课程大纲
COURSE SYLLABUS

1.	**课程代码/名称** **Course Code/Title**	存算一体导论 - 从材料到系统 Introduction to In-Memory Computing - From Materials to System
2.	**课程性质** **Compulsory/Elective**	专业选修课 Major Elective Courses
3.	**课程学分/学时** **Course Credit/Hours**	1/16
4.	**授课语言** **Teaching Language**	英语 English
5.	**授课教师** **Instructor(s)**	李毅达 Li Yida
6.	**是否面向本科生开放** **Open to undergraduates or not**	否 No
7.	**先修要求** **Pre-requisites**	无 None
8.	**教学目标** **Course Objectives**	
	什么是存内计算？存内计算与传统的冯诺依曼计算架构相比有何不同？ 本课程将向研究生介绍当今最流行的非冯诺依曼计算架构之一 – 存内计算。该架构即将在未来的计算机芯片中实现，克服计算能耗的问题，以进行大量数据的计算。教给学生的概念包括 1. 非冯诺依曼计算架构，2. 内存计算的新兴设备，3. 内存计算的应用，4. 使用基于存内计算的人工神经网络和硬件算法协同设计，5.内存计算的控制电路。 由于本课程涉及一个新兴的研究领域，因此将广泛使用该领域的研究论文来进行讨论。 What is in-memory computing, and how is it different compare to conventional von-Neumann computing architecture? This course will introduce graduate students to one of the most popular non-von Neumann computing architecture that is slated to be implemented in future computer chips for abundant data calculation. Concepts to be taught to students will include 1. Non- von neumann computing architecture, 2. Emerging devices for in-memory computing, 3. Analog Memory Programming Techniques and Variations, 4. Artificial Neural Networks based on In-memory computing, 5. Circuit Primitives for Analog Computing. As this course is on an emerging research field, specific examples using research papers in this field will be used extensively and discussed.	
9.	**教学方法** **Teaching Methods**	
	讲授 Lectures，讨论 Tutorials，报告 Presentations	
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	课程介绍，非冯诺依曼计算架构 Introduction to Non- von neumann computing architecture

Section 2	用于存算一体的新型存储器 Emerging devices for in-memory computing
Section 3	模拟态存储器的可变性和应用方案 Analog Memory Programming Techniques and Variations
Section 4	基于存内计算的人工神经网络 Artificial Neural Networks based on In-memory computing
Section 5	存内计算驱动电路介绍 Introduction to Circuit Primitives for Analog Computing
Section 6	
Section 7	
Section 8	
Section 9	
Section 10	
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11. 课程考核
Course Assessment

请再此注明：①考查/考试；②分数构成。

考查

出勤 Attendance	20%
课堂表现 Class Performance	30%
期末报告 Presentation	50%

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

1. Pedretti, G.; Ielmini, D. In-Memory Computing with Resistive Memory Circuits: Status and Outlook. Electronics 2021, 10, 1063. https://doi.org/10.3390/electronics10091063
2. Yan, B., Li, B., Qiao, X., Xue, C., Chang, M.-F., Chen, Y. and Li, H. (2019), Resistive Memory-Based In-Memory Computing: From Device and Large-Scale Integration System Perspectives. Adv. Intell. Syst., 1: 1900068. https://doi.org/10.1002/aisy.201900068
3. Chen, HY., Brivio, S., Chang, CC. et al. Resistive random access memory (RRAM) technology: From material, device, selector, 3D integration to bottom-up fabrication. J Electroceram 39, 21–38 (2017). https://doi.org/10.1007/s10832-017-0095-9
4. Zhou, F., Zhou, Z., Chen, J. et al. Optoelectronic resistive random access memory for neuromorphic vision sensors. Nat. Nanotechnol. 14, 776–782 (2019). https://doi.org/10.1038/s41565-019-0501-3
5. Zhou, F., Chai, Y. Near-sensor and in-sensor computing. Nat Electron 3, 664–671 (2020). https://doi.org/10.1038/s41928-020-00501-9
6. Jain, Saurabh, Lin, Longyang, Alioto, Massimo Bruno (2021-06-23). ±CIM SRAM for Signed In-Memory Broad-Purpose Computing from DSP to Neural Processing. IEEE JOURNAL OF SOLID-STATE CIRCUITS.