Math 415 Midterm 2 Exam Check List SP 2018

Chapter 2 Section 5: Applications to networks

- terms: edge-node incidence matrix for a digraph
- interpretation of null space as measuring connectedness
- interpretation of small loops as giving a restrictions representation for the column space
- interpretation of left null space as giving current loops in the graph
- interpretation of row space as giving a minimal spanning tree for the graph

Chapter 2 Section 6: Linear transformations

- terms: linear transformation
- geometric examples in 2D
- abstract examples in function space
- terms: rotation, projection, reflection

Chapter 2 Section 7: Coordinates of vectors and linear transformations relative to bases

- terms: coordinate vector of a vector
- examples of computing coordinate vectors for column vectors, polynomials, and matrices
- terms: coordinate matrix of a linear transformation
- instill that applying a linear transformation becomes multiplication by the coordinate matrix
- examples of computing coordinate matrices and checking the results

Chapter 3 Section 1: Orthogonal vectors, subspaces, and orthogonal complements

- terms: length, inner product, orthogonal vectors, unit vectors, orthonormal basis
- derive the result that mutually orthogonal implies independent
- terms: orthogonal subspaces, orthogonal complements
- establish the unique decomposition into orthogonal components
- establish the orthogonality results for the four fundamental subspaces

Chapter 3 Section 2: Projection onto a vector

- derive formula for orthogonal projection onto a line
- derive the alternate formula that uses a projection matrix
- do the minimization of squared errors for 2D via calculus

Chapter 3 Section 3: Projections onto subspaces and least squares approximation

- explain how least squares approximation is related to orthogonal projections
- terms: normal equations, best estimate, projection onto a subspace
- connection between invertibility of $A^{\mathrm{T}}A$ and independence of the columns of A
- terms: projection matrix
- discuss the least-squares fitting of data

Chapter 3 Section 4: Orthogonal bases, orthogonal matrices, Gram-Schmidt

- terms: orthogonal matrix, orthonormal basis
- expressing b as a linear combo of an orthonormal basis
- length in terms of orthonormal coordinates
- projection matrices in the orthogonal case
- description of the Gram-Schmidt procedure