MSAI 495 Introduction to Computer Vision - Assignment 2
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Morphological Operators

Algorithms Used:

I. For dilation:
   A. Scan the binary image pixel by pixel.
   B. For each pixel, extract a neighborhood around it using the kernel size.
   C. If **any pixel** in the neighborhood (overlapped with the kernel) is white (255), set the **center pixel** in the output to white.
   D. This causes white regions to grow or "dilate", filling small holes and connecting nearby white regions.

II. For erosion:
   I. Scan the binary image pixel by pixel.
   II. For each pixel, extract a neighborhood using the kernel size.
   III. If **all pixels** in the neighborhood are white (255), set the **center pixel** in the output to white.
   IV. If even one pixel is black, the output is black.
   V. This removes noise and shrinks the white regions, eroding away thin lines or edges.

III. Opening:
   A. Apply **erosion** first to remove small white noise.
   B. Then apply **dilation** to restore the main shapes that survived erosion.
   C. Good for removing small white specs or disconnected blobs.

IV. Closing:
   A. Apply **dilation** first to fill in small black holes or gaps.
   B. Then apply **erosion** to restore the original object size.
   C. Good for filling in gaps within the foreground objects.

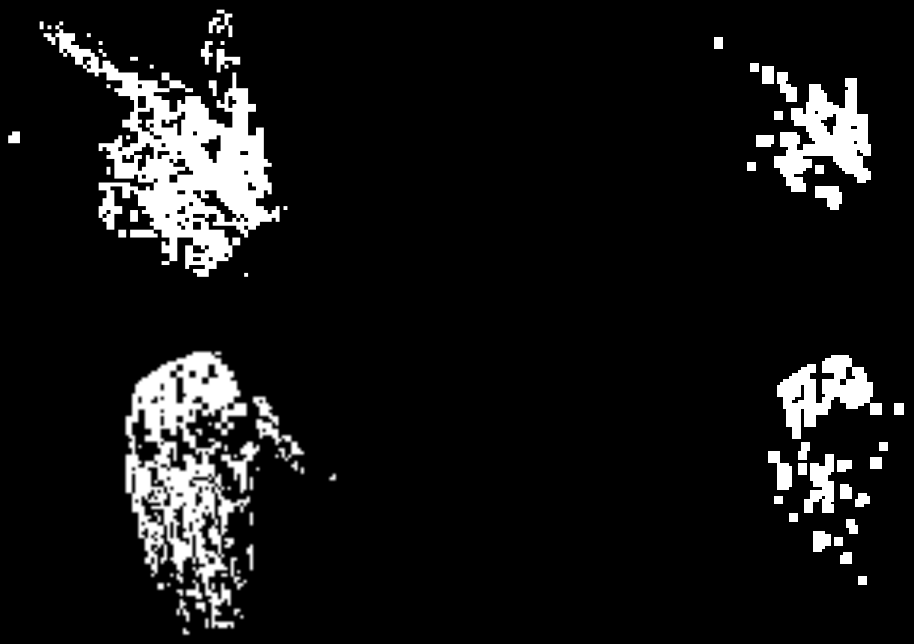
V. Boundary:
   A. Apply **dilation** and **erosion** on the binary image.
   B. Subtract the eroded image from the dilated one.
   C. The result highlights boundaries (edges) of the foreground objects.

Results:

1. Dilation (3*3 kernel with 1s)

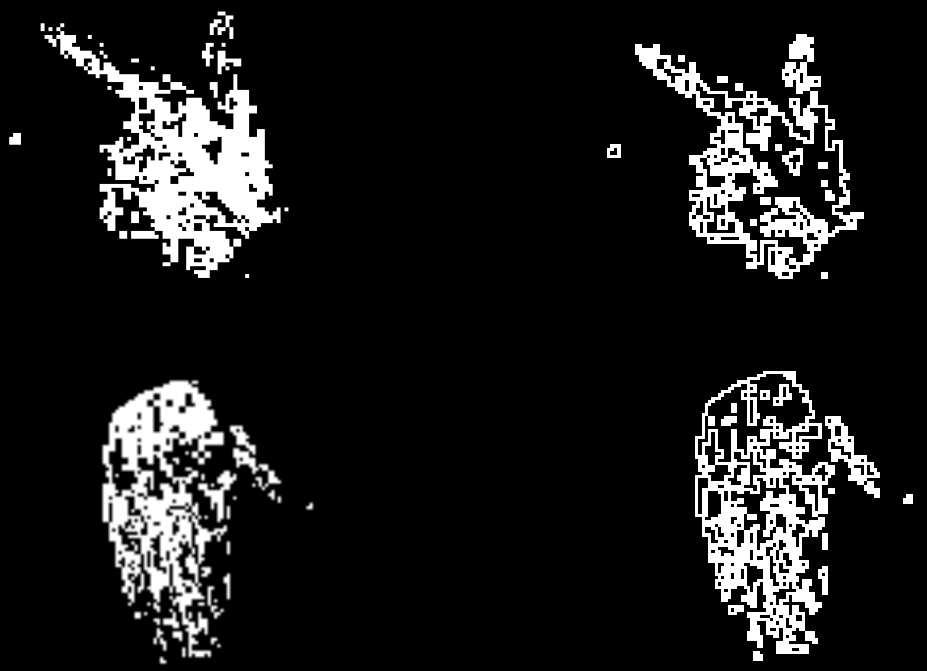
2. Erosion (3*3 kernel with 1s):

3. Opening:



4. Closing:

5. Boundary (2*2 Kernel gave better results for this)



6. Custom kernel structures:

```
[1 1 1 1]
[1 1 1 1]
[1 1 1 1]
[1 1 1 1]
```

```
[0 0 0 0]
[0 1 1 0]
[0 1 1 0]
[0 0 0 0]
```

```
[1 1 1 1]
[1 0 0 1]
[1 0 0 1]
[1 1 1 1]
```