南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

课程详述

COURSE SPECIFICATION

以下课程信息可能根据实际授课需要或在课程检讨之后产生变动。如对课程有任何疑问，请联系授课教师。

The course information as follows may be subject to change, either during the session because of unforeseen circumstances, or following review of the course at the end of the session. Queries about the course should be directed to the course instructor.

1.	**课程名称 Course Title**	**集成电路前沿-机器学习芯片设计** **Advanced integrated circuit design: machine learning on chip**
2.	**授课院系** **Originating Department**	电子与电气工程系 Department of Electrical and Electronic Engineering (EEE)
3.	**课程编号** **Course Code**	EE334
4.	**课程学分 Credit Value**	3
5.	**课程类别** **Course Type**	专业选修课 Major Elective Courses
6.	**授课学期** **Semester**	秋季 Fall
7.	**授课语言** **Teaching Language**	中英双语 English & Chinese
8.	**授课教师、所属学系、联系方式（如属团队授课，请列明其他授课教师）** **Instructor(s), Affiliation& Contact** **（For team teaching, please list all instructors）**	余浩，副教授，电子与电气工程系 办公室：第一教学楼 104 室 邮箱：yuh3@sustc.edu.cn 电话：0755-8801-8575 YU, Hao, Assoc. Prof., Department of Electrical and Electronic Engineering Office: Room 104, Teaching Building 1 Email: yuh3@sustc.edu.cn Telephone: 0755-8801-8575
9.	**实验员/助教、所属学系、联系方式** **Tutor/TA(s), Contact**	董龙涛/刘斌，硕士生，电子与电气工程系 邮箱：donglt@mail.sustc.edu.cn 电话：15039586999
10.	**选课人数限额(可不填)** **Maximum Enrolment（Optional）**	

11. 授课方式 Delivery Method	讲授 Lectures	习题/辅导/讨论 Tutorials	实验/实习 Lab/Practical	其它(请具体注明) Other（Please specify）	总学时 Total
学时数 Credit Hours	32	4	32		64

12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	EE202-17 数字电路 EE202-17 Digital circuit
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	本课程为电子与电气工程系微电子专业选修课，主要系统机器学习算法及其硬件实现与应用。其它专业学生如果想学习相关知识也可选修本课程。 This course is the elected course for undergraduate student in Microelectronics, and it includes the basic theory, hardware implementation and application of machine learning. It should however also be suitable for non-specialists, i.e. for all those students who show interests in lasers to gain a certain amount of relevant knowledge.
14. 其它要求修读本课程的学系 Cross-listing Dept.	无 None

教学大纲及教学日历 SYLLABUS

15. 教学目标 Course Objectives

本课程旨在培养本科生在机器学习算法及其数字电路芯片设计的兴趣与能力。本课程分为三个部分：1. 对机器学习算法理论的学习；2. 通过软件使用机器学习算法对模型进行训练（例如分类与聚类模型）；3. 对上述机器学习模型进行硬件实现，包括嵌入式设计以及 FPGA 实现。

After the completion of this course, students should know the following items. (1) Familiar with the basic theory of machine learning algorithms (2) Utilize software platforms to train and verify the machine learning algorithms and models, including classification and clustering (3) Implement the machine learning models on hardware with embedded system or FPGA.

16. 预达学习成果 Learning Outcomes

本课是微电子专业的主干专业课，学生将掌握机器学习与神经网络的基本原理，了解目前机器学习人工智能的研究热点，通过实验课学会并培养分析解决机器学习问题的能力，最终将算法实现在硬件中学到机器学习在物体检测人脸识别的重要了研究领域的结果的，为今后从事人工智能与芯片设计科研及开发工作打下良好的专业基础。

This course is the core course for students in Microelectronics. Students will learn the basic principle of machine learning and neural network, learn and cultivate the ability to analyse and solve the problems in the field of machine learning, and realize the algorithms on hardware，which provide the hardware implementation in face recognition and classification. It is essential for students to engage in research and development of artificial intelligence and integrated circuit design in the future.

17. **课程内容及教学日历 （如授课语言以英文为主，则课程内容介绍可以用英文；如团队教学或模块教学，教学日历须注明主讲人）**
Course Contents (in Parts/Chapters/Sections/Weeks. Please notify name of instructor for course section(s), if this is a team teaching or module course.)

机器学习芯片设计课程安排

第 1 周：课程介绍，及集成电路设计导论

第 2 周：机器学习导论

第 3 周：机器学习基础知识讲解，包含神经网络的拟合本质 、不同的优化方法、以及过拟合欠拟合问题分析

第 4 周：卷积层介绍，结合图像滤波来介绍卷积层的特征提取功能

第 5 周：全连接层介绍，结合全连接层来讲解反向传播算法

第 6 周：使用卷积层和全连接层搭建简单的分类网络

第 7 周：网络近似，讲解网络的量化算法即多种 BNN 网络和 QNN 网络

第 8 周：应用算法：YOLO，SSD,MTCNN,FACENET

第 9 周：期中考试

第 10 周：计算机架构

第 11 周：机器学习加速器

第 12 周：SoC 实现方法

第 13 周：硬件设计语言 I

第 14 周：硬件设计语言 II

第 15 周：论文报告

第 16 周：论文报告

Week 1: Introduction of machine learning

Week 2: Introduction of neural network

Week 3 to 5: Lecture on various machine learning algorithms,include CNN,RNN YOLO

Week 6: Lecture on software and hardware platform of machine learning algorithms. Software platforms include Matlab (matconvnet), python (tensorflow) and Lua (torch). Hardware platforms include the embedded systems and FPGA

Week 7 to 8: Mid-term quiz for students' understanding of the basic algorithms of machine learning. Students will run some machine learning algorithms towards face detection and recognition, bio-image processing on software platforms with provided workstations.

Week 9 to 10: Lecture on embedded system designs on the hardware platform with ARM core.

Week 11-12: Lecture on Verilog design on hardware platform

Week 13-16: Experiment of hardware implementation for machine learning algorithms. Students are required to implement one of the algorithms on a hardware platform (embedded system). Students will do this project in groups of 2-3. Students need to have a presentation and submit a report for evaluation of this project.

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

<Machine Learning> by ZHOU Zhihua;

<Digital Fundamentals, Tenth Edition> by Thomas L.Floyd

课程评估 ASSESSMENT

19.

评估形式 Type of Assessment	评估时间 Time	占考试总成绩百分比 % of final score	违纪处罚 Penalty	备注 Notes
出勤 Attendance		10		
课堂表现 Class Performance		10		
小测验 Quiz		0		
课程项目 Projects		0		
平时作业 Assignments		30		
期中考试 Mid-Term Test		20		
期末考试 Final Exam		30		
期末报告 Final Presentation				

其它（可根据需要改写以上评估方式） **Others (The above may be modified as necessary)**				

20. 记分方式 **GRADING SYSTEM**

☑ A. 十三级等级制 **Letter Grading**
☐ B. 二级记分制（通过/不通过） **Pass/Fail Grading**

课程审批 REVIEW AND APPROVAL

21. 本课程设置已经过以下责任人/委员会审议通过
This Course has been approved by the following person or committee of authority