

NOVA I4H – Thesis Proposal

Title:

Development of a fully functional service that performs automatic detection of pathological features, in neuroradiologic images using Deep Learning, within a totally secure and private environment, based on the blockchain technology.

Objectives :

The quality and quantity of medical images, in particular medical neuroimages has been increasing at great speed. Those images have central role in the diagnosis of several main neurological diseases. Thus, the error related to the analysis, interpretation and consequent diagnosis must be minimize, at all cost. With this objective in mind came into action algorithms of machine learning, that can learn from huge processed and labelled datasets of medical images and can detect pathological features in new images. Nowadays, deep learning is the most used family of machine learning methods in image-based medical diagnosis. Deep learning can achieve nearly perfect diagnosis accuracy on some datasets.

This type of algorithm needs a large amount of medical imaging data for training to achieve good levels of accuracy. The process of medical data-sharing can be a dangerous one because this type of data is very sensitive, valuable and private. The blockchain technology appears as an emergent technology (not so emergent in the economic field) to ensure total privacy and security when storing and sharing medical data. The main concepts behind this technology: decentralized management, transparency, immutability, autonomy, open source, anonymity.

The objective of this PhD work is to develop a fully functional “end to end” solution for automatic detection of pathological features in neuroradiologic images, from MRI sources, using deep learning. It is intended to use two architectures of convolutional networks, IBM Watson Image Recognition and PyTorch. The full and final solution will be implemented within a blockchain network in order to guaranty total security, privacy, data preservation and sharing of the analysed images and metadata.

Framework:

Compta SA is a company, with the aim of developing technological solutions with market orientation, based on a strong component of research and development.

The company is developing a very active collaboration with NOVA's Faculty of Science and Technology, resulting in a very important and substantial knowledge base between both institutions regarding the subject of this PhD proposal, which motivates the pursuit of new projects in this field.

NRD and ESTeSL have the expertise in fields of health technology to give the scientific and clinical support necessary to the full accomplishment of the proposed plan.

This project will be supported by Compta and FCT/UNL with a PhD grant assigned by Fundação para a Ciência e a Tecnologia.

Tasks:

1. Preliminary Studies – review of the state of the art
2. Identification of the physiological parameters more important to monitor and characterize the methods available to its quantification
3. Data pre-processing, training and validation of the selected convolutional neural network.
4. Design and build an architecture based in blockchain, for secure data transfer, storage and sharing.
5. Develop of a web-based service for interface with end users.
6. Clinical validation of the developed tools
7. Deployment of the tool in an online platform, so it becomes available to the clinical community.
8. Scientific Writing - The project is expected to result in several articles, to be published on specialty journals.

Venue:

This project will take place in Compta-SA, Miraflora, as well as in the Physics Department of FCT-UNL and the ESTeSL and NRD.

Candidate profile:

This project main study areas are: data analytics, medical neuroimaging interpretation, development of artificial intelligence algorithms and blockchain technology. The candidate must have interest and a strong background in these areas. Prior work experience in these areas is desirable, either in enterprise or university environment.

The candidate must have the capacity of innovate and the necessary critical aptitude to develop and evaluate new algorithms. It will be only accepted candidates with a master's degree in Bioengineering, Physics, Computing or similar.

In addition, since this collaboration is between two faculties, engineering and health technology, and an enterprise, the candidate must be prepared to develop his/her activity in an enterprise environment.

Supervisor

- Name: Pedro Vieira
- Institution: Compta and FCT/UNL
- Email: pmv@fct.unl.pt
- ORCID ID: 0000-0002-3823-1184