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Enhancing Web Service Classification with Explainable AI:A Semi-Supervised Learning approach

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Abstract: This project in machine learning concentrates on the development of web service selection accuracy and efficiency with two key parts being the classification model and the recommendation model.

Classification model classifies web services with respect to four qualities: response time, availability, reliability, and throughput concerning Quality of Service. This categorization is done utilizing multiple machine learning algorithms, among which are included Decision Trees, Support Vector Machines (SVM), Logistic Regression, K-Nearest Neighbors (KNN), Naive Bayes, Random Forest, Multi-Layer Perceptron (MLP), and XGBoost. To continue improving transparency with the classification results and to improve trust in a classification process, we use explainable AI approaches such as LIME, among others, with the ability to provide interpretability and insights to how classification is made. The Recommendation Model uses the K-Nearest Neighbors algorithm to determine the top 10 matching web services to be presented based on the preference of the user. It computes similarity scores between the user's input and the available services such that the system can guarantee relevance and precision in the recommendation. In fact, the interface is so intuitive that anyone can upload his data, inspect the classification results, and get recommendations personalized to his needs.

This will further improve the decision to select a service because the solution is adaptive and user-friendly for the framework. The intelligent classification and recommendation process improves the experience of the users and optimizes business operations with the selection of most business able web services.

I.INTRODUCTION:

The ever-expanding internet is a big challenge for the regular user. They face two main issues when selecting a web service: the large number of options and the quality differences vary. The usual quantitative and qualitative content analyses are not detailed enough to deal with quality-of-service measurement issues. These tools just generally focus on one aspect, i.e., either quantitative or qualitative. Therefore, the main idea of the project is to group the web services into different quality categories by using machine learning algorithm (QA): with the introduction of a new layer of representation for analysis (Bronze, Silver, Gold, and Platinum) by applying QoS metrics such as response time, availability, reliability, and throughput. This will help users to easily judge service quality. The project also incorporates LIME easing user concerns with the platform's opaque nature. It allows for classified information to be a logically comprehensible step-by-step process of the data as well as providing a future way to ensure transparency. In addition, the K-Nearest Neighbors (KNN) algorithm provides the best 10 services based on the user's specific requirements. With the method of advanced classification, transparent decision-making, and personal recommendations, the system is becoming a complete tool for the user to make a choice for the service needed in the easiest way. With proven scalable machine learning methods, accuracy in handling large datasets is guaranteed. Additionally, the system can adapt to dynamic environments. This helps not only the improvements in the selection of services but also is a great user experience where a simple, intuitive interface is offered. Users can upload service data, view classification results and receive personalized recommendations without any interruption. The incorporation of automation, transparency and precision in the process contributes to decision-making, m the system becomes a must-have tool for companies and people looking for web services with the best performance metrics.

II.PROBLEM STATEMENT:

The popularization of web services has spurred the growth of a wide variety of such services; ergo, finding the most

advantageous service due to service quality indicators like response time, reliability and availability has turned into a titanic task. The traditional methods for service selection are mostly based on the static ranking and basic filtering, which are not really that effective in dealing with the multi-dimensional nature of service quality. Also, users are often in the dark about the causes for service classification or recommendation. This project plans to deal with the afforested problems by building a system that sorts the various web services into the quality ranges and, as a result, to provide personalized recommendations, powered by the Explainable AI (LIME) to make the model transparent.

III.EXISTING SYSTEM:

The typical internet-based choice methods that are selection systems usually are simple and static for instance a keyword matching, a basic rule-based filtering, or a static ranking are the primary variants. These systems work on a predefined set of the criteria, which are often representing one or two of the main attributes like the response time or the availability. There is a static character in these systems and this is what they do wrong with them being unfit for the rapidly changing web service ecosystem, where the performance of the metrics can be drastically different than before. The issue with those systems is that they do not apply the advanced computational and data-driven methods so there is a lack of flexibility, adaptability, and precision. The way the system arranges the ranking is very often so rigid so that only in offering static results it does not care about the changes happening in the basic data or the diversity of requirements of the user. Besides, the users are usually the ones who have to go through the results to see if they are relevant, the downside of it is that they spend a lot of time doing so and sometimes it is incorrect.

