Proposal for an M.Sc. Thesis – nnnnn - 2022/2023

Title:

Forecast of Quality of Experience using Machine Learning in 4G/5G Networks

Supervisor:

Luis M. Correia

Co-Supervisor:

Name: Luis Santo

Company name: NOS

Objectives:

To develop a model for the classification of cells according to the Quality of Experience and its forecast in 4G/5G networks using Machine Learning techniques.

Requirements:

Preferential conditions are basic knowledge of mobile and wireless communication systems, and also general one of 4G/LTE and 5G/NR.

The student needs to master the English language, as the thesis will be written in English.

The student must commit to start his professional career only after finishing the thesis.

Framework:

The complexity of managing mobile communications networks has grown dramatically in the last years, given the increased support of several types of technologies and of services, traffic demand being higher than ever. The effort to manage networks is increasing to a stage that it is essential to introduce Machine Learning algorithms able to adapt to changes and evolve over time to achieve the automation of network planning and optimization tasks. Network capacity management is a critical task in the assurance of Quality of Experience provided by operators. The engineering teams monitor the network to ensure that network capacity is adequate for the traffic overtime, however, the diversity of services requirements and customer mobility makes capacity management increasingly difficult to perform. Network resource consumption is essentially determined by data services, which have a volume much higher than voice ones, hence, capacity management is mainly defined in terms of the minimum Quality of Experience of data services, namely in the 4G and 5G components, which essentially depends on the customer's installed capacity and radio conditions, although the terminal category needs also to be accounted for, as it defines which technologies are supported and the number of bands that can be aggregated. Therefore, operators need to evolve to a Machine Learning system, being expected that algorithms capable of modelling network traffic and of predicting areas where it will be necessary to act are obtained. The system will have several Key Performance Indicators as input variables, such as number of users, average user throughput, cell modulation ratios, average signal strength and timing advance, working with multi variable inputs, being robust to outliers and able to find seasonal effects. This thesis will address these matters, by developing a model for the classification of cells according to Quality of Experience and its forecast in 4G/5G networks using Machine Learning techniques. The theme of the thesis is within the area of Telecommunications.

Description:

The thesis will be developed according to the following steps:

--- Study of 4G/5G networks – study of the basic aspects of 4G/5G networks

--- Study of Machine Learning techniques – study of data analytics based on Machine Learning techniques

--- Study of performance parameters – study of performance parameters to be taken as metrics for the analysis.

--- Scenarios development – development of scenarios for the network analysis.

--- Model development – development of a model for the inclusion of Machine Learning in data analytics.

--- Model implementation – implementation of the developed model, using previously developed routines.

--- Results assessment – assessment of results by comparison with others from literature.

--- Scenario influence – analysis of the influence of the scenarios on the various performance parameters.

--- Thesis conclusion – conclusion of the thesis by finalising its writing (the previous steps include the writing of the corresponding chapters).

Expected result:

A model for the classification of cells according to the Quality of Experience and its forecast in 4G/5G networks using data analytics techniques and a simulator to implement it.

Industrial link:

This thesis will be developed in collaboration with NOS.

Observations:

The address <http://grow.tecnico.ulisboa.pt> contains general information on the various works developed within the group coordinated by the supervisor.

Besides the registration in fenix, an application form must be filled in, and sent to [luis.m.correia@tecnico.ulisboa.pt](mailto:luis.m.correia@tecnico.ulisboa.pt). The application form is available at: <https://fenix.tecnico.ulisboa.pt/disciplinas/SCM/2021-2022/2-semestre/master-theses>.

Candidates will be interviewed.