MECHA
Sogang University Robotics Team

OpenCV-Python

03. Line Detection

2021-W
MECHA Seminar

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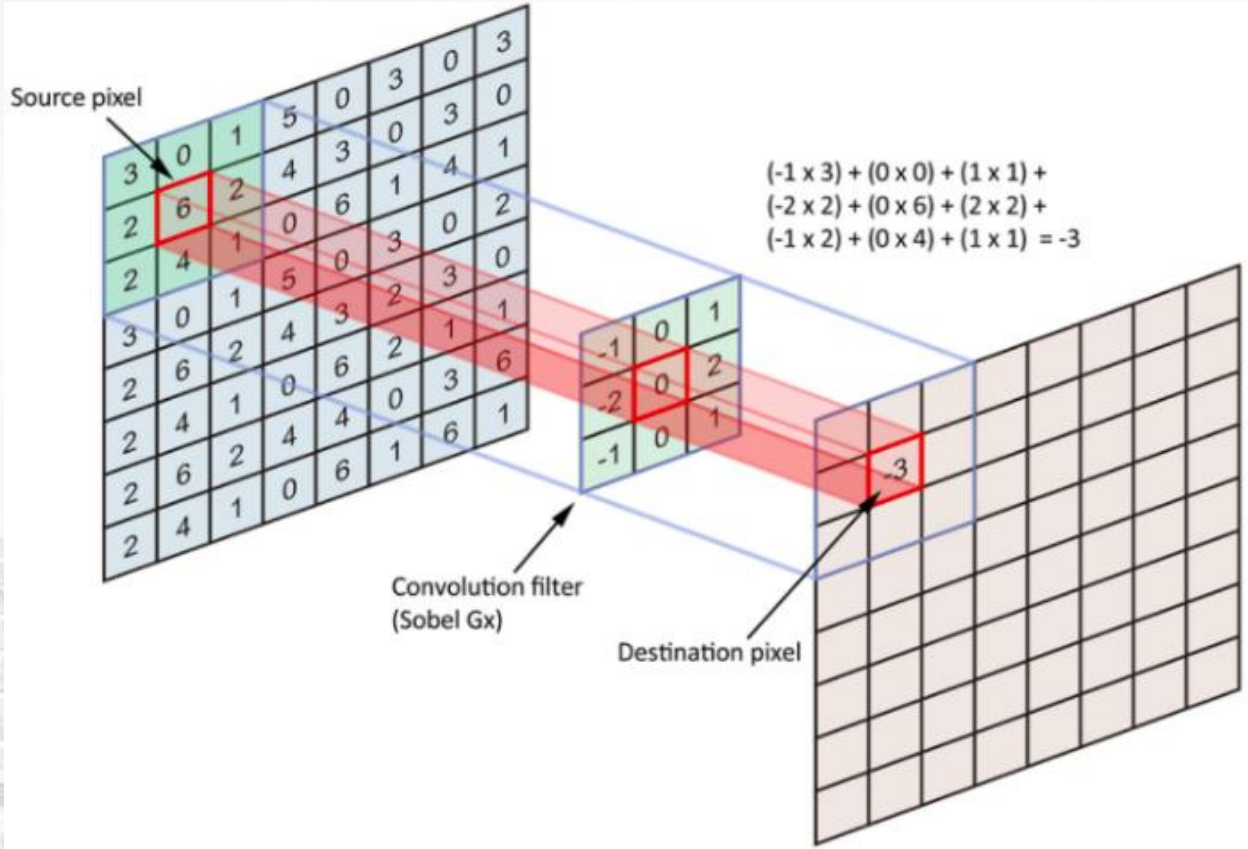
Contents :

