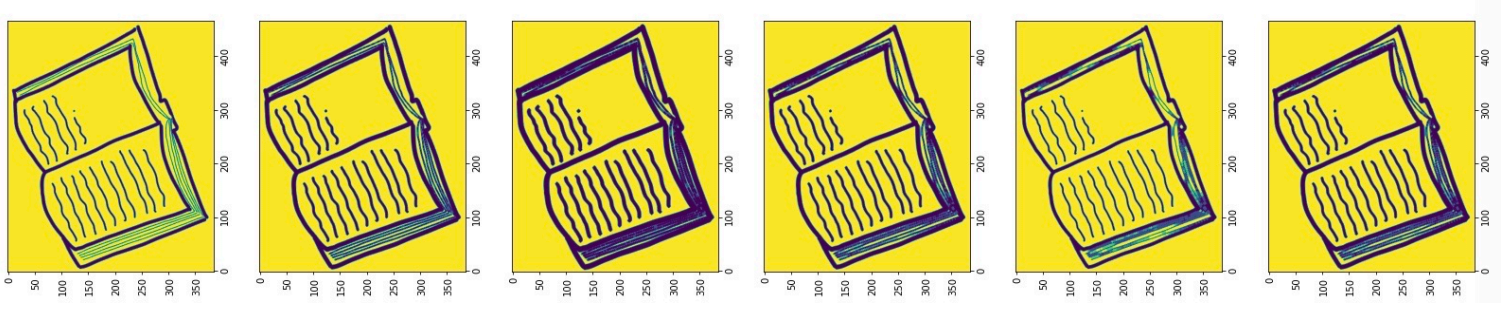
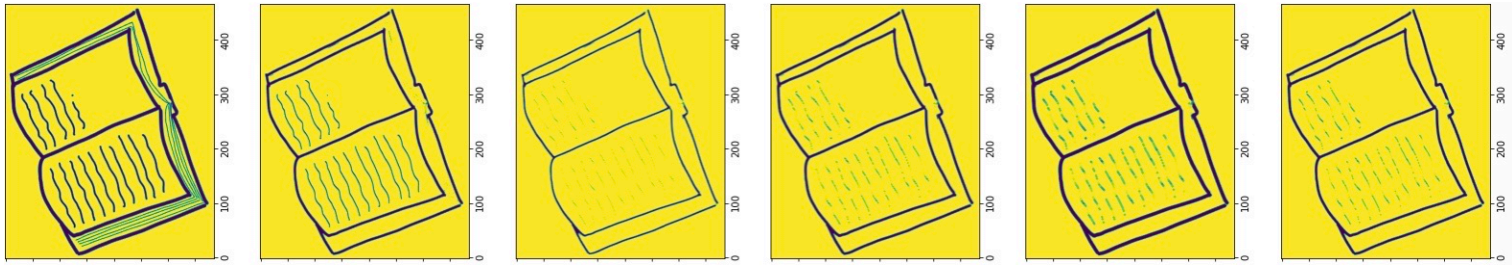
1. Apply Morphological Operations to your drawing in PSET 1, Q1, $S = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$. (2 pts)

(Hint: convert to white lines on black background first)

a. ⊕ → ⊕ → ⊖ → ⊖ → ⊕



b. ⊖ → ⊖ → ⊕ → ⊕ → ⊖

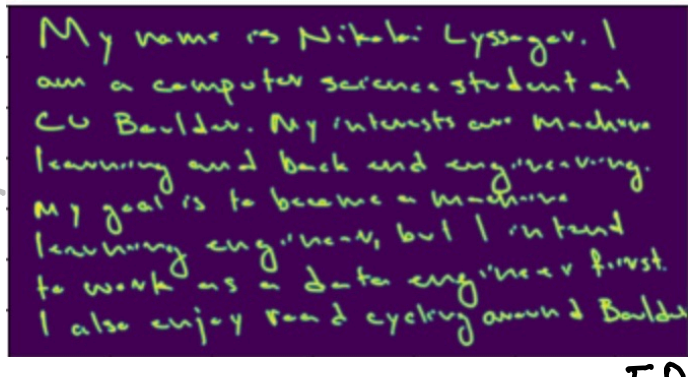


2. Use ⊕, ⊖, ⊙, ○ to modify your handwritten text in PSET 1, Q5. Find a combination of these operators to achieve the target outcome.
(Hint: Convert to white text on black background)

a. OCR Accuracy ≈ 50%, $S=\begin{bmatrix}0&1&0\\1&1&1\\0&1&0\end{bmatrix}$ (1 pt)

