Course Overview

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CS182: Introduction to Machine Learning (Fall 2022)
http://cs182.sist.shanghaitech.edu.cn

Outline

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CS 182 Is Not ...

- a general education or popular science course for a general audience;
- an easy course, even though it is an undergraduate-level introductory course;
- a good choice just to satisfy some area and/or credit requirements;
- a course for students who have a phobia of mathematics;
- a course that takes a black-box approach to teach students how to use the tools in a machine learning toolbox.

CS 182 Is ...

- very demanding, both for its workload and for the level of difficulty of the concepts and techniques covered;
- designed for students with strong interests in the theory and/or applications of machine learning.

Course Information

- Instructor: Prof. Ziping Zhao
  - office: Rm. 1A-404D, SIST Building
  - e-mail: zhaoziping@shanghaitech.edu.cn
- Lecture hours and venue:
  - Tuesday/Thursday 1:00pm–2:40pm, Rm. 303, Teaching Center
- Course helpers (all in Rm. 1A-409) whom you can consult:
  - Quan Wei, weiquan@shanghaitech.edu.cn
  - Mengting Chen, chenmt@shanghaitech.edu.cn
  - Cheng Cheng, chengcheng2@shanghaitech.edu.cn
- Course website: http://cs182.sist.shanghaitech.edu.cn
- Piazza: https://piazza.com/shanghaitech.edu.cn/fall2022/cs182 (access code: 2022fallcs182)

Course Description

- Machine learning is the science of making computer artifacts improve their performance without requiring humans to program their behavior explicitly.
- Machine learning has accomplished successes in a wide variety of challenging applications, ranging from computational molecular biology to computer vision, and from social web analysis to financial technology.
- This course is a undergraduate-level introductory course in machine learning with emphasis put on the computational and mathematical principles underlying the most common machine learning problems and methods.
- It is not only suitable for students pursuing or planning to pursue research in machine learning or other related areas that focus on model and algorithm development, but is also suitable for students who want to apply principled machine learning techniques competently to their application-oriented areas.

Learning Outcomes

By the end of this course, students are expected to demonstrate competence in the following:

- Ability to take a real-world application and formulate the learning problems involved in it by identifying the major learning-related issues;
- Ability to choose and apply the most common methods available for each of the major learning problem types;
- Ability to compare different machine learning methods according to common performance criteria;
- Ability to design and conduct empirical studies in such a way that the experiment results can be interpreted in accordance with scientific and statistical principles.

Major Topics

- Bayesian decision theory
- Parameter estimation for generative models
- Linear discrimination
- Multilayer perceptrons
- Support vector machines
- Dimensionality reduction
- Clustering and mixture models
- Nonparametric Methods
- Deep learning models
- Ensemble learning
- Model assessment and selection

- Some topics (on simple machine learning models) are for self-study

Andrew Ng's Course vs. CS 182

- Andrew Ng's course on Coursera (http://www.coursera.org/learn/machine-learning):
  - More hands-on advice and exposure for practitioners; applied machine learning
- CS 182:
  - More theoretical and algorithmic treatment for both practitioners and researchers

Prerequisites/Background Needed

- Computer science:
  - Object-oriented programming and data structures
  - Design and analysis of algorithms
- Mathematics:
  - Multivariable calculus
  - Linear algebra and matrix analysis
  - Probability and statistics
  - Optimization
  - Information theory

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Reference Books/Materials

- Ethem Alpaydin (2020). Introduction to Machine Learning (I2ML). Fourth Edition. MIT Press.
- Richard O. Duda, Peter E. Hart, and David G. Stork (2000). Pattern Classification. Second Edition. Wiley.
- Christopher M. Bishop (2006). Pattern Recognition and Machine Learning. Springer.
- Other assigned reading materials

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Assessment Tasks

- Problem sets with programming (30%):
  - PS1 due: end of week 4
  - PS2 due: end of week 7
  - PS3 due: end of week 10
  - PS4 due: end of week 13
  - PS5 due: end of week 16
- Final exam (40%)
  - 2 hours
  - Closed-book, closed-notes, two A4 “cheat sheet” allowed
- Final project (30%)
  - project guidelines will be provided in the middle of this course

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Programming Resources

- Python:
  - An interpreted high-level general-purpose open source programming language
  - Support Windows, Linux/Unix, and macOS
- MATLAB:
  - Software environment for numerical computing and graphics
  - Commercial software
  - Versions for Windows, Linux/Unix, and macOS available on ShanghaiTech IT Services platforms
- Octave:
  - One of the most popular MATLAB clones
  - Freeware (as 'GNU MATLAB')
  - Versions for Linux/Unix, Mac OS X and Windows available for free download
  - Video tutorial by Andrew Ng of Stanford available from coursera.org

Outline

The ShanghaiTech Academic Honor Code

- Honesty and integrity are central to the academic work of ShanghaiTech. Students of the University must observe and uphold the highest standards of academic integrity and honesty in all the work they do throughout their program of study.
- As members of the University community, students have the responsibility to help maintain the academic reputation of ShanghaiTech in its academic endeavors.
- Sanctions will be imposed on students, if they are found to have violated the regulations governing academic integrity and honesty.
- **Also check:** ShanghaiTech website on student conduct and academic integrity (https://oaa.shanghaitech.edu.cn/2015/0706/c4076a31250/page.htm)