Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

TRINITY COLLEGE

BUSINESS SCHOOL

" MERCADONA'S SUPPLY CHAIN AI MODEL"

Module: Data Management and visualization

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1.- Introduction:

Mercadona is a renowned grocery company in Spain that is devoted to providing its consumers with high-quality items and services. As part of its commitment to excellence, Mercadona is constantly searching for ways to improve its supply chain and delivery processes. In this report, we offer an endeavor to increase the efficiency of Mercadona's delivery routes through the use of artificial intelligence (AI) algorithms. Mercadona can cut transportation costs, delivery times, and greenhouse gas emissions while enhancing customer satisfaction by optimizing delivery routes. The objectives, data sources, data collection, data ingestion, and storage are all described in the development stage. It also outlines the methods employed and the deployment processes required to undertake this effort, as well as the requirements for it to be sustained over time without issues in the maintenance stage.

2.- Development:

2.1 Objective:
The purpose of this initiative is to improve Mercadona's supply chain efficiency by enhancing truck delivery routes. Mercadona can cut transportation costs, delivery times, and customer happiness by optimizing delivery routes.

To achieve this aim, Mercadona is using cutting-edge artificial intelligence (AI) algorithms to calculate the most efficient routes for its vehicles. To improve delivery routes, these algorithms take into account a range of parameters such as traffic patterns, weather conditions, and consumer locations.

Mercadona's delivery trucks now take pre-defined routes based on static data, which may not take into account changing traffic patterns or weather conditions. This might lead to inefficient routes, resulting in increased transportation costs and longer delivery times. With the implementation of AI algorithms, Mercadona will be able to dynamically adjust delivery routes to ensure that the most efficient path is chosen, hence decreasing delivery times and costs.

This approach is compatible with Mercadona's commitment to sustainability, in addition to improving efficiency. By upgrading delivery routes, the firm may substantially reduce fuel use and greenhouse gas emissions. This reduction is essential for increasing environmental performance and attaining sustainability goals.

2.2 Data source and collection:
To successfully manage and optimize Mercadona's distribution operations, structured, semi-structured, and unstructured data sources must be discovered, gathered, and analyzed. Truck fleet information, delivery schedules, client locations, traffic patterns, road conditions, and weather reports are among the data sources.

Structured data sources are information in a database that can be easily formatted and assessed. Structured data sources in this scenario include Mercadona's truck fleet statistics, delivery schedules, and consumer locations. These data sources are almost certainly available

in a structured format, such as spreadsheets or databases, making them relatively easy to extract and process for analysis.

Semi-structured data sources, on the other hand, may not have a formal structure but may have some amount of organization. Data about traffic patterns and road conditions, for example, may be supplied through APIs or other data sources in a structured format, such as JSON or XML. Although these data sources are not as well organized as structured data, they nonetheless give significant information for delivery operations analysis and optimization.

Lastly, weather reports are examples of unstructured data sources. Because this sort of data is not structured, it might be difficult to extract information from it. Unstructured data, on the other hand, may be turned into structured data and evaluated for important information using Natural Language Processing (NLP) and machine learning techniques.

Data collection and mining systems such as Apache Nifi may be used to gather and analyze these many sorts of data sources, and data quality validation technologies such as Talend can be used to guarantee that the data acquired is correct and comprehensive.

2.3 Data ingestion:
A mix of batch and stream processing might be used to load the data into the system. Batch processing can be used to ingest structured and semi-structured data at regular periods, such as daily or hourly. Stream processing might be used to process real-time data like traffic and weather updates.

Stream processing solutions such as Apache Kafka, which can ingest and handle real-time data streams, would be required for this phase. Moreover, batch processing techniques like Apache Spark might be utilized to analyse and analyze enormous amounts of data.

2.4 Data storage:
The information might be kept in a hybrid cloud and on-premises data storage infrastructure. Unstructured data might be saved on the cloud, while structured and semi-structured data could be stored in a centralized on-premises database or data warehouse. This method would enable effective data management while also guaranteeing that sensitive data is safely retained on-premises.

This stage would necessitate the adoption of database and data warehouse management systems such as Apache Hadoop, which can store and handle enormous amounts of structured and semi-structured data. Unstructured data might also be stored in cloud storage options such as Microsoft Azure Storage.

2.5 Method used:
A machine learning method such as a genetic algorithm or a simulated annealing algorithm can be utilized. These algorithms are a subset of operations research, which is concerned with optimizing complicated systems. Genetic algorithms are a sort of optimization method that simulates natural selection in order to discover the best solution. Another form of optimization method influenced by the metallurgical process of annealing is simulated annealing algorithms. These algorithms can improve delivery routes by minimizing the distance traveled, increasing the number of deliveries performed, and decreasing the number of vehicles required.

