Machine Learning based Vehicle Performance Analyzer

Introduction:

Predicting the performance level of cars is an important and interesting problem. The main goal of the current study is to predict the performance of the car to improve certain behavior of the vehicle. This can significantly help to improve the system's fuel consumption and increase the efficiency. The performance analysis of the car based on the engine type, no of engine cylinders, fuel type and horsepower etc.These are the factors on which the health of the car can be predicted. It is an on-going process of obtaining, researching, analyzing and recording the health based on the above three factors. The performance objectives like mileage, dependability, flexibility and cost can be grouped together to play a vital role in prediction engine and engine management system. This approach is the very important step towards understanding the vehicles performance.

LITERATURE SURVEY:

Instance-based prediction of real-valued attributes

Instance-based representations have been applied to numerous classification tasks with a fair amount of success. These tasks predict a symbolic class based on observed attributes. This paper presents a method for predicting a *numeric* value based on observed attributes. We prove that if the numeric values are generated by continuous functions with bounded slope, then the predicted values are accurate approximations of the actual values. We demonstrate the utility of this approach by comparing it with standard approaches for value-prediction. The approach requires no background knowledge.

Keywords: incremental learning, prediction, instance-based, continuous functions

Instance-based learning (IBL) strategies represent concepts using sets of instances and a similarity metric, where each instance is described in terms of a set of attribute-value pairs. IBL techniques have been applied to several learning problems, including speech recognition (Bradshaw, 1987), word pronunciation (Stanfill & Waltz, 1986; Stanfill, 1987), handwritten symbol recognition (Kurtzberg, 1987), thyroid disease diagnosis (Kibler & Aha., 1987), a.rod the cart-pole balancing problem (Connell & Utgoff, 1987). In ea.ch case, IBL techniques were shown to be computationally inexpen- sive methods for solving classification tasks. Most IBL ap- plications involve the prediction of symbolic values. Con- nell and Utgoff, however, applied their CART system to predict values for a. numeric domain, namely the degree of desirability of instances (which represent states in their domain). In this paper we present a method for applying instance-based techniques for predicting numeric val- ues. Theoretical and empirical arguments are supplied to support our claims.

The Effects of Driving Style and Vehicle Performance on the Real-World Fuel Consumption of U.S. Light-Duty Vehicles

Even with advances in vehicle technology, both conservation and methods for reducing the fuel consumption of existing vehicles are needed to decrease the petroleum consumption and greenhouse gas emissions of the U.S. light-duty vehicle fleet. One way to do this is through changes in driving style, specifically through reductions in driving aggressiveness. The role of vehicle performance is particularly interesting because of the recognized tradeoff between vehicle performance and certified fuel consumption and because more powerful vehicles are capable of more aggressive driving. This thesis analyzes the effects of driving style and vehicle performance on the real-world fuel consumption of conventional vehicles through two parts.

First, vehicle simulations assess the sensitivity of fuel consumption to a wide range of driving patterns. From these results, three aggressiveness factors were developed for quantifying driving aggressiveness. Each aggressiveness factor, although based only on the speed trace and vehicle characteristics, is proportional to fuel consumption in one of three specific speed ranges: neighborhood, city, or highway speeds. These aggressiveness factors provide a tool for comparing drive cycles and evaluating the real-world driving patterns.

Second, driving data from two U.S. sources was used to 1) provide illustrative examples of real- world driving and 2) assess the relationship between driving aggressiveness and vehicle performance. The distribution of aggressiveness among the driving data follows a lognormal shape. The average aggressiveness is either below or near the aggressiveness of the U.S. drive cycles developed in the 1990s. Moderate performance vehicles, the most common type of vehicle, are driven most aggressively. Low performance vehicles are driven least aggressively.

The results suggest that, for the illustrative data analyzed in this work, reducing velocities during highway driving would save roughly the same amount of fuel as reducing accelerations during all driving. However, on an individual basis, the fuel savings achieved from these behaviors would vary significantly. Aggressive drivers should focus on reducing accelerations, while less aggressive drivers should focus on driving at lower speeds on the highway. And the greatest fuel savings can be attained if the most aggressive drivers, those who drive moderate performance vehicles, drove with lower accelerations.

