Mcahine Vision HW5 Report

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Dependencies

```
python = ">=3.9,<4"
opencv-python = "^4.9.0.80"
alive-progress = "^3.1.5"
```

Run

```
python 110590004_hw5.py
```

Question 1

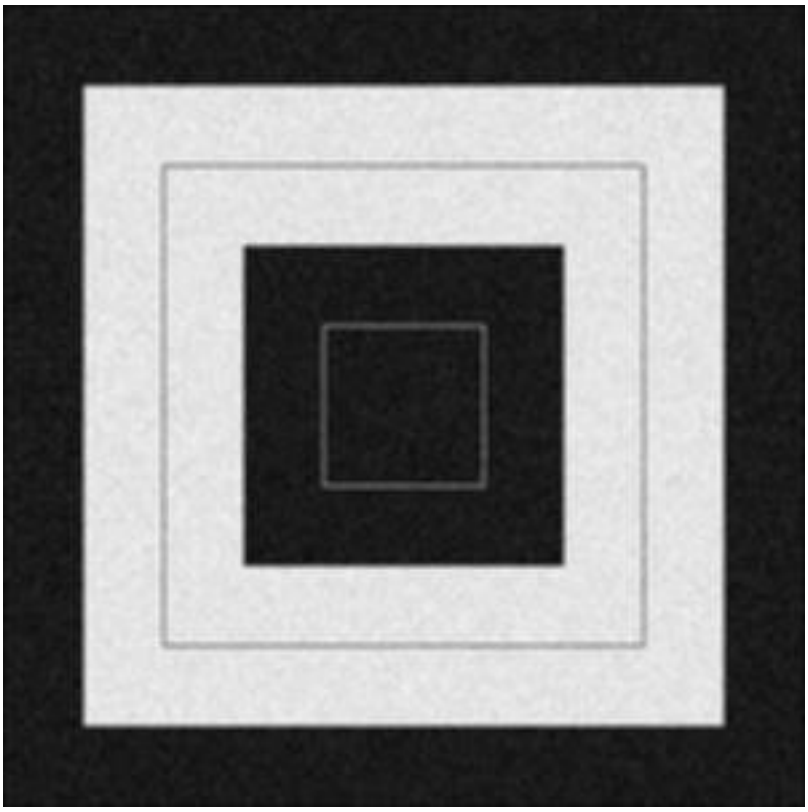
Mean Filter

- Implement a mean filter with a kernel size of 3x3 and 7x7.

3x3

- Kernel:

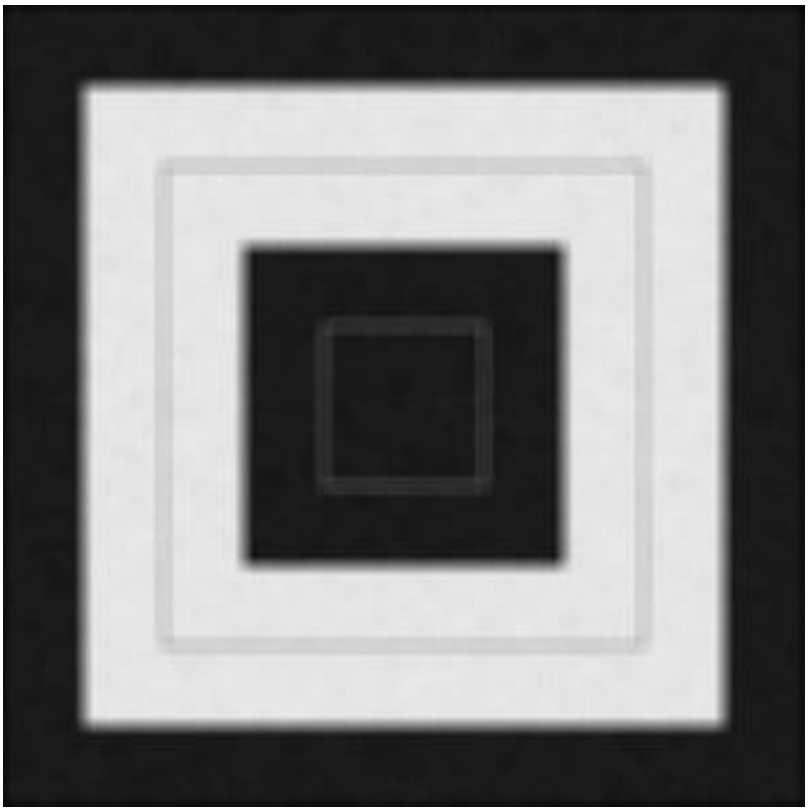
$$\begin{array}{|c|c|c|}\hline \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \hline \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \hline \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \hline \end{array}$$



7x7

- Kernel:

