

## 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.	<b>课程名称 Course Title</b>	An Introduction of Machine Learning and EDA 机器学习及电子设计自动化概论
2.	<b>授课院系 Originating Department</b>	深港微电子学院 School of Microelectronics
3.	<b>课程编号 Course Code</b>	SMES201
4.	<b>课程学分 Credit Value</b>	1
5.	<b>课程类别 Course Type</b>	专业选修课 Major Elective Courses
6.	<b>授课学期 Semester</b>	夏季 Summer
7.	<b>授课语言 Teaching Language</b>	英文 English
8.	<b>授课教师、所属学系、联系方式 (For team teaching, please list all instructors)</b>	陈全 (助理教授) 深港微电子学院 邮箱: chenq3@sustech.edu.cn 办公室: 第一教学楼 101 Quan CHEN (Assistant Professor) School of Microelectronics Email: chenq3@sustech.edu.cn Office: Room101, Teaching Building 1
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	无 NA
10.	<b>选课人数限额(可不填) Maximum Enrolment (Optional)</b>	

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				
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements					
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite					
14. 其它要求修读本课程的学系 Cross-listing Dept.					

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程将介绍以下知识点：机器学习的基本概念和基础知识，一种流行的深度学习框架和一些可以通过深度学习解决的简单任务，机器学习的可能研究方向，AI 和 EDA 硬件实现的基础知识，教授电路仿真的基本模型和算法，AI 硬件和 EDA 的未来主题。

Introduce the basic concepts and fundamentals of machine learning.

Introduce a popular deep learning framework and some simple tasks that can be solved with deep learning.

Introduce possible research directions of machine learning.

Introduce fundamental knowledge of hardware realization of AI & EDA.

Teach basic models and algorithms for circuit simulation.

Introduce future topics in AI hardware & EDA.

#### 16. 预达学习成果 Learning Outcomes

通过本课程的学习，学生可以了解机器学习和深度学习的基本概念和机制、能够使用机器学习框架实现神经网络、了解深度学习的可能研究方向、获取 AI 和 EDA 设计流程的硬件基础知识、了解半导体器件和电路的基本模型、能够理解和实现电路仿真的基本算法。

Understand the basic concepts and mechanisms of machine learning and deep learning.

Be able to implement neural networks with a machine learning framework.

Get to know possible research directions of deep learning.

Acquire basic knowledge of hardware for AI & EDA design flow

Understand basic models of semiconductor devices and circuits

Be able to understand and implement basic algorithms of circuit simulation

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.)**

**Credit Hour 1-4: Fundamentals of Machine Learning 学时 1-4: 机器学习的基础知识**

Day 1: Machine Learning basics: tasks (classification, regression), measurement (precision, recall, F-score), supervised learning and example (linear regression), No Free Lunch Theorem

第 1 天: 机器学习基础知识: 任务 (分类、回归)、测量 (精度、召回、f-分数)、监督学习和示例 (线性回归)、无免费午餐定理

Day 2: Deep Neural Network (MLP), Training a DNN (gradient back-propagation)

第 2 天: 深层神经网络 (MLP), 训练 DNN (梯度反向传播)

Day 3: Activation Function (sigmoid, ReLU->Leaky ReLU->PReLU), Loss function (MSE, Cross Entropy), Regularizer (L1, L2), Optimizer (SGD)

第 3 天: 激活函数 (sigmoid, relu > 泄漏的 ReLU -> PReLU), 损耗函数 (MSE, 交叉熵), 调节器 (L1, L2), 优化器 (SGD)

Day 4: Convolutional Neural Network (convolution, pooling, softmax), Recurrent Neural Network

第 4 天: 卷积神经网络 (卷积、池化、softmax)、递归神经网络

**Credit Hour 5-8: Deep Learning Practice 学时 5-8: 深度学习练习**

Day 1: Python basics, Pytorch basics (tensors, autograd, nn module)

第 1 天: Python 基础知识, Pytorch 基础知识 (张量、自动研究生、nn 模块)

Day 2: Handwritten digits classification with CNN

第 2 天: 基於 CNN 的手写数字分类

Day 3: Name Generation with RNN

第 3 天: 基於 RNN 的名称生成

Day 4: Research Directions & showcase

第四天: 研究方向和應用展示

**Credit Hour 9-12: Basic EDA Flow for VLSI 学时 9-12: VLSI 的基本 EDA 流程**

Day 1: Introduction of VLSI (with emphasis on AI hardware)

第 1 天: 超大规模集成电路介绍 (侧重人工智能硬件)

Day 2: Overview of EDA Flow

第 2 天: EDA 流程概述

Day 3: Circuit Simulation Basics (SPICE, netlist, MNA, software)

第 3 天: 电路仿真基础知识 (SPICE、网络列表、MNA、软件)

Day 4: Basic Semiconductor Devices Models (Drift-Diffusion model, compact models)

第 4 天: 基本半导体器件模型 (漂移扩散模型, 集约模型)

**Credit Hour 13-16: SPICE Circuit Simulation Methods & Algorithms 学时 13-16: SPICE 电路仿真方法和算法**

Day 1: Linear Circuit Simulation (linear systems, Gaussian elimination, Iterative solvers)

第 1 天: 线性电路仿真 (线性系统, 高斯消除, 迭代求解)

Day 2: Nonlinear Circuit Simulation (Newton's iteration, time integration algorithms)

第 2 天: 非线性电路仿真 (牛顿迭代, 时间积分算法)

Day 3: Physical Design I

第 3 天: 物理设计 I

Day 4: Physical Design II

第 4 天: 物理设计 II

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

(教材) Deep Learning Book: <http://www.deeplearningbook.org/>

Neural Networks and Deep Learning: <http://neuralnetworksanddeeplearning.com/>

Pytorch Tutorials: <https://pytorch.org/tutorials/>

(教材) CMOS VLSI DESIGN: A Circuits and Systems Perspective": <http://pages.hmc.edu/harris/cmosvlsi/4e/index.html>

SPICE Simulation Fundamentals: <http://www.ni.com/en-us/innovations/white-papers/06/spice-simulation-fundamentals.html>

Electronic design automation (Wiki): [https://en.wikipedia.org/wiki/Electronic\\_design\\_automation](https://en.wikipedia.org/wiki/Electronic_design_automation)

**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		30		
课堂表现 Class Performance		20		
小测验 Quiz				
课程项目 Projects				
平时作业(两次) Assignments		50		
期中考试 Mid-Term Test				
期末考试 Final Exam				
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**

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