Fall 2019 Linear Algebra Final Exam Study Guide
Dr. Day's section 002

The test is comprehensive, but it focuses on Chapters 5 and 6 of the book. Please also review the previous study guides, previous exams, quizzes, and homework.

You need to be able to do the following:

- Find lengths of vectors, distances between points, angles between vectors, and projections of vectors onto each other in inner product spaces, including $\mathbf{R}^n$ (section 5.1).
- Find a basis for the orthogonal complement of a subspace of $\mathbf{R}^n$ (express the subspace as the column space of a matrix, and find the nullspace of the transpose; see Theorem 5.2.1).
- Find the least-squares solution to an inconsistent system of equations (Theorem 5.3.2 shows how to do this).
- Find linear regressions using least-squares solutions (see example 2 on p. 230).
- Perform the Gram-Schmidt process (section 5.6).
- Find all eigenvalues of a matrix, and find a basis for the eigenspace of each eigenvalue (section 6.1).
- Diagonalize a matrix or determine that it is not diagonalizable (section 6.3).
- Find an orthogonal diagonalizing matrix for a symmetric matrix (see example 4 on p. 335).
- Find the singular value decomposition of a matrix (section 6.5).
- Put a two-variable quadratic equation into standard form (section 6.6).

You should review the definitions and theorem statements in Chapters 5 and 6. They may come up in the True/False section of the test. It is also a good idea to review concepts from the two midterms. Important concepts to review include:

- The scalar product in $\mathbf{R}^n$ and its basic properties (section 5.1).
- The definitions of orthogonal subspaces and orthogonal complements of subspaces (section 5.2).
- The basic properties of orthogonal complements (theorem statements in section 5.2).
- The definition of least squares solutions (p. 223).
- The definition and basic properties of inner products (section 5.4).
- The definition of orthonormal sets (p. 248).
- The definition and basic properties of orthogonal matrices (p. 251-253).
- Projecting to subspaces in $\mathbf{R}^n$ (p. 255-256).
- The definitions of eigenvalue, eigenvector, and eigenspace (section 6.1).
- The definition of "diagonizable", and Theorem 6.3.2 (p. 312).
- The spectral theorem for real matrices (Corollary 6.4.7 on p. 338).

You do not need to know anything from sections 5.7, 6.2, 6.7, or 6.8, or chapters 7--9.

Good luck!