Puzzles on morphological image processing

Puzzle 1: Shape Transformation

You have a **binary image** containing a single small square (3×3) inside a large empty space.
If you **apply dilation** using a **3×3 square structuring element**, how will the square change?

- (A) It will disappear
- (B) It will remain the same
- (C) It will grow in size ✅
- (D) It will shrink

Explanation:
Dilation expands the boundaries of objects by adding pixels to the foreground (white regions). A
3×3 square structuring element will increase the square's size by 1 pixel in all directions.

Puzzle 2: Hidden Letters

You have a **binary image** with text written in black on a white background.
To **remove noise** (small white specks in the black letters), which morphological operation should
you apply first?

- (A) Dilation
- (B) Erosion ✅
- (C) Opening
- (D) Closing

Explanation:
Erosion removes small unwanted white pixels (noise) by shrinking foreground objects. However,
if the noise is extensive, **opening (erosion followed by dilation)** is a better choice.

Puzzle 3: Counting Objects

A binary image contains **multiple circular objects** (white) on a black background. Some of these objects are very close together.
You want to **count the number of separate objects correctly**. Which combination of morphological operations is most useful?

- (A) Dilation followed by Closing
- (B) Opening followed by Erosion
- (C) Erosion followed by Dilation
- (D) Watershed segmentation ✅

Explanation:
If objects are **touching or overlapping**, **watershed segmentation** is the best technique to separate them. Erosion and dilation help, but they might not be enough when objects are too close.

Puzzle 4: Broken Lines

A binary image contains a **dashed line** (black) on a white background.
Which morphological operation will help in **connecting the broken parts** to form a continuous line?

- (A) Erosion
- (B) Dilation ✅
- (C) Opening
- (D) Hit-or-Miss Transform

Explanation:
Dilation expands black regions, which helps in **bridging gaps** between the broken line segments, making them continuous.

Puzzle 5: Noise Removal from Text

You have an image with **handwritten text**, but there is **salt-and-pepper noise** (random black and white pixels).
Which of the following will best **preserve the text while removing noise**?

- (A) Median filtering ✅
- (B) Erosion followed by Dilation
- (C) Dilation followed by Erosion
- (D) Closing followed by Opening

Explanation:
Median filtering is the best method for removing **salt-and-pepper noise** while preserving edges. Morphological operations (erosion/dilation) work better for **structured noise** rather than random pixel noise.