EAS 504: Applications of Data Science – Industrial Overview – Spring 2023

-Lecture by Anurag Bhardwaj

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Ques 1 : Describe the market sector or sub-space covered in this lecture :

The market sector or sub-space covered in this lecture is Role of Data Science in Retail Technology. Data science is a multidisciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data . data science plays a crucial role in helping retailers optimize their operations and improving customer experience. Data science may assist businesses in managing their inventory more efficiently by determining the ideal product mix and forecasting demand. Retailers may also utilize this data to track their inventory levels and decide when, how much, and which goods to prioritize restocking. There are many kinds of deals for benefiting consumers like location wise , few deals are based on climatic conditions ,so that the deals in buffalo or western new York differ from San Francisco and Manhattan . Some analytics are made as per the needs in locations , Like in Alaska people were offered discounts and coupons on fishing rods but not on bikes or beach mats .Based on lot of transactions we will decide what products to promote in what regions to increase the profits. According to a Deloitte survey, retailers who use data analytics and insights are more likely to see improved performance, with 63% of those polled reporting a significant positive impact on their business.

Ques 2 : What data science related skills and technologies are commonly used in this sector?

Data science is growing rapidly and it is very important in the retail technology, and now retailers recognizing the potential of data analytics to drive growth and profitability of the organization . As we all know , retail technology companies have a lot of products ,they have to maintain huge inventories and manage high demand sales which implies it has to store and process lots and lots of data . To gain more profits , all these data needs to be analyzed and business decisions should made accordingly . So, Retail technology, companies use big data technologies such as Hadoop

and Spark to process and analyze large volumes of data. E-commerce companies use statistical analysis to analyze customer behavior, sales trends, and other related data. This requires the use of statistical methods such as regression analysis, hypothesis testing and time series analysis. E-commerce companies use machine learning algorithms to analyze large data sets and extract insights. As the quantity of data collected by retailers grows, we can anticipate data science to play an increasingly more important role in influencing the retail industry's future. Machine learning algorithms are used by recommendation systems to assess client behavior and provide customized product suggestions. These suggestions are based on a number of criteria, including prior purchase history, browsing behavior, and demographics. For example Amazon's recommendation engine analyzes user data and makes product recommendations using machine learning methods such as collaborative filtering and content-based filtering. These algorithms are developed using past consumer data and are updated on a regular basis as new data becomes available. They also use Power BI, Tableau for visualization.

Ques 3 : How are data and computing related methods used in typical workflows in this sector? Illustrate with an example.

The applications of information data and computing related techniques are best explained using an example that how an Retail technology platform works . Retailers use data and computing methods to manage their inventory. They analyse the sales data to identify trends and patterns in various sectors like customer behavior, forecasting demand, and optimizing inventory levels to reduce waste and cut down production costs for the undemanded products.These way they can improve their profits .Retailers manage their supply chain using data and computer tools. Analyzing supplier data to identify risks and opportunities, improving transportation and logistics to cut costs and improve delivery times, and utilizing machine learning algorithms to forecast and avoid supply chain disruptions are all part of this. Retailers also plan and execute marketing and advertising strategies using data and computer tools. This involves evaluating consumer data to identify target demographics based on various criteria's , creating tailored marketing messages and product suggestions for each individuals , and optimizing advertising spend to ensure marketing activities are both effective and cost-effective. Stakeholders are communicated insights and trends through data visualization tools. In Retail technology, they utilize robots to automate a variety of operations, including product picking and packing in warehouses. Retailers utilize data science approaches such as predictive maintenance to guarantee that the robots perform properly and minimize problems. Retailers build interactive dashboards and reports using platforms likeTableau and PowerBI, which allow users to explore data and acquire insights. The increasing needfor data science related skills and technologies are key to the success of the retail technology sectorto meet their increasing data size every day.

Ques 4 : What are the data science related challenges one might encounter in this domain?

