The Why and How of Nonnegative Matrix Factorization

Topic Presentation

Group 02

LINMA2380 — Matrix computations

December 10, 2020

Applications - Image processing

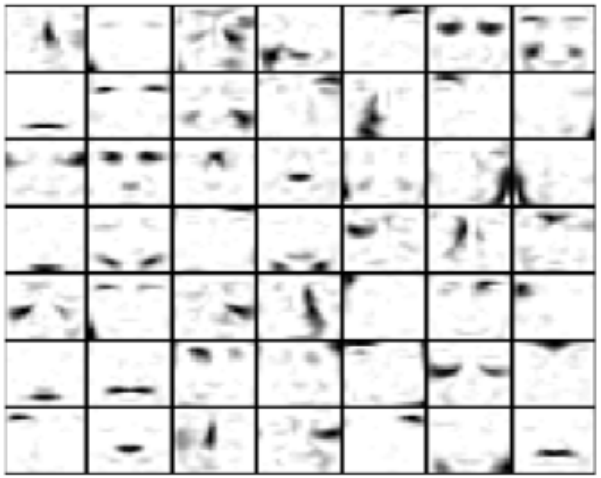
Goal : Facial Feature Extraction

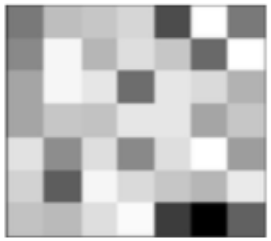
Data matrix : $X \in \mathbb{R}_+^{p \times n}$

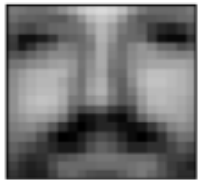
- p : total number of pixels
- n : number of faces
- $X(i,j)$: the gray-level of the i-th pixel in the j-th face

Applications - Image processing

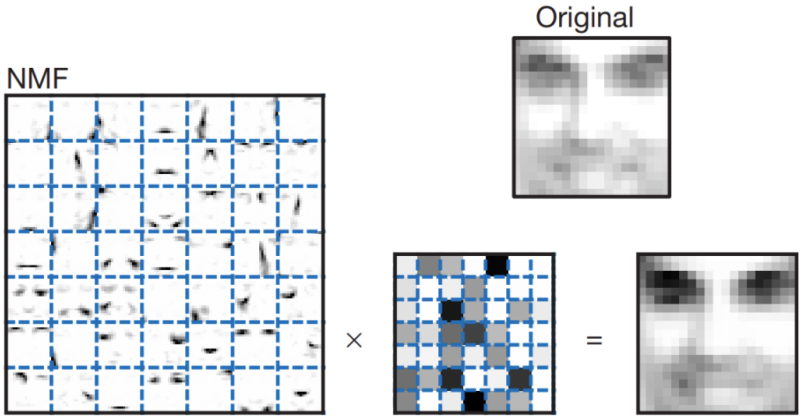
$$\underbrace{X(:,j)}_{j\text{th facial image}} \approx \sum_{k=1}^{r} \underbrace{W(:,k)}_{\text{facial features}} \underbrace{H(k,j)}_{\text{importance of features in } j\text{th image}} = \underbrace{WH(:,j)}_{\text{approximation of } j\text{th image}}$$



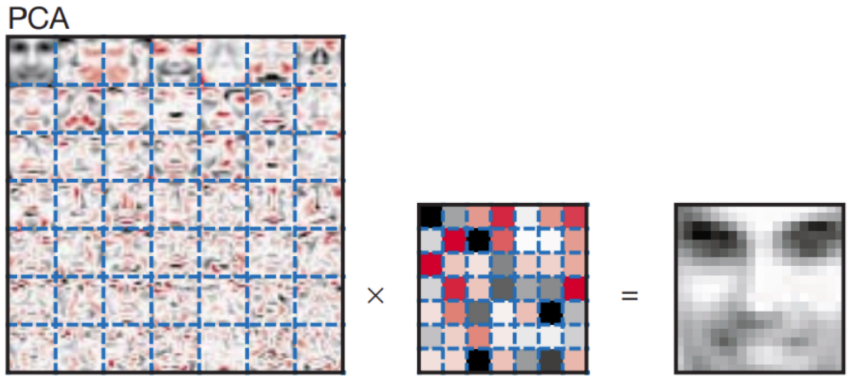




Applications - Image processing



NMF decomposition



PCA decompostion

Applications - Text mining

Goal : Topic Recovery and Document Classification

Data matrix : $X \in \mathbb{R}^{n \times m}$

- each column : a document
- each line : a word
- $X(i,j)$: number of times the i-th word appears in the j-th document

$$\underbrace{X(:,j)}_{j\text{th document}} \approx \sum_{k=1}^{r} \underbrace{W(:,k)}_{k\text{th topic}} \underbrace{H(k,j)}_{\substack{\text{importance of } k\text{th topic} \\ \text{in } j\text{th document}}}, \qquad \text{with } W \geq 0 \text{ and } H \geq 0.$$

Summary