Modeling and Evaluation

Fall 2014

Instructor:	Arman Shokrollahi	**Time:**	F 14:00 – 17:00
Email:	teach @ shokrollahi . org	**Place:**	107 Engineering Bldg.

Course Pages:

1. http://armanshokrollahi.com/teaching/AeLP/

2. http://armanshokrollahi.com/teaching/f14/model

Office Hours: After class, or by appointment, or post your questions in the forum provided for this purpose on AeLP.

Main References: This is a restricted list of various interesting and useful books that will be touched during the course. You need to consult them occasionally.

- Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer, 2006.

- Peter J. Carrington, John Scott, and Stanley Wasserman, *Models and Methods in Social Network Analysis*, Cambridge University Press, 2005.

- Richard O. Duda, Peter E. Hart, and David G. Stork, *Pattern Classification*, Wiley, 2nd ed., 2000.

- Peter Flach, *Machine Learning: The Art and Science of Algorithms that Make Sense of Data*, Cambridge University Press, 2012.

- Trevor Hastie, Robert Tibshirani, and Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, Springer, 2nd ed., 2009.

- David Insua, Fabrizio Ruggeri, and Mike Wiper, *Bayesian Analysis of Stochastic Process Models*, Wiley, 2012.

- Michael I. Jordan, *Learning in Graphical Models*, MIT Press, 1999.

- Daphne Koller, and Nir Friedman, *Probabilistic Graphical Models: Principles and Techniques*, MIT Press, 2009.

- Timo Koski, and John Noble, *Bayesian Networks: An Introduction*, Wiley, 2009.

- Dirk P. Kroese, and Joshua C. C. Chan, *Statistical Modeling and Computation*, Springer, 2014.

- Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.

- Mark Newman, *Networks: An Introduction*, Oxford University Press, 2010.

- Sheldon M. Ross, *Introduction to Probability Models*, Academic Press, 9th ed., 2006.

- Reuven Y. Rubinstein, and Dirk P. Kroese, *Simulation and the Monte Carlo Method*, Wiley, 2nd ed., 2007.

- Henk C. Tijms, *A First Course in Stochastic Models*, Wiley, 2nd ed., 2003.

Objectives: This course is primarily designed for graduate students, and will introduce an audience to the state-of-the-art in modeling techniques for computer science and engineering majors. We try to discuss as many models as possible. We chiefly focus on complex networks, inference, machine learning, and probabilistic/statistical models and methods.

At the end of the course, a successful student should be able to:

- understand and identify various models and know how and when to use them,

- comprehend and implement the most popular models and learning algorithms,

- perform experimental set up on real situation,

- develop an advanced-level understanding of statistical inference procedures,

- analyze, and make inferences and decisions.

Prerequisites: Being familiar with (or eager to learn) at least MATLAB, C++, Julia, R, OpenBUGS, and Infer.NET is essential, as we will visit them all in assignments. An undergraduate-level understanding of probability, statistics, graph theory, algorithms, and linear algebra is assumed.

Tentative Course Outline:

> A little of probability theory and graph theory
> Generative models
> Markov models and queues
> Markov chain Monte Carlo
> Gaussian models
> Linear models
> Graphical models
> Mixture models
> Support vector machines
> A glimpse of complex networks (e.g. social and biological networks)

Grading Policy: Homework and quizzes (20%), Midterm 1 (25%), Midterm 2 (25%), Final (30%).

Important Dates:

> Midterm #1 .... Ābān 16, 1393 ≡ November 7, 2014
> Midterm #2 .... Āzar 21, 1393 ≡ December 12, 2014
> Final Exam .... Dey 18, 1393 ≡ January 8, 2015

Course Policy:

- Please sign up for AeLP. I will confirm your enrollment for the course, then you will be able to see the course page.

- We have weekly homework and quiz. You will be given a quick quiz (based on the given homework) on the day that the homework is due. You are allowed to use your homework solutions to help you on the quiz, but not anything else.

- Late homework will never be accepted. Homework not submitted online before the deadline and/or not turned in with the quiz will be considered late.

- Homework solutions must be typeset (preferably using LaTeX), and all programming codes should be well documented.

- Nearly perfect solutions may be considered as an official solution of that homework and will be uploaded to the course web site, and the student gets a bonus mark.

- All homework solutions, programming codes, etc., must be submitted both electronically (through AeLP) and in class (along with the quiz). For electronic submission, create a folder (directory) on your computer, put your files all in there, zip the package, and submit it once you get them done. You can submit your files only once, and you are NOT allowed to edit the files after submission, so read/edit your files carefully before submission. If there is something that you would like me to know while grading your assignment, please write it in the comment box above the submit button or create a file called `README` in that directory and write your message there. So, please do not mail your homework solutions, codes, etc to me.

- You may discuss homework problems with other students, but you must write up your homework independently in your own words. You are not allowed to search the Web for solutions, as AeLP is equipped with a built-in plagiarism detector.

- Your lowest homework-quiz score will be dropped when calculating your final homework-quiz grade.

- The exams may or may not be take-home. If not, by default, all exams (midterms and final) are closed book, and you are not allowed to use any electronic devices such as mobiles and tablets.

Class Policy:

- Regular attendance is essential and expected. A student who incurs an excessive number of absences may be withdrawn from the class at the instructor's discretion.

- Be courteous when using mobile devices. Make sure your cell phone is turned fully off, or silent. No texting, reading emails, playing games, or whatever else it is that people do with those wretched gizmos.

- If you must use a laptop in class, then turn off the sound and do not type on laptop keyboards which is really distracting.

- Missing one class could easily lead to a disastrous domino effect. If you have to miss a lecture, then I strongly recommend you study the material you missed before you return to class. I require that you know all material covered in class. You are responsible for making up anything that was covered in lectures you missed. If you miss a lecture, I recommend doing the following:

  - Photocopy, and read notes from someone who was in class,
  - Reading the relevant sections from the lecture note, texts, Wikipedia, etc.

  After you have done this, you may contact me if you need clarification on any materials.

Academic Honesty: Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Questions related to course assignments and the academic honesty policy should be directed to the instructor.

☞ I certainly impose a sanction on the student committed to any academic fraud. It varies depending upon the instructor's evaluation of the nature and gravity of the offense. Possible sanctions include but are not limited to, the following: (1) Require the student to redo the assignment; (2) Require the student to complete another assignment; (3) Assign a grade of **zero** to the assignment; (4) Assign a final grade of **zero** for the whole course.

Install LaTeX on Linux: In case you do not have LaTeX installed on your PC, open the terminal and write the following commands (it may take a couple of hours):

```
1   $ sudo apt-get install texlive-full
```

In addition, you need a text editor. There are many text editors on the internet, but I myself prefer Texmaker and TeXstudio. If your Linux version is new (higher than 12.10), TeXstudio is available in the Repositories.

```
1   $ sudo apt-get install texmaker
2   $ sudo apt-get install texstudio
```