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CS 6795: Cognitive Science
Fall 2023
Keith McGreggor
Course Description and Syllabus

Description: CS 6795 is a 3-credit graduate introductory course on cognitive science. Cognitive science is an interdisciplinary study of mind and intelligence. The core question is *how does mind work? That is, how does mind produce intelligent behavior?*

Cognitive science lies at the intersection of computer science (especially artificial intelligence), psychology, biology (especially neurobiology), education, linguistics, anthropology, and philosophy, as indicated by this logo of the Cognitive Science Society (https://cognitivesciencesociety.org/):

From the Georgia Tech course catalog: "Multidisciplinary perspectives on cognitive science. Interdisciplinary approaches to issues in cognition, including memory, language, problem solving, learning, perception, and action."

Like the in-person version (CS 6795), this course is heavily project-based including both guided and self-directed projects. It will consist of series of twenty-nine video lessons; thirty-two reading assignments; twelve quizzes; six small individual exercises; and one self-directed term project. Unlike the on-campus class, this (OMSCS 6795) class is fully online and asynchronous, with the video lessons and the online discussion forum replacing the in-person classes. However, the professor will hold optional fireside chats at specific times throughout the semester.

Prerequisites: An open and inquisitive mind! An aptitude for reading! An aptitude for self-directed, project-based and collaborative learning. Also, some background in basic computer science and programming such as data structures and algorithms. Note again that this course requires substantial reading and writing, as well as considerable investment of time.

Learning Goals: The main learning goal of the course is an introduction to the basic concepts, hypotheses, models, methods, issues and debates in cognitive science. Specific objectives include: (1) Introduction to the main information-processing paradigms in cognitive science as well as the main critiques of the paradigms, (2) Introduction to the central questions, topics, themes and perspectives that drive the study of cognitive science, including their historical development as well as the state of the art, (3) Understanding the variety of methodologies used to explore cognitive science, including the capabilities and limitations of different research methods, and (4) Learning about the relationship between cognitive science and computing, including human-centered computing, design, and educational technology.

Learning Outcomes: By the end of the course, the typical student should know enough about cognitive science to: (1) Understand and participate in scholarly conversations on cognitive science, (2) read and understand the cognitive science literature, (3) take advanced courses in cognitive science, (4) take the cognitive science specialization in the Georgia Tech Ph.D. qualifying examination in human-centered computing, (5) analyze and address problems in human-centered computing from a cognitive science perspective, and (6) conduct research into cognitive science.

Learning Strategies: We will use a wide range of learning strategies to accomplish the above learning goals and outcomes, including learning by example, learning by doing, authentic learning, project-based learning, personalized learning, collaborative learning, peer-to-peer learning, learning by teaching, learning by reflection, and immersion in a community of interest. Much of the learning in this class will be self-directed.

Learning Assessments: We will use a wide variety of learning assessments to evaluate the learning outcomes in this class, including quizzes, small group exercises, two guided projects, and one self-directed project. The various projects will involving writing of project reports.

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Office Hours:
There will not be any formal office hours held during the semester, but students may request meetings with the teaching assistants as needed. Otherwise, please direct all questions to the course discussion forum.

Textbooks: The primary textbook is:

MIND, An Introduction to Cognitive Science, Paul Thagard, MIT Press, 2nd edition, 2005.

This is an easy to read book that offers a light but very useful introduction. It will provide a shared basis for our more advanced readings on selected topics. This book is provided in the "Readings and Additional Resources" section on Canvas.

Here are a few other general resources for cognitive science:

http://plato.stanford.edu/entries/cognitive-science/

http://en.wikibooks.org/wiki/Cognitive_Psychology_and_Cognitive_Neuroscience

Cognitive Science, Jay Freidenberg and Gordon Silverman, SAGE, 2016.
An earlier edition of this book is available online
http://www2.fiit.stuba.sk/~kvasnicka/CognitiveScience/Friedenberg_Cognitive%20science.pdf

The MIT Encyclopedia of the Cognitive Sciences
Robert Wilson and Frank Keil (editors)
MIT Press, 1999
http://www.aiai.ed.ac.uk/project/oplan/documents/1999/1999-MITECS.pdf

Readings: The accompanying class schedule specifies a series of reading assignments. We will provide digital copies of all readings. We expect that each student will have read at least the primary readings in the week they are assigned.

