

$$\begin{bmatrix} 0 & \dots & 0 \\ \vdots & & \vdots \\ 0 & \dots & 0 \end{bmatrix}_{N \times N} \xrightarrow{M \times} \begin{bmatrix} 0 & \dots & 0 \\ \vdots & & \vdots \\ 0 & \dots & 0 \end{bmatrix}_{N \times N}$$

$$X = \begin{bmatrix} \vdots \\ \vdots \\ \vdots \end{bmatrix}_{N^2 \times 1} \xrightarrow{M \times} \begin{bmatrix} 0 \\ \vdots \\ 0 \end{bmatrix}_{N^2 \times 1} \rightarrow \frac{\mu}{\Sigma}$$

PCA to find weights (idempotent. $X_{rec} - \mu \sim \sum_{i=1}^k a_i^T (X^* - \mu) a_i$)

$$\begin{matrix} \star \\ X \\ N^2 \times 1 \end{matrix} \rightarrow \begin{matrix} \star \\ w \\ k \times 1 \end{matrix}$$

$$1 \leq i \leq k \quad w_i^* = U_i^T (X^* - \mu)_{N^2 \times 1} \Rightarrow X_{reconstruct} = \mu + (a_1 \dots a_k) \begin{pmatrix} w_1^* \\ \vdots \\ w_k^* \end{pmatrix}$$

$N^2 \times 1 \quad N^2 \times 1 \quad N^2 \times 1$

$a_i = \text{loading}$
PCA with k
 $N^2 \times 1$,

$$w = \begin{pmatrix} w_1 \\ \vdots \\ w_k \end{pmatrix} = \begin{pmatrix} w_1^1 & \dots & w_1^M \\ \vdots & & \vdots \\ w_k^1 & \dots & w_k^M \end{pmatrix} \Rightarrow w^M \quad k \times M$$

$w_1^1 \quad w_k^1$

w
weight
for all in sample
pic

for new Pic X_{new}
 $N^2 \times 1$
find $w = \begin{pmatrix} w_1 \\ \vdots \\ w_k \end{pmatrix}$

$$\min_{1 \leq i \leq M} \|w - w_i^M\| \rightarrow \text{each dist}$$

$k \times 1 \quad k \times 1$