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Developing a computer vision system for automated medication identification and verification

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ABSTRACT

Drug repurposing is the process by which novel medications are discovered to cure or prevent illness. Furthermore, biological research has benefited from the astounding advancements in medicine brought about by new and sophisticated technologies. In order to better utilize the vast quantity of biological data that is currently available and to reduce the time and cost associated with the drug discovery and development process, numerous computational techniques are being used. As a result, attempts are being made to carry out drug repurposing, which comprises developing new uses for previously approved medications. To find new approaches for this kind of innovation, a number of computer techniques have been developed to forecast drug-target interactions (Drug target Interactions). Because the data sets gathered from Drug and Targets were so complex, traditional machine learning techniques like linear regression analysis were unable to analyze them effectively. Presenting several machine learning categorization models is the aim of this thesis. This thesis's experiments and assessments show the development of an integrative machine learning model for predicting and finding novel biomedical relationships from both text datasets.

Keywords: Drugs, data, security, Verification.

1. INTRODUCTION

The era of information technology is upon us. The development of new gadgets like smartphones, tablets, and laptops that have high-quality cameras, scanners, digital cameras, and video cameras has accelerated the expansion of image content storage. This most recent innovation is also applicable to the medical field [1]. These days, a variety of health hazards are reported, and diagnostic methods are also being developed concurrently. People's health issues worsen as they get older than forty. Numerous modern devices have been developed to scan the human body's organs. To diagnose health problems, clinicians prefer to use medical images from several modalities. With the development of new medical equipment, the quantity of medical images captured for diagnosis continues to rise hourly in many multispecialty institutions [2]. All of those photos are then kept in a centralized repository for use in patient records, diagnostics, education, and research. These photos can be downloaded from the repository whenever needed thanks to the Picture Archiving and Communication System (PACS) [16]. Based on the history of diagnosis, the recovery of medical photos helps the professionals make a prompt conclusion. PACS stores the image's textual information in the Digital Imaging and Communications in Medicine (DICOM) header. However, faults in accuracy were noted when images were retrieved using the information in the DICOM header [3]. The saying "A picture is worth a thousand words" is accurate [11]. The content of the photos was then used to determine the focus of medical image retrieval. Content Based Image Retrieval (CBIR) was first proposed by Smeulders et al. (2000) for retrieval problems. According to Muller et al. (2004), such CBIR has also demonstrated positive advancements in the medical field. However, the disadvantage of the CBIR method is that there is a semantic gap between the image's low-level visual features and the high-level semantic concepts that humans employ to identify the image. Using a variety of sophisticated algorithms, the researchers are attempting to close this semantic gap. Numerous studies on image retrieval based on image categorization and annotation have been published in recent years [6]. Therefore, the same method can be used to get the images in the medical field. Some filters are used to get the photos rapidly as the size of medical image databases, which range from primary health centers to multispecialty hospitals, continues to rise dramatically [4]. Since medical image databases typically include pictures from a variety of modalities, the image modality can be one of the best filters for the retrieval process [12]. Therefore, the automated system ought to be able to recognize and categorize the type of medical image. Before creating the modality identification and classification system, the next part reviews the several common modalities, the equipment that creates the images, sample images, and their uses. Photographs of different modality equipment are also included to give an understanding of how medical images are produced. Given the exponential growth in the number of pictures available in PACS, manual modality identification appears to be unfeasible and time-consuming. Therefore, an automated system is needed to recognize the modality and efficiently and successfully retrieve the stored photos [5]. Without a doubt, this will benefit researchers, educators, and physicians more. Consequently, the problem statement is as follows: The task or problem is to determine the image's modality based on visual attributes given a query medical image. The primary goals of this work are

1. The goal is to create an automated system that combines the best performance of several encoding techniques for dense SIFT features, including Fisher Vectors, Bag of Visual Words, and Vector of Locally Aggregated Descriptors.
2. The modality prediction's correctness is assessed by comparing it to the ground truth.

2. LITERATURE REVIEW

Physicians employ the medical imaging techniques is to diagnose patients and save their lives. From minor health centers to multispecialty institutions, these photos are widely accessible. Therefore, it appears that managing, storing, and retrieving these photos when needed is a crucial responsibility. According to the survey, one filter that may be used to narrow down the search space is imaging modality [17]. These days, metadata regarding the generated photos is provided by every medical equipment. Modality can serve as a filter in image retrieval by using the modality information that is stored with the image [8]. However, older computers are still in use, and modality information might not be present in earlier photos kept in the repository. Therefore, relying on the metadata that the equipment provides for medical image retrieval is not feasible. In those situations, clinicians now identify the modality manually, necessitating the development of an automated system that can identify the modality based on visual characteristics. Although modality classification has been the subject of numerous studies, there is still opportunity for improvement. Effectively converting low-level information to high-level representation, choosing the right classifier, and other factors are critical to classification success [7]. Therefore, the goal of the multifaceted research is to enhance categorization performance.

