

# Midterm 1 Review Outline

October 1, 2016

Test format: There are 5 problems in total. The first problem contains 10 True/False questions. The True/False question is like:

Question: 11 vectors in  $\mathbb{R}^{10}$  can be linearly independent.

Answer: False.

Midterm 1 covers Chapter 1, Chapter 2, Chapter 3 and Section 4.1.

## Chapter 1

Section 1.1 and 1.2: Solving a linear system. Given a linear system, write down the augmented matrix, perform elementary row operations on the augmented matrix to solve the linear system.

Section 1.2 and 1.3: The Reduced Row Echelon Form (RREF) of a matrix; Perform elementary row operations to obtain the RREF of a matrix; Decide whether a linear system has a unique solution, infinitely many solutions, or no solution from the RREF of the augmented matrix.

Section 1.3: Matrix operations: Matrix addition, scalar multiplication, vector dot product, matrix vector product.

Section 1.3: Properties of matrix operations.

Section 1.3: The rank of a matrix.

## Chapter 2

Section 2.1: Definition of linear transformations, Determine whether a transformation is linear or not.

Section 2.1: Given a linear transformation, write down the matrix representing the linear transformation.

Section 2.2: Linear transformation in geometry: scaling, orthogonal projection, reflection, rotation.

Section 2.3: Matrix product: compute matrix multiplication, write matrix product in terms of rows of the first matrix or columns of the second matrix (Theorem 2.3.2). Properties of matrix product. Notice that matrix multiplication is non-commutative.

Lecture notes: Definition of one-to-one and onto transformation. Given a linear transformation, determine whether it is one-to-one or onto. A linear transformation  $T : \mathbb{R}^n \rightarrow \mathbb{R}^m$  such that  $Tx = Ax$  is:

one-to-one,  $\text{Kernel}(T) = \{0_{\mathbb{R}^n}\}$ ,  $\text{rank}(A) = n$ .

A linear transformation  $T : \mathbb{R}^n \rightarrow \mathbb{R}^m$  such that  $Tx = Ax$  is:

























