Master thesis projects

Spring 2019
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- Classifying vertebrae in medical images using machine learning
  - **Required skills**: Machine learning, image analysis
- Automatic evaluation of tissue segmentation quality in medical images
  - **Required skills**: Machine learning, image analysis
- Sharing personal health information on the web in a secure and compliant manner
  - **Required skills**: Computer security, web technologies
- Automated orchestration of cloud based computing resources
  - **Required skills**: Software engineering, distributed computing
- Volume visualization
  - **Required skills**: Visualization, Volume Visualization
Application and admission

• We will only run one of the projects during the spring semester
• Preferably two students working together in one project
• Application with personal letter and CV (incl. Ladok excerpt)
• For questions and applications, contact
  • Peter Karlsson Zetterberg (peter.karlsson.zetterberg@amramedical.com)
  • Magnus Borga (magnus.borga@amramedical.com)
Classifying vertebrae in medical images using machine learning

**Required skills:** Machine learning, image analysis

Vertebras are used as anatomical landmarks in the body to define the extent of different anatomical definitions, e.g. the upper limit of the abdominal region. Today, these landmarks are defined manually. This master thesis project aims at prototyping and evaluating an automated tool for vertebrae detection and classification in magnetic resonance images.
Automatic evaluation of tissue segmentation quality in medical images

**Required skills:** Machine learning, image analysis

A key concept at AMRA is atlas-based segmentation using non-rigid registration. Unsuccessful registrations that need adjustments are manually identified by inspecting the resulting segmentations. In order to reduce manual work, we would like to identify unsuccessful registrations automatically. The goal of this project is to evaluate different strategies for classifying and describing the quality of a registration, and to implement a prototype using at least one of these strategies.
Sharing personal health information on the web in a secure and compliant manner

**Required skills:** Computer security, web technologies

The aim of this project is to investigate how personal health information created at AMRA by our image analysis service can be shared in a safe, secure and compliant manner on the web directly with customers, partners and end users. How can we use federated security models for safe and secure data exchange with users in different parts of the world? How do we expose personal health information in our databases only to the users that are allowed to view it? What kind of encryption and data transport strategies should be employed?
Automated orchestration of cloud based computing resources

Required skills: Software engineering, distributed computing

Currently, AMRA is operating an on premise cloud solution where we run our application suite in Docker containers. We want to take advantage of the elastic computing resources that operating in the cloud would give us. This Master thesis project should produce an inventory of some available technologies for constructing a hybrid cloud solution that can operate both with our current infrastructure and using cloud based solutions. Kubernetes and Nomad are two such technologies. It should also produce a prototype implementation evaluating at least one of the identified technologies.
Volume visualization

**Required skills**: Visualization, Volume Visualization

The volume data from MR scans is possible to visualize in 3D in real-time using different techniques. It would be useful to visualize the segmented fat and muscle regions for an end user (patient) in an informative way. Currently, there is a prototype 3D visualizer written in WebGL and GLSL that uses volume ray casting to show fat or muscle data with segmented fat regions or muscles or shown in different colors. This Master Thesis project should investigate and prototype one or more algorithms and techniques to visualize volume data in real time in an informative way for an end user. The visualizations could show segmented muscle and fat regions, fat and muscle data simultaneously, differences in fat or volume data between different scan occasions, etc. Possible extensions: Support for VR glasses.