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AI-Powered Sorting in E-commerce: Personalization and Performance Optimization

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Abstract: *Traditional e-commerce platforms primarily utilize static sorting algorithms based on attributes such as price, popularity, or recency. This one-size-fits-all approach fails to address the unique preferences and behavioral patterns of individual users, leading to suboptimal user experiences and missed revenue opportunities. This paper proposes a framework for an AI-powered sorting system that dynamically re-ranks products for each user in real-time, leveraging machine learning to personalize product discovery and optimize platform performance. By analyzing user data, including clickstream, search queries, and purchase history, the system learns to predict a user's likelihood of engaging with a product. The proposed methodology outlines the data collection, feature engineering, and model architecture required to build a robust and scalable solution. We discuss the potential for this system to significantly enhance key e-commerce metrics, such as click-through rate, conversion rate, and customer satisfaction, representing a major advancement over conventional, rule-based systems.*

Keywords: E-commerce, Personalization, AI, Machine Learning, Sorting Algorithms, Recommender Systems, User Experience, Performance Optimization.

1. Introduction

The e-commerce landscape is intensely competitive, with a customer's attention span being a primary resource. The way products are presented and sorted on a website or mobile application is a critical factor in a user's journey. For years, the default sorting options, such as "Best Sellers," "Price: Low to High," and "Newest Arrivals," have dominated the user interface. While these methods are simple and transparent, they are inherently generic. They assume that all users, regardless of their browsing history, past purchases, or current intent, share the same preferences.

The evolution of artificial intelligence and machine learning presents an opportunity to fundamentally change this paradigm. An AI-powered sorting system moves away from static, predefined rules and toward a dynamic, learned policy that is tailored to each user. This paper explores the design and implementation of such a system, drawing a clear distinction between the limitations of a traditional IF-THEN rule-based expert system (1-Introduction.pdf) and the adaptability of a modern machine learning approach. By creating a system that can reason about a user's preferences, we aim to not only improve the user experience but also drive significant business value by optimizing the performance of the e-commerce platform.

2. Objectives

The objectives of this research are to:

- Propose a conceptual architecture for an AI-powered sorting system in e-commerce.
- Explain the role of machine learning models in dynamically personalizing product rankings.
- Compare the proposed AI methodology with traditional, static sorting methods and rule-based expert systems.
- Discuss the expected performance improvements and challenges associated with implementing such a system.

3. Problem Statement

The central problem is that static product sorting methods, while easy to implement, create a non-personalized and inefficient shopping experience. They fail to account for the unique context of each user's shopping journey, which may be influenced by a myriad of factors, including their current search query, past purchases, or even the time of day. This lack of personalization leads to a poor user experience, with customers often having to sift through many irrelevant products to find what they are looking for. The result is a high bounce rate, low conversion rate, and an overall reduction in customer satisfaction and loyalty. The challenge is to replace a brittle, predefined logic with an intelligent system that can learn and adapt to each user's latent preferences in a fast and scalable manner.

4. Literature Review

Early attempts at solving complex problems involved the creation of expert systems, which relied on a knowledge base of hand-crafted IF-THEN rules (1-Introduction.pdf) and a powerful inference engine (4-Reasoning.pdf) to mimic human expertise. For e-commerce, this could be a simple system of rules like: IF user_searched_for "running shoes" THEN sort by brand Nike. However,

as discussed in the course material, expert systems are plagued by the knowledge acquisition problem and struggle with inexact knowledge and uncertainty (5-Reasoning-Uncertainty.pdf). This makes them ill-suited for the vast, dynamic, and often ambiguous nature of user preferences.

Modern approaches to this problem leverage advanced machine learning models, which learn patterns directly from data rather than relying on explicit rules. Recommender systems, a core component of e-commerce, have evolved from simple collaborative filtering to sophisticated deep learning models that can process vast amounts of user and product data [11]. These models are trained to perform pattern matching (8-ES-Implementation.pdf) on a massive scale, identifying correlations between user behavior and product attributes that are invisible to a human expert. The ability of these models to handle the imprecision and ambiguity inherent in user behavior (6-Approximate-Reasoning.pdf) is what gives them a significant advantage over rule-based systems.

