**CSC 4080: Artificial Intelligence in**

**Medical Imaging and Health**

**Homework Set 1  
Due date: Feb. 20, 2022**

**Note:** The weight assigned to each problem is given below.   
This HW set **counts 6% of your course grade**.

**Short Answer questions:**

1. Explain the image acquisition process for digital CT Imaging in math. (10%)
2. What is the purpose of filtering with a Hamming window filter when reconstructing CT images? (10%)
3. What is the advantage and disadvantages of X-ray, CT, ultrasound, and MRI? (10%)

**Calculation problems:**

1. Get the derivatives for the sigmoid function and softmax function (you should write down the explicit matrix form different from the slides). Talk about the similarities of these two functions and their applications, respectively. (10%)
2. Write down the cross-entropy loss function, and its derivatives. Discuss how it works for classification tasks. Is there any disadvantage of using naïve cross-entropy for classification? (10%)

**Programming problems:**

1. Install Anaconda (a very good Python version that can help you easily implement data science applications).  
   Based on Anaconda, install some commonly used packages for Python, including Numpy, Pandas, Matplotlib, Seaborn, PyTorch (CPU version is OK if you don’t have GPU on your device). Record your installation process in detail, screenshots for every step are needed. (10%)

For your reference:

<https://docs.anaconda.com/anaconda/install/>

<https://pytorch.org/get-started/locally/>

1. Here’s two basic Python programming problems: (10%)

1) Write a program to sum all the numbers in a list;

2) Write a program to find all prime numbers in a list.

1. Here’s two basic Numpy programming problems: (10%)

1) Given an array, calculate its softmax result;

2) use the softmax result to calculate the cross-entropy loss (you are free to construct the input x, and ground truth label y by yourself).

1. Medical data exploration. You are going to work with a real medical image dataset, including exploring data labels, visualizing and observing the data, along with processing the data. Please fill in the blanks in “data\_exploration.ipynb” and successfully run all the cells. (20%)

**Submitting the assignment:**

Please submit a pdf file containing all written problems, and screenshots for programming problems that you think necessary. Codes can be submitted in “.py” or “.ipynb” files.