Capstone Assignment

Assignment Introduction and Learning Goals

The objective of this capstone project is to build and train a deep learning model for image classification. You will utilize a publicly available dataset, implement a deep neural network, and evaluate its performance. This project will allow you to apply the concepts and skills you have learned in deep learning to a real-world problem.

Course Learning Outcomes Addressed

- **CLO #1** - Understand the principles and concepts of deep learning.

- **CLO #2** - Implement and train deep neural networks using Python and PyTorch.

- **CLO #3** - Apply deep learning techniques to solve real-world problems in diverse fields, from medicine, computer vision, natural language processing, and generative modeling.

- **CLO #4** - Evaluate and compare the performance of different deep learning models.

- **CLO #5** - Analyze and interpret the results of deep learning experiments.

- **CLO #6** - Demonstrate proficiency in using PyTorch for deep learning tasks.

- **CLO #7** - Design and execute a project that applies deep learning techniques to a specific problem domain.

Assignment Value

40%

Assignment Instructions

1. Dataset Selection:

- Choose a suitable image dataset for your project. You can consider any of the well-known datasets here [Datasets — Torchvision 0.17 documentation (pytorch.org)](#) for simplicity.
- Ensure that the dataset contains a reasonable number of classes and a sufficient number of images per class.
- If the dataset has very large number of images, you can use a subset (e.g., 1000 images per class if number of classes are 10 or less)
- If the dataset has more than 20 classes, you can use a subset of the classes (e.g., only use 10 classes)

2. Data Preprocessing:

- Perform data preprocessing steps such as resizing images, normalizing pixel values, and splitting the dataset into training, validation, and test sets.
- Apply data augmentation techniques to increase the diversity of the training data.

3. Model Selection and Architecture:

- Select an appropriate deep learning architecture for image classification. You can start with a convolutional neural network (CNN).
- Define the architecture of your model, including the number of layers, activation functions, and any regularization techniques.

4. Model Training:

- Train your deep learning model using the training dataset.
- Monitor training progress, including loss and accuracy, and consider using early stopping to prevent overfitting.

5. Hyperparameter Tuning:

- Experiment with different hyperparameters (e.g., learning rate, batch size) to optimize the model's performance.
- Keep a record of the hyperparameters used and their impact on the model.

6. Evaluation:

- Evaluate your trained model using the validation dataset to assess its performance.
- Calculate relevant metrics such as accuracy, precision, recall, and F1-score.
- Visualize the model's predictions and misclassifications.

7. Fine-Tuning and Iteration:

- If necessary, make adjustments to the model architecture or hyperparameters based on the evaluation results.
- Reiterate the training and evaluation steps until you achieve a satisfactory performance.

8. Final Model Testing:

- Test your final model on the held-out test dataset to assess its generalization to unseen data.

9. Documentation and Reporting:

- Create a project report summarizing your dataset, model architecture, training process, evaluation results, and insights gained.
- Include visualizations and explanations to make your findings clear.

10. Presentation:

- Prepare a brief presentation to showcase your project's key findings and outcomes.
- Share your experiences, challenges faced, and lessons learned during the project.

11. Conclusion:

- Conclude your capstone project by summarizing your achievements and any future work or improvements that could be made to the model.

Remember to maintain good coding practices and seek guidance or feedback from your instructor throughout the project. This capstone project will demonstrate your ability to apply deep learning techniques to real-world problems and showcase your skills to potential employers or collaborators.

Due Date (Due last Day -2)

Your grades are divided as follows:

- **5%** on your project proposal (one page contains, title, project description, why it is it good? how do you think you will do it? what data will you use? and how to will you evaluate your system performance) **(Due 03/11/2025)**

- Running project **(20%)**

- **15%** report & presentation & GitHub project page

How to Submit your Assignment

Present your capstone project (including code)

Grading Criteria

Take a look at [the detailed rubric for the capstone assignment](). (THIS IS JUST FOR YOUR INFO - don't worry about the grades there)