

The University of Texas, El Paso
Department of Computer Science
CS 5390/4390: Special Topics in Computer Science
Applied Computational Modeling
Spring 2023

Name of course: Applied Computational Modeling CRN: 25466/24457 Time and Location: <ul style="list-style-type: none">• TR: 3:00 PM-4:20 PM• Location: BUSN 301	Instructor: Palvi Aggarwal Email: pagggarwal@utep.edu Phone: (915) 747-6399 Office: CCSB 3.1014 Office Hours: 1:30 PM – 2:50 PM Office Hours Location: CCSB 3.1014
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Requirements: This course will require students to learn the concepts of cognitive modeling and apply to an application of their choice. The assignments and project in this course would require students to develop cognitive model using Python/MATLAB. The models would be analyzed against human data. The model evaluation will be done using measures such as mean square deviation of model predictions and human responses in the task.

Course Website: Blackboard for all course material, assignments, and announcements

Course Description: The objective of this course is to understand the human mind and decision-making processes in terms of underlying cognitive processes. Students will learn about the leading computational framework Adaptive Control of Thought—Rational (ACT-R) [1] and Instance Based Learning Theory [2]. Scientists are working with increasingly large quantities of human behavioral data. To better understand and explain the behavioral data, development of computational cognitive modeling has shown promising impact. Cognitive models have been used to model complex cognition across a range of decision-making tasks, including repeated binary-choice decisions [3], multi-choice decisions [4], decision making in teams, dynamic environments such as social dilemmas [5], complex situations of cybersecurity including intrusion detection systems, phishing, and honeypots [6, 7] and cognitive tutors [8, 9]. This course provides students an introduction to the basic methods used to develop and test computational models of cognition. It will answer questions including:

- How to develop cognitive models? How cognitive models are different from other machine learning models?
- To what extent the computational cognitive models could replicate and predict human behavior?
- What does cognitive model explain about human behavior?

COURSE OBJECTIVES

By the end of this course, students will be able to:

- Provide exposure to students in various applications of cognitive models
- Learn and apply computational cognitive modeling in various domains
- Learn how humans make decisions and predict their actions using cognitive models
- Be able to collaborate with interdisciplinary teams toward project completion
- Write and present research papers and scientific finding

References

1. Anderson, J. R., & Schunn, C. (2000). Implications of the ACT-R learning theory: No magic bullets. *Advances in instructional psychology, Educational design and cognitive science*, 1-33.
2. Gonzalez, C., Lerch, J. F., & Lebiere, C. (2003). Instance-based learning in dynamic decision making. *Cognitive Science*, 27(4), 591-635.
3. Lejarraga, T., Dutt, V., & Gonzalez, C. (2012). Instance-based learning: A general model of repeated binary choice. *Journal of Behavioral Decision Making*, 25(2), 143-153.
4. Cranford, E. A., Gonzalez, C., Aggarwal, P., Tambe, M., Cooney, S., & Lebiere, C. (2021). Towards a Cognitive Theory of Cyber Deception. *Cognitive Science*, 45(7), e13013.
5. Gonzalez, C., & Ben-Asher, N. (2014). Learning to cooperate in the Prisoner's Dilemma: Robustness of Predictions of an Instance-Based Learning Model. In *Proceedings of the Annual Meeting of the Cognitive Science Society* (Vol. 36, No. 36).
6. Cranford, E. A., Lebiere, C., Rajivan, P., Aggarwal, P., & Gonzalez, C. (2019). Modeling cognitive dynamics in (End)-user response to phishing emails. *Proceedings of the 17th ICCM*.
7. Aggarwal, P., Moisan, F., Gonzalez, C., & Dutt, V. (2020). Learning About the Effects of Alert Uncertainty in Attack and Defend Decisions via Cognitive Modeling. *Human Factors*, 0018720820945425.
8. Anderson, J. R., Corbett, A. T., Koedinger, K. R., & Pelletier, R. (1995). Cognitive tutors: Lessons learned. *The journal of the learning sciences*, 4(2), 167-207.
9. Nguyen, T. N., & Gonzalez, C. (2021). Theory of Mind From Observation in Cognitive Models and Humans. *Topics in Cognitive Science*.

Course Topics and Schedule (tentative):

Week	Date	Topic	Assignment (due)	Points
Week 1	01/17/2023	Introduction: Welcome, course polices, overview		
	01/19/2023	Python Programming		
Week 2	01/24/2023	Introduction to Cognitive Modeling	HW1: 02/01/2023	100
	01/26/2023	Cognitive models, model evaluation and parameter estimation	P1:02/10/2023	50
Week 3	01/31/2023	Cognitive Architectures		
	02/2/2023	Instance Based Learning Model		
Week 4	02/7/2023	Instance Based Learning Model	HW2: 02/15/2023	100
	02/9/2023	Introduction to Python IBL (PyIBL)		
Week 5	02/14/2023	PyIBL: Class demonstration for Binary choice Task		
	02/16/2023	Binary Choice Task Models	HW3:02/27/2023	100
Week 6	02/21/2023	Treasure Hunt Game		
	02/23/2023	Project Idea and Plan Presentation	P2	50
Week 7	02/28/2023	Class Test	T1	100
	03/02/2023	Modeling attacker's decisions in Deception Game	HW4: 03/09/2023	100
Week 8	03/07/2023	Modeling two player interaction: Prisoner's Dilemma Model		
	03/09/2023	Models of Attacker's and Defender's interaction		
Week 9	Spring Break			
Week 10	03/21/2023	Project Presentation (progress)	P3	100
	03/23/2023	Modeling attackers' decisions in Insider Attack Game	HW5: 03/29/2023	100
Week 11	03/28/2023	Guest Lecture: Insider Attack Game		
	03/30/2023	Modeling the exploration behavior in humans		
Week 12	04/04/2023	Class Test	T2	100
	04/06/2023	Modeling human decisions in Complex Cybersecurity Tasks		
Week 13	04/11/2023	Model Tracing and Knowledge Tracing	HW6: 04/19/2022	100
	04/13/2023	Guest Lecture: Cognitive Salience of Features		

