International Scientific Journal "Internauka" https://doi.org/10.25313/2520-2057-2025-3

Technical sciences

## UDC 004.6

### **Masol Andrii**

Higher Education Specialty, Architect in Digital technologies University Association 42 (Paris, France); Software Developer (Kyiv, Ukraine) ORCID: 0009-0005-4695-8366

# METHODS OF APPLYING ARTIFICIAL INTELLIGENCE FOR PERSONALIZING ONLINE SHOPPING

Summary. Artificial intelligence has become an integral part of modern online shopping, offering unique opportunities for personalizing the user experience. This article examines the main methods and technologies for applying artificial intelligence to online shopping personalization, such as big data analysis to identify customer behaviour patterns and preferences. One of the key AI-based personalization methods in online shopping is the creation of personalized recommendations based on browsing and purchase history. Algorithms take into account not only the customer's current interests but also their potential needs, creating a unique and appealing product selection. The article provides examples of successful AI implementations for online shopping personalization.

*Key words: artificial intelligence, application methods, online shopping, personalization.* 

**Introduction.** In today's world, artificial intelligence technologies have become an integral part of everyday life. Revolutionary changes in e-commerce have made artificial intelligence (AI) a key tool for creating a unique shopping experience. The development of machine learning algorithms enables online stores to analyze vast amounts of data on user behavior, preferences, and purchase history. Based on this analysis, precise product recommendations are generated that may interest a specific customer [1].

The aim of this article is to describe the methods of applying artificial intelligence for personalizing online shopping and to determine the directions for its further development.

**Research Methods**. The following research methods were used in this article: a study of theoretical approaches on the research topic, system and functional approaches, data collection and analysis from the global Internet, and a scientific analysis of model architecture selection.

**Essence and Relevance of Online Shopping Personalization.** The revolution in online commerce has led to a shift where every customer expects a personalized approach and relevant offers. Thanks to artificial intelligence and big data, businesses can anticipate customer needs even before they recognize them themselves.

Personalization in e-commerce encompasses multiple aspects, from adaptive website design to individualized pricing strategies and loyalty programs. This creates a unique shopping experience that enhances customer satisfaction and boosts conversion rates.

The future of e-commerce is closely tied to further advancements in personalization, which is no longer just a competitive advantage but a necessity for survival in the digital marketplace [2].

The integration of AI-powered chatbots and virtual assistants enables 24/7 customer support and assistance in product selection. This is particularly crucial in the face of growing competition in the e-commerce sector.

It is predicted that the role of artificial intelligence in online retail will continue to expand in the coming years. Companies that fail to implement AI- driven personalization technologies risk losing their competitive edge in the ecommerce market [3].

Thus, the application of artificial intelligence for personalizing online shopping is not just a current trend but a vital requirement for the successful growth of modern e-commerce businesses.

**The Role of Artificial Intelligence in Online Shopping Personalization.** The use of AI in e-commerce platforms involves leveraging advanced AI capabilities and machine learning tools for data analysis. It enables automation, helps predict consumer behavior, and optimizes operations. Figure 1 illustrates the advantages of using AI for online shopping personalization.



Fig. 1. Advantages of Using AI in Online Shopping Personalization Source: developed by author

With the rapid growth of e-commerce, global payment fraud has become a pressing issue. AI-powered fraud detection can provide crucial protection by quickly identifying potential threats, preventing financial losses, and enhancing trust in transactions.

AI tools in e-commerce, such as chatbots for customer support, can offer 24/7 assistance, which is a critical factor in customer retention. Negative experiences with call centers drive 60% of consumers to switch brands. Additionally, for 70% of brands, customer service directly impacts performance

and brand loyalty. The key role of customer service in brand loyalty is evident, making AI-driven support a necessity in modern business strategies [4].

The use of AI in e-commerce enhances logistics by providing data-driven insights for demand forecasting, inventory management, and recommending efficient delivery routes—effectively solving the "traveling salesman problem". This can significantly improve delivery times and increase cost efficiency in the global e-commerce logistics market.

This transformative technology helps predict demand, minimizes excess inventory, and offers recommendations for supply chain optimization—an evolving aspect of modern supply chain management. AI-driven solutions ensure customer satisfaction and maintain a competitive edge by ultimately reducing delivery times and lowering costs [5].