- Gaussian Blur
- Canny Edge Detection
- Hough Transform
- 과제: example3

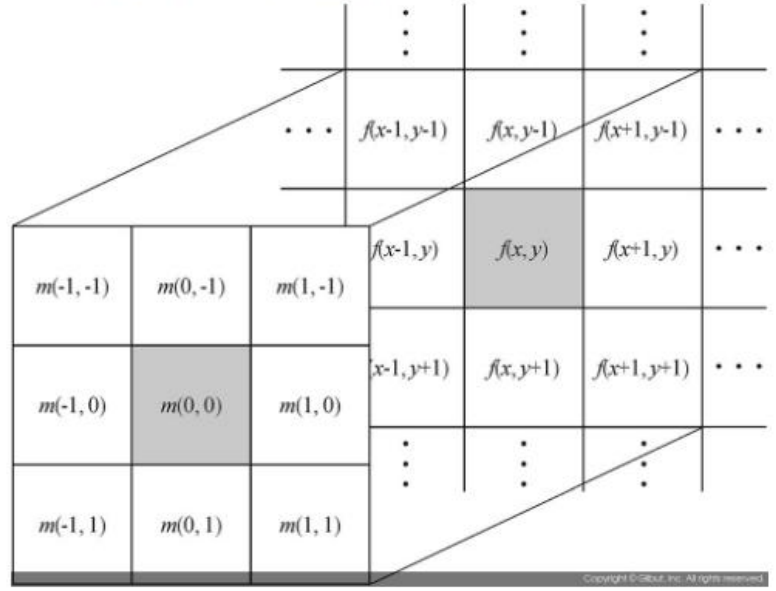
Gaussian Blur :

필터 & 컨볼루션(Convolution) 연산

- 계산 방법 ex 2행 2열
- Source: 원본 이미지, Destination: 마스킹 연산 이미지



▼ 그림 8-1 마스크를 이용한 필터링 방법



마스크 연산에 의해 새로 결정되는 영상의 픽셀 값은 다음과 같다.

$$g(x,y) = \sum_{j=-1}^{1}\sum_{i=-1}^{1} m(i,j) f(x+i, y+j)$$
$$= m(-1,-1) f(x-1,y-1) + m(0,-1) f(x,y-1) + m(1,-1) f(x+1,y-1)$$
$$+ m(-1,0) f(x-1,y) + m(0,0) f(x,y) + m(1,0) f(x+1,y)$$
$$+ m(-1,1) f(x-1,y+1) + m(0,1) f(x,y+1) + m(1,1) f(x+1,y+1)$$

GaussianBlur :

Average Blurring

- Average Blurring: 필터의 value가 모두 같음
- 단점: 필터의 크기가 클 때 선명도가 떨어짐

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

90	90	90	90	90	90	90
90	90	90	90	90	90	90
90	90	255	255	255	90	90
90	90	255	255	255	90	90
90	90	255	255	255	90	90
90	90	90	90	90	90	90
90	90	90	90	90	90	90

(a) 원본 영상

90	90	90	90	90	90	90
90	105	120	135	120	105	90
90	120	150	180	150	120	90
90	135	180	255	180	135	90
90	120	150	180	150	120	90
90	105	120	135	120	105	90
90	90	90	90	90	90	90

(b) 블러링 영상

(a) 입력 영상

(b) 3×3 평균 값 필터

(c) 5×5 평균 값 필터

GaussianBlur :

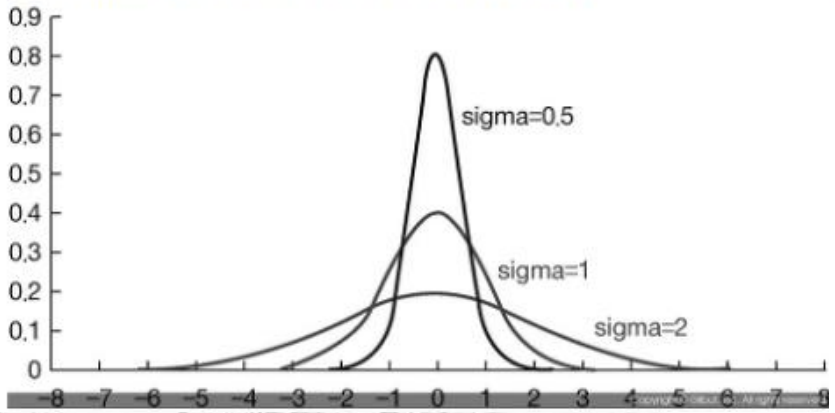
Gaussian Filtered Blurring

- Gaussian Filter: 자연현상을 가장 잘 표현하는 이산확률모형
- 2D Gaussian Function:

