COG403(W19): Seminar in Cognitive Science

Yang Xu

Day/Time/Location: **Wednesday 14pm-17pm @ BA2200**

Instructor: Yang Xu

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Office Hours: Friday 14:00–15:00pm @ DL Pratt 390

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*Syllabus might be adjusted as the course progresses.*

**Description**
This course is a sequel to COG260: Data, Computation, and The Mind. It provides advanced treatment of cognitive science topics by focusing on computational tools for research in this field. The course is organized roughly into four related topics: a) a bootcamp that discusses the mathematical and computational basics; b) neural networks and paradigms of learning; c) probabilistic inference and its links to optimal behaviour under uncertainty; d) efficient communication and the evolution of language. We will discuss classic and recent papers on these topics. All students are expected to take the initiative in leading the paper discussions. Students will also build and evaluate computational models with real-world data in a project.

**Prerequisites:** COG260, CSC148H1, (MAT135H1, MAT136H1)/ MAT137Y1, 0.5 FCE in statistics.

**Objectives**
1. Introduce common tools for computational approaches to cognition.
2. Develop skills in computational thinking and modelling.
3. Build experience in scientific presentation and writing.

**Recommended References**
Deliverables and Assessments

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<td>Paper presentation (including slides)</td>
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<td>Paper summary</td>
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<td>Labs 1-2</td>
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<td>Project proposal</td>
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<td>Project report</td>
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<td>Code repository</td>
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Grading Scale

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Policies and guidelines

- Students are expected to attend the lectures and labs.

- Students should complete the labs individually and collaborate in pairs on the projects. Plagiarism is strictly forbidden and any such case if identified will be reported according to the university guidelines (see http://www.governingcouncil.utoronto.ca/Assets/Governing+Council+Digital+Assets/Policies/PDF/ppjun011995.pdf).

- Every student is expected to present. PDF slides should be emailed to the instructor at least two days prior to the presentation.

- Every non-presenting student is expected to raise one non-clarification question related to the paper presented.

- Critical summary (including one summary paragraph and one non-clarification question) of each paper should be submitted online at least one day prior to the class in which the paper will be presented.

- Programming tasks from the lab and project assignments should be completed in Python or Python Jupyter Notebooks.

- Late deliverables, labs, or written assignments will be discredited at 1 point per delayed hour based on the time stamps of submission. Exceptional circumstances should be explained in writing to the course instructor, at least three days prior to the due date.
Lab + Lecture Schedules and Readings (due/required items are highlighted)

• Jan 8 (Wed) Cognition and Computation

  Course overview

  Background readings for this and the following weeks:


  Assignment: Email the TA *prior to the class next week* 3 preferred paper choices for presentation; choose papers from the following Readings and Presentations sections.

• Jan 15 (Wed) Computational Bootcamp

  Lab time

• Jan 22 (Wed) Connectionism and Neural Networks

  Readings and Presentations (summary due 1 day before):


  Background readings:


  Lab 1 out (due in 2 weeks)

• Jan 29 (Wed) Deep Learning

  Readings and Presentations (summary due 1 day before):


Background readings:

**Project announcement**

**Lab time**

- **Feb 5 (Wed) Bayesian Inference**

  **Readings and Presentations (summary due 1 day before):**


Background readings:

  **Lab 1 due; Lab 2 out** (due in 2 weeks)

**Lab time**

- **Feb 12 (Wed) Latent Semantic Models**

  **Readings and Presentations (summary due 1 day before):**


Background readings:

**Project proposal due**

**Lab time**

**Feb 26 (Wed) Interim Session**

Research lecture

**Project round-table discussion**

**Mar 4 (Wed) Optimal Cue Integration**

**Readings and Presentations (summary due 1 day before):**


Background readings:


**Project time**

**Mar 11 (Wed) Efficient Communication**

**Readings and Presentations (summary due 1 day before):**


Background readings:


**Project time**

**Mar 18 (Wed) Language Evolution**

**Readings and Presentations (summary due 1 day before):**


Background readings:

Project time

- **Mar 25 (Wed)** Project clinics
  - Project Q&A
  - Project time

- **Apr 1 (Wed)** Project Presentations
  - Project report due Monday the following week (10am) after presentation
Paper–Project Presentation Guidelines

- Paper presentation should take about 30-40 minutes, allowing time for question from each student. Project presentation duration will be announced in due time.
- Joint presentation should distribute the labour evenly between the presenters.
- Presenters in a joint presentation will be assessed individually and not as a group.
- Presentation structure should be roughly as follows:
  
  Motivation - Background - Methods and Materials - Results - Limitations and Extensions - Conclusion.
  
- Background should provide sufficient context by a brief discussion of 2-3 prior work relevant to the paper, e.g., drawn from Background readings or elsewhere.
- Presenters should emphasize clarity and encourage class participation.
- Whiteboard may be used to facilitate the presentation.
- Slides should be submitted as a single PDF to the instructor, with name(s) on the front page.

Project Report Guidelines

- Report should be 5-6 pages long with 1 additional page of references.
- Report should follow the LaTex template here: https://github.com/rlevy/cogsci-template.
- Report should be structured as follows:
  
  Abstract - Introduction - Methods - Data - Results - Discussion.
  
- Methods should provide GitHub (github.com) or OSF (osf.io) link to code/data.
- Report not conforming to the above standards will not receive any credit.
- Reporting style should support replication of the analyses and results described.
- Report and appendix should be submitted as a single PDF, with name(s) on page 1.
Example Project Topics and Data Sources

• 1. Modelling visual categories and concepts:
   ImageNet: http://www.image-net.org/

• 2. Modelling children’s language:
   CHILDES: https://chiltes.talkbank.org/

• 3. Modelling metaphorical mappings:
   IDS: https://mappingmetaphor.arts.gla.ac.uk/

• 4. Modelling moral sentiments:
   Twitter: https://dornsife.usc.edu/labs/cssl/software/

• 5. Modelling pop culture:
   Million Song: http://millionsongdataset.com/musixmatch/