湖北工業大學
HUBEI UNIVERSITY OF TECHNOLOGY

Course Title	Computational Modeling of Cognitive Processes
Course Code	COGS 2731
Semester	Summer 2025
Course Length	5 Weeks, 60 Contact Hours
Credits	4
Instructor	TBA
Office	TBA
Email	TBA
Prerequisite	COGS 1111 Introduction to Cognitive Science

Course Description:

This course aims to introduce students to the basic concepts and methodology needed to implement and analyze computational models of cognition. It considers the fundamental issues of using a computational approach to explore and model cognition. In particular, we explore the way that computational models relate to, are tested against, and illuminate psychological theories and data.

The course will provide students in cognitive science and computer science with the skills to develop computational models of human cognition, giving insight into how people solve challenging computational problems, as well as how to bring computers closer to human performance. The course will explore three ways in which researchers have attempted to formalize cognition -- symbolic approaches, neural networks, and cognitive architectures. The course also considers philosophical implications of computational cognition and the nature of intelligence.

Course Goals:

Students who successfully complete this course will demonstrate competency in the following general education core goals:

- **Critical thinking skills** – Students will engage in creative and/or innovative thinking, and/or inquiry, analysis, evaluation, synthesis of information, organizing concepts, and constructing solutions.
- **Communication skills** – Students will demonstrate effective written, oral, and visual communication.
- **Teamwork** – Students will demonstrate the ability to work effectively with others to support a shared purpose or goal and consider different points of view.
- **Social responsibility** – Students will demonstrate intercultural competency and civic knowledge by engaging effectively in local, regional, national, and global communities.

Student Learning Outcomes:

Upon completion of this course, students will be able to:

- Learn to discuss, evaluate, and analyze computational modeling research;
- Evaluate how computational models can improve our understanding of the human mind;
- Understand debates surrounding different approaches to modeling cognitive processes;
- Develop novel research that involves constructing or modifying computational models to understand some aspect of human cognition;
- Gain familiarity with foundational concepts such as information theory, cognitive modeling, and cognitive architectures;
- Develop practical skills in implementing and analyzing simple cognitive models.

Textbooks/Supplies/Materials Requirements:

Required: Zenon W. Pylyshyn. *Computation and Cognition: Toward a Foundation for Cognitive Science.* MIT Press.
Optional: Friedenberg & Silverman. *Cognitive Science: An Introduction to the Study of Mind.*

Course Requirements:

Assignments:
Assignments will involve computational exercises that explore key concepts in computational cognitive science. These tasks may include writing simple Prolog or R programs to simulate cognitive processes such as reasoning, problem-solving, and decision-making. Assignments will also include analytical questions designed to deepen understanding of theoretical models and their practical applications.

Quizzes:
The course will feature short quizzes to assess understanding and retention of key topics. These quizzes will cover materials from lectures and assigned readings, helping students stay engaged and reinforce learning throughout the term. Quizzes will include multiple-choice, true/false, and short-answer questions and will be administered at the beginning of classes.

Midterm Exam:
The midterm exam will assess students' grasp of core concepts from the first half of the course, including logic-based reasoning, symbolic models, and basic neural network principles. The exam will include multiple-choice questions, short-answer questions, and a programming component that may require debugging or implementing simple algorithms to model cognitive tasks.

Group Project:
Students will work in small groups of utmost 3 people each to explore a current research topic in computational cognition. Each group will prepare a video presentation and submit a written report that critically examines the chosen topic, including a review of relevant literature, a discussion of key findings, and an

evaluation of implications for the broader field of cognitive science. Group members will be assessed on both the final product and their contributions, as determined through peer evaluations.

Final Exam:
The final exam will be a comprehensive assessment of all course material, with an emphasis on synthesizing and applying learned concepts. Questions will test theoretical understanding, critical thinking, and practical skills related to computational models. The exam format will include multiple-choice, short-answer, and programming tasks designed to evaluate students' mastery of the course learning outcomes.

Assessments: Activity	**Percent Contribution**
Assignments	15%
Quizzes	15%
Midterm Exam	20%
Group Project	20%
Final Exam	30%

Grading:

Final grades will be based on the sum of all possible course points as noted above.

Percentage of available points	**Grade**
90 - 100	A
80 - 89	B
70 - 79	C
60 - 69	D
＜60	F

Course Schedule:
The schedule of activities is subject to change at the reasonable discretion of the instructor. Minor changes will be announced in class, and major ones provided in writing.

