Homework-5

Q1:

You are given the following picture:

P =

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  | 8 |  |  |  | 8 | 8 |  |  |
|  |  |  |  |  |  | 8 | 8 |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  | 8 | 8 | 8 | 8 |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

What picture is obtained if noise is applied to P, using the technique of smoothing with the following mask:

|  |  |
| --- | --- |
| **0.25** | 0.25 |
| 0.25 | 0.25 |

(Assumption: I take 0 into calculation for blank pixels in this question.)

M’ =

|  |  |
| --- | --- |
| 0.25 | 0.25 |
| 0.25 | **0.25** |

P1 =

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2 | 2 | 0 | 0 | 2 | 2+2 | 2 | 0 | 0 |
| 0 | 2 | 2 | 0 | 0 | 2+2 | 2+2+2+2 | 2+2 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 2 | 2+2 | 2 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 2 | 2+2 | 2+2 | 2+2 | 2 | 0 | 0 |
| 0 | 0 | 0 | 2 | 2+2 | 2+2 | 2+2 | 2 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

=

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2 | 2 | 0 | 0 | 2 | 4 | 2 | 0 | 0 |
| 0 | 2 | 2 | 0 | 0 | 4 | 8 | 4 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 2 | 4 | 2 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 2 | 4 | 4 | 4 | 2 | 0 | 0 |
| 0 | 0 | 0 | 2 | 4 | 4 | 4 | 2 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

What picture is obtained if noise cleaning is applied to P, performed by median filtering over a cross shaped neighborhood as shown below:

M2 =

|  |  |  |
| --- | --- | --- |
|  | X |  |
| X | **X** | X |
|  | X |  |

P2 =

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 8 | 8 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Q2:

The picture P is specified below:

P =

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | x = 0 | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 | x = 6 | x = 7 |
| y = 0 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |
| y = 1 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |
| y = 2 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |
| y = 3 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |
| y = 4 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |
| y = 5 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |
| y = 6 | 0 | 0 | 0 | 0 | 9 | 9 | 9 | 9 |

A.

What picture is obtained if noise cleaning is applied to P, using the technique with the following mask:

|  |  |  |  |
| --- | --- | --- | --- |
| 1/9 | 1 | 1 | 1 |
| 1 | **1** | 1 |
| 1 | 1 | 1 |

Compute the answer only for the window of 3 rows and 5 columns specified below.

PA =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 1\*3 | 1\*6 | 1\*9 |
| y = 3 | 0 | 0 | 1\*3 | 1\*6 | 1\*9 |
| y = 4 | 0 | 0 | 1\*3 | 1\*6 | 1\*9 |

=

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 3 | 6 | 9 |
| y = 3 | 0 | 0 | 3 | 6 | 9 |
| y = 4 | 0 | 0 | 3 | 6 | 9 |

B.

What picture is obtained if noise cleaning is applied to P, performed by median filtering over a cross shaped neighborhood as shown below:

|  |  |  |
| --- | --- | --- |
|  | X |  |
| X | **X** | X |
|  | X |  |

Computer the answer only for the window of 3 rows and 5 columns specified below.

PB =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 0 | 9 | 9 |
| y = 3 | 0 | 0 | 0 | 9 | 9 |
| y = 4 | 0 | 0 | 0 | 9 | 9 |

C.

What picture is obtained if the Sobel edge detection technique is applied to P?

Compute the answer only for the window of 3 rows and 5 columns specified below.

∆1 =

|  |  |  |
| --- | --- | --- |
| -1 | 0 | 1 |
| -2 | **0** | 2 |
| -1 | 0 | 1 |

∆1’ =

|  |  |  |
| --- | --- | --- |
| 1 | 0 | -1 |
| 2 | **0** | -2 |
| 1 | 0 | -1 |

PX =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 36 | 36 | 36-36 |
| y = 3 | 0 | 0 | 36 | 36 | 36-36 |
| y = 4 | 0 | 0 | 36 | 36 | 36-36 |

=

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 36 | 36 | 0 |
| y = 3 | 0 | 0 | 36 | 36 | 0 |
| y = 4 | 0 | 0 | 36 | 36 | 0 |

∆2 =

|  |  |  |
| --- | --- | --- |
| -1 | -2 | -1 |
| 0 | **0** | 0 |
| 1 | 2 | 1 |

∆2’ =

|  |  |  |
| --- | --- | --- |
| 1 | 2 | 1 |
| 0 | **0** | 0 |
| -1 | -2 | -1 |

PY =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 36-36 | 36-36 | 36-36 |
| y = 3 | 0 | 0 | 36-36 | 36-36 | 36-36 |
| y = 4 | 0 | 0 | 36-36 | 36-36 | 36-36 |

=

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 0 | 0 | 0 |
| y = 3 | 0 | 0 | 0 | 0 | 0 |
| y = 4 | 0 | 0 | 0 | 0 | 0 |

(For this question, I use |u| = |x| + |y| to detect edge.)

PU =

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | x = 1 | x = 2 | x = 3 | x = 4 | x = 5 |
| y = 2 | 0 | 0 | 36 | 36 | 0 |
| y = 3 | 0 | 0 | 36 | 36 | 0 |
| y = 4 | 0 | 0 | 36 | 36 | 0 |

(edge here)