

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

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Abstract

The economic courts in Egypt play a crucial role in resolving disputes related to economic and commercial matters. These cases cover a wide range of issues that require timely and cost-effective resolutions to ensure the effective management of huge construction projects in Egypt. Machine learning plays a crucial role in the cases handled by Egyptian Economic Courts. It helps in the analysis of large amounts of data, identifying patterns and trends, and making predictions based on historical data. The research delves into the application of various algorithms to identify similar court rulings within Arabic texts, using a dataset comprising 3633 court rulings from the Economic Court in Egypt. The employment of various algorithms has facilitated the efficient **selection** of comparable court rulings, thus expediting the process of deriving effective conclusions within a minimal timeframe. The evaluation of classifier performance was conducted using metrics such as accuracy, precision, recall, and the F1 score. Notably, the

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A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

feature extraction done after asking expert judges for the judicial dataset yielded promising results, with an accuracy rate of 95.32%, an F1 score of 95.05%, a recall rate of 95.32%, and a precision rate of 95.32% when employing the Random Forest Classifier algorithm. Conversely, the Support Vector Classification algorithm yielded slightly inferior results. These findings underscore the efficacy of employing the Random Forest Classifier algorithm in conjunction with the count vectorizer feature extraction method for judicial datasets, particularly within the context of court rulings from the Economic Court in Egypt.

Keywords Machine Learning Algorithms; Smart Model; Cases in Economic Courts; Smart Courts; Feature Extraction; Metrics

نموذج ذكي لتقليل زمن انتظار القضايا في المحاكم الاقتصادية المصرية الملخص

تلعب المحاكم الاقتصادية في مصر دورًا حاسمًا في حل النزاعات المتعلقة بالقضايا الاقتصادية والتجارية. تشمل هذه الحالات مجموعة واسعة من المشكلات التي تتطلب قرارات فعالة وفي الوقت المناسب من حيث التكلفة لضمان الإدارة الفعالة لمشاريع البناء الضخمة في مصر. يلعب التعلم الآلي دورًا مهمًا في القضايا التي تتعامل معها المحاكم الاقتصادية المصرية. يساعد في تحليل كميات كبيرة من البيانات ، وتحديد الأنماط والاتجاهات ، وإجراء التنبؤات على أساس البيانات السابقة. يبحث البحث في تطبيق مختلف الخوارزميات لتحديد أحكام المحكمة المماثلة ضمن النصوص العربية ، باستخدام مجموعة بيانات تضم 3633 حكم من المحكمة الاقتصادية في مصر. لقد سهل توظيف الخوارزميات المختلفة الاختيار الفعال لأحكام المحكمة المماثلة ، وبالتالي الإسراع في عملية استخلاص الاستنتاجات الفعالة في إطار زمني بسيط. تم إجراء تقييم أداء المصنف باستخدام مقاييس مثل الدقة ، والاستدعاء ودرجة F1. والجدير بالذكر أن استخراج البيانات تم بعد سؤال القضاة الخبراء بمجموعة البيانات القضائية أسفرت عن نتائج واعدة ، بمعدل دقة وقدره 95.32 % ، ودرجة F1 بنسبة 95.05 % ، ومعدل استدعاء قدره 95.32 % ، ومعدل تدقيق 95.32 % عند توظيفهم خوارزمية مصنف الغابة العشوائية. على العكس ، أسفرت خوارزمية تصنيف ناقلات الدعم عن نتائج أدنى قليلاً. تؤكد هذه النتائج على فعالية استخدام خوارزمية مصنف الغابات العشوائية بالتزامن مع طريقة استخراج ميزة المتجهات العد لمجموعات البيانات القضائية ، وخاصة في سياق أحكام المحكمة من المحكمة الاقتصادية في مصر.

الكلمات المفتاحية : خوارزميات التعلم الآلي، نموذج ذكي ،قضايا في المحكمة الاقتصادية، المحاكم الذكية ،محددات استخراج الخاص

I. Introduction

The Economic Court Law, which came into effect in October 2008, has significantly expanded the jurisdiction of the courts in handling various commercial and financial disputes. With a focus on investment operations, consumer protection, and banking transactions, the ordinary courts are now empowered to act as competent economic courts, addressing a wide range of causes related to capital markets, intellectual property, and insolvency and banking laws [7, 23].

However, the increasing number of cases has led to a backlog, posing a challenge to the timely resolution of disputes and the protection of legitimate rights. To alleviate this burden and improve efficiency, machine learning techniques can be employed to assist in the management and decision-making process within the Egyptian Economic Courts [24, 25].

By analyzing large volumes of data, machine learning algorithms can identify patterns and make predictions, helping judges and court administrators make more informed decisions. Using machine learning in the Egyptian Economic Courts can enhance the efficiency and accuracy of case management and decision-making processes, ultimately leading to fairer resolutions for economic disputes [26, 27].

In response to this dilemma, the digitalization of courts in China [5] offers a promising opportunity to enhance judicial efficiency and streamline the judicial process by leveraging modern technology, the economic courts can improve the conduct of procedures, ensuring that litigants have access to easy, effective, and timely judicial protection of their rights [3, 12].

This research aims to explore the use of several algorithms to find comparable court decisions in Arabic texts using data from the Egyptian Economic Court, which expedited the procedure of deriving efficacious conclusions within a limited time frame. The rest of this paper is organized as follows: Section 2 is a related work. Section 3 shows the proposed model. Section 4 presents the methodology and dataset. Section 5 presents the results. Section 6 presents the conclusion and future work.

II. Related work

This section includes an overview of prior research in the field that focuses on machine learning studies that examine historical court rulings.

Liu, Z., and Chen, H [28] conducted a study that involved an empirical examination wherein they compared the predictive efficacy of five renowned machine learning models, namely k-NN, logistic regression, bagging, random forests, and SVM. The objective of this investigation was to forecast judicial rulings made by the European Court of Human Rights (ECHR) solely based on the textual data extracted from pertinent sections of ECHR judgments. The dataset utilized in this paper comprises of instances asserting infringements upon the civil and political liberties stipulated within the European Convention on Human Rights (ECHR or Convention).

In [29] presented a technique for the efficient categorization of Chinese legal texts through the utilization of deep semantic comprehension. The suggested approach integrates the extraction of domain knowledge with Graph LSTM in order to enhance the accuracy of document classification, specifically within the framework of Chinese legal texts. The study outlines the development of a judicial domain model that is built upon

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

ontologies, encompassing both a high-level ontology and a specialized ontology within the legal domain.