Sequence of operators applied: (eg. ⊕→⊙→○→⊖)

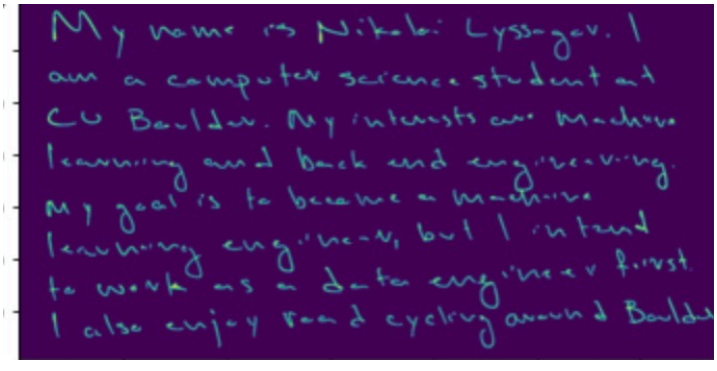
⊕ → ⊙ → ⊖



b. OCR Accuracy ≈ 10%, $S=\begin{bmatrix}0&1&0\\1&1&1\\0&1&0\end{bmatrix}$ (1 pt)

Sequence of operators applied: (eg. ⊕→⊙→○→⊖)

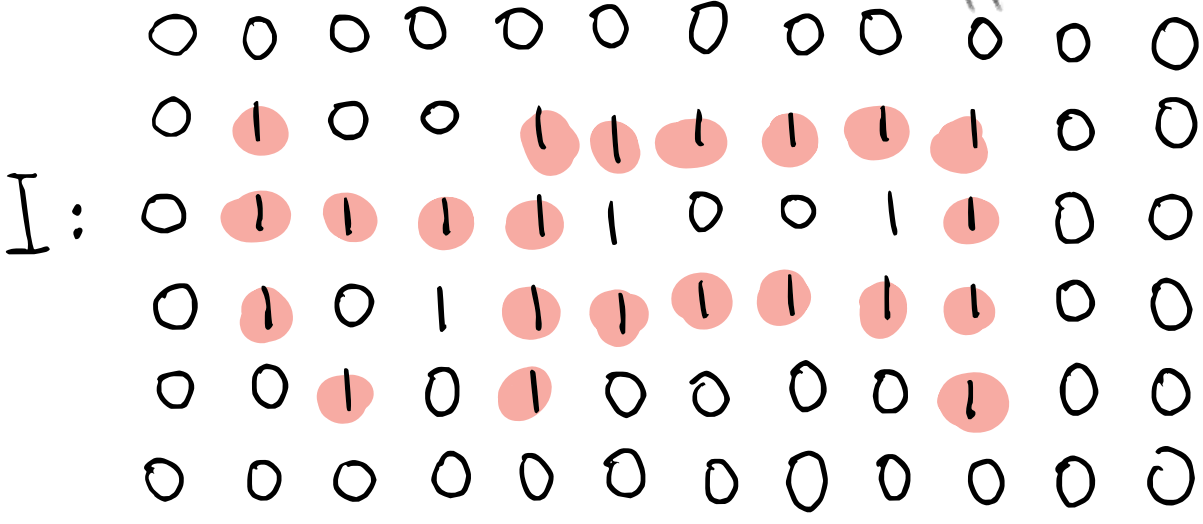
○ → ⊙ → ⊖



3. Perform $\ominus$ and $\oplus$ by hand.

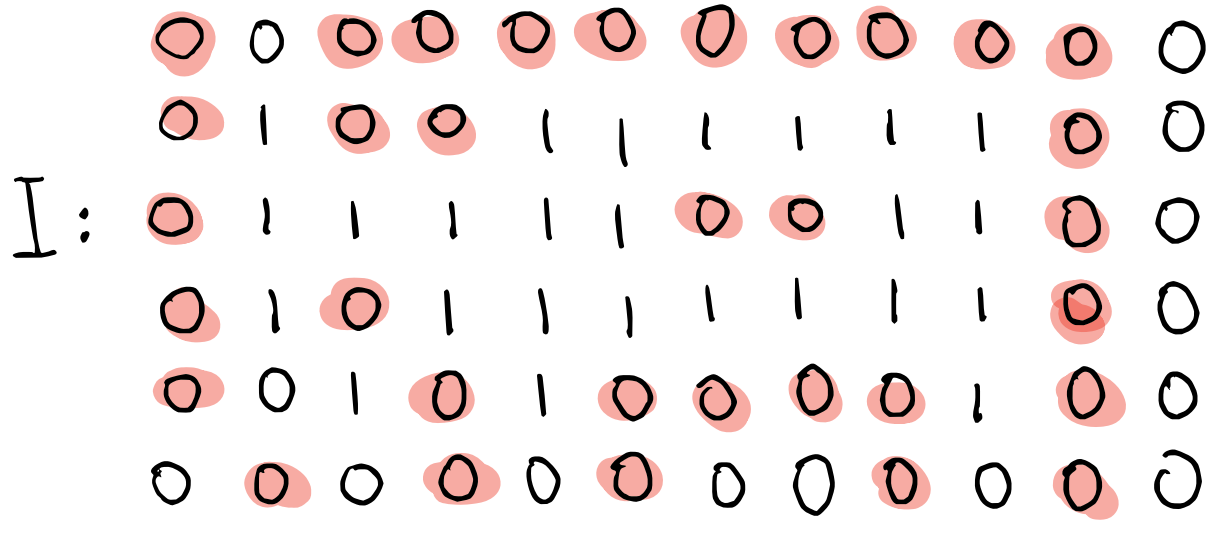
