MATH 307 Applied Linear Algebra

Course Outline 2024W1

Linear systems of equations, LU decomposition, condition number, orthogonal projection, QR decomposition, least squares approximation, orthogonal diagonalization, singular value decomposition, discrete Fourier transform. Applications: interpolation, differential equations, data fitting, principal component analysis, image deblurring, PageRank, digital signal processing. Matrix computations with mathematical software Python, SciPy and Jupyter.

Learning Goals

- Summarize properties and constructions of matrix decompositions LU, QR and SVD
- Perform matrix computations using mathematical software Python, SciPy and Jupyter
- Compute solutions of systems of linear equations using matrix decompositions
- Compute least squares approximations of linear systems using matrix decompositions
- Approximate eigenvalues and eigenvectors using numerical methods
- Analyze digital signals using the discrete Fourier transform
- Create and analyze mathematical models of real-world phenomenon

Instructors

Name	*Office*	*Email*
Elina Robeva (she/her)	MATX 1106	erobeva@math.ubc.ca
Sohail Akbari (he/him)	CEME 1051	soheil.akbari@ubc.ca
Ahmet Alacaoglu (he/him)	MATX 1114	alacaoglu@math.ubc.ca

Lectures

Section	*Instructor*	*Time*	*Location*
101	Elina Robeva	MWF 1–2pm	CHEM D200
102	Soheil Akbari	MWF 3–4pm	HENN 201
103	Ahmet Alacaoglu	TTh 8–9:30am	BUCH A103

Textbooks

MATH 307 Applied Linear Algebra	Linear Algebra with Applications
Scientific Computing	Mathematical Python

Canvas and Piazza

Announcements, assignments, grades, lecture notes and all other course information will be posted on Canvas. Please check it often! Use Piazza to ask and answer questions about lecture notes, textbook exercises, etc. Find the Piazza link on the Canvas course page.

Schedule

Hours	*Topics*
9	**Linear equations.** Gaussian elimination, LU decomposition, condition number. Applications: polynomial interpolation, cubic spline interpolation.
10	**Orthogonality.** Orthogonal subspaces, fundamental subspaces of a matrix, orthogonal projection, Gram-Schmidt orthogonalization, QR decomposition, least squares approximation. Applications: fitting models to data.
9	**Eigenvalues.** Diagonalization, spectral theorem, SVD, pseudoinverse, SVD expansion, power method. Applications: principal component analysis, image deblurring, PageRank.
6	**Discrete Fourier transform.** Complex vector spaces, discrete Fourier transform, sinusoids, frequency and phase. Applications: digital signal processing.
34	

Assessments

Canvas Quizzes	$4 \times 2.5\%$ each $= 10\%$
Python Assignments	$4 \times 2.5\%$ each $= 10\%$
Midterm Exams	$2 \times 20\%$ each $= 40\%$
Final Exam	40%

- Multiple attempts and collaboration allowed on Canvas quizzes
- Assignments do not require any prior Python experience
- Midterm exams scheduled during lecture time

Prerequisites

Linear Algebra	One of MATH 152, MATH 221, MATH 223
Multivariable Calculus	One of MATH 200, MATH 217, MATH 226, MATH 253, MATH 254

- See the UBC Course Schedule

Student Resources

Science Advising	Health and Wellbeing	Centre for Accessibility
Academic Concession	Academic Integrity	Counselling Services

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of

academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the UBC Senate website.