Singular Value Decomposition

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SVD

A large data set $\mathbf{X} \in \mathbb{C}^{n \times m}$:

$$\mathbf{X} = \begin{bmatrix} \mathbf{x}_1 & \mathbf{x}_2 & \cdots & \mathbf{x}_m \end{bmatrix} \tag{1}$$

SVD is a unique matrix decomposition that is defined by:

$$\mathbf{X} = \mathbf{U}\mathbf{\Sigma}\mathbf{V}^* \tag{2}$$

where $\mathbf{U} \in \mathbb{C}^{n \times n}$ and $\mathbf{V} \in \mathbb{C}^{m \times m}$ are unitary matrices with orthonormal columns, and $\mathbf{\Sigma} \in \mathbb{R}^{n \times m}$ is a matrix with real, nonnegative entries on the diagonal and zeros off the diagonal.