5. Methodology

The proposed AI-powered sorting system is a data-driven framework that operates in real-time. It consists of the following key components:

5.1. Data Pipeline The system is built on a robust data pipeline that collects, processes, and stores vast amounts of user and product data.

- **User Data:** This includes explicit signals like purchase history, ratings, and saved items, as well as implicit signals like clickstream data, search queries, time spent on pages, and device type.
- **Product Data:** This includes a rich feature set for each product, such as category, brand, price, description, images, and other metadata.

5.2. Machine Learning Model At the heart of the system is a ranking model, which is a supervised learning model. The model's task is to predict the probability that a given user will interact with a given product.

- **Input:** The model takes a combined feature vector as input, which includes features about the user (e.g., past purchases, demographics) and features about the product (e.g., category, price).
- **Output:** The model outputs a score, which represents the predicted likelihood of a click or a purchase.
- **Model Architecture:** A gradient boosting model like Light or a deep neural network would be suitable for this task due to their ability to handle large, sparse datasets and capture complex, non-linear relationships.

5.3. Real-time Inference and Sorting When a user visits a category page or performs a search, the system performs the following steps:

1. The user's current context and historical data are used to create a user feature vector.
2. The ranking model processes a list of potential products along with the user vector.
3. The model outputs a personalized score for each product.
4. The products are sorted in descending order of their scores and displayed to the user. This process must be optimized for low latency to ensure a seamless user experience.

6. Results (Hypothetical)

A hypothetical implementation of this system would lead to a measurable increase in key performance indicators compared to a baseline of static sorting.

Table 1: Hypothetical Performance Improvement

Metric	Traditional Sorting	AI-Powered Sorting	Improvement
Click-Through Rate (CTR)	2.5%	4.0%	+60%
Conversion Rate	1.8%	2.5%	+38%
Average Order Value (AOV)	$55	$60	+9%

7. Discussion

The hypothetical results demonstrate the clear benefits of an AI-powered approach. The substantial increase in CTR and conversion rate suggests that the personalized sorting is more effective at matching users with products they are likely to purchase. The increase in AOV indicates that the system is also effective at cross-selling and up-selling, by showing users complementary or higher-value items.

The success of this system hinges on the quality and quantity of the data. A cold-start problem, where a new user has no behavioral data, must be addressed using alternative methods like sorting by popularity or product metadata. Furthermore, the system must be continually monitored and updated to prevent the creation of "filter bubbles," where a user is only shown items similar to what they have already seen, limiting discovery. This is a form of meta-knowledge (4-Reasoning.pdf) that the system must consider: the knowledge about how to reason, not just the reasoning itself.

8. Conclusion

AI-powered sorting represents a critical evolution in e-commerce, moving beyond the limitations of static rules to deliver a truly personalized shopping experience. By leveraging the power of machine learning, platforms can dynamically adapt to individual user preferences, leading to a more engaging, efficient, and ultimately more profitable experience for both the customer and the business. This approach provides a significant competitive advantage in the crowded e-commerce space and offers a powerful case study for the application of modern AI techniques to solve real-world business problems.

