Computational Modeling

Fall, 2016
Location: PSY B 248
Time: MW, 2:30-3:50

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Psychology B250
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Course Description

This course will act as both an overview of the how's and why's of computational modeling as well as a brief survey of models used in a variety of areas of human cognition. We will discuss what models are, why we use models, what models can and cannot tell us, how to recognize good versus bad modeling practices, how to implement a model, how to fit a model to data, how to evaluate the fit of a model, and how to compare and contrast competing models. Along the way, we will discuss models representing several different approaches to modeling (e.g., probabilistic, connectionist, etc.) and several different topics within psychology (e.g., learning, categorization, memory). The topics discussed will apply to all kinds of modeling, from very abstract cognitive models to fairly low level neural models.

Much like your graduate statistics course, this course will provide you with actual skills that you can use in future work. You will be able to implement and run models (both new and old), derive model predictions, fit models to data, and compare competing models. This course will also give you the tools and background to take a more critical eye to modeling work you might read in the literature. So even if you never using modeling in your own research, you will have the experience needed to understand and intelligently evaluate others' computational work.

The course will be roughly divided into 2 parts. The first portion will essentially be a lecture/lab course. We will spend time discussing the "how" of modeling, working through demos, and playing around with actual code. The second portion of the course will act as a seminar. We will read empirical papers that apply the techniques from the first part of the class to real-world psychological and neurobiological topics. The papers we choose to read will mainly be determined by the make-up of the class. It is my intention to choose papers that are relevant to the students in the course so that the course will be as useful as possible.

Software

The examples and assignments will be written in MATLAB (maybe a few things in Excel or Python). If you have never utilized these programs before, you will need to learn some basics in order to complete the homework assignments. If you have never used MATLAB before (or never done any programming before), we will take some time early in the semester to go over a variety of resources to help you get going. We will all try to learn the nuances and tricks of these programs from each other - *I always hope to learn some myself*. Some of you may have MATLAB installed on computers in your lab and it is installed on all SINC site machines. In addition, I have MATLAB installed on several machines in my own lab. Arrangements can be made to utilize these machines if need be. Excel should be readily accessible for everyone and Python (if you wish to play with it) installed on several machines in my own lab and also free and available for all computer platforms.

Course Requirements

Participation (25%): This is a graduate course. I expect people to debate, discuss, argue, and ask questions. If you're going to miss class, please let me know beforehand. Please complete the readings before class. Otherwise, you will not be able to effectively participate in the discussion.

Homework Assignments (50%): During the first half of the semester, there will be several homework assignments. The assignments will usually involve playing around with something in MATLAB (or Excel or Python). I will typically provide a lot of the skeleton code ahead of time, so the amount of actual programming should be minimal. This is like a statistics course – there's just no substitute for doing. I have no problem whatsoever with people talking about how to do the assignments, just so long as everyone does their own assignment. The assignments are due **before class on Tuesday** of the week listed on the syllabus.

Presentations (25%): During the second half of the course, readings will be assigned to individual students who will be responsible for presenting them during class meetings. I expect you to put Powerpoint slides together and present the readings in a way that stimulates discussion. If the paper is difficult and/or you are confused about, you should consider your job to lead/structure/organize the group discussion about the paper rather than expertly communicating the contents of the paper.

Readings

There is no textbook for this course. Instead, we will use a variety of readings from other sources. These readings will be posted to Blackboard.

Schedule

Week	Date	Topic	Papers	HW
1	8/29	Introduction to Cognitive Modeling	Busemeyer (2009) Chap. 1 Muchinsky (2003)	
2	9/5	Implementing, Running, and Testing Models	Watzl (2007) Collyer (1992) Supplemental (not required): Busemeyer (2009) Chap. 2	#1
3	9/12	Fitting Models to Data	Luce (1995) Busemeyer (2009) Chap. 3	#2
4	9/19	More Fitting	Pitt & Myung (2002) Roberts & Pashler (2000) Busemeyer (2009) Chap. 5	
5	9/26	Testing and Comparing Fits		#3
6	10/3	Finishing up Fitting	Wagenmakers, van der Maas, & Grasman (2007) Van Zandt (2000) Busemeyer (2009) Chap. 4	
7	10/10	Breaking Models: Neuropsychology & other Drastic Manipulations	Frank, Moustafa, Haughey, Curran, & Hutchison (2007) Frank, Samanta, Moustafa, Sherman (2007) Yechiam, Busemeyer, Stout, & Bechara (2004)	
8	10/17	Traditional (Associative) Learning Models	Rescorla & Wagner (1972) Pearce & Hall (1980)	
9	10/24	Reinforcement Learning Models	Schultz, Dayan, & Montague (1997) Supplemental (not required): Sutton & Barto (1998)	
10	10/31	Bayesian Models	TBA	
11	11/7	Connectionist Models	Beer(2000) McCloskey (2001)	

Student Presentations

Week	Date	Topic	Paper	Presenter
12	11/14			
13	11/21		**No Class – Thanksgiving**	
14	11/28			
15	12/5			