ECE 435/BME 403 Medical Image Processing Spring 2019
University of Victoria

Assignment 2. (6% of final course mark)
Due date: Sunday February 3 6:00 pm via CourseSpaces

Please type your answers or scan your hand-written answers. Your assignment should be submitted as one pdf file.

1. (0.5 p) For the following changes in an x-ray imaging system indicate the effect on subject contrast (i.e. increase, decrease or no effect):
- increase in patient thickness,
- increase in kVp,
- reduction in field of view of the detector
- use of a high atomic number contrast agent.

Provide a brief explanation for each of your answers.

2. (1 p) What is meant by vignetting in radiographic imaging and what are the effects of this artifact?

3. (0.5 p) What determines the highest energy of x-ray photons emitted from an x-ray tube? What determines the energy spectrum of the x-ray photons?

4. (1 p) Compare characteristic radiation and bremsstrahlung radiation. What are their similarities and differences?

5. (1 p) Using relativistic equations, determine the speed of an electron that is accelerated across a 120 kV potential in the X-Ray tube.

> From Einstein's theory of relativity, we know that the (relativistic) mass of a particle is given by
> $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}}$ where m_0 is the rest mass of the particle, v is the speed of the particle, and c is the speed of light.
>
> The kinetic energy of a particle is the difference in energy between the moving particle and the stationary particle.
>
> $KE = E - E_0 = mc^2 - m_0c^2$

6. (1 p) If 80% of x-ray photons of a certain energy pass through a slab of material, what percentage passes through a slab of the material which is twice as thick as the original slab?

7. (1 p) A chest radiograph is 36cm×43cm. If we want to preserve all the detail in the image, to a spatial resolution $5mm^{-1}$, how many pixels would be required? What will be the size of the image, if quantization were performed on 256 gray levels?