AMATH 352: Applied Linear Algebra and Numerical Analysis
(3 credits)
For students enrolled on campus / online

Instructor	TBA
Contact Info	Email, office location
Quarter	Quarter Year
Lecture Days/Times	TBD
Location	TBD
Office Hours	TBD
TA	TBD
TA Office hours	TBD

Overview
AMATH 352 is an introduction to matrix theory and its applications to various scientific and Welcome to AMATH 352. This is an introductory course to numerical linear algebra covering fundamental topics in the field. There will be a large coding component to the class, with an emphasis on applications to data science. We will use MATLAB or Python.

Catalog description
Analysis and application of numerical methods and algorithms to problems in the applied sciences and engineering. Applied linear algebra, including eigenvalue problems. Emphasis on use of conceptual methods in engineering, mathematics, and science. Extensive use of MATLAB and/or Python for programming and solution techniques.

Learning Objectives
In this course you will implement methods and tools from linear algebra. You will learn to:

- Understand and apply theorems from linear algebra
- Implement fundamental algorithms from linear algebra

Many students enjoy the dual nature of this course --- both theory (linear algebra) and computation (MATLAB or Python). But with this luxury comes potential complications. It is possible to understand linear algebra but struggle with the computation component of the course, and vice versa. So, it is imperative to make use of all resources that are available (instructor, TA, etc.).

Textbooks and Reading Material
We will be using Applied Linear Algebra by Peter J Olver and Chehrzad Shakiban (student solutions manual). An electronic copy of this book is available free of charge through SpringerLink @ UW Libraries. This text will be supplemented with notes and code.

Prerequisites
MATH 126 or MATH 136

Course Outline

1. Introduction to (or review of) basic linear algebra and coding basics
    - Vectors and vector spaces, linear independence and dependence, dimension of a vector space. Orthogonal vectors and the Gram-Schmidt algorithm. Matrix arithmetic. Ways of looking at matrix-vector and matrix-matrix multiplication. Solving triangular linear systems.
2. Floating point arithmetic, conditioning of problems, stability of algorithms
    - How does computer arithmetic work? Are there problems that one cannot expect to solve using computer arithmetic? If a problem is solvable using floating point arithmetic, will your algorithm return a solution that is as accurate as you could hope for?
3. Solving linear systems
    - Using factorizations to solve linear systems
    - Applications
4. The eigenvalue decomposition
    - The power method, inverse iteration/Rayleigh quotient iteration, QR iteration.
    - Spectral clustering, Google's page rank algorithm
5. The singular value decomposition
    - What is the SVD? Principal component analysis.
    - Image compression via the SVD.
6. Least squares problems
    - The normal equations
    - Using factorizations to solve least squares problems
    - Regression, digit identification via least squares, fitting polynomials to data.

Assessment

The grade breakdown for the course is:

- Coding projects 50%
- Weekly homework 30%
- Final project 20%

Canvas

The Canvas course management system is the primary means of interaction and participation. The Canvas course site will provide:

- Access to lecture videos
- News and announcements
- A general discussion forum for students, the TA, and instructor
- Archived lecture notes
- Assignment posting and submission
- Students should post course related questions to the general discussion forum for instructor, TA, and peer responses and discussion.

Academic Misconduct

Students at the University of Washington are expected to practice high standards of professional honesty and integrity as described in the Student Academic Responsibility statement: http://depts.washington.edu/grading/pdf/AcademicResponsibility.pdf

Accommodation
Your experience in this class is important to me. If you have already established accommodations with Disability Resources for Students (DRS), please communicate your approved accommodations to me at your earliest convenience so we can discuss your needs in this course.

Incompletes
An incomplete grade (I) is given only when a student has done satisfactory work up until the last two weeks of the quarter but cannot complete the remaining work because of illness or other circumstances beyond the student's control.

Inclusivity
Among the core values of the university are inclusivity and diversity, regardless of race, gender, income, ability, beliefs, and other ways that people distinguish themselves and others.

Religious Accommodation
Washington state law requires that UW develop a policy for accommodation of student absences or significant hardship due to reasons of faith or conscience, or for organized religious activities. The UW's policy, including more information about how to request an accommodation, is available at Religious Accommodations Policy (https://registrar.washington.edu/staffandfaculty/religious-accommodations-policy/). Accommodations must be requested within the first two weeks of this course using the Religious Accommodations Request form (https://registrar.washington.edu/students/religious-accommodations-request/).