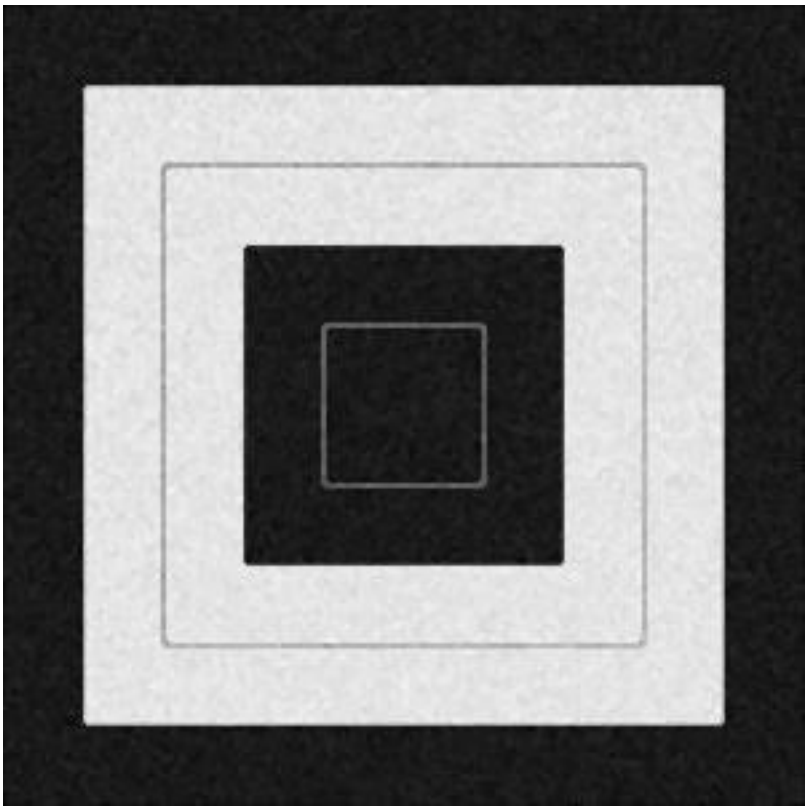
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$
$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$	$\frac{1}{49}$



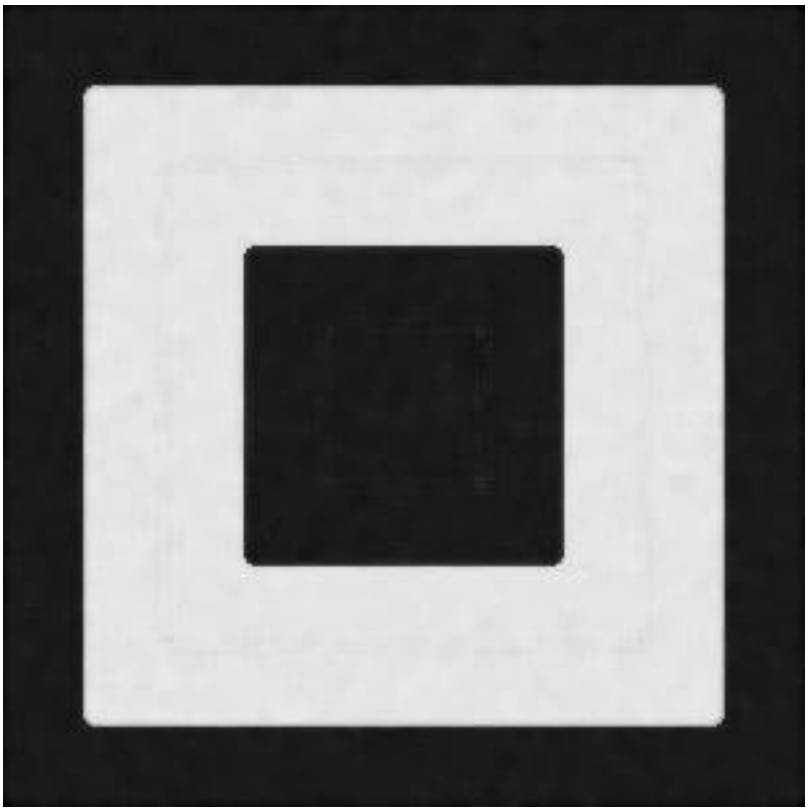
Median Filter

- Implement a median filter with a kernel size of 3x3 and 7x7.
- Find the median value of the pixel values in the kernel and assign it to the center pixel.

