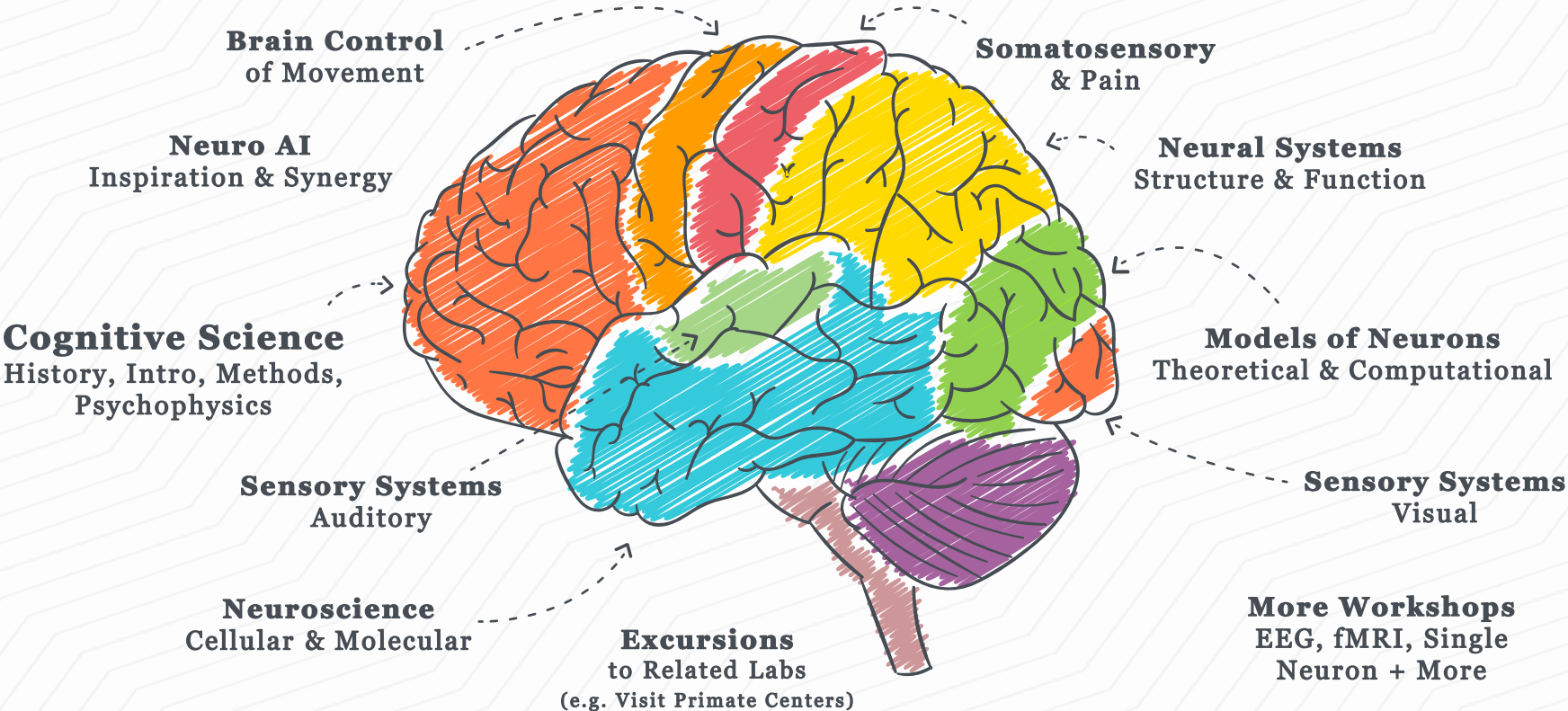


# Introduction to Cognitive Neuroscience

By Dr. A. Dehaqani

Spring 2025 Sat-Mon  
9-10:30



# INTRODUCTION TO Cognitive Neuroscience

SPRING 2025



Course page linked here



## TEACHING TEAM & HOURS

**Instructor:** Dr. Aboalghasemi Dehaqani

**Teaching Team:**

Bcol Lab x ECE school of AI

**Class Hours:** 9-10:30 **Saturday & Monday**

**Office Hours:**

**TA:** 13-15 Monday & Tuesday(Please message a day before)

**Instructor:** By Prior Arrangement



## COURSE DESCRIPTION

Cognitive Neuroscience is an exciting and rapidly evolving field that bridges the gap between neuroscience, psychology, and computational modeling. It offers deep insights into how the brain enables perception, thought, learning, and behavior. This course provides a foundational understanding of **neural systems**, their structure and function, and the methods used to study the brain—from **cellular** and **molecular** mechanisms to large-scale network dynamics. Students will explore how the brain encodes and **processes information**, spanning the intricate dynamics of neural activity, **sensory** representations, and **motor control**. The course goes into fundamental neural **computations**, uncovering how biological and theoretical models help explain cognition, perception, and action. In parallel we have hands-on **workshops**, including neural data analysis (**spikes**, **LFPs**, **EEG**), **fMRI** interpretation, and cognitive **modeling**. This year, we introduce **NeuroAI**, to the curriculum where we dive into **brain-inspired** architectures, the **synergy** between deep learning and cognitive science, and how AI can help us **understand**, **model**, and **predict** neural and cognitive processes.



## OVERVIEW OF THE TOPICS

Course calendar will be updated with order of presentation and details.

### 1 Foundations of Cognitive Neuroscience

Mind-brain relationship, historical perspectives, Neural organization and cognitive functions

### 2 Neural Systems & Signaling

Neurons, glia, synapses, neurotransmission, action potentials, resting membrane, neural dynamics

### 3 Sensory Coding & Perception

Visual, auditory, somatosensory systems, neural coding, psychophysics, sensory integration

### 4 Cognition & Higher Functions

Memory, decision-making, executive function, frontal, parietal, and temporal integration

