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Generative AI-Driven for Sap Hana Analytics

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Abstract : During the course of a year, a large organization that utilizes a complex information technology system such as SAP ERP typically receives hundreds of thousands of requests from its help desk. It is possible to make these requests either over the phone or online through the use of Service Manager (SM) or from the Service Desk. "Enterprise resource planning" (ERP) software automates procedures pertaining to technology, services, and human resources through a network of interconnected applications. It is a form of software used for business process management. An intelligent system that can provide user assistance for SAP ERP is suggested as a solution by this research study. Consumers are able to obtain automatic responses to their support requests, which not only results in a reduction in the amount of time spent on the investigation and resolution of issues, but also increases the level of responsiveness to end users. Classifying multiclass text for the purpose of efficient query interpretation is accomplished by the system through the utilization of machine learning methods. The evidence is retrieved by the system through the utilization of a customized framework, which enables the most effective response. The capabilities of conversational artificial intelligence make it possible for the framework to construct chatbots that enable different groups of people to work together simultaneously.

Keywords*: Artificial intelligence, Implementation, SAP, ERP, Service manager, Business.*

1. INTRODUCTION

In the course of the last several decades, technological developments have resulted in the creation of powerful computers that are not only more compact but also more affordable than they have ever been before. Because of this, firms now have easier access to more sophisticated mathematical tools. What are known as "intelligent technologies" are the tools that provide businesses the ability to delve deeply into the data pools that they currently possess in order to acquire analysis and business insight. If a company makes use of algorithms and automation, it will be able to leverage digital and automated solutions to supplement the manual business procedures that it now uses. An organization is said to be undergoing "digital transformation" when it moves away from using manual procedures and toward using digital ones. When it comes to adopting "smart" and intelligent technologies into its product line and features, SAP has been at the forefront of the industry throughout its history as one of the most prominent producers of software.

Artificial intelligence (AI) and machine learning (ML) that are integrated into corporate systems will assist customers in automating repetitive tasks and discovering new digital technologies. Data is used rather than explicitly programming rules in various applications. Within SAP applications, the cloud, and business networks, artificial intelligence is organically interwoven, which makes digital information easily consumable across the whole enterprise. There is a possibility that this will improve business operations, employee work satisfaction, and customer service, among other things. This piece of software provides a cloud-based machine learning platform that is completely suitable for enterprise use. It interfaces without any problems with SAP's corporate software and machine learning capabilities, and it is easy to follow and utilize. When it comes to adding intelligence to company operations and applications, software engineers may make use of a platform that is both scalable and safe.

1.1. Review of literature

The term "artificial intelligence" refers to the field of computer science that aims to simulate the intelligence and behaviour of humans or other animals. The capacity of information technology systems to independently find solutions to problems by recognizing patterns in databases is an alternative definition of machine learning that was proposed by Kersten et al. (2019).

There are currently various areas of the supply chain that have been integrated with artificial intelligence, and it is possible that it will have a big impact on both the beginning and the end of the process. H. Gonaygunta, G. S. Nadella (2024) In accordance with the findings of Dwivedi et al. (2019), the utilization of artificial intelligence (AI) unquestionably has an effect not only on the lives of individuals but also on the lives of society throughout its entirety. G. S. Nadella and S. E. (2024). As an illustration, a restaurant in the United States known as KiwiBot utilized artificial intelligence to develop miniature robotic cars that are able to blend in with urban environments in order to transport meals.

A behavioural neural network was utilized in the design process of these automobiles. KiwiBots, according to the company, have the potential to make cities more pleasant places to live by reducing the amount of traffic and other

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issues that are present (KiwiBot, 2020). In addition to being more inexpensive and faster, KiwiBots are also faster. Nadella, G. S. (2024). It is described in the appendix that there are further examples of such wide applications of AI and ML. Nadella, G. S., Gonaygunta, H (2024) Within the scope of this particular investigation, the employment of artificial intelligence and machine learning in conjunction with supply chain management was the primary focus of attention. H. Gonaygunta, G. S. Nadella (2024) This is something that a lot of companies are eager to do, and they are eager to apply artificial intelligence and machine learning.

