Math 327
Exam 1 Review Sheet

Section 1.1: Systems of Linear Equations

• Know the definition of the terms: linear equation, solution to a linear equation, system of linear equations, inconsistent and consistent linear systems, homogeneous system of equations, the trivial solution to a homogeneous system, a non-trivial solution to a linear system.
• Understand that systems of linear equations may have a unique solution, infinitely many solutions, or no solution.
• Know how to use the method of elimination and/or back substitution to find all solutions to a given linear system (if any exist).
• Be able to set up and solve a system of linear equations related to a given applied problem.

Section 1.2: Matrices

• Know the following terms and/or notation: an $m \times n$ matrix, row, column, (i, j) entry, double subscript notation, square matrix, main diagonal, n-vector, linear combination, and summation notation.
• Understand and be able to carry out the following operations: matrix equality, matrix addition, scalar multiplication, matrix transposition.
• Know and be able to apply the properties of summations.
• Be able to use matrices to represent data tables and be able to form the incidence matrix of a combinatorial graph.

Section 1.3: Matrix Multiplication

• Understand and be able to carry out the following operations: the dot product of two n-vectors, the product of two matrices of appropriate size.
• Be able to find the coefficient matrix or the augmented matrix for a linear system. Also be able to express a linear system as a matrix equation of the form $A\vec{x} = \vec{b}$
• Be able to express the product of two matrices as a linear combination of columns.
• Understand that matrix multiplication is non-commutative.
• Be able to verify that a given n-vector is the solution to a matrix equation. Also be able to find solution to matrix equations of various forms.

Section 1.4: Algebraic Properties of Matrix operations

• Understand and be able to apply the properties of matrix addition, matrix multiplication, scalar multiplication, and the transpose of a matrix.
• Know the definition of the following terms: zero matrix, additive identity, additive inverse, associative property, commutative property, distributive property.
• Be able to verify that one or more of the properties of matrix operations hold for a specific example.
• Be able to prove that one of the properties of matrix operations or of the dot product holds in general.

Section 1.5: Special Types of Matrices and Partitioned Matrices

• Understand the definition of the following: diagonal matrix, scalar matrix, identity matrix, symmetric matrix, skew symmetric matrix, upper triangular matrix, lower triangular matrix, submatrix, singular matrix, nonsingular matrix, the inverse of a matrix, powers of a square matrix.
• Know the statement of the properties of matrices as stated in Theorems 1.5, 1.6, 1.7, and 1.8, and be able to reproduce the proof of these theorems.
• Be able to find the inverse of a given matrix or show that the given matrix is singular.
• Be able to solve a linear system using the inverse of the coefficient matrix.
• Be able to determine which matrix forms (diagonal, scalar, upper triangular, nonsingular, etc.) are preserved by matrix multiplication.
• Know the properties of powers of a square matrix.

Section 1.6: Matrix Transformations

• Know the definition of the following terms: matrix transformation, function, domain, range, image, reflection, projection, dilation, contraction, rotation.
• Be able to both compute and graph the image of an n-vector under a given transformation.
• Be able to determine whether or not a given vector is in the range of a given transformation.
• Be able to classify a given transformation (i.e. describe its effect on input vectors geometrically)