Midterm 1 Conceptual Review

MATH 290, Fall 2018

- Midterm 1 is in class on **Thursday, September 27**.
- The exam covers §§1.1 – 1.3 and §§2.1 – 2.4.
- The best preparation is to **practice, practice, practice** problems. This includes **quiz problems**, **WebAssign problems**, and **book problems**.
- **Solutions** to odd-numbered additional practice problems can be found in the back of the textbook, and solutions to WebAssign problems can be found through WebAssign.
- You may use a **calculator** and $3'' \times 5''$ **notecard**, but cannot replace any class methods.
- To create your own **practice exam**, choose 1-2 problems from each section that cover a variety of the topics listed.
- Check out **extended office hours** that will be posted on the course website.

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§1.1: Systems of linear equations

- **Concepts**: Linear equation in n variables, system of linear equations, solution/solution set of a linear equation, parametric representation of the solution set of a system of linear equations, equivalent systems of linear equations
- **Goals**: Decide whether an equation is a linear equation, determine whether a given candidate is a solution to a system of linear equations, determine (the size of) the solution set of a system of linear equations, determine whether two systems of linear equations are equivalent, write the solution set of a system of linear equations parametrically, use a graph to determine the solution set of a system of linear equations in two variables
- **Practice problems**: §1.1: #27, 45, 70, 83, 89, 93; Ch 1 Review: #3, 59

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§1.2: Gaussian elimination and Gauss-Jordan elimination

- **Concepts**: Matrix, size of a matrix, elementary row operation, row-echelon form, Gaussian elimination, Gauss-Jordan elimination, homogeneous system of linear equations
- **Goals**: Turn a system of equations into a matrix, apply elementary row operations to put a matrix in row-echelon/reduced row-echelon form (perform Gaussian elimination/Gauss-Jordan elimination), use back-substitution to determine the solution set of a system of equations with a given row-echelon/reduced row-echelon matrix, write a solution set parametrically from (reduced) row-echelon form, solve a homogeneous system of linear equations
- **Practice problems**: §1.2: #9, 17, 49, 58, 59, 61, 67, 68; Ch 1 Review: #57, 60

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§1.3: Applications of systems of linear equations

- **Concepts**: Modeling phenomena using systems of linear equations, and using their solutions to make conclusions: Polynomial curve fitting, network analysis,
- **Goals**: Find a polynomial of smallest possible degree passing through given points (and apply this to estimate function values), solve network problems (including in electrical networks)

- **Practice problems**: §1.3: #14, 23, 25, 29, 33, 37, 42; Ch 1 Review: #70, 71

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§2.1**: Operations with matrices**

- **Concepts**: Operations with matrices: addition, scalar multiplication, multiplication; using matrices to solve systems of linear equations
- **Goals**: Determine which operations with matrices are valid, and perform them when they are valid; solve a system of linear equations using matrices
- **Practice problems**: §2.1: #29, 31, 33, 53, 57, 70, 72, 77, 85; Ch 2 Review: #1, 7

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§2.2**: Properties of matrix operations**

- **Concepts**: Properties of scalar multiplication of matrices, addition of more than two matrices, properties of zero matrices, solving an equation involving matrices, properties of matrix multiplication (associativity, but not commutativity nor cancellation in general!), identity matrix, the transpose of a matrix (and its properties), powers of a square matrix
- **Goals**: Perform matrix operations using their properties, solve equations of matrices, find and use transpose matrices
- **Practice problems**: §2.2: #13, 29, 36, 53, 57, 73; Ch 2 Review: #11

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§2.3**: The inverse of a matrix**

- **Concepts**: Invertible/nonsingular matrix, noninvertible/singular matrix, inverse of an invertible matrix, properties of inverse matrices (including cancellation)
- **Goals**: Determine whether a matrix is invertible, find the inverse of an invertible matrix using Gauss-Jordan elimination (or the equation for 2×2 matrices), apply properties of inverse matrices, solving systems of matrix equations using inverse matrices
- **Practice problems**: §2.3: #5, 17, 31, 43, 47, 57, 71, 74, 80; Ch 2 Review: #18, 19, 25, 29

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§2.4**: Elementary matrices**

- **Concepts**: Elementary matrix, row equivalence, equivalent conditions for a matrix to be invertible, upper-triangular/lower-triangular matrix, LU-factorization
- **Goals**: Determine whether a matrix is an elementary matrix, write a matrix obtained from elementary row operations as the product on the left of the original matrix by elementary matrices, determine whether two matrices are row equivalent, write an invertible matrix as the product of elementary matrices, find an LU-factorization of a square matrix, solve a linear system using LU-factorization
- **Practice problems**: §2.4: #21, 23, 33, 39, 45, 47; Ch 2 Review: #35, 41, 45