

# ECE523: Engineering Applications of Machine Learning and Data Analytics

## § Course Details

Instructor	Gregory Ditzler (Dept. of ECE)
Instructor Email	<a href="mailto:ditzler@email.arizona.edu">ditzler@email.arizona.edu</a>
Course Websites	<a href="https://d2l.arizona.edu">https://d2l.arizona.edu</a> <a href="https://piazza.com/arizona/spring2017/ece523">piazza.com/arizona/spring2017/ece523</a>
Lecture Times	MWF 10-10:50AM
Lecture Room	Harvill Bldg, RM404
Instructor Office Hour	ECE Bldg 556D F 2–4PM All other times are by appointment only.

## § Catalog Description

Machine learning deals with the automated classification, identification, and/or characterizations of an unknown system and its parameters. There are an overwhelming number of application driven fields that can benefit from machine learning techniques, such as self-driving cars, practical speech recognition, and teaching a computer to play a game. This course will introduce you machine learning and develop core principles that allow you to determine which algorithm to use, and/or design a novel approach to solve your engineering task. This course will also use software technology to supplement the theory learned in the class with applications using real-world data.

## § Prerequisite

ECE 503 (Probability and Random Processes for Engineering Applications) and knowledge of linear algebra.

## § Textbook Required

- “Introduction to Machine Learning,” E. Alpaydin, MIT Press, 2010, 2nd Ed.

## Recommend (and reference)

- “Machine Learning: A Probabilistic Perspective,” K. Murphy, MIT Press, 2012.
- “Elements of Statistical Learning Theory,” T. Hastie, R. Tibshirani, and J. Friedman, Springer, 2008.  
<http://statweb.stanford.edu/~tibs/ElemStatLearn/>
- “Pattern Classification,” R. Duda, P. Hart, and D. Stork, Wiley-Interscience, 2000.
- “Pattern Recognition and Machine Learning,” C. Bishop, Springer, 2007.

## § Software

You will be required to use Python to work on assignments throughout the course. Python is freely available for your local computer; however, it is very unlikely that computers in the campus labs will have it installed. It is recommended that you install the Anaconda distribution of Python ([www.continuum.io](http://www.continuum.io)). We will also use Google’s TensorFlow ([www.tensorflow.org](http://www.tensorflow.org)) for

implementing neural networks.

### § Grading

Your final numerical grade will be computed as follows.

Homework (5)	25 points
Mid-term Exams (2)	30 points
Scribe Notes	5 points
Project	40 points
Total	100 points

Your course letter grade will be assigned based on your final numerical grade as follows.

90	100	A
80	89	B
70	79	C
60	69	D
0	59	E

### § Topics

Week	Topic	Assignment
#0	Linear Algebra & Probability Refresher / Python <a href="https://developers.google.com/edu/python/">https://developers.google.com/edu/python/</a>	
#1	Introduction / Foundations	HW 1 Assigned
#2	Bayes Decision Theory / Discriminate Functions	
#3	Logistic Regression / Density Estimation	HW 2 Assigned HW 1 Due
#4	Dimensionality Reduction / Feature Selection	
#5	Optimization / Multi-Layer Perceptrons	HW 3 Assigned HW 2 Due
#6	Neural Networks / Deep Learning	
#7	Support Vector Machines / Risk Minimization	HW 4 Assigned HW 3 Due
#8	Exam / Mixture Models	Project Proposal
#9	Clustering / Unsupervised Learning	HW 5 Assigned HW 4 Due
#10	Decision Trees / Ensemble Classifiers	
#11	Boosting / PAC Models	HW 5 Due
#12	Online Learning / Multi-Arm Bandits	
#13	Exam / Applications	
#14	Big Data & Map-Reduce	
#15	Convolutional & Recurrent Neural Networks	
#16	Advanced Topics & The Future of ML	Final Report

### § Homework Submission Policy

You **must** submit all of the code, data, and pdf files in a zip folder (i.e., not rar, 7z, etc). Furthermore, each homework will have a theory and practice section. You must include a single pdf file

with the solutions to both the theory and practice components to the homework. Failure to follow any/all of these policies leaves the instructor the option to not grade the homework based on a failure to follow the homework submission policy.

### § Course Project

A final project to help you put all course-developed skills to work will be assigned. You will have a minimum of one month to work. All project ideas must be pre-approved by the instructor for appropriate scope and depth. Groups of two are welcome.

Graduate students are expected develop a novel technique, either from scratch, or by suitably modifying an existing technique for a specific problem of your interest; test it on at least five standard benchmark databases available at the UCI Machine Learning Repository or Kaggle. If this is an application specific project, then it should be tested on the data generated by that application. Many data sets are available through a link in this paper: <http://jmlr.org/papers/v15/delgado14a.html>.

Projects are expected to be of conference submission quality (i.e., some level of novelty is required). Many machine learning related conferences have deadlines after the semester ends and you're encouraged to submit your work with your advisor.

### § Academic Integrity

Students are responsible for completing homework assignments by themselves, but may work on strategies to complete the assignments with other students. You are encouraged to work in teams on homework assignments, but copying a completed assignment of another student and submitting it as your own is considered a violation of academic integrity—and it will hurt you when it comes to the exams. Any take-home examinations *may not consist of any group work, even for problem strategies*.

Additional exceptions to this policy will be plainly marked in the requirements for that exercise or project. Any violations of this policy will be dealt with to the full extent permitted by the University of Arizona, and *may result in suspension or expulsion from the university, in addition to a failing grade*. Please familiarize yourself with the Code of Academic Integrity if you have any questions (see <http://deanofstudents.arizona.edu/codeofacademicintegrity>).

### § Threatening Behavior by Students

The University seeks to promote a safe environment where students and employees may participate in the educational process without compromising their health, safety, or welfare. The Arizona Board of Regents (ABOR) Student Code of Conduct, ABOR Policy 5-308, prohibits threats of physical harm to any member of the University community, including to one's self. Threatening behavior can harm and disrupt the University, its community, and its families. Threatening behavior is prohibited.

### § Accessibility and Accommodations

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268) to explore reasonable accommodation.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

**§ Subject Change**

The contents of this syllabus are subject to change at the instructor's discretion.