When it comes to the implementation of artificial intelligence, however, several nations employ a variety of ways. Mohan Kunkulagunta (2024) As an illustration, information technology businesses in the United States are participating in a vigorous battle to create and implement AI and ML strategies, with the support of the government. (Kaplan and Haenlein, 2019) In other nations, such as China, the government is responsible for monitoring and controlling all technologies connected to artificial intelligence. Mohan Kunkulagunta (2024) In order to ensure that the privacy of their inhabitants is adequately protected, the nations that make up the European Union (EU) have put restrictions on the ways by which data can be gathered and processed (Farrow, 2019).

Figure 1. Word cloud made from the keywords used

Artificial intelligence and machine learning advocates argue that although new technologies may result in the loss of certain jobs, they will also usher in a period of unparalleled economic growth and job creation (Vocke et al., 2019). This is one of the arguments that they have presented. Mohan Kunkulagunta (2024) People are in agreement that the decisions they make about AI applications will have an impact on a variety of aspects of their lives. According to Dwivedi et al. (2019), it is necessary to conduct exhaustive research and analysis before making decisions that have the potential to significantly impact one's life.

The industries should also take into consideration all of the pros and downsides of the situation. It is important to take into consideration, for instance, the calls that Lee et al. (2018) and Sundarakani et al. (2020) have made for a comprehensive investigation and the requirement to investigate the consequences of artificial intelligence on industrial systems (more specifically, Industry 4.0). The F2 in Figure 1 demonstrates that the rate of progress in the domains of artificial intelligence and machine learning is accelerating at an extraordinarily quick pace. This is observed in the field of machine learning.

The goal of this research is to analyze the field of highly referred papers with the idea of throwing light on the extent to which organizations have implemented artificial intelligence and machine learning, as well as the models that have been successfully tested. Specifically, the research will focus on the models that have been tested successfully. Gradxs, Govind Prasad Buddha, Nagamalleswara Rao. (2023) In addition, a recent study effort has uncovered works that have proven the potential of artificial intelligence and machine learning that has not yet been fully realized. According to Toorajipour et al. (2021) and Feizabadi (2020), these works have the potential to capture the attention of other academics. As a result, our research stands out due to the fact that it offers a thorough assessment of the repercussions that AI and ML will have for SC in its whole.

2. AI IN SAP S/4HANA CLOUD, PUBLIC EDITION

The public edition of SAP S/4HANA Cloud, which is a contemporary cloud ERP system that is ready to run, has more than 25 use cases that are based on artificial intelligence technology. These use cases offer a wide range of applications.

The modular solution known as SAP S/4HANA Cloud provides a clean core that can help you drive your digital transformation forward in the direction you want it to go. Powerful financials that can manage numerous nations and companies are the foundation of your company, and you may expand features as it becomes necessary.

In addition, the SAP S/4HANA Cloud modules that are responsible for finance, sales, procurement, digital supply chain, and extra modules all have the possibility to incorporate an artificial intelligence component. An overview of some of the clever features that are available in SAP S/4HANA Cloud is shown below.

Finance: The Cash Application is one of the first artificial intelligence features that SAP has implemented into SAP S/4HANA Cloud. It is responsible for automating both the order-to-cash process as well as the accounting for accounts

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receivable. Other characteristics of intelligent finance include the administration of collections, the recommendation of accrual, and the reconciliation of intercompany transactions.

Sales: A number of intelligent sales capabilities are available in SAP S/4HANA Cloud. These features include the ability to predict sales success, create business partners, and generate sales orders based on unstructured data.

Procurement: These are only two instances of the intelligent procurement tools that SAP S/4HANA Cloud offers. Examples include predicting the consumption of a contract and predicting the delivery of a supplier.

Digital supply chain: Integrated business planning includes a number of different components, including demand forecasting through the use of external algorithms, intelligent lead time prediction, and the prevention of anomalies in master data. One example of an intelligent feature found in digital manufacturing is visual inspection, which may be used to identify potentially problematic components. In addition, as a result of SAP's continued dedication to innovation, the business is working on building more exciting capabilities related to artificial intelligence. These capabilities include generative AI, human-centered AI, next-generation productivity, and a digital assistant.

What is an ERP, and how does it work?

Fig 2: ERP working.

