PSYC513A:
Special Topics in Developmental Psychology

Fall 2018
Tue 10:00a-1:00p

KENNY 2563

Computational Modelling in Cognitive Development

Instructor:
Darko Odic
darko.odic@psych.ubc.ca
Office Hours by Appt.

Website:
This course will run a Canvas (canvas.ubc.ca) website that will include all your readings, slides, etc.

If you are auditing the course and do not have access to Canvas, you can find all the materials at:

http://odic.psych.ubc.ca/teaching/PSYC513.html

The goal of this seminar is to provide a *novice-level* introduction to computational modelling in psychology, with a particular emphasis on cognitive development.

By the end of this seminar, you should expect to understand the basic principles of mathematical and computational modelling (e.g., parameter estimation, algorithms vs. implementation, etc.), as well as the principles guiding several popular and prominent families of computational models, including Connectionist, Bayesian, Dynamical, and Drift Diffusion models.

THIS SEMINAR WILL NOT TEACH YOU HOW TO MODEL. Instead, our focus will be on teaching you the basics of understanding how models work and how to appreciate and evaluate them theoretically. As such, this course should act as an ideal stepping stone in teaching you about how to implement various computational models in your own research, but you should not expect to be able to do so without additional work by the end of this seminar.

Course and Class Structure

You can broadly think about this seminar as made up of two phases. In the first phase – roughly the first three weeks – I will be providing you with a more lecture-style experience during which we are going to review the most important principles to doing computational modelling. I will assume little to no background in modelling (beyond what you already know from your graduate-level statistics courses), and the focus will be on teaching you skills and answering clarification questions.

After this is done, we'll begin the second phase, which will be much more similar to traditional graduate courses: each week you will have a set of readings that will be about a particular family of computational models. You will be asked to read and come prepared for a discussion about the readings.

For each family of models, we are going to broadly focus on the following questions, which will shape our debates each week:

1. From a computational and algorithmic perspectives, how does this family of models actually *work*?
2. What types of *phenomena* can these models account for well? What types of phenomena do these models struggle with?
3. What are *some key shortcomings* or often hidden things about these models?
4. What *implications* – if any – do these models have for broader theories of cognitive development, such as nativism vs. empiricism?
5. How should you approach *consuming research* that includes these types of models?

Are you worried about your math skills?

Because we are not focused on teaching you how to independently model, this seminar will not require you to do any high-level math on your own. Though you will read about and have to reflect on many equations and exercise your ability to think formally, you won't be alone in this and we will always provide whatever scaffolds you need to help you get there.

That being said, if you are at any point worried about keeping up with the course content because there is more math than you expected, or because some of your math skills are rusty (e.g., matrix algebra), I have provided a set of *Optional Readings* that act as a tutorial for the math skills that you may want to brush up on before reading the course content. These readings are entirely up to you and we will not be referring to them in the seminar itself.

Readings

All of the readings for this course will be provided to you over Canvas and online at http://odic.psych.ubc.ca/teaching/PSYC513.html

In addition, if you are worried about your math skills or are a little bit rusty, there is a set of *Optional Readings* from the below book that are a fantastic introduction to all the math skills that you might need for this seminar (and beyond). You can download the PDF chapters for free through the UBC library:

> Moore, W. H., & Siegel, D. A. (2013). *A Mathematics Course for Political and Social Research* (1 edition). Princeton, NJ: Princeton University Press.
>
> https://ebookcentral.proquest.com/lib/ubc/detail.action?docID=1205618#goto_toc

Are you auditing the course?

A lot of people have asked if they can audit this course, and – in general – I am really happy to accommodate everybody whether they want to take this course for grade (because they have to) or not.

With that being said, I want to set a few key rules for those of you auditing:

- You are free to drop in for some or all of the classes, and you do not need to alert me in advance.
- The students enrolled in the course will get priority for asking questions and leading debates, as part of their grade will be dependent on this.
- If we begin to fall behind, I will prioritize the pace for the enrolled students, even if they are in the minority.
- If you are interested, I would be on board for you doing one of the presentations on the last day of class, as I think it will really solidify your understanding.

Grading and Assignments

Your final grade in this course will be based on three components – described in detail below:

- **Weekly Critiques/Thought Papers (20%)**
- **Presentation (30%)**
- **Final Paper (50%)**

Weekly Thought Papers (20%)

Each week after the first, you will submit a brief 300-500 word thought paper on either one of the readings we did, or an integrative one on multiple readings assigned for that week.

These thought papers do not need to be overly structured: I am primarily interested in hearing what (if anything) you found interesting, confusing, etc., and what aspects of what you read you have thoughts about (positive or negative). You can think about it as the kinds of questions you might raise during class (and, in fact, I may sometimes use your thought papers to help guide discussion during the class itself).

Things you can include in your thought papers include:

- What aspects of the reading did you find particularly confusing?
- What struck you the most about the models you were reading about?
- If you were a reviewer for this manuscript, what would you say?
- What kinds of links between readings across multiple weeks?

This is all purposefully vague: I want to hear your thoughts on what you are reading in an unfiltered and unstructured way.

The thought papers are due **via email** up to 2 hours before class begins each week (at darko.odic@psych.ubc.ca). Please do not give me hard copies, email only.

