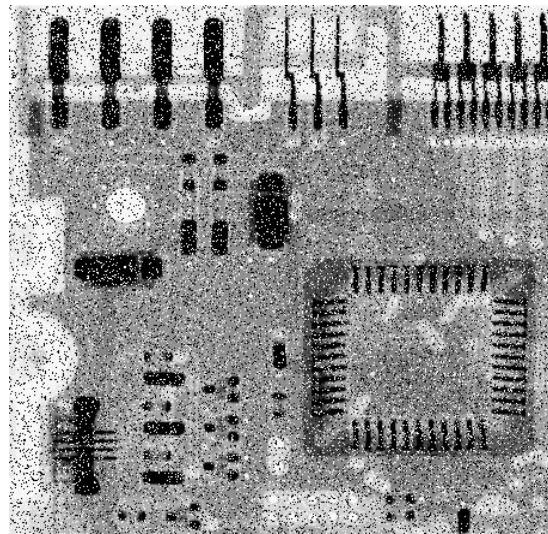
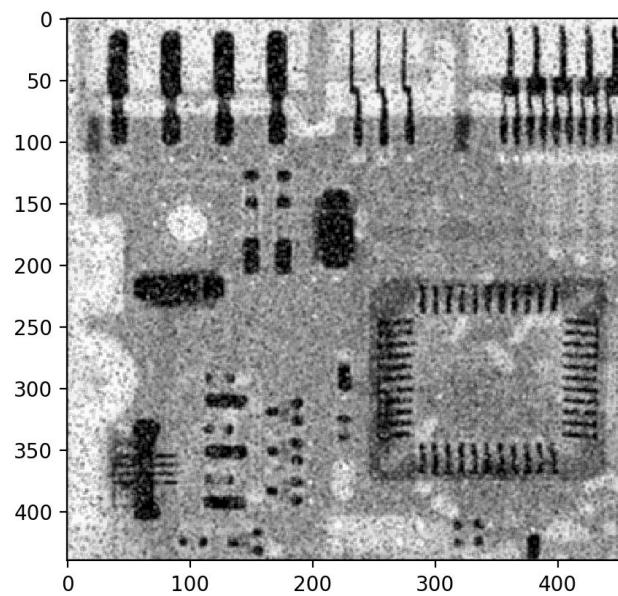


[3]

Input image:



Output image (linear average filter):



## [4]

### Details of Method:

Within the calcMedian function, gray-level intensities of the 3x3 subimage centered at the index (y,x) are appended into an array. The function then returns the median of the array using the stats library. A deep copy of the original image is made and the program replaces each index with its median determined by the calcMedian function.

### Code:

```
import numpy as np
from matplotlib import pyplot as plt
import math
import statistics
import copy

# returns median value of mxm subimage centering at (y,x)
def calcMedian(img, m, y, x):
    a = int((m-1)/2)
    y_max, x_max = img.shape

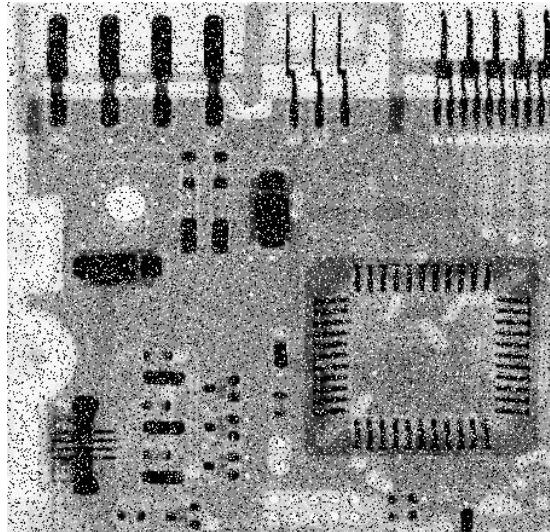
    vals = []
    # iterate over each mxm index centered at [y][x]
    for i in range(-1*a, a+1):
        for j in range(-1*a, a+1):
            y_pos = y + i
            x_pos = x + j
            # check if index is within img
            if 0 <= y_pos < y_max:
                if 0 <= x_pos < x_max:
                    vals.append(int(img[y_pos][x_pos]))
    return statistics.median(vals)

img = plt.imread('./images/Fig0335(a).tif', 0)
max_y, max_x = img.shape

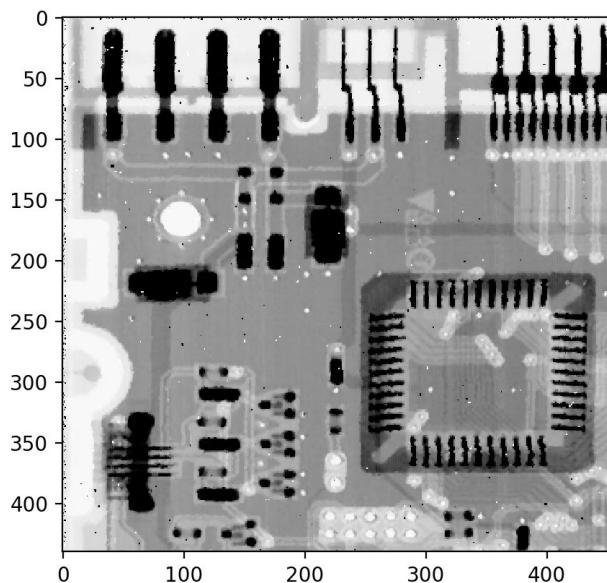
# perform median filter on image
result = copy.deepcopy(img)
for i in range(3, max_y):
    for j in range(3, max_x):
        result[i][j] = calcMedian(img, 3, i, j)

# plt.imshow(img, cmap='gray')
# plt.show()
plt.imshow(result, cmap='gray')
plt.show()
```

Input image:



Output image (median filter):



#### Analysis:

The output image results in a much finer and detailed image than the input image. This is because the median filter changes intensity values to be more similar to those of its neighbors. Therefore isolated intensity values ("random" white/black spots) are replaced and smoothed out. Although the linear average filter improves the quality of the input image, the median filter produces clearly a better result. The linear average filter isn't as "harsh" as the median filter such that it takes the average of all the values around it, but this results in a blurred image. Median filter emphasizes contrast and forces pixels to be similar to those around it.