References

1. Abu Naser, S. S. (2008). "Developing visualization tool for teaching AI searching algorithms." Information Technology Journal, Scialert 7(2): 350-355.
2. Abu Nasser, B. S. and S. S. Abu-Naser (2024). "Leveraging AI for Effective Fake News Detection and Verification." Arab Media Society(37).
3. Abu, S., et al. (2024). "AI in Digital Media: Opportunities, Challenges, and Future Directions 2 Naser-and." International Journal of Academic and Applied Research (IJAAR) 8: 1-10.
4. AbuEl-Reesh, J. Y. and S. S. Abu-Naser (2018). "An Intelligent Tutoring System for Learning Classical Cryptography Algorithms (CCAITS)." International Journal of Academic and Applied Research (IJAAR) 2(2): 1-11.
5. Abu-Naser, S. S., et al. (2023). "Heart Disease Prediction Using a Group of Machine and Deep Learning Algorithms." Advances on Intelligent Computing and Data Science: Big Data Analytics, Intelligent Informatics, Smart Computing, Internet of Things 179: 181.
6. Abunasser, B. S., et al. (2022). "Breast Cancer Detection and Classification using Deep Learning Xception Algorithm." International Journal of Advanced Computer Science and Applications 13(7).
7. Abunasser, B. S., et al. (2023). "Abunaser-a novel data augmentation algorithm for datasets with numerical features." Journal of Theoretical and Applied Information Technology 101(11).
8. Abunasser, B. S., et al. (2023). "Predicting Stock Prices using Artificial Intelligence: A Comparative Study of Machine Learning Algorithms." International Journal of Advances in Soft Computing & Its Applications 15(3).
9. Abunasser, B. S., et al. (2023). Literature review of breast cancer detection using machine learning algorithms. PROCEEDINGS OF THE 1ST INTERNATIONAL CONFERENCE ON FRONTIER OF DIGITAL TECHNOLOGY TOWARDS A SUSTAINABLE SOCIETY, AIP Publishing LLC.
10. Abu-Saqer, M. M., et al. (2024). "AI Regulation and Governance." International Journal of Academic Engineering Research (IJAER) 8(10): 59-64.
11. Al Qatrawi, M., et al. (2025). "AI and Climate Action: Technology's Role in Mitigating Environmental Challenges."
12. Al-Bayed, M. H., et al. (2024). "AI in Leadership: Transforming Decision-Making and Strategic Vision." International Journal of Academic Pedagogical Research (IJAPR) 8(9): 1-7.
13. Al-Dahdooh, R., et al. (2024). "Explainable AI (XAI)." International Journal of Academic Engineering Research (IJAER) 8(10): 65-70.
14. AlDammagh, A. K. and S. S. Abu-Naser (2025). "AI-Driven Sorting Algorithms: Innovations and Applications in Big Data." International Journal of Academic Engineering Research (IJAER) 9(6): 11-18.
15. Alkayyali, Z. K., et al. (2023). "A new algorithm for audio files augmentation." Journal of Theoretical and Applied Information Technology 101(12).
16. Alkayyali, Z. K., et al. (2024). "Advancements in AI for Medical Imaging: Transforming Diagnosis and Treatment." International Journal of Engineering and Information Systems (IJEAIS) 8(8): 10-16.
17. Alkayyali, Z., et al. (2023). "A systematic literature review of deep and machine learning algorithms in cardiovascular diseases diagnosis." Journal of Theoretical and Applied Information Technology 101(4): 1353-1365.
18. Alnajjar, M., et al. (2024). "AI in Climate Change Mitigation." International Journal of Engineering and Information Systems (IJEAIS) 8(10): 31-37.
19. Alqedra, H. I. and S. S. Abu-Naser (2025). "Intelligent Sorting Systems for Humanitarian Data: Leveraging AI for Efficient Emergency Response." International Journal of Academic Engineering Research (IJAER) 9(6): 29-40.
20. S. E. and S. S. Abu-Naser (2025). "AI-Enhanced algorithm Sorting Techniques: Revolutionizing Data Processing and Analysis." International Journal of Academic Engineering Research (IJAER) 9(6): 44-47.
21. Al-Zamily, J. Y. I., et al. (2023). A survey of cryptographic algorithms with deep learning. PROCEEDINGS OF THE 1ST INTERNATIONAL CONFERENCE ON FRONTIER OF DIGITAL TECHNOLOGY TOWARDS A SUSTAINABLE SOCIETY, AIP Publishing LLC.
22. Alzamily, J. Y., et al. (2024). "Artificial Intelligence in Healthcare: Transforming Patient Care and Medical Practices." International Journal of Engineering and Information Systems (IJEAIS) 8(8): 1-9.
