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PhD Proposal: Development and application of deep learning methods for medical image analysis
Αναπτυξη και υλοποίηση μεθοδολογιών βαθιάς μάθησης στην αναλυση ιατρικής εικόνας

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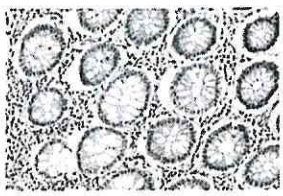
1 Introduction

With the evolution of computational pathology, some physicians in clinical practice manually perform segmentation of pathology images, a task of great importance to assist diagnosis, but subject to the inter-observer and intra-observer reliability. Thus, great opportunities arise for taking advantage of modern technologies and deep learning sophisticated algorithms in order to (a) automate the laborious task of image segmentation and (b) facilitate computer aided diagnosis. Many studies have been published proposing automatic segmentation methods and classification, utilizing machine learning and deep learning algorithms to serve that purpose. Our aim is to develop segmentation and classification methods based on state-of-art algorithms, such as Convolutional Neural Networks, Deep Feed Forward Neural Networks, Deep Belief Neural Networks, Deep Spiking Neural Networks, Genetic Algorithm Neural Networks etc. We will employ parallel processing procedures on Graphics Processing Units (GPUs) so as to assist in the design of optimal methods for segmentation and classification. Our algorithms will be tested on publicly available data that have been already employed by other studies for comparing our results with those of other investigators. We will employ data, such as histopathology images for colorectal adenocarcinoma. Such data is publicly available and it consists of 165 histological images of colorectal cancer and benign lesions, as demontsrated in the images of a benign and malignant lesions in the figures below:



(a) Benign

(b) Malignant

2 Literature Review

With aim to solve the segmentation problem of glandular epithelium in histological images, Van Eycke with his team in [1] explored the possibility and finally managed to achieve better results than the winning state-of-the-art algorithm of the GlaS challenge. Their method include extraction of the Hematoxylin layer by colour deconvolution which is used as input in their model. Also they created a new deep learing network which architecture integrates the efficient parts of U-Net [2] and DCAN [3]. Their method produces better results in haematoxylin-eosin (H&E) stained slides which can be easily generalized to slides of immunohistochemistry (IHC) stain.

A different approach to the segmantation problem was presented in [4] where BenTaieb and Hamarneh designed a fully convolutional network where they tried to encode geometrical and topological priors into the learning of deep fully convolutional networks. Their algorithm was also tested on the publicly available dataset of histology colon glands of Warwick Univercity. The tests indicated that their algorithm produces more accurate segmentation and is also time-efficient during the test phase. This method can be regularized for other medical image segmentation problems.

A classification approach on colorectal images was made by Ruqayya Awan where in his publication [5] proposes to train a convolutional neural network (CNN) on features that vary rather than correlate among the different classes. The study reveals that the classification results are improved on one hand, but on the other hand the classifiers efficiency strongly depends on the segmentation method.

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