13. Determinant

Given a matrix, $\mathbf{A}$, we denote its transpose as $\mathbf{A}^T$. The transpose of a matrix is equivalent to writing its rows as columns, or its columns as rows. Then, $\mathbf{A}^T{}_{i,j} = \mathbf{A}_{j,i}$.

Recall that the **determinant** $\det(\mathbf{A})$ of a square matrix $\mathbf{A}$ indicates whether it is invertible. For 2×2 matrices, it has the formula

$$\det \begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc.$$

For larger matrices, the formula is a bit more complicated.

Compute the Determinant

2/2 points (graded)

Let $\mathbf{A} = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 1 & 2 & 1 \end{bmatrix}$

1. Compute $\det(\mathbf{A}^T)$.

$\det(\mathbf{A}^T) =$ 6 ✔ **Answer:** 6

2. Compute $\det(\mathbf{A})$.

6 ✔ **Answer:** 6

STANDARD NOTATION

Solution:

1. First compute $\mathbf{A}^T$ by writing the first row as the first column. This gives us $\begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$ as the first column. Repeat with rows 2 and 3 to arrive at the solution.
   Then compute the determinant as follows:
   $1(5-12) - 4(2-6) + 1(12-15) = 6.$

2. $\det(\mathbf{A}) = 1(5-12) - 2(4-6) + 3(8-5) = 6$. Notice that $\det(\mathbf{A}) = \det\mathbf{A}^T$. This is not a coincidence. In fact, this useful property holds for all matrices.

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Answers are displayed within the problem

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