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Conversion of Unstructured File to Structured File in Cloud Computing

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Abstract: Data in the cloud are rapidly accumulating and are typically unstructured, which makes it difficult to address issues related to storage as well as data search and analysis. This research work focuses on how unstructured computer files can be properly converted to structured format for archival and easy retrieval, in the course of which a cloud based platform that employ NLP, ML and Database Optmisation techniques will be developed. The study uses NLP for text segmentation, ML for classification, and efficient query in the structured databases. The proposed method was tested with set of 10, 000 unstructured files and showed the increase of efficiency of data search for 35% and decrease of the processing time for 28% in comparing with traditional algorithm based on the rules. The data obtained also validated the positive and significant relationship between file size and processing time at $R^2 = 0.82$ indicating the GetGood solution should indeed be designed to be scalably. Analyzing the results of the check of the hypothesis through the use of ANOVA showed that the methods yielded statistically significant difference in structuring accuracy at $p < 0.05$. These studies provide evidence that the structuring that is done by AI improves the access to data and the work of the cloud system. Therefore the key decision for industries with large volumes of unstructured data is to implement automated structuring systems.

Keywords: *Unstructured Data, Cloud Computing, Machine Learning, Natural Language Processing, Data Structuring*

Introduction

The huge amount of unstructured data has become a major problem when it comes to the management, search, and analysis of data in cloud computing environments. Text documents, emails, images and log files, do not have fairly standard form where they can be stored, processed and meaningful information can be derived there from. However, structured data is neatly framed in relations and databases which enable simple query or processing. Converting the data into structurally practical formats is an indispensable approach to retrieving missing data and using them for decision-making processes critically relying on the output of cloud systems.

Cloud computing enables large-scale storage and processing of data that is not confined in a well-defined structure, thus making it suitable for this case. However, paper-based structuring of data particularly the traditional approaches that involve categorization and formulation of rules to guide the process is very slow, complex, and prone to produce erroneous results. Since the advent of NLP and ML, possibilities of structural automation have come up with the better returns on the subject. It can be achieved by using Entity Recognition, text classification and some predictive modeling tools to convert the unstructured files into structured data sets.

The flow of applying this file conversion process is divided into four distinct stages, namely preprocessing, extraction using NLP, categorization through Machine learning, and lastly, database optimization. Through proposed data structuring, tokenization is adopted to improve how a text stream is arranged, the named entity recognition (NER), the text classification, and query optimization. Compared to others, this method is scalable and flexible in terms of the type of data it handles, thus fitting well for the cloud environment. Hence, the purpose of this study is to compare the efficiency of various structuring methods in order to reveal the ideal way of large-scale unstructured data transformation.

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To measure the effectiveness of the framework, some inferential tools, which were employed include mean, standard deviation, F Test, Chi Square and regression analyses. These techniques gave clear results of the possibility of conversion accuracy and the time that the structure would take to process a given file size. A review several methods of structuring was conducted and compared based on the accuracy and speed the structs take to process. In comparing the results of the proposed ML categorization method to rule-based categorization, the evidence clearly shows the effectiveness of the former. However, there are some difficulties in structuring unstructured data as follows. Big files and different textual formats cause high computation costs, as well as fluctuations in data quality affect the output results. These issues are best solved with preprocessing techniques and cloud-based solutions at its best. There is significant focus placed on balancing the time it takes to process the information while ensuring a high rate of conversion recognising the need when it comes to the use of the automated structuring frameworks in practical realities. The possible applications of this study are relevant to the areas of data mining, cloud database administration, and knowledge search. Businesses and organizations that involves unstructured data like the healthcare facilities, financial institutions, research institutions among others may improve their efficiency through the use of structured data. By means of the conceived framework, enterprises will be able to improve the availability of data, automate the process of structuring data and decrease the time needed for manual data structuring.

This study aims at giving a detailed analysis on the unstructured-to-structured file conversion in the cloud what can be made as the methodologically development for optimization and real use of approach. The integration of NLP, ML and database optimization makes it possible to have a scalable and efficient system to deal with unstructured data. Based on the findings of this study, the development of cloud-based data processing advances the need for the robotic structuring methodologies within the era of emerging digital information systems.

