

# 0. 课程信息

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# Course Information

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计算机专业选修课  
人工智能专业核心课

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课程名称 机器学习

授课时间 2023年春

考试形式 考试/考查

学分 3

讲者 吴晓堃

总计时长 48学时（12周）

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# Short Intro

The objective of this course is to provide a complete introduction to machine learning, which discusses computer programs that automatically improve their performance through experience (e.g., programs that learn to recognize faces, recommend music and movies, and drive autonomous robots)

# Description

This course covers theoretical and practical algorithms for machine learning from different perspectives: theoretical concepts include induction bias, PAC learning framework, Bayesian learning methods, and Occam's razor; programming assignments include hands-on experiments with various learning algorithms. This course is designed to provide a solid foundation for students who wish to master modern artificial intelligence techniques and to provide the necessary methods, techniques, mathematics, and algorithms for those who wish to pursue future research in machine learning.

The course will touch on the following topics:

- decision tree learning, linear models
- model selection and optimization, statistical learning methods
- neural networks, deep learning
- nonparametric models, ensemble learning

**Keywords:** machine learning, neural networks, deep learning



# Prerequisites

We expect you to have the following skills before taking this course:

## Required:

- Linear algebra (vector, matrix computation, Euclidean spaces).
- Differential calculus (Jacobian, Hessian, chain rule).
- Probabilities and statistics (common distributions, law of large numbers, conditional probabilities, Bayes)
- Proficient in one programming language (Python recommended).

## Recommended:

- Numerical optimization (notion of minima, gradient descent).
- Algorithm analysis (computational costs).
- Specialized knowledge (visual computing, robotics, speech and language processing).

# Teaching Plan

This course is organized into a 12-week session (4 hours per week)

1. Introduction 导言, Preliminaries 预备知识
2. Decision Trees 决策树
3. Linear Models 线性模型
4. Model Selection 模型选择
5. Nonparametric Models 非参数化模型
6. Ensemble Learning 集成学习
7. Statistical Learning Concepts 统计学习概念
8. Probability Models: Complete Data 概率模型: 完备数据
9. Probability Models: Hidden Variables 概率模型: 隐变量
10. Feedforward Networks 前馈网络, Back Propagation 反向传播
11. Deep Learning Computation 深度学习计算
12. Convolutional Neural Networks 卷积神经网络
13. Modern Convolutional Neural Networks 现代卷积神经网络
14. Recurrent Neural Networks 循环神经网络
- ≡ 15. Modern Recurrent Neural Networks 现代循环神经网络

# Tutorial Plan

1. Decision Trees 决策树
2. Linear Regression 线性回归
3. Linear Classification 线性分类
4. Nonparametric Models 非参数化模型
5. Ensemble Learning 集成学习
6. Feedforward Networks 前馈网络
7. Convolutional Neural Networks 卷积神经网络
8. Recurrent Neural Networks 循环神经网络



# Evaluation

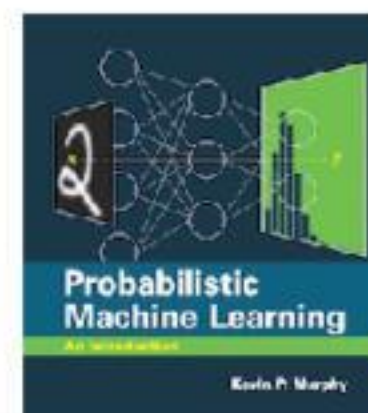
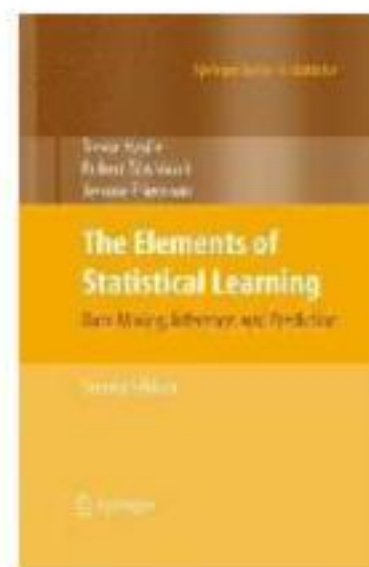
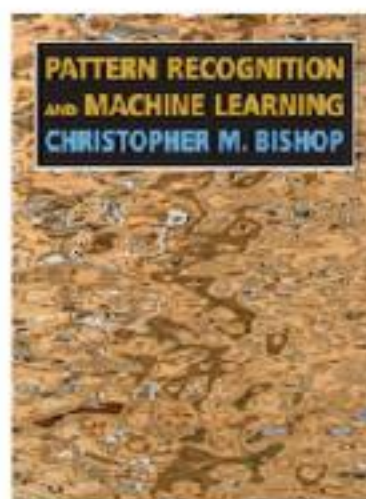
- Attendance & participation: 20%
- Understanding of topics: 20%
- Final exam: 60%



# Textbook

Not mandatory but recommended:

- Christopher Bishop, *Pattern Recognition and Machine Learning*
- Zhang et al., *Dive into Deep Learning*
- Friedman et al., *The Elements of Statistical Learning*
- Murphy, *Probabilistic Machine Learning: An Introduction*



# Resource

- 课程网页<sup>1</sup>
- 动手学深度学习<sup>2</sup>
- PRML Book<sup>3</sup>
- Probabilistic Machine Learning: An Introduction<sup>4</sup>
- Mathematics for Machine Learning<sup>5</sup>

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1. <https://xkunwu.github.io/teach/MachineLearning23F/2023F.html>↩
  2. <https://zh-v2.d2l.ai>↩
  3. <https://www.microsoft.com/en-us/research/people/cmbishop/prml-book/>↩
  4. <https://probml.github.io/pml-book/book1.html>↩
  5. <https://mml-book.github.io/>↩