3. METHODOLOGY

The process of data mining entails identifying issues and gathering information to improve model analysis using statistical, visualization, correlation, and other methods. A data mining tool must be flexible, meaning it must be able to adjust to a wide range of tasks. It should ideally be scalable, meaning that models may be applied to small or big datasets and be able to accurately forecast the relationship between actions and recurring outcomes. From simple mathematical equations produced through linear procedures to highly nonlinear models created using nonlinear approaches, data mining models include a broad spectrum of topics and applications [12]. Because it takes data from multiple viewpoints and condenses it into valuable information, data mining is significant not just in the scientific domain but also in the fields of marketing, banking, and robotics. It crosses many fields, including database systems, statistics, artificial intelligence, and machine learning. The majority of data mining methods are statistically based. It is therefore challenging to identify the optimal algorithm because it depends on the problem definition and the data format. In essence, data mining is the statistical process of identifying a valuable pattern in large data sets. Large datasets are typically divided into two sections as part of the normal procedure [5]. Regardless of the modeling technique utilized, one part of the data is frequently used as the training set for the model's construction, and the other part is used as the test set to evaluate the generated model [13]. On the other hand, a third piece of data is used in other applications to confirm the generated model. In this way, a more accurate model can be obtained. A model that links a collection of molecular descriptors to biological activity, efficacy, or (ADMET) qualities is developed using data mining techniques, which are extensively used in drug discovery. After that, a new screening set's key property values are predicted using this model in order to prioritize it and determine its Structure Based Structure (SBS). Computational methods are used to scan vast databases in order to locate and prioritize novel leads that have a high likelihood of being on the target structure or in a complete cell screen [9]. This is one of the main applications in the field of cheminformatics spectrum, or virtual screening. Machine learning (ML), a branch of artificial intelligence, examines the theoretical, computational, and applied facets of teaching computers to learn from examples [17]. This can help a computer learn from its errors and develop a classifier model that it can use to categorize fresh data. One of a number of previously known classes can then be applied to a new object. The classifier model is created using a variety of algorithms, including Artificial Neural Networks (ANN), Non Linear Machine Learning Models, and Linear Machine Learning Models. Inductive learning is used in this situation, where knowledge is constructed from data and new data is anticipated using this knowledge. This is commonly known as supervised learning and is mostly used to predict results using many types of analysis, including regression and classification. Building a classification model on a given dataset with different attributes and labeled classes is often accomplished through supervised learning. The dataset is split into training and testing sections in order to achieve classification. While test data is used to evaluate the model's performance, training data is used to create a prediction model that takes into account the dataset's many properties [7].

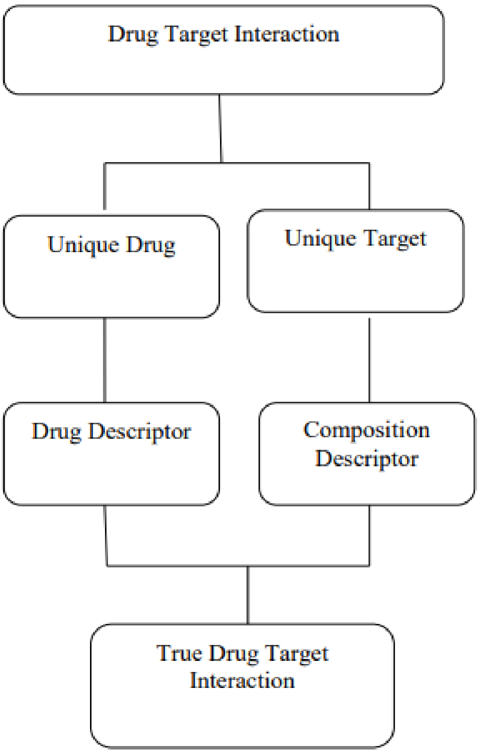

Figure 1: Proposed Framework

The borders of an n-dimensional class space can be represented by a number of lines and decision boundaries. Therefore, we need to find the simplest decision boundary in order to classify the dataset. This optimum boundary analysis is known as the SVM hyperplane. The properties of the dataset determine the hyperplane's dimensions. These factors define if two target labels are present in the dataset. After then, the hyperplane will resemble a line. Additionally, the hyperplane will be two-dimensional if it has three target labels. Every time, we construct a hyperplane with the maximum margin. As a tool for completing machine learning tasks like regression and classification, kernel techniques have become more and more popular [14]. They demonstrate a high level of generalization across numerous real-world datasets. By applying a suitable kernel function, SVM provides a general method for fitting the surface of the hyperplane to the data points [15]. This means that data points that are not linearly separable in the input space can be converted into a high dimensional feature space and made so. The effectiveness of the suggested drug target interaction prediction system for drug repurposing is assessed using the Standard Gold Dataset (SGD). The suggested Drug Repurposing and Linear Machine Learning approach's simulation results [10][18].