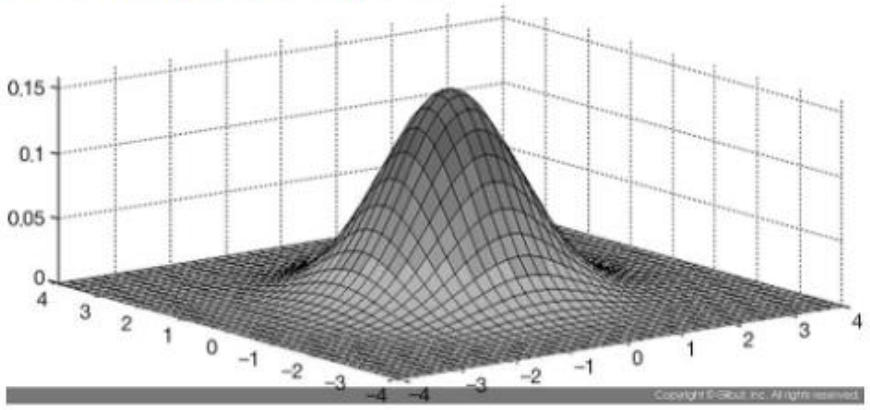
$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

- Sigma 값을 조정하여 필터의 weight를 조절함. 영상을 부드럽게 하기 위해 가장 많이 사용됨

▼ 그림 8-9 다양한 값에 따른 1차원 가우시안 함수의 모습



▼ 그림 8-10 2차원 가우시안 함수의 모습



GaussianBlur :

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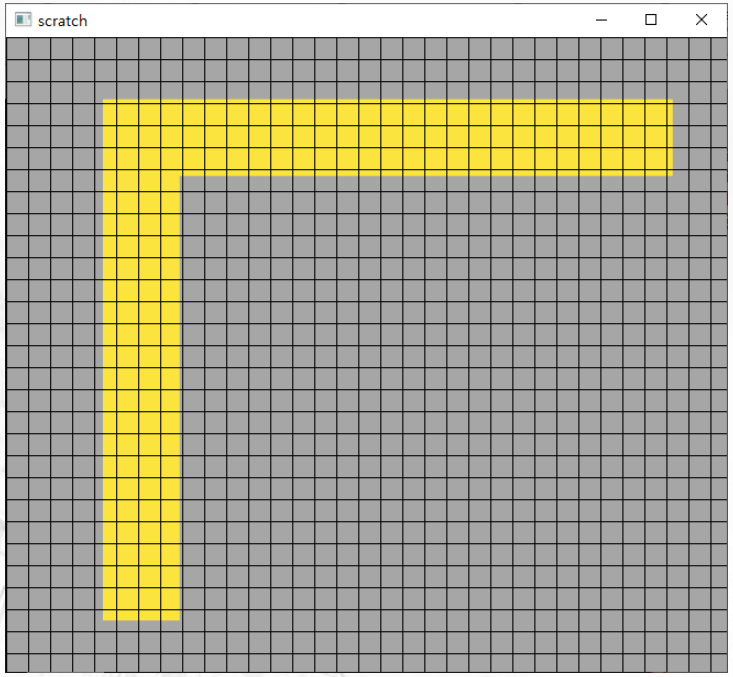
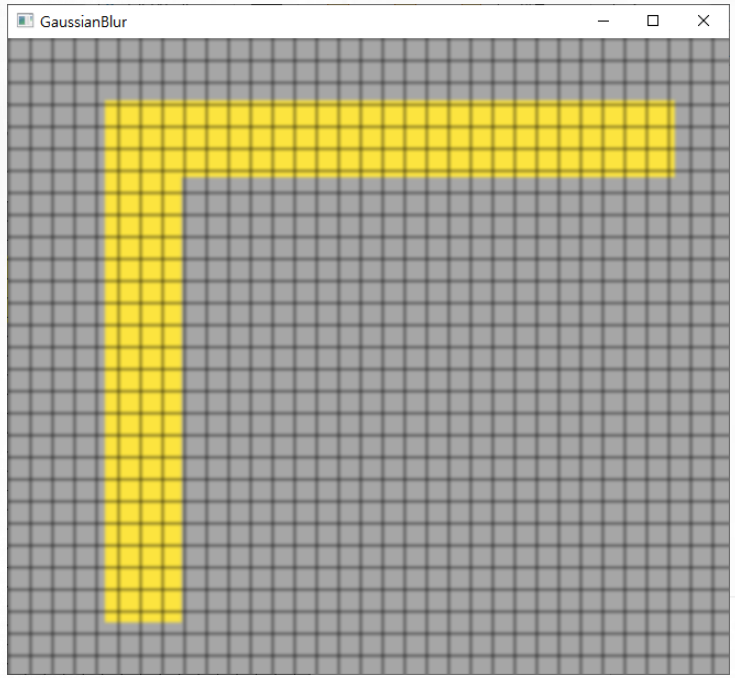
linedetect.py

