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**	深度学习芯片设计 Deep Learning on Chip
2.	**授课院系 Originating Department**	深港微电子学院 School of Microelectronics
3.	**课程编号 Course Code**	SME310
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**	春季 Spring
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 长聘教授，深港微电子学院 办公室：崇文智园 3 号楼 525 邮箱： yuh3@sustech.edu.cn 电话：0755-8801-0180 YU, Hao Professor (tenured) , School of Microelectronics Office : Room 525, Building3, Nanshan i Park Chongwen Email : yuh3@sustech.edu.cn Telephone : 0755-8801-0180
9.	**实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact**	To be announced
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		32		64

12.	先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	SME202 集成电路基础 II-数字集成电路 Fundamentals of Integrated Circuit II- -Digital Integrated Circuit
13.	后续课程、其它学习规划 Courses for which this course is a pre-requisite	本课程为微电子学院选修课，主要关于深度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 an elective course in the School of Microelectronics, mainly about deep learning algorithms and their hardware implementation and applications.Students in other majors can also take this course if they want to learn 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

本课程旨在通过基于华为人工智能软硬件平台来培养本科生在机器学习芯片设计及其微处理器芯片设计的兴趣与能力。本课程分为四个部分：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.计算机架构理论的学习；4.对上述机器学习模型运用华为人工智能开发套件进行硬件实现。通过该课程培养学生将掌握机器学习与神经网络的基本原理，学会并培养分析解决机器学习问题的能力，并将算法实现在硬件中，为今后从事人工智能芯片设计科研及开发工作打下良好的专业基础。

This course aims to cultivate students' interest and ability in machine learning chip design and microprocessor chip design based on Huawei's artificial intelligence software and hardware platform. This course is divided into four parts: 1.Learning machine learning algorithm theory. 2.Training machine learning models on software platform (such as classification and clustering models). 3.Learning computer architecture theory. 4.Implementing the above-mentioned machine learning model in hardware using Huawei's artificial intelligence development kit. Through this course, students will master the basic principles of machine learning and neural networks, learn and cultivate the ability to analyse and solve machine learning problems, and implement algorithms in hardware, which will lay the professional foundation for future research and development of artificial intelligence chip design.

16. 预达学习成果 Learning Outcomes

本课程将着眼于作为下一代深度学习神经网络超低功耗高通量人工智能芯片教学工作，致力于让学生们了解人工智能所面临的核心技术难题，通过培养学生理论与动手能力深入探索新架构、新器件和新电路。课程基于华为人工智能软硬件平台培养学生掌握机器学习与神经网络的基本原理，提高分析解决机器学习问题的能力，并将算法实现在硬件中，通过培养学生理论与动手能力，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 will focus on teaching work of ultra-low-power high-throughput artificial intelligence chips for the next generation of deep learning neural network. It is committed to let students understand the core technical problems faced by artificial intelligence, and explore new architecture, new devices and new circuits by cultivating students' theoretical and practical skills. The course is based on Huawei's artificial intelligence software and hardware platform to train students to master the basic principles of machine learning and neural networks, improve their ability to analyse and solve machine learning problems, and implement algorithms in hardware. By cultivating students' theoretical and practical skills, the course will lay the professional foundation for future research and development of artificial intelligence chip design.

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.)

理论课内容：

第 1 周：课程介绍

第 2 周：深度学习导论

第 3 至 5 周：深度学习基础知识

第 6 周：经典网络结构分析讲解

第 7 周：网络的量化算法

第 8 周：应用算法：图片分类，目标检测，语义分割

第 9 周：期中考试

第 10 周：计算机架构

第 11 周：深度学习加速器

第 12 周：SoC 实现方法

第 13 至 14 周：计算机设计语言

第 15 至 16 周：课程项目报告

实验课内容：

第 1 周：深度学习环境搭建

第 2 周：神经网络入门：手写数字识别实验

第 3-4 周：目标检测模型 YOLO 实验

第 5-6 周：华为 ModelArts AI 云平台介绍及实践

第 7-8 周：华为 Atlas AI 开发板介绍及实践

第 9-10 周：硬件描述语言 Chisel 介绍及 AI 加速器实现

第 11-16 周：期末项目辅导

Theory lesson content：

Week 1: Course introduction

Week 2: Introduction of deep learning

Week 3 to 5: Basic knowledge of deep learning

Week 6: Classical network structure analysis and explanation

Week 7: Quantification algorithm for the network

Week 8: Application algorithm: image classification, object detection, and semantic segmentation

Week 9: Mid-term examination

Week 10: Computer Architecture

Week 11: Deep learning accelerator

Week 12: SoC implementation method

Week 13 -14: Computer Design Language

Week 15-16: Course project report

Experiment content：

Week 1: Building a deep learning environment

Week 2: Introduction to Neural Networks: Handwritten Digit Recognition Experiment

Week 3-4: Object detection model YOLO experiment

Week 5-6: Introduction and Practice of Huawei ModelArts AI Cloud Platform

Week 7-8: Introduction and practice of Huawei Atlas AI development board

Week 9-10: Introduction to the hardware description language Chisel and implementation of AI accelerator

Week 11-16: Final project counseling

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

参考书目 Reference：

Machine Learning, First Edition, Zhou Zhihua, Tsinghua University Press, 2016.

Digital Fundamentals, Tenth Edition, Thomas L.Floyd, Pearson, 2008.

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		0		

期中考试 **Mid-Term Test**		30		
期末考试 **Final Exam**		0		
期末报告 **Final Presentation**		50		
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