

Programming assignment Week 3

Question

Calculate the error in approximating the derivative of the given function:

$$f(x) = \frac{1}{1+25x^2}, \quad x \in [-1, 1].$$

The way to approximate the derivative of function

(This report used chatgpt for assistants to complete the code)

Use previous function hypothesis: $h(x) = W_2 \tanh(W_1 x + b_1) + b_2$. Calculate MSE/max error between $f(x)$ and $h(x)$. Then calculate MSE/max error between $f'(x)$ and $h'(x)$. Note that $f'(x) = \frac{-50x}{(1+25x^2)^2}$, $h'(x) = W_1 \times W_2 (1 - \tanh(W_1 x + b_1)^2)$.

Result

Test MSE = 5.6968e-03

Test max abs error = 2.1816e-01

Derivative approximation:

Derivative MSE: 0.6317719479200686

Derivative max abs error: 2.298151405116966

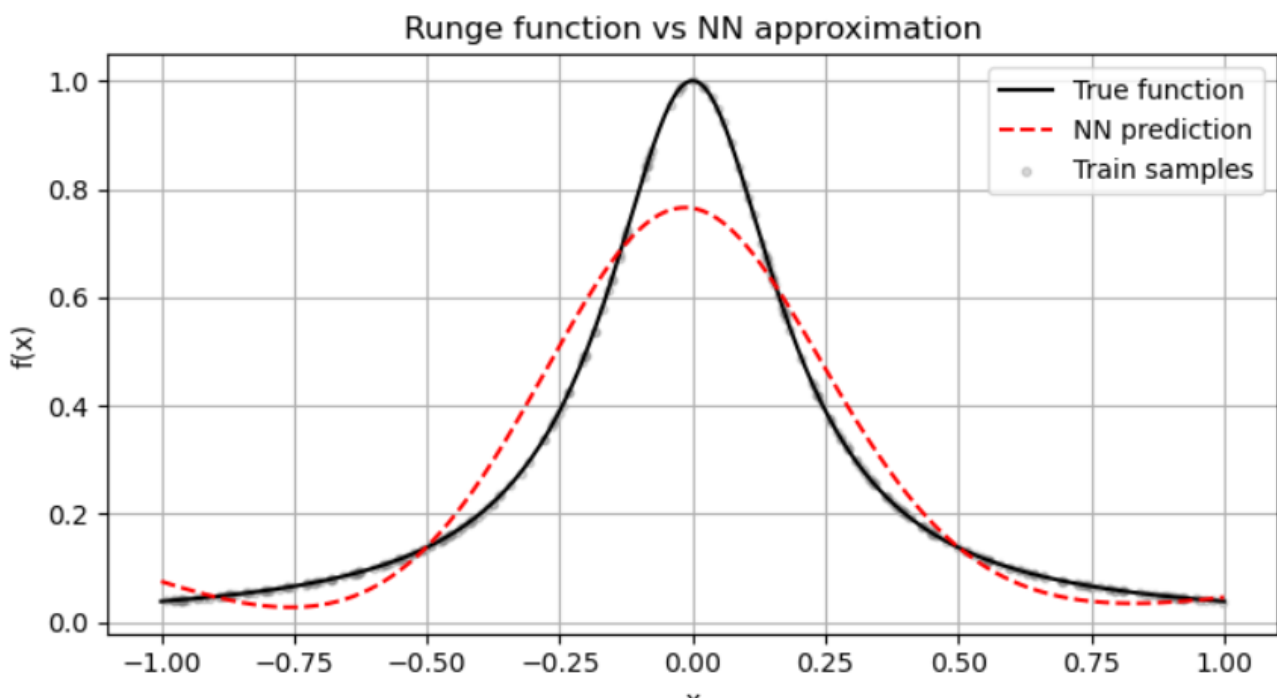


Figure 1: The true function and The neural network prediction

After 1000 epochs, the MSE between $f(x)$ and $h(x)$ have already drop to 0.0056968. However, the MSE between $f'(x)$ and $h'(x)$ is about 100 times bigger than the function error, which is a high value.

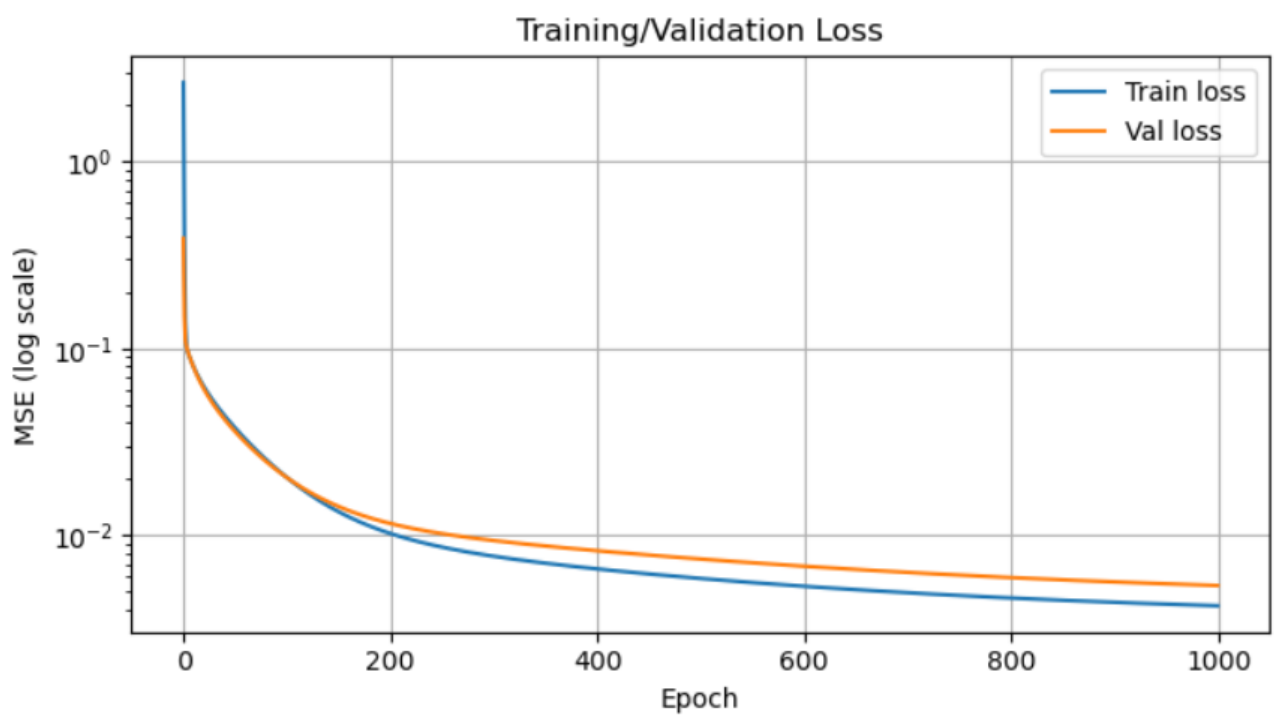


Figure 2: The training/validation loss curves