Machine learning frameworks and optimization tools such as Python or R would be required for this stage. To train the algorithm, machine learning frameworks such as Scikit-Learn may be utilized, while optimization tools such as Gurobi can be used to tackle the optimization problem. These software tools provide the libraries and functions required to create and train the optimization algorithm as well as solve the optimization issue in order to determine the best delivery routes.

Python and R are both prominent data analysis and machine learning programming languages. They include a variety of libraries and packages that make it simple to create and deploy machine learning models, including those used for optimization challenges.

Scikit-Learn is a popular Python machine-learning toolkit that includes methods for classification, regression, and clustering.

Gurobi offers a range of tools and methods for dealing with difficult optimization challenges. These tools may be used to identify the best answer for the delivery route optimization problem while taking into consideration all of the limitations and objectives.

3.- Deployment:

3.1 Implementation and integration:
After developing and training the optimization algorithm utilizing machine learning frameworks and optimization tools such as Python or R, it may be integrated with Mercadona's fleet management software.

Integration tools, such as Apache Camel, are commonly used to connect various software systems and data sources throughout the integration process. The result of the algorithm may be given to the fleet management software through Apache Camel, which can then construct efficient delivery routes for the trucks.

Mercadona's fleet management software may be used to manage and monitor the delivery routes suggested by the algorithm. The program may modify the delivery routes as needed in response to changes in traffic, weather, or other conditions.

3.2 Personnel required:
The following personnel will be required for the successful implementation of the AI model:

Data Engineers are in charge of creating and executing the data pipeline, which is an important part of the data-driven AI approach. They make certain that data is acquired from diverse sources, consumed into the system, and stored in an effective and scalable manner. They also guarantee that data is cleaned and processed so that data scientists and AI developers may work with it.

Data scientists are responsible for developing the machine learning models and algorithms needed to achieve a business goal. They study data in search of patterns, relationships, and insights that can be used to develop predictive models. They work closely with business analysts to understand the business problem and create requirements for AI models. They also collaborate with AI engineers to ensure the scalability and efficiency of model implementations.

AI developers are responsible for developing and deploying the AI model on their preferred platform. They work closely with data engineers and analysts to ensure that the models are correctly incorporated into the data pipeline and deployed in a scalable and efficient manner. They are also responsible for testing and validating the models to ensure that the desired results are achieved.

Business Analysts oversee comprehending the business challenge and determining the AI model's needs.

The project manager is in charge of managing the project from beginning to end. They guarantee that the project is completed within the schedule and budget constraints. They also guarantee that the project is completed with the required quality and outcomes for the stakeholders.

3.3 Business functions:
The AI model will impact the following business functions:

Sales: The AI model will provide insights into customer purchasing patterns, enabling the company to optimize sales strategies.

Operations: The AI model will improve the efficiency of the delivery service, reducing delivery times and increasing customer satisfaction.

IT: The AI model will require the implementation of new software and infrastructure, leading to changes in IT operations and support.

Finance: The AI model will impact the budget and financial performance of the company, requiring financial analysis and planning to ensure a positive return on investment.

4.- Maintenance:

A well-defined maintenance plan is required to assure the continuous success of the strategy and model. This section describes the important components of our maintenance strategy, such as scheduling, KPIs, and updates.

Maintenance Plan:
Assess the model's performance on a daily basis to verify it is working smoothly.

Weekly updates: Analyze any new data, make any necessary adjustments, and verify the model's accuracy.

Monthly evaluation: Assess the model's performance metrics and compare them to key performance indicators (KPIs) to discover areas for improvement.

Quarterly updates: Include any major modifications or new features in the model.

Yearly evaluation: Conduct a thorough evaluation of the model's performance and make any required improvements.

Key Performance Indicators (KPIs):
KPIs are key measurements that assist us to assess the efficacy of our maintenance strategy. We will monitor the following key performance indicators (KPIs):

Model performance will be regularly monitored, and any variations from the predicted output will be tracked.

Uptime: We will monitor the percentage of time that the model is available and working properly.

Reaction time: We will time how long it takes the model to respond to a user request.

Error rate: We will monitor and attempt to decrease the number of errors that occur while the model is running.

Updates:
We will follow a specified process to maintain and update the strategy and model, which comprises the following steps:

Identifying Issues: We will regularly check the system for issues such as faults and poor performance.

Prioritization of Issues: We will prioritize issues based on their importance and influence on the system.

We will remedy issues using a combination of code updates, configuration modifications, and infrastructure improvements.

Testing: We will test any system upgrades or modifications to verify that they do not harm a detrimental impact on the system's performance or stability.

Deployment: We will deliver system upgrades and modifications in a controlled and progressive way.

Documentation: We will keep thorough records of all system modifications, including the cause for the change, the personnel involved, and the impact on the system.

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