Use $S = \begin{bmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 1 & 0 & 1 \end{bmatrix}$ $\begin{cases} \text{if } 0 \to 1 \Rightarrow \oplus \\ \text{if } 1 \to 0 \Rightarrow \ast \end{cases}$

a. $I \ominus S$ (1pt)



* Highlighted values are ones flipped to zeros by erosion

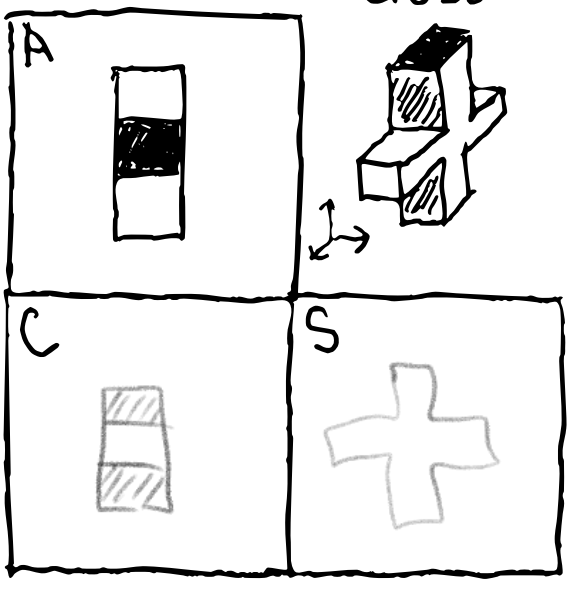
b. $I \oplus S$ (1pt)



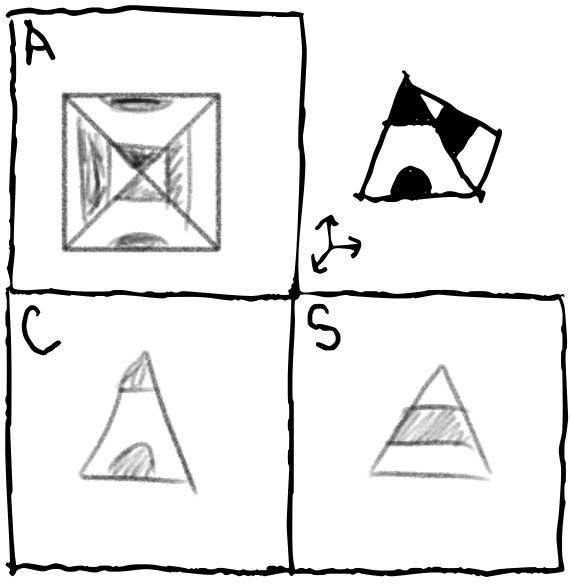
* Highlighted values represent zeros flipped to ones by dilation

