

## 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>	机器学习及医学工程应用 Machine Learning and its Medical Engineering Applications
2.	<b>授课院系 Originating Department</b>	生物医学工程系 Department of Biomedical Engineering
3.	<b>课程编号 Course Code</b>	BMEB215
4.	<b>课程学分 Credit Value</b>	3
5.	<b>课程类别 Course Type</b>	专业基础课 Major Foundational Courses
6.	<b>授课学期 Semester</b>	春季 Spring
7.	<b>授课语言 Teaching Language</b>	英语 English
8.	<b>授课教师、所属学系、联系方式 Instructor(s), Affiliation &amp; Contact</b> (For team teaching, please list all instructors)	刘泉影, 生物医学工程系 liuqy@sustech.edu.cn
9.	<b>实验员/助教、所属学系、联系方式 Tutor/TA(s), Contact</b>	待公布 To be announced
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	48				48
12. 先修课程、其它学习要求 Pre-requisites or Other Academic Requirements	MA102B、MA107A; MA212				
13. 后续课程、其它学习规划 Courses for which this course is a pre-requisite	无				
14. 其它要求修读本课程的学系 Cross-listing Dept.	无				

### 教学大纲及教学日历 SYLLABUS

#### 15. 教学目标 Course Objectives

本课程的教学目标是：使学生理解机器学习中大量的学习算法，理解如何评估学习算法优缺点和如何挑选模型，并能够对常用的机器学习算法进行编程。机器学习方面主要包括了线性模型、支持向量机、核方法、人工神经网络、聚类和降维等主题。此外，本课程还将详细介绍机器学习在医学图像分割、配准、预测、分类等方面的应用，锻炼学生运用机器学习解决医学实际问题的能力，并以小组的形式完成一次课课题研究。

The goal of this course is understanding a large number of learning algorithms in machine learning and knowing how to evaluate the learning algorithm and how to select models. Implementing in code common machine learning algorithms. Machine learning mainly includes linear model, support vector machine, kernel method, artificial neural network, clustering and dimension reduction, etc. topics. In addition, this course will also introduce the application of machine learning in medical image segmentation, registration, prediction, classification, etc. fields. Training students' ability to solve practical medical problems by machine learning. Students will complete a course research in the form of a group.

#### 16. 预达学习成果 Learning Outcomes

通过学习，本课程预达下列学习成果：

1. 对机器学习有基础的认识
2. 掌握常用的机器学习算法
3. 了解机器学习在医学各个方面的应用
4. 以小组的形式，研究一个具体的医学应用问题，阅读相关研究文献，尝试使用机器学习方法对相关问题进行解决。在课程上完成小组汇报，展示研究成果。

After one semester of course study, we plan to achieve the following goal:

1. Have a basic understanding of machine learning
2. Master commonly used machine learning algorithms
3. Knowing applications of machine learning in medicine
4. In the form of group, study a specific medical application problem, read related research literatures, and try to use machine learning methods to solve this problem. Show the group research results and complete the

course group report.

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.)**

**Section 1 机器学习简介（3 学时）**

介绍机器学习并学习其相关基础知识。

**Section 1 Introduction of Machine Learning**

Introduction of machine learning and learning relevant basic knowledge.

**Section 2 模型评估选择（3 学时）**

学习精度、误差、过拟合等概念，了解评估模型的多种方式。

**Section 2 Model Evaluation and Selection**

Learning the concepts of precision, error, overfitting, and understanding various ways of evaluating models.

**Section 3 参数估计技术基础（3 学时）**

介绍基本的参数估计技术，包括最大似然参数估计、贝叶斯参数估计

**Section 3 Basic Parameter Estimation Techniques**

Introduction of basic parameter estimation techniques.

**Section 4 线性模型（3 学时）**

介绍经典的线性模型及线性回归。

**Section 4 Linear Model**

Introduction of linear model and linear regression.

**Section 5 人工神经网络（3 学时）**

介绍人工神经网络，学习误差反向传播算法。

**Section 5 Artificial Neural Network**

Introduction of artificial neural network and error back propagation algorithm.

**Section 6 支持向量机与核方法（3 学时）**

介绍支持向量机与核方法。

**Section 6 SVMs and Kernel Methods**

Introduction of SVMs and kernel methods.

**Section 7 集成学习（3 学时）**

介绍集成学习概念、Boosting、Bagging 及随机森林算法。

**Section 7 Ensemble Learning**

Introduction of concept of ensemble learning, Boosting, Bagging and random forest algorithms.

**Section 8 聚类（3 学时）**

介绍聚类及常见的聚类算法。

#### Section 8 Clustering

Introduction of clustering and common clustering algorithms.

#### Section 9 降维 (3 学时)

介绍降维的目的以及常见的算法。

#### Section 9 Dimensionality Reduction

Introduce the purpose of dimensionality reduction and common algorithms.

#### Section 10 图模型 (3 学时)

介绍图模型及其应用。

#### Section 10 Graphical Models

Introduction of probabilistic graphical models and the applications

#### Section 11 医学应用领域介绍 (3 学时)

介绍机器学习在医学应用的发展过程及其在各个领域所做出的贡献。

#### Section 11 Introduction of Medical Application

Introduce the development process of machine learning in medical application and its contribution in various fields.

#### Section 12 医学图像重建及配准 (3 学时)

介绍机器学习在医学图像重建及配准中的应用。

#### Section 12 Medical Images Reconstruction and Registration

Application of machine learning in medical images reconstruction and registration.

#### Section 13 医学图像分割及形状检测 (3 学时)

介绍机器学习在医学图像分割及形状检测中的应用。

#### Section 13 Medical Images Segmentation and Shape Analysis.

Application of machine learning in medical images segmentation and shape analysis.

#### Section 14 医学中的疾病预测、诊断问题 (6 学时)

介绍机器学习在医学中的预测、诊断问题中的应用。

#### Section 14 Prediction and Diagnosis in Medicine

Application of machine learning in prediction and diagnosis.

#### 期末汇报 (3 学时)

学生在课堂上对小组的项目进行展示及讨论。

#### Final Presentation

According to the group project in this semester, students present their research topics and communicate in class.

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

**Textbook**  
Machine Learning: A Probabilistic Perspective, by Kevin P. Murphy

**Supplementary Readings**  
Medical Image Computing and Computer Assisted Intervention-MICCAI 2020: 23rd International Conference, Lima, Peru, October 4-8, 2020, Proceedings, Part I-VII. Springer Nature, 2020.

**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				
课堂表现 Class Performance				
小测验 Quiz		10		实时反馈学生课堂学习情况; Give feedbacks of the course study in the classroom.
课程项目 Projects		30		以小组汇报的形式完成课程项目, 目的培养学生小组合作能力; Finish a team project via presentation and help students to learn about teamwork.
平时作业 Assignments		30		通过期中、期末总结, 让学生回顾并总结近半学习的学习内容以及学习收获; Through mid-term and final revision, help students to summarize the whole course and their results.
期中考试 Mid-Term Test				
期末考试 Final Exam		30		通过期末考试形式, 考察学生对课程知识理解程度; Through the final exam, we try to help students learn the important contents in the course.
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

生物医学工程系教学委员会

