Morphology

Vision week 3

Miroslav Gechev

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Contents

Morphology

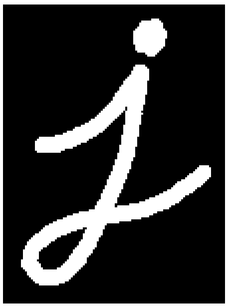
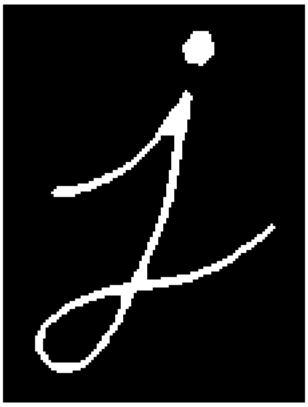
Week 3 assignments for Vision had to do with morphology. We were asked to write a program that shows the following: - Erosion - custom solution and with OpenCV - Dilation - custom solution and with OpenCV - Measure the time and compare for the custom and opencv solutions - Opening - with OpenCV - Closing - with OpenCV - Skeleton - with OpenCV - Measure the length of an object

Erosion and Dilation

Erosion and Dilation are similar procesess - Erosion deletes pixels and dilation is the oposite - it adds white pixels on a white object ### Custom - Erosion - Solution is similar to min-max operatio

```
def custom_erosion(img):
    kern = np.ones((5, 5), dtype="int")

    print("start custom_erosion")
    t_start = start()
    # grab the spatial dimensions of the image, along with
    # the spatial dimensions of the kernel
    (iH, iW) = img.shape[:2]
    (kH, kW) = kern.shape[:2]

    # allocate memory for the output image, taking care to
    # "pad" the borders of the input image so the spatial
    # size (i.e., width and height) are not reduced
    pad = (kW - 1) // 2
    img = cv2.copyMakeBorder(img, pad, pad, pad, pad,
                             cv2.BORDER_REPLICATE)
    output = np.zeros((iH, iW), dtype="float32")
    # loop over the input image, "sliding" the kernel across
    # each (x, y)-coordinate from left-to-right and top to
    # bottom
    for y in np.arange(pad, iH + pad):
        for x in np.arange(pad, iW + pad):
            # extract the ROI of the image by extracting the
            # *center* region of the current (x, y)-coordinates
            # dimensions
            roi = img[y - pad:y + pad + 1, x - pad:x + pad + 1]

            # perform the actual convolution by taking the
            # element-wise multiplicate between the ROI and
            # the kernel, then summing the matrix
            k = (roi * kern).min()
```

```
        # store the convolved value in the output (x,y)-
        # coordinate of the output image
        output[y - pad, x - pad] = k
# rescale the output image to be in the range [0, 255]
output = rescale_intensity(output, in_range=(0, 255))
output = (output * 255).astype("uint8")
t_end = stop()
time = elapsed(t_start, t_end)
print("end custom_erosion. Elapsed: {}".format(time))

# return the output image

cv2.imwrite("custom_erosion.png", output)
return output
```

- Dilation - As stated dilation is the oposite, so we take k = (roi * kern).max() instead
- Results:
  - Test image
    - 
  - Erosion - for custom the time it took to execute was: 0.14856889999999998
    - 
  - Dilation - for custom the time it took to execute was: 0.16502219999999998

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With opencv

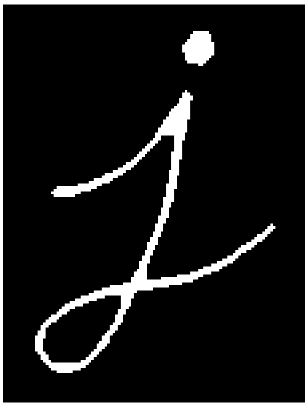
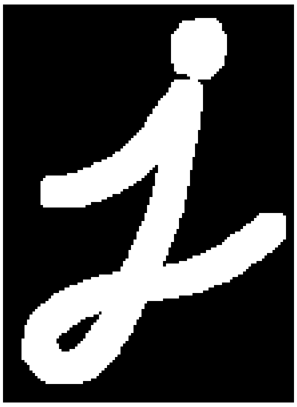
With OpenCV the whole process is much simpler and faster - Erosion

```
def erosion(img):
    ker = np.ones((5, 5), np.uint8)

    # start timer
    # process to measure
    print("start erosion.")
    t_start = start()
    new_img = cv2.erode(img, ker, iterations=1)
    t_end = stop()
    time = elapsed(t_start, t_end)
    print("end  erosion. Elapsed: {}".format(time))

    cv2.imwrite("erosion_opencv.png", new_img)
    return new_img
```

