Math 6610: Analysis of Numerical Methods, I
Introduction and Hello

Department of Mathematics, University of Utah

Fall 2026

Math 6610

This is a PhD qualifying exam course:

- Regular homework assignments (∼weekly)
- A midterm and a final exam
- Exams are closed-book, closed-notes

Expectations/prerequisites:

- Undergraduate linear algebra
- Familiarity with proofs
- Familiarity with (basic) programming

What is this course about?

This is a graduate-level course in numerical analysis, intended to build on a similar undergraduate course you may have been exposed to before. (But we'll cover things in detail beyond the typical undergraduate level.)

If one wanted to prescribe a theme for this course, there are two major questions we seek to answer:

- How are eigenvalues (numerically) computed?
- How does one build accurate and stable approximations to functions?

These questions are relatively narrow, but cogent answers to these questions can be provided by exposure to diverse aspects of numerical analysis, and this is essentially what we'll do in this course.

This course is intended to prepare you for the next one in the sequence, MATH 6620, when solutions to ordinary/partial differential equations will be explored.

Some logistics

We'll always meet here (JWB 333) over the semester. I won't record/post lecture videos.

Online portals:

- The Math 6610 course website
  This is the primary location I'll post info: lecture slides and homework assignments.
- Canvas (accessible through your CIS portal)
  I'll post private information here, namely grades for your submissions and exams

Office hours: TBA, we'll discuss and finalize these later this week.
The grader will also run a weekly problem session. (Time TBD)

Your grade

Your grade in this course has three components:

- 25%: Homework assignments (about weekly, completion-based only)
- 15%: 1:1 discussions with me (completion-based only)
- 35%: Midterm Exams (3)
- 25%: Final exam

Attendance is not a factor in your grade.

Textbook

There isn't really a textbook for this course. Informally, we'll use the following book:

Lloyd N. Trefethen and David Bau (1997). *Numerical Linear Algebra*. SIAM: Society for Industrial and Applied Mathematics. ISBN: 0-89871-361-7

You should arrange to have a copy of this text.

However, we'll cover material that's some amalgamation of stuff from additional resources:

Kendall Atkinson (1989). *An Introduction to Numerical Analysis*. New York: Wiley. ISBN: 978-0-471-62489-9

Abner J. Salgado and Steven M. Wise (2022). *Classical Numerical Analysis: A Comprehensive Course*. Cambridge: Cambridge University Press. ISBN: 978-1-108-83770-5. DOI: 10.1017/9781108942607

Endre Süli and David F. Mayers (2003). *An Introduction to Numerical Analysis*. Cambridge: Cambridge University Press. ISBN: 978-0-521-00794-8. DOI: 10.1017/CBO9780511801181

Lloyd N. Trefethen (2012). *Approximation Theory and Approximation Practice*. Philadelphia: Society for Industrial and Applied Mathematics. ISBN: 978-1-61197-239-9

Homework

Assigned approximately weekly. Current plan:

- Due on Fridays at 5pm MT
- Submit online through Canvas/Gradescope (handwritten or typed solutions are fine, I'd suggest handwritten)
- Problem sets will cover material up through the previous Monday
- First assignment due next Friday, Sept 4. Material covered up through next Monday, Aug 31.
- Probably 3-6 problems per assignment, some with multiple parts
- Mostly proof-based, with some computing problems sprinkled in
- I <u>encourage</u> you to work with others. (But submissions must be individual.)

Grading procedure: 100% of grade based on completion
Will be awarded based on demonstrating effort for *all* problems on the assignment.

All assignments are equally weighted

Your lowest two homework assignment grades over the semester will be dropped in the computation

Exams

Four exams:

Midterm exam

- Friday, September 25; Friday, October 23; Monday, November 23 (all in-class)
- Each will cover $\sim$3 homework assignments worth of material.
- Closed-book, closed-notes, no computational assistance

Final exam

- Tuesday, December 15, 10:30-12:30 here (JWB 333)
- Is a cumulative exam
- Closed-book, closed-notes, no computational assistance

Slides and material

The material for this course is an amalgamation from a few sources.

Instead of listing all these sources as required, slides like this will be posted.

- I'll mark on slides during class meetings (to explain something, demonstrate a computation/proof, etc.)
- The course webpage will have PDFs of both the unmarked (clean) slides, and the marked slides.
- (I aim to ensure) slides will have references to appropriate text sections.
- I will also post notes online; these notes are a companion that covers the material in the slides in a more formal narrative style.

Course notes

There are LaTeX notes accompanying slides that I will post.
https://www.sci.utah.edu/~akil/docs/courses/2026fall/math6610/notes.pdf
(This link is currently broken... it will work around ∼Friday of this week.)

I'll periodically updates these notes with extra chapters corresponding to the material we have covered.

Homework assignments are problems taken from these notes. (So you'll have to access these anyway.)

The slides and notes contain duplicated information: You need only read one source, but reading both will probably be useful.

I *strongly recommend* you do some form of note-taking in class.
This is not to avoid missing content; the very act of writing concepts, proofs, problems, etc., promotes learning.

An overview of topics

Roughly speaking, this course will follow the anatomy:

- 3 weeks: linear algebra review/exposure
- 1 week: finite precision and numerical stability
- 2 weeks: core factorizations (LU, Cholesky, QR, SVD)
- 2 weeks: eigenvalue algorithms
- 2 weeks: numerical solutions to linear and nonlinear systems, optimization
- 2 weeks: Fourier approximation
- 2 weeks: polynomial approximation

(Cf syllabus calendar for an even more approximate but more detailed list of topics)

The use of AI/LLMs

Both exams are in-class and no resources (notes, books, computer, phone, calculators) are permitted.
So no use of AI tools for exams.

Submission of direct AI-generated content for homework is expressly forbidden. You may use AI to help with understanding how to solve problems, but you should understand how to complete problems yourself, and should compose and craft your own solutions.

“Why do any of this if AI can do it for me?”

The goal is (and has always been) for you to train to reason, think, plan, and execute an investigation. If there’s a “right answer”, it’s important to identify it, but it’s arguably more important to develop independent skills that allow you to reach that answer.

U policies and recommendations: AI & U Student Guide

General FYI: Leiden Declaration on AI and Mathematics

References

Atkinson, Kendall (1989). *An Introduction to Numerical Analysis*. New York: Wiley. ISBN: 978-0-471-62489-9.

Salgado, Abner J. and Steven M. Wise (2022). *Classical Numerical Analysis: A Comprehensive Course*. Cambridge: Cambridge University Press. ISBN: 978-1-108-83770-5. DOI: 10.1017/9781108942607.

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