

DLCV Homework 1

- R07944007 林良翰

1. Bayes Decision Rule

- Find Best T

$$\begin{aligned} & \min_{2 \leq T \leq 5} \int_T^\infty P(x|w_1) P(w_1) dx + \int_{-\infty}^T P(x|w_2) P(w_2) dx \\ &= \min_{2 \leq T \leq 5} \frac{2}{9} \int_T^\infty P(x|w_1) dx + \frac{7}{9} \int_{-\infty}^T P(x|w_2) dx \\ &= \min_{2 \leq T \leq 5} \frac{2}{9} \left[\frac{1}{5}(5 - T) \right] + \frac{7}{9} \left[\frac{1}{7}(T - 2) \right] \\ &= \min_{2 \leq T \leq 5} \frac{T}{15} \Rightarrow T = 2, P_e = \frac{2}{15} \end{aligned}$$

- Decision Regions

$$R_1 : x < 2$$

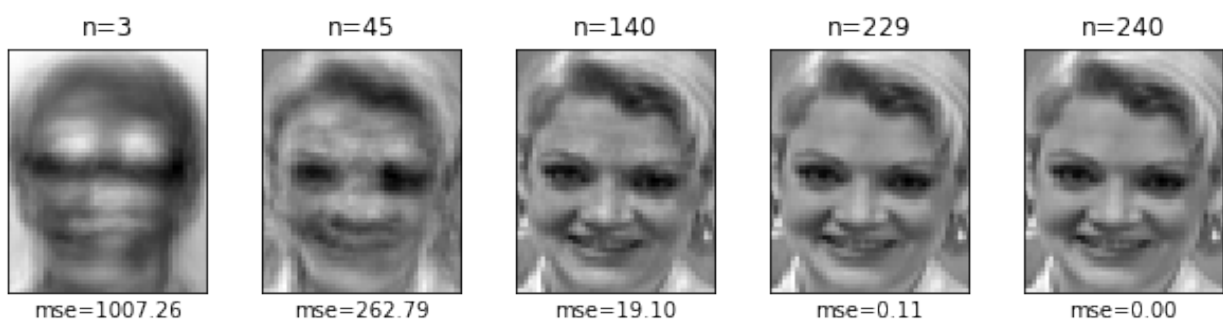
$$R_2 : x \geq 2$$

2. PCA for Eigenfaces

2.1.



2.2. 2.3.



2.4.

Accuracy	k=1	k=3	k=5
n=3	0.6792	0.5958	0.5208
n=45	0.9292	0.8333	0.7833
n=140	0.9333	0.8542	0.7583

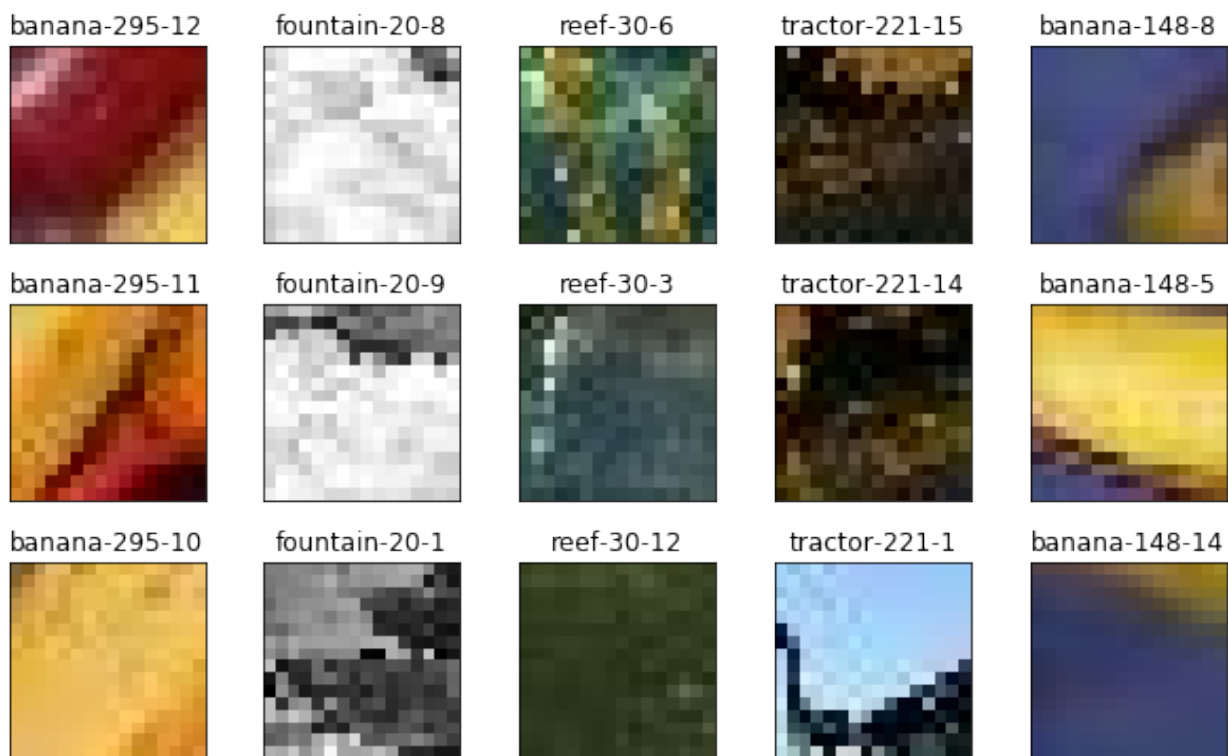
- Best $(n, k) = (140, 1)$

2.5.

