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Estimating Parking Availability using Decision Tree Regressor

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***Abstract*—Recent growth in the number of personal vehicles has aggravated the parking issue. Thus smart parking management system is a must in each metropolitan area. We use Decision Tree Regressor (DT) model to forecast the number of available parking places in the upcoming time. We tune the hyper-parameters max_depth of the DT on three datasets, CNR-A, CNR-B, and KLCC. Experiments show that our proposed model can be used for both small and large datasets. Our model outperforms the Random Forest Regressor (RFR), proposed in recent work, in term of MSE, MAE, RMSE, and R^2 metrics.**

***Index Terms*—Regression models, machine learning, Decision Tree, Forest Tree, forecasting parking availability.**

I. Introduction

Cities will be home to more than a third of the population by 2050, and the people who live there will seek the comfort of their daily lives. Among the things that make people's lives easy, is owning a personal vehicle. This could cause considerable problems such as congestion of road traffic or difficulty in finding parking spaces. Thus, the presence of intelligent parking management in each agglomeration becomes essential to organize the parking of this large number of cars.

Several approaches have been proposed to address the car parking issue. We can distinguish two types of solutions, prediction, and estimation also known as forecasting. The prediction uses classification algorithms such as [1] and [2]. The forecasting uses regression algorithms such as [3] and [4]. The prediction type provides the state of an individual or a group of places in real-time. The forecasting can be in the short or long term and allows the user to know, in the future, the number of available places without having access to their exact localization.

One of the best-known machine learning algorithms that have been applied in practice for a variety of classification tasks is the decision tree, which is an effective learning approach [5]. Decision trees are also used for regression problems. The structure of this model looks like a tree, where each node represents a feature and each leaf is a target output. We opted for this model for its advantages which are summarized as follows [6]:

- Decision trees take less work to prepare the data during pre-processing than other methods;
- Data normalization is not necessary for a decision tree;
- Standardization of data is not necessary when using a decision tree;
- The construction of a decision tree is not significantly impacted by missing values in the data;
- DT is an explainable model. Therefore we can interpret and explain the outputs of the model.

Our main contributions are summarized in: (i) Pre-processing the data of two public datasets (ii) Tuning parameters of a Decision Tree Regressor (iii) Training and testing the defined model (iv) Comparing the results to related work. The objective is a model that forecasts the number of available parking places in the upcoming time.

This paper is organized as follows: in Section II, we discuss related work. Section III defines the used models and metrics. In Section IV and V present our approach and discuss the results and analyses, respectively. Finally, in Section VI we conclude the paper and draw some further work.

II. Related work

In this section, we will discuss some of the machine learning algorithms for parking occupancy forecasting. We focused on those using Trees Regressor.