Computational Cognitive Modeling
PSYC 768 (section 3)
Syllabus

Time: Thursdays, 4:30-7:10pm **Last day to add:** 29 Jan 2017
Classroom: King Hall, room 2073A **Last day to drop:** 24 Feb 2017
Instructor: William G. Kennedy, PhD
Research Assistant Professor, Krasnow Institute for Advanced Study
Office Phone: 703-993-9291 e-mail: wkennedy@gmu.edu
Office hours: Thursdays, 3-4pm, Research Hall, room 380.

Course Description: This course will introduce the concept and practice of modeling cognitive behavior. We will review the basic concepts of cognitive architectures, cognitive models, their use in Cognitive Science, and associated issues. Students will learn how to build computational cognitive models using ACT-R and will exercise the perception, memory, reasoning, and learning theories in the "off-the-shelf" version of ACT-R. The class will include some programming to run ACT-R models, but it will be minimized. Class will include lectures, demonstrations, reading assignments, hands-on modeling exercises, and a project in computational cognitive modeling.

Prerequisites: General knowledge of human cognitive psychology is necessary. While no knowledge of a specific computer programming language is required, familiarity with programming concepts will be beneficial and familiarity with the academic use of personal computers for writing short pieces and e-mail is assumed. Students are not expected to have prior knowledge of a cognitive modeling system or computational cognitive modeling.

Objectives:
1. Students can discuss cognitive architectures, cognitive modeling systems, particularly ACT-R, and the goals of Cognitive Science and Artificial Intelligence.
2. Students are able to build models of cognitive behavior in ACT-R.
3. Students understand issues associated with the cognitive plausibility of models.

University Policies: The University Catalog, http://catalog.gmu.edu, is the primary resource for university policies affecting student and faculty conduct in university affairs.

Attendance Policy: Attendance is not graded, but as a seminar, most of the readings will be discussed in class each week and project will be presented to the class. Attendance is expected.

Office of Disability Services: If you are a student with disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 709-993-2474. All academic accommodations must be arranged through that office.

Class communications: Mason uses electronic mail to provide official information to students. Examples include communications from course instructors, notices form the library, notices about academic standing, financial aid information, class materials, assignments, questions, and

instructor feedback. Students are responsible for the content of university communication sent to their mason e-mail account, and are required to activate that account and check it regularly. I intend to respond to all student e-mails within a couple of hours of receipt and always within 24 hrs. I have official office hours during which I will be available for drop-in discussions. Other meetings outside class are certainly possible but should be scheduled in advanced. I will also maintain a website with class materials throughout the course. Its address will be provided in the first class.

Academic Integrity: Mason is an Honor Code university; please see the University Catalog for a full description of the process. The principle of academic integrity is taken very seriously and violations are treated gravely. Academic integrity means when you are responsible for a task you perform that task. When you rely on someone else's work, text, or code, even if in the public domain, in any aspect of the performance of that task, you must cite the source in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind), please ask for guidance and clarification. As instructor for this course, I reserve the right to enter a failing grade to any student found guilty of an honor code violation.

Late submission of class work: Homework is due at the beginning of next class. Lateness reduces the possible graded points at a rate of approximately 20% per day.

Evaluation:
Reviews of readings: 30%
Students are expected to write a short review (300-600 words) of selected readings identifying the contribution, strengths, and weaknesses of the reading. I have identified the six readings by * in class schedule). Each will be worth 5 pts.

Cognitive Modeling exercises: 42%
We will work through seven exercises of the ACT-R tutorial. Students are encouraged to consult each other on the tutorial exercises, but each student is expected to submit their own ACT-R model, evidence of successful completion, and comments on the unit (100-200 words) at the beginning of the next class. Tutorials 2-7 will be worth 7 points each.

Cognitive Modeling project: 28%
The cognitive modeling project is intended to have students apply their knowledge of cognitive modeling in ACT-R by developing a cognitive model for a behavior of their choosing. Projects will be done individually or in teams and presented to the class near the end of the classes. Students will propose a cognitive modeling project (7 pts) and the instructor will provide feedback on scope and projected level of difficulty. Presented projects will be graded model operation (10 pts), matching of data (6 pts), and cognitive plausibility, (5 pts).

Grading scale: (points = percentage)

90-100 = A	84-86 = B+	77-79 = B-	<69 = F
87-89 = A-	80-83 = B	70-76 = C	

Required Text: none.
Recommended Text: John R. Anderson, (Anderson 2007) *How Can the Human Mind Occur in the Physical Universe*. Oxford University Press.

