**Using artificial intelligence for analyzing the retinal images (OCT) in people with diabetes**

**Abstract**

Diabetic macular edema (DME) is a common disease of diabetic retinopathy (DR). Due to the infection of DME disease, many patients’ vision is lost. To cure DME eye disease, early detection and treatment are very important and vital steps. Medical imaging developed rapidly to play a central role in medicine today by supporting diagnosis and treatment of a disease. Furthermore, plays an important role in initiatives to improve public health for all population. To automatically diagnosis DEM disease, strategies involving Artificial Intelligence (AI) could provide a solution. Among the most promising clinical applications of AI is diagnostic imaging, and mounting attention is being directed at establishing and fine-tuning its performance to facilitate detection and quantification of a wide array of clinical conditions. The main goal of this project is develop an Artificial Intelligence solution that can help to classify OCT. To achieve our goal, Deep-Learning (DL) model will be used to predict the risk of patients with diabetes developing diabetic retinopathy. The outcomes would improve patient access to treatment and ease pressures on time and resources in ophthalmology clinics.

**Design**

This work shows how machine learning can be effectively adopted in the health field to derive models that use patient data to predict an outcome of interest. Artificial Intelligence may be applied to the construction of models for the prediction of patients at high risk of DME, which – once evaluated and tested– may be embedded within health care systems. Patients having high risk of DME can be predicted to set appropriate proactive interventions that reduce the negative impact and provides insightful implications for decision-making by management. The steps of the modeling process described in the following subsections with details of each step.

**Data**

The dataset downloaded from the Kaggle <https://data.mendeley.com/datasets/rscbjbr9sj/2>. A total of (11,598)\* OCT images included in this dataset. The dataset is organized into 2 folders (train, test) and contains subfolders for each image category (NORMAL and DME). There are 84,495 X-Ray images (JPEG) and 2 categories (NORMAL and DME). Images are labeled as (disease)-(randomized patient ID)-(image number by this patient). Optical coherence tomography (OCT) images (Spectralis OCT, Heidelberg Engineering, Germany) were selected from retrospective cohorts of adult patients from the Shiley Eye Institute of the University of California San Diego, the California Retinal Research Foundation, Medical Center Ophthalmology Associates, the Shanghai First People’s Hospital, and Beijing Tongren Eye Center between July 1, 2013 and March 1, 2017.

*\*Will not use all (11,598) images, the number will depend on computational power of my PC.*

**Feature Engineering**

Resize image to establish a base size for all images fed into our machine learning algorithms. Classic augmentation techniques like flips and rotations will applied to each image in the training set without manually processing each image. The dataset contained three categories: demographic attributes, clinical attributes, and appointment characteristics considered relevant to patient appointment history. Finally, data transformation applied where all nominal values were converted to binary attributes.

**Models**

Classification is the most widely used technique for machine learning, especially in prediction models. The machine learning algorithm will be Convolutional Neural Networks (CNN). It used for solving any image data challenge. CNN is a powerful neural network that uses filters to extract features from images. It also does so in such a way that position information of pixels is retained. All popular frameworks support Convolutional Neural Networks like Tensorflow-Keras.

**Model Evaluation and Selection**

The dataset will divide into two sets: the training set for the development of the model, and the testing set for validation. The training set included (70%) outpatient records, while the remaining 30% will use for testing the trained models. Matrices that used to select the best model are:

* Confusion Matrix
  + True Positive =True Positive/(True Positive+False Negative)
  + False Positive (FPR)=False Positive/(False Positive+True Negative)
  + Precision=True Positive/(True Positive+False Positive)
  + Recall=True Positive/(True Positive+False Negative)
  + F-measure: F\_score =2\*(precision\*recall)/(precision+recall)
* Area Under the ROC curve (AUROC)
* Loss to evaluate and diagnose model optimization. Cross-entropy and mean squared error are the two main types of loss functions to use when training neural network models.

**Tools**

* The Jupyter Notebook: it is an open-source web application include data cleaning and transformation, numerical simulation, statistical modeling, data visualization, machine learning, and much more.
* Python programming language: the most popular language for machine learning and artificial intelligence.
* Libraries: A library is a collection of pre-combined codes that can be used iteratively to reduce the time required to code.
  + Tensorflow-Keras for developing deep learning models.
  + Numpy and pandas for data manipulation
  + Matplotlib and seaborn for visualization