

Singular Value Decomposition (SVD)

Singular Value Decomposition is a factorization (breaking down) method in linear algebra, from it's name it decomposes a given matrix into **three other matrices** which gives a way to represent data in terms of **singular values**

Given a **data matrix** A :

$$A = U\Sigma V^{\top}$$

- U and V^{\top} are both unitary matrices (**Orthogonal**)
- Σ is a **Diagonal matrix**

$$U = \begin{bmatrix} u_1 & u_2 & \dots & u_n \\ \vdots & \vdots & & \vdots \\ \vdots & \vdots & & \vdots \end{bmatrix}$$

- The columns of U have the same **shape** as the columns in our **data matrix** A

$$\Sigma = \begin{bmatrix} \sigma_1 & & & \\ \vdots & \sigma_2 & & \\ \vdots & \vdots & \ddots & \\ \dots & \dots & \dots & \sigma_m \end{bmatrix}$$

$$V^{\top} = \begin{bmatrix} \vdots & \vdots & & \vdots \\ v_1 & v_2 & \dots & v_m \\ \vdots & \vdots & & \vdots \end{bmatrix}^{\top}$$

$$A = U\Sigma V^T$$

