

Student ID:

Name:

2021 Vision System Midterm (1726)

Date: 2021. 04. 21

Room: Robot Building #211

1. [6pt] Why do we study computer vision (vision system)?

Also, write down at least 2 examples of computer vision applications.

2. [5pt] If we apply 3x3 mean filter over $F(x, y)$. What is the result value of the filter response?

아래의 F 에 3x3에 필터를 적용 (mean filter)

$F(x, y) =$

0	0	0
0	0	0
90	90	90

3. [5pt] If we want to enhance the detail of the image. What can we use or apply for image sharpening? (이미지 디테일을 강화(선명)하기 위해 어떤 방법을 적용할 수 있는가?)



Student ID:

Name:

4. [6pt] Write down 3 aspects (criteria) of a good edge detector.

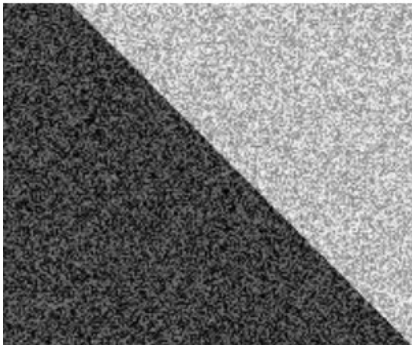
(좋은 edge detector가 가져야할 3가지 요건에 대해서 작성)

5. [6pt] Write down the gradient strength and direction equation using image gradient

$$\nabla f = \left[\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y} \right]$$

(위 식을 이용해 gradient strength와 direction을 구하시오)

6. [5pt] If you have input image as a following image, what will you do to detect edge clearly?



(위와 같이 이미지가 주어졌을 때, edge를 강건하게 추출하기 위한 방법에 대해서 서술하시오)

Student ID:

Name:

7. [10pt] Question about canny edge detector.

- A. [3pt] Explain 4 steps of Canny edge detector. (Canny 검출기의 4단계 설명)
- B. [2pt] If we want to decrease discontinuous edges, what we can do to the hysteresis thresholding? (불연속적인 edge들을 줄이기 위해서 히스테리시스 threshold에서 어떤 수정을 하면 되는가?)
- C. [3pt] Write down the reason of Non-maximum suppression (NMS을 활용하는 이유)
- D. [2pt] If we increase sigma (σ), what will happen on detected edges? (Gaussian Sigma를 증가시키면, 검출되는 edge들은 어떤 변화가 생기는가?)

8. [5pt] Explain how to detect corner (Harris corner detector) using following 2nd moment matrix? (아래와 같이 H matrix가 주어졌을 때, harris corner를 검출하기 위한 과정을 작성)

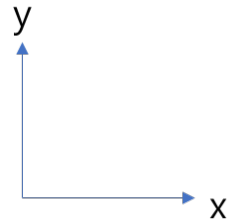
$$H = \sum \begin{bmatrix} I_x^2 & I_x I_y \\ I_x I_y & I_y^2 \end{bmatrix}$$

Student ID:

Name:

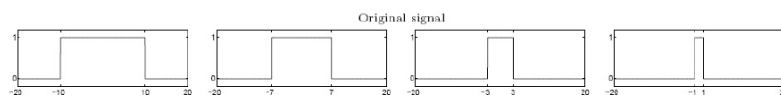
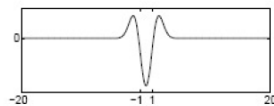
[5pt] Draw eigenvectors on the 2D coordinates. (아래 식을 참고해서 eigenvector를 좌표계 위에 그리시오)

$$\begin{bmatrix} 4 & 0 \\ 0 & 1 \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}_{\text{Eigenvectors}} \underbrace{\begin{bmatrix} 4 & 0 \\ 0 & 1 \end{bmatrix}}_{\text{Eigenvalues}} \underbrace{\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}}^T$$



9. [6pt] If you have a Laplacian filter and original signals. Draw the convolution result of each original signal and explain which result has maximum response. (입력에 대해 Laplacian filter와의 convolution결과를 그리고 어떤 입력에서 가장 높은 response가 나오는지 설명)

A.



