BM 641 Magnetic Resonance Imaging Principles
Take Home Midterm Exam
Due: 14/05/2020

Name:

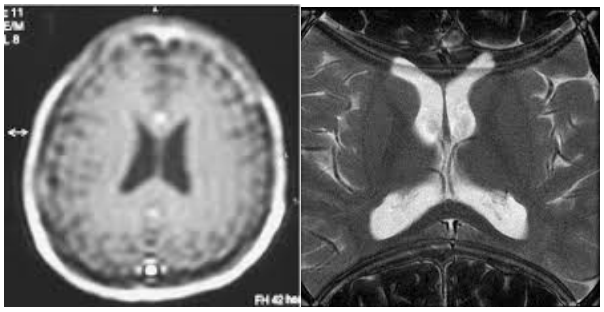
*This midterm exam is take home, and you are allowed to use all the resources, including articles, books, and any other documents available on the internet, but please list your references at the end of your exam. Additionally, your exam should have a less than **15%** total similarity (iThenticate/Turnitin) with the available resources. Moreover, everyone is required to do his/her own work, and the same answer with another student would get you half the grade. Good luck!*

Dear MRI Expert,

I arrive at an outpatient MRI unit to get a head scan. This is my first time seeing an MRI scanner, and it is a rather large and scary looking equipment. I have a few questions and would appreciate your help in understanding this technology. Thank you in advance for your time and help.

1. (3 points) How should I prepare for an MRI scan? Are there any dietary restrictions before an MRI scan? Are there any health conditions that might prevent me from getting an MRI scan?
2. (3 points) Can I just walk towards the MRI technician who sits in front of a computer in the control room with my clothes, cell phone, and jewelry on? How about the inner room where the big cylinderical equipment (the technician tells me it is called a 'magnet') sits, can I just walk in there with all my belongings? If not, why?
3. (5 points) Will I feel any discomfort while I am being scanned? What are some possible complications of an MRI scan?
4. (5 points) Now, I am in and getting scanned. What are all these noises, should I be scared?
5. (7 points) Could you please explain to me how magnetic resonance imaging is performed.
6. (7 points) What are the hardware components of an MRI scanner? What are their roles in generating an MR image?
7. (7 points) I don't really understand the magic behind forming an MR image. Could you please explain to me how you create those super-detailed cool images that I see on the screen by just placing me into that large cylinder that you call a magnet?
8. (8 points) They took me out, and now I see an image of my brain, incredible! Why are some parts of the image dark, while other parts are bright? Now I scroll down to the next image with the help of the technician. How come the image contrast is different now, and the dark and bright parts were interchanged? How do you use the same equipment and get two different contrasts of the same tissue? Are you using a filter like the ones that I apply to my photos on my cell phone?

9. (8 points) Do you get a continous MR signal, or do you need to sample it, and why? If sampled, what is the effect of sampling in your MR image?
10. (8 points) The technician tells me about a weird thing called ‘k-space’. What is it, can I touch it? How do you traverse this k-space?
11. (8 points) Can I observe all the contents of this weird k-space when I acquire an MR image? What are the limitations in terms of the extent of the k-space that I could/should cover? What is the effect of the k-space extent on my resultant MR image?
12. (8 points) The technician keeps talking, and he tells me that MR signals like to relax. What is relaxation, does it have anything to do with meditation? How many different types of MR relaxations exist? Are all the tissues relax the same way?
13. (8 points) The technician tells me that you use MRI pulse sequences. Can you draw me an example pulse sequence and explain its components?
14. (7 points) How do you see the finer details of the brain? Is there a way to increase the image spatial resolution?
15. (8 points) Two of my brain images came out weird (please see below). What went wrong while acquiring these images? Is there a way to prevent these imaging errors?



BONUS: (10 points) What do you think the next big improvement in MRI technology might be?