### 5 Motor Control & Action

Motor cortex, basal ganglia, cerebellum, movement planning, disorders, mirror neurons

### 6 NeuroAI: Bridging Brain & AI

Brain inspired AI, How AI opens a window into the brain

### Workshops

Cognitive modeling (PsychoPy + more), Neural data analysis (EEG, fMRI), Single Neuron Recordings (Spikes and more)



## PREREQUISITE

No prerequisite courses, but needs:

- Basic Programming Skills
- Basic understanding of Signals
- Basic Statistical Understanding



## MODES OF ASSESMENT

### Mini Projects

40%

There are around four mini-projects, each starting with an in-person workshop where you'll explore key concepts through hands-on activities related to (and beyond) the current chapter. After the workshop, you'll apply what you've learned in a structured yet creative mini-project. All projects are interconnected, slowly teaching you how one tackles a major research question.

### Midterm Exam

30%

### Final Exam

35%

Mostly conceptual questions . No need for too much memorization.

### Bonus Mini Project

7.5%

This bonus assignment (beyond your 20 points) is designed to deepen your understanding of Brain inspired and related AI/ML concepts. You can choose between exploring a NeuroAI project or designing a behavioral modeling task and analyzing its outcomes.

### Bonus Quizzes + Brainstorm Sessions

5%

Bi-weekly short-answer quizzes to help students keep up with the course and improve their weaknesses followed by a brain storming sessions to catch-up and talk about the world surrounding the course.

**\*Note 1:** In the spirit of reducing the stress of grades, the sum of grades is **22.5** instead of **20**.

**\*Note 2:** The structure of the course grading is subject to change. But it will always be in favour of the students.



## JOURNAL DAYS

This course covers a rapidly evolving field, and while it dives into the latest discoveries, understanding the history is just as important. To balance both, we have journal days where our team presents **new research** related to their innovative work. These sessions, usually after bi-weekly quizzes or in class, will help you **navigate** research papers, break them down efficiently, and get more **excited** about what you're learning.



## RESOURCES

- **Class Slides**
- Some class videos will be available on our **YouTube** channel
- Tailored workshop material will be given out specific to the course



Coordinated by  
The Brain Computations Lab x School of AI, UT