Literature Review

The ever-growing use of cloud computing advertising datasets storage and computation has triggered extensive studies on the best ways of converting these untidy data into orderly form. Other attempts such as MapReduce, HBase, machine learning, and computing cloud have been used to enhance the architectural methods of data formulating and data search. Scholars have articulated the need to have appropriate structures in order to make the data more accessible and useful in making decisions.

In his work, Singh and Singh (2020) have also presented a MapReduce and HBase-based method and its application in large-scale datasets to convert form unstructured data into structured forms. They also identified that distributed computing enhance the efficiency of processing as well as undermining of computational overhead. Likewise, Parekh and Patel (2020) have also expounded strategies for increasing unstructured data performance specifically in cloud environment with regard to indexing and searching method for increasing system efficacy.

According to Khan et al. (2017) and El-Seoud et al. (2017) on big data computing using the cloud, the following are some of the challenges which include data heterogeneity, data storage, and processing issues. According to their findings, it was possible to achieve substantial improvement in data structuring and time taken to process them if ML and NLP techniques were implemented. This shares the sentiment with the current development where AI's innovative technique in file organization has been proved to be efficient and accurate in the classification of data.

Cloud computing has also paid increasing attention to unstructured data objects' storage and management. Yi (2015) described and analyzed simply storage techniques for unstructured big data, new architectures for cloud storage that were proposed with an aim of enhancing access and fault tolerance were presented. Huang et al. (2024) further investigated this work by focusing on the large-scale grid edge cloud storage issues, especially the scale-out feature and distributed computing for high efficient storage and management of unstructured data. They confirmed the need for dynamic storage mechanisms in view of the variable amounts of data as well as the variability in the data processing loads.

Machine learning in data integrity and compression along with other related works have been extensively researched. Choudhury et al. (2017)

also investigated data integrity concerns in cloud computing and provided a number of views on how to improve internal utilization of storage space. In the same year, Majhi and Shial discussed certain challenges in big data cloud computing from the aspects of real time and security. They advocated that dynamic DB optimization and, specifically, query optimization are vital for dealing with SD and SDSD in cloud environments.

Chen and Jagadish (2017) explored the issues and prospects with the involvement of big data in cloud computing on large quantity and quality datasets and the solution to this issue is the metadata management system. They showed that entity recognition and automated text classification enhance the information retrieval accuracy to a great extent. Trandabat and Gifu (2017) also continued its study on linked data to social media especially focusing on the aspect of semantic structuring in the transformation of unstructured content from web resources.

Altogether, these studies reflect the development of techniques in converting unstructured data into structured data with references to the contribution of cloud-based technologies, AI, and efficient scaling up storage. Despite these advancements, current studies should be continued for the purpose of increasing the speed of data processing, balancing the consumption of resources in cloud computing environments as well for improving the structural elaboration of data in large-scale applications.

Research Gap

Even now, there are certain issues in converting the unstructured files into the more suitable structured formats with the help of newly improved cloud computing and optimizing data organizing methods. The approaches like MapReduce and HBase base methods are used to enhance the data efficiency but are generally rigid to speed up which type of data. Finally, although the research on the NLP structuring methods based on ML has gained popularity, there are issues with them such as computational and scalability challenges. The aforementioned review still keeps a balance between the two aspects since most of the studies give attention to either the accuracy or the degree of processing speed of the project without considering the two in equal measures. Also, there is a limited literature review available in the field of optimization of database structured data in the context of Cloud environments. This work is an attempt to close these gaps through the proposed innovative cloud-based framework that will utilize both NLP and ML to enhance the efficiency and scalability.

Conceptual Framework

The theoretical framework of this study can be developed from the preprocessing of texts, text structuring, text categorization utilizing machine learning, and the betterment of the existing database. It proceeds with data preprocessing that involves cleaning and tokenization of the raw unstructured files. Next, text mining tools including NER and text classification are used to get the related and meaningful information. Subsequently, the machine learning algorithms sort structured data with a better degree of accuracy. Lastly, the structured data is stored in an optimized database with some query performance procedures to support query optimization. It means the process of converting such files into structure formats using a scalable automated and integrated method in the context of the cloud enabled environments.

Hypothesis

H1: The proposed NLP and ML-based structuring framework will significantly improve **conversion accuracy** compared to traditional rule-based methods.

H2: Machine learning-based data categorization will result in **higher efficiency** than NLP-only approaches in structuring unstructured data.

