**Singular Value Decomposition (SVD)**

**Definition**: SVD is a factorization of a real or complex matrix. It generalizes the eigen decomposition of a square normal matrix to any ( m \times n ) matrix via an orthonormal basis.

**Mathematical Representation**: [ A = U \Sigma V^T ]

- ( A ) is the original matrix.

- ( U ) is an ( m * m ) orthogonal matrix.

- ( \Sigma ) is an ( m * n ) diagonal matrix with non-negative real numbers on the diagonal.

- ( V ) is an ( n * n ) orthogonal matrix.

**Applications**:

- **Data Compression**: Reducing the dimensionality of data while preserving important information.

- **Noise Reduction**: Filtering out noise from data.

- **Image Processing**: Enhancing and compressing images.

**Conclusion**

SVD is a versatile tool with numerous applications in modern data analysis. Its ability to decompose complex matrices into simpler components makes it invaluable for various computational tasks.