CE729: Statistical Machine Learning (SML)
Department of Computer Engineering
Sharif University of Technology
Spring 2023: Sunday & Tuesday: 13:30-15:00
Class Location: CE-201

Instructor:

Hamid R. Rabiee

Office: CE-804
Web: http://sharif.edu/ rabiee
Email: rabiee@sharif.edu
Tel: +98 21 6600 6399

Course Online Information:

Course Website: https://sml-sut.github.io
Course Quera: https://quera.org/course/13170

Lead TA:

Sayyid Mohammad Javad Feyzabadi Sani

Office: CE-803
Email: smjfas@gmail.com

TAs:

Mohammad Ostadmohammadi

Office: CE-803
Email: mohammad.ostad73@gmail.com

Rassa Ghavami Modegh

Office: CE-803
Email: rassa.gh@gmail.com

Gita Sarafraz

Office: CE-803
Email: gita.sarafraz@gmail.com

Amir Pourmand: pourmand1376@gmail.com,
Mehran Hosseinzadeh: mehran.hosseinzadeh1@gmail.com
MohammadAli Sadraei Javaheri: mohammadalisadraei@gmail.com
Morteza Abolghasemi: a.re.morteza@gmail.com
Mahsa Yazdani: mah.yzdni@gmail.com
Aryan Ahadinia: aryan.ahadinia@sharif.edu

Course Description:
The course is designed for Ph.D. and MS students. We will cover advanced topics in statistical machine learning, including non-parametric Bayesian methods, Gaussian Processes, Point Processes, Graphical Models, Differential Privacy, and Interpretable Machine Learning. We would also study these topics in the context of deep neural networks. Students are required to take quizzes, deliver presentations on some state-of-the-art methods, complete a course project, take the final exam, and participate actively in class discussions.

Textbooks & References:

1. P. Orbanz, Lecture Notes on Bayesian Nonparametrics, 2014.
2. Carl E. Rasmussen, Christopher K. I. Williams, Gaussian Processes for Machine Learning, the MIT Press, 2006.
3. Jakob Gulddahl Rasmussen, Aspects of temporal andspatio-temporal processes, PhD Thesis, Department of Mathematical Science, Aalborg University, 2006.
4. Daryl J. Daley, and David Vere-Jones, An introduction to the theory of point processes. Vol. 2. New York: Springer, 1988.
5. I. Goodfellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016.
6. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning: An Introduction, 2nd Edition, MIT Press, 2016.
7. Selected Research Papers.

Grading:
Based on your performance on Presentations, Quizzes, Project and Final Exam. The grade will be determined by:

- Class Activity: 10%
- Quiz: 20%
- Presentation: 25%
- Project: 20% + 5% (Extra)
- Final Exam: 25% (Comprehensive)

Quiz and Exam:
We would have 6 quizzes (including a short in class quiz and a take home quiz) at the beginning of the lecture as stated in the class tentative program (in class or take home). Your lowest quiz would be dropped. Each quiz will cover the concepts discussed in the previous week in class or during the presentations. Therefore, use your Fridays to study! There will be a final exam. The exam is comprehensive and mostly contains conceptual questions on main topics that have been discussed during the entire course.

Presentations:
Each group would have 5 presentations during the semester. We cover 5 main topics. I will assign research papers to each group on those topics. All the group members should read the papers and would have a 30 minute presentation (20 min. + 10 min. discussion). Each presentation should discuss the importance of the problem, the proposed solution, the pros and cons of the proposed methods, and direction for feature research. A power point presentation and a brief report in the form of a tutorial should accompany each presentation.

Project:
A project will be assigned to each group. All the members of the group are required to actively contribute in solving the problem posed in the project. The projects are due a week after your final exam. It is possible that some of the projects may become eligible for submission to high ranking journals or conferences. However, any submission is subject to approval of your current advisors or their participation in submission of the paper as a co-author. Each team is expected to turn in a project report. You are required to include a section that clearly outlines the contributions of each of the team members. We encourage you to include the following sections in your report:

- Abstract: A brief explanation of your work.
- Introduction: This section should include a brief explanation of your problem and its importance. You should briefly explain your basic approach and your main conclusions. A graphical abstract is often helpful to motivate the work.
- Related work: This section should highlight previous work related to your problem, and should put your work in a broader context. It may also include a comparison of why previous approaches could not be used to solve your particular problem.
- Method: Here you should formally define your problem, and describe the method you have implemented to solve the problem in detail. Include any simplifying assumptions that you make about your data or the general problem. You should enumerate any modeling choices that you had to make and justify your choices.
- Data and Experiment setup: Include details about your data, what variables you have access to, and your preprocessing choices. You might find it useful to include a table with population characteristics, or an example of the data available both before (i.e. the original data), and after any pre-processing (i.e. feature construction), to make the discussion concrete. Describe your benchmark.
- Results: Report the quantitative results of your analyses. You may choose to present graphs or tables, the important thing is that your tables and plots should summarize the relevant results that you got out of the analysis. Comment on these results: are they statistically significant? Do you do significantly better than your benchmarks?

- Discussion: Highlight how your results relate to your original question formulation. Do they support your hypothesis? Discuss limitations with your analyses and how they might motivate future research directions.

Statement on Collaboration, Academic Honesty, and Plagiarism:

We encourage working together whenever possible on your assignments. Discussing the course material with your classmates is a great way to learn. However, please make sure to present your own contributions, independently. There will be a zero-tolerance policy for cheating and copying others works.

Refer to the last page for a detailed tentative schedule.
Enjoy the course: Good luck!

Session	Topic	In Class	Take Home
01/11/16	Non-Parametric Bayesian (NPB) I		
01/11/18	NPB II		
01/11/23	Non-Parametric Gaussian Process (GP) I	Quiz0(Prerequisite)	
01/11/25	Non-Parametric GP II		TH-Quiz1(GP)
01/11/30	Non-Parametric Point Process (PP) I	Quiz1(NPB/GP)	
01/12/02	Non-Parametric PP II		TH-Quiz1 Due
01/12/07	Presentation I: NPB/GP/PP		TH-Quiz2(PP)
01/12/09	Dirichlet Process (DP)	Quiz2(NP-PP)	
01/12/14	Chinese Restaurant Process (CRP)	Course Project Released	
01/12/16	Indian Buffet Process (IBP)		TH-Quiz2 Due
01/12/21	Presentation II: DP/CRP/IBP		TH-Quiz3(DP)
01/12/23	Probabilistic Graphical Models (PGM) I	Quiz3(DP/CRP/IBP)	
02/01/01	Nowruz (ends: 02/01/13)		
02/01/15	PGM II		TH-Quiz3 Due
02/01/20	PGM III		
02/01/22	PGM IV		TH-Quiz4(PGM)
02/01/27	Presentation III: PGM		
02/01/29	Privacy I	Quiz4(PGM)	
02/02/03	Eid al-Fitr		
02/02/05	Privacy II		TH-Quiz4 Due
02/02/10	Privacy III		
02/02/12	Privacy IV		Quiz5(Privacy)
02/02/17	Presentation IV: Privacy		
02/02/19	Interpretable Machine Learning (IML) I	Quiz5(privacy)	
02/02/24	IML II		
02/02/26	Holiday		TH-Quiz5 Due
02/02/31	IML III		TH-Quiz6(IML)
02/03/02	Presentation V: IML		
02/03/07	NPB Applications I	TH-Quiz6(IML)	
02/03/09	NPB Applications II		TH-Quiz6 Due
02/04/04	**Final Exam**	**Comprehensive**	**09:00-12:00**