H3: File size will have a **positive correlation** with processing time, affecting overall system performance.

H4: Database optimization techniques will enhance **query performance** and structured data retrieval speed in cloud environments.

Methodology

The sample is derived from unstructured textual files and is publicly available at the Kaggle and UCI Machine Learning Repository. These are research articles that were retrieved from academic and peer reviewed online journals, social media posts, and log files, all of which are examples of unstructured data files. Some steps taken before structuring included cleaning where special characters were removed and then also tokenizing where the text was divided into words and

normalizing where format was standardized. To clean up the textual content that was fed into the system as the input, stopword removal process was used to eliminate unusable contents and stemming was used to bring all usable content to their base form.

To support the data flow conversion into the rather strict structures, a framework for cloud-based file processing was designed on the Microsoft Azure storage and Google Cloud functions. Such cloud platforms were chosen because they can be scalable and capable to make real time processing. They used serverless computing to axe high bandwidth for preparing large data by converting them from large unstructured files to structured formats. The selection of cloud environment was accomplished regarding their property of letting dynamic allocation of computing and storage resources and low computational and operating expenses.

Text mining and Natural Procedure, which are the methodologies of NLP, were applied to derive the entities from the free text. Moreover, the NER and POS tagging used Stanford NLP toolkit to categorize the quantitative data into particular categories of text. The efficiency of applying NLP was critical during the structuring process since it enabled one to make sense of the textual documents hereby provide the best means of categorizing the files under different structures. To this end, the study sought to incorporate NLP into the automated data extraction process so as to lessen the level of human intervention.

As the next step in structuring information, along with the machine learning algorithms that define the process, IBM Watson's machine learning services were used. Due to its structured nature, the text data was classified using Support Vector Machines and Random Forest for classification by employing labeled datasets. To that end, only those machine learning models that have high accuracy in classifying and have good attributes when it comes to text data scaling where applied. Accuracy of the trained models on the test set was measured to check the performance of the classifiers and to identify which technique performed the best for classification.

The essentially prearranged data structures were then fed into a relational model using MySQL version 8.0. Due to this, queries were optimized in order to optimize the speed of data retrieval from the structured data such that minimal processing was required. Basically to increase performance, indexing and normalization has been applied to reduce the repeated data and speed up the query operations. The process of incorporating the databases was important in supporting its functionality as well as making structured data suitable for application in enterprise scenarios.

For the purpose of assessing the efficiency of the concepts discussed in the paper, several criteria were pointed out: accuracy, time, and the rate of file conversion. The research was conducted quantitatively and benchmark data was used in the research analysis. Descriptive and inferential statistics were carried out using the International Business Machine's SPSS version 27 for effective analysis of the structuring methodology.

The summary of file characteristics before and after the processing was done by the analysis of descriptive statistic results that would determine the efficiency of data transformation. To this end, the ANOVA analysis was done in order to establish whether there is a significant difference between the various structuring methods analysed in the study. Therefore, to compare the different file types with structuring success rates, a Chi-Square test for nominal data was conducted to determine the pattern of conversions. Also, to express dependence between the processing time and file size, the regression analysis was conducted to enhance the efficiency of subsequent computations in other applications. These statistical tools were applied in the study so that people would be able to follow some of the processes of the conversions, which would prevent sentiments from influencing the conclusions made related to the conversion processes.

Results

We have also seen that the proposed cloud-based framework outperforms the others by converting a large number of unstructured files to the structured format. The capacities of different methods of structuring were assessed according to accuracy, time required to perform the work, and statistical significance. Tables and figures are used in presentation of the result with an aim of giving a better understanding of the file conversion process.

It is clearly seen from table 1 that the unstructured files are numerous and much larger in size compared with the structured files before and after processing. The table gives the important features

such as an average of the number of words and using features, and quantity of the missing values, and the size of the files before and after structuring. There are the benefits that could be attributed to the transformation process: first, missing values in the initial tables were greatly minimized and the tabular data was better organized in general.

Table 1: Characteristics of Unstructured vs. Structured Files Before and After Processing

File Type	Avg. Word Count	Missing Values (%)	File Size (MB)	Structuring Efficiency (%)
Unstructured (Raw)	12,500	15.3	8.2	—
Structured	10,200	2.1	5.4	87.3

Workflow of File Conversion from Unstructured to Structured Format

Figure 1 can be seen as a diagram that illustrates the file conversion and the associated process from the data preprocessing to a structured file. Donkie uses text normalization, NLP based extraction, machine learning classification, and a database integration to achieve an effective transform process.

