

WK3 Report

Replication of *Deepfake Representation with Multilinear Regression*

Yunting Chiu



Data (video frames) Preprocessing

Step 1: Vectorizing video frames

Step 2: Finding eigenfaces of each class

-
-
-
-
-
-
-

Step 1: Vectorizing video frames

- It is preferable to vectorize an image and treat it as a single observation rather than a collection of independent column/row observations
- By vectorizing an image, the authors treat an image as a point in high dimensional pixel space and calculate all possible combinations of pixel statistics
- e.g. n is amount of colors and r is amount of pixels. 300x300 full RGB color image?
 $(255^3)^{(300^2)}$
- `img.shape()`: `img[0]` is height, `img[1]` is width, `img[2]` is channels

Step 2: Finding eigenfaces of each frame

- A. Eigenfaces are eigenvectors(**B**) when the images are human faces
- B. The eigenfaces represent a basis set of all faces used to construct the covariance matrix (for dimensionality reduction \Rightarrow the eigenfaces are equal to basis vectors of PCA decomposition)

$$\mathbf{D}_{\text{real}} = \mathbf{U}_{\text{real}} \mathbf{\Sigma}_{\text{real}} \mathbf{V}_{\text{real}}^T = \mathbf{B}_{\text{real}} \mathbf{V}_{\text{real}}^T \quad (11)$$

$$\mathbf{D}_{\text{fake}} = \mathbf{U}_{\text{fake}} \mathbf{\Sigma}_{\text{fake}} \mathbf{V}_{\text{fake}}^T = \mathbf{B}_{\text{fake}} \mathbf{V}_{\text{fake}}^T \quad (12)$$

Where \mathbf{B}_{real} and \mathbf{B}_{fake} are basis matrices and \mathbf{V}_{real} and \mathbf{V}_{fake} are the normalized coefficient matrices of the corresponding classes.

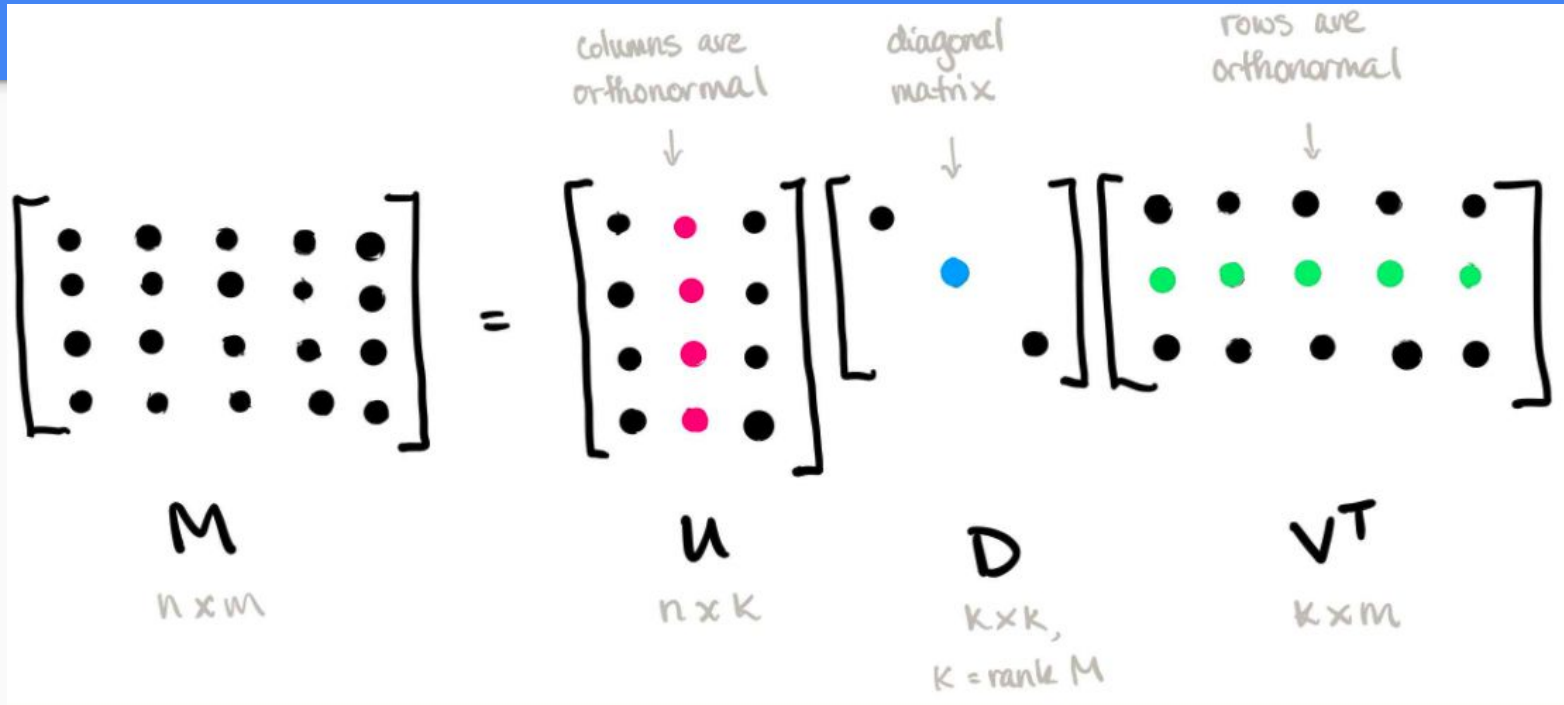
Step 2: Finding eigenfaces of each frame

C. The classification could be achieved **by comparing how different faces are represented by the basis set of the corresponding class**. That is, B (fake or real basis matrices).

D. create two separate metrics: B_{real} , B_{fake}

Singular Value Decomposition (SVD)

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



Principal Components Analysis (PCA)

Rewriting equation 1 in conventional linear algebra, the Principal Components Analysis (PCA) is:

$$\mathbf{D} = \underbrace{\mathbf{U}}_{\text{Basis}} \underbrace{\boldsymbol{\Sigma} \mathbf{V}^T}_{\text{Coefficient}} \quad (3)$$

The same as:

$$\begin{aligned} & \mathbf{B}_{\text{real}} \mathbf{V}_{\text{real}}^T \\ &= \mathbf{B}_{\text{fake}} \mathbf{V}_{\text{fake}}^T \end{aligned}$$