- Test accuracy = 93.75%

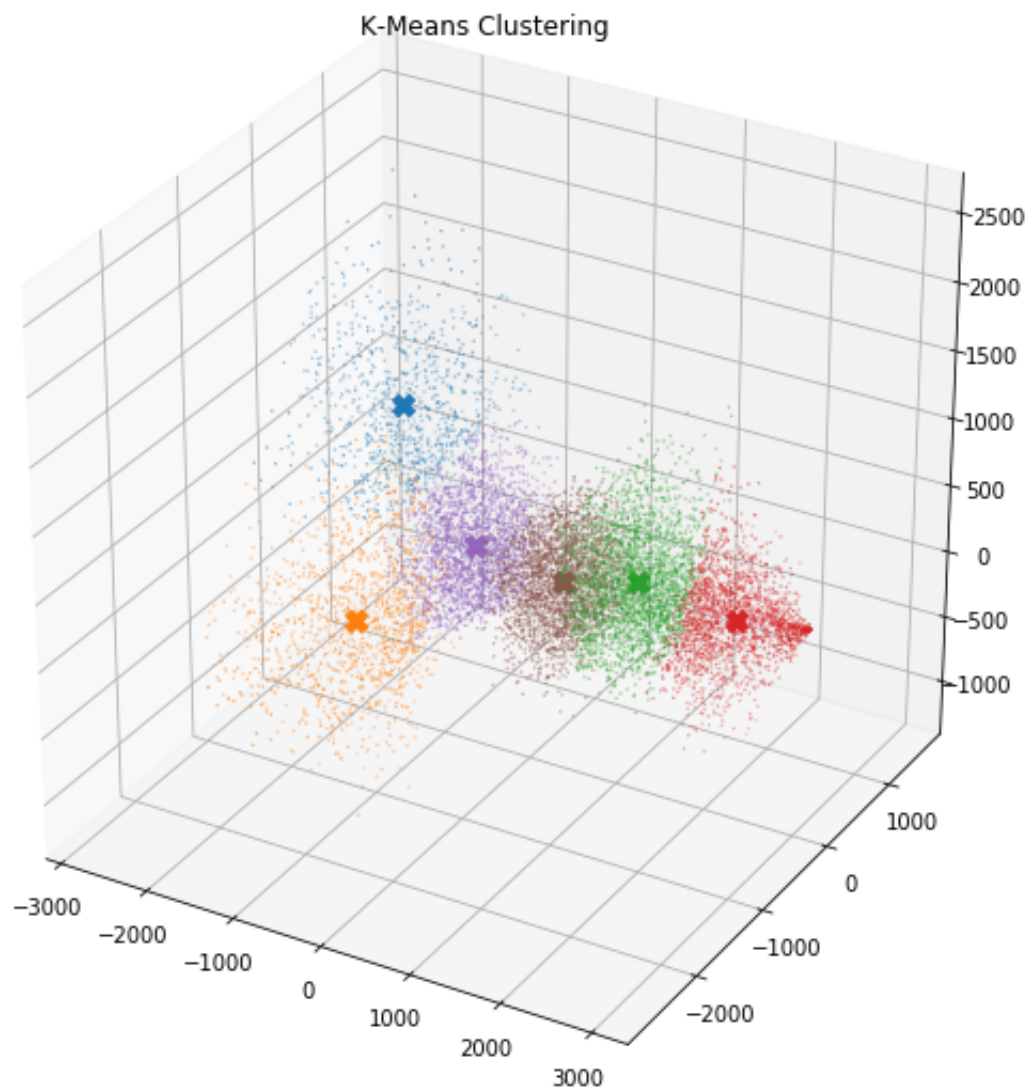
3.

3.1.