Paper [30] discussed the progress of an information extraction system for Arabic law documents, employing a hybrid technique that amalgamates machine learning and rule-based methodologies. Additionally, it tackled the obstacles and feasible implementations of Arabic information extraction in the realm of law. The paper used the decision tree classifier as the most efficient method for relation extraction and proposes showcasing outcomes in a more user-friendly approach.

The researchers in [31] evaluated the foreseeability and lucidity of judicial rulings, in addition to deducing the foundation of these forecasts through data-centric methodologies. They also scrutinized the possibility of employing these methodologies to anticipate results and enhance prognostications by employing more sophisticated machine learning techniques and incorporating more comprehensive linguistic data.

The authors of [1] gave a summary of how big data, artificial intelligence, and technology are used in the Chinese legal system and offered a critical analysis of the advantages and disadvantages that could arise from their use. They outlined the possible advantages of the smart court system, including reduced costs, quicker conflict resolution, simpler access to justice, and enforceable rulings. The use of automated judgments, challenges with the digital division, judicial independence, privacy, and data protection are some of the other concerns raised by the report.

Study [32] presented a legal framework derived from machine learning algorithms to categorize perpetrators in legal

proceedings, with a specific emphasis on cases involving dowry-related fatalities. It explores the adoption of various classifiers and ensemble classifications to enhance precision. The proposed framework seeks to mechanize the procedure of legal text classification to prognosticate the wrongdoing of the implicated individual.

In the field of legal studies, a comprehensive investigation was conducted by [33] regarding the forecast of verdicts in diverse courts within the Turkish legal system. This study specifically concentrates on the prognostication of judgments rendered by the Turkish Constitutional Court and the Courts of Appeal, solely relying on factual descriptions rather than direct exposure to the actual rulings. Consequently, this examination furnishes a systematic framework that possesses the capacity to be implemented in the analysis of alternative legal systems, thereby transcending the confines of the Turkish legal system.

The authors in [34] gathered a dataset containing 514 legal judgments from the Errachidia Court in Morocco and subsequently analyzed this dataset to extract significant features that may have an impact on the results of such cases. The objective of the research is to make a valuable contribution to decision-making within the justice system by employing machine learning algorithms to forecast legal outcomes. However, the precise machine learning techniques utilized are not explicitly specified.

Study [35] focused on formulating a predictive model that can replicate the actions of adjudicators and contribute to the acceleration of the decision-making procedure. The dataset employed for this purpose encompasses rulings emanating from the Errachidia court in Morocco, with particular emphasis on episodes of mishaps that transpired between the years 2017 and 2019. The research endeavor involved the application of three

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

distinct machine learning methodologies, namely linear regression, decision tree, and random forests, in an attempt to prognosticate the quantum of compensation that ought to be awarded to victims of accidents

Paper [36] highlighted value-laden character of decision-making in the creation and formulation of Machine Learning (ML) systems, underscoring the fact that these decisions encompass compromises that mirror societal, political, and ethical principles. Furthermore, the paper offered suggestions for the application of ML in penal systems, with a particular emphasis on tackling the possible uneven consequences and ethical deliberations linked to recidivism prediction algorithms. Paper [37] illustrated the utilization of natural language processing (NLP) in the processing of legal text data, the extraction of valuable insights from unstructured legal documents, and the development of predictive models to comprehend and potentially predict case outcomes. Furthermore, the paper underscored the potential advantages and difficulties of employing machine learning and NLP in the legal field, accentuating the significance of comprehending the constraints and ethical considerations associated with these technologi

Table 1 provides a summary of the literature comparison that highlights the main objective and limitations of each paper

Table 1. Literature comparison

Authors	Year	The main objective	ML Model	Limitations
Liu, Z., & Chen, H	2017	This study investigated and contrasted the predictive efficacy of distinct machine learning models regarding judicial cases.	k-Nearest Neighbors (k-NN), logistic regression, bagging, random forests, and Support Vector Machine (SVM)	<ul style="list-style-type: none"> - the dataset utilized in the study is of a relatively diminutive scale, encompassing solely 250, 80, and 254 samples for every grouping of trials. - the study failed short to provide a comprehensive analysis of the elements that motivate judicial determinations.

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

Li, G., Wang, Z., & Ma, Y.	2019	This paper suggested a deep semantic understanding-based approach for classifying Chinese legal documents.	Graph LSTM	The study lacked a thorough examination of the suggested approach's performance in terms of recall, precision, and F1-score. Moreover, the computational complexity of the suggested method is not thoroughly examined, which is crucial for real-world applications.
Shamma, S. A., Ayasa, A., & Yahya	2020	The primary objective of this research is to construct an information retrieval	Decision Tree classifier(j48)	- The paper mentioned the difficulty in learning due to significant differences in requirements and style

		framework for legal documents in the Arabic language by employing a mixed methodology that integrates both machine learning and rule-based approaches.		between legal systems. - Additionally, the suboptimal outcome observed when considering complete documents as singular entities for each of the extracted connections resulted in the determination to utilize separate paragraphs as the instructional materials for diverse connections.
Medvedeva, M., Vols, M., & Wieling,	2020	The research paper investigated the	Support Vector Machine (SVM)	The study recognized the conjectural quality of the error

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

M.		utilization of machine learning and natural language processing methodologies in order to forecast judicial rulings, with a particular emphasis on court verdicts originating from the European Court of Human Rights.		examination, as it presents a formidable task to precisely identify the specific variables exerting influence on the prognostications generated by the machine learning algorithm.
Shi, C., Sourdin, T., & Li, B.	2021	This study aimed to investigate the deployment of the 'smart court' system in the People's Republic of China and its	----	The absence of case studies or empirical evidence in the study

		consequential influence on the judicial process.		
Sil, R., & Roy, A.	2021	This research introduced a legal model that utilizes machine learning algorithms to classify offenders involved in legal proceedings, with a specific emphasis on cases related to dowry deaths.	Decision Tree Classifier, K-Nearest Neighbour Classifier, Naïve-Bayes Classifier	the paper failed to consider the possible obstacles or constraints associated with employing machine learning in the legal field, such as the interpretability of the model's determinations and the potential biases present in the training data.
Mumcuoğlu, E., Öztürk, C. E., Ozaktas,	2021	This paper examined the efficacy of machine learning	Decision Trees, Random Forests, Support	It is evident that the efficacy of models is significantly

