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Deep Learning for Medical Imaging (EE41203)
Assignment 1

- **Question 1**

  We start considerin tion problem, given the dataset $\{(\mathbf{x}^1, t^1), .., (\mathbf{x}^N, t^N)\}$ where

  - $\mathbf{X}$ is the train trix of dimensions $(N \times D)$;
  - $\mathbf{t}$ is the binary target (scalar number);
  - $\mathbf{w}$ is the vector of the weights parameters.

  1. Describe what is the regularization and why it is used. Comment the role of the regularization parameter.
  2. Considering the binary classification problem, describe how to obtain L^2-norm regularized logistic cross-entropy loss function and formulate the mathematical expression that we need to minimize during the binary classification training. (Tip: we have seen in the lecture the L^2-norm regularized linear regression, think how to apply the same idea to logistic regression).
  3. Write a function which implements the L^2-norm regularized logistic cross-entropy loss function in Python using Numpy.

- **Question 2**

  Given the optimization problem in Question 1, we consider the iterative solver for finding the minimizer of the L^2-norm regularized logistic cross-entropy loss function:

  1. Derive the gradient descent equation for the L^2-norm regularized logistic optimization problem.
  2. Write a function which implements the gradient descent algorithm in Python using Numpy.

- **Question 3**

  Now you can apply the functions that you have implemented in the previous questions for the binary classification to cancer data. Complete the Python script **CW1_Question_3.ipynb** by implementing the tasks which are asked. You can find the Python script at the following Google Drive folder.

  Describe the implementation in the report, collect and comment the results in the report.

- **Question 4**

  Describe the 3 different deep learning approaches that can be used for medical image reconstruction. Analyse and compare the positive and negative aspects of each method.

  Complete the Python script **CW1_Question_4.ipynb** by implementing the tasks which are asked using Tensorflow and Keras. You can find the Python script at the following Google Drive folder.

  Describe the implementation in the report and collect and comment the results in the report.

Submit all the answers in the form of a report and the Jupyter notebook files.