Reading a research paper is not easy and can take several hours. To make the process easier and more efficient, you want to read a paper in multiple passes. In the first pass, read only the title, abstract, the introduction, and the conclusions. This should be easy and fast and will give you a gist of the paper. In the second pass, also read the section and subsection headings, the illustrations (figures, tables, and their captions), the discussion section, and browse through the list of references. This should give you a better understanding of the paper. In a third pass, if needed and/or if you want to, you can read the full paper. Here are some more tips on how to read a research paper:

https://web.stanford.edu/class/ee384m/Handouts/HowtoReadPaper.pdf

https://www.elsevier.com/connect/infographic-how-to-read-a-scientific-paper

Writing: Each student in the class will engage in six individual exercises and a semester-long self-directed project. The project will entail the writing of a paper: the length of the paper will vary depending on the project. Here are two tutorials on how to write a term paper:
http://www.wikihow.com/Write-a-Term-Paper

http://www.collegeonline.org/library/online-assignments/termpaper-writing.html

We encourage all students to think of the semester-long self-directed team project as potentially leading to a paper worthy of publication. Here is the IEEE template for writing papers:
https://www.ieee.org/conferences/publishing/templates.html

Generative AI: Use of ChatGPT and other LLMs: If you wish, you are permitted to use ChatGPT and other LLMs to support your writing for any assignment. However, if you do so, you must do both of the following:

1. You must properly cite each and every section within which the tool was used, even if you have rephrased the generated information. See the IEEE guidelines for proper citation methods.
2. In each submission that used such a tool, you must include an appendix of no less than 500 words within which you reflect on the effect of using that tool in your own writing (style, voice, emphasis, etc.).

Canvas site: The Head TA will maintain a Canvas site for the class that will provide information about the course, assessments, and grades. The Head TA will also maintain the discussion forum.

Class Participation: This class requires strong participation in the class through the online discussion forum, completion of class surveys, and peer feedback for the term project milestone assignments.

Quizzes: We will have a quiz almost every week for a total of twelve quizzes. Each quiz will consist of multiple-choice questions. The quizzes will be directly from the primary readings and are intended to make sure that all students are doing the readings. Two attempts are permitted per quiz, and the highest score will be recorded.

Individual Exercises: We will have six individual exercises. Each of the six exercises will also pertain to the readings in the class. Each exercise will result in a short (2-3 page) report on the exercise. The lowest exercise grade will be dropped, so your total score will be comprised of the 5 highest exercise scores.

Term Project: The semester-long term project will unfold over 12 weeks. Students may choose to investigate a topic of their choice. We expect each student to spend at least 100 person hours on the project. Hours will be tracked via a task list that is included with your initial project milestone. The project itself

includes a detailed analysis of a problem from the perspective of cognitive science and survey of the related literature. The TAs will work with the students in helping them with their term projects. To keep track of students' progress, we will have 4 milestones, and we will provide details as part of the project release. We expect some of the term project reports to be of a quality that can be submitted to professional workshops for potential publication.

Peer Feedback: Peer Feedback will not factor into your assignment's final grade, but it provides an opportunity to practice providing peer reviews. Please note that for all peer reviews, the feedback must be useful. Simply filling out the form and writing a couple words isn't sufficient to receive credit. Here are some examples of what we'd expect for peer reviews.

Examinations: There are no examinations in this class.

Assignment Due Dates: All assignments are due at 11:59pm Anywhere on Earth time, unless otherwise noted. We will not accept assignments submitted late due to time zone issues. You should update your Canvas to reflect your time zone. **There are no exceptions**; sorry.

Late and Make-up Work Policy: There will be no make-up work provided for missed assignments. Of course, emergencies (illness, family emergencies) will happen. In those instances, please contact the Dean of Students office. The Dean of Students is equipped to verify emergencies and pass confirmation on to all your classes. For consistency, we ask all students to do this in the event of an emergency.