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

H. M., & Koç, A.		models in forecasting the decisions of Turkish higher courts through the sole analysis of provided factual descriptions.	Vector Machines (SVMs).	impacted when operating on lengthy texts. In an attempt to address this problem.
Aissa, H., Tarik, A., Zeroual, I., & Yousef, F.	2 021	The research examined machine learning techniques in predicting the outcomes of accident litigations in the judicial system of Morocco.	linear regression, vector support machines, and decision trees	The dataset is constrained in terms of its size and scope, as well as the specific reasoning for choosing these algorithms, and the potential constraints in their application are not addressed.
Biddle, J. B.	2 022	The study analyzed the significance of subjective assessments	No techniques	This paper offered suggestions for the utilization of

		in the construction of machine-learning (ML) frameworks		machine learning in correctional systems and does not extensively discuss the practical obstacles and intricacies.
Haidar, A., Ahajjam, T., Zeroual, I., & Farhaoui, Y.	2022	This study examined the application of machine learning algorithms in forecasting the outcomes of accident cases in Moroccan courts.	Linear Regression, Decision Tree, Random Forests	The need to investigate natural language processing techniques to extract additional data from the judgments and improve the accuracy of the predictive model in order to expedite the decision-making procedure.
Lockard, K., Slater, R., &	2023	In this work, the modeling of US Supreme	NLP	Because of the unbalanced data, the

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

Sucrese, B.		Court cases using Natural Language Processing (NLP) approaches was investigated.		model had trouble with recall and had poor F1 scores, this suggested that more balanced datasets are needed to enhance model performance.
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Presentation of historical data via descriptive analytics, with a focus on business events. Descriptive analytics, in contrast to other analytical approaches, seeks to provide the data in an intelligible manner rather than drawing conclusions or forecasts from it.

The significance of this paper is evaluating the effectiveness of several machine learning strategies for recognizing court decisions from the Economic court system utilizing Arabic dataset content. Through an analysis of these methods' efficacy, this study seeks to further the development of legal technology and data analysis within the context of the Egyptian economic court system.

III. The proposed model

According to the related work in the previous section, we proposed the following model for Egyptian Economic Courts.

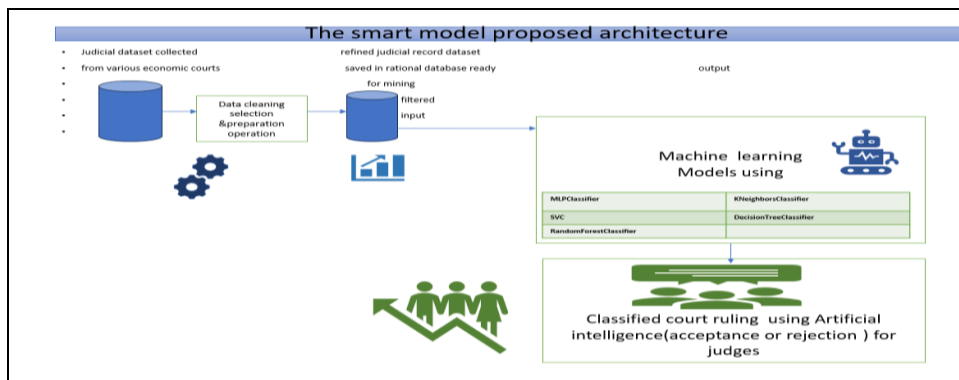


Figure [1] The proposed smart model to minimize the waiting time for cases in Egyptian economic courts

The previous modeling figure [1] the proposed smart model illustrates the steps suited to obtain classified cases using artificial intelligence, it consists of five steps:

A. Judicial data collection

The datasets collected come from one or more courts according to the datasets available in the system of the court usually it is not prepared for using techniques but they will be filtered and prepared for the mining process.

B. Data Cleaning

Here the judicial data is cleaned by excluding unused data then the datasets are ready for the mining process.

C. Data Preparation

The act of readying unprocessed information to make it appropriate for subsequent processing and examination.

D. Using machine learning techniques

Processing the prepared datasets and using artificial intelligence techniques that separately reflect each algorithm results, the used algorithms as shown in the model:

- The Multilayer Perceptron (MLP) Classifier: which utilizes artificial neural networks to map input data to appropriate outputs through interconnected layers of neurons [9].
- Support Vector Classifier (SVC) Classifier: is a supervised learning algorithm that operates by mapping data points to a high-dimensional space and identifying the optimal hyperplane to separate the data into distinct classes [4].
- Random Forest Classifier: employs multiple decision trees to generate class predictions through a majority voting system, these machine learning techniques have significantly advanced the capabilities of computer programs in processing and analyzing data, making them invaluable tools for a wide range of applications [9].
- Decision Tree Classifier: use attribute values to predict class labels, with a process of iterative growth and pruning to improve generalization [6].
- K-nearest neighbors (KNN) Classifier: which leverages proximity to classify or predict data points based on their similarity to neighboring points [2].

E. Results

The utilization of diverse assessment criteria to comprehend the effectiveness of a machine learning model.

The current system in the Economic Court describes the steps of the lawsuit from the beginning at first the registration of new

lawsuit original data as shown in figure [2]. It can be clarified through the following steps:

1-Entry of original information of the lawsuit: economic courts data entry employees receive the new lawsuit and begin to enter the original information of the lawsuit and scan the documents of it such as (the national number or Cartier of a lawyer, original paper of the lawsuit which includes the requests of the plaintiff, notes from the plaintiff against the defendant, original cheques).

2-The citizen or lawyer pays the worthy amount, and the confirmation is done by the accounting system.

3-The secretary of the session adds the lawsuit to the agenda, the lawsuit session date is defined, and the session minute data is entered.

4-The lawsuit life is the court ruling has been written by the judge manually,

This thesis focuses on this step after all steps have been completed.

