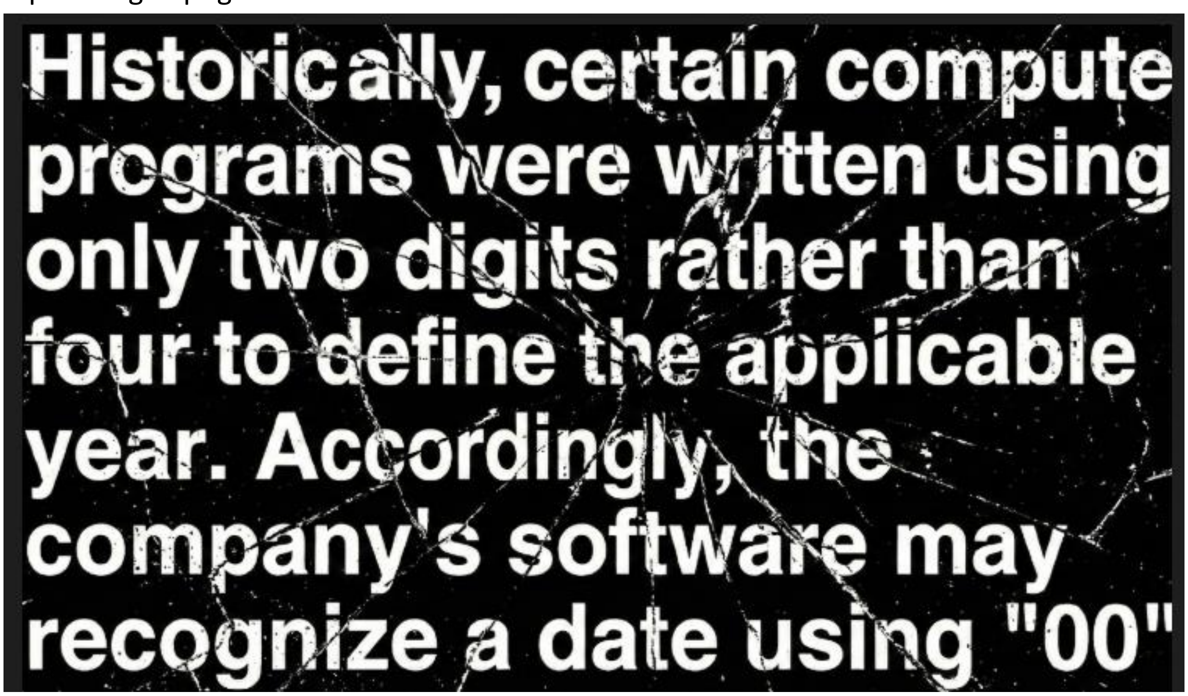
Lab 6: Morphological Image Processing

1. Task1: Repair Broken Characters

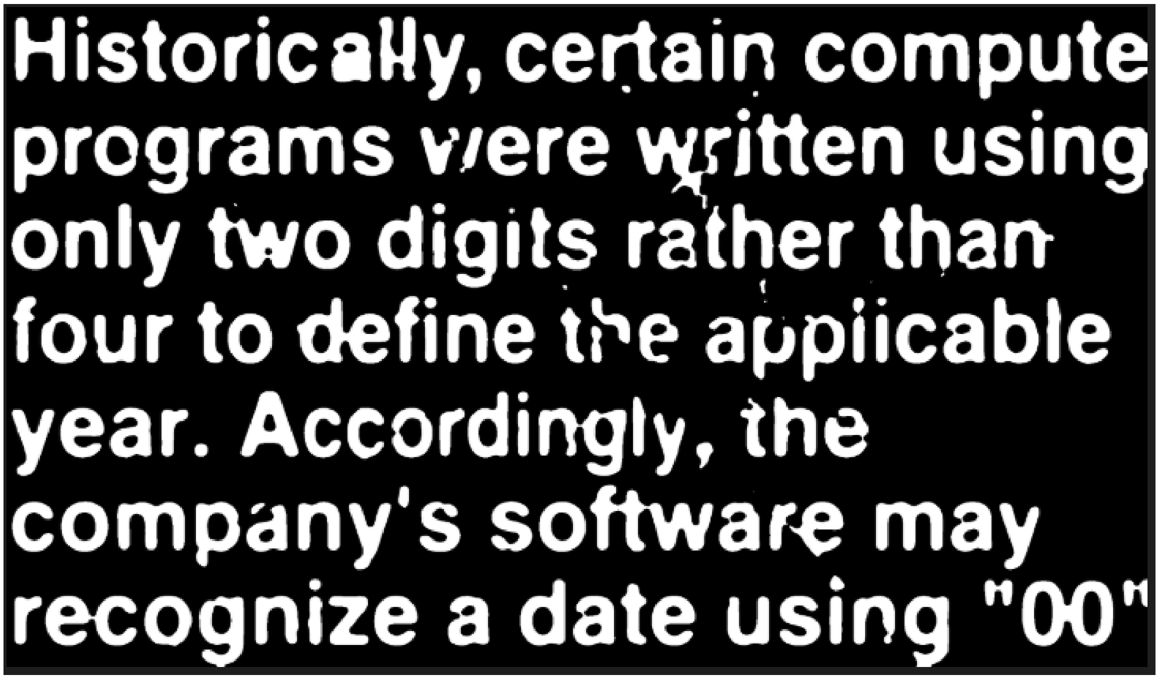
- Problem:
  Scanned text has broken strokes and disconnected letters, which can reduce OCR accuracy.
- Goal:
  Restore continuity of characters so thay the text becomes readable and connected.
- Algorithm Summary:

a. Threshold image to get binary text.
b. Apply large Gaussian blur to connect broken parts.
c. Morphological closing with ellipse kernel to fill gaps.
d. Slight dilation to reinforce strokes.
e. Final thresholding to obtain clean binary image.

- Why it will work?
  - ✓ It combine of blur and closing bridges broken letters.
  - ✓ Elliptical kernel preserves natural character shapes.
  - ✓ Final binary ensures text is readable and connected.
- Input image1.png