COGS 2731 Schedule

Lecture	Topic	Readings
L1	Course Introduction and Overview of Cognitive Science Exploring Computation in Cognition	*Zenon* Ch. 1
L2	The Computational Approach to Cognition Mental Processes and Information Processing The Explanatory Role of Representations	*Zenon* Ch. 1-2
L3	Basics of Formal Logic and Its Applications in Cognitive Processes Introduction to Logic-Based Cognitive Models	*Zenon* Ch. 1
L4	Prolog, Basic Syntax, and Running Simple Programs Writing Prolog Rules and Queries **Assignment 1**	*Zenon* Ch. 3
L5	Problem-Solving, Reasoning, and Planning in Cognitive Models Representing and Processing Numerical Data.	*Zenon* Ch. 3
L6	Hands-on Session: Building Simple Logic Programs	*Zenon* Ch. 3
L7	Constraint Satisfaction Problems in Cognitive Modeling Case Study: Cognitive Models in Real-World Applications	*Zenon* Ch. 3

L8	Introduction to Information Theory Key Concepts in Information Theory (Entropy, Information Gain)	*Zenon* Ch. 3
L9	The Psychological Reality of Programs: Strong Equivalence Functional Architecture and Computer Programs **Assignment 2**	*Zenon* Ch. 4
L10	Algorithms' Dependence on Functional Architecture Functional Architecture and Mental Processes	*Zenon* Ch. 4
L11	Physical Symbol System Hypothesis Artificial Neural Networks: Basics, History, and Applications	*Zenon* Ch. 2, 6
L12	Artificial Neural Networks: Structure and Function Implementation of Simple Feedforward Neural Networks **Assignment 3**	*Zenon* Ch. 2
L13	Example Models from Cognitive Science Literature	*Zenon* Ch. 2
/	**Midterm Exam**	/
L14	Overview of Cognitive Architectures Introduction to ACT-R Cognitive Architecture	*Zenon* Ch. 4, 7
L15	SOAR and CLARION Architectures	*Zenon* Ch. 4, 7
L16	Comparative Analysis of Cognitive Architectures	*Zenon* Ch. 4, 7
L17	Applications of Cognitive Architectures in AI and Psychology **Assignment 4**	*Zenon* Ch. 4, 7
L18	Early Project Research Paper Presentation Peer Collaboration	/
L19	Natural Language Processing (NLP): Basics	*Zenon* Ch. 7
L20	NLP: Syntax, Semantics, and Pragmatics	*Zenon* Ch. 7
L21	Memory Models: Short-Term and Long-Term Memory	*Zenon* Ch. 6
L22	Ethical Considerations in AI and Computational Models **Assignment 5**	Handouts
L23	The Philosophy of Mind and Artificial Intelligence	Handouts
L24	Final Project Proposal Workshop	/
L25	**Final Project Presentations and Course Wrap-Up**	/
/	**Final Exam**	/

Accommodation Statement

Academic accommodations may be made for any student who notifies the instructor of the need for an accommodation. It is imperative that you take the initiative to bring such needs to the instructor’s attention, as he/she is not legally permitted to inquire. Students who may require assistance in emergency evacuations should contact the instructor as to the most appropriate procedures to follow.

Academic Integrity Statement

Each student is expected to maintain the highest standards of honesty and integrity in academic and professional matters. The University reserves the right to take disciplinary action, up to and including dismissal, against any student who is found guilty of academic dishonesty or otherwise fails to meet the standards. Any student judged to have engaged in academic dishonesty in coursework may receive a reduced or failing grade for the work in question and/or for the course.

Academic dishonesty includes, but is not limited to, dishonesty in quizzes, tests, or assignments; claiming credit for work not done or done by others; hindering the academic work of other students; misrepresenting academic or professional

qualifications within or without the University; and nondisclosure or misrepresentation in filling out applications or other University records.

Other Items:

Attendance and Expectations
All students are required to attend every class, except in cases of illness, serious family concerns, or other major problems. We expect that students will arrive on time, be prepared to listen and participate as appropriate, and stay for the duration of a meeting rather than drift in or out casually. In short, we anticipate that students will show professors and fellow students maximum consideration by minimizing the disturbances that cause interruptions in the learning process. This means that punctuality is a must, that cellular phones be turned off, and that courtesy is the guiding principle in all exchanges among students and faculty. You will be responsible for the materials and ideas presented in the lecture.

Assignment Due Dates
All written assignments must be turned in at the time specified. Late assignments will not be accepted unless prior information has been obtained from the instructor. If you believe you have extenuating circumstances, please contact the instructor as soon as possible.

Make-Up Work
The instructor will not provide students with class information or make-up assignments/quizzes/exams missed due to an unexcused absence. Absences will be excused and assignments/quizzes/exams may be made up only with written documentation of an authorized absence. Every effort should be made to avoid scheduling appointments during class. An excused student is responsible for requesting any missed information from the instructor and setting up any necessary appointments outside of class.

Access, Special Needs, and Disabilities
Please notify the instructor at the start of the semester if you have any documented disabilities, a medical issue, or any special circumstances that require attention, and the school will be happy to assist.