Application of Machine Learning Algorithms in Medical Data Processing

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Abstract: Machine learning (ML) leverages sophisticated computation and inference to generate insights, enables the system to reason and learn, and empowers clinician decision making. Starting from data (medical images, biomarkers, patients' data) and using powerful tools such as convolutional neural networks, classification and regression models, etc., it aims at creating personalized models, adapted to each patient, which can be applied in real clinical practice as a decision support system to doctors.

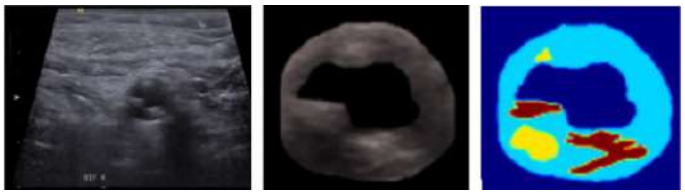
Keywords: image processing, deep learning, data mining, medical expert systems

1. Introduction

Advances in computational power paired with massive amounts of data generated in healthcare systems make many clinical problems ripe for Machine Learning (ML) applications. Machine Learning has been successfully applied in the automation of the process of analysis of medical data, shortening the time for diagnosis, as well as ensuring high accuracy and repeatability of results. Algorithms can be applied to automatically diagnose diseases based on MRI/CT/X-ray images, predict patient survival rates more accurately, estimate treatment effects on patients using data from randomized trials and automate the task of labeling medical datasets using natural language processing. Algorithms in medicine have so far demonstrated several potential benefits to both physicians and patients.

2. Application of Machine Learning in Medical Data Processing

ML has found application in several fields of medicine. One example is the stratification of patients with carotid artery disease by analysing clinical and personalized data, plaque and cerebral image processing and novel biomarkers [1]. Convolutional neural network U-net was used in plaque components segmentation (semantic segmentation) (Figure 1).



a) b) c)

Figure 1. Original ultrasound image (a), extracted carotid artery (b), annotated plaque (c).

Another interesting area of ML application is the analysis of patient-specific data and the development of patient-specific models for monitoring and assessment of patient conditions with familiar cardiomyopathy [2]. Ultrasound images are processed in order to segment the Left ventricle and reconstruct a 3D model of the heart (**Figure 2**).

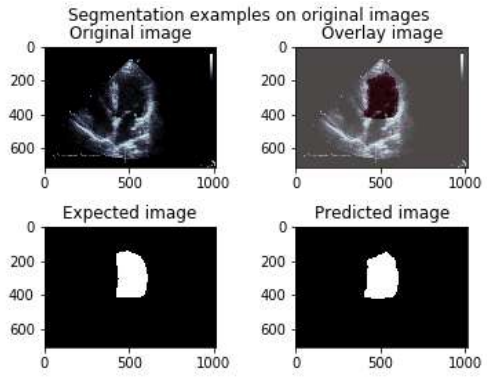


Figure 2. Segmentation of Left Ventricle in apical view images performed by U-net.

Other areas include the integration of different machine learning algorithms into one multiscale platform to investigate cancer, cardiovascular, bone disorders and tissue engineering [3], prediction of coating thickness to increase the lifespan of biomaterial susceptible to corrosion [4] or even contribute to developing drug-eluting devices to combat the burden of peripheral artery disease (PAD) [5]. Machine Learning also plays its role in the development of personalized models for COVID-19 prediction in patients or epidemiological models for monitoring of number of people infected with COVID-19 [6].

3. Conclusions

The astonishing capacity of machine learning to analyse massive quantities of data, make sense of images, and discover patterns that even the most expert human eye

misses, has inspired hope that technology may improve medicine. Finally, ML holds the promise of "making health care human again" by bringing the physician closer to the patient by creating personalized models.

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