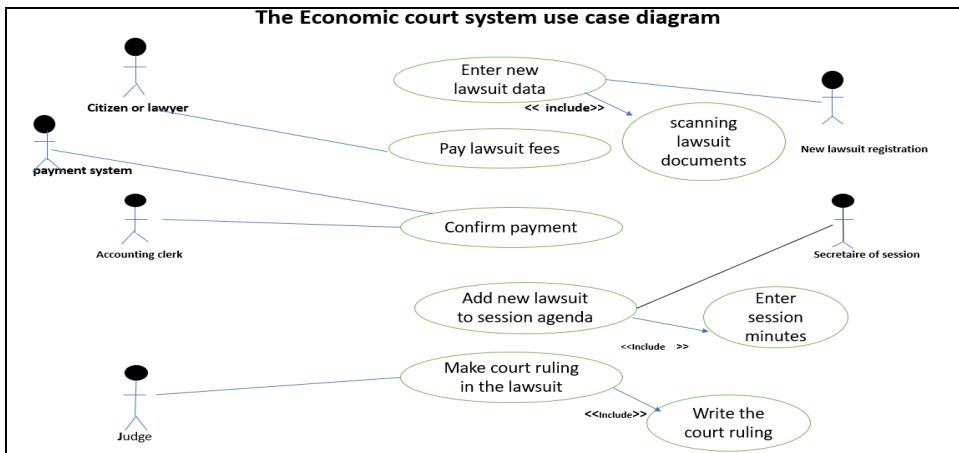


FIGURE2. THE ECONOMIC COURT USECASE DIAGRAM

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

Figure [3] Activity diagram for the machine learning techniques used provides a visual representation of the workflow involved in processing datasets, extracting features, applying classification algorithms, and evaluating the performance of the models using metrics such as accuracy, F1 score, recall, and precision. Each component plays a crucial role in the data processing pipeline, contributing to the overall analysis and interpretation of the data.

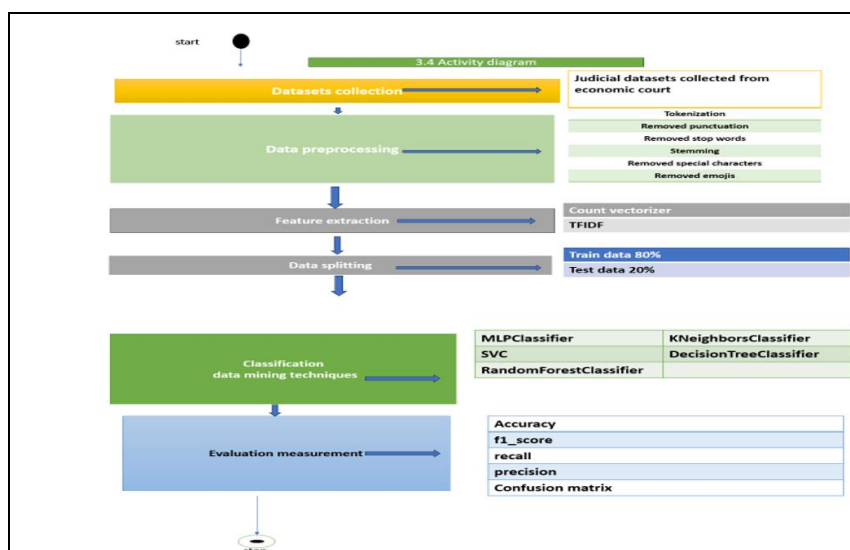


FIGURE3. ACTIVITY DIAGRAM FOR THE MACHINE LEARNING USED TECHNIQUES

Figure [4] The flowchart of the machine learning techniques used in this study illustrates the iterative nature of machine learning, with feedback loops between model training and evaluation, as well as the importance of data in driving the entire process. Additionally, the image might include specific algorithms or techniques commonly used in machine learning, such as regression, classification, clustering, deep learning, and

more. The purpose of this diagram would be to visually explain and simplify the complex process of creating a machine-learning model, providing a high-level overview of the key steps involved.

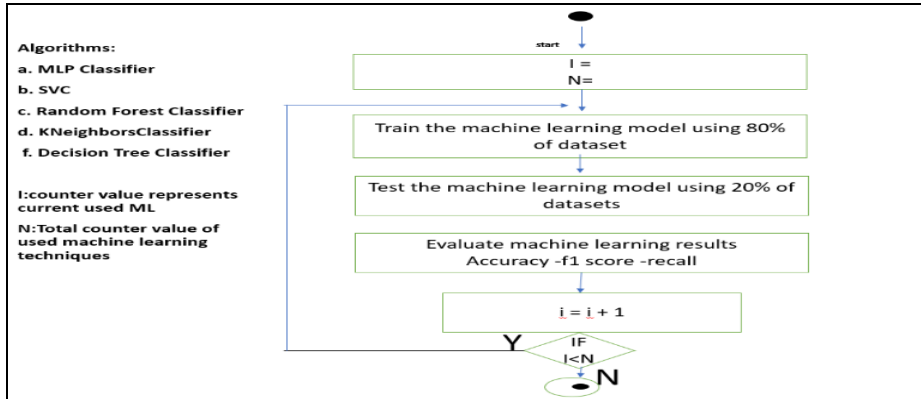


FIGURE 4 FLOWCHART OF MACHINE LEARNING

USED TECHNIQUES

IV. Methodology

A. Problem formulation and dataset

The goal of this research is to create a model that will reduce the period cases at the Egyptian Economic Court must wait. Three primary steps comprise the suggested model: input, processing, and output, in that order. After the initial data is cleaned and sorted to remove punctuation, stop words, tokenization, and stemming, it is divided into training and testing sets. Various methods are then chosen, features are chosen, and the outcomes are assessed.

To write the court ruling now it would take from 30 to 60 days and the judge writes it manually in the system after applying the model it is predicted to take one hour to write the court ruling and the judge can browse easily the similar court ruling issued before at the Economic court

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

all over the other Economic court in Egypt which can achieve transparent justice. To achieve this goal, we can take 4 steps:

- Get historical datasets from the Economic court consisting of past court rulings issued before by the court saved in an Excel sheet
- Using a program suitable for applying Artificial Intelligence techniques to preprocess the datasets, train and test the dataset's results outcome
- Evaluate the best outcomes that appeared at the program
- Choose the best outcomes for applicable

To minimize the waiting time for the cases the datasets as shown in figure [5] were collected from the Economic Court of Qena system as a branch of the Economic Court in Egypt for this purpose we converted this dataset to comma-separated value (CSV) format.

There is a total of 3633 records of economic court rulings which contain 7 attributes as shown in table [2], 3129 acceptance of requests and 504 rejections of requests.

