This is the topic list for the final skills check. It includes ALL topics from the first two skills checks, plus some new material. New material is in **bold**.

You should be able to give a mathematically precise definition of the following:

- linear combination

- linearly independent/dependent

- span

- consistent/inconsistent

- free variable

- trivial/nontrivial linear combination

- . . . and any other terminology or notation we've discussed in class.

- Linear transformation

- Inverse of a linear transformation

- Inverse of a matrix

- Elementary matrix

- Rank of a matrix

- Subspace

- Basis

- Dimension

- Range

- Null space

- Row space

- Column space

- **Eigenvalue**

- **Eigenvector**

- **Eigenspace**

- **Characteristic polynomial**

- **Diagonalization/diagonalizable**

You should be able to state the following theorems:

- The Rank-Nullity Theorem

- The Invertible Matrix Theorem (or most of it)

You should be able to do the following computations:

- Give mathematically precise definitions for all terms used in class, particularly including the ones used later on this list.

- Do vector arithmetic: addition, subtraction, scalar multiplication, and dot product.

- Multiply matrices.

- Express a vector as a linear combination of other vectors.

- Determine whether or not a set of vectors is linearly independent.

- Determine whether one vector is in the span of others.

- Find the span of a set of vectors.

- Put a matrix into reduced row echelon form, and recognize whether or not it is.

- Convert a system of linear equations into augmented-matrix form and matrix-equation (Av=b) form, and vice versa.

- Find all solutions to a system of linear equations.

- Given a linear transformation T, compute $T(\vec{v})$.

- Given a linear transformation T, find a matrix for T.

- Find the inverse of a matrix.

- Use several different methods to determine whether or not a matrix is invertible.

- Determine whether or not a transformation is linear.

- Determine whether or not something is a subspace.

- Given a subspace, find a basis for it and compute its dimension.

- Describe the range and null space of a linear transformation.

- Give a basis for the range and null space of a linear transformation.

- Describe the row space, column space, and null space of a matrix.

- Give a basis for the row space, column space, and null space of a matrix.

- **Given a vector in one basis, convert it to another basis.**

- **Given a linear transformation expressed as a matrix in one basis, express it as a matrix in another basis.**

- **Given two bases, find a change-of-basis matrix to convert between them.**

- **Compute the eigenvalues of a linear transformation, and their corresponding eigenvectors.**

- **Given a linear transformation and one of its eigenvectors, find the corresponding eigenvalue.**

- **Given a linear transformation and one of its eigenvalues, find a basis for the corresponding eigenspace.**

- **Given the eigenvalues and eigenvectors of a linear transformation, find a matrix for it.**

- **Given a linear transformation (or a matrix for it), find its characteristic polynomial.**

Also remember that problems from HW7 (or close variations on them) may appear on the skills check!