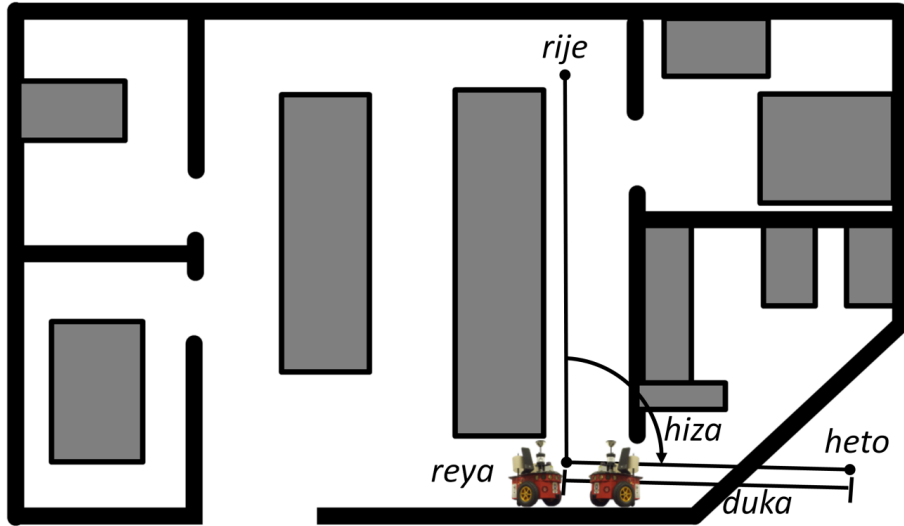


Lingodroids playing a location language game

# Artificial Language: Lingodroids



# Artificial Language: Lingodroids



# 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.