Performance of Motor Vehicle based on Driving and Vehicle Data using Machine Learning

With the increasing population demographics and the dependency of man on motor vehicles as the primary source of transportation, the number of motor vehicles being registered for commercial as well as non-commercial activities on a daily basis is massive and yet continues to increase at an alarming rate. This has a direct and an unambiguous effect on the amount of fossil fuels being utilized globally and its subsequent environmental effects, which is of great concern in the present situation. Several attempts from various research sectors are ongoing in order to overcome this global issue and promising results are expected. This project is one such attempt at identifying the performance of small passenger cars in terms of fuel efficiency and map them with factors affecting it using machine learning techniques. The commencing activity while carrying out any such research activity will be the identification of the problem and all its possible sources. In this case, two potential sources can be identified and they are; the vehicle characteristics and the driver/driving behaviour. The relevant data for this analysis was taken from the public source, Kaggle which is the data collected from the OBD of the car and models are built using techniques like Multiple Linear Regression, XGBoost, Support Vector Machine and Artificial Neural Network and their performance is compared to discover the firstrate technique in predicting the fuel efficiency and to propose the optimum driving behaviour in terms of throttle position to achieve better fuel efficiency. The results reveal that XGBoost model outperforms all other models developed in predicting the fuel efficiency for the different split ratios evaluated and comparing the throttle position with the predicted fuel efficiency explains that to achieve better fuel efficiency the throttle position must be around 70 to 80 on a scale of 100, referred to as full throttle position. The knowledge discovered from the research could be used by car manufacturers to design cars in future to mitigate the fuel consumption.

Automotive Performance Tests Based on Machine Learning Algorithms

This paper suggests an innovative approach to define and perform tests of communication systems in cars. The test concept requires the placement of the vehicle under test on a planar turntable in an anechoic chamber. Software-defined multimode transceiver modules, referred to as radio heads, are placed in a quarter circle or half circle around the car at an adequate distance. This setup allows flexible, realistic, reproducible and dynamic over-the-air testing of the cars communication systems in the sense of a virtual drive test. One key topic - which is still open - is the definition of sufficiently realistic test scenarios related to real outdoor scenarios. The full description of those scenarios would require a prohibitively large number of parameters from the network and the channel to be considered, making it impractical to perform this derivation following a classical straight-forward approach. Therefore, this paper suggests the derivation of realistic test cases via a machine learning (ML) approach: instead of attempting to create a 1:1 mapping of real scenarios into the test chamber, we propose to use ML to identify and classify critical test cases via analysis of key performance indicators (KPI) of test data and from this to create representative synthetic test cases. This approach is currently under development and open for discussion here.

According to the comprehensive evaluation of vehicle performance, the vehicle performance evaluation model based on set theory sets not only the identity of the problem but also the opposition and difference of the problem. The practical application showed that the set pair evaluation model could synthesize the index information, and was more scientific than the single index information evaluation, so as to more fully reflect the vehicle performance. Therefore, this method provides an effective new approach for the comprehensive evaluation of vehicle performance and is simple, easy to implement and has good practical value.

Reference:

Kibler, Dennis Aha, David W,”Instance-based prediction of real-valued attributes”,March 1988.

Irene Michelle Berry,“The Effects of Driving Style and Vehicle Performance on the Real-World Fuel Consumption of U.S. Light-Duty Vehicles”, January 20, 2010 .

Punith Kumar Nagaraje Gowda,”Performance of Motor Vehicle based on Driving and Vehicle Data using Machine Learning”,January 29, 2020.

M. Geissler; J. Kunisch; C. Oikonomopoulos-Zachos; A. Friedrich,”Automotive Performance Tests Based on Machine Learning Algorithms”, DOI: 10.23919/EuCAP53622.2022.9769399, 27 March 2022 - 01 April 2022