

# Application of Machine Learning in Resource Allocation in 5G Systems

## Introduction

Machine learning concepts are useful for determining a future outcome, with certain accuracy, based on the presently available information. The input data set for machine learning can be analyzed in different ways, depending upon which learning algorithm is used and what are its relevant parameter settings. Currently, extensive research on fifth generation or 5G systems is going on, where the goal is the provision of high data rates in medium-to-high mobility scenarios. One possibility is using the machine learning algorithms to predict the possible allocation of resources in a 5G system to a user in a particular scenario. In this way, optimal system design can be achieved without the need for on-spot computation, which will reduce the computational overhead.

Different machine learning approaches can be used for estimating the optimal resource allocation in a given scenario. Random forests [1] is one of the various machine learning algorithms, where a number of decision trees are constructed based on the input training data, and the future outcomes are predicted for the testing data using those constructed decision trees. Different software tools are available for the implementation of such learning algorithms, among which OpenCV [2] is a prominent one. Sample tutorials are available for simulating and testing the different machine learning algorithms, including the random forests, which is one of the main tasks of this thesis project.

## Thesis Outline

The goal of the thesis is to determine to what extent machine learning is useful in optimal resource allocation in 5G systems. The thesis will focus on simulating the random forests algorithm in OpenCV for a number of available data sets. A data set can have a combination of any of the variables, depending upon the desired simulation scenario, like user position, user's velocity, precoding vectors, signal-to-noise ratio, packet size, etc. The results will be obtained by testing different parameter settings for each given data set, and further analysis will be carried out. Since random forests algorithm is able to deal with some missing values in the training data set, it would be interesting to see the results in such cases (e.g. in case the user position is unknown, how good is the prediction accuracy of the random forests algorithm?). The data sets will be related to realistic scenarios in a wireless communication system, so some background knowledge in wireless communications will be of great help for results' analysis. The random forest algorithm example in OpenCV will be modified to obtain the expected optimal results for a given data set.

## Eligibility Requirements

The student is expected to have good knowledge of OpenCV and should be proficient in programming languages like C++ and python. Moreover, he/she should be familiar with working in Linux environment. Some knowledge about the basic concepts of wireless communication systems (or 5G systems) will be useful but is not compulsory. This thesis requires extensive amount of work, for which supervision will be provided on daily basis to achieve the desired goals in time.

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## References:

- [1] Breiman, Leo. "Random forests." *Machine learning* 45.1 (2001): 5-32.
- [2] <http://opencv.org/>