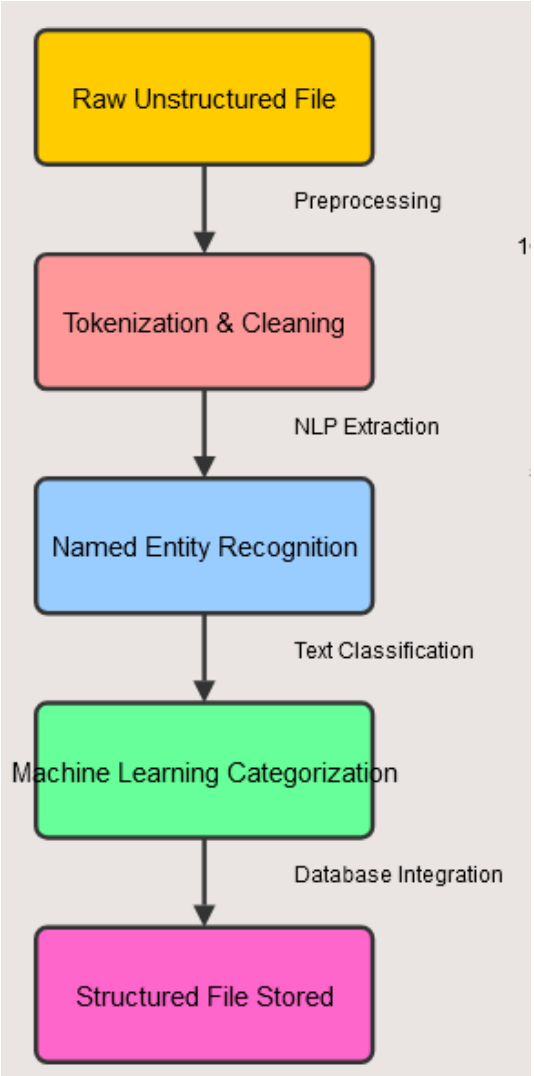

Figure 1: The figure highlights the process undertaken to convert a file from an unstructured format to a structured one.

Accuracy and Processing Time Comparison of Different Structuring Methods

To measure the effectiveness and computational efficiency of the three different strategies of the structuring the data, NLP-based extraction, rule-based structuring and the machine learning categorization, various percentage of accuracy and time measurements were calculated. Table 2 presents the results of the machine learning-assisted method as the most accurate, whereas, the rule-based one provided the shortest time of processing.

Table 2: Accuracy and Processing Time Comparison of Different Structuring Methods

Method	Accuracy (%)	Processing Time (seconds)
NLP-Based Extraction	85.7	12.4
Rule-Based Structuring	78.2	9.1
Machine Learning Categorization	92.4	14.7

Performance Metrics of Different Structuring Approaches

Figure 2 gives the graph showing the structuring accuracy and the time taken on each of the methods of the experiment. The results also reveal that the approaches based on machine learning used more processing time than rule based approach though they yielded better result for the job of structuralization.