Communication Policy:

You are responsible for knowing the following information:

1. Anything posted to this syllabus

2. Anything emailed directly to you by the teaching team (including announcements via Canvas and Ed Discussions), 24 hours after receiving such an email or post.

Because Canvas and Ed Discussions announcements are emailed to you as well, you need only to check your Georgia Tech email once every 24 hours to remain up to date on new information during the semester. Georgia Tech generally recommends students to check their Georgia Tech email once every 24 hours. So, if an announcement or message is time sensitive, you will

not be responsible for the contents of the announcement until 24 hours after it has been sent.

Grades: Here is a distribution of weights for different activities for calculating the final grade.
Class surveys: 2%
Peer feedback: 5%
Participation in the discussion forum: 8%
Quizzes (Q1-Q12): 15%
Individual Exercises (IE1-IE6): 30%
Self-directed term project (M1-M4): 40%

We will assign extra credit to exemplary exercises and projects and post them on Canvas. Thus, it is possible to get a score higher than 100% in this class.

The final grades may be normalized (or curved).

Proctoring Information: In order to verify the identity of all GT online students, all online students are required to complete the onboarding quiz that uses Honorlock. Honorlock is utilized for student identity verification and to ensure academic integrity. Honorlock provides student identity verification via facial and ID photos. You may also be asked to scan the room around you. The onboarding quiz will be a practice quiz that will not affect your grade in the course. You can take the onboarding quiz as many times as you want. All potential violations are reviewed by a human. The Honorlock support team is available 24/7. While Honorlock will not require you to create an account, download software, or schedule an appointment in advance, you will need Google Chrome and download the Honorlock Chrome Extension. Information on how to access Honorlock and additional resources are provided below. You can also access Honorlock support at https://honorlock.com/support/.

Honor Code: Learning is a social process. This is why encourage class participation. Thus, on one hand, we strongly encourage collaboration in this class. On the other, we will abide by the Georgia Tech's honor code of academic conduct. This means that any work submitted by a student must be his or her own. With the advent of the internet, it has become easy to take materials from various resources available on the web. But please remember that it has also become easy to check for it: the TA can and will enter an arbitrary sentence from a paper into a search engine and find out if the sentence has been taken from elsewhere. Students are encouraged to consult

resources available on the web and elsewhere. However, any material taken from any resource must be properly attributed. The paper must reflect the student's own design and analysis, work and writing.

Georgia Tech Counseling: The COVID-19 global pandemic has caused many problems related to health, including mental health. Georgia Tech offers counseling services to all students, staff and faculty (https://counseling.gatech.edu/content/services). It also offers emergency counseling services (https://counseling.gatech.edu/content/students-crisis). It is for all of us to take care of one another as well as ourselves.

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Class Schedule

This is a day-by-day schedule for our class. The schedule specifies a series of video lessons and corresponding reading assignments. All readings are listed by the last names of the first author. All readings are available on Canvas in a digital form. We expect that each student will have watched the video lessons and read at least the primary readings on each topic in the assigned week.

The schedule also specifies the activities and assessments for each week: surveys, quizzes, exercises, and self-directed projects. Note also that all assessments are due on Sunday midnight AOE, which translates to Monday 8 am in Atlanta.

There will be three class surveys in all, including the final CIOS survey administered by Georgia Tech.

The quizzes are multiple-choice and based on the reading assignments. All twelve quizzes will be based on the primary readings.

The individual exercises too will be based on the primary readings. There will be six exercises in total.

In the self-directed term project, students will work on a theme/problem on their choice. The term project will unfold over 12 weeks, with 4 milestones.

