**CS332 Visual Information Processing in Computer and Biological Vision Systems**

## Assessment #1 Solutions: Edge Detection in Computer Vision Systems

This is an "open-book" assessment for which you can refer to the reading, *Edge Detection in Computer Vision Systems*, and the two videos, *Edge Detection Overview* and *Edge Detection in Computer Vision Systems*. You should complete this assessment on your own, without consulting other students. There is no time limit other than the due date and time listed above.

To complete this assessment, create a copy of this Google doc, write your answers directly on your copy, and share your document with me. Please give me Edit privileges so that I can provide feedback directly in the shared document. Thanks!

**Problem:** Suppose you are given the following (tiny) image and 3x3 convolution operator:

| | | | | |
|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 |
| 10 | 10 | 10 | 1 | 1 |
| 10 | 10 | 10 | 1 | 1 |
| 10 | 10 | 10 | 1 | 1 |

image

| | | |
|---|---|---|
| 1 | 1 | 1 |
| -2 | -2 | -2 |
| 1 | 1 | 1 |

convolution operator

(a) On the grid shown at the top of the next page, indicate the values that result from the convolution of the above image and operator, for the four empty locations shown with the white background. The convolution values for two locations in the white area are given.

| | | | | |
|---|---|---|---|---|
| | | | | |
| | 27 | 18 | | |
| | -27 | -18 | | |
| | | 0 | 0 | |
| | | | | |

(You should be able to click on each cell and enter your answers.)

(b) What general type of operation is performed by the convolution operator used in Part (a)? For example, does this operator perform some smoothing of the image? Does it compute a derivative? if it computes a derivative, is it a first or second derivative? Is it a directional or non-directional derivative (like the Laplacian)?

The convolution operator computes a second derivative in the vertical direction, incorporating a small amount of smoothing within a 3x3 neighborhood of each image location.

(c) Is it possible to locate the intensity changes (edges) in the original image, from the convolution output derived in Part (a)? If so, how?

Yes, the intensity changes (edges) are indicated by the locations of zero-crossings, as illustrated by the red line on the result (above).

(d) Can you detect the intensity changes (edges) at all orientations in the image using this convolution operator? Why or why not?

No, vertical edges cannot be detected because this operator does not measure intensity changes in the horizontal direction.

(e) (optional) Do you have questions about the reading or videos that you would like me to address in class, or answer here?