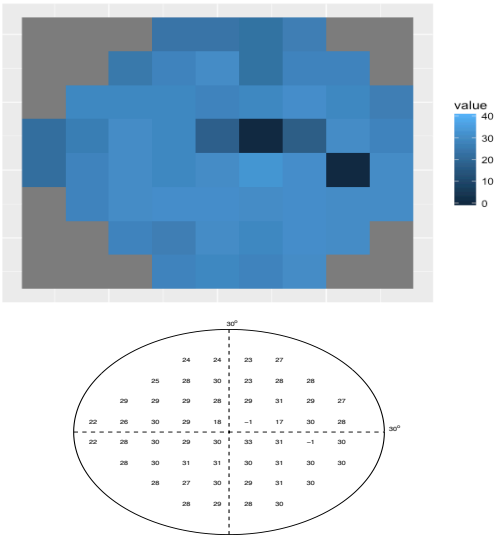
Identification of Glaucomatous Visual Field Defect Components via Auto-Encoders

Background: Perimetry testing is a procedure that quantitatively determines visual function of an eye in a detailed manner. This test results in a so-called visual field (VF, see Fig.1) where visual function at specific retinal locations is shown within a given visual field extent. Such a map is very useful to identify precisely visual impairment due to several eye disorders, especially Glaucoma, which would otherwise easily be missed.

Being a leading cause of total blindness, Glaucoma generally appears as localized depression in the visual field. Glaucomatous defects appear as specific patterns within a VF, compatible with retinal structure [1]. To have prior information about the potential extent and shape of the glaucomatous defects is of clinical importance in order to facilitate and accelerate the disease diagnosis and follow-up. Previous works [1,2,3] have used several machine learning tools to find components of visual field defects and to see the spatial relationships within a VF. This work will attempt to propose an alternative way to find glaucomatous defect components using Deep Learning framework.

Purpose: To explore and extract the latent defect patterns related to Glaucoma.

Materials and Tools: Student will investigate different auto-encoder structures which would successfully achieve the intended purpose. Three different longitudinal VF datasets are available fro evaluation of the proposed methods.



Nature of the thesis: Literature review: %10, theory: %25, data analysis and interpretation: %25 implementation: %40

Requirements: Familiarity with Machine Learning, Deep Learning, Python experience

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References:

[1] Elze et al. (2015). Patterns of functional vision loss in glaucoma determined with archetypal analysis. J. R. Soc. Interface 12:20141118

[2] Goldbaum et al. (2005) Using unsupervised learning with independent component analysis to identify patterns of glaucomatous visual field defects. Invest. Ophthalmol. Vis. Sci. 46:3676--3683.

[3] Sample et al. (2004). Using unsupervised learning with variational Bayesian mixture of factor analysis to identify patterns of glaucomatous visual field defects. Invest. Ophthalmol. Vis. Sci. 45:2596--2605.