AI-powered predictive analytics for inventory management in e-commerce can help eliminate demand-supply imbalances.

The implementation of AI-driven inventory optimization has shown promising results in reducing excess stock and significantly cutting warehouse costs. Efficient inventory management is becoming a necessity for substantial cost savings and improved operational efficiency in the highly competitive retail sector.

The rapid growth of voice commerce is reshaping the retail landscape. Consumer preferences are driving this evolution: 22% of shoppers prefer making direct purchases via voice commands, while 17% use them for reordering. Notably, 71% of consumers favor voice search over manual text input. The integration of AI-powered voice recognition technology has fundamentally shifted retail paradigms, offering enhanced convenience and accessibility for customers seeking a seamless shopping experience.

AI plays a crucial role in personalizing the user experience, especially in online retail. By analyzing past purchases and browsing behavior, AI can tailor a

user's homepage to showcase products that match their preferences. Personalized recommendations account for 30% of e-commerce site revenues.

As the digital landscape evolves, AI is expected to handle 70% of all customer interactions, emphasizing its transformative impact and the increasing reliance on AI to deliver individualized and engaging consumer experiences in e-commerce.

AI-driven visual search and image recognition are also transforming ecommerce. Users can search for products using images, enriching their shopping experience and making product discovery seamless. The significance of this technology is evident, as 36% of consumers have used visual search systems, with more than half emphasizing the importance of visual information over text when shopping online.

Moreover, 55% of consumers acknowledge that visual search tools significantly influence their style and taste. Online behavior reflects this shift: image-based search accounts for 27% of core search functionalities. The integration of AI into visual search options is undoubtedly transforming how consumers interact with e-commerce platforms, emphasizing the power of visual information in the shopping process [6].

AI-driven real-time data in e-commerce can be a game-changer. By continuously monitoring website traffic, AI provides the necessary insights to make instant adjustments, ensuring a seamless browsing experience and personalized interactions for each user. This optimization greatly enhances user satisfaction and engagement—both critical success factors.

The ability to adapt and personalize user experiences in real-time makes AI an indispensable tool for modern e-commerce, improving not only customer satisfaction but also overall business efficiency.

Additionally, 64% of marketing executives recognize the crucial role of data-driven marketing in the global economy. It is fundamental to customer

acquisition (54%) and retention (50%), while 67% of marketers believe it increases decision-making speed and accuracy [7].

**Examples of AI Applications for Online Shopping Personalization.** Founded in the U.S. in 1994, Amazon is one of the first e-commerce companies that continues to thrive today.

Amazon's constant drive for innovation and improvement led it to become a pioneer in e-commerce personalization, introducing it more than 20 years ago. Over time, this technology has only improved, making Amazon a prime example of personalized e-commerce.

Amazon provides a highly personalized shopping experience for all its users. The company focuses on making shopping easier for customers. Its advanced recommendation system, along with various other personalized features, enables this seamless and tailored shopping experience.

Amazon tracks every action its customers take using Big Data Analytics, which serves as the foundation of its successful personalization strategy.

AI-powered personalized recommendations act as a virtual shopping assistant for each customer, promoting products based on their interests and offering suggestions across different categories. This approach significantly boosts Amazon's revenue through upselling and cross-selling.

Amazon has reported that 35% of its sales come from personalized recommendations.

The company employs an aggressive personalization strategy, leveraging multiple data points at every customer touchpoint throughout the shopping journey.

Amazon's personalization strategy is highly aggressive and involves tailoring the shopping experience based on multiple data points at every customer touchpoint throughout the purchase journey.

Since Amazon operates exclusively in the e-commerce space, without any physical presence, its aggressive personalization system helps the company maintain its leadership, as well as sustain customer engagement and satisfaction [8].

Best Buy has established itself as a leading electronics retailer in the United States and has expanded its presence into Mexico and Canada.

Unlike Amazon, Best Buy operates both online and offline, and they have leveraged this to their advantage when it comes to personalization.

In addition to personalizing their website and e-commerce app through machine learning and data-driven product recommendations, as well as personalized email campaigns, Best Buy has also found smart and effective ways to integrate online and offline personalization.

One unique personalization feature is the "Local Store Mode" in their mobile app. As soon as a customer enters a Best Buy store, this feature is automatically activated, sending personalized push notifications tailored to the inventory of that specific store location.

