Edges and Corners
Practice Questions

Multiple Part True/False Questions. For each question, indicate which of the statements, (A)–(D), are **true** and which are **false**? Note: Questions may have zero, one or multiple statements that are true.

Question 1: We have considered two approaches to edge detection, one based on extrema of a 1st derivative operator and the other based on zero crossings of a 2nd derivative operator. Which of the statements, (A)–(D), are **true** when designing a digital filter to use for differentiation and which are **false**?

(A) Filter values are normalized to sum to one.

(B) Filter values are normalized to sum to zero.

(C) Filter values are normalized so that the sum of the squared values is one (i.e., so that the filter has magnitude one).

(D) Filter values are whatever they are. Normalization is not required.

Question 2: Two thresholds are used when linking edge points in Canny edge detection. Which of the statements, (A)–(D), are **true** of Canny edge detection and which are **false**?

(A) Different thresholds are needed to select edge points when linking edges forward or backward from the starting location.

(B) The detection of edge points is more accurate when two thresholds are used.

(C) The use of two thresholds prevents gaps that would otherwise appear in the linked edge points.

(D) The X and Y directional derivatives each require a threshold when linking to new edge points.

Question 3: The Harris corner detector is stable under some image transformations. For which of the image transformations, (A)–(D), is it **true** that the Harris corner detector is stable? For which is it **false**? Hint: Features are considered stable if the same locations on an object are typically selected in the transformed image.

(A) Image scaling.

(B) Image translation.

(C) Image rotation.

Short Answer Questions.

Question 4: Name four scene properties that would cause an edge (brightness discontinuity) in an image.

Question 5: Consider the matrix, $\mathbf{M}$, defined at each image point where

$$\mathbf{M} = \begin{bmatrix} {I_x}^2 & I_x I_y \\ I_x I_y & {I_y}^2 \end{bmatrix}$$

Note that $\mathbf{M}$ can also be written as the outer product of the image gradient, $[I_x, I_y]$, with itself. That is,

$$\mathbf{M} = \begin{bmatrix} I_x \\ I_y \end{bmatrix} [I_x, I_y]$$

(a) Assuming I_x and I_y are not both zero, what is the rank of $\mathbf{M}$?

(b) Write expressions for the eigenvalues, λ_1 and λ_2, of $\mathbf{M}$.

(c) Is the computation of $\mathbf{M}$ at each image point a linear operation? Is it shift invariant?