114-1 Machine Learning

Week 2 Assignment

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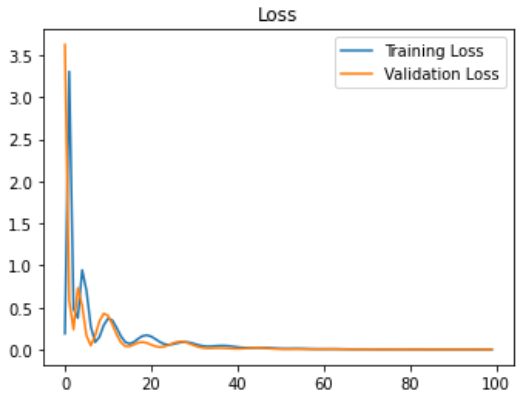
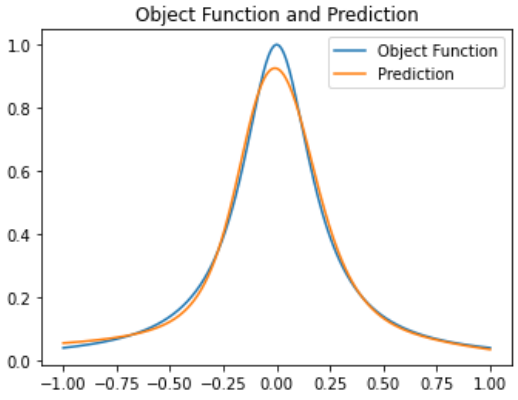
Problem 1.

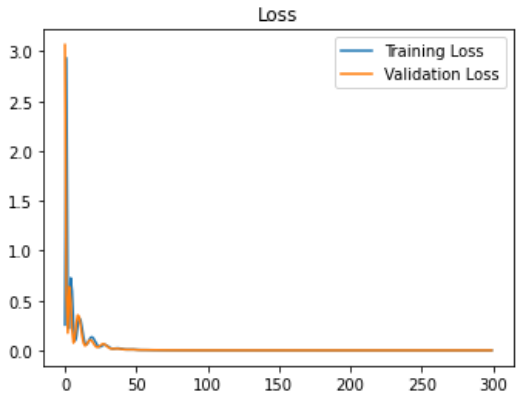
Use a neural network to approximate the Runge function

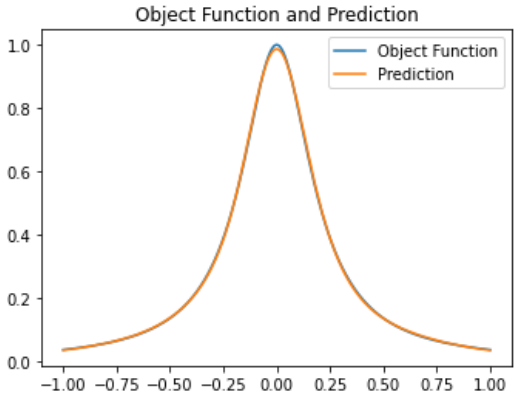
$$f(x) = \frac{1}{1+25x^2}, x \in [-1, 1].$$

Solution.









NOTE OF PROBLEM 1.

About my hypothesis	
training data	300 equally spaced points in the interval $[1, 1]$.
testing data	500 equally spaced points in the interval $[1, 1]$.
$f_\theta : \mathbb{R} \to \mathbb{R}$	$f_\theta = t_3(L_3(t_2(L_2(t_1(L_1(x))))))$
	where $t_i = tanh(x)$ $L_i = W_i x + b_i$
Hidden layer and activation function	3 *linear layer* with *tanch*
Trainable params	8,577
Loss function	mean square error
epoch	300

The programming language I used is Python, and I mainly relied on the PyTorch library to carry out the simulations. Based on the trained model, the mean squared error (MSE) of the prediction results, evaluated on 500 points within the interval$[1, 1]$, is 0.000520.

Figure1 shows the results of the preliminary test. After tuning more parameters (such as the number of epochs), better results can be obtained, as shown in Figure2, with the MSE reduced to 0.000014.