Week 14	04/18/2023	Personalized Models of Human Behavior	P4: Project submission	100
	04/20/2023	Guest Lecture: Phishing Models		
Week 15	04/25/2023	Project Presentations	P5	200
	04/27/2023			
Week 16	05/02/2023			
	05/04/2023			

*HW-Homework assignments, T1&T2 – class tests and P1-P5-Project related activities

Course Assignments and Grading

Assignments for this course are assessed according to rubrics. You can find these rubrics by clicking on the appropriate assignment link in Blackboard and choosing to “View Rubric” from the button beneath the Points Possible for the assignment.

Grade Distribution (tentative):

Graduate Students:

100%-90% = A

89.9%-80% = B

79.9%-70% = C

69.9%-60% = D

59.9% and Below = F

Undergraduate Students:

100%-85% = A

84.9%-75% = B

74.9%-65% = C

65.9%-55% = D

55.9% and Below = F

- Project: 500 points (40%)
- Class Test: 200 points (20%)
- Assignments: 600 points (40%)

Project: There will be one group projects for the graduate and undergraduate students. The instructor will form teams and provide a list of potential projects that teams can choose from. A team can create their own project too, with approval from the instructor. The target of the project is to deliver a publishable report along with the description of the methodology and full experimental results.

Assignments: Regular assignments will be given which will require significant effort outside of class. The assignments are designed to challenge you by requiring that you apply learned concepts to new situations. You should start working on your assignment immediately after receiving it.

Class Test: There will be two class tests. The purpose of each test is to ensure that you are staying current with the class content and to verify that you have acquired the skills introduced in the class. There will be **no make-up** on missed tests.

Late Policy: All the assignments and projects are due at **midnight (11:59 PM)** of the provided date, unless otherwise stated. There will be a penalty of 10% points for each day after the deadline. No assignment will be accepted after 5th day of the deadline.

Class Participation: This is a discussion-based course and your attendance in class is mandatory. Attendance in the course is determined by participation in the learning activities of the course. Your

participation in the course is important not only for your learning and success but also to create a community of learners. Participation is determined by completion of the following activities:

- Reading/Viewing all course materials to ensure understanding of assignment requirements
- Participating in engaging discussion with your peers on the discussion
- Participating in scheduled Blackboard Collaborate sessions
- Other activities as indicated in the weekly modules

Because these activities are designed to contribute to your learning each week, they cannot be made up after their due date has passed.

Technology Requirements

Course content is delivered via the Internet through the Blackboard learning management system. Ensure your UTEP e-mail account is working and that you have access to the Web and a stable web browser. Google Chrome and Mozilla Firefox are the best browsers for Blackboard; other browsers may cause complications. When having technical difficulties, update your browser, clear your cache, or try switching to another browser.

You will need to have access to a computer/laptop. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player and Slack. Check that your computer hardware and software are up-to-date and able to access all parts of the course.

If you do not have a word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about [Microsoft Office 365](#) and follow the instructions.

IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the CS Tech as they are trained specifically in assisting with technological needs of students. Please do not contact me for this type of assistance. The Tech team is much better equipped than I am to assist you!

Alternative means of submitting work in case of technical issues

I strongly suggest that you submit your work with plenty of time to spare if you have a technical issue with the course website, network, and/or your computer. I also suggest you save all your work (answers to discussion points, quizzes, exams, and essays) in a separate Word document as a back-up. This way, you will have evidence that you completed the work and will not lose credit. If you are experiencing difficulties submitting your work through the course website, please contact the CS Tech team or UTEP Helpdesk. You can email me your back-up document as a last resort.

Netiquette

As we know, sometimes communication online can be challenging. It's possible to miscommunicate what we mean or to misunderstand what our classmates mean given the lack of body language and immediate feedback. Therefore, please keep these netiquette (network etiquette) guidelines in mind. Failure to observe them may result in disciplinary action.

- Always consider audience. This is a college-level course; therefore, all communication should reflect polite consideration of other's ideas.
- Respect and courtesy must be provided to classmates and to the instructor at all times. No harassment or inappropriate postings will be tolerated.

- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a face-to-face situation.
- Blackboard is not a public internet venue; all postings to it should be considered private and confidential. Whatever is posted on in these online spaces is intended for classmates and professor only. Please do not copy documents and paste them to a publicly accessible website, blog, or other space.

Course Policies

EXCUSED ABSENCES AND/OR COURSE DROP POLICY

According to UTEP Curriculum and Classroom Policies, "When, in the judgment of the instructor, a student has been absent to such a degree as to impair his or her status relative to credit for the course, the instructor may drop the student from the class with a grade of "W" before the course drop deadline and with a grade of "F" after the course drop deadline." See academic regulations in the UTEP Undergraduate Catalog for a list of excuse absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will drop you from the course. I will provide 24 hours advance notice via email.

INCOMPLETE GRADE POLICY

Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

ACCOMMODATIONS POLICY

The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the [UTEP Center for Accommodations and Support Services](#) (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the [CASS portal](#).

SCHOLASTIC INTEGRITY

Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, **cheating, plagiarism, and collusion**. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the [Office of Student Conduct and Conflict Resolution \(OSCCR\)](#) for possible disciplinary action. To learn more, please visit [HOOP: Student Conduct and Discipline](#).

COPYRIGHT STATEMENT FOR COURSE MATERIALS

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

COVID-19 PRECAUTIONS

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible, so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID 19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org