

AI61002: Deep Learning Foundations and Applications (Spring 2024)

Programming Assignment 3

The goal of this assignment is to implement and use gradient descent (and its variants) with backpropagation for a regression task. Here you need to implement a feedforward neural network. This network will be trained and tested using the [california housing dataset](#).

1. Create a neural network with 3 hidden layers [(input features -> 128 -> 64 -> 32 ->1), ReLU activation for hidden layers and linear activation for the output layer.] [3 marks]
2. Implement Adam **from scratch** for the above model. [6 marks]

You need to make the following plot:

- x-axis: number of epochs, y-axis: training loss and validation loss (2 curves) [2 marks]

3. Implement Nesterov Accelerated Gradient (NAG) **from scratch** for the above model. [6 marks]

You need to make the following plots:

- x-axis: number of epochs, y-axis: training loss and validation loss (2 curves) [2 marks]

4. Use [torch.optim](#) and implement Adam, NAG, Adagrad, Adamax, Adadelata, Vanilla Gradient Descent for the above model. [3 marks]

You need to make the following plots:

- x-axis: number of epochs, y-axis: training loss (6 curves - each curve corresponding to one of the optimization methods mentioned above) [1 mark]
- x-axis: number of epochs, y-axis: validation loss (6 curves - each curve corresponding to one of the optimization methods mentioned above) [1 mark]

5. Verify the synchronization of the Adam and NAG curves when using pre-built libraries (torch.optim.optimizer) and when implementing from scratch. Plot separate curves to show it. [1 mark]

Note:

1. Set the seed value to 42.
2. Use the initial learning rate as 0.0001 and set the number of epochs to 100.
3. Use MSE loss, batch size 32
4. Do 80:20 split for training and validation.
5. For training, we recommend using Google Colab for GPU access.
6. **Submit both .py and .ipynb files of code.** [Filename: your_rollno.extension]