

**MATH 223.** Preparation for the exam.

Some students ask about how to study. One recommendation is to create some summary notes from what we have covered. Then reading assignments and your midterms come next. Try to figure out what you do wrong. I won't entertain regrading at this point. You have two practice exams from 2008,2009 and the department website has additional 223 exams.

The following is a list of topics (not guaranteed to be complete and not intended to order the topics. Perhaps it will help you remember what we have done. Note that Symmetric matrices should play a role even though they did only appear on assignment 9.

**Topics**

1. linear transformations (representation as matrices, matrix multiplication as function composition)
2. Gaussian elimination including vector parametric form.
3. Determinants (how to calculate, product rule)
4. Vector Spaces (linear independence, linear dependence, basis, extending a set of vectors to a basis)
5. Row Space, Column Space, Rank, Nullspace, nullity thm (how multiplication on left or right affects row and column spaces)
6. Change of Basis
7. Eigenvectors/Eigenvalues (eigenspace for eigenvalue  $\lambda$  is  $\text{nullspace}(A - \lambda I)$ , dimension of eigenspace is at most multiplicity as a root in  $\det(A - \lambda I)$ , similarity e.g. preserves the determinant  $\det(A - \lambda I)$ , matrix is diagonalizable if sum of dimensions of eigenspaces in equal to size of matrix or each eigenspace dimension is equal to multiplicity as a root, examples of non diagonalizable matrices, applications of diagonalizability to computing powers etc, dominant eigenvectors/eigenvalues )
8. Differential equations (diagonalization, exponentiation of matrices, complex numbers)
9. Vector geometry (length of vector, dot product and angle between vectors, projections, Gram Schmidt process, orthogonal vectors, orthonormal bases)
10. Orthogonal vector spaces (orthogonal complement, projection onto a vector space using an orthonormal basis for the space, least squares)
11. Symmetric matrices (are diagonalizable, have real eigenvalues, have an orthonormal basis of eigenvectors, Hermitian definition)
12. Matrices for various linear transformations including rotation about an axis in 3-space

We also has lectures on applications which would not be directly testable (Smolensky proof of bound of Sauer, Perles and Shelah and Vapnik and Chervonenkis, equiangular lines, Fourier coefficients, Petersen graph)