4. EXPERIMENTAL ANALYSIS

According to simulation results, when the number of characteristics is increased, the suggested Drug Repuposing method produces a prediction system that greatly increases the accuracy, sensitivity, and specificity rates. As a result, it is claimed that the suggested Drug Repurposing and Prediction approach is more effective at identifying drug-target interactions. The performance of the suggested Standard Gold Dataset and allLinear Machine Learning approaches is shown graphically in Figures 2, 3, and 4. It is noted that the suggested system achieves good classification results. As you can see, we obtained the best results for 1000 descriptor characteristics across all suggested systems using various machine learning approaches. The performance of the complete linear machine learning algorithm covered in the previous chapter was compared using 200, 500, and 1000 descriptor features in the section below.

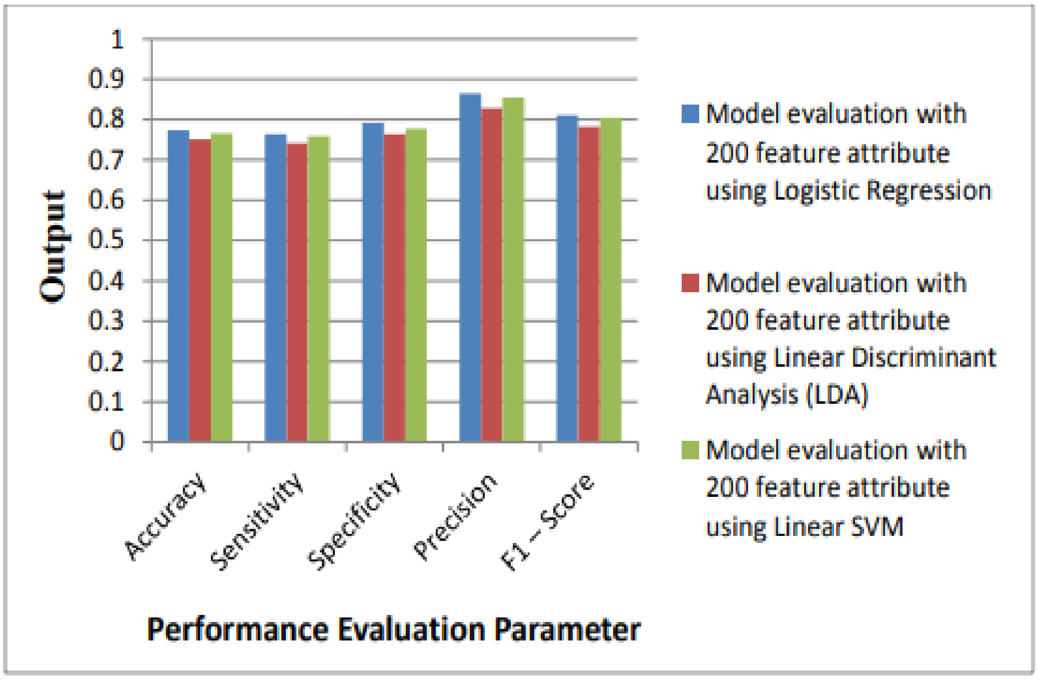

Figure 2: Comparative evaluation of various linear machine learning algorithms using cross-validation with 200 feature selection

Finally, the time needed to finish the cryptographic procedure is described together with the results of the encryption and decryption of the data from QR codes. Additionally discussed were the use of smart contracts and the amount of gas needed to implement these functions. In terms of transactions and execution costs, Figure 3 illustrates how the IPFS smart contract's encryption, digital signature, uploading, and data transport features are implemented.

