1) Name the filters.

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Shovel ✗

Sovel ✗

Sobel ✓

Prewit ✗

Prewitt ✗

Previt ✗

Roberts ✗

Robert ✗

Row-bert ✗

---

2) Name the filters.

+1	0	-1
+1	0	-1
+1	0	-1

Gx

-1	-1	-1
0	0	0
+1	+1	+1

Gy

Shovel ✗

Sovel ✗

Sobel ✗

Prewit ✗

Prewitt ✓

Previt ✗

Roberts ✗

Robert ✗

Row-bert ✗

---

3) Name the filters.

+1	0
0	-1

Gx

0	+1
-1	0

Gy

Shovel ✗

Sovel ✗

Sobel ✗

Prewit ✗

Prewitt ✗
Previt ✗

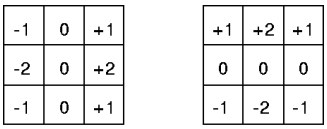
Roberts ✓

Robert ✗

Row-bert ✗

---

4) Which components of the gradient do these correlational filter masks compute?



-1	0	+1
-2	0	+2
-1	0	+1

+1	+2	+1
0	0	0
-1	-2	-1

magnitude and direction of the gradient ✗

gradient in 45 and 135 degrees ✗

vertical and horizontal gradient ✗

magnitude and orientation of the gradient ✗

horizontal and vertical gradient ✓

gradient in 45 and -45 degrees ✗

---

5) How many steps does the Canny edge detector have?

0 ✗

1 ✗

2 ✗

3 ✗

4 ✗

5 ✗

6 ✓

7 ✗

8 ✗

9 ✗

10 ✗

---

6) The last (6th) step in Canny edge detection is...

Gradient computation in perpendicular directions ✗

Gradient computation in terms of magnitude and orientation ✗

Double thresholding ✗

Noise removal ✗

Non-maxima suppression ✗

Hysteresits ✓

---

7) The second to last (5th) step in Canny edge detection is...

Gradient computation in perpendicular directions ✗

Gradient computation in terms of magnitude and orientation ✗

Double thresholding ✓

Noise removal ✗

Non-maxima suppression ✗

Hysteresits ✗

---

8) The fourth step in Canny edge detection is...

Gradient computation in perpendicular directions ✗

Gradient computation in terms of magnitude and orientation ✗

Double thresholding ✗

Noise removal ✗

Non-maxima suppression ✓

Hysteresits ✗

---

9) The third step in Canny edge detection is...

Gradient computation in perpendicular directions ✗

Gradient computation in terms of magnitude and orientation ✓

Double thresholding ✗

Noise removal ✗

Non-maxima suppression ✗

Hysteresits ✗

---

10) The second step in Canny edge detection is...

Gradient computation in perpendicular directions ✓

Gradient computation in terms of magnitude and orientation ✗

Double thresholding ✗

Noise removal ✗

Non-maxima suppression ✗

Hysteresits ✗

---

11) The first step in Canny edge detection is...

Gradient computation in perpendicular directions ✗

Gradient computation in terms of magnitude and orientation ✗

Double thresholding ✗

Noise removal ✓
Non-maxima suppression ✗

Hysteresits ✗

---

12) What noise removal technique should we use when applying Canny edge detection? (first step)

Median filter ✗

Mean filter ✗

Correlation using a box filter ✗

Gaussian filtering ✓

Non-maxima suppression ✗

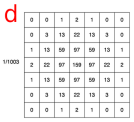
---

13) Based on the previous question, what filter or filters could we use in the first step?

a 

b 

c 

d 

e 

f 

a ✓

b ✓

c ✗

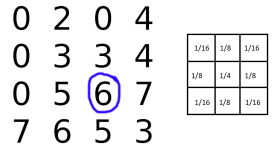
d ✓

e ✗

f ✗

---

14) Apply the Gaussian filter in the figure to the highlighted pixel. [RESULTS IN NEXT QUESTION]



