科目ナンバリング	U-LAS04 20049 LE46						
授業科目名 <英訳>	Computational Cognitive Psychology-E2 Computational Cognitive Psychology-E2			担当者所属 職名・氏名	教育学研究科 特別招へい教授 O'Reilly, Randall Charles		
群	人文・社会科学科目群	分野(分類)	教育・心理・社会(各論)	使用言語	英語		
旧群	A群	単位数	2単位	時間数	30時間	授業形態	講義（対面授業科目）
開講年度・ 開講期	2025・ 後期集中	曜時限	集中	配当学年	全回生	対象学生	全学向

[授業の概要・目的]

This three-week intensive course will introduce the basic ideas and methods in computational cognitive psychology, which focuses on how neurons in the brain support cognitive functions. Specifically, we focus on simulating cognitive and perceptual processes using neural network models. We start by understanding the basic properties of individual neurons and networks of neurons. We then discuss learning mechanisms, which enable networks of neurons to work together to perform complex cognitive tasks. We will examine a range of cognitive functions, including attention, memory, language, and higher-level cognition. Students will understand how our neurons give rise to these cognitive functions and will appreciate the depth of the human mind in general.

[到達目標]

The overarching goal is to use computer simulations to help us to understand our cognitive functions, including perception, memory, language, and higher-level cognition.

[授業計画と内容]

Prof Randall O'Reilly is the instructor for all classes

【February 27, 4th period】Session 1: Course overview, role of computer models in psychology and overview of different levels of models, specific examples of different models and what they can, and can not, tell us.

【March 2, 4th period】Session 2: Models of individual neurons: what fundamental computation does an individual neuron perform, and how does its biology support that function?

【March 3, 4th period】Session 3: Models of networks of neurons: how do multiple neurons interact through excitatory and inhibitory channels to perform more complex collective functions, building on the capabilities of individual neurons?

【March 4, 4th period】Session 4: Models of neural learning: how does synaptic plasticity allow neurons to learn to perform various cognitive functions? Initial focus on Hebbian and self organizing learning.

【March 5, 4th period】Session 5: Models of learning, focusing on error-driven learning to achieve particular outcomes.

【March 6, 4th period】Session 6: Overview of large-scale brain organization, showing how networks of neurons are organized to perform different psychological functions in different brain areas.

【March 9, 4th period】Session 7: Models of perception: neural network models are current best solution for object recognition -- we explore such models in their simple form, and how they relate to what we know about the corresponding brain structure in the visual system.

【March 10, 4th period】Session 8: Models of attention: how inhibition and bidirectional connectivity interact to produce attentional effects.

【March 11, 4th period】Session 9: Models of memory: overview and specific case of the hippocampus and its contributions to episodic memory.

【March 12, 4th period】Session 10: Models of motor control and learning: dopamine and reinforcement learning of instrumental motor actions, and a brief overview of the cerebellum.

【March 13, 4th period】Session 11: Models of executive function: overview of executive function and the

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case of the Stroop model for the contribution of the prefrontal cortex.
【March 16, 4th period】Session 12: Models of executive function, focusing on basal ganglia and prefrontal cortex interactions for learning complex cognitive tasks (e.g., N-Back task).
【March 17, 4th period】Session 13: Models of language: overview of language models, and specific case of reading and dyslexia.
【March 18, 4th period】Session 14: Models of language, focusing on semantics and sentence-level processing.
【March 19, 4th period】Session 15: Conclusions and review: what have we learned, and how much can neural models account for, and what are the key current challenges for such models?

[履修要件]

At the beginning of the course, you do not need the knowledge of Cognitive Psychology, Neuroscience, or Computer Models, as essential knowledge for the course will be provided as needed in class. However, prior experience in one or more of these areas is beneficial to provide a foundation for learning; students without any exposure to any of these topics will have to work harder to learn all of the material.

[成績評価の方法・観点]

Evaluation will be based on active participation (20 points) and homework assignments based on selected computer models (80 points). Students who are absent more than four times will not be credited.

[教科書]

O'Reilly, Munakata et al., 2024 『Computational Cognitive Neuroscience』 （Amazon）ISBN:979-8336823622

（関連ＵＲＬ）

https://compcogneuro.org/

[授業外学修（予習・復習）等]

The computer models can be easily run by students through an intuitive graphical interface. Homework assignments involve running the models and answering basic questions about what the models do, and what this means for the aspect of cognition that they are modeling. Simulation models are part of online textbook written by Professor O'Reilly, which students are also expected to read: https://compcogneuro.org. Students will need their own computers -- all major operating systems are supported (Windows, Mac, Linux).

[その他（オフィスアワー等）]

The course will comprise lectures presented by the instructor using Powerpoint presentations, in-class discussions, interactive computer models demonstrated and explored by the students directly in a hands-on manner (they will be given instruction on using the simulation software during class, and are expected to bring their laptop to class). This is an intensive, three-week course, taking place in February-March 2026, and so the student grading will be completed at the end of the course by March 31, 2026. It is advisable that students make comments willingly during the class. Students will be expected to read the recommended text material and perform the computer model explorations outside of class time. It is expected that students will undertake at least one hour of preparation (textbook reading) and one hour of hands-on computer modeling for each class in the course.

[主要授業科目（学部・学科名）]