Chapter 1
1. Vectors
   - Vector operations
   - Lengths, inequalities
   - Dot products
   - Angles
2. Linear combinations
   - Definition
   - Matrix times vector

Chapter 2
1. Vectors & Linear Equations
   - Linear equations, vector equations
   - Solving linear systems with elimination
2. Matrix Operations
   - + and scalar
   - Properties & non-properties of matrix mult.
   - Computing matrix mult. different ways
   - Elimination steps by matrix mult.
3. Inverse Matrices
   - Computing
   - When it exists
   - Properties
4. Transposes & Permutations
   - And symmetric matrices
Chapter 3

7. Vector spaces
   - definition & subspaces
   - examples & non-examples

2. Solving linear systems
   - computing nullspace
   - computing special solutions
   - particular solutions
   - echelon & reduced echelon forms
   - solution sets & rank

3. Linear independence, spanning, basis
   - definitions
   - when a set of vectors in $\mathbb{R}^n$ is ______
   - bases for nullspace & columnspace
   - dimension
   - dimensions of subspaces
Chapter 4
1. Orthogonality
   - orthogonal vectors
   - orthogonal spaces/complements
   - orthonormal bases
   - \[ \text{C}(A) \perp \text{N}(A) \iff \text{C}(A) \perp \text{N}(A^T) \]
2. Projections
   - what are projection & error
   - \[ A^T A \mathbf{x} = A^T \mathbf{y} \] projecting onto subspace
   - least-squares solutions
   - projection matrices
3. Orthogonal bases
   - Gram-Schmidt process
   - orthogonal matrices \( Q^T = Q^{-1} \)
   - orthogonal matrices & angles/lengths

Chapter 5
1. Properties of the Determinant
   - \( \det I = 1 \), pull out, switch \( \pm \) sign, add/subtract rows, multiply/divide, transpose
   - \( \det \) stays same under \( R_i \rightarrow R_i + k R_j \) elimination step
   - product of pivots of triangular matrix
   - computing by elimination etc.
   - determinant & invertibility
2. Determinant, geometrically
   - volume of parallelopiped
   - orientation
3. Cofactor expansions - cofactors
   - using cofactor expansion to compute lets
   - when is cofactor exp. convenient?

4. Cramer's Rule / Inverses
   - Cramer's rule for solving equations
   - formula for inverse matrix

Chapter 6
1. Eigenvalues & Eigenvectors
   - definitions
   - geometric interpretation
   - eigenvalues & invertibility
   - characteristic polynomial
   - computing eigenvectors & eigenvalues.
   - eigenvalues & det

2. Diagonalization
   - pieces of $A = S \Lambda S^{-1}$
   - computing
   - powers of a matrix & limits

3. Symmetric Matrices

   - Spectral Theorem: real eigenvals & orth. nor. basis of eigenv.
   - factorization $A = Q \Lambda Q^{T}$
   - positive definiteness / semidefiniteness
   - testing for positive definiteness
   - principal square roots

4. Singular Value Decomposition
   - low rank approximation
chapter 7

1. Linear transformations
   - definition
   - examples
   - relationship between matrices & linear transformations
   - the matrix of a linear transformation

2. Change of basis
   - change of basis matrices
   - similar matrices / change of basis for transformations
   - diagonalization as a change of basis