ERP, or enterprise resource planning shown in figure 2, is a type of "integrated management of main business processes, used frequently in real-time and mediated by software and technology," according to the definition of ERP. ERP stands for enterprise resource planning, and it is a system that is utilized to organize and manage typical company procedures. These processes include accounting, project management, and supply chain operations.

What are the primary business benefits of an ERP system?

An enterprise resource planning system (ERP) that is tailored to match the individual requirements of a business can enable new levels of operational effectiveness, customer responsiveness, employee pleasure, and profitability.

There are no limits to what an ERP system is capable of doing when it comes to what we like to refer to as "back office" functions (for example, finance and human resources). Through its role as a virtual manager, it helps a firm become more productive by consolidating and simplifying information in order to ensure that it operates more efficiently. Within the context of this type of operation, your conventional business procedures have the potential to become strategic differentiators, thereby placing you ahead of your competitors.

Who are the primary users of ERP systems?

Any business, regardless of its sector, that is interested in streamlining its operations. The use of enterprise resource planning (ERP) is expected to continue to increase, with spending on ERP expected to reach $78 billion by the year 2026, as stated in a recent analysis.

3. SAP HANA ANALYTICS

OLTP, or online transaction processing, and OLAP, or online analytical processing, are both functionalities that are unified into a single system by SAP HANA, which is a column-oriented database that operates in memory. As a consequence of this, it is commonly referred to as a "online transaction and analytical processing" (OLTAP) system or a hybrid transactional/analytical processing (HTAP) system. Both of these terms refer to the same thing. This chapter examines the primary differences that exist between SAP systems that were developed in earlier generations and HANA systems that were developed in more recent generations. The utilization of main memory storage as opposed to disc storage allows for faster access to data and, as a result, faster processing of that data.

3.1 Introduction

SAP HANA (High-performance Analytic Application) is an in-memory, column-oriented, relational database management system developed and marketed by SAP SE. The software that runs a database server is employed for the primary purpose of storing and retrieving data in response to queries made by applications. In addition, it is able to do advanced analytics, such as predictive analytics, spatial data processing, text analytics, text search, streaming analytics, and graph data processing. Finally, it is equipped with the ability to extract, transform, and load (ETL), in addition to having the capacity to function as an application server.

3.1.1 **History**

In the early phases of the development of SAP HANA, SAP SE was responsible for the creation of a number of technologies or the acquisition of others. This was done in

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order to facilitate the HANA development process. Not only that, but SAP SE was the company that invented SAP HANA. The in-memory column-oriented search engine known as TREX, the in-memory online transaction processing (OLTP) Platform known as P*TIME, which was bought by SAP in 2005, and MaxDB, which had an in-memory liveCache engine were among the technologies that were listed in this category. In addition to that, TREX was one of them. The next year, 2011, software development teams from SAP SE, the Hasso Plattner Institute, and Stanford University presented an application architecture for real-time analytics and aggregation. The architecture was presented under the appellation HYRISE.

This was the first major presentation of the platform that took place in 2011. This architecture was referred to as "Hasso's New Architecture" by Vishal Sikka, a former executive at SAP SE. People used to refer to this product as "New Database" until the name "HANA" became more stable. "SAP High-Performance Analytic Appliance" was the prior name for this piece of software. HYRISE was the subject of the first research study, which was published in November of 2010. A newer version of the research engine was made available to the public in 2013, and it underwent a reengineering process in 2016 to become HYRISE2 in 2017. Late in the month of November in 2010, the first product was dispatched. By the middle of 2011, more experienced business clients judged the technology to be "in its early days." This was despite the fact that the technology had already garnered interest. The HANA support for SAP NetWeaver Business Warehouse (BW) was supposed to become available by the month of November, according to an announcement that was made in September of 2011. The announcement was made in 2011.

