National Tsing Hua University
Fall 2023 11210IPT 553000
Deep Learning in Biomedical Optical Imaging
Homework 2 Description

Objective: The goal of Homework 2 is to deepen your comprehension and hands-on experience in developing and assessing deep learning models. You will embark on a journey of crafting, tuning, and evaluating a model, focusing on a comprehensive exploration of how various hyperparameters influence its performance. Through this assignment, you will not only reinforce their theoretical knowledge but also gain valuable insights into the practical application of deep learning.

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1. Coding (40pts)

1.1 Task A: Transitioning to Cross-Entropy Loss (20 pts)

In Lab, we utilized the Binary Cross-Entropy (BCE) Loss for a binary classification task. The BCE loss is articulated as:

$$\text{BCE}(y, \hat{y}) = -\left(y \log(\hat{y}) + (1-y)\log(1-\hat{y})\right)$$

Here, y is the true label (0 or 1), and $\hat{y}$ denotes the predicted probability of $y = 1$.

In this task, we aim to explore the implementation of a model using Cross-Entropy (CE) Loss, which is a more common approach for classification tasks,

1.2 Task B: Creating a Evaluation Code (20 pts)

Evaluate the performance of a pretrained deep learning model with a test dataset of chest X-ray images available in *test_normal.npy* and *test_pneumonia.npy* files. These files respectively contain 200 grayscale normal and pneumonia chest X-ray images, each of size 256×256. The objective is to calculate the model's accuracy, defined as the percentage of images correctly classified. To accomplish this, you are tasked to write code that loads, processes, and evaluates the model on this specific dataset.

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2. Report (60 pts)

2.1 Task A: Performance between BCE loss and BC loss (20 pts)

Compare and analyze the model's performance such as loss and accurary in both training and testing phases when applying Binary Cross-Entropy (BCE) loss and Cross-Entropy (CE) loss. To ensure a fair comparison, maintain the same deep learning architecture and hyperparameters.

2.2 Task B: Performance between Different Hyperparameters (40 pts)

Choose two hyperparameters and experiment with three distinct values for each. Train and test your experiment with the provided chest X-ray dataset. You need to indicate what hyperparameters you choose and which values you use in your report.

2.3 Report Guidelines

- **Template**: Utilize the provided template for writing your analysis report.
- **Format**: The report should be submitted in PDF format, with the file named as “hw2.pdf”.
- **Content**: Incorporate figures and tables to illustrate your findings (optional) and make your analysis comprehensive and understandable.
- **Page Limit**: Ensure your report is a minimum of 3 pages and does not exceed 5 pages.

2.4 Grading Criteria

- **Analysis Depth**: This is our primary focus for grading. We seek a thorough and insightful analysis concerning the impact of changes on the model's performance. It is crucial to base your analysis on the empirical results obtained from your experiments, not on hypotheses or assumptions. Ensure your report express the outcomes of your experiments in a clear and concise manner. We are interested in your analytical skills and the ability to explain the results effectively. We are not grading based on the performance improvements attributed to the changes you made. As such, it is entirely acceptable if the modifications you make do not lead to performance enhancement or significant differences in the results.
- **Report Presentation**: Clarity and structure are paramount, and adherence to the provided template and style is mandatory. A deviation from the template will result in a 5-point deduction.
- **Code for Supporting Report**: The supporting code won’t be a focal point during grading unless there is an apparent absence of evidence backing your findings. Clean, readable, and well-commented code is encouraged. If falsification or dishonesty is detected in your results, a 0-point penalty will be imposed for this report section.

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3. Submission Details

3.1 Deadline

Submit all components by **23:59, 16th Oct. (GMT+8)**, with timestamps on Github and EEclass being considered.

3.2 Github and EEclass

- **Github**: Create a “hw2” folder in your repository, “NTHU_2023_DLBOI_HW”, containing “hw2.ipynb”, “hw2_report.ipynb” and “hw2.pdf”. Ensure that you run your code and all outputs are saved within the .ipynb files.
- **EEclass**: You are required to submit only the GitHub link of your Homework 2. Do not upload files directly to EEclass.