- Matrices are arrays of numbers.
- Suppose A is an $m \times n$ matrix (i.e. m rows and n columns).
    - $A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}$
    - m and n are the dimensions of the matrix.
- **Square Matrix**
    - $m = n$ Same number of rows as columns.
    - **Determinant**: $\det(A) = |A|$
        - 2×2 matrix $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$: $\det(A) = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$
        - All other determinants can be simplified into determinants of 2×2 matrices
        - Example: 3×3 matrix A.

          $$\det(A) = \begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} = a_{11}\begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12}\begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13}\begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$$

            - Remember to alternate the signs
        - Represents signed volume inside matrix
    - **Trace**: Sum of diagonal entries. $tr(A) = a_{11} + a_{22} + ... + a_{nn}$
    - **Symmetric Matrix**: A square matrix such that $A = A^T$
    - **Orthogonal Matrix**: A square matrix such that $A^{-1} = A^T$.
- **Zero Matrix**: A matrix with entries of only 0
    - Example: 3×2 zero matrix $0_{3,2} = \begin{pmatrix} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{pmatrix}$
    - Any matrix multiplied by a zero matrix is another zero matrix.
- **Identity Matrix**: A square matrix with entries of 1 on its diagonal and 0 elsewhere
    - Example: 3×3 identity matrix $I_3 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$.
    - Any matrix multiplied by the identity matrix is itself.