Class Plan

Class 1: (1/26) In class (topic for this class): Introduction: models, architectures, cognitive plausibility, AI, Cognitive Science, Computational Social Science
Outside class (due at the start of the next class):
Read: (Anderson, 2007) chap. 1*
Do: install ACT-R software from www.act-r.psy.cmu.edu and run "hello" demo

Class 2: (2/2) In class: Newell's UTC concept, ACT-R, Lisp, knowledge representation
Outside class: Read: (Anderson, 2007) chap. 2*
Do: ACT-R Tutorial Unit 1 (Production Systems)

Class 3: (2/9) In class: Cognition at the symbolic level, perception & action
Outside class: Read: (Anderson, 2007) chap. 4*
Do: ACT-R Tutorial Unit 2 (Perception and Motor Actions in ACT-R)

Class 4: (2/16) In class: Discussion of Tutorial Unit 2, attention & executive control
Outside class: Read: (Altmann & Trafton, 2002)*
Do: ACT-R Tutorial Unit 3 (Attention)

Class 5: (2/23) In class: Discussion of Unit 3 & Sub-symbolic memory representation
Outside class: Read: Anderson, 2007 chap. 3, pages 91 through 110
Do: ACT-R Unit 4 (Activation of Chunks and Base-Level Learning)

Class 6: (3/2) In class: Discussion of Tutorial Unit 4, Spreading of Activation
Outside class: Read: (Anderson, 2007) chap. 3, pages 111 through 134
Do: Complete Unit 4

Class 7: (3/9) In class: Discussion of ACT-R Model Design and Debugging & start ACT-R Tutorial Unit 5 (Activation and Context)
Outside class: Read: (Anderson, 2007) chap. 5, pages 187-208.5.
Do: ACT-R Unit 5 (Activation and Context) (due 3/21)

SPRING BREAK (3/16)

Class 8: (3/23) In class: Discussion of Tutorial Unit 5 & Production Subsymbolic Representation & start ACT-R Tutorial Unit 6 exercise
Outside class: Read: (Anderson, 2007) chap. 5, pages 187-208.5.
Do: ACT-R Tutorial Unit 6 (Selecting Productions on the Basis of Their Utilities and Learning these Utilities)

Class 9: (3/30) In class: Discussion of Tutorial Unit 6, Production Learning, & start ACT-R Tutorial Unit 7
Outside class: Read: (Anderson, 2007) rest of chap. 5 & chap. 6
Do: ACT-R Tutorial Unit 7 (Production Rule Learning)

Class 10: (4/6) In class: Discussion of Tutorial Unit 7, Introduction to Soar
Outside class: Read: (Lehman, Laird, & Rosenbloom, 2006)
Do: submit 1 page project proposal

Class 11: (4/13) In class: Other cognitive modeling systems and multi-agent systems
Outside class: Read: (paper on Soar, Clarion, or Icarus)*
Do: cognitive modeling project

Class 12:(4/20) In class: Applications of cognitive modeling
Outside class: Read: (NRC, 2008), chapter 5, pp 149-184
Do: cognitive modeling project

Class 13:(4/27) In class: Issues in cognitive plausibility and cognitive modeling
Outside class: Read: (Fum et. al., 2007)*
Do: cognitive modeling project

Class 14:(5/4) In class: Cognitive modeling project presentations
Outside class: Read: (Epstein, 2008)
Do: cognitive modeling project

Class 15: (5/11) In class: Cognitive modeling project presentations
Outside class: nil

Exam: (5/18?) In class: Cognitive modeling project presentations
Outside class: nil

References:

Altmann, E. M., & Trafton, J. G. (2002). Memory for Goals: An activation-based model. *Cognitive Science, 26*(1), 39-83.

Anderson, J. R. (2007). *How Can the Human Mind Occur in the Physical Universe?* Oxford: Oxford University Press.

Epstein, J.M. (2008) Why Model? *Journal of Artificial Societies and Social Simulation* **11**(4 12).

Fum, D., Del Missier, F., Stocco, A. (2007) Modeling of human behavior: Why a model is (sometimes) better than 10,000 words. *Cognitive Systems Research,* **8**, 135-142.

Lehman, J. F., Laird, J., & Rosenbloom, P. S. (2006). A Gentle Introduction to Soar, An Architecture for Human Cognition: 2006 Update. Soar Group Website.

National Research Council (2008) *Behavioral Modeling and Simulation: From Individuals to Societies.* Greg L. Zacharias, Jean MacMillan, & Susan Van Hemel (eds.) National Academies Press (available online at: http://books.nap.edu/catalog.php?record_id=12169)