- Output result

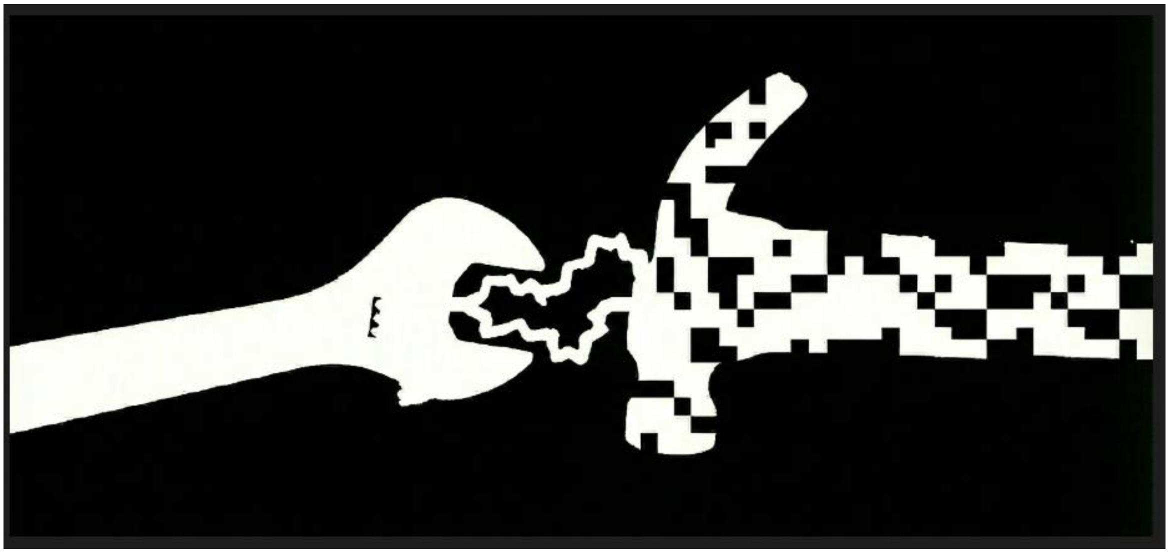


2. Task2: Separate Merged Objects

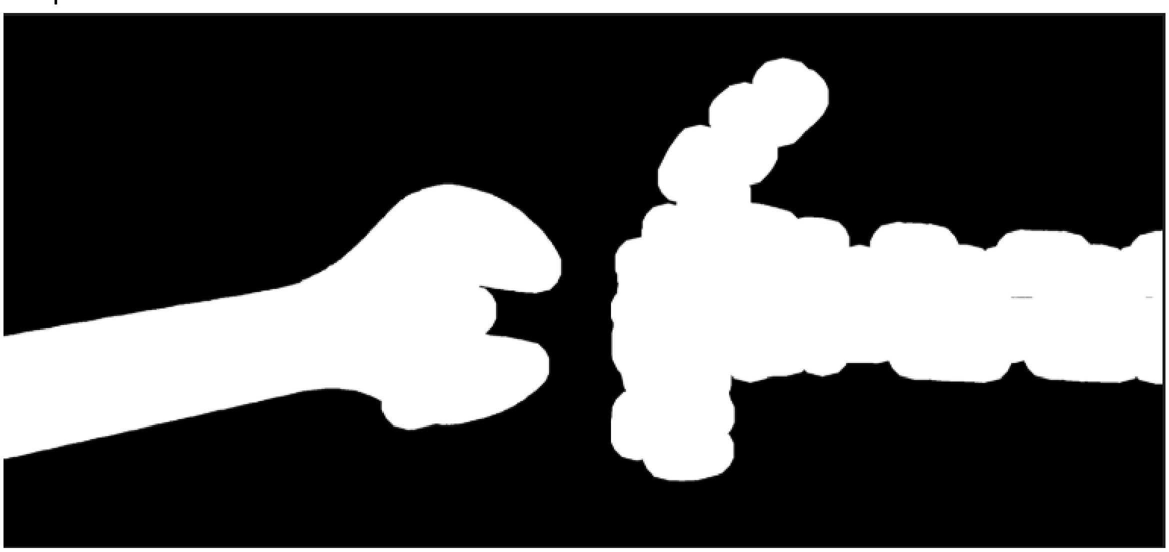
- Problem:
  Two objects in the image are merged due to thresholding errors, and one object may be broken.
- Goal:
  1. Split merged objects into distinct regions.
  2. Connect any broken parts of the same object.
- Over process flow that I have thought:
  1. Original image → grayscale → binary.
  2. Erosion removes thin bridges between merged objects.
  3. Dilation restores object sizes while keeping them separate.
  4. Result → objects separated and broken parts (if any) reconnected.
- Algorithm summary
  1. Convert image to binary using Otsu thresholding.
  2. Apply the larger randomly to make sure it able to remove thin connection between those two object or the middle one.
  3. Apply dilation back to restore original object size.
  4. Save and display the final separated objects.
- Why it will work?

- ✓ Erosion will remove unwanted thin connections.
- ✓ Dilation restores object structure without reconnecting separate objects.
- ✓ The kernel size and iterations control the separation strength.

- Input image2.png



- Output result



3. Task3: Removing noise

- Problem:
  Fingerprint images often contain small noise(isolated pixels) and holes in ridges due to scanning artifacts. These defects can reduce the accuracy of fingerprint analysis.

