Syllabus, MAP 5114 Basic Math for Machine Learning, Class Number 19239
Spring 2024

Sources: Deisenroth, M., A. Aldo Faisal, Ch. S. Ong "Mathematics for Machine Learning" **ISBN-10 :** 110845514X **ISBN-13 :** 978-1108455145

Excerpt from the preface of the book:

We appreciate that Cambridge University Press strongly supports our aim to democratize education and learning by making this book freely available for download at

https://mml-book.com

where tutorials, errata, and additional materials can be found.

Synopsis: This course is intended to be a quick, but rigorous, introduction to some math used in studying data. Arguably, most, if not all, of "pure" math was developed for that purpose! It is impossible to cover even a small part of all that in a one-semester course. The course's goal instead is to emphasize on the most popular and classical methods developed in areas such as Linear Algebra (including Matrix Theory and Analytic Geometry), Multivariate Analysis, Continuous Optimization, and Probability and Statistics. An overview of these methods constitutes the first part of the book we will be using as a source.

Everyone of the mentioned areas can be studied taking courses from the grad program in math at FIU. This course is different in form and shape from those courses. The choice of the areas and the methods studied in this course are motivated by their remarkable applications to Machine Learning. Our goal is to distill from those areas the facts that pertain to the applications we are interested in. The second part of the source book is devoted to some of them.

Without going too much afield, we also plan to add a bit to what the book contains on the subject. For example, as much as the time permits, we will include a discussion on non-linear regression, logistic regression, k-nearest neighbor, k means clustering, the "kernel trick", and decision trees.

Loosely speaking, from mathematical perspective (supervised) Machine Learning is about approximating unknown functions (continuous or discrete), and optimizing that process. A very efficient method for approximation and optimization is provided by the Neural Networks. We will pay the needed attention to them, too.

This course will barely touch, if at all, the theory of learning using algorithms. We will be discussing the mathematical aspect of the algorithms used.

Course Policy: The overall grade will be based on the results on several Turn-in Homework
Assignments, Midterm, and Final Exam. All the problems for the exams will be taken from the ones
given for work at home during the Semester. The novelty here is in two specific features of the course. It is designed for both under- and graduate students. On the exams, the students will have the opportunity to work on problems for their respective levels. In particular, the students will be asked to give proofs of selected theorems from the course. Those will reflect the level of the students as well. The overall grade will be based on 30% of the Turn-in homework's total score, 30% of the total of the Midterms' scores, and 40% of the Final Exam score. The scale for the overall grades follows:

Example: Suppose a student has A points total on the HW, B points total on the Midterm Exams, and C points on the Final Exam. Suppose further that the maximal possible points one can get on these are A', B', C', and D' respectively. Then, one can compute a number S by the formula

$$S = [30*A + 30*B + 40*C] / [30*A' + 30*B' + 40*C'].$$

The overall grade of the student above is determined now by the scale:

$$0.92 < S : A \qquad 0.89 < S < 0.92 : A-$$
$$0.86 < S < 0.89 : B+ \quad 0.78 < S < 0.86 : B \quad 0.75 < S < 0.78 : B-$$
$$0.71 < S < 0.75 : C+ \quad 0.62 < S < 0.71 : C \quad 0.58 < S < 0.62 : C-$$
$$0.55 < S < 0.58 : D+ \quad 0.49 < S < 0.55 : D \quad 0.46 < S < 0.49 : D-$$
$$S < 0.46 : F$$

No make-up exams will be scheduled.

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For additional assistance please contact FIU's Disability Resource Center

Important note: The Instructor reserves the right to make any changes he considers academically advisable. Any such changes will be announced in advanced in class or by posting them to the e-mail accounts of the students. The students are responsible to be aware of the changes announced this way.