The increasing need for data science related skills and technologies are key to the success of the retail technology sector to meet their increasing data size every day.They maintain large warehouses and inventory which leads to huge chunks of Data.Some of the data science challenges that can be encountered are data variability - different types of data , quantity - data size, speed - processing speed where data can often be complex and difficult to process and data can contain missing values, which are some of the obstacles that can be encountered in Retail technology data when doing operations and analytics over it. Retailers gather a large amount of sensitive client data, such as personal information, shopping history, and payment information. Data scientists must guarantee that this information is kept private and safe, and that it is not exposed to theft or hacking. As, we have already seen many small companies or ticketing sites, movie ticket booking websites getting hacked many times and compromising sensitive information like credit card numbers and putting them in dark web. This will bring a huge impact on companies as it will loose customers trust and also affects the operations of the organization. In Retail technology,tracking a customer behavior is really a hectic task , as sometimes models that were previously useful may become less accurate when client behavior changes. This is referred to as model drift. Data scientists must continuously evaluate and update their models to ensure that they stay accurate and effective to gain more profits and standout among their competitors.

Ques 5 : What do you find interesting about the nature of data science opportunities in this domain?

Increasing demand in the use of data is exponentially growing from past few years in online shopping, use of mobile phone apps , including sales transactions, customer interactions, social media, and more…. For instance, the amount of data in 2010, which was being created every two days, and in 2021 it was being created just for every 40 minutes. Data scientists may use this data to identify insights and patterns that can help guide company choices and enhance performance. In Retail technology,tracking a customer behavior is really a hectic task , as sometimes models that were previously useful may become less accurate when client behavior changes. This is referred to as model drift. Data scientists must continuously evaluate and update their models to ensure that they stay accurate and effective to gain more profits and standout among their competitors.So there is continuous need for data scientists in this field . Another area that provides intriguing issues is fraud detection, where data scientists must design models that can reliably identify fraudulent transactions while avoiding false positives that might hurt genuine consumers. Pricing optimization is crucial in retail, and machine learning may assist merchants in analyzing massive quantities of data to optimize their prices in real-time. To determine ideal prices for each items, machine learning models can be used to assess consumer data, competitive pricing,historical sales data, and other criteria and give the best price for each products. This can assist merchants in increasing earnings while remaining competitive in the market.

(i) Describe some of the data science problems relevant to Manufacturing and Warehousing in the Retail Product Lifecycle. (10 pts of the 80 C+R points in the rubric)

Suppose if you are manufacturing some product , it varies from product to product, it could even be a small product or it can be tesla car. Quality control is vital in the automobile sector, and data science may play an important role in detecting faults and increasing final product quality. Machine learning models can detect faults and automatically trigger warnings and steps to solve the issue by evaluating data from sensors and cameras. Also for increasing profits, Predictive maintenance may assist decrease downtime, increase equipment longevity, and enhance final product quality. Yield optimization is crucial in semiconductor production because it directly affects product profitability. Machine learning models may be used to discover the main causes of yield loss and optimize the manufacturing process to enhance yield by evaluating data from sensors, machine logs, and other sources. Machine learning models can forecast when maintenance is needed and improve the maintenance plan by evaluating data from sensors, machine logs, and other sources. Infrared imaging may also be used to monitor the temperature of materials and machinery as they are being manufactured. Machine learning algorithms can detect temperature differences and adapt the production process to maintain constant quality by evaluating this data. Infrared imaging may also be used to monitor the temperature of materials and machinery throughout the production process. Machine learning algorithms can detect temperature differences and adapt the manufacturing process to maintain constant quality by evaluating this data.

(ii) Describe some of the data science problems and techniques that would be useful in Inventory Management and Pricing Optimization . (10 pts of the 80 C+R points in the rubric)

The process of studying previous sales data to uncover patterns and trends that may be utilized to estimate future demand is known as time series analysis. Machine learning and deep learning approaches use past data to train models that forecast future demand based on characteristics such as seasonality, promotions, and market trends. External elements like as weather, economic statistics, and competition pricing can also be incorporated into these strategies. To determine ideal prices for each items, machine learning models can be used to assess consumer data, competitive pricing, historical sales data, and other criteria and give the best price for each products. This can assist merchants in increasing earnings while remaining competitive in the market. Retailers use an omni-channel pricing strategy to deliver an uniform purchasing experience to their customers, regardless of how they engage with the brand. This implies that whether a client buys a product in-store or online, the pricing should be the same, and the same promotions and discounts should

be offered across all channels. Retailers may also utilize this data to track their inventory levels and decide when, how much, and which goods to prioritize restocking.