- cv2.GaussianBlur(image, kernelsize, sigma)
- 원본이미지에 임의의 noise를 주고 kernel size=7인 gaussianblur 진행
- Non-Blur vs Blur





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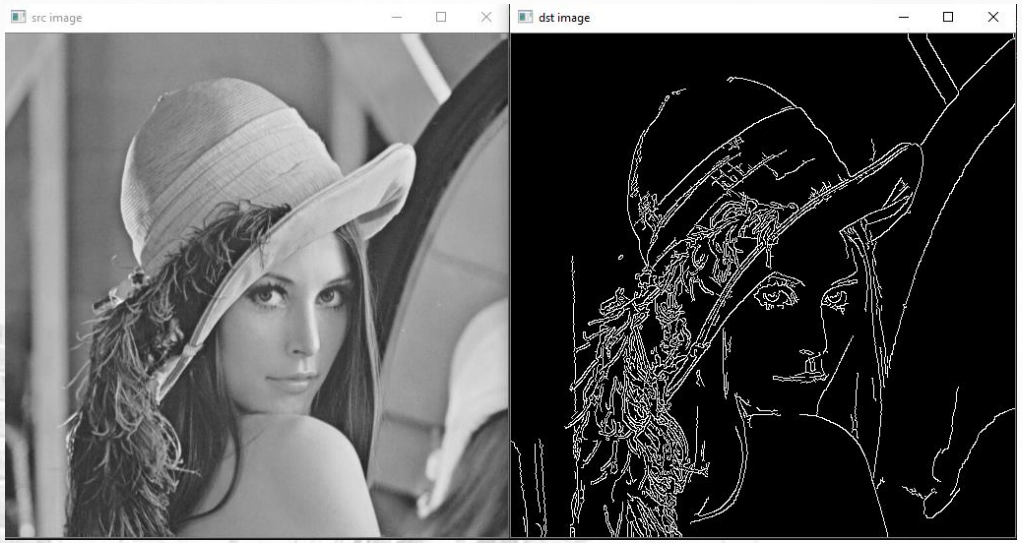
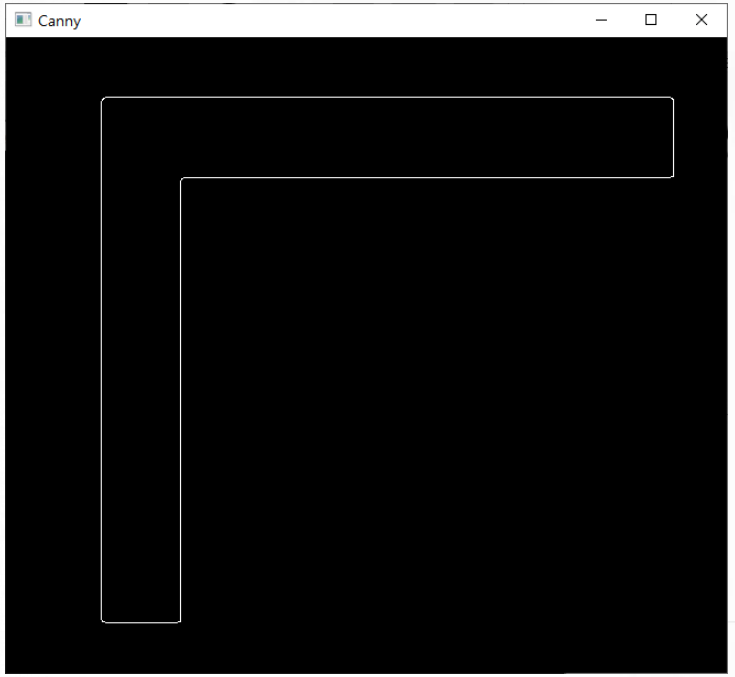
Canny Edge Detection :

