**Aisha Wahid COMP27211 Lab 3**

1. **Is Otsu’s method successful in thresholding all the images?**

The Otsu method is not successful for all the images. It gave a good thresholding result for the motorway image as it had a good intensity distribution, however the remaining 3 images were not thresholded well. The Fundus and the Glaucoma were not thresholded well, due to the variance in intensity within the specimen being relatively low compared to the difference in intensity between the specimen and the background which was high as the photos were taken against a black background. Hence the details of the specimen cannot be seen. The optical nerve head had a better result however was still not very successful as the image did not have a good intensity distribution as there is not a lot of contrast in the image.

1. **How would you modify the thresholding algorithm to address any problems?**

To modify the thresholding algorithm, I would use a variety of pre-processing techniques to improve the image’s intensity distribution. One being Histogram equalisation which is a type of contrast enhancement. It works by spreading out the intensity values of a wider range, making it easier to distinguish between areas of the image. The aim is to achieve an equalised histogram where the intensity values are spread equally over the entire 8-bit grayscale range. This would improve the result of the optical nerve image.

Another way to adapt the thresholding algorithm is to use adaptive thresholding. This is a technique where the threshold value is determined based on the statistical characteristics of the local region of the image. This allows the method to account for variations in lighting or background across the image. Adaptive thresholding can be used to pre-process the image and split it into similar regions. Then we can apply Otsu's thresholding method to each of these regions separately to obtain a more accurate thresholding result. This would improve the Glaucoma and Fundus images.

1. **What metrics are there for assessing the success of thresholding?**

To measure the success of image thresholding we can use the following 3 measures: precision, recall, F1-score. Precision and recall can be measured for different thresholding values and different thresholding algorithms. The way we can measure the success of thresholding is by have a goal image which we compare the image generated by our thresholding algorithm to. We compare each pixel in the goal image to the generated image and note whether they were thresholded correctly with respect to our goal image.

Precision is the fraction of the pixels in the generated image that are correctly classified as object pixels with respect to the goal image. Precision = true positives / (true positives + false positives) where true positives are the number of pixels correctly classified as object pixels, and false positives are the number of pixels classified as object pixels but are background pixels in the goal image.

Recall is the fraction of the object pixels in the goal image that are correctly classified as object pixels in the generated image. Recall = true positives / (true positives + false negatives) where true positives are the number of pixels correctly classified as object pixels, and false negatives are the number of object pixels in the goal image that are incorrectly classified as background pixels in the generated image.

The F1 score is the harmonic mean of precision and recall. F1 score = 2 \* precision \* recall / (precision + recall).