Fall 9-1-2021

M 514.01: Topics in Applied Mathematics - Linear Algebra and Optimization for Machine Learning

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M514 – Linear Algebra and Optimization for Machine Learning
(Fall 2021)

Instructor information:

Instructor: Javier Pérez-Álvaro
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Office hours: See http://www.umt.edu/people/perezalvaro for up-to-date OH.

Course Format:
Meetings: Monday, Wednesday, Friday 2:00-2:50 pm.

Course content:

1. Vector norms and distances. The k-nearest neighbors classification algorithm. The k-means clustering algorithm.
2. Three factorizations from linear algebra: the LU-factorization, the QR-factorization and the eigenvalue factorization. The PageRank algorithm.
3. Symmetric and positive definite matrices.
4. Positive definite matrices in Machine Learning: The graph Laplacian matrix and the Hessian.
5. Applications of positive definite matrices: linear discriminant analysis, multidimensional scaling, graph spectral partitioning, spectral embedding, spectral clustering.
6. The singular value decomposition. Image compression, topic modeling, and principal component analysis.
7. Linear and nonlinear least squares problems.
8. Convex optimization. Logistic regression and support vector machines

Textbook: None

Getting Python:
You can download Python from Python.org. If you do not already have Python, I recommend instead installing the Anaconda distribution (www.anaconda.com), which already includes most of the tools that you need to do Machine Learning/Data Analysis

Homework
Homework exercises emphasizing applications of the algorithms and/or theory will be assigned weekly.

Grading policy:

Your course grade will be based on homework and a take-home exam

Item	Percentage
Homework	80%
Take-home exam	20%

Student Conduct:

All students need to be familiar with the Student Conduct Code. You can find in the "A to Z Index" on the UM home page. All students must practice academic honesty. Academic misconduct is subject to an academic penalty by the course instructor and/or a disciplinary sanction by the University.

Accommodation:

The University of Montana assures equal access to instruction through collaboration between students with disabilities, instructors and Disability Services for Students (DSS). If you think that you may have a disability adversely affecting your academic performance, and you have not already registered with DSS, please contact DSS in Lommasson Center 154 or call 406.243.2243. I will work with you and DSS to provide an appropriate accommodation.

Safety:

1. Mask use is required within the classroom.
2. Each student is provided with a cleaning kit. The expectation is that students will clean their personal workspace when they arrive for class, and before they leave the classroom.
3. Students are discouraged from congregating outside the classroom before and after class.
4. Drinking liquids and eating food is discouraged within the classroom.
5. Stay home if you feel sick and/or if exhibiting COVID-19 symptoms.
6. If you are sick or displaying symptoms, please contact the Curry Health Center at (406) 243-4330.

Digital Access:

Digital devices (like laptops and cell phones) are becoming increasingly important to success in college. I recognize that some students are unable to afford the cost of purchasing digital devices and that other students rely on older, more problem-prone devices that frequently break down or become unusable. I also recognize that those technology problems can be a significant source of stress for students. Given those challenges, I encourage students to contact me if you experience a technology-related problem that interferes with your work in this course.

Important note:
Announcements made in class are considered addenda to this syllabus. Make sure you stay informed as the progress of the class.