Identification Systems

Exercises 3

Piotr Syga

May 1, 2021

1. For matrices

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \; B = \begin{bmatrix} 0 & 2 & 4 \\ 4 & 16 & 8 \\ 32 & 8 & 0 \end{bmatrix} \; C = \begin{bmatrix} 3 & 5 & 8 & 16 & 8 & 5 \\ 0 & 1 & 2 & 4 & 16 & 2 \\ 0 & 0 & 16 & 8 & 24 & 0 \\ 4 & 16 & 55 & 7 & 3 & 1 \\ 1 & 0 & 2 & 10 & 4 & 2 \end{bmatrix}$$

   perform convolution with kernels:

   (a)
   $$\begin{bmatrix} 1 & 0 & -1 \\ 0 & 0 & 0 \\ -1 & 0 & 1 \end{bmatrix}$$

   (b)
   $$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix}$$

   (c)
   $$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

   (d)
   $$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

   (e)
   $$\begin{bmatrix} -1 & 2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

(f)

$$\begin{bmatrix} \frac{1}{16} & \frac{1}{8} & \frac{1}{16} \\ \frac{1}{8} & \frac{1}{4} & \frac{1}{8} \\ \frac{1}{16} & \frac{1}{8} & \frac{1}{16} \end{bmatrix}$$

(g)

$$\begin{bmatrix} \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \end{bmatrix}$$

2. For a single channel image find all pixels connected with $p_0 = (20, 25)$, for $V = \{0, 1, \ldots, 38\}$.

3. Implement a method for finding the longest path and the largest connected component in an image. What are the differences between the two?

4. For the image containing a crossword find all the vertical edges. Use `filter2D` or `convolve`.

5. Load an image and convolve it with kernels

   - $$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$
   - $$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 0 & 0 \end{bmatrix}$$
   - $$\begin{bmatrix} 0 & 3 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$
   - $$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8+A & -1 \\ -1 & -1 & -1 \end{bmatrix}$$

     for various A

   What are the results?

6. Using image segmentation try to estimate the number of flowers on the images containing patch of white flowers, scattered white flowers, two kinds of yellow flowers, tulips.
   Hint: you may start with selecting a proper channel and derive the number of sufficiently large connected components. Morphological operations may come in handy for noise reduction.

7. Use Haar-like feature cascades (`cv2.CascadeClassifier`) to detect face on arbitrary images. You may use GAN generated faces for sample images.

8. Use the results obtained in two previous tasks to estimate the number of faces on "world's largest selfie".

9. Implement a simple script that captures livefeed from a camera and detect the face. Select only the part of the image containing the face and adjust the lighting. Test the script against various face alignments, lighting conditions and multiple faces simultaneously present on the screen.

10. Implement a script that on a keypress fetches an image from sample images and detects and superposes on the image 68 facial landmarks. Calculate the average time between feching an image and finding the landmarks.