



Electrical & Electronics Engineering Department
EE434 – Biomedical Signal Processing - Final Takehome Exam
Deadline: January 11th, 2024 23:59
Instructor: M. Zübeyir Ünlü

Name:

Student No:

Honor statement: *I pledge that I have not used any notes, text, or any other reference materials during this exam. I pledge that I have neither given nor received any aid from any other person during this examination, and that the work presented here is entirely my own.*

Signature:

You may use Matlab's or any other tool's functions directly!

Important Notes:

1. In below questions, the selections (filter selections, some numbers and values, etc.) to be used is left to you in order to detect cheating and plagiarism situations. Please explain why these choices were made this way.
2. When you make the plots please label all the axes, write their units, and give an explanatory title for each plot.
3. Put everything (Matlab functions you wrote, results, plots, comments, explanations etc.) sequentially for each question in a pdf file and load your Final Exam using the name template: **Final-Your_School_ID.pdf**

Download [Head-CT.png](#) and [Head-CT-Transformed.png](#). We will use [Head-CT.png](#) in questions 1, 2, and 3 and we will use [Head-CT.png](#) and [Head-CT-Transformed.png](#) in question 4.

Question #1 (30 pts): About Image Segmentation and Related Subjects.

- a) About applying the first order derivative (gradient) to find edges.
 - i. Plot the $|g_x|$ (magnitude of the gradient image in x direction) of the image.
 - ii. Plot the $|g_y|$ (magnitude of the gradient image in y direction) of the image.
 - iii. Plot the gradient image, $|g_x| + |g_y|$.
 - iv. Apply a 5x5 smoothing filter and after that apply the steps (i), (ii), and (iii) again. Plot the resulting images. Compare them with the previous ones.
- b) Apply Marr-Hildreth algorithm to find edges. Plot the resulting image.
- c) Apply Canny edge detection algorithm to find edges. Plot the resulting image.
- d) Compare all the results.

Note: In any of the steps above to obtain better results you can apply extra operations mentioned in the slides or on the literature. However, if you use them please mention them.

Question #2 (20 pts): About Image Segmentation and Related Subjects.

Using Otsu's method find the optimum thresholds to segment out this image into different subregions. To find the optimum number of subregions according to the image given, try different numbers. After that show each subregion in a separate image.

Note: Repeat the above operation after applying 5x5 smoothing filter. Compare results.

Question #3 (20 pts): About Image Segmentation and Related Subjects.

Apply k -means clustering to the image. Try at least three different k 's. Which one is appropriate for the given image? Show the resulting images.

Question #4 (30 pts) (About Medical Image Registration):

Using only the rotation and translations in x and y please register [Head-CT-Transformed.png](#) to [Head-CT.png](#). At the end please show the resulting image (call it as [Head-CT-Registered.png](#)) and the difference image (call it as [Head-CT-Difference.png](#)). Please also give the values for rotation in degree, and translations in x and y to register [Head-CT-Transformed.png](#) to [Head-CT.png](#). (To find the optimum ones you should try different values. It is not necessary for all of you to have the same values. There may be slight differences.)