Midterm exam schemata - These are (most of) the ingredients for questions on the midterm.

- Given a matrix A, compute bases/dimensions for $\operatorname{Col} A$, $\operatorname{Nul} A$, $\operatorname{Row} A$.
- Given a subspace W of $\mathbb{R}^n$, compute basis/dimension for $W^{\perp}$.
- Give solution set to $A\vec{x} = \vec{b}$ in parametric vector form.
- Given subspace W of $\mathbb{R}^n$ and $\vec{v} \in W$, compute $\operatorname{proj}_W \vec{v}$ or $\operatorname{proj}_{W^\perp} \vec{v}$. Decompose $\vec{v}$ into parallel and perpendicular components.
- Given spanning set for subspace, compute basis.
- Given independent set of vectors, find a vector not in the span of the vectors (if one exists).
- Given equation on A (for instance, with 2×2 matrix A, $A^2 = A$ and $A \neq I_2$), compute eigenvalues.
- Compute A^n for some diagonalizable matrix A, either with n fixed or varying.
- Given square A, determine whether diagonalizable or compute diagonalization. Interpret columns of P as eigenvectors.
- Given a function $T : V \to W$ between vector spaces, determine whether it is a linear transformation. If not, give counterexample, if it is, demonstrate the two properties.
- Given a subset W of a vector space V, determine whether it is a subpsace. If not, give counterexample, if it is, demonstrate the two closure properties.
- Compute matrix of a transformation $T : \mathbb{R}^n \to \mathbb{R}^m$. Or, given a basis of V, compute the matrix of a transformation $T : V \to V$ relative to the basis.
- Compute coordinate vector (a.k.a. weights) of a vector relative to a given basis, or given coordinate vector, find the corresponding vector.
- Determine whether a square matrix is invertible. Compute the inverse of a matrix.
- Determine whether a matrix A has $\vec{x} \mapsto A\vec{x}$ onto, one-to-one, or both. Know how this is related to pivots, spanning, and independence.
- Given a matrix A, compute $\operatorname{rank} A$ or $\dim \operatorname{Nul} A$, or compute one from the other.
- Given an $m \times n$ matrix A, determine whether there is an $n \times m$ matrix B or $n \times m$ C so that $BA = I_n$ or $AC = I_m$. Compute such a matrix.
- Compute basis/dimension of $\ker T$ or $\operatorname{im} T$ given some linear transformation T.
- Compute orthogonal/orthonormal basis of some subspace W of $\mathbb{R}^n$ given a basis.
- Compute $\operatorname{proj}_{\operatorname{Col} A} \vec{b}$ or least-squares solution $A\vec{x} = \vec{b}$.
- Compute rank/invertibility/spanning columns/independent columns of AB, A, or B, given information about AB, A, and/or B.
- Determine whether a matrix is orthogonal.
- Given eigenvalues of A, determine whether $A - kI$ is an invertible matrix (for a given k).
- Eigenvalues of A^{-1} or A^T from those of A.