Note: 1.3.4 means ‘Problem 4 in section 1.3’

IMPORTANT QUESTIONS

Chapter 3: Determinants

- Calculate the determinant of a matrix, possibly using row-reductions (3.1.9, 3.1.11, 3.1.13, 3.2.5, 3.2.7, 3.2.11, 3.2.21)
- Calculate volumes using determinants (3.3.21, 3.3.32)

Chapter 4: Vector Spaces

- Determine if a set is a vector space or not (4.1.1, 4.1.3, 4.1.17, 4.2.7, 4.2.9, 4.2.11)
- Given $[x]_B$, find $x$, and vice-versa (4.4.1, 4.4.3, 4.4.5, 4.4.7, 4.4.11)
- Find the change-of-coordinates matrix from $B$ to the standard basis in $\mathbb{R}^n$ (4.4.9)
- Determine whether a set is linear independent or dependent (4.3.3, 4.4.27)
- Find a basis and state the dimension of a vector space (4.5.1, 4.5.3, 4.5.5, 4.5.7, 4.5.9, 4.5.11)
- Given a matrix $A$, find a basis for $\text{Nul}(A)$, $\text{Col}(A)$, $\text{Row}(A)$, and also find $\text{Rank}(A)$ (4.2.3, 4.2.5, 4.3.9, 4.3.11, 4.5.13, 4.5.15, 4.5.17, 4.6.1, 4.6.3)
- Use the rank-nullity theorem to find $\text{Rank}(A)$ etc. (4.6.7, 4.6.9, 4.6.11, 4.6.13, 4.6.15)
- Find the change-of-coordinates matrix from $B$ to $C$ (4.7.7, 4.7.9)
- Use the change-of-coordinates matrix to find $[x]_C$, $[x]_B$ (4.7.1, 4.7.3)

Chapter 5: Diagonalization

- Find a diagonal matrix $D$ and a matrix $P$ such that $A = PDP^{-1}$, or say $A$ is not diagonalizable (5.2.9, 5.2.11, 5.2.13, 5.3.9, 5.3.11, 5.3.17)
- Show that a given matrix is not diagonalizable (5.4.11)
- Find the matrix of a linear transformation (5.4.1, 5.4.3, 5.4.9, 5.4.11, 5.4.17(b))

Date: Friday, October 14th, 2011.
Chapter 6: Inner Products and Norms

- Determine if a set is orthogonal, or orthonormal (6.2.3, 6.2.19, 6.2.21)
- Find the orthogonal projection of \( x \) on a subspace \( W \). Use this to write \( x \) as a sum of two orthogonal vectors, and to find the smallest distance between \( x \) and \( W \) (6.2.11, 6.3.3, 6.3.5, 6.3.1, 6.3.7, 6.2.15, 6.3.11)
- Use the Gram-Schmidt process to produce an orthonormal basis of a subspace \( W \) spanned by some vectors (6.4.1, 6.4.3, 6.4.5, 6.4.7, 6.4.9, 6.4.11)
- Find the least-squares solution (and least-squares error) of an inconsistent system of equations (6.5.1, 6.5.3, 6.5.7, 6.5.9, 6.5.11)
- Find inner products, lengths, and orthogonal projections of functions \( f \) and \( g \) using fancier inner products \( \langle f, g \rangle \) (6.7.3, 6.7.5, 6.7.7, 6.7.9, 6.7.11, 6.7.22, 6.7.24)
- Show a given formula defines an inner product (6.7.13)
- Use the Gram-Schmidt process to find an orthonormal basis of functions (6.7.25, 6.7.26)
- Remember the Cauchy-Schwarz inequality (6.7.19, 6.7.20)

**TRUE/FALSE EXTRAVAGANZA**

Do the following set of T/F questions: 3.2.27, 4.1.24, 4.2.25, 4.3.21, 4.6.17, 4.7.11, 5.3.21, 6.3.21, 6.5.17 (check out the hints to HW 4,5,6,7,8 for answers)

**CONCEPTS**

Understand the following concepts:

- Vector space, Subspace (4.1, 4.2)
- Basis, Dimension (4.3, 4.5)
- Coordinates of \( x \) with respect to \( B \) (4.4)
- \( \text{Null}(A), \text{Col}(A), \text{Row}(A), \text{Rank} \) (4.6)
- Rank-Nullity Theorem (4.6)
- Change of coordinates matrix (4.7)
- Eigenvalues, Eigenvectors, Characteristic polynomial (5.1 - 5.3)
- \( A \) is similar to \( B \) (5.2)
- Diagonalizable, Diagonalization Theorem (Theorem 5 in section 5.3)
- Matrix of a Linear transformation (5.4)
- Inner products, Norms, Orthogonal vectors, Orthogonal Matrix (6.1)
- Orthogonal projection (6.2, 6.3)
- Gram-Schmidt process (6.4)
- Least-squares (6.5)
- Inner product space (6.7)
- Cauchy-Schwarz inequality (6.7)
NOT-SO-IMPORTANT QUESTIONS (ONLY DO THEM IF YOU HAVE THE TIME)

- Solve questions using the fact that $\det(AB) = \det(A)\det(B)$ (3.2.31, 3.2.33, 3.2.34, 3.2.35)
- Solve a system using Cramer’s rule (3.3.1, 3.3.3, 3.3.5)
- Show the intersection of two subspaces is a subspace (4.1.32)
- Show the nullspace/range of a linear transformation are vector spaces (4.2.30)
- Find an infinite-dimensional vector space (4.5.27)
- Use the decomposition $A = PDP^{-1}$ to find $A^k$ for any $k$ (5.3.1, 5.3.3)
- Find the complex eigenvalues and eigenvectors of a matrix (5.5.1, 5.5.3, 5.5.5)
- Find a matrix $C$ and a matrix $P$ such that $A = PCP^{-1}$ (5.5.13, 5.5.15, 5.5.17)
- Interpret what the matrix $C$ means geometrically (5.5.7, 5.5.9)
- Prove the parallelogram law (6.1.24)
- Given an orthogonal basis $B$, find $[x]_B$ (6.2.9)
- Find the $QR$-decomposition of a matrix $A$ (6.4.13)
- Use the $QR$-factorization of a matrix $A$ to find a least-squares solution of $Ax = b$ (6.5.15)
- Use the method of least-squares to fit data points to a line (6.6.1, 6.6.3)
- Same thing as above, but with weighted least squares (6.8.1, 6.8.2)
- Find quadratic/cubic trend functions (6.8.3, 6.8.4)