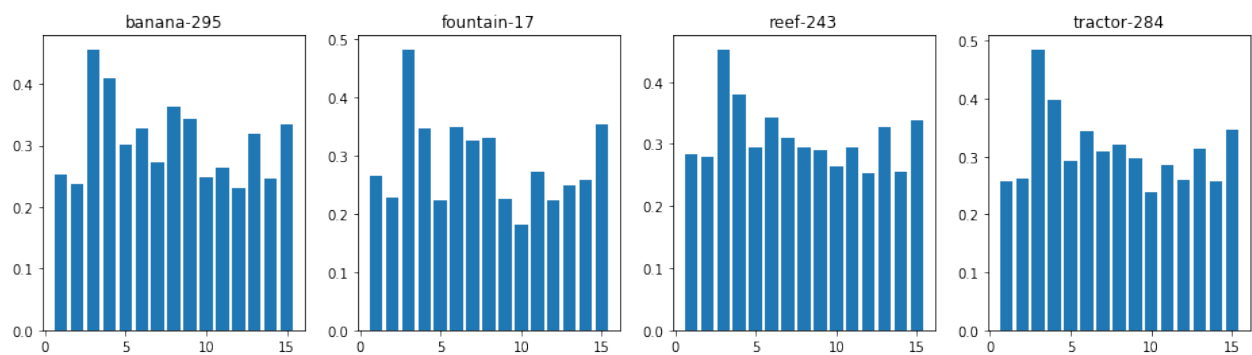


- I can't classify an image by seeing just a few patches, because there are some patches that are similar but with different classes.

3.2.



3.3.



3.4.

- Test accuracy = 53.8%

4. Image Filtering

4.1.

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{x^2}{2\sigma^2}}$$

$$G(y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{y^2}{2\sigma^2}}$$

$$G(x) G(y) = \frac{1}{(\sqrt{2\pi\sigma^2})^2} e^{-\frac{x^2}{2\sigma^2} - \frac{y^2}{2\sigma^2}} = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}} = G(x, y)$$

4.2.

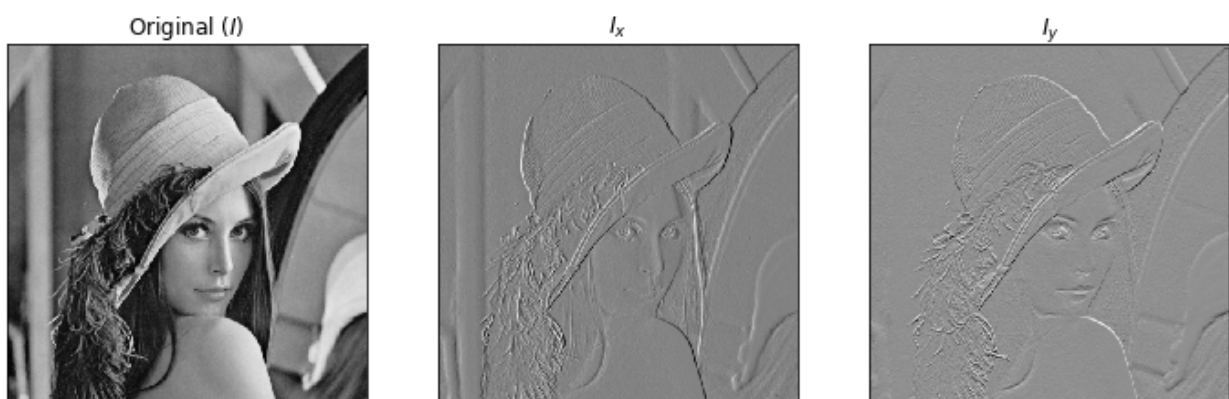


- The filtered image is smoother.

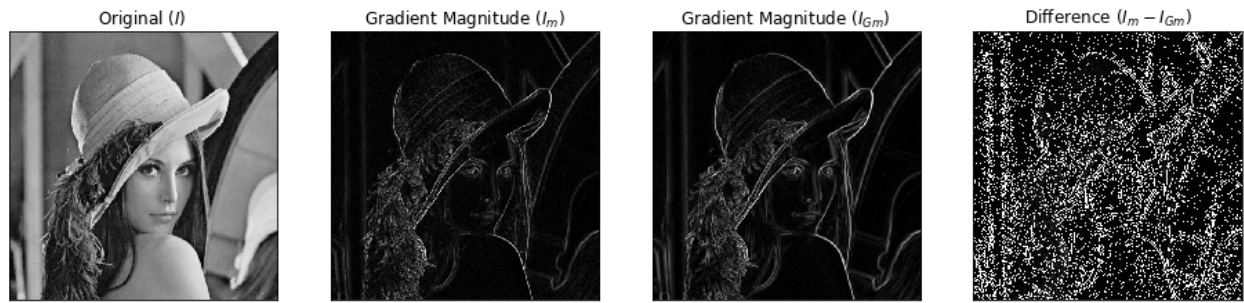
4.3.

$$\bullet \quad k_x = \frac{1}{2} \begin{bmatrix} 0 & 0 & 0 \\ -1 & 0 & +1 \\ 0 & 0 & 0 \end{bmatrix}$$

$$\bullet \quad k_y = \frac{1}{2} \begin{bmatrix} 0 & -1 & 0 \\ 0 & 0 & 0 \\ 0 & +1 & 0 \end{bmatrix}$$



4.4.



- The Gaussian-blurred image has less gradient magnitude than original image.