- Goal:
    - Remove small noise pixels.
    - Fill small holes in ridges.
    - Smooth ridge pattern for clean representation.
- Algorithm summary
    1. Convert image to binary using Otsu thresholding.
    2. Apply the larger randomly to make sure it able to remove thin connection between those two object or the middle one.
    3. Apply dilation back to restore original object size.
    3. Apply the larger randomly to make sure it able to remove thin connection between those two object or the middle one.
    4. Save and display the final separated objects.
- Input image3.png

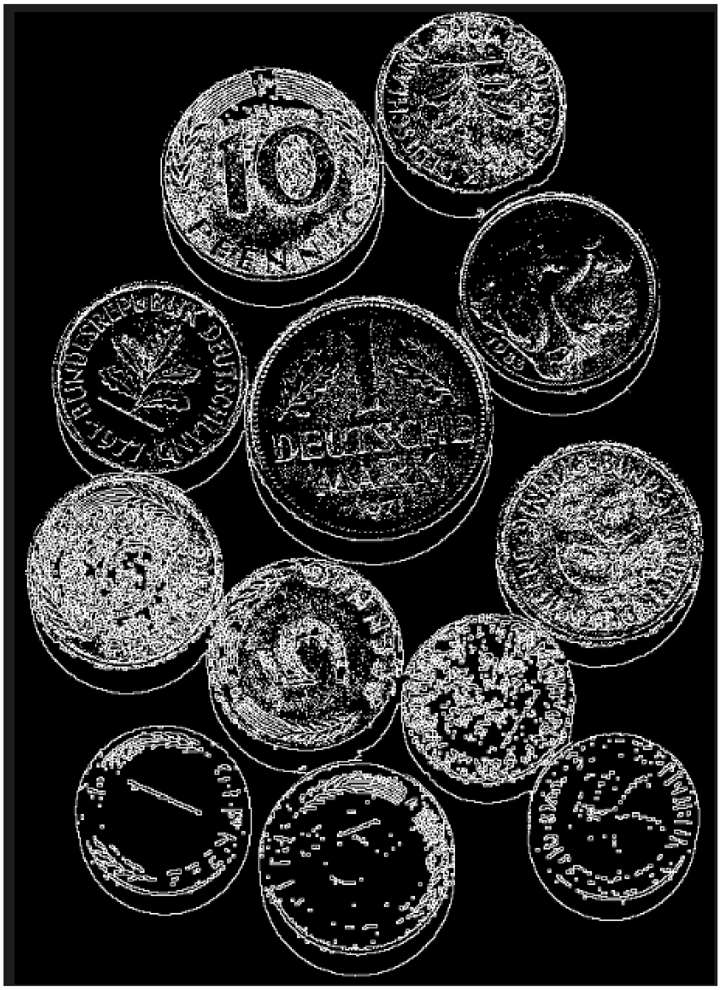
- Output result

4. Task4: Boundary Extraction

- Problem:
  In this chosen image, I've selected the coins image and want to detect the boundaries of the objects in an image(each coin edge or shapes).
- Extract the object outline for analysis or shape recognition.
- Algorithm summary
  1. Read the color image -> convert to grayscale -> threshold -> binary
  2. Create a structuring element (3x3 rectangle).
  3. Erode the binary object → removes outer layer.
  4. Subtract eroded image from original → extract boundary.
  5. Save and display boundary image.

- Input coin.png

- Output result



5. Task5: Leaf Skeletonization

- Problem:
  - Extract the vein structure from a leaf image. This problem also found by internet and it very useful technique and challenge as we have to obtain a clean, thin, connected skeleton of veins from binary image.
- Goal:
  - Skeleton shows primary, secondary, and tertiary veins clearly.
  - Minimal fragmentation and the topology of veins is preserved.
- Algorithm summary
  1. Convert image to grayscale and enhance contrast.
  2. Apply adaptive thresholding -> binary image.
  3. Morphological closing → fill gaps in veins.
  4. Morphological opening → remove noise.
  5. Light dilation → improve vein connectivity.
  6. Skeletonization → produce single-pixel-wide vein structure.

- Input leaf.png

- Output results