Numerical Methods, Math 685 / OR 682
Fall 2022

- **Instructor:** Tyrus Berry, tberry@gmu.edu, `http://math.gmu.edu/~berry/`
- **Office:** Blackboard Collaborate
- **Office hours:** Thursdays 4:00pm-6:00pm (Eastern)
- **Course Website:** Blackboard, https://mymasonportal.gmu.edu/
- **Book:** Numerical mathematics, by Alfio Quarteroni, Riccardo Sacco, and Fausto Saleri, SECOND EDITION (2007)

  The book is available free as a PDF from the Library (click to view)
- **Topics:** The course will cover portions of Chapters 1-12 of the text.
- **Course Goals:** Mathematical analysis and implementation of algorithms for the solution of scientific and engineering problems.
- **Classroom:** Synchronous meeting on Blackboard Collaborate (recorded, attendance optional) Tuesdays 4:30pm-5:45pm. Remaining lectures will be asynchronous.

Approximate Weekly Schedule

- Week 1: Sources of Error, IEEE Floating Point Arithmetic, Interval Arithmetic, Loss of Precision
- Week 2: Stability of numerical methods, condition number, Taylor series and Big-O, Linear Systems
- Week 3: Gaussian Elimination, LU factorization, Matrix square roots, Cholesky factorization
- Week 4: Linear least squares, Normal equations, Gram-Schmidt, Given Rotations, Householder Transforms
- Week 5: Eigensolvers, Power iteration, inverse iteration, QR iteration, SVD
- Week 6: Nonlinear equations, Bisection, FPI, Newton's method, Secant/Broyden's method
- Week 7: Approximation theory, polynomial approximation (Taylor, Lagrange, Hermite, Chebyshev) and error bounds
- Week 8: Polynomial of best approximation, Piecewise approximation
- Week 9: Numerical integration and differentiation
- Week 10: Numerical solutions to ODEs
- Week 11: Numerical solutions to PDEs
- Week 12: Stability, Consistency, Convergence, Lax-Equivalence Theorem
- Week 13: Iterative solvers, Jacobi method, Gauss-Seidel method, SOR method
- Week 14: Sparse solvers, preconditioning, Krylov subspaces

Office Hours

Office hours will all be held online via Blackboard Collaborate.

Student Engagement: Weekly Learning Plan

Your week should be split up into three study periods (on three different days) each consisting of:

1. Viewing a short lecture video on Blackboard.
2. Reading a section or two in the book.
3. Working a quick "quiz" problem on Blackboard (unlimited attempts).

Your remaining time will be devoted to projects. Projects will have a large computational aspect and Matlab/Octave/FreeMat are highly recommended but alternatives such as Python may be acceptable, please discuss in advance if you would like to use an alternative language. Matlab is available free on a university license by registering at mathworks.com using your GMU email address.

1 Grading

- **Homework Projects:** 40%
  - **Homework should be submitted online via Blackboard in PDF format.**
  - Homework will be accepted late for up to $\frac{1}{2}$ credit and lowest grade will be dropped.
- **Cumulative Exams:** 40%
  - Midterm 1: Sept. 27th (tentative), 10%
  - Midterm 2: Nov. 1st (tentative), 10%
  - Final Exam: Dec. 7th, 20%
- **Blackboard Quizzes:** 20% (unlimited attempts)

Academic Policies

Mason is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. With collaborative work, names of all the participants should appear on the work. Collaborative projects may be divided up so that individual group members complete portions of the whole, provided that group members take sufficient steps to ensure that the pieces conceptually fit together in the end product. Other projects are designed to be undertaken independently. In the latter case, you may discuss your ideas with others and conference with peers on drafts of the work; however, it is not appropriate to give your paper to someone else to revise. You are responsible for making certain that there is no question that the work you hand in is your own. If only your name appears on an assignment, your professor has the right to expect that you have done the work yourself, fully and independently.

Disability Accommodations

Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process.

Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email: ods@gmu.edu
Phone: (703) 993-2474

Non-Discrimination Policy

George Mason University is committed to providing equal opportunity and an educational and work environment free from any discrimination on the basis of race, color, religion, national origin, sex, disability, veteran status, sexual orientation, gender identity, gender expression, age, marital status, pregnancy status or genetic information. George Mason University shall adhere to all applicable state and federal equal opportunity/affirmative action statutes and regulations.

The University is dedicated to ensuring access, fairness and equity for minorities, women, individuals with disabilities, and veterans (as covered by law) in its educational programs, related activities and employment. George Mason University shall thus maintain a continuing affirmative action program to identify and eliminate discriminatory practices in every phase of university operations.

Any employee who becomes aware of sexual harassment or other potentially discriminatory behavior must contact Compliance, Diversity, and Ethics.

Retaliation against an individual who has raised claims of illegal discrimination or has cooperated with an investigation of such claims is prohibited.