- Dilation

```
def dilitation(img):
    ker = np.ones((5, 5), np.uint8)
    # start timer
    # process to measure
    print("start dilitation")
    t_start = start()
    new_img = cv2.dilate(img, ker, iterations=1)
    t_end = stop()
    time = elapsed(t_start, t_end)
    print("end  dilitation. Elapsed: {}".format(time))

    cv2.imwrite("dilitation_opencv.png", new_img)

    return new_img
```

- Results

- Test image - we use the same image
- Erosion - with Opencv the time it took to execute was: 0.0001358
  * 
- Dilation - with Opencv the time it took to execute was: 4.699999999999995e-05
  * 

Conclusion

The OpenCv library is huge and very optimised tool, as expected, it was much faster to use the library for the Erosion and Dilation.

Opening and Closing

Opening and Closing are again 2 processes that counter each other - both do the same process, its just the opposite result.

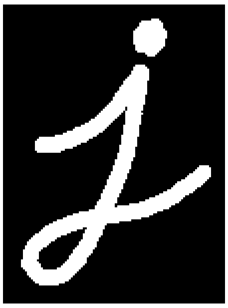
Opening

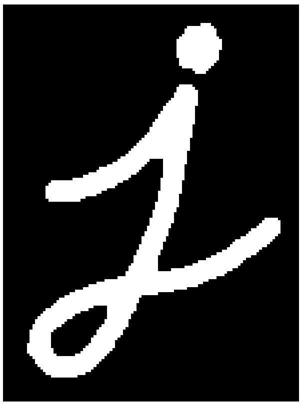
```
def opening(img, ):
    ker = np.ones((5, 5), np.uint8)
    # start timer
    # process to measure
    print("start opening")
    t_start = start()
    new_img = cv2.morphologyEx(img, cv2.MORPH_OPEN, ker)
    t_end = stop()
```

```
    time = elapsed(t_start, t_end)
    print("end  opening. Elapsed: {}".format(time))

    cv2.imwrite("opening_opencv.png", new_img)

    return new_img
```

Closing

```
def closing(img, ):
    ker = np.ones((5, 5), np.uint8)
    # start timer
    # process to measure
    print("start closing")
    t_start = start()
    new_img = cv2.morphologyEx(img, cv2.MORPH_CLOSE, ker)
    t_end = stop()
    time = elapsed(t_start, t_end)
    print("end  closing. Elapsed: {}".format(time))

    cv2.imwrite("closing_opencv.png", new_img)

    return new_img
```

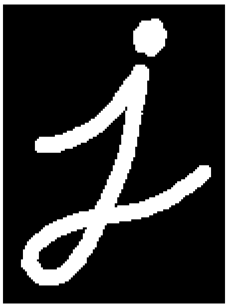
- Results:
  - Test image - we use the same as the previous
    * 
  - Opening -
    * 
  - Closing -

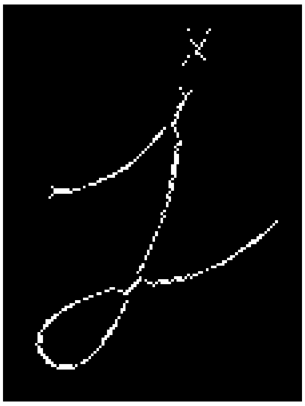
*  ## Skeleton A skeleton of an object is a line that is midway between the boundaries of that object and which exhibits the same topology. "'python def skeleton(img): skltn = np.zeros(img.shape, np.uint8) eroded = np.zeros(img.shape, np.uint8) temp = np.zeros(img.shape, np.uint8)

print("start skeleton") t_start = start() _, thresh = cv2.threshold(img, 127, 255, 0)
kernel = cv2.getStructuringElement(cv2.MORPH_CROSS, (3, 3))
iters = 0 while (True): cv2.erode(thresh, kernel, eroded) cv2.dilate(eroded, kernel, temp) cv2.subtract(thresh, temp, temp) cv2.bitwise_or(skltn, temp, skltn) thresh, eroded = eroded, thresh # Swap instead of copy

```
iters += 1
if cv2.countNonZero(thresh) == 0:
    t_end = stop()
    time = elapsed(t_start, t_end)
    print("end  skeleton. Elapsed: {}".format(time))

    cv2.imwrite("skeleton_opencv.png", skltn)
    return skltn, iters
```

