

Machine Learning's Growing Impact on E-Commerce

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1. Introduction

In the modern day, where technology develops at an exponential rate, business and commerce have undergone a transition that heavily relies on data structures and computer technology, more specifically machine learning. Over the past years, machine learning has become the backbone of information technology, and has made an instrumental contribution to effective business development, resulting in competitive advantages (Sarkar, 2016). With the transition to an electronic format, these sectors have come across an increasing amount of data associated with strategic planning and development of the e-commerce sector (Vaduva, 2014, p. 53). Moreover, the success of today's e-commerce platforms can be credited specifically to the massive amount of data that can be analyzed for effective decision making (Choudhury, 2015). This report will aim to describe the notion of machine learning, the contributors and important actors involved, the effects of machine learning on e-commerce and, ultimately, why machine learning is vital for the growth of e-commerce.

2. What is the History and Context of the Problem?

2.1 Machine Learning Explained

Andrieu, Freitas, Doucet, and Jordan (2003, p. 40) believe machine learning came into existence from the marriage of pattern recognition and the theory that machines could learn without being strictly programmed for a certain task, ie. artificial intelligence. Therefore, machine learning is a kind of artificial intelligence (AI) which provides the computers with the ability to learn without being programmed for that specific task (Del Rowe, 2016).

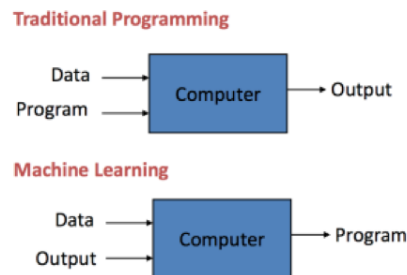


Figure 1. Traditional Programming vs. Machine Learning. Reprinted from Machine learning mastery, by Jason, Brownlee.

Figure 1 demonstrates how machine learning takes the data and desired output and computes a solution, as opposed to traditional programming which requires data and a program to provide resulting output. The process is very similar to that of data mining;

systems search through data in order to recognize patterns. Instead of data extraction for human comprehension like data mining applications, machine learning utilize that data for detection of patterns present within data and adjust the actions of the program accordingly (Rouse, 2016).

2.2 Need for Machine Learning

The fact that machine learning is an iterative algorithm, meaning it is always generating better solutions than the previous, is vital for machine learning models exposed to new data to adapt autonomously (Sebastiani, 2002, p. 13). And, this autonomous adaptation allows for the flexibility and use of machine learning within all disciplines. For example, by recognizing patterns and trends, this kind of computation can be used in science for measurements, mathematics for trend analysis, business for consumer analysis and finance for stock trends, among many other possible uses.

Growing interest in machine learning is due to the same factors which have increased the interest in statistical paradigms, such as Bayesian analysis and data mining. These factors include the increase in the amount and variety of data, affordable but powerful computational processing and affordable storage of data. All these factors mean that it is possible to efficiently produce models capable of analyzing complex large amounts of data and deliver accurate results in a short time. And through these precise models, organizations have a better chance to identify profitable opportunities and avoid unknown and costly risks (Watkins, 2016).

2.3 Machine Learning in E-Commerce

It is evident that machine learning plays a part in our daily lives; for example, slang words on a smartphone will not be recognized as typos if used enough times. In terms of e-commerce, machine learning is most often seen in online advertisements. The data stored from searches for certain products is used by machine learning algorithms to present a user with advertisements related to the searched product. This results in constant pressure on the user to purchase the product, which directly proves how implementing machine learning algorithms into business strategies can be profitable for companies. Therefore, it can be concluded that the more data a machine learning algorithm has on its consumers, the more capable it will be to tailor advertisements to its consumers, which in turn results in more profits for the business.

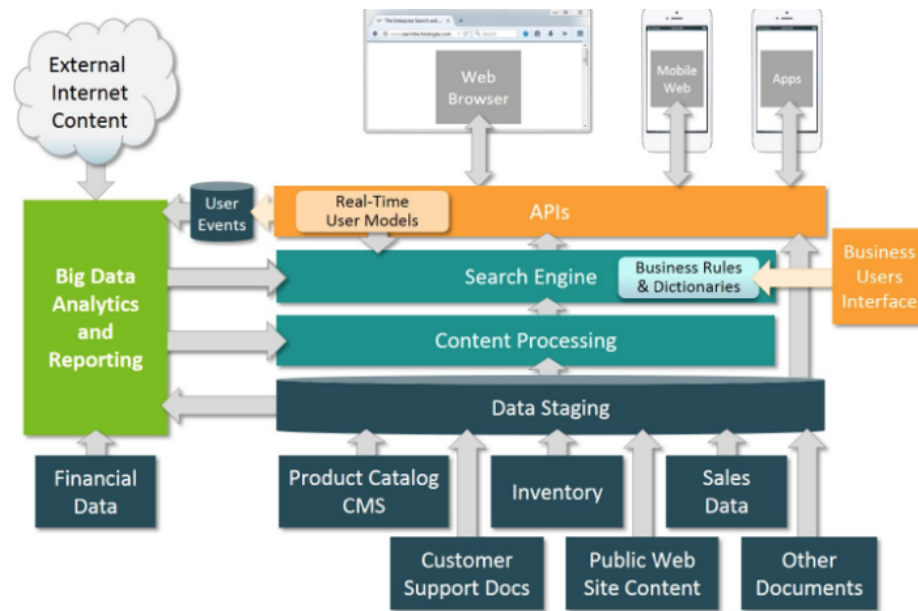


Figure 2. Big data architecture for e-commerce search platforms. Reprinted from Search Technologies, 2016.

