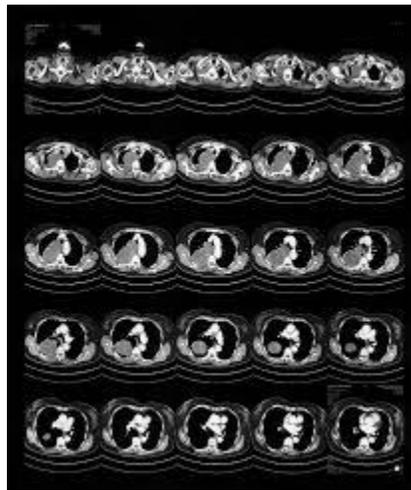
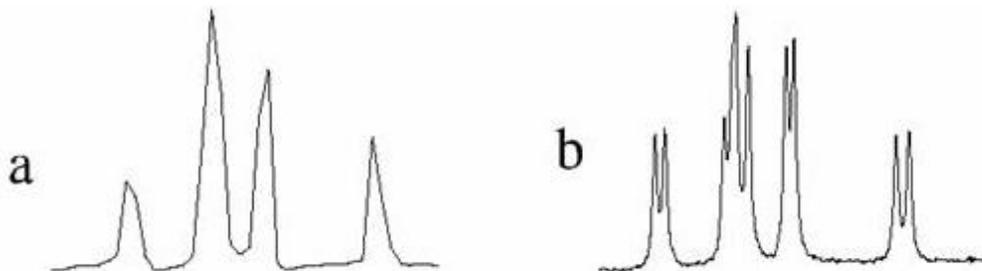


Guide: Please provide your answers as a brief paragraph of not more than a few lines or points. You do not need to perform any computations or coding. Just clearly express your independent ideas.

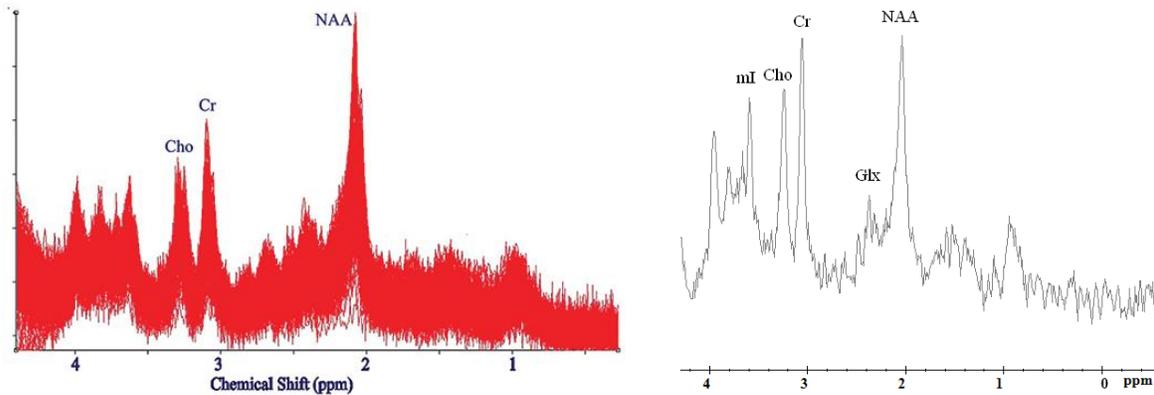
1. In diagnosing lung cancer, a volumetric CT scan is performed to collect a set of slices for the whole chest as shown. It is desired to design a CAD system to detect lung cancer from the collected volume. Provide a list of processing blocks that should be included in such system and list the possible differences between such system and the one used for digital mammography.