TABLE 2. CATEGORIZED LAWSUIT MODEL DIAGNOSTIC INFORMATION

1	Lawsuit no(رقم الدعوي)	This number is a unique number at the court (each lawsuit has a number and the year of lawsuit was born)
2	Year of lawsuit (سنة الدعوى)	The year of recordation of the lawsuit
3	Dispute type (نوع المنازعة)	Each lawsuit belongs to a specific law which could be subjected to their judicial decision
4	Sub-dispute type (نوع المنازعة الفرعي)	The more specific law type to which the lawsuit is subject to it (more detailed branch choice)
5	The requests (الطلبات الختامية) Input	Explain the final and all requests the plaintiff person needs to issue a judgment against the defendant
6	The decision of the judge or the court ruling (منطوق الحكم)	The court ruling that the judge issued after he read and heard from both sides of the conflict
7	Results (حالة الدعوي من حيث قبول او رفض) Output	If the judge accepts the requests of the plaintiff or does not accept the requests

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

رقم القضية	تاريخ التظلم	الجهة الداعية	الجهة المدعى عليها	القيمة المدعى عليها	القيمة المدعى عليها	القيمة المدعى عليها	القيمة المدعى عليها	القيمة المدعى عليها	القيمة المدعى عليها
1	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
2	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
3	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
4	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
5	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
6	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
7	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
8	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
9	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
10	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
11	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
12	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
13	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000
14	2023-01-01	مكتبات تليفون	مكتبات تليفون	100000	100000	100000	100000	100000	100000

FIGURE[5]. SCREENSHOT OF THE DATASETS WITH SEVEN ATTRIBUTES THAT WERE CONVERTED TO CSV FORMAT FILE

B. Data Cleaning Preprocessing & Data Preparation

Pre-processing techniques are essential steps in preparing textual data for analysis. These techniques involve removing punctuation and non-alphabetic characters, a process known as cleansing. Tokenization is another important step, where the text is divided into individual words or tokens. Stemming, which involves reducing words to their base or root form, is also commonly used. Additionally, removing stop words, such as "the" and "and", can help improve the efficiency of text analysis by eliminating common words that do not carry significant meaning. Overall, these pre-processing techniques play a crucial role in ensuring that textual data is clean, organized, and ready for further analysis.

1. Removed punctuation

As shown in figure [6], Punctuation removal is a technique utilized to minimize the amount of data by eliminating unnecessary characters such as (!"#%&\'()*+,-./:;<=>?@[\\]^_`{|}~'). This process aids in streamlining the information and reducing the overall data size [22]

رقم الدعوى	السنة	نوع المتابعة	نوع المتابعة الفرعي	requests	منقول الحكم	results	requests_nopunc
0	1 - اشكال	2023	إشكالات تنفيذ	قانون البنك المركزي والجهاز المصرفي والنقد	الزام المدني عليهم بالتكاسف فيما بينهم بأن يؤدوا...	الزام المدني عليه بالتكاسف فيما بينهم بأن يؤدوا...	الزام المدني عليهم بالتكاسف فيما بينهم بأن يؤدوا...
1	117 - اقتصادي	2013	اقتصادي	اخرى	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	الزام المدني عليه بان يؤدي المدني مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...
2	15 - س -	310	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
3	15 - س -	311	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
4	15 - س -	35	اقتصادي	اخرى	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	الزام المدني عليه بان يؤدي المدني مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...
5	15 - س -	310	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
6	50 - س -	36	اقتصادي	اخرى	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...
7	15 - س -	311	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
8	15 - س -	35	اقتصادي	اخرى	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	الزام المدني عليه بان يؤدي المدني مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...
9	53 - اقتصادي	2018	اقتصادي	اخرى	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...

FIGURE[6] SHOTSREEN REMOVED PUNCTUATION

2.Tokenization

As shown in Figure [7], the tokenization data handling technique involves dividing the given text into smaller units known as tokens. This process allows for easier analysis and manipulation of the text data [22].

رقم الدعوى	السنة	نوع المتابعة	نوع المتابعة الفرعي	requests	منقول الحكم	results	requests_nopunc	requests_tokenized
0	1 - اشكال	2023	إشكالات تنفيذ	قانون البنك المركزي والجهاز المصرفي والنقد	الزام المدني عليهم بالتكاسف فيما بينهم بأن يؤدوا...	الزام المدني عليهم بالتكاسف فيما بينهم بأن يؤدوا...	الزام المدني عليهم بالتكاسف فيما بينهم بأن يؤدوا...	الزام المدني عليهم بالتكاسف فيما بينهم بأن يؤدوا...
1	117 - اقتصادي	2013	اقتصادي	اخرى	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	الزام المدني عليه بان يؤدي المدني مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...
2	15 - س -	310	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
3	15 - س -	311	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
4	15 - س -	35	اقتصادي	اخرى	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	الزام المدني عليه بان يؤدي المدني مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...
5	15 - س -	310	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
6	50 - س -	36	اقتصادي	اخرى	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...	بإلزامه بان يؤدي لتكف المدني بمصقله مبلغ القرض الموزع في الموزع في 2-1-...
7	15 - س -	311	اقتصادي	اخرى	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...	الزام المدني عليهم متكاسفين بان يؤدوا لتكف...
8	15 - س -	35	اقتصادي	اخرى	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	الزام المدني عليه بان يؤدي المدني مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...	براهة ذمة المدني من مبلغ القرض الموزع في الموزع في 2-1-...
9	53 - اقتصادي	2018	اقتصادي	اخرى	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...	الزامهم متكاسفين ضمانين بان يؤدوا لتكف...

