**Department of Artificial Intelligence**

**College of Computer and Cyber Sciences**

**Introduction to Deep Learning**

***Segmentation with a Pre-Trained Model in PyTorch***

1. **Learning Objectives**

By the end of this lab, students will:

* Understand the concept of **semantic segmentation**.
* Learn how to fine-tune a model for segmentation tasks.
* Train and evaluate a segmentation model on the **Cityscapes dataset**.

1. **Explanation of Key Concepts**

* **Semantic Segmentation:**

Is a deep learning algorithm that involves classifying each pixel in an image into a predefined label or category. Unlike object detection, which identifies and localizes objects with bounding boxes, semantic segmentation provides a pixel-wise classification, effectively segmenting the image into meaningful regions.

* **Cityscapes Dataset:**

The Cityscapes Dataset is a large-scale dataset designed for semantic segmentation, instance segmentation, and scene understanding in urban environments. It contains high-resolution images captured from street scenes in multiple European cities.

Key Features of Cityscapes:

Size: Around 25 thousand images.

Image Format: Images are 2048×1024 pixels, in RGB format.

Labels: Has 30 classes grouped into 8 categories (only 19 are commonly used for training).

* **Data Augmentation:**

It involves applying random transformations to training images to increase dataset diversity and improve model generalization.

1. **Activities**

* **Exercise 1: Fine-Tuning a Pre-Trained Model for Cityscapes Segmentation.**

In this exercise, we will fine-tune a pre-trained model for semantic segmentation on the Cityscapes dataset using PyTorch. You will Load and preprocess the dataset, modify the model architecture to match the dataset labels, apply data augmentation techniques to enhance training, and train the model then evaluate its performance on validation images.

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| # Code provided in the notebook |

1. **Tasks**

* **Task 1:**

In the provided segmentation notebook, some errors have been intentionally introduced in the data loading or model inference phase. Your task is to:

1. Identify and fix the error.
2. Explain why the error occurs and how your fix resolves the issue.

Submit your jupyter notebook & Add a screenshot of the result:

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Explanation:

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| The code encountered four errors. The first issue was related to the file path after extraction. The second error involved the parameters used in the Resize function—since the segmentation maps were ultimately resized to (96, 256), mismatched dimensions caused an error, which was resolved by standardizing all resize operations to (96, 256). The third problem was a naming inconsistency between “Labels” and “Masks.” Finally, the validation loop was mistakenly using the training data loader instead of the validation loader. |

1. **References**

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[Semantic Segmentation - MATLAB & Simulink](https://www.mathworks.com/solutions/image-video-processing/semantic-segmentation.html)

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