IV.PROPOSED SYSTEM:

Our project develops a dynamic, scalable, and explainable framework for web service selection using machine learning. The Classification Model categorizes services into Bronze, Silver, Gold, and Platinum tiers based on Quality of Service (QoS) attributes like response time, availability, reliability, and throughput. It uses the algorithms including Decision Trees, Support Vector Machines (SVM), Logistic Regression, K-Nearest Neighbors (KNN), Naive Bayes, Random Forest, Multi-Layer Perceptron (MLP), and XGBoost that provide more precise classification. The Recommendation Model powered by KNN outputs the top 10 web services relevant to the users. Explainable AI (LIME) provides transparency by giving insight into classification decision-making. Thus, the system enhances service selection, optimizes decision-making, and improves user experience.

V. SYSTEM ARCHITECTURE

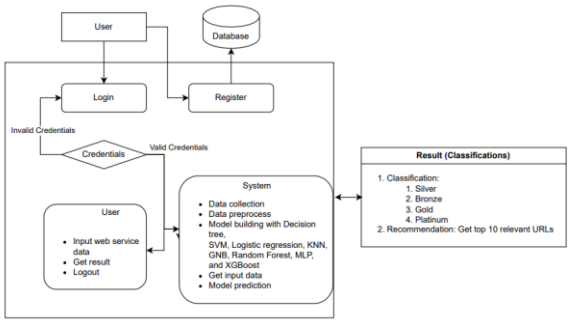

Fig 1 System architecture

The method of web service classification and recommendation is based on User Interaction, where users can Register or Login. User credentials are saved and validated in the Database. After successful login, users can input web service data, view results, or log out.

The primary procedures are Data Collection that allows us to receive information about the web service, Data Preprocessing for cleaning, and Model Building using machine learning models such as Decision Tree, SVM, Logistic Regression, KNN, Gaussian Naive Bayes, Random Forest, MLP, and XGBoost. The trained models are pattern matched to data and then use it to make predictions.

The system has two outputs: Classification Results, that is, the services are divided into Silver, Bronze, Gold, or Platinum grades, and Recommendations are at the top of the list of recommended web services according to classification and similarity scores. This will guarantee that a success pattern remains where user interaction, data analysis, and personalized service recommendations are concerned.

VI.MODULES

a. System Module

Data processing and model building are the tasks done by the system module while the predictions are the outcomes:

QoS Time Data Upload:

Information related to durability time (response time, availability, reliability, throughput) is collected.

Preprocessing:

Data cleaning is the first stage; subsequently, missing values are handled and formats are standardized.

Model Building:

Classification:

The use of machine learning algorithms can classify web services into four main segments, namely Bronze, Silver, Gold, and Platinum.

Venue:

The-output (recommendations) of 10 web services using K-nearest Neighbors and their relevancy to the input provided by the customer will be presented in this section.

Classification:

At a minimum, the spectrum grades of ISP based on machine learning techniques will be displayed in this section. The grades are raised to the level of Bronze, Silver, and Gold where Platinum is the highest.

Recommendation:

The machine learning algorithm KNN will be the one of the methods to implement top 10 service-based recommendations for the user.

Predictions and Results:

Quality rankings shown in an understandable manner include LIME explanations to the user. To present the 10 top recommendations including URLs and their similarities to the ones input by the user. Show a list of quality categories with explainable insights using LIME. Provide top 10 recommendations with key details like URLs and similarity scores.

b. User Module

The user module enables the user to interact easily with the system:

Register/Login:

Securely access the system features. Input Data: Data encoding the QoS information used for the classification and recommendation.

View Results:

Mention what all the classifications of quality class are and how they came about. First, the suggestions will be the user's top ones and later followed by new ones those are similar to the user. Quality classifications with explanations. List the top 10 personalized recommendations.

Logout:

Secure the current session.

VII.CONCLUSION

The Quality-Based Grade Classification using Explainable AI and Recommendation System is a project that is aimed to use machine learning to group web services based on their quality (Bronze, Silver, Gold, Platinum), which is supported by the QoS metrics such as response time, availability, and reliability. It employs K-Nearest Neighbors in making knowledge-based service recommendations and relies on LIME, an explainable AI tool, to provide understandable decision insights. The system is relatively strong—it can be easily restructured, handle large datasets, and has error handling which allows the end-users to work without interruptions or system reboots.

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