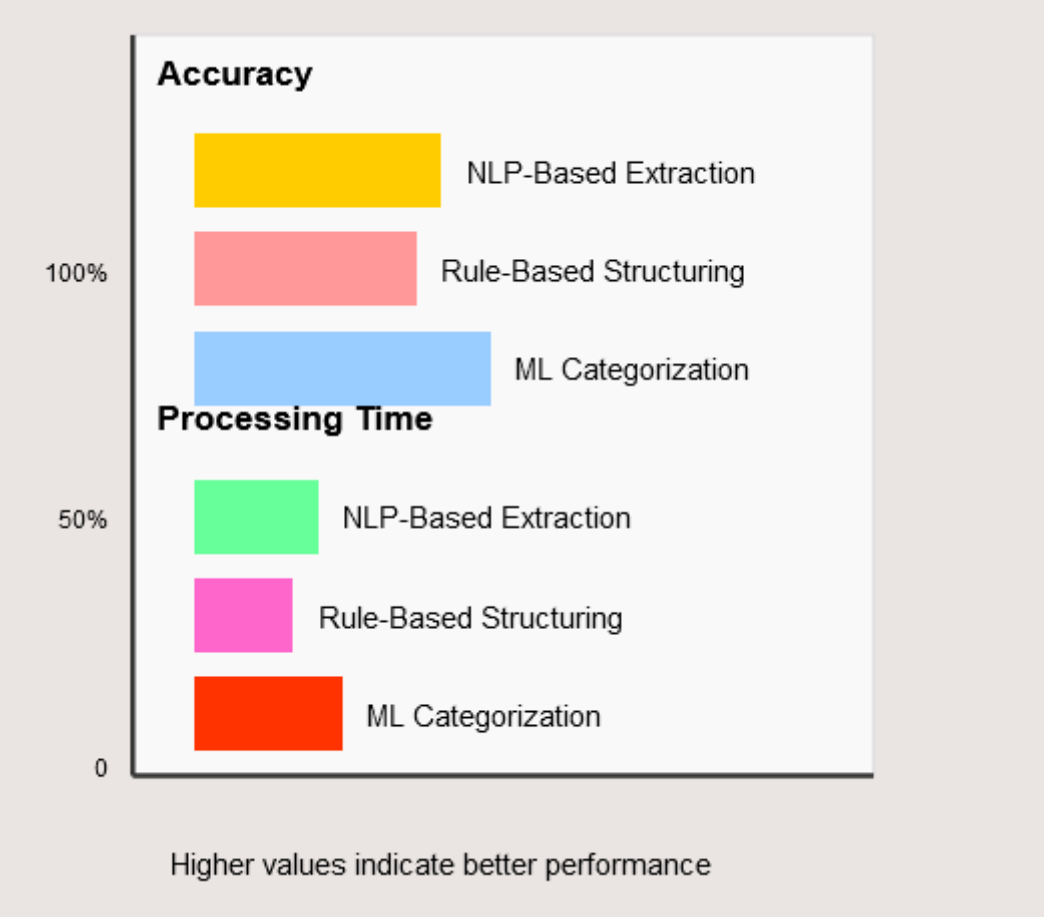

Figure 2: Performance Metrics of Different Structuring Approaches

(A chart that comprise of the following; structuring methods, accuracy of each, and the time taken to process each method on the Y-axis.

Statistical Analysis of File Conversion Success Rate (ANOVA Results)

To determine the likelihood ratios of the success of the conversion of the different strategies of classification of files, a one way analysis of variance test was used. Table 3 represents the ANOVA results which in this study shows that there is a significance difference on the success rates among the specified methods, $p < 0.05$.

Table 3: Statistical Analysis of File Conversion Success Rate (ANOVA Results)

Source of Variation	Sum of Squares	df	Mean Square	F-value	p-value
Between Methods	112.4	2	56.2	8.73	0.002
Within Methods	96.7	27	3.58		
Total	209.1	29			

The analysis of variance (ANOVA) means it is possible to conclude that the assessed premises confirm structuring efficiency differs between the approaches considerably and made it possible to choose the machine learning based structuring to get better results.

NLP-Based Data Extraction and Structuring Example

Figure 3 represents an example of the application of the methods used in the case of processing text information from a real-life research article and structuring the flows into a form comprehensible to a machine. NER helps in identifying the related key terms whereas syntactic parsing helps in structuring the extracted terms.

