

Tentative Syllabus and Problem List for Math 550: Applied Linear Algebra

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Class meetings: MW 4:30–5:50 in Hill 423

Text: Gilbert Strang, *Linear Algebra and its Applications*, 3rd Ed., 1988,

ISBN #0=15-551005-3, Saunders/Harcourt Brace Jovanovich

| Date | Lecture | Reading | Topics |
|-------|---------|---------------------|---|
| 9/1 | 1 | 1.1–1.4 | Linear equations; Matrix algebra |
| 9/8 | 2 | 1.5 | Triangular, Diagonal, Permutation matrices; Gaussian elimination by matrix multiplication |
| 9/13 | 3 | 1.6 | <i>LU</i> and <i>LDU</i> factorizations; echelon form MatLab Assignment # 1 (due 9/20) |
| 9/15 | 4 | 2.1, 2.2 | Vector spaces and subspaces; solving $k \times n$ systems |
| 9/20 | 5 | 2.3 | Linear independence; dimension |
| 9/22 | 6 | 2.4, 2.6 | Column space; Null space; rank and nullity |
| 9/27 | 7 | 3.1, 3.2 | Linear transformations; orthogonal geometry; Inner products and projections Matlab Assignment # 2 (due 10/6) |
| 9/29 | 8 | 3.3 | Least squares approximations |
| 10/4 | 9 | 3.4 | Orthonormal bases; Gram-Schmidt process; <i>QR</i> factorization |
| 10/6 | 10 | 5.5 | Complex matrices; hermitian geometry; |
| | | 3.5 | Discrete Fourier Transform |
| 10/11 | 11 | 3.5, 3.6 | Fast Fourier transform; General vector spaces MatLab Assignment # 3 (due 10/25) |
| 10/13 | 12 | 3.6 | Sums of subspaces; Dimension formula |
| 10/18 | 13 | 4.1, 4.2 | Properties of the determinant function |
| 10/20 | 14 | 4.2, 4.3 | Formulas for determinants; Permutations |
| 10/25 | 15 | 4.4 | Determinant formulas for inverses; Cramer's rule |
| 10/27 | 16 | Midterm Exam | Closed book; On Chapters 1, 2, 3 |
| 11/1 | 17 | 5.1, 5.2 | Eigenvalues and eigenvectors; Diagonalization |
| 11/3 | 18 | 5.3, 5.4 | Difference and differential equations Matlab Assignment # 4 (due 11/15) |
| 11/8 | 19 | 5.4, 5.5 | Matrix exponentials; Hermitian and unitary matrices |
| 11/10 | 20 | 5.6 | Schur triangular form; diag. of Hermitian matrices; unitary equiv. |
| 11/15 | 21 | 5.6 | Normal matrices, Circulant matrices, Cayley-Hamilton Theorem |
| 11/17 | 22 | App. B | Similarity of matrices; Jordan canonical form; Application to differential equations Matlab Assignment # 5 (due 12/8) |
| 11/22 | 23 | 6.1, 6.2 | Quadratic forms; Positive-definite matrices |
| 11/24 | | | No class meeting |
| 11/29 | 24 | 6.3 | Indefinite quadratic forms and law of inertia |
| 12/1 | 25 | App. A | Singular value decomposition; polar decomposition |
| 12/6 | 26 | App. A | Pseudo-inverse |
| 12/8 | 27 | 7.3 | Hessenberg form and <i>QR</i> algorithm |
| 12/13 | 28 | | Catch up and review |
| 12/20 | | Final Exam | Noon–3:00pm. Hill 124 Closed book |

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Suggested Problem List for 642:550 Applied Linear Algebra

Text: Gilbert Strang, *Linear Algebra and its Applications*, 3rd Ed., ISBN #0-15-551005-3, Saunders Publishing/Harcourt Brace Jovanovich

Computer/Calculator: An ideal computer environment for working with matrices is MATLAB. This software is installed on the **gauss** computer and accounts can be set up for students in the course. Several other computer networks in the School of Engineering also have MATLAB. The Student Editions of MATLAB for PCs and MACs can be purchased from the web site of Mathworks, Inc: www.mathworks.com. You may also translate the assignments to another computer algebra system such as Maple or Mathematica.

