a. ...

## EECS 16B CSM

Bryan Ngo

UC Berkeley

2020-11-02

EECS 16B CSM

Bryan Ngo

$$oldsymbol{A} = \sum_{i=1}^{r} \sigma_{i} oldsymbol{u}_{i} \left[oldsymbol{v}_{i}
ight]^{\!\top} = oldsymbol{U} oldsymbol{\Sigma} \left[oldsymbol{V}
ight]^{\!\top} = egin{bmatrix} oldsymbol{u}_{1} & oldsymbol{u}_{2} & \cdots & oldsymbol{u}_{r} \end{bmatrix} egin{bmatrix} \sigma_{1} & 0 & \cdots & 0 \ 0 & \sigma_{2} & \cdots & 0 \ \vdots & \vdots & \ddots & \vdots \ 0 & 0 & \cdots & \sigma_{n} \end{bmatrix} egin{bmatrix} \left[oldsymbol{v}_{1}\right]^{\!\top} \\ \left[oldsymbol{v}_{2}\right]^{\!\top} \\ \left[oldsymbol{v}_{n}\right]^{\!\top} \end{bmatrix}$$

$$(1)$$

- *U*: orthonormal matrix
- $\Sigma$ : diagonal matrix
- $[V]^{\top}$  orthonormal matrix

# **Applications**

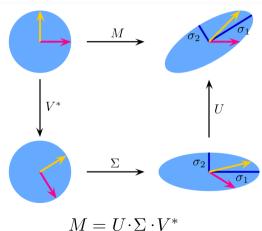
EECS 16B CSM

Bryan Ngo

- PCA
- least squares, pseudoinverse
- splitting up matrix operations

## Visualization

EECS 16B



$$M = U \cdot \Sigma \cdot V^*$$

#### **Gram-Schmidt Process**

EECS 16B CSM

Bryan Ng

$$\boldsymbol{p}_i = \boldsymbol{v}_i - \sum_{j=1}^{i-1} ([\boldsymbol{v}_i]^{\mathsf{T}} \boldsymbol{w}_j) \boldsymbol{w}_j$$
 (2)

$$\boldsymbol{w}_i = \frac{\boldsymbol{p}_i}{\|\boldsymbol{p}_i\|} \tag{3}$$

- turns set of basis vectors to set of orthogonal basis vectors
- systematically removing parallel components of our vector