Best Buy reported that 72% of customers using its app enter stores with items already in their online carts. The "Local Store Mode" feature notifies the customer if an item in their cart is available in the store and provides other relevant offers.

Another example of e-commerce personalization is the "On My Way" feature, which alerts store staff when a customer arrives to pick up their online order. This ensures that the customer receives fast and seamless service.

Best Buy is a prime example of personalization in e-commerce, demonstrating how companies operating both online and offline can use personalization to enhance customer service across both platforms simultaneously.

This approach to adopting innovative features has helped Best Buy remain competitive against giants like Amazon and Target.

Netflix, the world's largest streaming service, has become a global phenomenon. Personalization plays a key role in this success.

According to Netflix, 80% of what people watch on the platform comes from its personalized recommendation algorithms. With the overwhelming number of shows and movies constantly growing on Netflix, finding something to watch can become exhausting for users. The personalized recommendation system is designed to address this challenge. Netflix's machine learning algorithms process vast amounts of data and recommend shows and movies tailored to each user's unique tastes [9].

Netflix goes beyond just personalized recommendations by tailoring its promotions, messaging, page generation, and even the display of show images/posters to meet the needs of different audience segments.

The company focuses on using advanced mathematical machine learning to personalize every possible aspect of its service, ensuring a truly individualized experience for each user.

Spotify, one of the world's leading music streaming platforms, competes with Apple Music and Pandora, and serves as another prime example of ecommerce personalization.

One of Spotify's standout personalization features is "Discover Weekly" a personalized playlist delivered to each user every week. This playlist combines a user's personal listening data with data from users who have similar listening profiles, creating a curated selection of songs almost perfectly matched to each listener's musical taste.

Spotify has found that users spend more time listening to personalized playlists, further emphasizing the effectiveness of their personalization strategy.

The personalization strategy benefits both artists and music lovers. More artists gain visibility, and users enjoy a higher-quality service with tailored music experiences.

E-commerce personalization is also steadily growing in the aviation industry, as companies begin to recognize the advantages of personalization.

EasyJet was one of the first airlines to adopt personalization, making it a notable example of e-commerce personalization within the aviation sector.

To mark its 20th anniversary, EasyJet launched a personalized email marketing campaign, which turned out to be a massive success. The campaign, titled "How 20 Years Flew By", was built using data from each customer's travel history with EasyJet over the years.

The personalized emails included images and links that showcased the journey of each customer, from their first flight with EasyJet to their future trips. This personalized and emotional campaign resulted in a 100% increase in performance compared to the average email metrics for EasyJet. The click-through rates increased by 25%, and in all markets, 7.5% of customers who received a personalized email made a booking within the next 30 days. Specifically, in the Swiss market, there was a 30% increase in conversion rates [10].

There are many other ways that airlines can optimize their e-commerce through real-time personalization on a daily basis, maximizing the benefits from personalized customer interactions.

**Example of Implementing a Program to Segment E-Commerce Customers into Groups.** The program processes a CSV file containing data on customer purchases and generates a new file in the same format, where customers are grouped into clusters with assigned numbers (an example is shown in Table No. 1).

Table 1

N⁰	Name	Туре
1	Customer ID	GUID
2	Date and time of purchase	DateTime
3	Purchase amount	Money

**Description of columns in the input file (CSV format)** 

International Scientific Journal "Internauka" https://doi.org/10.25313/2520-2057-2025-3

The result of clustering is recorded in the output CSV document, mapping each customer to a specific cluster (an example is shown in Table No. 2).

Table 2

## Description of columns in the output file (CSV format):

N⁰	Name	Туре
1	Client ID	GUID
2	Cluster Number	Cluster

Table No. 3 presents the data types used to describe the columns of the input and output files (CSV format).

Table 3

## Data types used to describe the columns of the input and output files (CSV format)

Туре	Description	Format
GUID	Global Unique	"xxxxxxx-xxxx-xxxx-xxxx-
	Identifier	xxxxxxxxxxx, where each x is a value from
		0-9 or a-f.
DateTime	Date and Time	In the format: yyyy-MM-dd
		HH:mm:ss.fff, where:
		yyyy – year,
		MM – month,
		dd - day,
		HH – hour,
		mm – minute,
		ss-second,
		fff – millisecond.
Money	Monetary amount	In the form of a decimal number, where
		the integer part represents rubles and the
		fractional part represents kopecks. The
		fractional part is separated from the integer
		part by a comma.
Cluster	Cluster number	An integer from 1 to 3.

