Probabilistic machine learning from advanced MR scans to assist early prognosis in traumatic brain injury
Diagnostic Image Analysis Group (Radboudumc) & Institute for Computing and Information Sciences (RU)

Trauma to the brain can cause wide spread brain injury, referred to as diffuse axonal injury (DAI), which is the result of traumatic shearing forces that occur when the head is rapidly accelerated or decelerated, as may occur in auto accidents, falls, and assaults. In such cases, prognosis—predicting the patient’s course of recovery and outcome in future—is a crucial task to allow patients and families have realistic expectations about the patient’s health and well-being, and if possible, to timely plan a treatment intervention. Important prognostic factors include the results from brain image scans. However, DAI is difficult to detect since it does not show up well on CT (Computed Tomography) and MRI (Magnetic Resonance Imaging), but its presence can be inferred when small bleeds are visible, or by observing abnormal differences in diffusivity as measured by an MR technique called diffusion tensor imaging (DTI). The uncertainty that exists about the precise nature of the relationships between the DTI results and the likely outcome after DAI makes the prognosis a challenging task even for clinicians with much experience, and automated assisting approaches are highly sought after.

In this applied project, the student is expected to utilize probabilistic machine learning approaches to extract relevant information from early MR scans, such that they can be used to make a better prognosis for the patient at an early stage. The learning is to be performed on MR scan data of 56 traumatic brain injury patients, imaged shortly after trauma in the Radboudumc. In addition, clinical tests were done with these patients at 7 weeks, 6 months and 12 months, to measure the severity of the injury and their memory and frontal lobe performance, which are to be explored as well. The learning approaches will be based most likely on probabilistic graphical models such as Bayesian networks, which are able to deal with much of the uncertainty in medical data.

Tasks
- Consult neurologists and radiologists to find out about their requirements and study the literature to gain knowledge in the domain
- Research and develop probabilistic approaches for machine learning from medical image data to assist prognostic tasks for the clinical problem at hand
- Discuss the outcomes with the clinical users
- Write a master thesis

Students are invited to apply who have
- A major in computer science, artificial intelligence, or a related area in the final stage of master level studies
- An interest in clinical applications
- An ability to work independently and in cooperation with others

Information
- Project duration: 6-12 months
- Supervision and contact:
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