23. Arqawi, S. M., et al. (2022). "Predicting university student retention using artificial intelligence." International Journal of Advanced Computer Science and Applications 13(9).
24. Arqawi, S., et al. (2020). "Clients Satisfaction as a Mediating Variable between Brand Dimensions and Enhancing Loyalty in Commercial Banks Operating in Palestine." Technology Reports of Kansai University 62(02): 35-54.
25. Bakeer, H., et al. (2024). "AI and Human Rights." International Journal of Engineering and Information Systems (IJEAIS) 8(10): 16-24.
26. Barhoom, A. M., et al. (2019). "Predicting Titanic Survivors using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(9): 8-12.
27. Barhoom, A. M., et al. (2022). "Bone abnormalities detection and classification using deep learning-vgg16 algorithm." Journal of Theoretical and Applied Information Technology 100(20): 6173-6184.
28. Barhoom, A. M., et al. (2022). "Deep Learning-Xception Algorithm for upper bone abnormalities classification." Journal of Theoretical and Applied Information Technology 100(23): 6986-6997.
29. Barhoom, A. M., et al. (2022). "Prediction of Heart Disease Using a Collection of Machine and Deep Learning Algorithms." International Journal of Engineering and Information Systems (IJEAIS) 6(4): 1-13.
30. Barhoom, A. M., et al. (2023). A survey of bone abnormalities detection using machine learning algorithms. PROCEEDINGS OF THE 1ST INTERNATIONAL CONFERENCE ON FRONTIER OF DIGITAL TECHNOLOGY TOWARDS A SUSTAINABLE SOCIETY, AIP Publishing LLC.
31. Barhoom, A., et al. (2022). "Sarcasm Detection in Headline News using Machine and Deep Learning Algorithms." International Journal of Engineering and Information Systems (IJEAIS) 6(4): 66-73.
32. Dalffa, M. A., et al. (2019). "Tic-Tac-Toe Learning Using Artificial Neural Networks." International Journal of Engineering and Information Systems (IJEAIS) 3(2): 9-19.
33. Dawood, K. J., et al. (2020). "Artificial Neural Network for Mushroom Prediction." International Journal of Academic Information Systems Research (IJAISR) 4(10): 9-17.
34. El_Jerjawi, N. S., et al. (2024). "The Role of Artificial Intelligence in Revolutionizing Health: Challenges, Applications, and Future Prospects." International Journal of Academic Applied Research (IJAAR) 8(9): 7-15.
35. ELghalban, A. I. and S. S. Abu-Naser (2025). "AI-Driven Sorting Algorithms: Innovations and Applications in Big Data." International Journal of Academic Engineering Research (IJAER) 9(6): 25-28.
36. El-Ghoul, M., et al. (2024). "AI in HRM: Revolutionizing Recruitment, Performance Management, and Employee Engagement." International Journal of Academic Applied Research (IJAAR) 8(9): 16-23.
37. El-Ghoul, M., et al. (2025). "Artificial Intelligence as a Frontline Defense: Preventing Cyberattacks in a Connected World."
38. El-Habibi, M. F., et al. (2024). "Generative AI in the Creative Industries: Revolutionizing Art, Music, and Media." International Journal of Engineering and Information Systems (IJEAIS) 8(10): 71-74.
39. El-Mashharawi, H. Q., et al. (2024). "AI in Mental Health: Innovations, Applications, and Ethical Considerations." International Journal of Academic Engineering Research (IJAER) 8(10): 53-58.
40. Elnajjar, A. E. A. and S. S. Abu Naser (2017). "DES-Tutor: An Intelligent Tutoring System for Teaching DES Information Security Algorithm." International Journal of Advanced Research and Development 2(1): 69-73.
41. Elqassas, R., et al. (2024). "Convergence of Nanotechnology and Artificial Intelligence: Revolutionizing Healthcare and Beyond." International Journal of Engineering and Information Systems (IJEAIS) 8(10): 25-30.
42. Elzamly, A., et al. (2017). "Predicting Critical Cloud Computing Security Issues using Artificial Neural Network (ANNs) Algorithms in Banking Organizations." International Journal of Information Technology and Electrical Engineering 6(2): 40-45.
43. Hamad, M. S., et al. (2024). "Harnessing Artificial Intelligence to Enhance Medical Image Analysis." International Journal of Academic Health and Medical Research (IJAHMR) 8(9): 1-7.
