Congratulations! You passed!

Grade received	Latest Submission Grade	To pass
100%	100%	70% or higher

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1. We expect a gradient based edge detector to produce all of the following pieces of information, except for: **1 / 1 point**

- ○ Edge position
- ○ Edge magnitude
- ○ Edge orientation
- ◉ Edge depth

Correct
It would be nice for detectors to be able to also determine the depth of an edge in the scene, but this is not possible using just image gradients.

2. If $\frac{\partial I}{\partial x}$ and $\frac{\partial I}{\partial y}$ are the first derivatives of an image at an edge, the orientation of the edge is: **2 / 2 points**

- ○ $\theta = \sqrt{\left(\frac{\partial I}{\partial x}\right)^2 + \left(\frac{\partial I}{\partial y}\right)^2}$
- ○ $\theta = \tan\left(\frac{\partial I}{\partial y} + \frac{\partial I}{\partial x}\right)$
- ◉ $\theta = \tan^{-1}\left(\frac{\partial I}{\partial y} / \frac{\partial I}{\partial x}\right)$
- ○ $\theta = \cos^{-1}\left(\frac{\partial I}{\partial y} / \frac{\partial I}{\partial x}\right)$

Correct
See definition of edge orientation

3. What is the minimum size of a square window needed to compute the x and y derivatives on an image using finite differences? **1 / 1 point**

- (●) 2x2
- ( ) 3x3
- ( ) 4x4
- ( ) 5x5

Correct
We need at least 2 pixels along each dimension to compute the first derivative.

4. Imagine you are tasked with developing an edge detection app which deals with very grainy images. For the app, detecting the exact position of the edges is unimportant, but detecting their presence is crucial. Which out of the following edge detectors would be best suited for this task? **2 / 2 points**

- ( ) Roberts
- ( ) Prewitt
- ( ) Sobel (3x3)
- (●) Sobel (5x5)

Correct
Since the app must deal with noisy images, the app designer should pick the largest gradient operator out of the ones offered, that is Sobel (5x5). This is also because we know that for this app robust localization does not matter nearly as much as robust detection.

5. A 2x2 edge detector has certain advantages over a 5x5 edge detector. Which of the following is one of those advantages? **1 / 1 point**

- ( ) High noise sensitivity
- (●) Better localization
- ( ) Higher orientation accuracy
- ( ) Better detection rate

Correct

Large operators are almost always better than small ones, except that they are more influenced by image content at a distance from the edge. Hence, they tend to produce higher errors in the location of the edge.

6. In the lecture we discussed an improved method for edge thresholding called Hysteresis Based thresholding. When the image gradient threshold $\|\nabla I(x,y)\|$ is such that $T_0 \leq \|\nabla I(x,y)\| < T_1$, the tie-break rule is: **1 / 1 point**

- (●) If the neighboring pixel is definitely an edge, it is an edge. Otherwise, it is not an edge.
- ( ) Set equal to an edge with probability p based on the number of neighboring edges.
- ( ) Choose a smaller filter and recompute $\|\nabla I(x,y)\|$ until it can be clearly categorized.
- ( ) If the neighboring pixel is definitely not an edge, it is not an edge. Otherwise, it is an edge.

Correct

See the definition of Hysteresis Based thresholding in the lecture.

7. Which of the following pieces of information does the gradient edge operator provide that a Laplacian operator does not? **1 / 1 point**

- ( ) Edge location
- (●) Edge orientation
- ( ) Zero crossing
- ( ) Edge blur

Correct

The Laplacian of Gaussian filter is rotationally invariant by design and so does not reveal the orientation of the edge. In contrast, a gradient operator uses the first derivatives in two perpendicular directions and hence can estimate edge orientation.

8. Which of the following statements about edge detectors is true? **1 / 1 point**

- ○ Computing Laplacian is a linear operation which requires two convolutions.
- ○ Computing a Gradient-based detector is a non-linear operation which requires one convolution.
- ○ Computing Laplacian is based on Maxima Thresholding.
- ◉ Laplacian does not provide the direction of the edge.

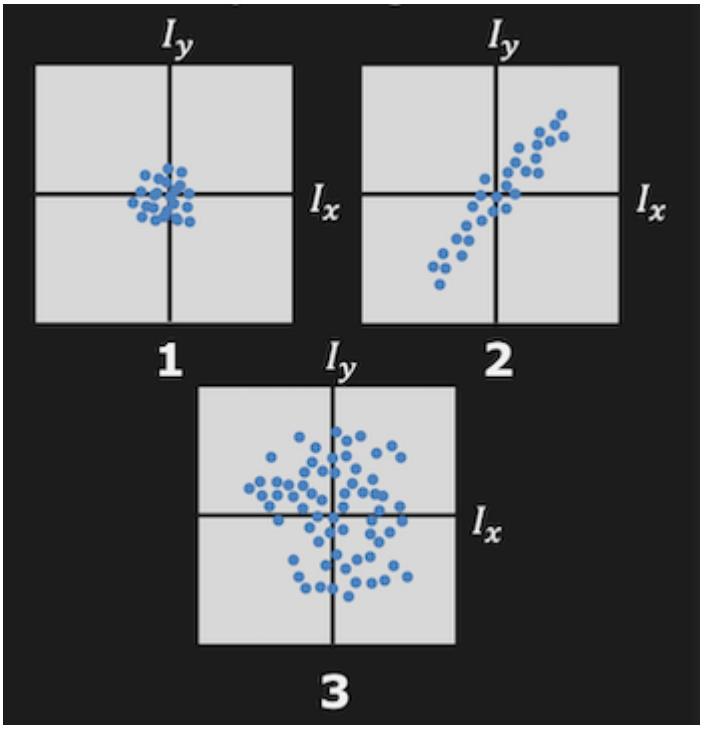
Correct
Since Laplacian is defined as a sum of pure second derivatives, computing a Laplacian simply returns a single value from which the direction of the edge cannot be inferred.

9. Which of the following statements about the Canny Edge Detector is false? **1 / 1 point**

- ○ To find Zero Crossings, it needs to compute the Laplacian.
- ◉ It finds the edge location by using the Sobel edge detector.
- ○ The Scale Space of the edge detector is affected by changing sigma.
- ○ Changing sigma influences the amount of smoothing applied to the image.

Correct
The Canny Edge Detector uses the Sobel operator to compute the direction of the edge. However, it uses a Laplacian to find the edge location.

10.



3 / 3 points

We find the first derivatives I_x and I_y within each small patch in an image. The distribution of the first derivatives within each patch appears like one of the three distributions shown above. Which of the following interpretations of the distributions would you use to correctly assign a feature type to each patch?

- ○ 1: Corner, 2: Line, 3: Flat
- ○ 1: Flat, 2: Corner, 3: Line
- ◉ 1: Flat, 2: Line, 3: Corner
- ○ 1: Corner, 2: Flat, 3: Line

✓ **Correct**

Both derivatives are small for a flat region, resulting in a compact distribution close to the origin. The derivatives are distributed along a line for a line with stronger edges further away from the origin. A corner has a more complex and spread-out distribution as it has two sides and the corner itself.