Liver Medical Image Semantic Segmentation

Project Overview:

In this assignment, students are required to use a U-Net model based on deep learning to perform semantic segmentation on liver medical images. Students will learn how to process medical images, build and train a deep learning model, and evaluate the model's segmentation performance. The project covers the entire workflow from data preprocessing to model training and evaluation.

Tasks:

1. Environment Setup: Set up the development environment using Python + PyTorch.

2. Dataset download and preprocessing:

- The dataset includes 400 liver images and their corresponding labels, located in `. /Liver_Medical_Image_Datasets/Images` and `. /Liver_Medical_Image_Datasets/Labels`.
- Split the dataset into training and validation sets (recommended: 360 images for the training set and 40 for the validation set).
- Download link for the dataset:
  https://drive.google.com/file/d/1nQ6Sh_Y8rbP_m6j2xUb7zvSV0-XY2d9c/view?usp=sharing
  (Contact xi.xuan@uef.fi if the download link is not working).

3. Build the U-Net Architecture: Build the U-Net network structure (or feel free to try other networks; you must specify whether the architecture is custom-built or based on a research paper).

4. Model Training: Report the hyperparameter settings (optimizer, training strategy, etc.) and track the loss values (train loss and val loss) during model training. Save the final model file.

5. Model Evaluation: Evaluate the trained U-Net model on the test set using mIoU (mean Intersection over Union) and mPA (mean Pixel Accuracy) as performance metrics.

6. Single Image Segmentation: Perform semantic segmentation on a single test image using the trained model and save the segmented liver image (the result of semantic segmentation).

Submission Requirements:

1. Submit the complete code, including data preprocessing, model training, model evaluation, and image prediction sections.

2. Submit screenshots or graphs of the loss progression during training.

3. Submit an evaluation report containing the model's mIoU and mPA values, along with an analysis of the model's performance.

4. Submit three test set images and their corresponding segmentation results to demonstrate the model's segmentation performance.

Reference Resources:

1. U-Net Paper: [U-Net: Convolutional Networks for Biomedical Image Segmentation] (https://arxiv.org/abs/1505.04597)
2. PyTorch Documentation: https://pytorch.org/docs/stable/index.html