**SVKM’s NMIMS**

**Mukesh Patel School of Technology Management & Engineering**

Program: BTI Computer Engineering

**Course: Data Mining**

**Experiment No.01**

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| Roll No.: C026 | Name: Anirbaan Ghatak |
| Class : B | Batch : B1 |
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**Paper Title: Optimizing the Performance of a Formula One Car Using a Genetic Algorithm**

**Summary:**

The paper focuses on the use of a genetic algorithm to optimize the performance of a Formula One car. The authors begin by highlighting the significant investment made by Formula One teams in research and development to produce highly competitive racing cars. They argue that a genetic algorithm can be an effective method to improve the performance of these cars.

The authors describe the system they developed, which combines a genetic algorithm with a racing simulator. They explain that the algorithm adjusts variables such as tire pressure, brake pressure, and gear ratios to improve lap times. They also mention the use of macro software to automate the testing of car setups and the selection of variables that can be adjusted to improve performance.

The experiments conducted in the study demonstrates the effectiveness of the genetic algorithm in optimizing the car's setup parameters. The authors compare the performance of the genetic algorithm with other methods tested, and the results show that the genetic algorithm consistently produces faster lap times.

The data obtained from the simulation in lap times at Silverstone is used as the fitness evaluation for each individual in the population. The lap times serve as a measure of the performance of the car with the specific setup parameters represented by each individual.

The fitness evaluation is a crucial step in the genetic algorithm as it determines the selection of individuals for reproduction and the evolution of the population towards better solutions. Individuals with faster lap times are considered to have higher fitness and are more likely to be selected as parents for the next generation.

The lap times obtained from the simulation are directly used as the fitness values in the genetic algorithm, guiding the algorithm to search for optimal setup parameters that result in faster lap times.

The conclusion of the paper is that the genetic algorithm used in the study is an effective method for optimizing the setup parameters of a Formula One car. The experiments conducted demonstrate that the genetic algorithm consistently produces faster lap times compared to other methods tested. The authors suggest that the same algorithm could be used to optimize real Formula One car setups with equal success, and they express the potential for collaborations with Formula One teams to further refine and improve the algorithm.

**Paper Title: Virtual Strategy engineer Using artificial neural networks for making race strategy decisions in circuit motorsport**

**Summary:**

This paper presents the development of a virtual strategy engineer (VSE) for automated race strategy decisions in Formula 1 racing. The VSE utilizes artificial neural networks (ANNs) to determine optimal pit stop decisions and tire compound choices. The VSE is trained on historical timing data from Formula 1 races and is designed to automate strategy decisions in race simulations.

The paper discusses the background of sports analytics and the use of machine learning algorithms in decision making. It provides an overview of research in various sports, including motorsport, and introduces the methodology used in the study.

The researchers used a combination of feed-forward neural networks (FFNNs) and recurrent neural networks (RNNs) to predict pit stop decisions and tire compound choices. The FFNNs were not accurate in predicting pit stops, while the RNNs had difficulty in making comprehensible predictions. Therefore, a hybrid neural network (NN) model was created, combining the advantages of both models. The hybrid NN showed improved decision behavior and achieved an average F1 score of 0.59 on the test data.

The evaluation metrics used to assess the accuracy of the neural network predictions for pit stop decisions and tire compound choices were precision, recall, and F1 score. Precision represents the fraction of correct positive predictions, recall represents the fraction of the positive class that was correctly predicted, and the F1 score is the harmonic mean of precision and recall.

These metrics were used because accuracy alone is not appropriate for binary classification problems with imbalanced data, as it places too little focus on the positive class (in this case, pit stop).

The conclusion of this paper is that the virtual strategy engineer (VSE) utilizing artificial neural networks (ANNs) shows promise in making race strategy decisions in Formula 1 racing. The hybrid neural network model developed for pit stop decisions and tire compound choices achieved good prediction quality, as evidenced by the precision, recall, and F1 score evaluation metrics. However, the VSE has limitations, including limited training data, lack of adaptability, and the need for further optimization and consideration of advanced tactical opportunities. Future improvements suggested include incorporating additional features, considering opponent behavior, and developing a reinforcement learning approach. Overall, the VSE demonstrates the potential of machine learning algorithms in automating race strategy decisions in motorsport