linedetect.py

- cv2.Canny(maskedimage, min threshold, max threshold, apertureSize)
- pixel 색상 변화 gradient를 이용하여 경계선 검출

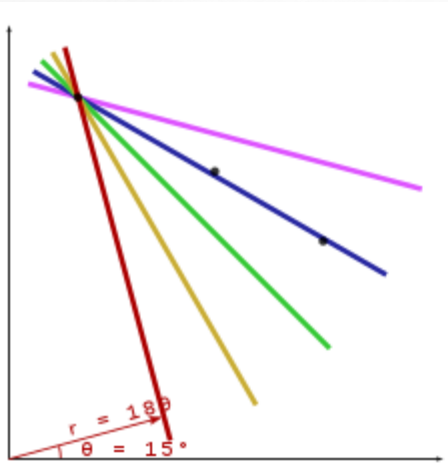




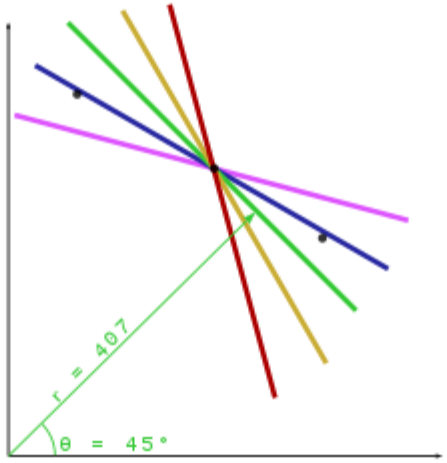
Hough Transform :

극좌표계로 변환

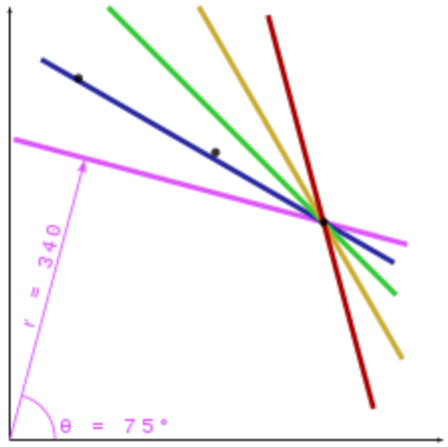
- 하나의 점을 지나는 직선의 방정식을 y=mx+n이 아닌 $r = x\cos\theta + y\sin\theta$, 로 생각
- theta=1~180 로 변화하면서 근접한 기울기를 찾는 방식