Figure 2 represents the central role big data plays in all interactions done by the user and the architecture of an e-commerce platform. All interactions from the user are stored as user events in the big data along with all the data the business has concerning their product catalogue, inventory, sales data etc. Outside information also stored in the big data is external internet content which can be relevant information regarding the products being sold and financial data. This is where machine learning algorithms comes in to make sense of all of this data and compute solutions that wouldn't be possible without the use of this technology. In summary, it is clear that a large amount of data can help a business in numerous ways.

Behind any major service on the web, a principle of machine learning is present. Machine learning is now providing applications the necessary algorithms and frameworks for bringing greater predictive value and accuracy to the e-commerce business; resulting in diverse strategies that succeed in shorter periods of time and with higher net profits (Zaproo, 2016). A number of applications of machine learning have already been adopted in e-commerce, such as improvement in product search/recommendation and promotion, business intelligence, managing prices and strengthening supply chain management.

3. Who is the Problem Important to?

3.1 Effects on the Business

Retailers are always looking at different tactics to make the most out of their marketing. Traditionally, marketers would spend months on research to try to formulate the most effective marketing plan for a product to target a specific audience. Sometimes this wouldn't result in a great enough acceptance by the consumers and be deemed a failure. Through the use of machine learning, businesses are no longer leaving the decisions to marketers who are prone to human error. Applying the algorithms machine learning provides, on the same large sets of data marketers are using, results in much more effective and cheaper solutions. On the same large sets of data that marketers have access to, machine learning algorithms are able to provide cheaper, more effective solutions than any team of marketers. This is very important to businesses as they are able to save costs on salaries for a team of marketers and have better marketing effectiveness.

4. Why is the Problem Important?

4.1 Discussion of Different Applications

4.1.1 Improving Search Results

When it comes to consumer products and e-commerce platforms, machine learning can play a significant role in improving what consumers buy and where they decide to buy from. One of the many effective yet subtle applications of machine learning on e-commerce platforms are the effects of better and smarter product searches and search results in particular. When a consumer is searching for a specific product, many factors come into play to successfully present the consumer with the best results.

One important factor that comes into effect, particularly for search queries, are the user behavioural data that are stored in databases. The data, in fact, provides a link from the search query and holds information on what the user clicks to view as opposed to what the user clicks to purchase. Machine learning algorithms are then applied to analyze this data to produce graphs and results that display the relationship between the search query and the actual product being purchased. This helps to understand the intent of the consumer's search query and

ensures the consumer is presented with the most appropriate results. For instance, when a consumer searches for “Toyota Corolla”, it is important to know whether he/she is looking for a new car or just parts for the particular car. Search query intent detection comes in handy in such cases where the requirement is to understand the user’s search context (Srivastava, 2015).

Other factors that also come into play for improving search results are product rankings from other users and user personalization profiles. User personalization profiles are also an effective method of improving product searches and search results. Such profiles are updated constantly and are created based on the consumer’s purchase history and past search queries to create the illusion of presenting products to consumers that seem to match their interests and needs almost precisely.

4.1.2 Improving Promotions and Recommendations

Another application of machine learning with e-commerce platforms is the improvement of promotional and recommended content to the consumer. As shown below, *Figure 3* presents the multi-step process of what a system with machine learning algorithms goes through when a user is about to receive a recommended product. Typical methods of providing product recommendations relied on the principle of “Collaborative Filtering”, where similar purchasing patterns of past consumers would be utilized to predict intentions of present consumers.

Machine learning makes product recommendation simple by understanding the behaviour of consumers, including the consumer’s purchase history, and gauging how well multiple products sell on a website to successfully determine relevant recommendations to consumers, which in turn, have a higher probability to generate sales (Shish, 2015). The same concept can be applied when determining how well a promotion will do for a certain product. This is done by identifying how well a product currently sells, when it sells the most and the success of previous promotions for this product.

