

Numerical Methods I, Fall 2018
Tentative Plan for Lectures, Reading and Homeworks
Will be Updated Weekly

#	Date	Topics	Reading	Homework
1	Sept 10	Floating point arithmetic and the IEEE standard, correctly rounded arithmetic, exceptions (including inf, NaN)	MO, Ch 1–7	hw1 due Sept 18
2	Sept 17	Orthogonal vectors and matrices, vector and matrix norms, the singular value decomposition (SVD) and low rank approximation, MATLAB's svd	T&B, Lec 1–5 *	hw2 due Sept 25
3	Sept 24	The QR factorization: projectors, Gram-Schmidt orthogonalization, Legendre polynomials, MATLAB's qr	T&B, Lec 6–9, * command-history	hw3 due Oct 2
4	Oct 1	Householder trangularization, linear least squares via the normal equations, QR and SVD. Polynomial interpolation and approximation via the Vandermonde matrix.	T&B, Lec 10-11	hw4 due Oct 10
5	TUES Oct 9	Conditioning and stability	MO, Ch 11–14, T&B, Lec 12–17, [T&B, Lec 18-19]	hw5 due Oct 16
6	Oct 15	Gaussian elimination and LU factorization, pivoting for stability, sparse LU factorization, MATLAB's backslash (\)	T&B, Lec 20–22	hw6 due Oct 23
7	Oct 22	Symmetric positive definite systems of equations: Cholesky factorization, conjugate gradient (CG) method, preconditioning.	T&B, Lec 23,38,40	hw7 due Oct 30
8	Oct 29	Methods for computing eigenvalues: reduction to Hessenberg or tridiagonal form, power iteration, inverse iteration, Rayleigh quotient iteration. Other methods. MATLAB's eig	T&B, Lec 24–27 * [T&B, Lec 28–31]	hw8 due Nov 6
9	Nov 5	Nonlinear equations: bisection, fixed-point iteration, Newton's method in several variables and its convergence analysis, Gauss-Newton method for nonlinear least squares	D&H, Sec 4.1–4.3	hw9 due Nov 13
10	Nov 12	Optimization: convexity, gradient descent, Newton's method with Hessian modifications when necessary, line search, Zoutendijk's theorem, convergence rates	N&W, Ch 1–3.4	hw10 due Nov 20
11	Nov 19	Polynomial interpolation: existence, uniqueness, error bound, Runge's phenomenon, Hermite interpolation, piecewise cubic interpolation, cubic splines	S&M, Ch 6 runge_demo	no hw
12	Nov 26	Chebyshev points and interpolants, Chebfun, Chebyshev polynomials and series, barycentric interpolation formulas	ATAP, Ch 1-5 [ATAP, Ch 16]	hw11 due Dec 4
13	Dec 3	Numerical integration in one dimension: trapezoidal and Simpson's rules, order of accuracy, asymptotic error expansion, Richardson extrapolation, Gauss quadrature	S&M, Ch 7, 10.1–10.2 [Six Myths]	hw12 due Dec 11
14	Dec 10	Arnoldi, Lanczos, GMRES and CG revisited	[T&B, Lec 32–37]	no hw
15	Dec 17	Final exam		

MO: [M.L. Overton, Numerical Computing with IEEE Floating Point Arithmetic, SIAM \(2004\)](#)

T&B: [Trefethen and Bau, Numerical Linear Algebra, SIAM \(1997\)](#)

D&H: [P. Deuffhard and A. Hohmann, Numerical Analysis in Modern Scientific Computing, Springer \(2003\)](#)

N&W: [J. Nocedal and S.J. Wright, Nonlinear Optimization, Springer \(2006\)](#)

S&M: [E. Süli and D. Mayers, An Introduction to Numerical Analysis, Cambridge University Press \(2003\)](#)

ATAP: [L.N. Trefethen, Approximation Theory and Approximation Practice, SIAM \(2013\)](#)

Six Myths: [L.N. Trefethen, Six Myths of Polynomial Interpolation and Quadrature \(Lecture, 2011\)](#)

* See also [these notes](#)

Readings in square brackets [...] are recommended but *not required* for the homeworks or the exam.