MATH 430/603 Matrix Analysis

Section 01 Spring 2017

- Instructor: Dr. Jinglai Shen
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- Phone: (410) 455–2402
- Lectures: Tue and Thu, 1:00–2:15 pm, at Sherman Hall 145
- Office hours: Tue and Thu, 2:30–3:30 pm or by appointment
- Course web-page: http://www.math.umbc.edu/~shenj
- Prerequisites: Math 221, 251 and 301
- Textbook: *Matrix Analysis and Applied Linear Algebra* by Carl D. Meyer, SIAM Press, 2000.
- Other books:
  - *Linear Algebra and Its Applications*, by David C. Lay (Math 221 text)
  - *Linear Algebra and Its Applications*, by Gilbert Strang, 4th Edition
- Important dates:
  - No class on March 20-24 (spring break)
  - Last class: May 16 (Tue)
  - Final exam: May 23 (Tue)

Course Description This course addresses matrix algebra, fundamental properties of finite-dimensional vector spaces, linear transformations and projections, and vector space and matrix decompositions. Rigorous mathematical foundations will be developed. The main topics include: matrix operations, algebraic and geometric properties of vector spaces, norms, inner products and orthogonality, determinants and their properties, eigensystems and spectrum properties of matrices and linear transformations. This class will equip you with important matrix techniques to be useful in a wide range of pure and applied mathematics, such as algebra, differential equations, scientific computing, optimization, and statistics, as well as computer science, engineering, and economics.

We will cover most of Chapters 3–7 of the textbook. Specific topics are:

- Introduction and Review (Chapters 1-2)
- Matrix Algebra (Chapter 3)
  - Matrix operations ($\S 3.2 - 3.6$)
  - Matrix inverse ($\S 3.7$)
- Vector Spaces (Chapter 4)
  - Subspaces and fundamental subspaces ($\S 4.1 - 4.2$)
  - Linear independence, basis, dimension and rank ($\S 4.2 - 4.5$)
  - Least squares ($\S 4.6$)
  - Linear transformations and change of basis ($\S 4.7 - 4.8$)
- Norms, Inner Products, and Orthogonality (Chapter 5)
  - Vector and matrix norms ($\S 5.1 - 5.2$)
  - Inner products and orthogonality ($\S 5.3 - 5.4$)
  - Gram-Schmidt procedure, and unitary/orthogonal matrices ($\S 5.5 - 5.6$)
  - Complementary subspaces, orthogonal decomposition and projection ($\S 5.9 - 5.11$)
- Determinants (Chapter 6)
- Eigenvalues and Eigenvectors (Chapter 7)
  - Eigensystems and diagonalization ($\S 7.1 - 7.3$)
  - Normal matrices and positive definiteness ($\S 7.5 - 7.6$)
  - Jordan structure and canonical form, ODE applications ($\S 7.7, 7.8, 7.4$)

Please note that these topics are subject to change, depending on class progress.

Homework Weekly homework will be assigned. Homework is usually collected in Tuesday's class unless a due date change is announced. *No late homework will be accepted.* Present your answers neatly and show all your work; answers without supporting work may not receive full credit. Please staple your homework if it has multiple pages.

Exams There will be two in-class mid-term exams and one final exam. Exam date will be announced at least one week before an exam is held. A mid-term exam mainly focuses on topics covered by that month, and the final exam is comprehensive but focus more on the last part of the course. Please note that there will be *no* optional final exam, and all the exams are closed book.

Grading Policy The grading scheme is as follows:

- homework: 24%
- mid-term exams: 48% (24% for each)
- final exam: 28% (the final is comprehensive)

The letter grade will be computed based upon the numerical grade:

$$A :\geq 90; \quad B : 89 - 80; \quad C : 79 - 65; \quad D : 64 - 50; \quad F :< 50$$

Academic Integrity

- The UMBC Academic Integrity Statement:

  "*By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.*"

- All work in a homework or an exam must be your own; collaborating on an exam is *not* permitted. Discussions with other students on homework problems are allowed, but you should present your own work in the final turn-in; simply copying other people's work is violation of academic integrity code.

- If you wish to contest a graded exam, you must make an appeal within *one week* of the return date to the class. All appeals should be made in writing to the instructor with a signed and dated note on the exam. End of the semester appeals for earlier exams will be ignored.

- Make-up tests: if you must miss an exam due to a prior obligation, you must speak to the instructor *in advance* of the exam. If you must miss an exam due to an unforseen but valid reason (e.g. illness), you must submit a written excuse. Failing to do so may result in loss of substantial points in your make-up.