Applied Machine Learning Assignment

Literature review and Ethical aspects of Machine Learning

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Introduction

In different areas, the application of machine learning models is becoming more widespread. These models may offer many benefits, including more accurate and efficient results, but they also have some ethical concerns. In particular, three reports were presented in this report that illustrate these concerns with regard to deep learning models for tool wear prediction, as well as home price predictions and personality prediction from Twitter data.

1 Tool wear predicting based on multi-domain feature fusion by deep convolutional neural network in milling operations

The paper[1] proposes a system to predict tool wear in milling operations using deep convolutional neural networks(DCNN). The model uses cutting forces and vibrations in multidomains (time, frequency, and time-frequency domain) as input to the neural network. These data are collected in real-time via sensors.
The authors chose DCNN because of its ability to automatically infer characteristics from input data and achieve high performance with minimal preprocessing, making it an important advantage in real-time applications.

The dataset consists of 300 samples containing the tool wear (inspected via a microscope), applied forces, and vibrations detected during machining for each tool. In addition, normalization of data to reduce internal variance has been carried out to improve dataset stability as well as cross-validations in order to avoid overfitting and backpropagation to minimize loss functions.

In this study, ethics can be limited only to the scope of job safety. Since understanding the wear and life cycle of a tool can be a complex task, inexperienced and lower skilled workers can overestimate the capabilities of the model and fail to pay attention to crucial signs that can lead to machine damage, or even harm to workers.

In terms of jobs, more problems could be addressed. Workers who perform manual inspection and maintenance of tools could be displaced by this approach. This may lead to redundancies and a negative impact on the labor force, particularly in areas where production is a crucial factor.

2 Housing Price Prediction via Improved Machine Learning Technique

The paper[2] proposes a machine learning-based approach for predicting house prices. Despite its potential, this implementation presents several ethical problems.

The dataset used was "Housing Price in Beijing", from Kaggle platform, that contains more than 300000 data points with 26 variables. To improve the robustness of the dataset, authors also removed variables with more missing data than 50%.
Before the model creation, numerical values were standardized, while categorical values were one-hot-encoded to improve prediction. The correlation between some features was discovered with an exploratory data analysis.
The models compared in this task were

- Random Forest
- Extreme Gradient Boosting
- Light Gradient Boosting Machine
- Hybrid Regression
- Stacked Generalization Regression

and in the end authors claimed that there wasn't a best model, but it depended on the application requirements since some were more accurate and other faster.
Only Random Forest, XGBoost, and LightGBM were tuned by GridSearchCV.

The potential for biased outcomes is a concern for ethics. The model's predictions may be biased if the training set of data is distorted, which could result in unfair treatment or judgments based on factors such as socioeconomic position, race, or gender. For this reason, to prevent unintentional negative effects, it is vital to ensure data diversity.

Additionally, applying a machine learning model to real estate valuation may have social repercussions, since people may suffer financial loss if the model anticipates prices incorrectly. The potential effects of the model's implementation on society must be considered and the necessary precautions have to be taken to guarantee that it does not harm people.

Finally, the model cannot be responsible for its prediction if it is not clear how

it takes them, so it is essential to make sure that the model is transparent and understandable to stakeholders to prevent unintended repercussions.

3 Personality Prediction from Twitter Dataset using Machine Learning

In this paper[3], the authors aim to predict personality traits based on the user tweets. To do this, they used a Myers-Briggs Type Indicator® (MBTI®) dataset from the Kaggle platform, which contains 8675 people's type of personality and their last 50 tweets.

The authors used several machine learning techniques to predict personality traits from tweets. Those predictions were based on a range of features extracted from the data, including linguistic, syntactic, and semantic. The classifiers used were:

- Support Vector Machines (SVM)
- Random Forest (RF)
- Extreme Gradient Boosting (XGB)
- Stochastic Gradient Descent (SDG)
- K-nearest neighbors (KNN)
- Logistic Regression (LR)

In terms of ethics, the use of social media data to predict personality traits could pose several potential ethical problems. The accuracy of the predictions is a problem because personality is an intricate, multi-dimensional system that cannot be accurately measured in tweet data.

Moreover, there is a limited sample of the population in the database that does not provide any evidence of its fairness. In this way, if the training of models does not involve cultural differences or traditions among people, it risk being biased and unfair.

Overall, while predicting personality traits from Twitter data using machine learning can have potential benefits, such as enabling personalized content recommendations or mental health support, it is imperative to understand that this model can be used oppositely, giving someone the power to hurt or control other people's thinking and perceptions for social, political, or economic purposes.

Conclusion

Ethical implications for the development and deployment of machine learning models must be taken into account, as their use continues to increase. The report identifies a number of important challenges which need to be addressed, including the need for transparency, accountability, and fairness. Taking into account those concerns, we will be able to design and use such models in a way that benefits society at the same time as minimizing possible harm.

References

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