Student ID:

Name:

10. [6pt] Explain the pros and cons of following image descriptors. (각 descriptor 표현 방법의 특징과 장단점을 설명)

A. Image patch [2pt]

B. Image gradient [2pt]

C. Histogram [2pt]

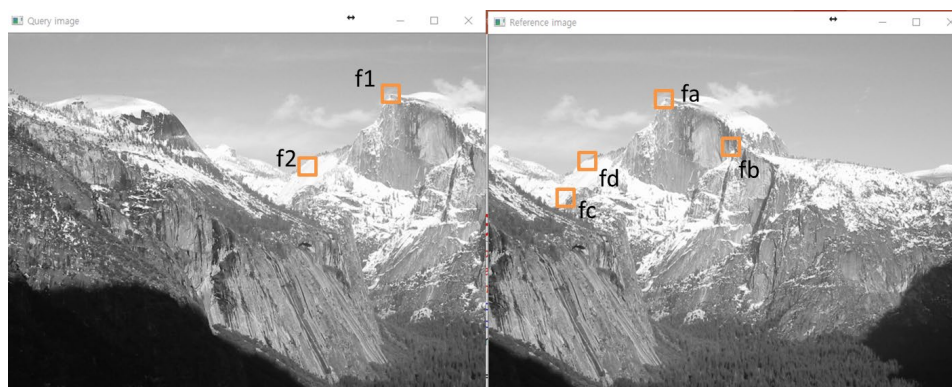
11. [6pt] Let's assume we have detected features and descriptors of two images. What would be the selected match for feature f1 and f2 using feature distance and ratio (0.6)?

(아래와 같이 feature들이 검출되었다. 각 feature들의 descriptor간 distance가 $d(f, f)$ 함수와 같을 때 f1, f2 feature에 대한 matching되는 feature를 찾으시오. Feature distance ratio는 0.6으로 한다)

$d(f, f)$ = feature (descriptor) distance

$d(f1, fa) = 0.2$, $d(f1, fb) = 0.8$, $d(f1, fc) = 0.9$, $d(f1, fd) = 0.95$

$d(f2, fa) = 0.8$, $d(f2, fb) = 0.9$, $d(f2, fc) = 0.4$, $d(f2, fd) = 0.35$



Student ID:

Name:

12. [6pt] Explain how you would use a scale-invariant feature detector to propose a set of probable correspondences between two images of the same object, but taken with a different zoom setting. (만약 카메라로 같은 물체를 다른 zoom으로 촬영했을 때, 두 이미지에서 같은 feature를 검출하기 위한 방법에 대해서 설명하시오)

13. [5pt] What is the benefit of inverse warping over forward warping?
(Inverse warping이 forward warping에 비해 가지는 장점이 무엇인가?)

14. [6pt] Fill blanks of the 2D transformation classification chart.
(아래 차트에서 빈칸을 채우시오)

Name	Matrix	# D.O.F.	Preserves:
translation	$\begin{bmatrix} I & t \end{bmatrix}$		
rigid (Euclidean)	$\begin{bmatrix} R & t \end{bmatrix}$		
similarity	$\begin{bmatrix} sR & t \end{bmatrix}$		
affine	$\begin{bmatrix} A \end{bmatrix}$		
projective	$\begin{bmatrix} \tilde{H} \end{bmatrix}$		

Student ID:

Name:

15. [5pt] Homogeneous Coordinate 을 Up-to-scale 로 표현하는 이유에 대해 설명하시오.

16. [6pt] [OpenCV problems]

A. [3pt] If we use uint8 data type for image filtering, what would be problems?
(image filtering에서 uint8 데이터 타입 활용 시 발생하는 문제점은?)

B. [3pt] Explain the changes of the filtered image when we apply larger Gaussian filter (smoothing) before edge detection. (더 큰 사이즈의 Gaussian Filter 적용시 결과에 어떤 변화가 발생하는가?)