

Massachusetts Institute of Technology
6.S077, Fall 2018
Department of Electrical Engineering and Computer Science
Final Project Topics: Biological Intelligence

Released: Wednesday, November 8

Due: Wednesday, November 21 (Weds. before Thanksgiving break)

What: email me a 1-paragraph description (at most) of what you want to write about for your final project. It doesn't have to be what's included here, but I need to approve over Thanksgiving break.

Topics

1. Anything-literally—that we've talked about in this class: how babies learn speech; animal "language," including artificial language experiments, dolphins, chimps, parrots; sign language; honeybee dance and navigation; how kids learn words; etc.

There's a long list of topics cribbed from the Wikipedia entry on animal cognition, here, that you can also select from:

https://en.wikipedia.org/wiki/Animal_cognition

We've collected some references cited in this article and posted them to the wiki page for 6.S077.

In particular, the following topics might spark your interest:

2. How children learn numbers and how to count, and the difference between analogical "numeracy" and their adult-like number cognition and counting
3. Same topic, but for animals (see "Animals that count – how numeracy evolved" on the wiki); Anderson, U.S.; Stoinski, T.S.; Bloomsmith, M.A.; Marr, M.J.; Smith, A.D.; Maple, T.L. (2005). Also, "Relative numerosness judgment and summation in young and old western lowland gorillas." *Journal of Comparative Psychology*. 119: 285–295
See also Wikipedia entries on dogs: https://en.wikipedia.org/wiki/Dog_intelligence
And for cetaceans: https://en.wikipedia.org/wiki/Cetacean_intelligence
For macaque monkeys, see the PNAS article by Livingstone, 2014 on the wiki
4. Echolocation in bats: https://en.wikipedia.org/wiki/Animal_echolocation
5. Dead-reckoning in insects (ants, etc.) – i.e., "path integration." See the wiki, "ant-path-integration."
6. Attention in other animals (and human); see Blough, D. S. (2006) Reaction-time explorations of visual attention, perception, and decision in pigeons. In E. A. Wasserman & T. R. Zentall (Eds) *Comparative Cognition: Experimental Explorations of Animal Intelligence* pp. 89-105. New York: Oxford.
7. Visual search and attention, see preceding reference.
8. Concepts and categories in other animals, and in humans: review article by Zentall, 2008, posted on the wiki. See the references contained there. (animal-concepts.pdf)
This is a big topic, so you could focus on some particular animal: songbirds, for vocal categories; honeybees/insects, for the concepts of "up" and "down" (see the wiki, "insect-above-below.pdf")
Fish: https://en.wikipedia.org/wiki/Fish_intelligence
9. Concepts in humans: read J. Fodor's (scathing) review of our weak ideas about concepts re the "Big Book of Concepts" and write a paper for and against Fodor's views; review is on the wiki ("fodor-on-concepts").

10. Associative learning, e.g., in pigeons, Vaughan, W.; Jr (1988). "Formation of equivalence sets in pigeons". *Journal of Experimental Psychology: Animal Behavior Process.* 14: 36-42. doi:10.1037/0097-7403.14.1.36.
11. Rule learning in other animals, e.g., rats; see wiki pdf, "rat-rule-learning."
12. Rule learning in monkeys, Vaughan, W.; Jr (1988). "Formation of equivalence sets in pigeons". *Journal of Experimental Psychology: Animal Behavior Process.* 14: 36-42. doi:10.1037/0097-7403.14.1.36
13. How can neural nets encode symbols? R. Gallistel, on the "Language of Thought" – on the course wiki.
14. Memory
 - Memory for locations by birds: Balda, R.; Kamil, A. C. (1992). "Long-term spatial memory in Clark's nutcracker, *Nucifraga Columbiana*". *Animal Behaviour.* 44 (4): 761–769. doi:10.1016/S0003-3472(05)80302-1.
 - Seasonal hippocampal plasticity in food-storing birds, David F. Sherry and Jennifer S. Hoshooley, *Philos Trans R Soc Lond B Biol Sci.* 2010 Mar 27; 365(1542): 933–943. doi: 10.1098/rstb.2009.0220
15. "Naïve" physics in infants, perhaps other animals; see Baillargeon, R. (1994). "How Do Infants Learn About the Physical World?". *Current Directions in Psychological Science.* 3 (5): 133–140. doi:10.1111/1467-8721.ep10770614.
See: Needham & Baillargeon, Intuitions about support in 4.5 month old infants, *Cognition*, on course wiki.
See also: https://en.wikipedia.org/wiki/Naïve_physics
16. Causal reasoning, infant "metaphysics." See Xu & Carey, "Infant Metaphysics" on course Wiki.
17. False beliefs. Baillargeon, R. & Onishi, K. H. (2005). Do 15-Month-Old Infants Understand False Beliefs? *Science*, 308(5719), 225-258. doi: 10.1126/science.1107621;
Baillargeon, R., Scott, R. M., & He, Z. (2010). False-belief understanding in infants. *Trends in cognitive sciences*, 14(3), 110-118. doi:10.1016/j.tics.2009.12.006.
18. Tool use. Please look at: https://en.wikipedia.org/wiki/Tool_use_by_animals
19. Theory of mind in nonhuman animals. See Buckner, 2017, on the course wiki.
20. Spontaneous creation of sign languages. See "Emerging sign languages" on the course wiki.