CE717: Machine Learning
Department of Computer Engineering
Sharif University of Technology
Fall 2021: Sunday & Tuesday: 9:00-10:30

Instructor:

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Course Links:

- **Website:** `http://mlclass.ir`
- **Piazza:** `piazza.com/sharif/fall2021/ce7172`
- **Quera:** link will be announced at Piazza!

Overview:

Combining data, computation, and inferential thinking, machine learning is redefining how people and organizations solve challenging problems and understand their world. This intermediate level class bridges between fundamental courses such as Engineering Probability and Statistics and Design Algorithms and upper division computer science and statistics courses. In this class, we explore key areas of machine learning with an emphasis on applied techniques in data collection and cleaning, visualization, statistical inference, predictive modeling, and decision making and brief introduction to more advanced topics such as probabilistic graphical models and deep neural networks. Through a strong emphasizes on data centric computing, quantitative critical thinking, and exploratory data analysis this class covers key principles and techniques of data science.

Goals:

- **Familiarize** students with fundamental concepts in machine learning and some of popular algorithms in ML
- **Empower** students to apply computational and inferential thinking to tackle real-world problems
- **Enable** students to start careers as data scientists by providing experience working with real-world data, tools, and techniques

Textbooks & References:

1. Ch. Bishop, **Pattern Recognition and Machine Learning**, 2nd Edition, Springer, 2006.Online Free Version.
2. A. Zhang, Z. Lipton, M. Li, A. Smola, **Dive into Deep Learning**. Online Free Version.
3. S. Lau and J. Gonzalez, D. Nolan, **Principles and Techniques of Data Science**. Online Free Version.
4. Instructor Handouts.

Prerequisites:
Students who take this course should have basic exposure to python programming and also passed the following prerequisite courses:

- **Engineering Probability and Statistics**: Students should be comfortable with basic concepts of probability and statistics such as random variable, expected value and sample mean and variance
- **Math**: We will need some basic concepts like linear operators, eigenvectors, derivatives, and integrals to enable statistical inference and derive new prediction algorithms. This may be satisfied concurrently to Linear algebra or second general math courses.

Grading:
Based on your performance on Homework, Quizzes and Final Exams. The grade will be determined by:

- Homework: 25%
- Project: 15%
- Random Quiz: 5%
- Mini Exams: 30%
- Final: 25%

Course Description:
The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets. These include analyzing data; principles behind creating informative data visualizations; algorithms for machine learning methods including regression, classification and clustering and a brief introduction to deep learning methods; Best Practices for applying machine learning in practice; and theoretical foundations and applied techniques for data processing and machine learning. The course will cover the following topics:

Quizzes & Exams:

- **Random Quiz**: There will be 2 short quizzes which will be taken at **random**.
- **Mini Exam**:There will be 2 mini exams which will be held on Thursdays. The first one will be taken on **11 Azar** and the second one will be on **9 Day**. These mini exams are considered midterm exams.
- **Final**: There will be a comprehensive final exam at the end of the semester on **5 Bahman**.

Statement on Collaboration, Academic Honesty, and Plagiarism:
We encourage working together whenever possible on homework, working problems in tutorials, and discussing and interpreting reading assignments. Talking about the course material is a great way to learn. Regarding homework, the following is a fruitful (and acceptable) form of collaboration; discuss with your classmates possible approaches to solving the problems, and then have each one fill in the details and write her/his own solution *independently*. There will be a zero tolerance policy for Cheating/Copying HW's. The first time you are caught, you will fail the course. In general, we expect students to adhere to basic, common sense concepts of academic honesty. Presenting other's work as if it was your own, or cheating in exams will not be tolerated.

Homework grading policy:
Pay attentions to the homework policy attachment.

Table 1: Course Calendar

Session	Topic	Readings
00/06/28	Introduction & Course Overview	
00/06/30	Exploratory Data Analysis	DS. Ch.4-5
00/07/03	HW1 Release	Review
00/07/04	Visualization	DS. Ch. 6
00/07/06	Visualizing high dimensional data I	Bishop Ch. 12
00/07/11	Visualizing high dimensional data II	Handout
00/07/13	Holiday	
00/07/16	HW1 Deadline	Review
00/07/17	HW2 Release	EDA and Visualization
00/07/18	Data Modeling	DS. Ch. 10, 12.3
00/07/20	Probabilistic and Bayesian ML	Bishop Ch. 1.2.5
00/07/25	Linear Regression I	Bishop Ch. 3
00/07/27	Linear Regression II	Bishop Ch. 3
00/07/30	HW2 Deadline	EDA and Visualization
00/08/01	HW3 Release	Regression
00/08/02	Holiday	
00/08/04	Linear Regression III	Bishop Ch. 3
00/08/09	Linear Classification	Bishop Ch. 4.1
00/08/11	Probabilistic Generative Classifiers	Bishop Ch. 4.2
00/08/14	HW3 Deadline	Regression
00/08/16	Probabilist Discriminative Classifier	Bishop Ch. 4.3
00/08/18	Decision Trees & Bagging	Bishop Ch. 14
00/08/22	HW4 Release	Classification
00/08/23	Boosting	Bishop Ch. 14
00/08/25	Classification Evaluation	Handout
00/08/30	K-Means, GMM	Bishop Ch. 9
00/09/02	Expectation Maximization	Bishop Ch. 9
00/09/05	HW4 Deadline	Classification
00/09/06	HW5 Release	K-Means, GMM, EM
00/09/07	Expectation Maximization	Bishop Ch. 9
00/09/09	MultiLayer Networks	Bishop Ch. 14
00/09/11	Thursday: Mini Exam I 9:00-10:30	Up to end of classification
00/09/13	Project release	
00/09/14	BackPropagation	Handout
00/09/16	Training models in practice	Handout
00/09/19	HW5 Deadline	K-Means, GMM, EM
00/09/21	CNNs	Handout
00/09/23	CNNs	Handout
00/09/28	CNN	Handout
00/09/30	ML Ops	Handout
00/10/05	ML Ops	Handout
00/10/07	ML Ops	Handout
00/10/09	Thursday: Mini Exam II 9:00-10:30	Up to end on deep
00/10/12	ML Ops	Handout
00/11/05	**Final Exam 9:00-12:00**	**Comprehensive**
00/11/15	Project deadline	