

Week 3 Programming assignment

In this assignment, you will use a neural network to approximate both the **Runge function** and its **derivative**. Your task is to train a neural network that approximates:

- The function $f(x)$ itself.
- The derivative $f'(x)$.

You should define a **loss function** consisting of two components:

- Function loss:** the error between the predicted $f(x)$ and the true $f(x)$.
- Derivative loss:** the error between the predicted $f'(x)$ and the true $f'(x)$.

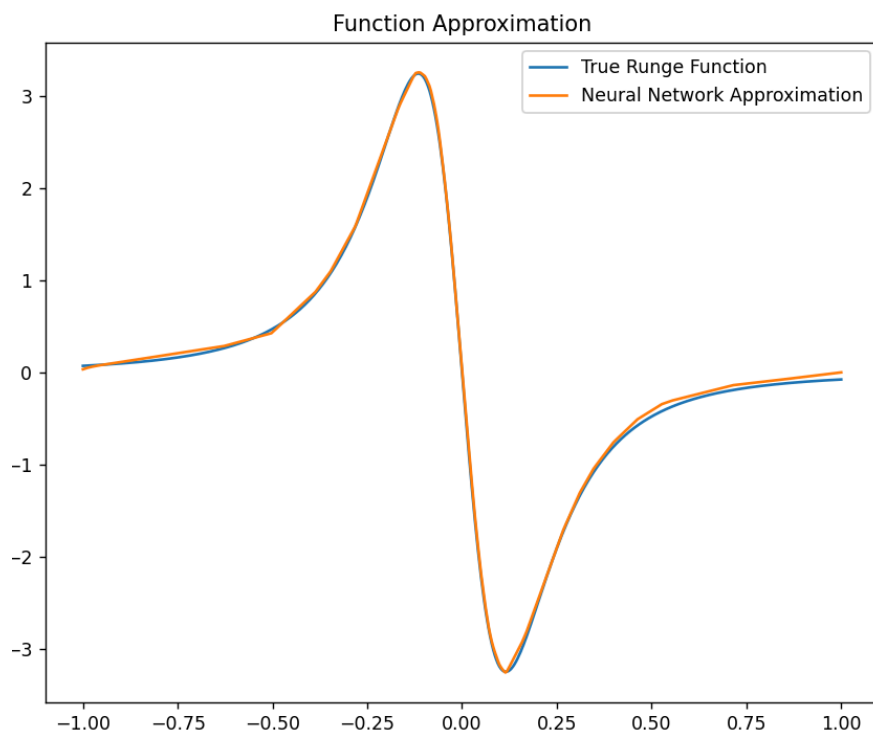
1. Data Generation

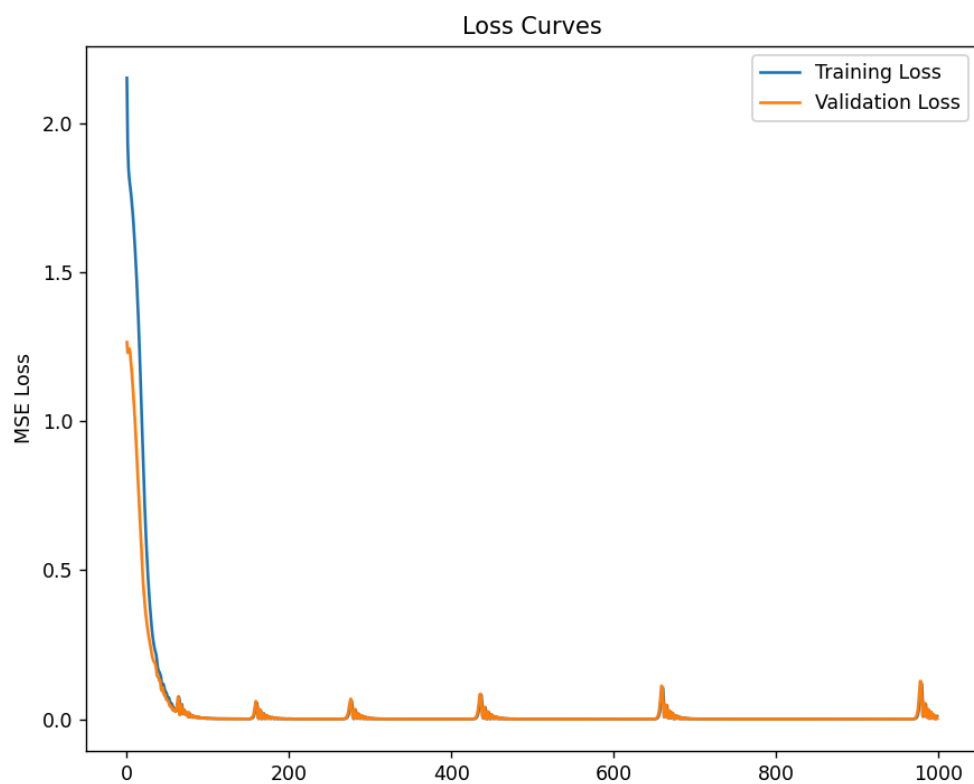
We generate a set of training points x in $[-1, 1]$ using a uniform distribution. The range of x will help train the neural network to learn the behavior of the function and its derivative across the entire domain.

$$f(x) = \frac{1}{1+25x^2} \quad f'(x) = -\frac{50x}{(1+25x^2)^2}$$

2. Neural Network

I use a neural network with an input layer, 64 neurons on 2 hidden layers, and an output layer.





MSE for Function: $\text{MSE}_f = 0.0001$

MSE for Derivative: $\text{MSE}_{f'} = 0.0002$

Max Error for Function: $\text{Max Error}_f = 0.005$

Max Error for Derivative: $\text{Max Error}_{f'} = 0.01$