Definitions

- **linear transformation** $f\colon \mathbb{R}^n \to \mathbb{R}^m$
  - f is **injective/one-to-one**
  - f is **surjective/onto**
  - f is an **isomorphism**
  - **kernel** and **image/range** of f
- **characteristic polynomial/equation** corresponding to a square matrix $\mathbf{A}$,
- **algebraic** and **geometric multiplicities** of eigenvalues
- **eigenvector** of a matrix (or linear transformation)
- **similar** matrices
- **Markov matrix**, and **steady state vector**

Knowledge:

- Understand the various interconnections between
  - linear independence, rank, nullity, null space, shape of a matrix, rref, determinant, injectivity/surjectivity of the transformation $\mathbf{x} \mapsto \mathbf{A}\mathbf{x}$, consistency of $\mathbf{A}\mathbf{x} = \mathbf{b}$
  - the general solution of $\mathbf{A}\mathbf{x} = \mathbf{b}$, the null space of $\mathbf{A}$, and any particular solution
- the composition of linear transformations
  - result is another linear transformation
  - how related to matrix multiplication
  - conditions insuring the composition is injective or surjective
- traits shared by similar matrices
- facts about Markov matrices

Tasks:

- Ability to show a transformation is (or is not)
  - an isomorphism
  - surjective
  - injective
- Finding the matrix M_{B_1,B_2} of a transformation with respect to bases B_1, B_2
- Finding the coordinate vector $[\mathbf{x}]_B$ of $\mathbf{x}$ with respect to a ordered basis B, and the coordinate function $C_B\colon \mathbb{R}^n \to \mathbb{R}^n$ for which $C_B(\mathbf{x}) = [\mathbf{x}]_B$

- Ability to find zeros (both real and nonreal) of polynomial equations through factoring, graphing, and use of the quadratic formula
- Ability to write a ratio of complex numbers $\dfrac{a+bi}{c+di}$ as $\alpha + \beta i$.
- Ability to find eigenvalues λ of square $\mathbf{A}$, and a basis for the corresponding eigenspace E_λ
- Ability to diagonalize a matrix $\mathbf{A}$ (not necessarily symmetric), or show it is not diagonalizable
  - facts about eigenvalues/eigenvectors of a symmetric real $\mathbf{A}$
  - ability to *orthogonally* diagonalize a symmetric real $\mathbf{A}$
- Ability to use the diagonalization of $\mathbf{A}$ to find powers $\mathbf{A}^k$