5. Practice sketching in 3D. (Assume symmetry) (4 pts)

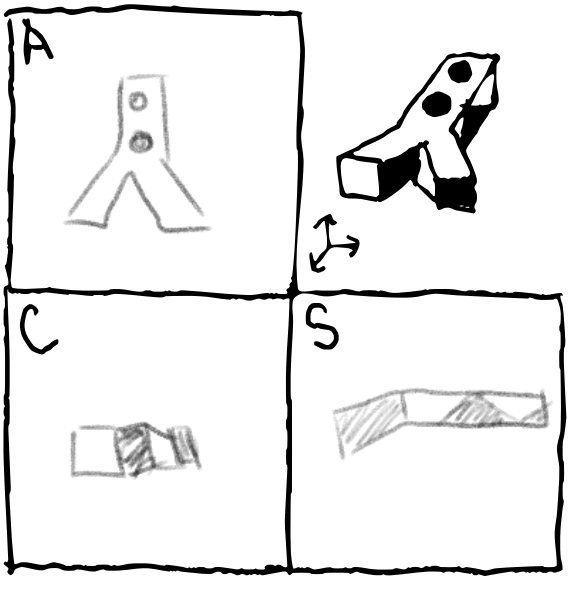
a. Cross



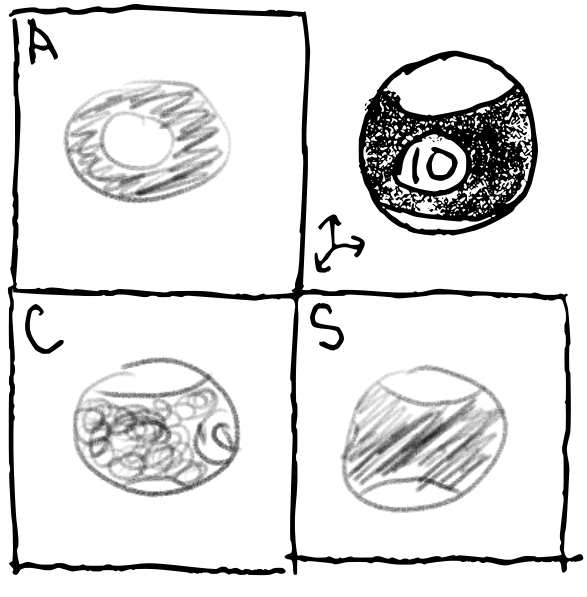
b. Pyramid



c. Y-shape

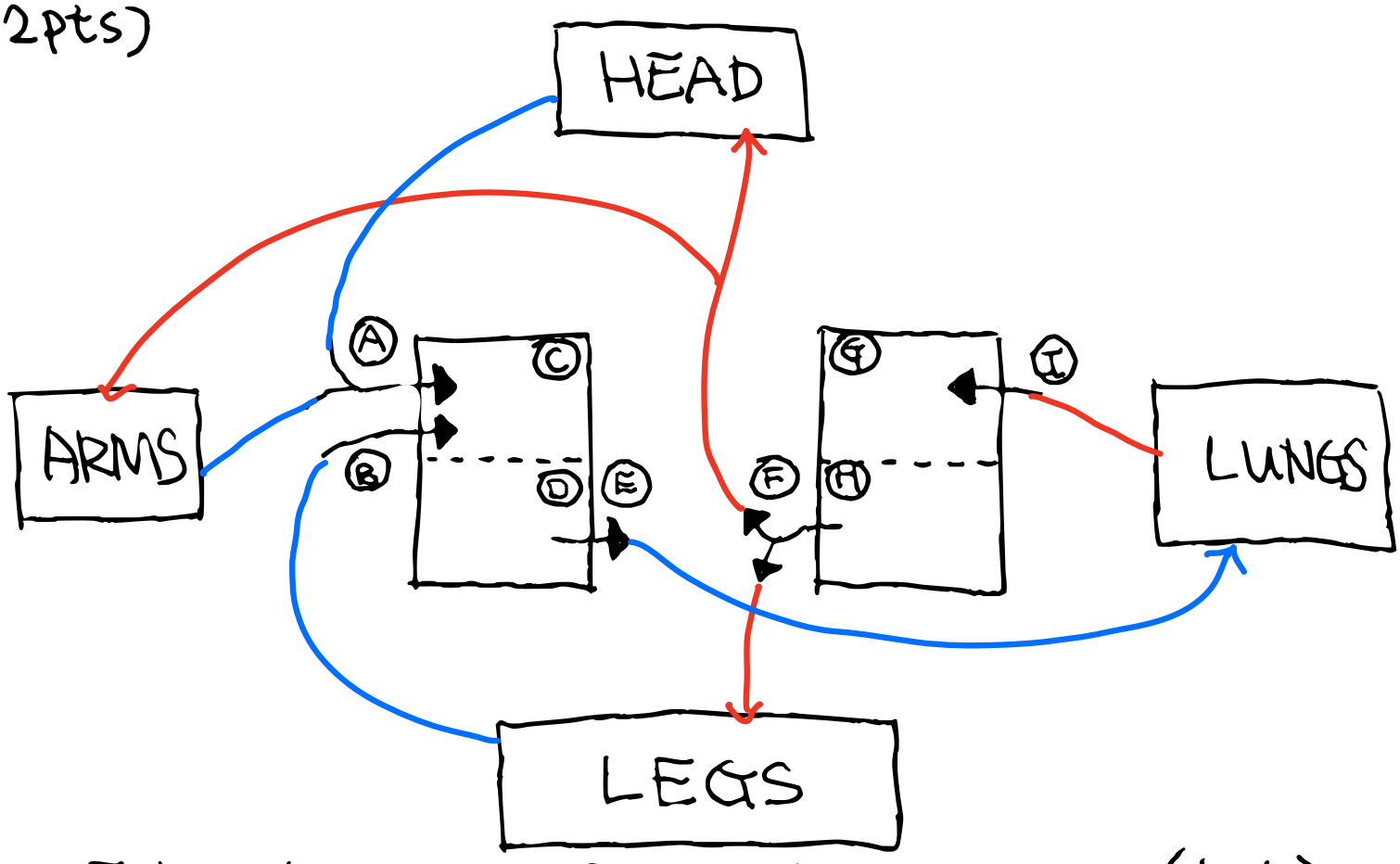


d. Sphere



6. Learn basic heart function

a. Connect arrows from the heart to body parts (2pts)



b. Fill in the name of each heart part. (1 pt)

(A) superior vena cava

(B) inferior vena cava

(C) right atrium

(D) right ventricle

(E) pulmonary artery

(F) aorta

(G) left atrium

(H) left ventricle

(I) pulmonary vein

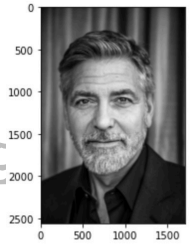
7. Implement a custom padding function. Test it on your own face photo (Grayscale).

