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Developing a Smart Business Intelligence System by Leveraging the Artificial Intelligence Tools, Techniques and Algorithms[1]

Ahmed Abbas Naqvi

New Delhi, India

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ABSTRACT

When the BI analytics market leaders started massively presenting their solutions based on the interaction of artificial intelligence and Business intelligence, which made advanced real-time data analytics possible, the years 2020 to 2021 became significant in the development of BI systems. Most BI solution developers prioritize expanding the capabilities of business intelligence systems due to the integration of BI systems with machine learning tools. BI system manufacturers develop different approaches to integrating machine learning into Business Intelligence systems to accommodate the various requirements of users. This study aims to demonstrate the advanced applications of artificial intelligence (AI) in Business Intelligence systems, depending on how AI algorithms are integrated into a BI system.

INTRODUCTION

The expansion of BI systems' capabilities with artificial intelligence (AI) mechanisms, primarily machine learning (ML) algorithms, is one of the primary market trends in Business Intelligence (BI). Based on an algorithm's search for a particular kind of pattern in training data and solving a problem based on the patterns it finds, machine learning is generally regarded as a subfield of artificial intelligence [1]. The term "machine learning" is used in business analytics to refer to machine learning algorithms integrated into the BI system and can function both in the background and upon user request. Put another way. This refers to having access to the environment for creating and executing machine learning models without importing scripts from data processing programs or other external tools. Advanced or augmented analytics [2] is the common name for adding business intelligence with artificial intelligence functions and machine learning in particular.

In their works, Jakia Sultana [3], Aastha Jain [4], Prakhar Mehrotra [5], Shrutika Mishra [6], Scott P.J. и Yampolskiy R.V. [7], Rath [8], Waqar Ahmed Khan [9] noted the potential of artificial intelligence in conjunction with business intelligence systems. When the studies above are taken together, it is possible to conclude that the majority of authors concur that BI systems will become even more prevalent in business and the public sector of the economy. A fundamentally new approach to organizing data analytics in an enterprise is using embedded machine learning algorithms for the data collected by BI systems, including streaming data. This will require a change in the IT architectures of businesses and their business models.

Because they only became widely available to users in 2020 and 2021, the advanced capabilities of BI systems still need to be studied, both from a methodological and practical perspective. This explains why this study is important.

The study aims to demonstrate the advanced applications of artificial intelligence (AI) in Business Intelligence systems, depending on how AI algorithms are integrated into a BI system.

ALGORITHMS FOR MACHINE LEARNING IN BUSINESS INTELLIGENCE SYSTEMS

The most common machine learning models utilized by analysts are clustering, classification, and regression.

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An unsupervised machine-learning task is the clustering task. The initial sample of objects needs to be broken up into non-intersecting sets or clusters so that objects in the same class share the same statistical characteristics. On the other hand, the objects of other classes are as distinct as possible. The distances from the object referred to as cluster centroids serve as the foundation for the algorithm. The object will be placed in the cluster at the centroid with the shortest distance from it. The k-means algorithm and agglomerative clustering are two examples of common clustering algorithms; others include DBSCAN, the Birch method, the Word method, spectral clustering, the Gaussian mixture method, and others [12].

The researcher is the one who decides which method to use. Concentrating on the initial distribution of the data, testing various approaches, and assessing the model's accuracy is necessary. Because it doesn't require a lot of computing power and can be used in standard mode, the k-means method, the simplest clustering algorithm, is typically built into BI systems. When analysts work with a sample, the result is a complex distribution that is difficult to divide into clusters using the BI system's built-in method. The direct execution of Python or R scripts is a preferred method for incorporating machine learning into the BI system. The analyst can use advanced data analysis algorithms with this strategy.

Formally, the following is how the clustering problem is defined:

The distance function is also given, with X representing a finite set of objects and Y representing a finite set of clusters. Each object where the learning sample is generated by algorithm a must match the element: In this instance, there should be objects that are close to each other in the metric p in one cluster, and the chosen metric should be as different as possible between the objects in the other clusters. The number of classes could be known in advance, for instance, from an analyst's experience or knowledge of the subject, or it could be unknown. The Chebyshev distance, the Euclidean distance, or the Manhattan distance typically constitute the metric p.

A well-known illustration of a supervised machine-learning problem is the classification issue. We have a limited number of objects with specific features—training data—for which we know which classes they belong to—a response. The fact that we know in advance whether the objects in the training sample belong to a particular class distinguishes the classification problem from the clustering problem. The task of classification is to place a new object into one of the available classes that best describe it using the trained model [13]. There are both binary and multiple classifications. Binary classification is frequently interpreted as a yes/no response to a question because it implies only two classes: positive (+1) and negative (-1). For instance, whether the customer places a second order if there is a person in the picture, if the letter is spam, etc. If there are more than two responses (classes), the problem of multiple classifications is solved. For instance, using external signs to determine a dog's breed, determining whether an object in an image belongs to a person, animal, or category, and classifying news by text (such as politics, economics, sports, culture, and others). Let's make the problem's mathematical statement as follows:

As a training sample, let X be a finite set of objects. There are only so many responses in Y. Additionally, it is known that the mapping for training sample components. An established algorithm that makes it possible for each element to match another element is required.

Another example of a supervised machine-learning problem is the regression problem. The responses for the objects are also known, but unlike the classification problem, they are continuous. Identifying a specialist's salary based on his age, education, grade point average, and work experience is an example of a regression problem. In this instance, we will receive a real number or, in programming language terms, a floating-point number [12] as a response. As a result, when we solve the classification problem, we get an accurate estimate of whether an object belongs to a particular class from a set that has been predetermined.

CONCLUSION

The work looked at the features and functionality of third-generation BI systems. The main difference is that the basic functionality has been expanded with built-in artificial intelligence, and machine learning tools can be later integrated into the BI system.

In addition, the term "machine learning" in a business intelligence (BI) system refers to both "classical" machine learning tasks that are based on the specific principles of operation of the BI systems themselves and, as a result, enable the application of ML capabilities in real or close to real-time and are executed in the background for business users' convenience.

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