SAP placed a strong emphasis on a number of different aspects of cloud computing in the year 2012.16 When it was first introduced to the public in October of 2012, the SAP HANA Cloud Platform was a product that offered platform as a service technology. Additionally, at the same time, SAP HANA One was introduced, which was a variant of the platform that consumed a smaller amount of memory than the original version. A managed private cloud service that was referred to as the HANA Enterprise Cloud service was the subject of an announcement that was made prior to the beginning of the year 2013. Customers are now able to execute SAP Enterprise Resource Planning services on the HANA platform for the first time since the release of Business Suite on HANA in May of 2013. This is made possible by the availability of the software. The HANA system known as S/4HANA, which was introduced in 2015 and was developed specifically for the HANA platform, is a HANA system that integrates capabilities for enterprise resource planning (ERP), customer relationship management (CRM), and other specialized applications into a single HANA system. Enterprise resource planning (ERP) systems of previous generations will be replaced by the S/4HANA business suite, which is intended to be a more straightforward business suite. In spite of the fact that it is quite likely that SAP will focus its development efforts on S/4HANA, there have been concerns raised by customers who use systems that are not based on SAP that they will be compelled to utilize SAP products. Customers who are currently running SAP business suite applications on hardware that is not approved by SAP would be required to make the transition to a HANA database that is certified by SAP in order to take advantage of the features that are provided by S/4HANA. This is due to the fact that S/4HANA is dependent on a SAP HANA system in order to function.

In place of versioning, the software makes use of service packs, which are also known as Support Package Stacks (SPS), in order to implement improvements. Each and every six months, Support Package Stacks are made available. Two new cloud services that are included in SAP HANA 2, which was released by SAP in November of 2016, are text analysis and earth observation analysis. Both of these services are currently available. Improvements have been made in a variety of other areas, including database administration and application management, in addition to the two brand-new cloud services that are included in SAP HANA 2. Beginning with SPS10 and higher, customers of HANA have the opportunity to upgrade to HANA 2, which is the platform's successor. Before they are able to upgrade to HANA 2 SPS01, customers who are currently operating on SPS9 or lower are required to first upgrade to SPS12 at the earliest.

3.1.2 Architecture

Overview

It is a column-oriented database that runs in memory and combines online analytical processing (OLAP) and online transaction processing (OLTP) into a single system and operates in memory. Although it is more widely known as a hybrid transactional/analytical processing (HTAP) system, SAP HANA is a "online transaction and analytical processing" (OLAP) system. This is another name for SAP HANA. The reason for this is that SAP HANA is a hybrid environment. Following is a list of some of the most significant differences that can be found between SAP systems and HANA systems that were established in the generation that came before this one.

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Because it is simpler to retrieve the data when it is kept in main memory rather than on disk, it is also simpler to query and analyze the data. This is because main memory is more accessible than disk storage. There are performance benefits associated with keeping data in memory; nonetheless, this type of data storage is more expensive than other options. Due to the fact that the patterns of data access are taken into consideration, it is likely that up to 85 percent of the data included inside an enterprise system is accessed infrequently. Therefore, it may be more cost-effective to store data that is often accessed, also known as "hot" data, in memory, while storing data that is accessed less frequently, known as "warm" data, on disk. This is because "hot" data is stored in memory instead of disk. In 2016, SAP began to support this method, which they referred to as "Dynamic tiering," and it has evolved since then. Column-oriented systems store all of the data for a single column in one place, as opposed to row-oriented systems, which store all of the data for a single row in one place. Data is arranged and stored using row-oriented systems. This might potentially lead to increased efficiency for OLAP searches on large datasets and allow for more robust vertical compression of identical data types inside a single column. These two advantages are likely results of this. Should the read times for data contained in columns be sufficiently quick, then consolidated views of the data can be performed dynamically. If the data is kept in columns, then this is the situation. This means that there is no longer a need to maintain aggregate views and the related data redundancy. Development of hybrid systems appropriate for online transaction processing (OLTP) and online analytical processing (OLAP) is made possible by the usage of in-memory storage. Online transaction processing (OLTP) and online analytical processing (OLAP) processes no longer require separate systems, as was formerly the case. When it comes to online transaction processing (OLTP), row-oriented systems have traditionally been the chosen technology.

