


Applications of Data Science and Artificial Intelligence

Carlos J. Costa ^{1,*}  and Manuela Aparicio ²

¹ Advance/ISEG (Lisbon School of Economics and Management), Universidade de Lisboa, 1200-781 Lisboa, Portugal

² NOVA Information Management School (NOVA IMS), Universidade NOVA de Lisboa, 1070-312 Lisboa, Portugal; manuela.aparicio@novaims.unl.pt

* Correspondence: cjcosta@iseg.ulisboa.pt

A series of waves have marked the history of artificial intelligence (AI). The journey began in the 1950s when the field of AI was born with the ambitious goal of creating machines that could replicate human intelligence [1,2]. The initial enthusiasm led to significant progress, but by the late 1960s, unrealistic expectations and limited computing power resulted in the first AI winter. Funding and interest diminished as early AI projects failed to deliver their promises. The 1980s saw a resurgence as new approaches, such as expert systems, gained popularity. However, once again, high expectations collided with the limitations of the technology, leading to the second AI winter in the late 1980s and early 1990s. Disappointment and lack of practical applications caused funding to dry up, and AI research entered a prolonged period of stagnation. The turn of the millennium brought renewed hope with breakthroughs in machine learning and neural networks. The emergence of big data and more powerful hardware provided the necessary fuel for AI to thrive again. Deep learning played an essential role in this period [3]. This period, known as the “AI spring”, witnessed incredible progress, with AI becoming integrated into our daily lives through virtual assistants, recommendation systems, and image recognition technologies.

In recent years, data science and artificial intelligence (AI) fields have experienced significant advancements, leading to widespread adoption across diverse domains. A comprehensive overview of the various applications of data science and AI shows their transformative impact in healthcare, finance, marketing [4], transportation, and more [5]. By harnessing the power of data analytics, machine learning, and deep learning algorithms, data science and AI have revolutionized decision-making processes and empowered organizations to gain valuable insights, optimize operations, and deliver innovative products and services [6].

Data science and artificial intelligence have emerged as pivotal disciplines in the era of big data and automation. With the ability to analyze massive datasets, uncover patterns, and predict outcomes, these technologies have found applications in numerous sectors, revolutionizing how we interact with information and make decisions. Here, we highlight some of the most significant applications of data science and AI and their impact on various industries [7].

The integration of data science and AI has profoundly transformed the healthcare industry. From diagnostic imaging and drug discovery to personalized medicine and patient care, data-driven approaches have revolutionized healthcare delivery. Machine learning algorithms analyze medical records, genetic data, and clinical notes to provide accurate diagnoses and treatment recommendations [8]. Additionally, AI-powered wearable devices and remote monitoring systems enable continuous health tracking, improving patient outcomes and reducing hospitalization rates.

Data science and AI have become indispensable for risk assessment, fraud detection, price prediction [9], and investment strategies in the financial sector. AI-driven chatbots and virtual assistants enhance customer service and streamline financial operations. Furthermore,



Citation: Costa, C.J.; Aparicio, M. Applications of Data Science and Artificial Intelligence. *Appl. Sci.* **2023**, *13*, 9015. <https://doi.org/10.3390/app13159015>

Received: 2 August 2023

Accepted: 3 August 2023

Published: 7 August 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

the rise of fintech startups has been fueled by data analytics, enabling innovative solutions in areas like peer-to-peer lending, robo-advisors, and blockchain-based transactions.

Data science and AI have revolutionized marketing strategies, enabling businesses to target specific customer segments with personalized campaigns. Sentiment analysis and natural language processing (NLP) techniques gauge customer feedback, while recommendation systems boost cross-selling and upselling. Furthermore, this application may not be restricted to the traditional business context but also the political context or government [10]. Additionally, data-driven insights facilitate efficient resource allocation and marketing budget optimization.

Data science and AI are crucial in route optimization, fleet management, and predictive maintenance in the transportation and logistics industry [11]. AI-powered autonomous vehicles are paving the way for the future of transportation, promising enhanced safety and efficiency. Moreover, real-time data analysis optimizes supply chain operations, reducing delivery times and minimizing costs. This approach may have significant consequences for the sustainability of our cities by using more environmentally friendly transportation [12].

Data science and AI contribute significantly to building smart cities and sustainable urban environments. By analyzing data from various sources, including IoT sensors and social media, cities can improve traffic management, optimize energy consumption, enhance public services [13], and predict real estate prices [14]. Smart infrastructure and predictive analytics enable proactive decision making to address urban challenges effectively.

The advancement of natural language processing has given rise to robust conversational AI systems. Virtual assistants like Siri, Alexa, and Google Assistant can understand and respond to human language, providing valuable information and performing tasks on voice commands [15]. NLP technologies enable sentiment analysis, language translation, and information extraction from unstructured data sources [16].

