Math 2135 Fall 2018 - Review for Finals

1. **Vectors in $\mathbb{R}^n$.**
   (1) parametric form of lines and planes in $\mathbb{R}^2, \mathbb{R}^3$
   (2) dot product, length, orthogonality, projection of vectors
2. **Systems of linear equations.**
   (1) coefficient and augmented matrix
   (2) solving a linear system by row reduction, pivot columns, free variables, solution in parametrized vector form
   (3) solutions of homogenous vs. inhomogenous systems
3. **Fields.**
   (1) axioms of fields, examples $\mathbb{R}, \mathbb{Q}, \mathbb{C}, \mathbb{Z}_2, \mathbb{Z}_3, \ldots$, properties of fields
4. **Vector spaces.**
   (1) operations and their properties for vector spaces over arbirtrary fields
   (2) examples of vector spaces: tuples, functions, polynomials P_n
   (3) subspaces: definition and examples (span, null space)
5. **Basis of vector spaces.**
   (1) linear independence, spanning set, dimension
   (2) reduce a spanning to a basis, extend a linear independent set to a basis of a subspace
   (3) bases for column space, row space, null space of a matrix
   (4) coordinates with respect to a basis, change of coordinate matrix $P_{B,C}$
6. **Matrices.**
   (1) matrix sum, multiplication and their properties
   (2) inverse matrices and their properties
   (3) inverse matrix via row reduction, formula for inverse of 2×2-matrix
   (4) determinant via cofactor expansion and via row reduction
   (5) eigenvalues and eigenvectors of matrices, characteristic polynomials
   (6) diagonalizing matrices, powers of matrices
7. **Linear maps.**
   (1) standard matrix of a linear map on F^n
   (2) matrix $[f]_{B,C}$ of a linear map $f\colon V \to W$ with respect to arbitrary bases B, C of V, W, respectively
   (3) matrices for rotation and reflection in $\mathbb{R}^2, \mathbb{R}^3$
   (4) range, kernel of linear maps and their connection with surjectivity, injectivity
   (5) isomorphism between vector spaces