



Deep learning spine segmentation

Project Management and Software Development
for Medical Applications

General Info



Virtonomy.io

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Project Abstract

The human vertebral column has a complex anatomy that consists of 33 vertebrae, 23 intervertebral disks, the spinal cord, and connecting ribs. It has important physiological functions such as support for the spinal canal and locomotion and for this reason its complications can have a significant impact on the patients' living. The spine segmentation is important for diagnosing spine conditions but also challenging problem also because the input images contain less distinctive features compared to other segmentations. Also when scanning older adults with osteoporotic bones, the contrast is very low and the spine tissue is not easily distinguishable from surrounding tissues.

Background and Motivation

Virtonomy GmbH is developing the first web platform for conducting fully data driven clinical trials of medical devices with the use of virtual patients. Our system is based on clinical scans (CT, MRI), pathology data and data about the medical devices. The 3D anatomy model reconstruction from image data is one of the key parts of the entire processing pipeline. By having a thorough three-dimensional reconstruction of the each vertebrae and the intervertebral discs, 3D printing or VR systems are possible. These will allow the

surgeon pre-operation preparation as well as *in vitro* simulations to push implants development.

Student's Tasks Description

- Development of an automated approach for spine segmentation in CT images.
- Integration of this approach in the MLflow to record and track experiments and package the models in a format to reproduce runs on any platform.
- Compare results against traditional algorithms, e.g., Active Shape Model / Region growing

Technical Prerequisites

- Experience with Python and deep learning libraries (preferably PyTorch);
- Knowledge in Statistical Shape Models is a plus;
- Interest to go beyond the pure development of Deep Learning applications, especially to understand the life cycle of a model with MLflow;
- Basic understanding of GIT.

Why you should choose us

- Opportunity to work in an international start-up environment or remotely
- Participation in the exciting development and growth of a start-up
- Contributing to an exciting real-life medical data solution with impact

References

- <https://github.com/anjany/verse>
<http://spineweb.digitalimaginggroup.ca/>
Vania, M., et al. "Automatic spine segmentation from CT images using convolutional neural network via redundant generation of class labels." *Journal of Computational Design and Engineering* 6.2 (2019): 224-232.
Deng, Y., et al. "CTSpine1K: A Large-Scale Dataset for Spinal Vertebrae Segmentation in Computed Tomography." *arXiv preprint arXiv:2105.14711* (2021).

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.