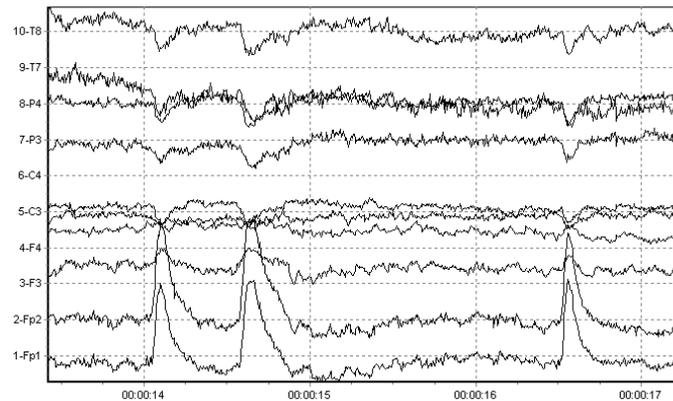
2. In magnetic resonance spectroscopy, the spectrum of metabolites inside a region of interest are mapped to different frequencies and hence can be quantified and measured. One problem in this technique is that the resolution of such maps depends on acquisition time. That is, to obtain high quality map, one has to scan the patient for 30-45 minutes. Knowing that such scanning requires the patient to not move for the entire duration of the scan, this makes this technique hard for patients and doctors. It is desired to find another way of improving the resolution of the outcome without having to increase the scan time. Given the spectroscopic map in a, can you propose a technique that would be used to improve the resolution to become more like b?



3. In the same magnetic resonance spectroscopy application above, the maps often come out very noisy as shown to the left. Design a method to improve the quality of the outcome to be like the clean one to the right.

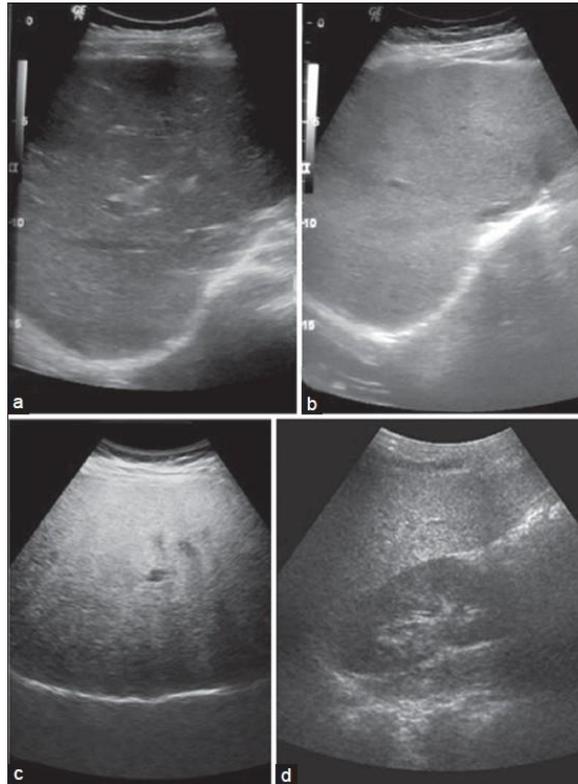


4. What is meant by the term “spatial filter”? Show an example of a case where such filter is used to illustrate its performance in a medical application.
5. In Brain-computer interface, EEG signals (like the ones shown) are collected from up to 64 channels and used to identify the mental state of the subject and use that to communicate particular instructions. Describe how you can design a data processing system that can be trained to identify particular mental states for a particular subject.



6. You are given the data set for a binary classification problem (e.g., normal/abnormal) that includes 14 different measurements (features) taken for 100 cases. How can you make sure that a particular measurement (for example, body weight) is relevant to the classification? Provide the steps to allow you to confirm the result.

7. Consider the four images shown below showing grades of fatty liver based on visual appearance (a: normal, b: fatty liver grade 1, c: fatty liver grade 2, d: fatty liver grade 4). Can you propose a few features that you think will help discriminate between images? Explain your answers.



8. Where can you find image databases to download for your research? Describe 3 such resource for different imaging problems.
9. Write a brief research proposal that can be suitable for a master's degree thesis in the area of medical imaging or image processing. This summary should include (a) clinical problem, (b) approach or methodology to be used, (c) available data to apply methods, (d) the performance metrics that should be used to assess the results.