To solve the given task, key tools of Python development were utilized. The core functionality was provided by three fundamental libraries: Scikit-learn, responsible for the algorithmic component of clustering and performance evaluation; pandas, for manipulating tabular data; and Matplotlib, which enables the creation of clear 2D and 3D visualizations of the results.

After installing the necessary software, the information database was loaded. The source was an active online store that provided data in CSV format. The dataset structure included three main parameters: the unique customer ID (IdClient), the timestamp of the transaction (InsertDate), and the purchase amount (sumTotal).

Based on the prepared database, a machine learning system was implemented, capable of analyzing and processing the provided data according to the specified parameters.

To analyze the time intervals between purchases, the datetime library was integrated, and a custom function called delta\_date was developed. It calculates the difference between the current date and the transaction date in days.

A new data table is created in the system, initially empty. It is intended to store three key metrics for each customer: frequency of their activity, number of purchases, and total spending.

The classification system assumes distributing customers on a five-point scale. Special attention is given to the recency of purchases: the highest score of R = 5 is assigned to the most active customers with recent purchases, while those inactive for a long time receive the minimum score of R = 1. This segmentation allows the entire customer base to be divided into five clear categories.

The encode functionality enables processing of the input DataFrame by applying a specified operation to a particular column, using the complete customer database. During the analysis of purchasing activity, all customers are classified into five categories. The system takes into account the chronology of transactions, identifying the most recent purchase for each customer. The customer activity rating is indicated by the value F: the most active customers are assigned the highest score, F = 5, while those with the least activity receive F = 1. Each transaction is assigned a corresponding identification code based on its temporal proximity to the current moment.

A 3D visualization using Matplotlib was employed to verify the data distribution, with recency, frequency, and monetary values plotted along the axes. The results are presented in Figure 2. In addition, segmentation by the monetary criterion was performed: the highest spending corresponds to a value of M = 5, and the lowest to M = 1.



Fig. 2. 3D plot with the dimensions *recency*, *frequency*, and *monetary Source:* developed by author

The Scikit-learn library includes a built-in function that allows customers to be grouped into clusters. It was decided to create three customer clusters, so the n\_clusters parameter was set to three. The segmentation of the customer base was performed using k-means, one of the most widely used clustering algorithms. Figure 3 shows how the algorithm divided the data on a 3D plot.



Fig. 3. Data clustering algorithm *Source:* developed by author

In conclusion, the DataFrame with clustering results is converted into a CSV format that is convenient for further use.

**Prospects for the Development of Artificial Intelligence in Personalizing Online Shopping.** By adapting AI approaches to user needs, online stores are beginning to offer unique, personalized recommendations, which significantly enhance customer satisfaction. These technological innovations not only enable a deeper understanding of customer desires but also greatly improve their interaction with e-commerce platforms.

Artificial intelligence has the potential to radically transform how people shop online. From product recommendations that best match individual preferences to predicting future purchases based on previous interactions, the possibilities and prospects appear endless.

Moreover, integrating AI into online shopping contributes to more efficient inventory and logistics management, ultimately reducing costs and improving service for end consumers. This opens the door to a more personalized approach for each customer while ensuring high efficiency and a more satisfying shopping experience.

It is also important to note that progress in AI and its application in online retail comes with numerous challenges, including issues of data privacy and security. Nevertheless, with the right approach and adherence to necessary safety measures, the opportunities for both retailers and customers can far outweigh the existing risks [11].

**Conclusion.** In today's world, where technology is advancing at an incredible pace, one of the most promising directions is the use of artificial intelligence (AI) to enhance the quality of online shopping. The application of AI in e-commerce opens up new horizons for creating personalized customer experiences.

In conclusion, it can be confidently stated that artificial intelligence plays a key role in transforming online shopping, making it more convenient, personalized, and efficient. As technologies continue to evolve, we can expect these trends to deepen and expand further, undoubtedly having a significant impact on the entire e-commerce industry.

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of the Asia Pacific Software Engineering Conference 2020, November 2020, Sydney, Australia.