0 ✗

1 ✗

2 ✗

3 ✗

4 ✗

5 ✓

6 ✗

7 ✗

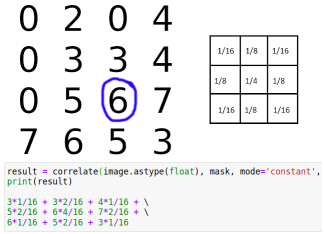
8 ✗

9 ✗

10 ✗

---

15) [RESULT]

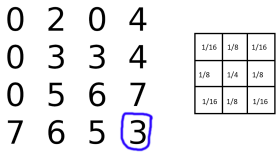


5 ✓

0 ✗

---

16) Apply the Gaussian filter in the figure to the highlighted pixel. [RESULTS IN NEXT QUESTION]



1.135 ✗

1.615 ✗

2.325 ✗

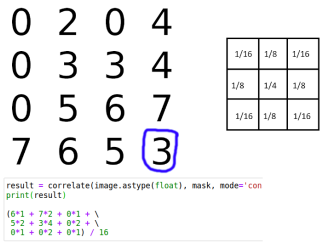
2.625 ✓

3.325 ✗

3.652 ✗

---

17) [RESULT]



2.625 ✓

0 ✗

---

18) Assume that you have computed the gradients of an image and used them to

calculate the gradient orientation and its magnitude. The results are shown in the image. Perform the non-maxima suppression of the Canny edge detector for the horizontal direction and select the elements that would be sent to zero in the image. [RESULTS IN NEXT QUESTION]

orientation

1	0	0	2
2	0	1	2
2	0	0	3
2	0	3	3

magnitude

10	34	12	10
12	21	9	12
1	26	19	36
5	32	28	29

0 horizontal
1 45 degrees
2 vertical
3 135 degrees

---

19) Assume that you have computed the gradients of an image and used them to calculate the gradient orientation and its magnitude. The results are shown in the image. Perform the non-maxima suppression of the Canny edge detector for the horizontal direction and select the elements that would be sent to zero in the image. [RESULTS IN NEXT QUESTION]

orientation

1	0	0	2
2	0	1	2
2	0	0	3
2	0	3	3

magnitude

10	34	12	10
12	21	9	12
1	26	19	36
5	32	33	29

0 horizontal
1 45 degrees
2 vertical
3 135 degrees

---

20) RESULTS

orientation

1	0	0	2
2	0	1	2
2	0	0	3
2	0	3	3

magnitude

~~10~~	34	~~12~~	~~10~~
12	21	9	12
~~1~~	26	~~19~~	36
~~5~~	32	33	29

0 horizontal
1 45 degrees
2 vertical
3 135 degrees

---

21) On paper, perform double thresholding with thresold values of 20 and 34. Provide your answers on Vevox for the high threshold only.

orientation

1	0	0	2
2	0	1	2
2	0	0	3
2	0	3	3

magnitude

0	34	0	10
0	21	0	12
0	26	0	36
0	32	33	29

---

22) RESULTS

low

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

high

0	255	0	0
0	0	0	0
0	0	0	255
0	0	0	0

---

23) Perform ONE hysteresis step.

low

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

high

0	255	0	0
0	0	0	0
0	0	0	255
0	0	0	0

---

24) RESULTS

low

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

high

0	255	0	0
0	0	0	0
0	0	0	255
0	0	0	0

X

0	255	0	0
0	255	0	0
0	0	0	255
0	0	255	255

---

25) Perform a SECOND hysteresis step.

low

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

high

0	255	0	0
0	0	0	0
0	0	0	255
0	0	0	0

X

0	255	0	0
0	255	0	0
0	0	0	255
0	0	255	255

---

26) RESULTS

low

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

high

0	255	0	0
0	0	0	0
0	0	0	255
0	0	0	0

X

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

---

27) Do we need to run a third hysteresis step?

low

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

high

0	255	0	0
0	0	0	0
0	0	0	255
0	0	0	0

X

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255

no ✗

it depends ✓

yes ✓

---

28) RESULTS

0	255	0	0
0	255	0	0
0	255	0	255
0	255	255	255