Out[18]:	requests_stemmed	requests_nostop	requests_tokenized	requests_nopunc	results	منطوق الحكم	requests	نوع المتزعة	نوع المتزعة الفرعي	السنة	رقم الدعوى
	إزاد مدع على مختصان, بان, يودو بلكر, ميع, ...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد المدعي عليه مختصان فيما بينهم بان يودو...	قرون العائلات	الزام المدعي عليه مختصان فيما بينهم بان يودو...	إزاد المدعي عليه مختصان فيما بينهم بان يودو...	قانون البنك المركزي والجمهور المصرفي وبنك	شكايات تنفيذ	2023	1 - 0
	إزاد مدع على مختصان, بان, يودو بلكر, ميع, ...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد مدع المدعي من ميع, مختصان, الموزج, ...	قرون العائلات	براهة مدع المدعي من ميع, مختصان, الموزج في 1201...	إزاد المدعي عليه بان يودو مختصان في الموزج في 1-2...	أخرى	الاقتصادي	2013	117 - 1
	إزاد مدع على مختصان, بان, يودو بلكر, ميع, ...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد مدع المدعي من ميع, مختصان, الموزج, ...	قرون العائلات	إزاد المدعي عليه مختصان بان يودو مختصان فيما مختصان...	إزاد المدعي عليه مختصان بان يودو مختصان فيما مختصان...	أخرى	الاقتصادي	10	15 - 2
	إزاد مدع على مختصان, بان, يودو بلكر, ميع, ...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد مدع المدعي من ميع, مختصان, الموزج, ...	قرون العائلات	إزاد المدعي عليه مختصان بان يودو مختصان فيما مختصان...	إزاد المدعي عليه مختصان بان يودو مختصان فيما مختصان...	أخرى	الاقتصادي	11	15 - 3
	إزاد مدع على مختصان, بان, يودو بلكر, ميع, ...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد المدعي عليه, مختصان, يودو بان, ي...	إزاد مدع المدعي من ميع, مختصان, الموزج, ...	قرون العائلات	إزاد المدعي عليه مختصان بان يودو مختصان فيما مختصان...	إزاد المدعي عليه مختصان بان يودو مختصان فيما مختصان...	أخرى	الاقتصادي	5	15 - 4

FIGURE [9.] SHOTSREEN OF STEMMING

C. Feature extraction & and selection

After completing the data cleaning, and data preparation process the data is ready for feature extraction using machine learning techniques [20]. The procedure known as "feature extraction" transforms raw data into an asset. As part of the feature extraction procedure, the acquired data are clustered, which entails grouping them according to two elements: their features.

This method effectively minimizes the quantity of data that needs to be processed while properly representing the original material by breaking text down into its most basic qualities. Numerous approaches can be employed for feature extraction [10].

Feature selection is defined after asking the experts and specialized judges in the judicial field to prove that two important features are related to each other in such specific Economic court lawsuits which are the requests and results attributes. In this feature extraction count vectorizer for the judicial dataset collected from the Economic court system results in the best accuracy of 95.32, F1 Score 95.05%, Recall 95.32, and precision 95.32 generated from Random Forest

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

Classifier on the other hand SVC generated less results accuracy 94,77%, F1 Score 94.30%, precision 94.77%.

Data is split into two categories: training data and test data. This division may allow for the use of one subset of the data for training and another for evaluating the prediction performance. To assess the model trained on the dataset, we make use of some of the remaining cases from the dataset. There are various techniques for splitting data, such as the hold-out method and the cross-validation method [9].

Judicial datasets were subjected to machine learning algorithms to identify the accepted results or rejected results. A binary categorization system has been developed in which any court ruling including acceptance is coded as 1 and the rejected results are coded as 0, the dataset is divided into 80 % training and 20% test.

V. Results and Discussion

A. Evaluation Metrics

In the context of the data analytics lifecycle, the assessment of the constructed models holds significant importance. The efficacy of classification models is typically gauged by their ability to accurately predict outcomes for new data points. This evaluation is often conducted using a test or holdout dataset, which is imperative for determining the model's performance [15]. We employed the following metrics to assess the judgment: accuracy, precision, recall rate, and F1-score.

- **Accuracy**

The accuracy assesses the overall ratio of correctly classified court ruling documents to the total number of accepted requests documents, as well as refused requests documents, using the formula [12]:

$$\text{Accuracy} = \frac{\text{TP} + \text{TN}}{\text{TP} + \text{FP} + \text{TN} + \text{FN}}$$

- F1- Score

The F1_ score is a weighted average of the accuracy and recall scores. The worst F1 score is 0, and the finest F1 score is 1. It is noted as [19]:

$$2 * \text{Precision} * \text{Recall}$$

$$\text{F1 score} = \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}}$$

- Recall

It means the number of correct results divided by the number of results that should have been returned In binary classification, recall is called sensitivity. It can be

viewed as the probability that a relevant document is retrieved by the query [18].

$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}$$

- Precision

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

Precision is calculated by dividing the total number of true positives by the total number of true positives + false positives [11].

$$Precision = \frac{TP}{TP+FP}$$

B. Results and Discussion

Various machine learning algorithms, such as the Decision Tree Algorithm, K-Nearest Neighbors Algorithm, MLP Classifier Algorithm, Random Forest Algorithm, and Support Vector Classification Algorithm are commonly employed in these studies. The results of the other 5 algorithms have been processed and used in the Classifier Model algorithm.

In figure [10], used Accuracy, F1-Score, Recall, and Precision to get the results of the performance of five machine learning classifiers on 3633 Arabic datasets. The Random Forest Classifier and Decision Tree Classifier did better results with count Vectorizer feature extraction with the judicial dataset from the economic court achieving an Accuracy of 95.46, F1-Score 95.17, and Recall 95.46 while MLP Classifiers and KNeighbors classifier did the lowest result with count vectorizer feature extraction Accuracy 95.32, F1_Score 94.96, Recall 95.32, precision 95.57. Classified cases after using the machine learning techniques are ready for the judge's decision (acceptance or rejection).

Model	Accuracy	f1_score	recall	precision
RandomForestClassifier	95.46	95.17	95.46	95.55
DecisionTreeClassifier	95.46	95.17	95.46	95.55
MLPClassifier	95.32	94.96	95.32	95.57
SVC	95.32	94.96	95.32	95.57
KNeighborsClassifier	95.32	94.96	95.32	95.57

FIGURE [10] SHOTSREEN OF THE USED MODELS SCORES COMPARISON

Figure [10] The used models' scores shotscreen illustrates the model score table comparison, the best model results from the Random Forest classifier and Decision Tree Classifier, and the lowest model results MLP Classifier, SVC, and KNeighbors Classifier respectively.