θ	r
15	189.0
30	282.0
45	355.7
60	407.3
75	429.4



θ	r
15	318.5
30	376.8
45	407.3
60	409.8
75	385.3

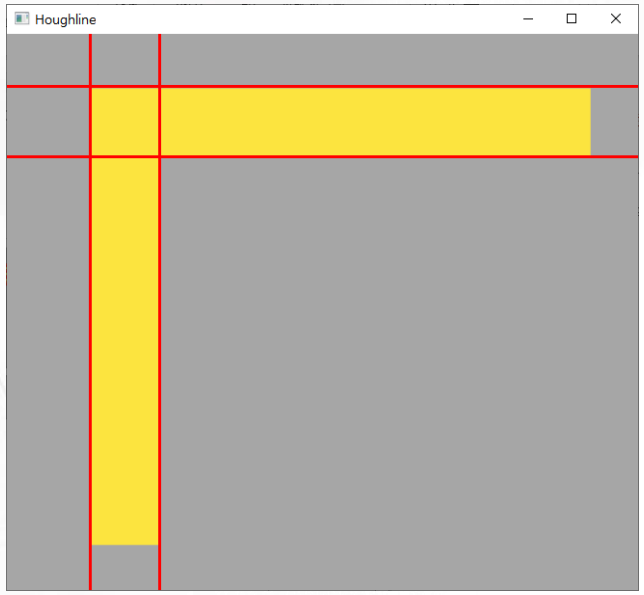


θ	r
15	419.0
30	443.6
45	438.4
60	402.9
75	340.1

Hough Transform :

linedetect.py

- cv2.HoughLines(canny image, rho, theta, threshold)
  - rho= 거리 측정 해상도(pixel 간격), theta = pi/180
- HoughLine을 찾은 뒤에 line을 그려주는 작업 진행
- cv2.line(image, startpoint, endpoint, color, thickness) 로 라인 그리기



Results of Non-Blur vs Blur : Masking, Canny, HoughLines

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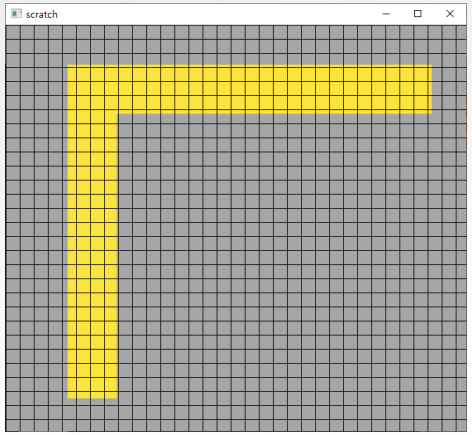
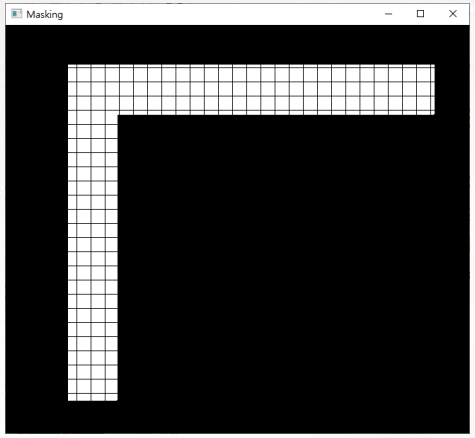
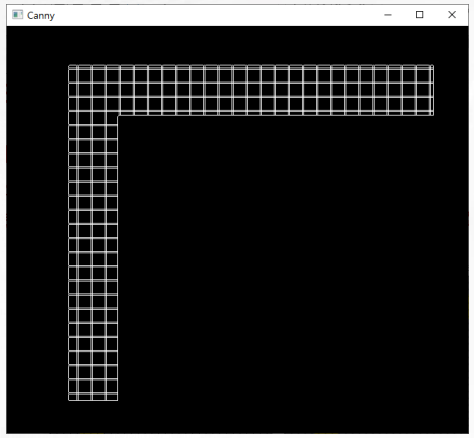
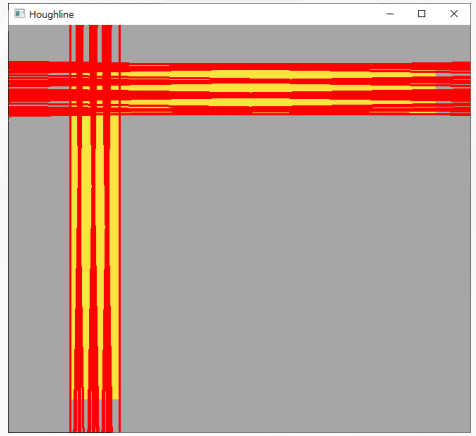
Non-Blur