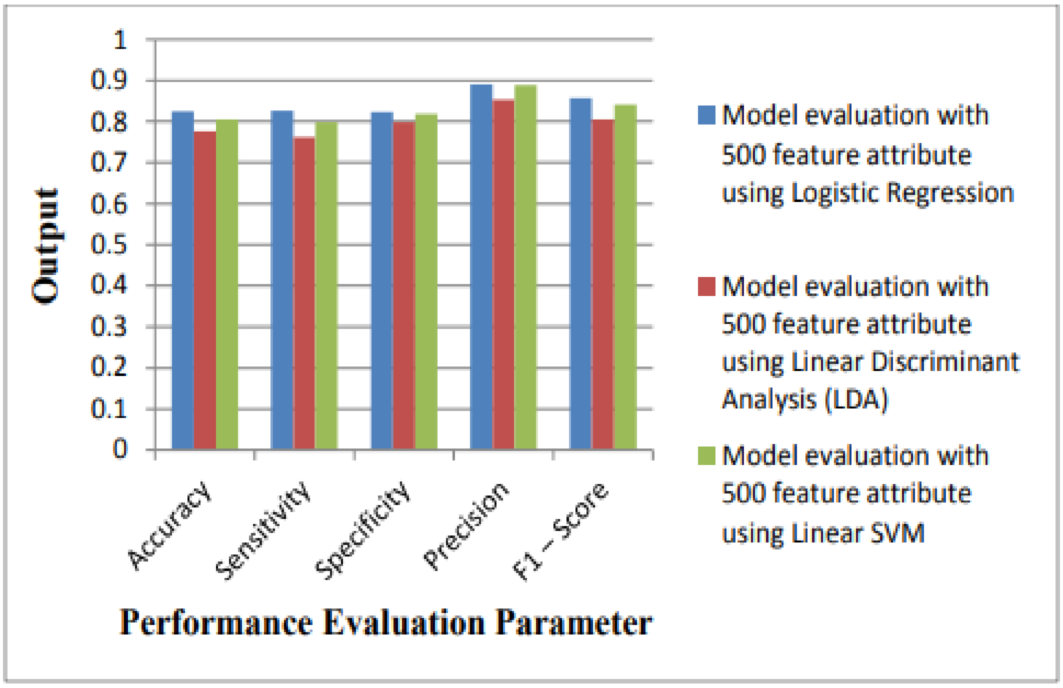

Figure 3: comparative analysis of different Linear Machine Learning Algorithm with 500 features

In figure 4 depicts the comparative analysis of different Linear Machine Learning Algorithm with 200, 500 and 1000 features selection below.

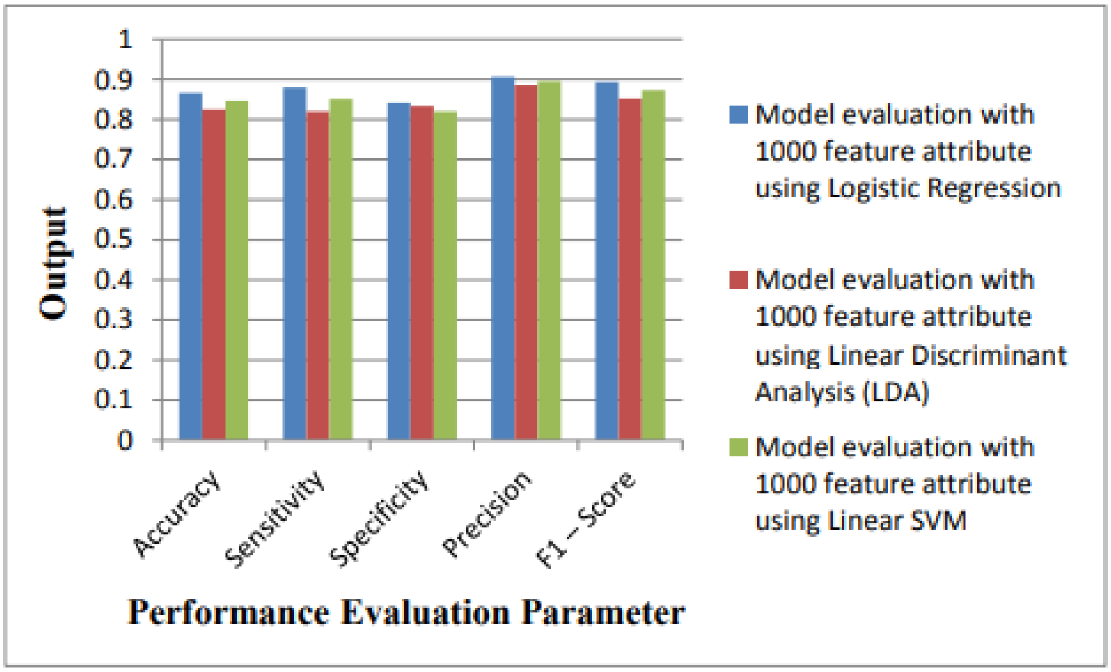

Figure 4: comparison of various linear machine learning algorithms using a thousand features

According to several cited research, there is no one perfect way to solve every ML algorithm performance problem. A strategy's effectiveness can be assessed by taking into account the size and distribution of the dataset, the complexity of the chemical problem, and the degree of correlation between the descriptor set. Experiment robustness and ML project validation are therefore essential. If the two sets share the same chemical space, the typical training-test split of the dataset is a useful validation method in machine learning procedures.

