CS-E4740 - Federated Learning D, Lectures, 28.2.2024-29.5.2024

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Time left 1:59:43

Question 1

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Linear regression learns the parameters $\mathbf{w} \in \mathbb{R}^d$ of a linear map by minimizing the average squared error loss incurred on a training set. Can the objective function of linear regression always be written as a quadratic function,

$$f(\mathbf{w}) = \mathbf{w}^T \mathbf{Q} \mathbf{w} + \mathbf{q}^T \mathbf{w} + c \text{ with some } \mathbf{Q} \in \mathbb{R}^{d \times d}, \mathbf{q} \in \mathbb{R}^d, c \in \mathbb{R}?$$

- a. Yes.
- b. No.

Question 2

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Ridge regression learns the parameters $\mathbf{w} = \left(w_1, \ldots, w_n\right)^T$ of a linear map by minimizing the sum of the average squared error loss on a training set and the penalty term $\alpha \|\mathbf{w}\|_2^2$. Is it possible to formulate ridge regression as the minimization of a quadratic function of the form

$$f(\mathbf{w}) = \mathbf{w}^T \mathbf{Q} \mathbf{w} + \mathbf{q}^T \mathbf{w} \, ?$$

- a. Yes.
- b. No.

Question 3

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Consider some ERM-based ML method that learns model parameters by minimizing the average loss on a training set. After completing this training process, we compute the resulting average loss on the training set (the training error) and the average loss on a validation set (the validation error). Can it happen that the validation error is smaller than the training error?

- a. Yes, for some training and validation sets.
- b. No, the validation error is **always (for any dataset)** at least as high as the training error.
- c. Yes. Moreover, the validation error is **always (for any dataset)** smaller than the training error.

Question 4

Flag question Marked out of 1.00 Not yet answered

*This question refers to **the student task #1** in the "ML Basics" assignment.*

The coding assignment required you to read temperature measurements from a CSV file. Each temperature measurement is a data point characterized by seven features (location and time-stamp of measurement) and the measured temperature value as its label. The assignment required training a linear model on the first 100 data points and evaluating the validation error on the remaining data points. What were the observed values for training and validation errors in student task #1?

- ☐ a. The value of the **training** error was between 0 and 5.
- ☐ b. The value of the **validation** error was between 40 and 50.
- ☐ c. The value of the **validation** error was between 15 and 20.
- ☐ d. The value of the **training** error was between 15 and 20.

Question 5

Flag question Marked out of 2.00 Not yet answered

*This question refers to **the student task #2** in the "ML Basics" assignment.*

The coding assignment required you to study the effect of augmenting the given features (latitude, longitude, day, month, year, hour, minute of measurement) by their polynomial combinations up to a given maximum degree d.
For each choice of $d = 1, 2, 3$, you had to learn the parameters of a linear model and then compute the training and validation errors (average squared error loss) of the learnt model parameters. How do the training and validation errors change with increasing polynomial degrees d?

- ☐ a. The validation error might increase with increasing d.
- ☐ b. The training error might increase with increasing degree d.
- ☐ c. The validation error never increases with increasing d.
- ☐ d. The training error never increases with increasing d.

Question 6

Flag question Marked out of 2.00 Not yet answered

*This question refers to **the student task #3** in the "ML Basics" assignment.*

The coding assignment required you to use ridge regression to learn the parameters of a linear model using the original features and their polynomial combinations. You had to determine the resulting training and validation errors for different choices for the regularization parameter α of ridge regression. How do they vary with increasing values of α?

- ☐ a. The training error always decreases with increasing α.
- ☐ b. The validation error always increases with increasing α.
- ☐ c. The training error might increase with increasing α.
- ☐ d. The validation error might decrease with increasing α.
- ☐ e. The training error does not change with increasing α.

Finish attempt ...