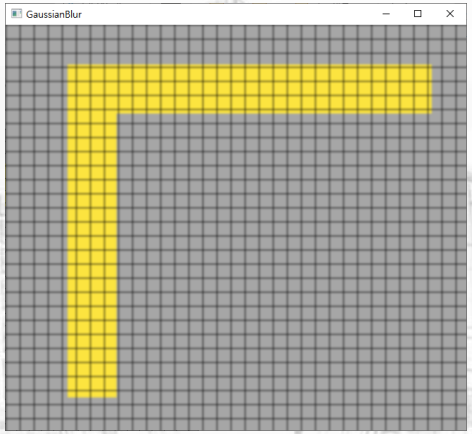


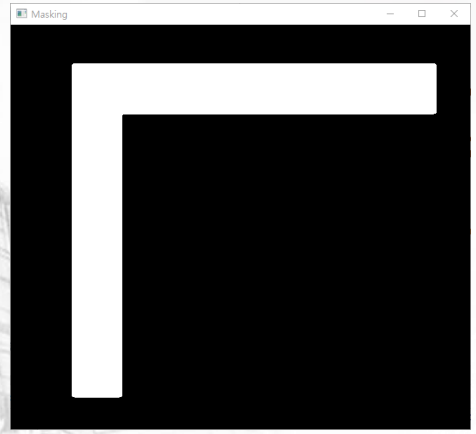


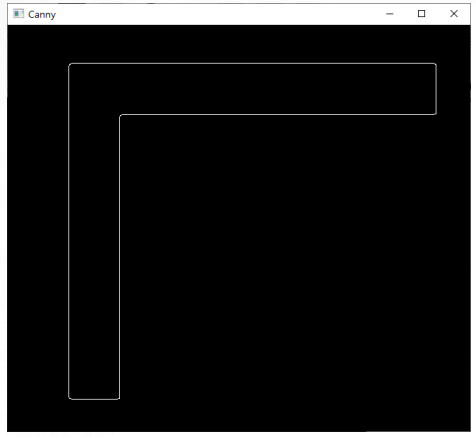


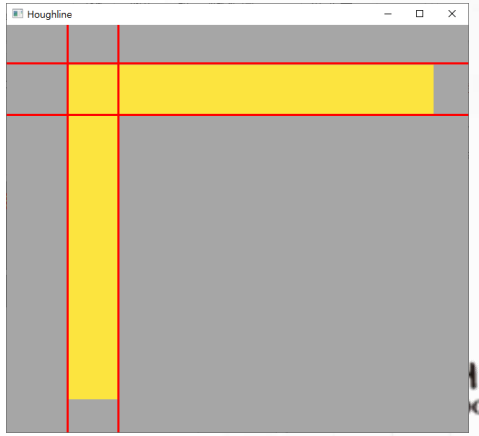


Blur









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과제3 :

tline.png에서 라인 가장자리를 검출 후 직선을 다음과 같이 그리시오.

- 제목을 example3.py로 새 python file 생성
- Hint:
- Cv2.HouthLines의 threshold 숫자 조절
- 1(좌) 2(우). 직선의 개수는 표시된 그림보다 많을 수도 있음