Part A of the course: Basics of Cognitive Science

Week of 8/21

Videos	Lesson 1	
	Lesson 2	
	Lesson 3	
Readings	Representation -1	Thagard Ch. 1
	Logic, probability	Thagard Ch. 2
	Rules -1	Thagard Ch. 3
	Concepts -1	Thagard Ch. 4
Activities	Onboarding quiz assigned 8/21, due 8/27	
	Start-of-Course survey assigned 8/21, due 8/27	

Week of 8/28

Videos	Lesson 4	
	Lesson 5	
	Lesson 6	
Readings	Analogies -1	Thagard Ch. 5
	Images -1	Thagard Ch. 6
	Connections -1	Thagard Ch. 7
Activities	Quiz 1 assigned 8/28, due 9/3	

Week of 9/4

Videos	Lesson 7	
	Lesson 8	
Readings	Review of CogSci	Thagard Ch. 8
	Brains	Thagard Ch. 9
	Emotions	Thagard Ch. 10
Activities	Quiz 2 assigned 9/4, due 9/10	
	Individual exercise 1 assigned 9/4, due 9/10	
	Milestone 1 assigned 9/4, due 9/24	

Week of 9/11

Videos	Lesson 9	
	Lesson 10	
Readings	Consciousness	Thagard Ch. 11
	Body	Thagard Ch. 12
	Culture	Thagard Ch. 13
	Review	Thagard Ch. 14
Activities	Quiz 3 assigned 9/11, due 9/17	
	Individual exercise 1 assigned 9/11, due 9/17	

Part B of the course: Computational Cognitive Science

Week of 9/18

Videos	Lesson 11 Lesson 12		
Readings	Explanations Information-processing levels	Simon – Ch.1 Marr	Simon Ch. 5 Newell
Activities	Quiz 4 assigned 9/18, due 9/24 Milestone 1 due 9/24		

Week of 9/25

Videos	Lesson 13 Lesson 14		
Readings	Representation – 2 Concepts - 2	Markman Schank	Bechtel Nersessian
Activities	Quiz 5 assigned 9/25, due 10/1		

Week of 10/2

Videos	Lesson 15 Lesson 16		
Readings	Analogies - 2 Images - 2	Kolodner Larkin	Centner Dehaene
Activities	Quiz 6 assigned 10/2, due 10/8 Individual exercise 3 assigned 10/2, due 10/8 Milestone 2 assigned 10/2, due 10/22		

Week of 10/9

Videos	Lesson 17 Lesson 18		
Readings	Cognitive Architectures	Laird, Libere, Rosenbloom	Langley
	Neural Networks	Rogers	Bengio
Activities	Quiz 7 assigned 10/9, due 10/15 Individual exercise 4 assigned 10/9, due 10/15		

Week of 10/16

Videos	Lesson 19 Lesson 20		
Readings	Embodied Cognition	Brooks	
	Distributed Cognition	Hutchins	Grosz
Activities	Quiz 8 assigned 10/16, due 10/22 Milestone 2 due 10/22		

Part C of the course: Cognitive Science and Human-Centered Computing

Week of 10/23

Videos	Lesson 21 Lesson 22		
Readings	Culture	Tomasello	Shore
	Relationship to AI	Langley	Goel
Activities	Quiz 9 assigned 10/23, due 10/29		

Week of 10/30

Videos	Lesson 23 Lesson 24		
Readings	Relationship to Learning	Bransford	Lave
	Relationship to Design	Norman	Simon
Activities	Quiz 10 assigned 10/30, due 11/5 Individual exercise 5 assigned 10/30, due 11/5		

Week of 11/6

Videos	Lesson 25 Lesson 26		
Readings	Relationship to Human-Computer Interaction		Baron-Cohen
	Relationship to Robotics	Cakmak	Fitzgerald
Activities	Quiz 11 assigned 11/6, due 11/12 Individual exercise 6 assigned 11/6, due 11/12 Milestone 3 assigned 11/6, due 11/26		

Week of 11/13

Videos	Lesson 27 Lesson 28	
Readings	Relationship to Creativity	Boden
Activities	Quiz 12 assigned 11/13, due 11/19 Milestone 4 assigned 11/13, due 12/3	

Week of 11/20

Videos	None
Readings	None
Activities	Milestone 3 due 11/26

Week of 11/27

Videos	None
Readings	None
Activities	Milestone 4 due 12/3

Week of 12/4

Videos	None
Readings	None
Activities	End-of-Course survey assigned 12/4, due 12/10 CIOS survey due 12/10