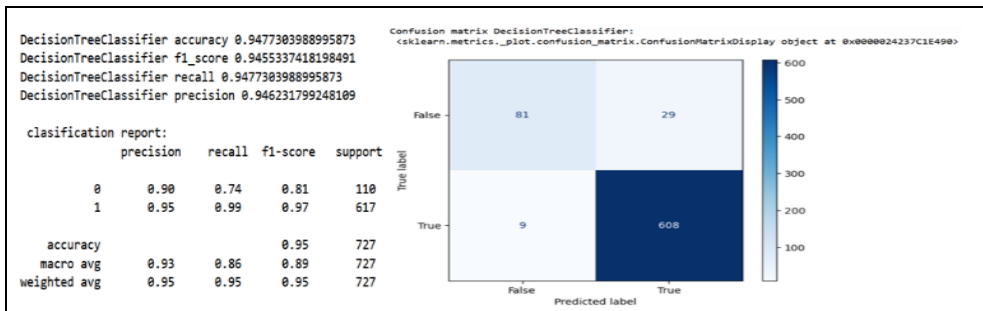
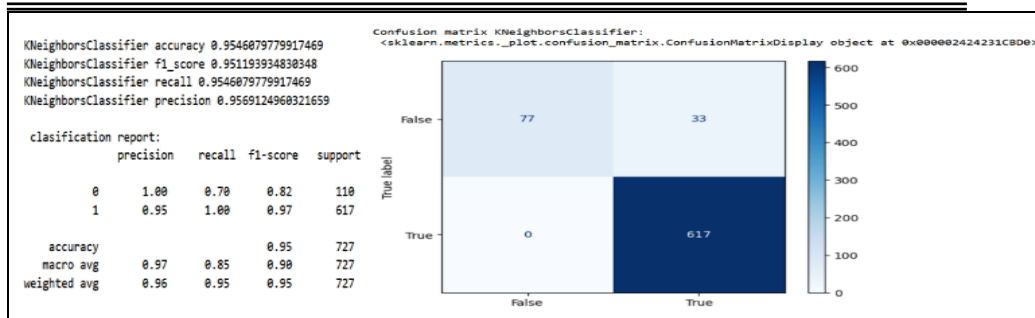


FIGURE [11] SCREENSHOT OF THE CONFUSION MATRIX AND CLASSIFICATION REPORT DECISION TREE CLASSIFIER

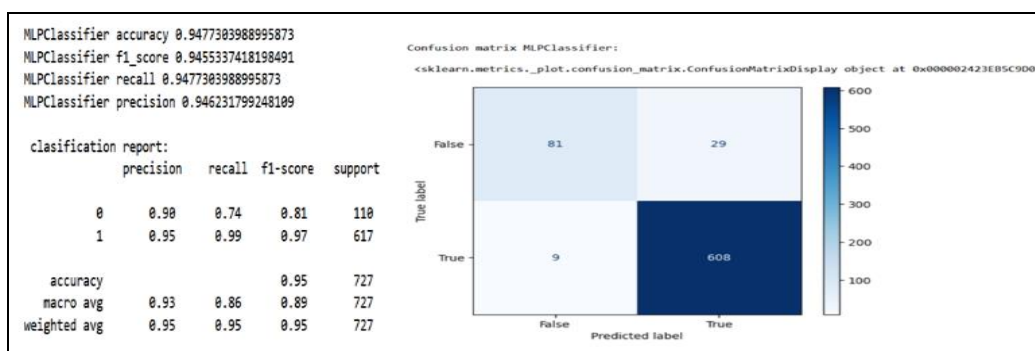
Figure [11] The confusion matrix and classification report of the decision tree classifier illustrates the result of judicial Datasets (The operative court ruling) from the Economic court System and the Confusion Matrix of the Decision Tree Classifier after applying the Count Vectorizer for Acceptance or Rejection of the Plaintiff's final Requests.

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts



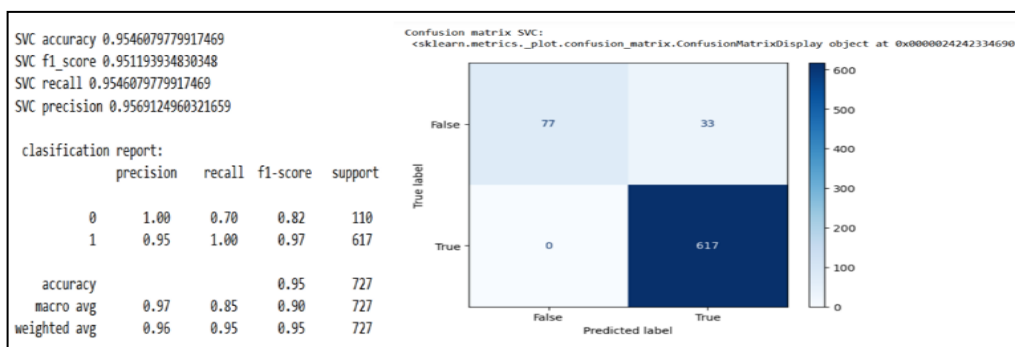
FIGURE[12] SCREENSHOT OF THE CONFUSION MATRIX AND CLASSIFICATION REPORT KNEIGHBORS CLASSIFIER MODEL.

Figure [12] The confusion matrix and classification report of the KNeighbor classifier model illustrates the result of judicial Datasets (The operative court ruling) from the Economic court System and the Confusion Matrix of the KNeighbors classifier after applying the Count Vectorizer for Acceptance or Rejection of the Plaintiff's final Requests



FIGURE[13] SCREENSHOT OF THE CONFUSION MATRIX AND CLASSIFICATION REPORT MLP CLASSIFIER MODEL.

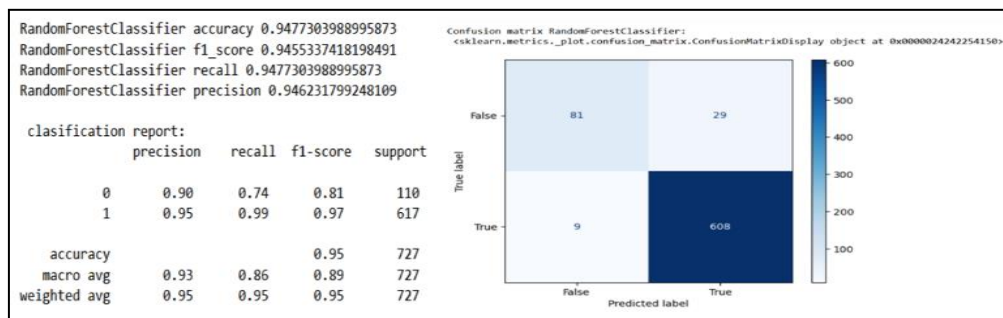
Figure [13] The confusion matrix and classification report of the MLP Classifier model illustrates the result of judicial Datasets (The operative court ruling) from the Economic court System and the Confusion matrix of the MLP Classifier after applying the Count Vectorizer for Acceptance or Rejection of the Plaintiff's final Requests.



FIGURE[14] SCREENSHOT OF THE CONFUSION MATRIX AND CLASSIFICATION REPORT SVC MODEL.

