COMP411/511: Exercise 0

Deadline: November, 1st

1 Pen-and-Paper

1. Given an input vector $\mathbf{x} \in \mathbb{R}^{n\times 1}$, a linear layer with weights $W = [w_0, w_1, ..., w_{n-1}] \in \mathbb{R}^{n\times 1}$, and a forward calculation $\hat{y} = W^T x$, Smooth-L_1 loss is defined as:

$$\mathcal{L} = \begin{cases} 0.5(\hat{y} - y)^2/\beta & |\hat{y} - y| \leq \beta \\ |\hat{y} - y| - 0.5 * \beta & \text{else} \end{cases}$$

where β is a predefined positive threshold.

Your task is to compute the derivative of the loss with respect to each weight w_i, which is $\dfrac{\partial \mathcal{L}}{\partial w_i}$.

Hint: The derivative of piecewise functions can be computed separately for each case, and then recombined as a single function. You can express the piecewise function as a single formula by multiplying by an indicator function $\mathbb{1}(\text{condition})$, where $\mathbb{1}(\text{condition}) = 1$ if the condition holds, and 0 otherwise. For example, $x \cdot \mathbb{1}(c > 5) = x$ if $c > 5$, otherwise 0.

2 Coding with EDF

This problem set involves understanding and modifying the Educational Framework (EDF). It is highly recommended that you use a conda environment to run the code.

1. Please download and install miniconda
2. Run the following commands on the terminal to create an environment named *edf* and activate it:

```
$ conda create -n edf
$ conda activate edf
```

3. Install the required dependencies:

```
$ pip install numpy matplotlib
```

4. Finally, you can run the code:

```
$ python main.py
```

You will run **main.py** to train and test a simple model on a dataset. The code in this file is provided, and you **do not** need to change anything. However, you must complete the implementation of **BCELoss** (both forward and backward) in **edf.py** so that the **main.py** can be run properly. After running the code, a figure named **error_metrics.png** will be created. If your implementation is correct, it should look similar to the plot shown in Fig. 1. Please upload the completed **edf.py** file, along with the generated **error_metrics.png** after running.

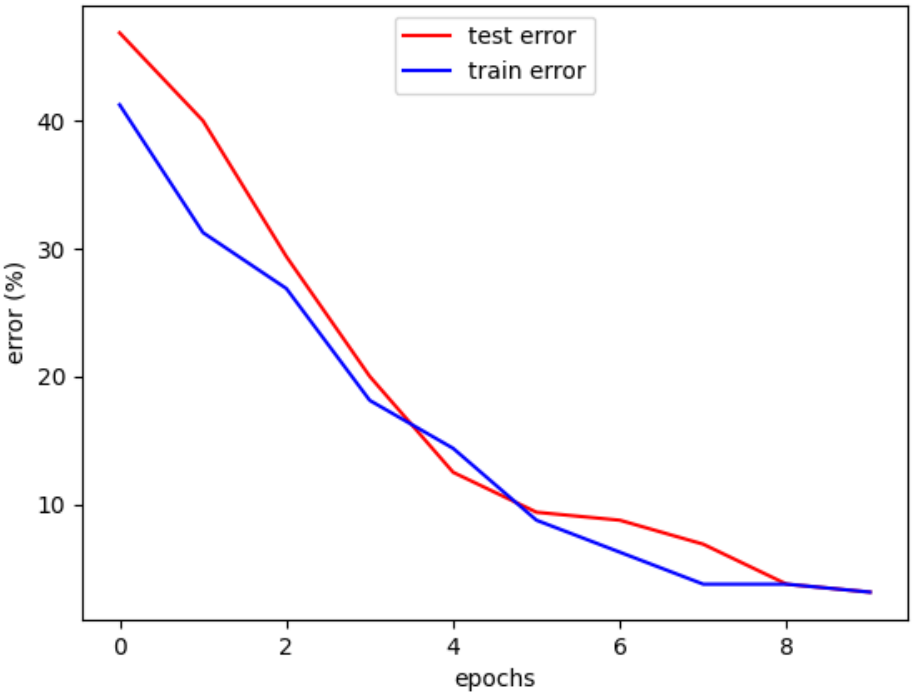

Figure 1: **Sample Output** with Train (blue) and Test (Red) Error through Epochs.