3x3



7x7



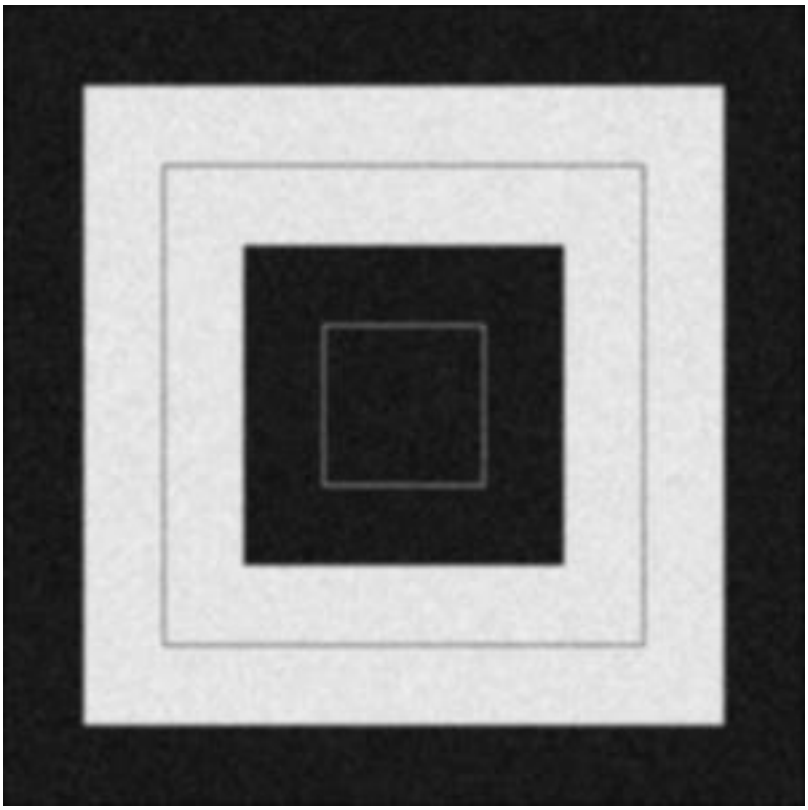
Gaussian Filter

- Implement a Gaussian filter with a kernel size of 5x5
- Kernel:

$\frac{1}{273}$	$\frac{4}{273}$	$\frac{7}{273}$	$\frac{4}{273}$	$\frac{1}{273}$
$\frac{4}{273}$	$\frac{16}{273}$	$\frac{26}{273}$	$\frac{16}{273}$	$\frac{4}{273}$
$\frac{7}{273}$	$\frac{26}{273}$	$\frac{41}{273}$	$\frac{26}{273}$	$\frac{7}{273}$

$\frac{4}{273}$	$\frac{16}{273}$	$\frac{26}{273}$	$\frac{16}{273}$	$\frac{4}{273}$
$\frac{1}{273}$	$\frac{4}{273}$	$\frac{7}{273}$	$\frac{4}{273}$	$\frac{1}{273}$

Result



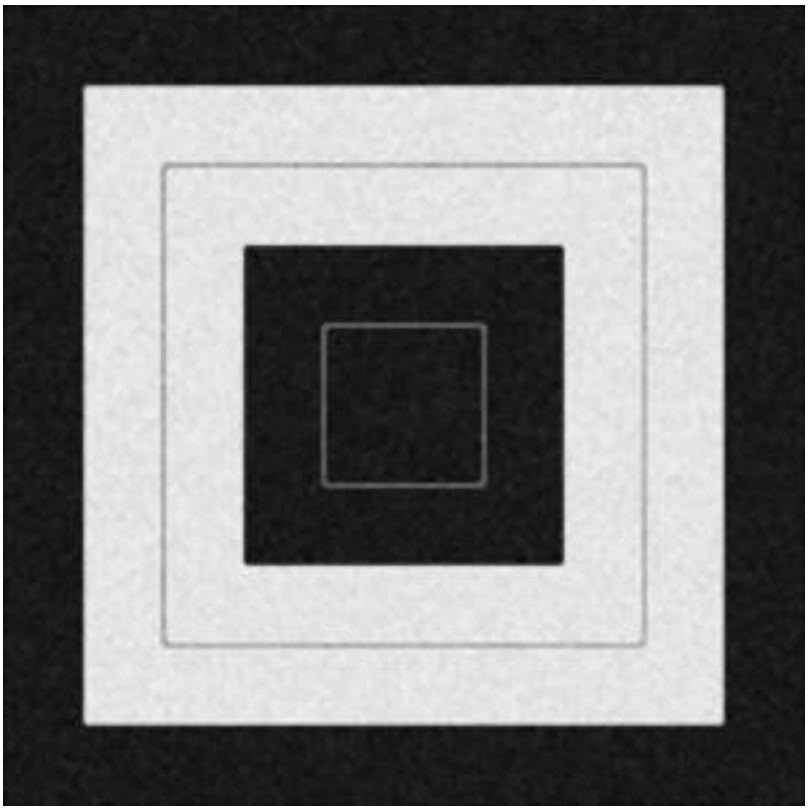
Bonus

Customized Filter

- Implement a customized filter with a kernel size of 3x3
- Kernel:

```
kernel = (np.ones((3, 3)) * 0.3)/ (9) + 0.7 * (median of the neighbors)
```

Result



Discussion

- The mean filter is a simple filter that replaces the center pixel with the average of the pixel values in the kernel. It is effective in removing noise but may blur the image.
- The median filter is a non-linear filter that replaces the center pixel with the median value of the pixel values in the kernel. It is effective in removing noise while preserving edges.
- The Gaussian filter is a linear filter that uses a Gaussian kernel to blur the image. It is effective in removing noise and preserving edges.
- The customized filter is a combination of the mean filter and the median filter. It replaces the center pixel with a weighted average of the pixel values in the kernel and the median value of the pixel values in the kernel. It is effective in removing noise while preserving edges.