Figure [14] The confusion matrix and classification report of the SVC model illustrates the result of judicial Datasets (The operative court ruling) from the Economic court System and the Confusion Matrix of SVC after applying a Count Vectorizer for Acceptance or Rejection of the Plaintiff's final Requests.

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts



FIGURE[15] SHOTSREEN OF THE CONFUSION MATRIX AND CLASSIFICATION REPORT RANDOMFOREST CLASSIFIER MODEL.

Figure [15] The confusion matrix and classification report of the Random Forest Classifier model illustrates the result of judicial Datasets (The operative court ruling) from the Economic court System and the Confusion Matrix of the Random Forest Classifier after applying the Count Vectorizer for Acceptance or Rejection of the Plaintiff's final Requests.

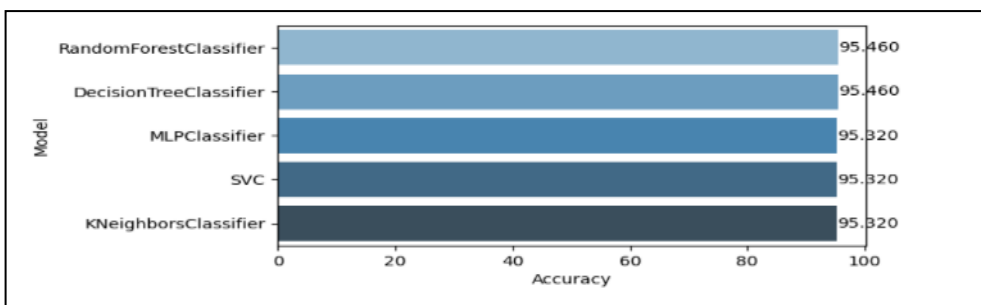


FIGURE [16] SHOTSREEN OF THE ACCURACY RESULT IN COMPARISON BETWEEN THE USED AI MODELS

Figure [16] Screenshot of accuracy results illustrate the five-model accuracy comparison from the best accuracy result to the lowest accuracy result.

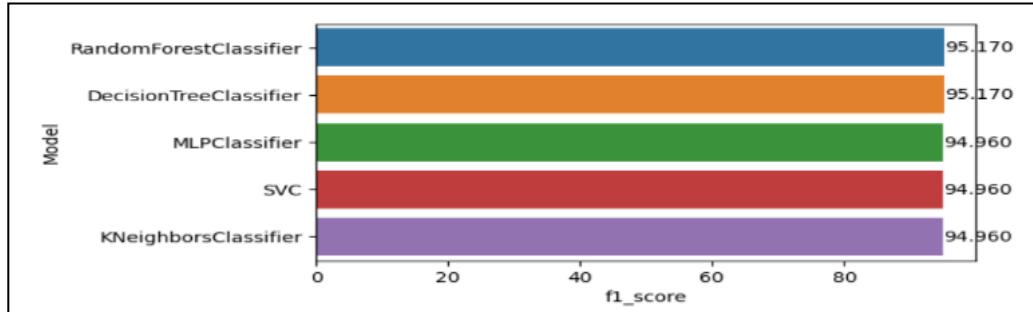
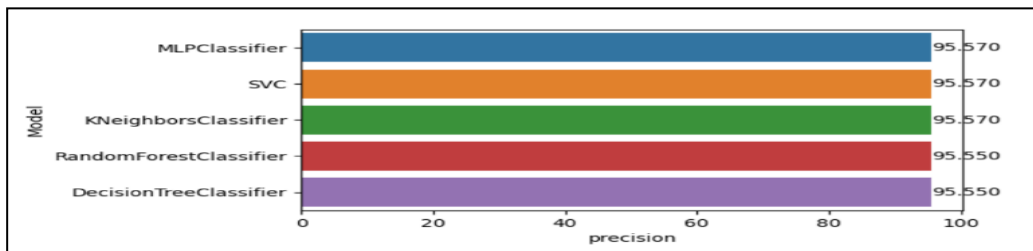


FIGURE [17] SHOTSCREEN OF THE F1 SCORE RESULT IN COMPARISON BETWEEN THE USED AI MODEL

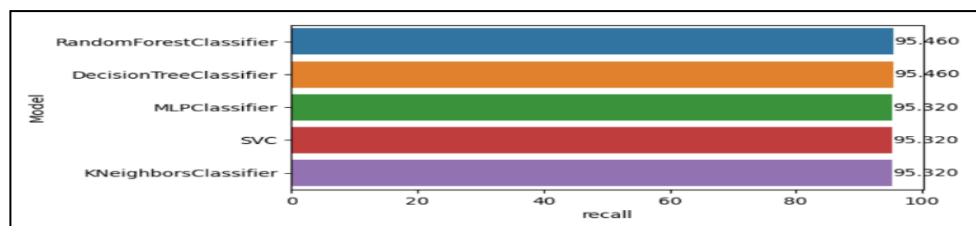
Figure [17] The f1 score results illustrate the five models' F1 score comparison from the best f1 score result to the lowest F1 score result.



FIGURE[18] SHOTSCREEN OF THE PRECISION RESULT IN COMPARISON BETWEEN THE USED AI MODELS

A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

Figure [18] The precision results illustrate the five models' precision comparison from the best precision result to the lowest precision result.



FIGURE[19] SHOTSREEN OF THE RECALL RESULT IN COMPARISON BETWEEN THE USED AI MODELS

Figure [19] The recall results illustrate the five models' precision comparison from the best recall result to the lowest recall result.

I.

Judicial datasets were gathered from the Egyptian Economic court system in Arabic because the decision-making process is not something that can be taken lightly and should be done correctly, effectively, and promptly. This would allow the Arabic judicial court ruling a good chance to be examined and be useful for future court rulings.

The accuracy, f1 score, recall, and precision of the chosen feature of the dataset were assessed using five techniques. This study varies from others in that the court ruling was examined using machine learning algorithms (MLP Classifier, Random Forest Classifier, Decision Tree Classifier, Neighbors Classifier), and the Arabic language was used throughout. This study hopes in the future to be done on a large number of court rulings all over Egyptian courts with its different types to minimize the waiting time for the cases, also it would lead to

predicting the court ruling automatically in easily and effective way without consuming more time searching manually the old book or the web, using artificial intelligence techniques in Egyptian courts would save more time, efforts, and would achieve transparent all over justice in Egypt.

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A Smart model to minimize the waiting time for the cases in Egyptian Economic courts

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