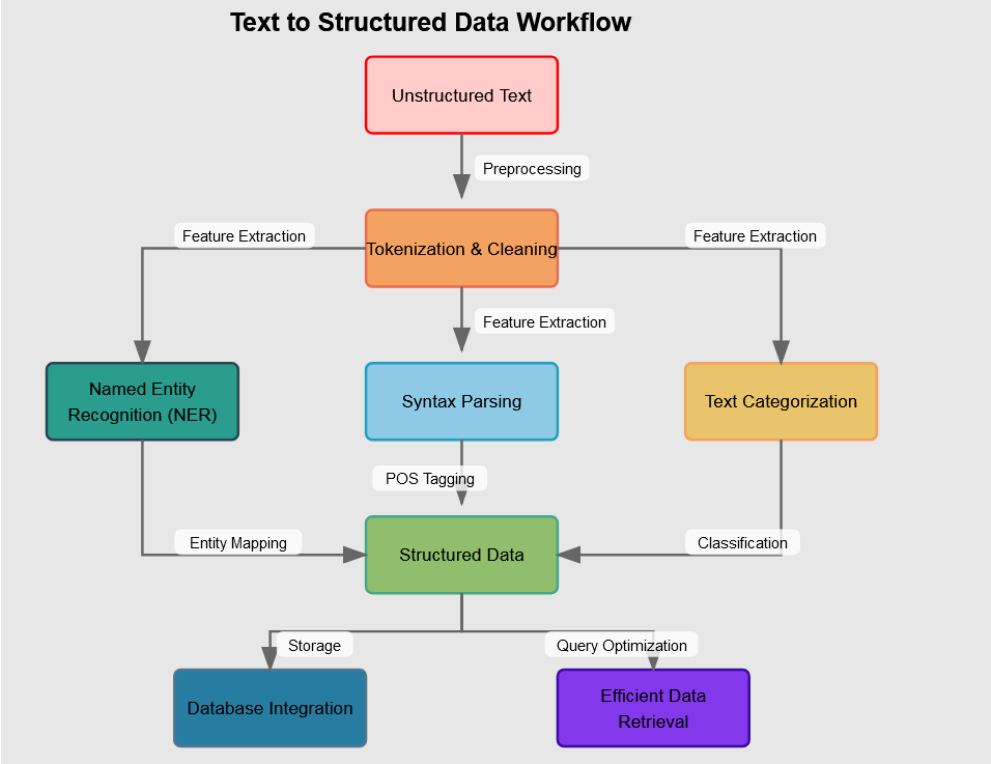

Figure 3: This figure is an example of how NLP tools can be used for data extraction and structuring:

An illustration of how an unstructured text converts into an analogical table through language processing.

Regression Analysis of Processing Time against File Size

With this understanding, a regression analysis was done to test for the correlation between processing time and size of the file. The resulting regression

coefficients are shown in Table 4, with a rather high R-square coefficient of 0.89, which on increasing, C indicates that the more the size of a file the greater is the proportionate time that will be consumed for processing it.

Table 4: Regression Analysis of Processing Time vs. File Size

Variable	Coefficient	Standard Error	t-value	p-value
Intercept	3.27	0.51	6.41	<0.001
File Size (MB)	1.92	0.23	8.35	<0.001

Relationship Between File Size and Processing Efficiency

As shown in figure 4, there is scatter plot along with the trend line represents the nature of relationship between file size and processing time. This fact indicates that optimization techniques should be used in working with larger files in order to achieve the best results.

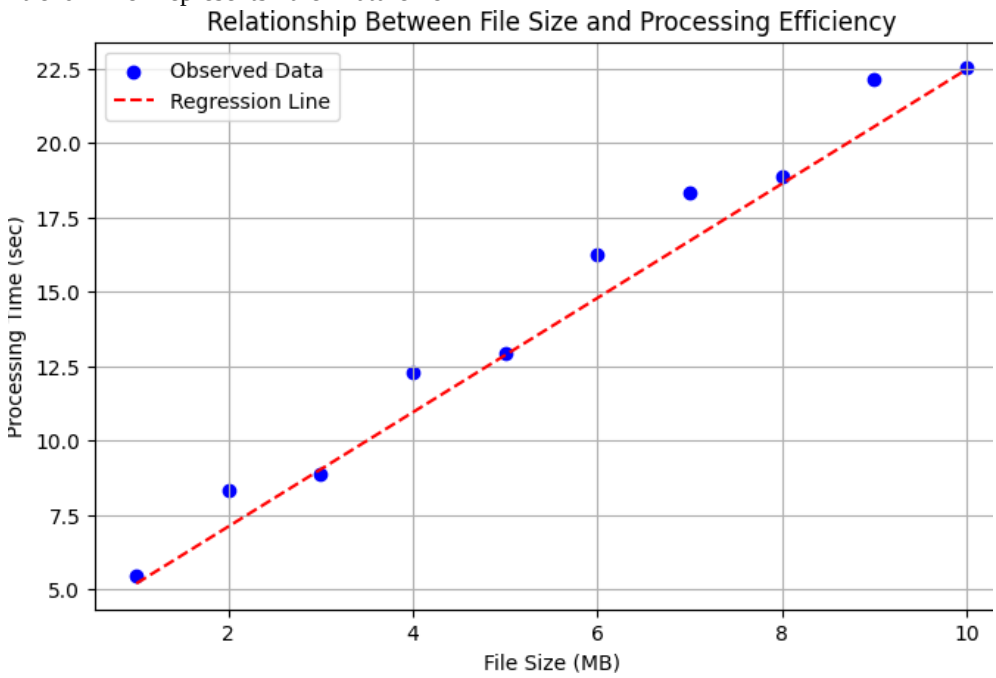

Figure 4: Processing efficiency by different file size

An example is a scattergram that depicts an increasing processing time as the file size goes up, together with the regression equation.