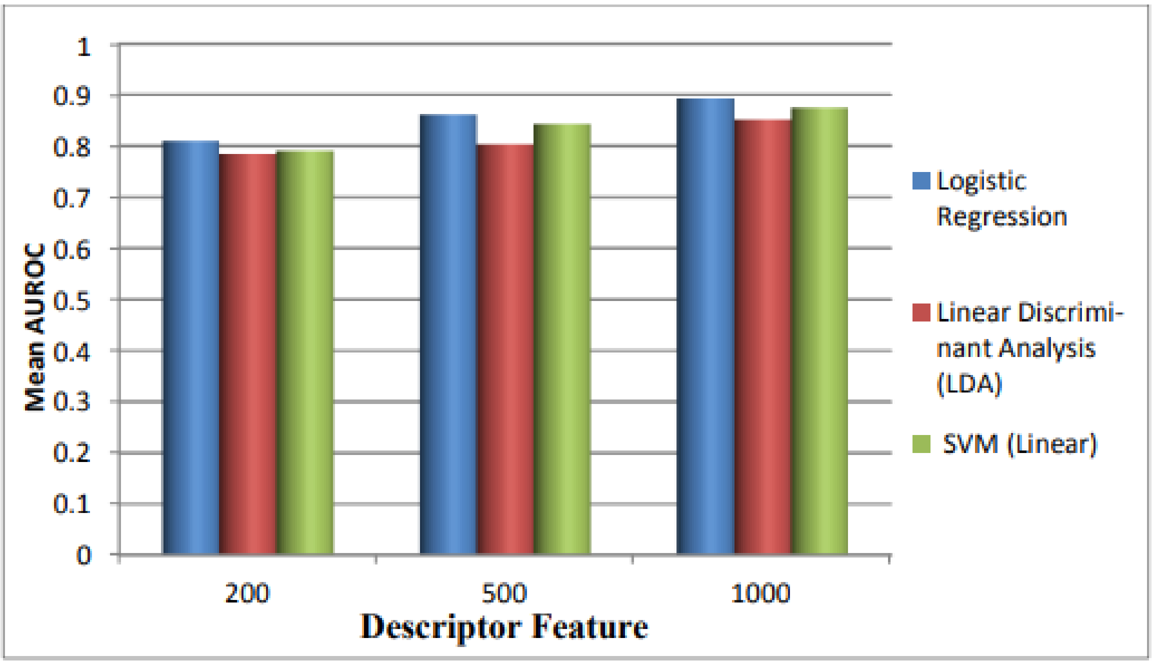

Figure 5: Evaluation of several linear machine learning algorithms using 200, 500, and 1000 features in comparison

All linear machine learning techniques perform well with this Standard Gold Dataset and prediction system, however logistic regression produces the best results out of all the linear machine learning algorithms covered above. In order to better forecast drug-target interactions and assess the efficacy of the suggested method, datasets are also assessed. Among linear classifiers, the Logistic Regression classifier produced the greatest results, with an average of 89.4%. The use of nonlinear machine learning methods and their performance on the Standard Gold Dataset (SGD) will be covered in the upcoming chapter.

5. CONCLUSION

In this binary classification problem, every case in the validation set is either successfully or incorrectly predicted. Due to misclassification in the eighth factor, the accuracy of nonlinear SVM marginally declines after increasing sixfold. Comparing MLP to nonlinear SVM, the accuracy of MLP first increases and subsequently declines due to a misclassification factor, but the ratio is lower. The reduction of tuples—just 110 out of 591 tuples for each of the three datasets under analysis had misclassified tuple 42, 112 had misclassified tuple 36, and 116 had misclassified tuple 26—is responsible for MLP's higher accuracy compared to nonlinear SVM. Only the most important characteristics are examined in this hybrid method. In order to identify drug-target interactions for drug repurposing, this study obtained a high sensitivity and specificity score. Rapid drug reuse in drug development is the analysis's final result, which enhances healthcare quality and reduces the failure rate of medication development. We might be able to offer a service at a reduced cost by taking into account basic biological findings. Although it cannot anticipate the exact drug, this hybrid model can predict how the drug and target will interact.

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