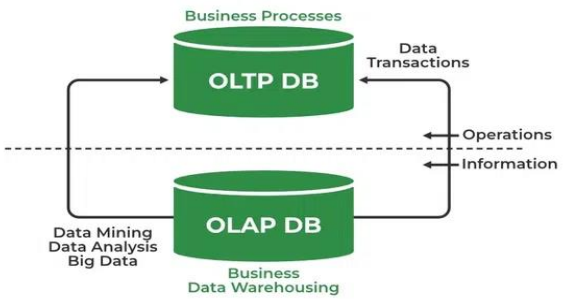

Fig 3: OLTP vs OLAP

3.2 Indexer components

The index server is responsible for a variety of services, including the maintenance of sessions, authorization, transaction management, and command processing. Row stores and columnar stores are both included in the database's structure. If users want to create tables, they can use either store; however, the columnar store is the one that is more commonly utilized because it has greater features. In addition to managing a number of functions, the index server is also responsible for maintaining persistence between cached memory images of database objects, log files, and permanent storage files. This is one of the functions that the index server is responsible for managing. Through the use of the XS engine, it is possible to create applications for the web. The process of designing HANA applications includes a component that is known as SAP HANA Information Modeling. This component is also known as SAP HANA Data Modeling. Both names refer to the same thing. Through the utilization of a methodology known as modeling, the process of exposing operational data to the end user can be accomplished. For the purpose of the modeling process, reusable virtual objects, also known as computation views, are utilized.

3.2.1 MVCC

Managing concurrency across several users is accomplished by SAP HANA through the utilization of a technique known as multiversion concurrency control (MVCC). Through the utilization of this method, each transaction is provided with a snapshot of the database at a certain instant in time. When an MVCC database has to update a particular piece of information, it will not replace the old data with new data; rather, it will classify the old data as obsolete and add the more recent version of the information. This approach is taken when the database needs to update a specific piece of information. Because of this, the database will not update the data that is already there with new information.

3.3 **Big data**

HANA is capable of storing volumes of data that are as large as a petabyte in memory in a scale-out scenario, and it can provide query responses in less than a second. The scale-out technique is only practical for certain time-critical use cases because random-access memory (RAM) is still significantly more expensive than disk space. This is the reason why the technology is not widely used. This is due to the fact that random access memory (RAM) continues to be substantially more expensive than disk space.

3.4 **Analytics**

A number of analytical engines that are capable of handling a wide variety of data processing tasks are incorporated into the SAP HANA platform on which it is built. Some of the typical business data processing algorithms that are featured in the

Business Function Library are asset depreciation, rolling forecast, and moving average. These are just a few examples. The purpose of making these algorithms public is to address the typical data processing requirements of businesses. There are native methods that are provided in the Predictive Analytics Library that are used to generate fundamental statistical measurements. The implementation of these methods can be beneficial in a variety of domains, including clustering, classification, and time series analysis, to name just a few of potential applications.

In order to make it possible for the open-source statistical programming language R to be utilized as a supported language within HANA's internal stored procedures, it has been introduced into the system. R is utilized by the HANA community as a resource. The column-store database solution provides access to graph database capabilities for users to take use of. In order to carry out visual graph editing, the graph engine makes use of a program that is known as Graph Viewer. In addition, the graph engine is responsible for supporting the Cypher Query Language. When utilizing HANA's column store, graph data structures are preserved in relational databases in a straightforward manner. Within the context of this process, there is no intermediary involved. Pattern matching, neighborhood search, single shortest path, and strongly connected components are some of the pre-built algorithms that are included in the graph engine. Other algorithms include "strongly linked components." Components that are strongly related are considered in other approaches. A wide range of applications can be carried out with the assistance of the Graph Engine. Some of these applications include the construction of supply chain traceability, the identification of fraudulent behavior, and the planning of logistics and routes.

CONCLUSION

The concept of artificial intelligence (AI) has been a source of fascination for humans ever since the middle of the twentieth century, as it is explained in this study. Science fiction was the first medium in which the theory gained popularity; nonetheless, it wasn't until the polymath Alan Turing pondered the possibility that the concept may actually be successful that it was finally accepted by the scientific world. In his seminal paper "Computing Machinery and Intelligence," which was published in 1950, Alan Turing created the conceptual groundwork for artificial intelligence by posing fundamental questions concerning the capacity of machines to do reasoning in a manner similar to that of humans. Within the SAP Business Technology Platform (SAP BTP), generative artificial intelligence capabilities have been added in order to provide developers and data professionals with even more capability. SAP Build Code offers professional developers the opportunity to collaborate on projects and utilize productivity solutions that are powered by artificial intelligence. Among the numerous capabilities that SAP HANA Cloud provides, a unique vector embedding feature is one of the features that enables developers to harness the power of artificial intelligence (AI) for the goal of generating intelligent data applications and insights.

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