Homework Problems: The problem listed should be done by the lecture following the coverage of the section or chapter. I may periodically collect one or more of the starred problems or have students present them in class.

| Section | Suggested problems (especially * problems) |
|--------------|--|
| 1.2 | 3, 8, 9, 10 |
| 1.3 | 1, 2*, 3, 4, 8, 12, 13 |
| 1.4 | 2, 3, 6, 8, 10, 11, 14*, 15, 17*, 19, 22, 24 |
| 1.5 | 4, 5*, 9, 11*, 13, 15*, 16, 19 |
| 1.6 | 1, 2, 5*, 6*, 7, 11*, 12, 14, 15, 21*, 22*, 23* |
| 1.7 | 2, 3, 4, 6, 7 |
| Ch. 1 Review | 4*, 5*, 12*, 13*, 18*, 27*, 28*, 29* |
| 2.1 | 2*, 5*, 6, 8 |
| 2.2 | 3*, 4, 6*, 7, 8, 10*, 12 |
| 2.3 | 1*, 2, 3, 4*, 6, 8, 9, 10, 12*, 16, 17, 18*, 22*, 23* |
| 2.4 | 1*, 2*, 4, 5*, 6*, 8, 9, 11, 12, 14*, 15, 17, 19*, 20*, 21* |
| 2.6 | 1, 2, 4, 6, 8, 9, 16, 19 |
| Ch. 2 Review | 1*, 2*, 3*, 4*, 11*, 12*, 22*, 30*, 33* |
| 3.1 | 1, 2, 3, 4, 5, 6*, 7, 8*, 9*, 11, 12, 14, 16, 17, 18, 19*, 20*, 22 |
| 3.2 | 1, 2, 3, 4, 5, 8, 9, 10, 11*, 13, 15* |
| 3.3 | 1, 3*, 5, 7*, 11, 12*, 15, 16, 18, 19*, 25* |
| 3.4 | 2*, 3*, 4, 5, 6, 11, 13*, 15, 16*, 17*, 21, 22, 23 |
| 3.5 | 1, 2, 3, 4, 7, 8, 11, 13 |
| 3.6 | 1*, 2*, 8*, 10*, 11*, 12*, 13* |
| Ch. 3 Review | 2*, 9*, 18*, 20*, 33*, 34*, 39*, 40* |
| 4.2 | 1, 4, 6, 7, 9, 10, 11, 12, 13*, 14*, 17 |
| 4.3 | 1, 3, 5*, 6*, 9, 13* |
| 4.4 | 3, 5, 6, 8, 12, 13, 14, 15, 16 |
| Ch. 4 Review | 3*, 4, 5, 6*, 8*, 9, 13, 15, 21 |
| 5.1 | 1*, 2, 4, 7, 8, 9, 12, 13*, 14*, 15, 17*, 18 |
| 5.2 | 1, 2, 3, 4, 5*, 6*, 7*, 8, 10, 11, 13, 14 |
| 5.3 | 1, 2, 3*, 5, 9, 12 |
| 5.4 | 1*, 2*, 3, 4*, 5*, 12* |
| 5.5 | Lecture 10: 1, 2, 3, 4, 5, 6, 7, 8, 17*, 18, 19* Lecture 19: 10, 11, 12*, 13*, 14, 15, 20, 22 |
| 5.6 | 1, 2, 3*, 4, 5*, 6, 13, 15, 16*, 17, 18, 23, 25, 27, 30*, 31 |
| Ch. 5 Review | 3*, 4*, 8*, 11*, 15*, 19*, 20* |
| 6.1 | 1, 2, 5*, 7, 13* |
| 6.2 | 2*, 3, 4*, 5, 7*, 8, 9, 16*, 18 |
| 6.3 | 1, 2*, 3, 5*, 11* |
| 7.3 | 3*, 4, 5*, 7, 9* |
| App. A | 2*, 4, 5*, 6*, 9, 10 |
| App. B | 1*, 3, 4, 5*, 6* |