DLCV Homework 1

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1. Bayes Decision Rule

ullet Find Best T

$$egin{aligned} \min_{2 \leq T \leq 5} \int_{T}^{\infty} P\left(x|w_{1}
ight) P\left(w_{1}
ight) dx + \int_{-\infty}^{T} P\left(x|w_{2}
ight) P\left(w_{2}
ight) dx \\ &= \min_{2 \leq T \leq 5} rac{2}{9} \int_{T}^{\infty} P\left(x|w_{1}
ight) dx + rac{7}{9} \int_{-\infty}^{T} P\left(x|w_{2}
ight) dx \\ &= \min_{2 \leq T \leq 5} rac{2}{9} \left[rac{1}{5}(5-T)
ight] + rac{7}{9} \left[rac{1}{7}(T-2)
ight] \\ &= \min_{2 \leq T \leq 5} rac{T}{15} \ \Rightarrow T = 2, P_{e} = rac{2}{15} \end{aligned}$$

• Dicision Regions

 R_1 : x < 2

 R_2 : $x \geq 2$

2. PCA for Eigenfaces

2.1.











n=240

2.2. 2.3.







n=140 mse=19.10 n=229

mse=0.11 mse=0.00

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 |

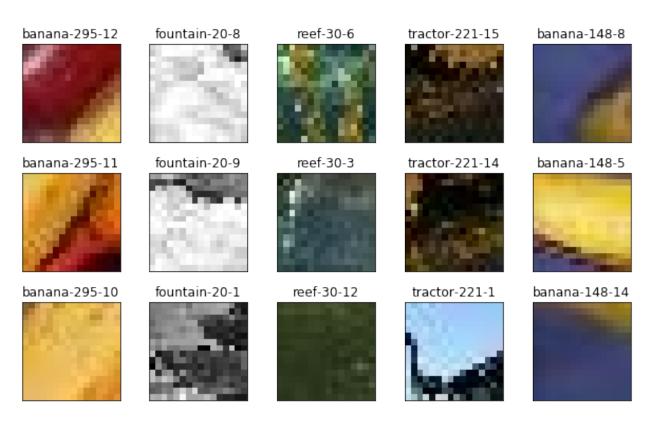
• Best (n, k) = (140, 1)

2.5.

• Test accuracy = 93.75%

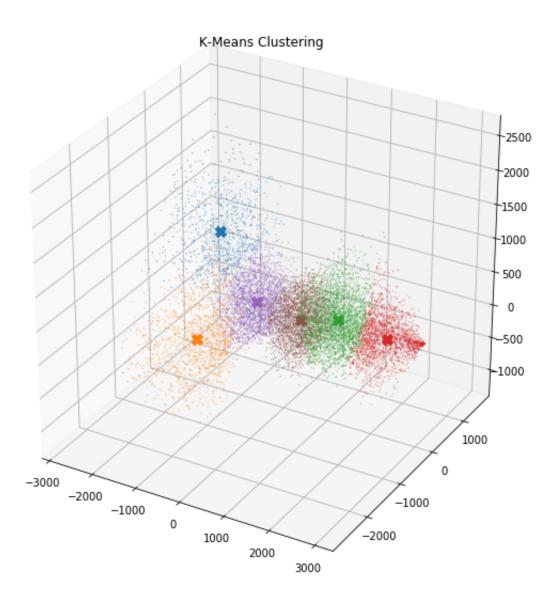
3.

3.1.

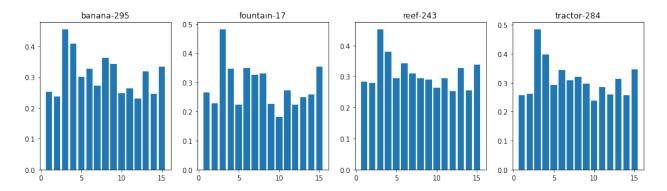


• I can't classify an image by seeing just a few patches, because there are some patches that are similar but with different classes.

3.2.



3.3.



3.4.

• Test accuracy = 53.8%

4. Image Filtering

4.1.

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

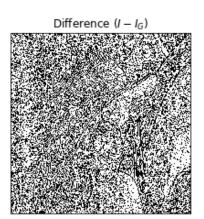
$$G\left(y
ight)=rac{1}{\sqrt{2\pi\sigma^{2}}}e^{-rac{y^{2}}{2\sigma^{2}}}$$

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

4.2.







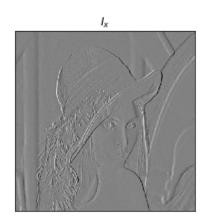
• The filtered image is smoother.

4.3.

$$egin{aligned} ullet k_x &= rac{1}{2} egin{bmatrix} 0 & 0 & 0 \ -1 & 0 & +1 \ 0 & 0 & 0 \end{bmatrix} \ ullet k_y &= rac{1}{2} egin{bmatrix} 0 & -1 & 0 \ 0 & 0 & 0 \ 0 & +1 & 0 \end{bmatrix} \end{aligned}$$

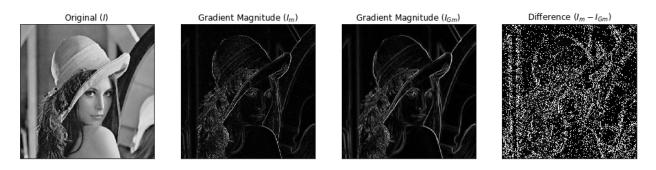
$$ullet k_y = rac{1}{2} egin{bmatrix} 0 & -1 & 0 \ 0 & 0 & 0 \ 0 & +1 & 0 \end{bmatrix}$$







4.4.



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