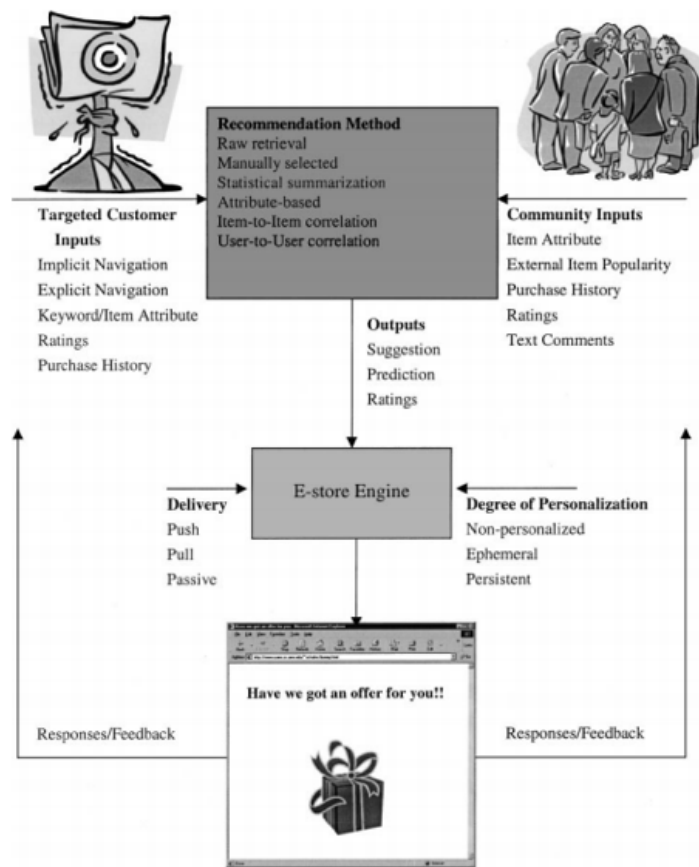


Figure 3. Recommendations through personalization level. Reprinted from “E-Commerce Recommended Applications”, Schafer, Joseph and John, 2001, *Data Mining and Knowledge Discovery*, 5, pp. 115-153.

4.1.3 Revamping Business Intelligence

Business strategies are always changing with time, and revamping business intelligence is important to understand and examine the overall dynamics of the business. Most large online businesses are faced with unique problems due to their large and diverse inventory, which have many products. In such a case, there is no complete catalogue of products in which all the items being sold are covered. Kohavi, Mason, Parekh, and Zheng (2004, p. 100) ask the important question of how an E-commerce business such as eBay know exact numbers of specific products sold over their website, when products can be listed under different categories with different descriptions and titles or even offered as a bundle with other items. Bose and Mahapatra (2001, p. 213) explain that inventory intelligence is a solution to this problem which requires the use of data mining for processing the items and mapping them to a correct category for the

product. This process involves the understanding of natural language, text mining and techniques of machine learning. Successfully classifying inventory also helps to provide a better experience with searching and gives users more relevant products (Yadav, 2015).

4.1.4 Strengthening Supply Chain Management

Predictive analysis assists in understanding the demand of the consumer in order to manage the process of supply chain effectively. This includes forecasting and planning, fulfilment, sources, returns, and delivery (Srivastava, 2015). If a retailer is able to predict revenue from a particular product, it results in better management of inventory, optimized use of the warehouse space, better cash flow use, and avoidance of items that are out-of-stock. Inkiru, an active learning system that uses real-time predictive intelligence and big data analytics to streamline business decisions, was recently acquired by Walmart. This allows a global giant like Walmart to continue to increase their capital by implementing the latest technologies with machine learning to improve their business strategies.

4.1.5 Price Management

Price trends are an analysis completed with regard to information of sales for determining the appropriate prices of products for specific times to maximize profit and revenue. Product pricing is managed through the use of a predictive model which looks at historical data for sales, products, customers and more. Using this model, prices for a given product are predictable at any time, allowing the business to set the prices for a product accordingly. For example, Amazon is a heavy user of pricing products over real time, which is based upon a pricing algorithm that looks at several inputs like product pricing trends and competitor pricing (Yadav, 2015).

5. How Many Customers are Affected?

5.1 Effects on Customers

People everyday are exposed to multiple advertisements whether it be online or out in the real world. While real world advertisements may not be customized to each individual, they are still placed in areas where their target market would possibly be

exposed to such advertisements. Where online advertisements shine is through hyper personalization, in other words, they are directly targeting each consumer, which results in a much higher chance of actually appealing to this consumer. Every time someone interacts with their web browser they are essentially adding to their online web profile, which is used by businesses to target them for advertising. This means that almost everyone connected to the internet is affected by machine learning algorithms used by businesses.

Consumers these days turn to online shopping to avoid the chance of a product being out of stock in a brick and mortar store. This factor gives e-commerce businesses a competitive advantage, which they should look to capitalize on. Consumers are directly associated to supply chain management as they are apart of the demand factor in the equation companies use to order more inventory. If a company has troubles with their supply chain management, they may find that they do not have in-demand products in stock, which is a big problem as they lose their competitive advantage. A consumer looking for this specific product may take their business elsewhere due to the freedom of online shopping.

6. Conclusion

In conclusion, machine learning algorithms aim at having the computer discover patterns or trends in some data set without being programmed explicitly to recognize those programs or trends. E-commerce businesses can take advantage of machine learning technology in numerous ways to advance their business in many ways, such as cutting unnecessary costs, efficiently marketing online and keeping records of trends that may occur with the purchasing of their products. Regardless of the size of the e-commerce business, implementing the latest machine learning technology is key to meeting the constantly changing expectations of customers, in terms of service and quality. So, it can be said with confidence that the future of e-commerce rests on machine learning.

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