

**EBME/CSDS 361/461. Homework 6. Spring.**  
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**Department of Biomedical Engineering**  
**Homework: Morphology**

All homework assignments must be completed individually (no teams/groups).

Your responses to each question to each should include:

- A short discussion of each problem. **Code/images alone will not suffice.** A brief description/explanation should accompany each image/algorithm.
- Any processed images
- All MATLAB code used to generate results and images. NOTE: MATLAB/Python code may be randomly tested by TA for functionality!
- Be sure to comment your MATLAB/Python Scripts thoroughly! We need to understand your approach to each problem.

Please submit the following files in Canvas:

- Your responses to each question in PDF format, titled “[caseID]\_HW06.pdf” **Be sure to include all generated images in your PDF report.**
- All generated images, MATLAB/Python code in one zip file titled “[caseID]\_HW06\_Code.zip”

Please read the question descriptions carefully. Be sure to address every question. We try to give you sufficient information to get you successfully started on this simple, but interesting, project.

The following files will be provided by the TA.

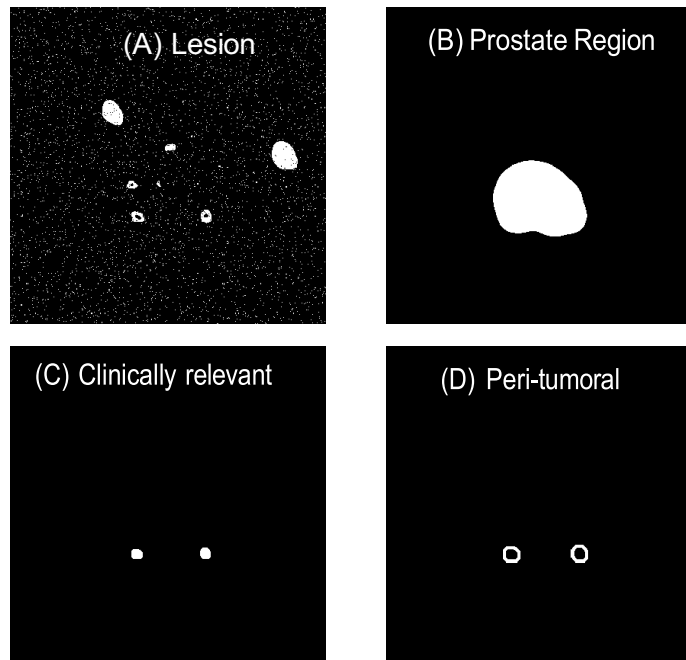
- prostate.mat
- prostate.png – this is the prostate region
- lesionNoise.mat
- lesionNoise.png

prostate.mat/prostate.png is the prostate region. lesionNoise.mat/lesionNoise.png is the lesion segmentation result. You can read these images in MATLAB using ‘**imread**’ function

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**Background:** The output of image segmentation algorithms is often noisy and needs post-processing to clean up and remove artifacts. We extensively use morphological operations for such tasks and eventually use the result for classification and machine learning.

**Problem:** In this assignment, you will work on cleaning up a noisy segmentation result of prostate cancer lesions on MRI. The MRI is not given but you’ll be provided with prostate region and the noisy segmentation result. You are required to clean up this result based on instructions provided below.



**Question 1:** Retaining clinically relevant lesions

- Clinically relevant lesions are those which are within the prostate and of diameter at least 12 pixels. Please de-noise the image, fill any existing holes and retain only clinically relevant lesions. Your result should be something similar to the thumbnail provided above in 'C'. You may use any of dilation, erosion, opening, closing, addition, subtraction operations that were discussed in the lectures.
- You need to provide detailed intermediate results, explain the morphological operation, structuring element used and the rationale for the use. You will be graded on your approach and not the final result.

**Question 2:** Derive a peri-tumoral region

- The region outside the cancer lesion but within the prostate is called *peri-tumoral region*. Please derive the peri-tumoral region for the lesions obtained from Task 1. This region should be about 5 pixels extended outward from the lesion boundary. Your result should be something similar to the thumbnail provided above in 'D'. You will be graded on your approach and not the final result. You may use any of dilation, erosion, opening, closing, addition, subtraction operations that were discussed in the lectures.

### **Functions of particular interest**

MATLAB Functions:

**imopen(), imclose(), imfill(), bwconncomp(), imdilate()**

Python Functions:

**cv2.erode, cv2.dilate(), cv2.morphologyEx, cv2.getStructuringElement(),  
skimage.measure.label()**