7.1.3 What you will learn

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Upon completion of this unit, you should be able to

- Determine, recognize, and apply permutation matrices.
- Apply permutation matrices to vectors and matrices.
- Identify and interpret permutation matrices and fluently compute the multiplication of a matrix on the left and right by a permutation matrix.
- Reason, make conjectures, and develop arguments about properties of permutation matrices.
- Recognize when Gaussian elimination breaks down and apply row exchanges to solve the problem when appropriate.
- Recognize when LU factorization fails and apply row pivoting to solve the problem when appropriate.
- Recognize that when executing Gaussian elimination (LU factorization) with $Ax = b$ where A is a square matrix, one of three things can happen:
  1. The process completes with no zeroes on the diagonal of the resulting matrix U. Then $A = LU$ and $Ax = b$ has a unique solution, which can be found by solving $Lz = b$ followed by $Ux = z$.
  2. The process requires row exchanges, completing with no zeroes on the diagonal of the resulting matrix U. Then $PA = LU$ and $Ax = b$ has a unique solution, which can be found by solving $Lz = Pb$ followed by $Ux = z$.
  3. The process requires row exchanges, but at some point no row can be found that puts a nonzero on the diagonal, at which point the process fails (unless the zero appears as the last element on the diagonal, in which case it completes, but leaves a zero on the diagonal of the upper triangular matrix). In Week 8 we will see that this means $Ax = b$ does not have a unique solution.
- Reason, make conjectures, and develop arguments about properties of inverses.
- Find the inverse of a simple matrix by understanding how the corresponding linear transformation is related to the matrix-vector multiplication with the matrix.
- Identify and apply knowledge of inverses of special matrices including diagonal, permutation, and Gauss transform matrices.
- Determine whether a given matrix is an inverse of another given matrix.
- Recognize that a 2×2 matrix $A = \begin{pmatrix} \alpha_{0,0} & \alpha_{0,1} \\ \alpha_{1,0} & \alpha_{1,1} \end{pmatrix}$ has an inverse if and only if its determinant is not zero: $\det$.
- Compute the inverse of a 2 \times 2 matrix A if that inverse exists.

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