"'

- Results:
  - Test image - we use the same as the previous
    * 
  - Skeleton -

* 

Measure length of an object

This task was more complicated to achieve. I found a tutorial i used, but it still needs some work until its finished and working on 100%

```
def measure_length(img, width):
    i = 0
    gray = cv2.GaussianBlur(img, (7, 7), 0)
    # perform edge detection, then perform a dilation + erosion to
    # close gaps in between object edges
    edged = cv2.erode(cv2.dilate(cv2.Canny(gray, 50, 100), None, iterations=1), None, iterat

    # find contours in the edge map
    cnts = cv2.findContours(edged.copy(), cv2.RETR_EXTERNAL,
                            cv2.CHAIN_APPROX_SIMPLE)
    cnts = imutils.grab_contours(cnts)

    # sort the contours from left-to-right and initialize the
    # 'pixels per metric' calibration variable
    (cnts, _) = contours.sort_contours(cnts)
    pixels_per_metric = None
    # loop over the contours individually
    for countour in cnts:
        # if the contour is not sufficiently large, ignore it
        if cv2.contourArea(countour) < 100:
            continue

        # compute the rotated bounding box of the contour
        orig = img.copy()
        box = cv2.minAreaRect(countour)
        box = cv2.cv.BoxPoints(box) if imutils.is_cv2() else cv2.boxPoints(box)
        box = np.array(box, dtype="int")

        # order the points in the contour such that they appear
        # in top-left, top-right, bottom-right, and bottom-left
        # order, then draw the outline of the rotated bounding
        # box
        box = perspective.order_points(box)
```

```python
    img = cv2.drawContours(orig, [box.astype("int")], -1, (0, 255, 0), 2)

    for (x, y) in box:
        cv2.circle(orig, (int(x), int(y)), 5, (0, 0, 255), -1)
        # unpack the ordered bounding box, then compute the midpoint
        # between the top-left and top-right coordinates, followed by
        # the midpoint between bottom-left and bottom-right coordinates
        (tl, tr, br, bl) = box
        (tltrX, tltrY) = midpoint(tl, tr)
        (blbrX, blbrY) = midpoint(bl, br)

        # compute the midpoint between the top-left and top-right points,
        # followed by the midpoint between the top-righ and bottom-right
        (tlblX, tlblY) = midpoint(tl, bl)
        (trbrX, trbrY) = midpoint(tr, br)

        # draw the midpoints on the image
        cv2.circle(orig, (int(tltrX), int(tltrY)), 5, (255, 0, 0), -1)
        cv2.circle(orig, (int(blbrX), int(blbrY)), 5, (255, 0, 0), -1)
        cv2.circle(orig, (int(tlblX), int(tlblY)), 5, (255, 0, 0), -1)
        cv2.circle(orig, (int(trbrX), int(trbrY)), 5, (255, 0, 0), -1)

        # draw lines between the midpoints
        cv2.line(orig, (int(tltrX), int(tltrY)), (int(blbrX), int(blbrY)),
                 (255, 0, 255), 2)
        cv2.line(orig, (int(tlblX), int(tlblY)), (int(trbrX), int(trbrY)),
                 (255, 0, 255), 2)
        # compute the Euclidean distance between the midpoints
        dA = dist.euclidean((tltrX, tltrY), (blbrX, blbrY))
        d_b = dist.euclidean((tlblX, tlblY), (trbrX, trbrY))

        # if the pixels per metric has not been initialized, then
        # compute it as the ratio of pixels to supplied metric
        # (in this case, inches)
        if pixels_per_metric is None:
            pixels_per_metric = d_b / width
            # compute the size of the object
        dim_a = (dA / pixels_per_metric)
        dim_b = d_b / pixels_per_metric

        # draw the object sizes on the image
        cv2.putText(orig, "{:.1f}cm".format(dim_a),
                    (int(tltrX - 15), int(tltrY - 10)), cv2.FONT_HERSHEY_SIMPLEX,
                    0.65, (255, 255, 255), 2)
        cv2.putText(orig, "{:.1f}cm".format(dim_b),
                    (int(trbrX + 10), int(trbrY)), cv2.FONT_HERSHEY_SIMPLEX,
                    0.65, (255, 255, 255), 2)
    i += 1

cv2.imwrite("object_length_{}.png".format(i), orig)
```

- Results:

– Test image - we use the following image for test

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– Length of an Object -

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