Presentation (30%)

The goal of the presentation is to allow you to showcase your understanding of the modelling approaches we discussed in class as applied to a case study that we did not yet explore. You will effectively present and lead a discussion on a publication that uses a particular model we learned about in a novel context we did not discuss.

More formally, you will choose one family of models we discussed in class and find a published manuscript that applies this model to a particular phenomenon of interest (this **cannot** be the same one you choose for your final paper). The paper must have been published in the past 5 years and you must first get it approved by me (email me or schedule a meeting to do so).

When choosing this manuscript, you are **not** restricted to phenomena within cognitive development, and you can choose anything within the realm of psychology, cognitive science, or linguistics, broadly construed.

You will present this paper to the class in a 10-15 minute overview presentation, which should include a full walkthrough of the manuscript, the data they are attempting to account for, and the model architecture. In essence, you will show us your ability to consume, understand, and evaluate the paper and the models therein. Subsequently, you will lead to a 5-10 minute discussion on the paper, including any questions from the audience.

Final Paper (50%)

The goal of the final paper is to allow you to integrate the content you have learned in this course with your own research. You will be asked to submit a 8-10 page (single-spaced) paper on one of two topics:

1. **Pick a modelling approach that we did not discuss in class.** Perform an analysis of this approach: how does it work, what phenomena does it capture well vs. poorly, and what broader theoretical implications does it have for cognitive development?
2. **Compare and contrast two modelling approaches we did discuss as applied to your own research**. You will have to go in detail on the particular phenomena you are interested in exploring, and explain how the two models would potentially capture and explain the phenomena. You do not need to build the models, but you do need to explain in sufficient level of detail how one might implement them.

The final paper is due December 13th, a week after the last day of class.

Academic Misconduct

What counts as Academic Misconduct?
The University of British Columbia has a very precise definition of which behaviours count as academic misconduct. You are strongly encouraged to read and make sure you understand this policy. If you have any questions, please ask us. You can find the UBC policy on Academic Misconduct here:
www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959

How is Academic Misconduct Caught?
Very easily (we are psychologists, after all). Besides being able to easily catch cheating during exams from simply seeing you, the Department has implemented software that can reliably detect cheating on multiple-choice quizzes, midterms, and exams by analyzing the patterns of students' responses.

How is Academic Misconduct Treated?
In all cases of suspected academic misconduct, the parties involved will be pursued to the fullest extent dictated by the guidelines of the University. Strong evidence of cheating may result in a zero credit for the work in question. According to the University Act (section 61), the President of UBC has the right to impose harsher penalties including (but not limited to) a failing grade for the course, suspension from the University, cancellation of scholarships, or a notation added to a student's transcript.

Academic misconduct, including cheating, plagiarism, and handing work in somebody else's name is simply not worth it. If you are struggling in this course, please come and talk to us – it is our job to help you!

Date	Topic	Readings	Optional Readings
Principles of Mathematical and Computational Modelling			
Sep-06 (Thursday)	Principles of Modelling	Marr '81 L&F 1	S&M 1, 2
Sep-13 (Thursday)	Principles of Modelling	F&L 3, 4	S&M 3, 4
Sep-18 (Tuesday)	Principles of Modelling	F&L 10	S&M 5, 6, 8
Exploring Various Families of Models in Cognitive Development			
Sep-25	Connectionism 1: Basics	F&L 13 Munakata & McClelland '03 McClelland & Rogers, '03	S&M 12, 13, 14
Oct-02	Connectionism 2: Applications and Criticisms	(§) Rummelhart & McClelland '87 (§) Pinker & Prince '88	
Oct-09	Connectionism 3: Deep Neural Nets	Zorzi et al. '13 Stoianov & Zorzi '12 Testolin et al. '17	
Oct-16	Dynamical Systems: Basics, Applications, Criticisms	Schöner '08 (§) Thalen & Smith, '98 Smith & Thalen, '03 Spencer et al., '09	
Oct-23	**NO CLASS**		
Oct-30	Bayesian Models 1: Basics	Griffiths et al. '08 Perfors et al., '11 Tenenbaum et al., '11 Vul et al., '14	S&M 9, 10, 11
Nov-06	Bayesian Models 2: Applications	Goodman & Frank, '12 Kemp et al., '07 Battaglia et al., '13 Yuille & Kersten '06	
Nov-13	Bayesian Models 3: Applications & Criticisms	Marcus & Davis '13 Goodman et al. '13 Costello & Watts, 2014	
Nov-20	Drift Diffusion Models: Basics, Applications	F&L 14 Ratcliff et al '16 Ratcliff et al. '12 Karalunas et al. '13	

Finale: Presentations and Final Paper			
Nov-27	Open Topic	TBD	TBD
Dec-04	Presentations	None	None
Dec-11	**FINAL PAPER DUE**		

Reading Codes:

(𝄞) = These readings are especially long and you may be able to skip sections: check with Darko about which pages to read and whether you can skip any of these readings entirely.

S&M = Moore, W. H., & Siegel, D. A. (2013). *A Mathematics Course for Political and Social Research* (1 edition). Princeton, NJ: Princeton University Press.

F&L = Farrell, S., & Lewandowsky, S. (2018). *Computational Modeling of Cognition and Behavior*. New York, NY: Cambridge University Press

L&F = Lewandowsky, S., & Farrell, S. (2010). Computational Modeling in Cognition: Principles and Practice (1 edition). Thousand Oaks: SAGE Publications, Inc.