University of Tehran
School of Electrical and Computer Engineering

Course:	**An Introduction to Cognitive Neuroscience**		
Course type:	Elective	EE, CE, and IT*	Credit: 3
Level:	Undergraduate- Graduate		
Co-requisite(s):			
Prerequisite(s):	At least 100 units should be taken and passed for undergraduates.		
Prerequisite by topic:	Background knowledge on programming in MATLAB and probability theory, statistics, and dynamical systems		
Textbook(s):	Bear F. Mark, et al. Neuroscience : exploring the brain, 4th edition, Philadelphia : Wolters Kluwer, 2016 Gerstner, Wulfram, et al. Neuronal dynamics: From single neurons to networks and models of cognition. Cambridge University Press, 2014.		
Coordinator:	Mohammad-Reza A. Dehaqani		
Goals:	This course is designed to provide the basic knowledge of cognitive science for engineering students. At first a short history and an introduction to different branches of cognitive neuroscience will be presented. In the next step, the popular methods in cognitive neuroscience will be discussed. After an overview on cellular and natural neural networks' mechanisms, students will get familiar with origin of biological implementations of computations and processing in the brain. The system level behavior of neural structures including sensory, motor, and association areas will be discussed. The computational background of students will be recruited in developing models and simulation of processes in the brain. Finally, the cognitive modeling and computational neuroscience beside their tools and methods will be presented in more detail.		
Outcome:	Upon successful completion of the course, students will be able: 1. To understand origin of biological implementations of computations and processing in the brain 2. To explain the information processing in the brain 3. To choose and apply appropriate statistical methods on experimental data 4. To read the neuroscience papers easily and understand them		

	well 5. To design paradigms for behavioral or imaging experiments with deeper insight

Topics:	• A short history and an introduction to cognitive science
	• Different branches and common methods in cognitive neuroscience
	• Cellular and molecular structure of neural system
	  o Computational neuroscience
	  o Models of single neurons and networks
	• Structure and function of neural systems, different sensory pathways, and association areas.
	• Sensory systems including:
	  o somatosensory and pain
	  o visual
	  o auditory
	• Motor cortex and basal ganglia
	• Motivation and reward system
	• Attention
	• Decision making
	• Neural data analyses
	  o Coding and decoding in neural systems
	  o Application of information theory in neural systems
	  o Population and single cell analyses
	• Cognitive modeling

Computer usage:	The students in this course will program their computer assignments and final project using different languages including MATLAB or Python.
Assignments:	Question about course contents, mathematical analysis of models, proposing and simulation of models
Projects:	Final project is mandatory beside an optional presentation of a paper
Grading:	• Assignments and quizzes %30 • Final project and presentation of a neuroscience paper relevant to the taught topics or methods %20 • Midterm exams: %20 • Final exam: %30
Further readings:	[1] درآمدی به فلسفه ذهن، کیت مسلین، ترجمه مهدی ذاکری. انتشارات پژوهشگاه علوم و فرهنگ اسلامی [2] مبانی علوم اعصاب شناختی/ برنارد بارس، نیکول گیج؛ ترجمه دکتر کمال خرازی. انتشارات سمت [3] Kandel, Eric R., James H. Schwartz, and Thomas M. Jessell, eds. Principles of neural science. Vol. 4. New York: McGraw-Hill,

	[4] Busemeyer etal. The Oxford Handbook of COMPUTATIONAL and MATHEMATICAL PSYCHOLOGY [5] Dayan, Peter, and Laurence F. Abbott. Theoretical neuroscience. Vol. 806. Cambridge, MA: MIT Press. [6] Gerstner, W., & Kistler, W. M. (2002). Spiking neuron models: Single neurons, populations, plasticity. Cambridge university press.
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Date:	January 7, 2017

*EE: Electrical Engineering CE: Computer Engineering IT: Information Technology