

Term Paper for 6.S063, Special Section on Artificial Intelligence, linked to 6.034

### Rules of Engagement

1. Length: 5-8 pages, not including references. (Specifications: not larger than 12pt font, and at most 1" margins),
2. Content: A *critical assessment* of one particular, focused question or topic regarding biological intelligence—human language, human or animal vision, motion, navigation, reasoning, number sense; etc. We are explicitly *not* looking for something about artificial or computer intelligence. By a *critical assessment* we mean that you are to take some position about an issue, and then critique or defend it, like a debate resolution. We are explicitly *not* looking for a survey regarding the question or topic you select. Please include at the end of your paper any references that you consulted.
3. Writing style guidelines:  
See Winston's course page for his 6.xxx course,  
<http://courses.csail.mit.edu/6.803/style.html>
4. Collaboration policy:  
Discussion with others is encouraged, but you are required to write down the names of other students in the class whom you collaborated at the top of your paper, and your writing should be your own. Duplicated submissions are not permitted, and overtly duplicated submissions will not be considered appropriate.
5. Topic selection:
  - i. Select one of the topics from the list below, most of which include further description along with a companion short pdf paper from the literature, and email me your selection before the Thanksgiving break *or*
  - ii. Select your own topic, and email me a brief description of your aims along with at least one reference you intend to consult to provide you with information, and proceed after you get my explicit approval.
6. Submission: send the final document to me by email as a pdf, Bob Berwick, [berwick@csail.mit.edu](mailto:berwick@csail.mit.edu), on or before the last day of finals, Thursday, December 22, 5pm. Please don't forget to include your name on your paper, along with the names of any of your collaborators. We need to read all the papers and submit your grade!
7. What if you're going to be late with your submission?  
Please get in touch with me as soon as possible before the due date so that we can discuss together what can be done.
8. Please email me with any questions, thanks! I am here to help.

## Topics

Each of these link through to associated papers and brief discussion. Two of them (#1, #7) have very explicit expanded discussions in the form of “guided questions”; if you are after a very directed writing experience and you don’t know what else to do, you might want to select one of these topics. But naturally, with great power comes great responsibility. The flip side to choosing one of these two is that I take these choices into account. If you select one of these two topics I expect a correspondingly more tightly focused and detailed paper that goes beyond simply answering the questions that the accompanying papers present.

1. GoogleTalk (several topics to investigate regarding what counts as a scientific theory of human language, described in more detail in the associated pdf): Are “language models” like those defined by statistical machine translation systems sufficient? What should the “data” be – should it be the more (or less) “acceptable” sentences in a language, or, rather what is or is not a “grammatical” sentence? What’s the difference between the two notions of “acceptable” and “grammatical” sentences anyway?

- Posted PDF: [googletalk.pdf](#); [chomsky.pdf](#)

2. Honeybee navigation and the “poverty of the stimulus”; what does this say about neural network learning?

- Posted PDF: [dyer.pdf](#)

3. How are neural nets and neural net learning unlike or like real neural learning in brains, and what are the implications?

- Read: any relevant section from Kandel and Schwartz, *Principles of Neural Science*, 5<sup>th</sup> edition, on how neurons and neural systems work.

4. Language: what is the balance between universal grammar and statistics?

- Posted PDF: [yang-tics.pdf](#)

5. Birdsong and human language: how is alike and how is it different?

- Posted PDF: [birdsong.pdf](#)

6. Teaching chimpanzees human language: what is the evidence for or against the success of such experiments?

- Posted PDF: [pnas.pdf](#)

7. Infant speech perception; infant “statistical” pattern recognition.

- Posted PDF: [saffran96.pdf](#); [babytalk.pdf](#)
- Also see: [PolishStory.txt](#); [HawaiianStory.txt](#)

8. Acquisition of language by blind and/or deaf children.

- Posted PDF: [blindchild.pdf](#)

9. Can neuroscientists understand the brain using their current tools (like brain imaging or electrical imaging or optical genomic methods)? One way to test this is to see if current tools could be used to figure out how a simple microprocessor operates. Is this possible? Could neuroscientists even understand a chip this way?

- Posted PDF: [chip.pdf](#)

10. How do children learn the meanings of words? Can children use Bayesian inference for this?

- Posted PDF: [bayesian.pdf](#)

11. Universal computational machinery is easy to build: a Turing machine takes just a read-write “memory tape” and a simple controller for any computable function. Surely

even honeybee or ant brains have such parts. So why don't we see lots of animals with universal and powerful computational abilities (more than just say, us)?

*Evolution of human language.* Pick some section in *Why Only Us* that advances a particular position about human language evolution and argue for or against it. Some examples:

12. The timing of the emergence of human language in sub-Saharan Africa between 100,000-200,000 years ago; what does paleoanthropology and archaeology tell us about human language?
13. Merge (see chapter 1 and lecture) is an operation unique to the human species that enabled language
14. Language first appeared as a vehicle for internal thought, not external communication
15. Genes and language: the *FOXP2* gene and human language
16. Did Neanderthals have human language? What about speech, human or otherwise?