Midterm 1 Concept Checklist

Chapter 1

- I understand what is meant by a linear system of equations and I understand the difference between a general system, a triangular system, and an echelon system.
- I understand how to use an augmented matrix to solve a system of equations. I understand Gaussian elimination and Gauss-Jordan Elimination, and I understand the difference between the two methods.
- I understand the terms consistent and inconsistent.
- I know what a homogeneous system of equations is, and I know that such a system always has at least one solution.
- I have a geometric understanding of what is meant by "solution set" of a general linear system of equations.
- I can identify pivot positions, pivots, and pivot columns.
- I know what a free variable is, and how to identify them in the algorithmic manner taught in class.

Chapter 2

- I understand addition and scalar multiplication of vectors algebraically and geometrically. I know the algebraic properties that vector addition and scalar multiplication satisfy. I know how to multiply an $n \times m$ matrix A by a vector $\vec{x}$ in $\mathbb{R}^m$.
- I can state the definition of the span of a set of vectors. I can determine if a vector in $\mathbb{R}^n$ is in the span of a set of vectors. I can determine if a set of vectors spans $\mathbb{R}^n$.
- I can state the definition of linear dependence and linear independence.
- I can determine whether a set of vectors is linearly independent or linearly dependent.
- I understand the connection between solving a linear system and determining if a vector is in the span of other vectors.
- I have a conceptual understanding of linear dependence and linear independence. I can rephrase the definition of linear independence or dependence in terms of span and in terms of solutions to linear equations.
- I understand this statement: The following are equivalent.

Chapter 3

- I can determine whether a function $T : \mathbb{R}^m \to \mathbb{R}^n$ is a linear transformation. I understand that a linear transformation is completely determined by its values on $e_1, e_2, \ldots, e_m$ and that every linear transformation can be represented by a matrix.
- Given a linear transformation T, I can find the matrix A associated to T.
- I can graphically represent linear transformations in $\mathbb{R}^m$. I know the matrices for linear transformations from $\mathbb{R}^2$ to itself, dilating, rotating, and reflecting the unit square. (This is all in the Lecture 3.1 notes towards the end).
- Given a linear transformation T, I can determine whether it is one-to-one and whether it is onto. I understand how a linear transformation T being one-to-one or onto translates into properties of the matrix associated to T.
- I can perform algebraic operations with matrices, including addition, subtraction, scalar multiplication, and matrix multiplication. I can compute the transpose of

matrices, and know how to identify diagonal and triangular matrices. I understand the connection between matrix multiplication and composition of linear transformations.
- I can find the inverse of a matrix or determine that no inverse exists using Gaussian elimination.
- I understand what it means for a matrix to be invertible, both algebraically and conceptually. I understand the relationships among a matrix being invertible, properties of the associated linear transformation, and spanning or linear independence properties of the columns of A (e.g., the Unifying Theorem v. 3).
- I understand the subtleties of what arithmetic properties break down with matrices (i.e. $AB \neq BA$), and how these can be resolved if a matrix is invertible (for example, see Question 13 in the Conceptual Problems for Chapter 3).

Chapter 4

- I can show whether or not a subset W forms a subspace. I can determine and characterize subspaces of $\mathbb{R}^n$. I have a geometric understanding of what subspaces look like in $\mathbb{R}^2$ and $\mathbb{R}^3$.
- I can rigorously show whether a subset of vectors from a subspace forms a spanning set for the subspace (or not). I can show whether a subset of vectors from a subspace is linearly independent (or not). I can determine whether a set of vectors forms a basis for a subspace, and if not, I can find a basis for it (see Method 1 and Method 2 in the 4.2 Lecture notes). I can find the dimension of a subspace. I can identify a basis for $\mathbb{R}^2$ and $\mathbb{R}^3$ pictorally.
- I can find a basis for the row space, the column space, or the null space of a matrix. I can determine the rank and nullity of a matrix and apply the rank-nullity theorem in appropriate situations.
- I can find a basis for the kernel and range of a linear transformation. I can rephrase statements about a linear transformation being one-to-one or onto in terms of statements about the kernel and range.

Math 126

- Given two vectors in a plane and a point, I know how to write the scalar equation of that plane.
- I know that the cross product gives me a way to find a vector normal to two given vectors. I know that I can use the cross product to find the area of a parallelogram.