ELEC4010N: Assignment 3

Submission requirement:

1. Report to show the results (e.g., performance, loss, figures, disucssion);
2. Code with a README file.

[40%] Problem 1

1.) [5%] Explain the imaging principles of X-Ray.

2.) [5%] Explain filtered back projection.

3.) [5%] Explain the imaging principles of Computed Tomography (CT).

4.) [5%] Explain the differences between CT and MRI.

5.) Literature review for CT reconstruction from multi-view X-Rays. (no more than 1 page.)

- [5%] Problem statement, difficulties, and why this problem makes sense?
- [15%] Related works (≥ 3 recent papers): how they solved this problem, novelties, and limitations.

[60%] Problem 2

Video regression on EchoNet-Dynamic. The full dataset has around 10k videos. Each video consists of 64 frames and each frame has the shape of 112×112. Each video is labeled with a EF (ejection fraction) value. In this problem, you are required to complete a video regression task on a subset (500 videos) of EchoNet-Dynamic, and the training, validation, and test splits have already been prepared in the folder.

The input is a video and can be represented as a 3D matrix with the shape of $k \times 112 \times 112$, where k is the number of sampled frames. The output is a EF value, and you can use regression loss like MSE for supervision. Since the input has three dimensions, we recommend you to regard the input as a 3D volume and design a 3D regression network.

1.) [20%] Run a baseline model, and

- a.) Report the final evaluation metrics, including mean absolute error (MAE) and and root

mean squared error (RMSE);
- b.) Plot the training/validation loss curves.

2.) [20%] Compare the perfrormance of the following loss functions.

- a.) Mean square error (MSE);
- b.) Mean squared logarithmic error (MSLE);
- c.) L_1 Norm;
- d.) Huber loss.

3.) [20%] Add supervsion to some intermediate layers of the model and report the result. More specifically, assume that the model has the structure of $x \rightarrow H_1 \rightarrow H_2 \rightarrow \ldots \rightarrow H_m \rightarrow y$, where H_i is the output of i-th intermediate layer and has the shape of $W \times H \times D$ and y is the final scalar output. Similar to adding regression supervision to y, you can add a tiny head f_i for some H_i to produce a intermediate regression value $y_i = f_i(H_i)$ and also use the true value as the supervision. You can also refer to the following papers:

- https://www.cs.unc.edu/~wliu/papers/GoogLeNet.pdf (see the second paragraph in page 5, and Figure 3)
- https://www.sciencedirect.com/science/article/abs/pii/S1361841517300725 (we have mentioned in the lecture)