Project Document for AI Group Project Groups A and B

Background

Optical Coherence Tomography images are 3D images of the eye created using a scanning laser. They are most commonly used to provide cross-sectional images of the retina and have become an essential tool in the diagnosis of retinal diseases. Machine learning tools have been used to classify images according to whether or not they show signs of a retinal disease. One challenge for these algorithms is that OCT devices produced by different manufacturers will generate images that are quite different. One approach is to have a two step process. The first step generates an image in which each pixel is labelled according to the type of tissue or fluid at that region of the image. The second step classifies the labelled image according to the kind of disease present. The algorithm in the first step will be need to be retrained for each device, but not the algorithm in the second step.

Challenge

This project has two stages. The first stage is to train a model to segment regions of intra-retinal fluid (IRF) and sub-retinal fluid (SRF) on OCT images, using a dataset including annotations showing which regions correspond to these two types of fluid. The second stage is to use the first model to label regions of fluid on images in a second dataset and use these labelled images to train a second model to classify images as disease cases or normal cases. The two datasets contain images from different devices, so the performance of the final algorithm is not expected to be high.

Data

Students will have access to two datasets:

1) The AROI datasets contains images and segmentations of IRF and SRF regions: https://www.tandfonline.com/doi/full/10.1080/00051144.2021.1973298
2) The OCTID database contains OCT scans labelled according to the disease state. We are interested only in AMD and Normal images.

https://arxiv.org/ftp/arxiv/papers/1812/1812.07056.pdf

Evaluation Criteria

The aim of the project is to determine the best possible performance on the image classification task, recognising that it involves transferring learning from one image dataset to another.

Notes for the teaching team:

The following milestones would be appropriate

1) Datasets prepared
2) Code for models implemented
3) Trained model 1 on dataset 1
4) Run model 1 on dataset 2

5) Trained model 2 on labelled images from dataset 2
6) Run model 2 on labelled images from dataset 2

Use a UNet to segment the images

A standard CNN to classify the images

Project will require GPUs, accessible from myriad