课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	**人脑智能和机器智能/Brain Intelligence and Machine Learning**
2.	**课程性质** **Compulsory/Elective**	专业选修课
3.	**课程学分/学时** **Course Credit/Hours**	3 学分/48 学时 3Credits/48Hours
4.	**授课语言** **Teaching Language**	中文&英语/Chinese & English
5.	**授课教师** **Instructor(s)**	刘泉影/Quanying Liu
6.	**是否面向本科生开放** **Open to undergraduates or not**	否
7.	**先修要求** **Pre-requisites**	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） 无/NA
8.	**教学目标** **Course Objectives**	
	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） **课程将从以下 4 个方向展开讨论学习：神经信号处理、神经认知计算、机器智能算法以及人脑智能和机器智能的交互。学习主流神经信号处理技术（EEG、fMRI、MEG 等）和机器学习的常用算法；了解神经认知计算、机器智能和人脑智能的交互等前沿动态领域的研究现状；实践科研项目设计与实施；具备对人脑智能和机器智能相融合的深入研究能力。**	
9.	**教学方法** **Teaching Methods**	
	（如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.） **课堂讲授+论文讨论+项目设计及答辩**	
10.	**教学内容** **Course Contents** （如面向本科生开放，请注明区分内容。 If the course is open to undergraduates, please indicate the difference.）	

Section 1	Introduction.
Section 2	EEG Signal Processing and Analysis
Section 3	fMRI Signal Processing and Analysis
Section 4	MEG Signal Processing and Analysis
Section 5	Statistical Methods for Data Analysis
Section 6	Machine Learning Techniques for Data Analysis
Section 7	Human intelligence: Human Observational Learning
Section 8	Human intelligence: Causal Inference in the Multisensory Brain

	Section 9	Human intelligence: Human Multisensory Perception
	Section 10	Human Intelligence: Human Decision-making
	Section 11	Machine Intelligence: Cognitive AI with Human-like Commonsense
	Section 12	Machine Intelligence: Building Machines That Learn and Think Like People
	Section 13	Machine Intelligence: Lifelong Learning in Artificial Neural Networks
	Section 14	Brain-Machine Intelligence: Cortical Activity Machine Translation
	Section 15	Brain-Machine Intelligence: Human-machine Interaction
	Section 16	Brain-Machine Intelligence: Neuroscience-inspired AI

11. 课程考核
Course Assessment

（①考核形式 Form of examination；②.分数构成 grading policy；③如面向本科生开放，请注明区分内容。If the course is open to undergraduates, please indicate the difference.）
课程讨论 30%
论文讨论 40%
项目设计 30%

12. 教材及其它参考资料
Textbook and Supplementary Readings

教材：
[1] Computational Modelling of Cognition and Behavior, by Simon Farrell and Stephan Lewandowsky
[2] Neuroscience: Exploring the Brain, by Mark F. Bear, Bear, Barry W. Connors, and Michael A. Paradiso

参考资料：
[1] EEGLAB Tutorial. https://sccn.ucsd.edu/wiki/EEGLAB#The_EEGLAB_Tutorial_Outline
[2] Statistical Parametric Mapping Tutorial: https://www.fil.ion.ucl.ac.uk/spm/doc/manual.pdf
[3] Murphy, K. P. (2012). *Machine learning: a probabilistic perspective.* MIT press.
[4] Hu, L., & Zhang, Z. (2019). *EEG Signal Processing and Feature Extraction*. Springer Singapore.
[5] Cao, Y., Summerfield, C., Park, H., Giordano, B. L., & Kayser, C. (2019). Causal Inference in the Multisensory Brain. *Neuron*, *102*(5), 1076-1087.e8.
[6] Charpentier, C. J., Iigaya, K., & O'Doherty, J. P. (2020). A Neuro-computational Account of Arbitration between Choice Imitation and Goal Emulation during Human Observational Learning. *Neuron*.
[7] Rohe, T., Ehlis, A.-C. & Noppeney, U. (2019). The neural dynamics of hierarchical Bayesian causal inference in multisensory perception. *Nature Communication.*
[8] Ji-An Li, Daoyi Dong, Zhengde Wei, Ying Liu, Yu Pan, Franco Nori, and Xiaochu Zhang. (2020). Quantum reinforcement learning during human decision-making. *Nature Human Behaviour*
[9] Lake, B. M., Ullman, T. D., Tenenbaum, J. B., & Gershman, S. J. (2017). Building machines that learn and think like people. *Behavioral and Brain Sciences*, *40*.
[10] Yixin Zhu, Tao Gao, Lifeng Fan, Siyuan Huang, Mark Edmonds, Hangxin Liu, Feng Gao, Chi Zhang, Siyuan Qi, Yingnian Wu, Joshua B. Tenenbaum, Song-Chun Zhu.(2020). Dark, Beyond Deep: A Paradigm Shift to Cognitive AI with Human-like Commonsense. *Engineering*
[11] Makin, J. G., Moses, D. A., & Chang, E. F. (2020). Machine translation of cortical activity to text with an encoder–decoder framework. *Nature Neuroscience*, *23*(4), 575–582.
[12] G. Gary Anthes. (2019). Lifelong learning in artificial neural networks. *Commun. ACM* 62, 13– 15.
[13] Nalepka, P., Lamb., M., Kallen, R. W., Shockley, K., Chemero, A., Saltzman, E., & Richardson, M. J. (2019). Human social motor solutions for human–machine interaction in dynamical task contexts. *PNAS*, 116 (4), 1437-1446.
[14] Hassabis D, Kumaran D, Summerfield C, Botvinick M.(2017) Neuroscience-Inspired artificial intelligence. *Neuron* 95, 245– 258.