Job Title: Thesis: Machine Learning for 5G Networks

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Background
Machine learning constitutes a set of algorithms that can learn from and make predictions on data. Such algorithms operate by building a model from inputs in order to make predictions or decisions, rather than following strictly static program instructions. These set of algorithms have successfully been applied to various applications such as computer security, bioinformatics, computer vision, medical diagnosis, and search engines. Common to all these fields is the need to automatically process large set of data in order to generate useful insights and take appropriate decisions. Mobile networks are complex by nature. A 4G (LTE) network today is by far more complex compared to a 2G (GSM) network due to increasing number of base stations and users, but also due to advancements in radio and network technology. In addition, it is expected that the next-generation, 5G, mobile communication systems will handle an even broader set of scenarios, not fully addressed by current cellular systems. This includes massive deployment of ultra-low power sensors, intelligent traffic systems, critical low-latency communications, enterprise networks, etc. To handle this complexity there is a need to deploy intelligent methods for analysing data from 4G and 5G networks. Such methods need to reduce efforts for network management (essentially offloading human effort needed to operate the networks), be able to draw new insights, and predict future network and user behaviour in order to make smarter decisions. This could result in higher network performance, better reliability and more adaptive systems.

Thesis Description
This thesis work will investigate a machine learning method called deep learning with the purpose of improving 5G network performance. Such a network will, using deep learning techniques, extract information and create relevant features that automatically optimizes network performance.In particular for 5G systems, the usage of beam forming will be a central technology component to increase data rates and coverage, where each base station will communicate with users through a set of defined beams pointing in different directions. With users moving around in the network, when to trigger a user beam switch to another target beam is problematic since it is hard to predict if the candidate target beam provides better performance. For example, the target beam might experience heavy interference resulting in a lower user bitrate. We would like to investigate possibilities of addressing the user beam switching using deep learning techniques. The purpose of the thesis is to use deep learning for extracting the features that optimizes the 5G network performance. Feasibility of such approaches will be investigated using a 5G simulator.

Qualifications
This project aims at Master of Science students in mathematics/statistics, computer science or electrical engineering. Java and Python/Matlab are our primary SW languages for simulation and machine learning work, so background in those languages is preferred. Successful candidate has a solid knowledge in machine learning techniques (preferably deep learning) and has average grade above B/4.0.

Extent
This position is for one student. Scope is for 30hp (Swedish högskolepoäng)

Preferred starting date
Jan 2017

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