Linear Algebra I (Math 129A)
Study guide for Midterm 1 (75 pts).

No notes or calculators are allowed during the test!

1. Determine if a linear system is consistent.

Sections 1.1 and 1.2: Elementary row operations, echelon and reduced echelon forms, pivot positions, the row reduction algorithm (Gaussian elimination and Gauss-Jordan elimination), parametric descriptions of solutions sets (basic and free variables). Theorem 2 (existence and uniqueness theorem)

2. (a) Find the general solution of a linear system whose augmented matrix is given.
   (b) Describe the solution of the given system in parametric vector form. Also, give a geometric description of the solution set.

Sections 1.2 and 1.5: Solutions of nonhomogeneous systems. Writing a solution set (of a consistent system) in parametric vector form.

3. *Section 1.3:* Vectors in $\mathbb{R}^2, \mathbb{R}^3$, and $\mathbb{R}^n$. Linear combinations. The definition of Span $\{\mathbf{v}_1, \mathbf{v}_2, \dots, \mathbf{v}_\mathrm{p}\}$. Geometric description of Span$\{\mathbf{v}\}$ and Span$\{\mathbf{u}, \mathbf{v}\}$.
   Section 1.4: Matrix-vector product. Theorem 4. How to determine if a vector is in the Span$\{\mathbf{v}_1, \mathbf{v}_2, \dots, \mathbf{v}_\mathrm{p}\}$. Do the columns of A span $\mathbb{R}^m$? Does the equation $A\mathbf{x} = \mathbf{b}$ have a solution for each $\mathbf{b}$ in $\mathbb{R}^m$?

4. *Section 1.3.* Prove one of the algebraic properties of $\mathbb{R}^n$ (page 27, see practice problem 1 and exercises 33 and 34).

5. and 6. *Section 1.5*: Homogeneous linear systems. Solutions of nonhomogeneous systems. Parametric vector equation of the line through **p** parallel to **v**.

7. and 8. *Section 1.7*: Linearly independent and linearly dependent sets of vectors. Linear dependence relation. Linear independence of matrix columns. Theorem 7 (characterization of linearly dependent sets), Theorem 8 and Theorem 9.

9. and 10. *Section 1.8:* Introduction to linear transformations: matrix transformations and linear transformation.

11. *Section 2.1.* Matrix operations: sums and scalar multiples. Theorem 1 (properties of sums and scalar multiples). Matrix multiplication. Row-column rule for computing AB. Properties of matrix multiplication. Powers of a matrix. The transpose of a matrix.