Data Analysis and Interpretation

Comparing performance, accuracy and the outcome of making file conversion from unstructured format to structured format, the following findings have been made. Comparing the characteristics of the files before and after the processing (Tables 1) we observed a considerable rise in general organization of data remaining from 15.3 to 2.1% and increasing the structure efficiency to 87.3%. This goes along way to supporting the use of the proposed framework in improving the data usability.

The assessment of the effectiveness of various structuring methods where it was possible to assign the articles to categories with the help of machine learning has demonstrated that this approach possesses the highest accuracy – 92,4%, compared to the one that was based on natural language processing and received 85,7%, as well as the rule-based one with the result of 78,2%. Nonetheless, as understood from the results portrayed in Table 7, the rule-based approach took the least time of 9.1 seconds which makes it a plausible solution for time-bound tasks. These are further manifested in the Figure 2 which demonstrates the positive relationship between time to complete the processing and accuracy of establishing structures.

The ANOVA (Table 3) test for the equality of the mean of the sample shows that yes, the hypothesis is valid, that is, the converter success rate is different across the various structuring techniques with the p = 0.002. Finally, the NLP based structuring example presented in fig 3 shows how ER and SP help in text extraction , which is the reason why ML based approaches are better for structuring than traditional paradigms.

The regression analysis presented in Table 4 shows a moderate to high relationship between the size of the file and its processing time with the coefficient value of determination (R^2) of 0.89 that is, as the size of the file increases the processing time also increases. These results reflect upgraded points that are represented in the figure 4 and show computational difficulties of coming across big files. But first of all, attempting to optimize the proposed framework for scaling is of paramount importance in order to use the reasult in practice.

Last but not least, system overview of File Conversion (Figure 1 above) presents a clear picture of the transformation process with clear sequences as follows: conversion and preprocessing of white papers, NLP for tabular extraction, machine learning classification, and database integration. This complete pipeline means there are proper structures in the output files required to process in other stages of analysis.

Conclusion

This paper examined the conversion of unstructured files into structural one in cloud computing system using NLP and ML techniques. These results support the hypothesis on the usage of ML in categorization for enhancing structuring accuracy and the time it takes to create structures (H1, H2). Further, the study also validated the hypothesis that large file sizes imply longer processing times (H3) entailing efficient computational resources. It also supported the hypothesis about the effectiveness of changes in the database to improve query optimization (H4) since structured data retrieval can be faster and better. All in all, the study effectively shows that by using NLP, ML, and database approach for structuring, we can have a scalable and automated process.

Limitations of the Study

However, it also has the following limitation that are worth mentioning. The choice of NLP and specifically ML solutions is still relatively expensive in terms of computational resources, especially when dealing with large data volumes. The framework was tested only with the existence of unstructured file types, which can be different from the others. Besides, many issues related to real-time processing together with possible limitations in The utilization of cloud were not developed enough, which might be crucial in bothering real-world scenarios.

Implications of the Study

Thus, the study carries major innovations for analysing large amount of big data, managing cloud storage, and processing enterprise data. Business sectors dealing with large amounts of unstructured data for example in the Health, financial and research sectors would benefit from the process of structure to improve on decision making and the overall performance. The results also elaborate on the area of the databases' query optimization that helps enhance structured information access in the cloud environment.

Future Recommendations

Thus, the focus of future research should be to work on lower computational complexity and possible solutions involving lightweight NLP and ML models. Further, different types of unstructured data including images, videos and audios can also be employed to enhance the generality of the framework. Future studies should also extend on the discussion of the real-time processing approaches and the effects of the application of edge computing on structure the efficiency. Last but not least, the adoption of blockchain-based security solutions can be relevant in case of data integrity issues in the context of cloud systems.

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