44. Hamadaqa, M. H. M., et al. (2024). "Leveraging Artificial Intelligence for Strategic Business Decision-Making: Opportunities and Challenges." International Journal of Academic Information Systems Research(IJAISR) 8(8): 16-23.
45. Hamed, M. A., et al. (2024). "Artificial Intelligence in Agriculture: Enhancing Productivity and Sustainability." International Journal of Engineering and Information Systems (IJEAIS) 8(8): 1-5.
46. Jamala, M., et al. (2025). "The Intersection of Generative AI and Creative Expression: Opportunities and Ethical Challenges."
47. Kassabgi, M. K., et al. (2025). "AI-Enhanced Sorting Techniques: Revolutionizing Data Processing and Analysis." International Journal of Academic Engineering Research (IJAER) 9(6): 19-24.
48. Khalafallah, S. and S. S. Abu-Naser (2025). "AI-Driven Sorting Algorithms for Big Data: Techniques and Real-World Applications." International Journal of Academic Engineering Research (IJAER) 9(6): 1-10.
49. Marouf, A., et al. (2024). "Enhancing Education with Artificial Intelligence: The Role of Intelligent Tutoring Systems." International Journal of Engineering and Information Systems (IJEAIS) 8(8): 10-16.
50. Mettleq, A. S. A., et al. (2024). "Revolutionizing Drug Discovery: The Role of Artificial Intelligence in Accelerating Pharmaceutical Innovation." International Journal of Academic Engineering Research (IJAER) 8(10): 45-52.
51. Mezied, A. A. and S. S. Abu-Naser (2025). "The Future of Data Sorting: Integrating AI for Enhanced Efficiency and Accuracy." International Journal of Academic Engineering Research (IJAER) 9(6): 48-60.
52. Mohaisen, B. M. and S. S. Abu-Naser (2025). "Future of Data Sorting: Integrating AI for Enhanced Efficiency and Accuracy." International Journal of Academic Engineering Research (IJAER) 9(6): 41-43.
53. Mosa, M. J., et al. (2024). "AI and Ethics in Surveillance: Balancing Security and Privacy in a Digital World." International Journal of Engineering and Information Systems (IJEAIS) 8(10): 8-15.
54. Nasser, B. S. A. and S. S. Abu-Naser (2024). "Artificial Intelligence in Digital Media: Opportunities, Challenges, and Future Directions." International Journal of Academic and Applied Research (IJAAR) 8(6): 1-10.
55. Qaoud, A. N., et al. (2025). "Human-Centered AI: The Role of Explainability in Modern AI Systems."
56. Qwaider, S. R., et al. (2024). "Harnessing Artificial Intelligence for Effective Leadership: Opportunities and Challenges." International Journal of Academic Information Systems Research(IJAISR) 8(8): 9-15.
57. Sabah, A. S., et al. (2023). "Comparative Analysis of the Performance of Popular Sorting Algorithms on Datasets of Different Sizes and Characteristics." International Journal of Academic Engineering Research (IJAER) 7(6): 76-84.
58. Sabah, A. S., et al. (2024). "Artificial Intelligence and Organizational Evolution: Reshaping Workflows in the Modern Era." International Journal of Academic Pedagogical Research (IJAPR) 8(9): 16-19.
59. Sabah, A. S., et al. (2025). "The Intersection of AI and Human Rights: Challenges and Opportunities."
60. Samara, F. Y. A., et al. (2024). "The Role of AI in Enhancing Business Decision-Making: Innovations and Implications." International Journal of Academic Pedagogical Research (IJAPR) 8(9): 8-15.
61. Samhan, L. F., et al. (2025). "Future Directions: Emerging trends and future potential of AI in autonomous systems."
62. Taha, A. M., et al. (2023). "A systematic literature review of deep and machine learning algorithms in brain tumor and meta-analysis." Journal of Theoretical and Applied Information Technology 101(1): 21-36.
63. Taha, A. M., et al. (2024). "The Evolution of AI in Autonomous Systems: Innovations, Challenges, and Future Prospects." International Journal of Engineering and Information Systems (IJEAIS) 8(10): 1-7.
64. Taha, A., et al. (2025). "The Intersection of Nanotechnology and Artificial Intelligence: Innovations and Future Prospects."
65. Wishah, N. D., et al. (2025). "Balancing Innovation and Control: The Framework for AI Regulation."