a. Random (2pts)

Pick different random pixel values from the input image for each padded pixel location.

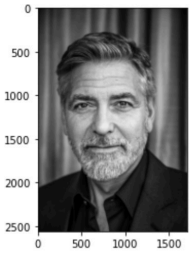
* values change → for visibility

(1) Pad width (3, 3) → 100 100

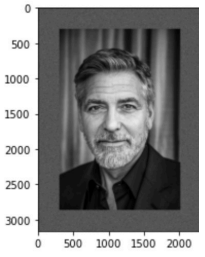


[PASTE IMAGE]

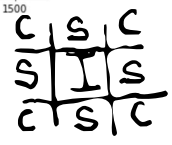
(2) Pad width (10, 10) → 300 300



[PASTE IMAGE]



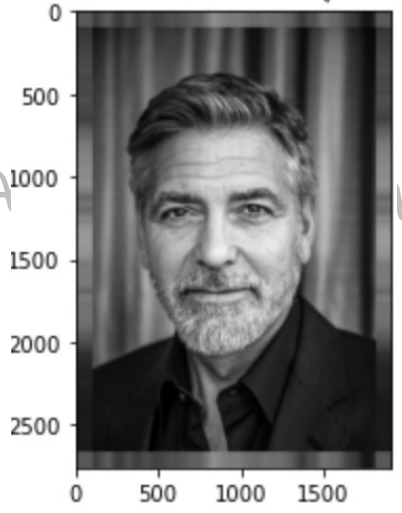
b. Average



(2 pts)

1. Each pixel in S is filled with the average of the pixels on the same row or column in I.
2. Each pixel in C is then the average of the same row in S.

(1) Pad width (3, 3) → 100 100



[PA IMAGE]

(2) Pad width (10, 10) → 300 300

[PA IMAGE]