



Deep Learning-based Tool for Automated Lymph Node Detection in Lymphoma Patients

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

Lymphoma is a type of cancer affecting the cells of the immune system, called lymphocytes. Typically, lymph nodes are investigated to diagnose Lymphoma. With the advent of AI, one common non-invasive approach to diagnose Lymphoma is to detect the lymph nodes in PET-CT scans and subsequently classify the presence of tumoral cells or not in the nodes. The project aims to develop an automatic tool focusing on lymph node detection, where the bounding regions around the lymph nodes are automatically cropped in PET-CT images.

Background and Motivation

Lymphoma is a type of cancer affecting the cells of the immune system, called lymphocytes. These cells can be found in several organs, such as the lymph nodes, spleen, thymus and bone marrow. Typically, lymph nodes are investigated to diagnose Lymphoma.

At the current state of the art, a Lymphoma diagnosis is usually obtained with a biopsy exam. This method has some weaknesses, such as the procedure's invasiveness or the relative delay in time between the sample collection and the diagnosis.

With the advent of AI-based technologies and the availability of massive amounts of medical data and

computational resources, new diagnostic approaches have been developed in the oncology field. Medical imaging techniques can be combined with AI methods to generate accurate and reliable cancer detection and prediction algorithms [1] [2]. Some advantages of the AI-based techniques compared to the standard biopsy include the faster processing time, the non-invasiveness and the high accuracy of the results achieved.

In the oncological field, a widely used acquisition technique is the PET-CT. In this type of acquisition, two different acquisitions are performed:

One acquisition is a CT scan, where a 3D anatomical image of the patient is produced. The other acquisition is a PET scan, where the metabolic activity of the patient is recorded and mapped in a 3D volumetric representation.

Several studies have shown the potential of Deep Learning(DL)-based methods applied to medical imaging tasks such as cancer prediction, detection and segmentation [1][3][4]. To classify the presence of Lymphoma correctly, the first step of a fully automated workflow needs to focus on lymph node detection in PET-CT.

Student's Tasks Description

The project is structured in two phases: in the first part, the student will apply the state-of-the-art Deep Learning methods (nnUNet [6] and nnDetection [5]) for object detection and instance segmentation, in order to train a DL model to detect the lymph nodes in PET-CT volumes. In this phase, the student will also learn and apply some DL techniques for image preprocessing, data augmentation and model training.

Please send the completed proposal to ardit.ramadani@tum.de, lennart.bastian@tum.de and tianyu.song@tum.de. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in case of acceptance.



In the second phase, the trained model will be served as a command line tool, with the final purpose of developing a tool for running inference on PET-CT volumes to produce cropped regions around the detected lymph nodes.

Technical Prerequisites

The student is required to possess a good knowledge of Python coding, as well as the basics of bash scripting. In addition, a basic understanding of the Pytorch DL framework is required. Furthermore, a basic understanding of the Docker environment is needed.

References

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