

# Syllabus

## Special Topics in Data Science, Mathematics for ML

### Course Description and Objectives:

This course covers fundamental knowledge of Linear Algebra, Matrix Decompositions, Vector Calculus, Gradient Descent and Optimization to advance students' understanding of supervised and unsupervised machine learning algorithms, including Generalized Linear Regression, Regularization, DNN and PCA. Students are recommended to take DATA 602 concurrently.

Throughout this course, students are expected to work on projects that involve applying Python including Numpy, Scipy, Pandas and Tensorflow to replicate commonly used machine learning algorithms. All classes will involve hands-on coding alongside instruction with lecture notes. I-Python notebooks are required during each session. In addition to the learning experience, one objective of the course is to better prepare students for the DS & MLE job market.

### Course Info:

Instructor: Xin Xue; [xxue@umbc.edu](mailto:xxue@umbc.edu)

Office hours: TBD

Textbook: <https://mml-book.github.io/>

### Grades and Expectations:

Quizzes, in-class participation (15%). Students are expected to review previous materials before your following class. Students are also expected to ask constructive and challenging questions during each lecture. Students should explain their thought processes instead of giving mere answers. Projects and Assignments (50%). Most projects are group projects. Group assignment changes every 2 weeks, and you can opt-in for a 1-person group. Final Project/Test (35%) TBD.

### Code of Conduct:

Copy-and-pasting others' work including but not limited to code, data without proper reference is considered academic dishonesty. This includes borrowing others' code and changing the placeholders, variable names, spacing and/or formats. Both the instructor and students are expected to respect others, demonstrate professionalism, and thoughtfulness. Improper behaviors such as physical/verbal violence, (sexual) harassment, arrogance and academic dishonesty will be treated seriously and escalated. See this [link](#). Personal beliefs and political views shall not be discussed in and out of the class. Accessibility and Disability Accommodation: please see this [link](#), and reach out to the instructor via email.

## Course Schedule:

Date	Topics
9/13	Overview of Linear Algebra and Applications in ML
9/20	System of Equations, Matrix Inversion, Rank
9/27	Vector Space, Analytic Geometry, Norms
<b>10/4 (Proj 1 Assigned)</b>	Application: OLS Closed-form
10/11	Matrix Determinant and Decomposition
10/18	Eigenvalues and Eigenvectors
<b>10/25 (Proj 2)</b>	Application: Principal Component Analysis
11/1	Calculus Revisit, Chain Rule
<b>11/8 (Proj 3)</b>	Vector Calculus, Gradient
11/15	Optimization and Gradient Descent
<b>11/22 (Proj 4)</b>	Application: Logistic Regression using GD
11/29	Constrained Optimization and Regularization
12/06	Backpropagation and Tensorflow
<b>12/13 (Proj 5)</b>	Application: Deep Neural Networks