National Tsing Hua University
Fall 2023 11210IPT 553000
Deep Learning in Biomedical Optical Imaging
Homework 3 Description

1. Report (100 pts)

1.1 Task A: Reduce Overfitting (30 pts)

In Lab 4's original code, we observe a phenomenon where the training accuracy continues to increase while the validation accuracy plateaus. This discrepancy typically indicates that the model is overfitting to the training data. Your objective in this task is to implement a technique or method of your choice that is known to reduce overfitting in deep learning models. Ensure the rest of the training settings remain the same for a fair comparison.

- **Discussion (20 pts)**: Analyze the observed effects of the implemented technique on the training dynamics. Focus on metrics such as loss, accuracy, and generalization. Discuss how and why the chosen method impacts these metrics and the model's ability to generalize to unseen data.
- **Implementation Visualization (10 pts)**: Include a figure in your report that highlights the sections of your code where the chosen method was implemented. Accompany this figure with a detailed caption explaining the modifications made to the original code.

1.2 Task B: Performance Comparison between CNN and ANN (40 pts)

The way Convolutional Neural Networks (CNN) and Artificial Neural Networks (ANN) handle input data directly influences their capacity to detect complex patterns. During the training phase, you might notice a difference in the training durations for the two models. Compare and analyze their performance.

- **Discussion (20 pts)**: Discuss the differences between CNN and ANN in terms of feature extraction capabilities, training speed, and model performance. Ensure the rest of the training settings remain the same for a fair comparison.
- **Architecture Description (20 pts, 10 pts for each architecture)**: Describe the architectures of both the ANN and CNN models. Visual representations, such as architectural diagrams or flowcharts, are encouraged but not mandatory. If you opt for a textual description, ensure it's detailed and clear, allowing readers to grasp the architecture's structure and flow.

1.3 Task C: Global Average Pooling in CNNs (30 pts)

In Lab 4's setup, flattening is used which necessitates determining feature numbers manually prior to the fully connected layer. A more streamlined alternative is the Global Average Pooling (GAP). However, transitioning to GAP with the same 30 epochs has shown a performance drop.

- **Explanation (10 pts)**: Elucidate the role of GAP and why it can eliminate the need for manual dimension calculations.

• **Increase Performance** (20 pts): Notably, the use of GAP has caused a slight performance decline. Identify strategies to elevate this performance. Detail your approach and the validation results. Possible approaches could include altering hyperparameters, modifying the architecture, or extending training epochs. If performance enhancement is not achieved, report your attempts and the outcomes.

1.4 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 "hw3.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 4 **pages** and does not exceed **6 pages**.

1.5 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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2. Submission Details

2.1 Deadline

Submit all components by **23:59, 30th Oct. (GMT+8)**, with timestamps on Github and EEclass being considered.

2.2 Github and EEclass

- **Github**: Create a "hw3" folder in your repository, "NTHU_2023_DLBOI_HW", containing "hw3_report.ipynb" and "hw3.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 . Do not upload files directly to EEclass.