As data science and AI applications become more pervasive, ethical considerations become increasingly critical. Privacy, data bias, and algorithmic transparency must be addressed to ensure responsible and equitable deployment of these technologies. Data science projects are often complex and involve multiple stakeholders, which leads to the need to adopt adequate data science management processes [17]. Efficient planning and management are essential for their successful execution. Additionally, ongoing research is required to address challenges related to interpretability, fairness, accountability in AI systems, and most recently Generative AI.

Data science and artificial intelligence have transformed industries and reshaped our lives and work. From healthcare and finance to marketing, transportation, and urban planning, data-driven insights and AI-powered solutions offer immense potential for positive change [18]. As we navigate the future, it is imperative to balance innovation with ethical considerations, ensuring that data science and AI technologies work toward the betterment of society.

Author Contributions: Conceptualization, C.J.C. and M.A.; methodology, C.J.C. and M.A.; investigation, C.J.C. and M.A.; writing—original draft preparation, C.J.C. and M.A.; writing—review and editing, C.J.C. and M.A. All authors have read and agreed to the published version of the manuscript.

Funding: The authors acknowledge financial support via ADVANCE-CSG from the Fundação para a Ciência and Tecnologia (FCT Portugal) through research grant number UIDB/04521/2020, and we gratefully acknowledge the financial support from FCT—Fundação para a Ciência e Tecnologia, I.P., (Portugal), national funding through research grant UIDB/04152/2020—Centro de Investigação em Gestão de Informação (MagIC).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Turing, A.M. I.—COMPUTING MACHINERY AND INTELLIGENCE. *Mind* **1950**, *LIX*, 433–460. [[CrossRef](#)]
2. McCarthy, J.; Minsky, M.; Rochester, N.; Shannon, C. A Proposal for the Dartmouth-Summer Research Project Artificial Intelligence. Available online: <https://web.archive.org/web/20070826230310/http://www-formal.stanford.edu/jmc/history/dartmouth/dartmouth.html> (accessed on 1 August 2023).
3. LeCun, Y.; Bengio, Y.; Hinton, G. Deep Learning. *Nature* **2015**, *521*, 436–444. [[CrossRef](#)] [[PubMed](#)]
4. Vorobeva, D.; Costa Pinto, D.; António, N.; Mattila, A.S. The Augmentation Effect of Artificial Intelligence: Can AI Framing Shape Customer Acceptance of AI-Based Services? *Curr. Issues Tour.* **2023**, 1–21. [[CrossRef](#)]
5. Aparicio, J.T.; Arsenio, E.; Henriques, R. Assessing Robustness in Multimodal Transportation Systems: A Case Study in Lisbon. *Eur. Transp. Res. Rev.* **2022**, *14*, 28. [[CrossRef](#)]
6. Hajishirzi, R.; Costa, C.J. Artificial Intelligence as the Core Technology for the Digital Transformation Process. In Proceedings of the 2021 16th Iberian Conference on Information Systems and Technologies (CISTI), Chaves, Portugal, 23–26 June 2021; pp. 1–6. [[CrossRef](#)]
7. Aparicio, S.; Aparicio, J.T.; Costa, C.J. Data Science and AI: Trends Analysis. In Proceedings of the 2019 14th Iberian Conference on Information Systems and Technologies (CISTI), Coimbra, Portugal, 19–22 June 2019; pp. 1–6. [[CrossRef](#)]
8. Gruson, D.; Helleputte, T.; Rousseau, P.; Gruson, D. Data Science, Artificial Intelligence, and Machine Learning: Opportunities for Laboratory Medicine and the Value of Positive Regulation. *Clin. Biochem.* **2019**, *69*, 1–7. [[CrossRef](#)] [[PubMed](#)]
9. Aparicio, J.T.; Romao, M.; Costa, C.J. Predicting Bitcoin Prices: The Effect of Interest Rate, Search on the Internet, and Energy Prices. In Proceedings of the 2022 17th Iberian Conference on Information Systems and Technologies (CISTI), Madrid, Spain, 22–25 June 2022; pp. 1–5. [[CrossRef](#)]
10. Costa, C.; Aparicio, M.; Aparicio, J. Sentiment Analysis of Portuguese Political Parties Communication. In Proceedings of the 39th ACM International Conference on Design of Communication, Virtual, 12–14 October 2021; Association for Computing Machinery: New York, NY, USA, 2021; pp. 63–69. [[CrossRef](#)]
11. D’Orey Pape, R.; Costa, C.J.; Aparicio, M.; de Castro Neto, M. Determinants of City Mobile Applications Usage and Success. In *Proceedings of the International Conference on Information Technology and Applications*; Anwar, S., Ullah, A., Rocha, A., Sousa, M.J., Eds.; Springer Nature: Singapore, 2023; pp. 605–613. [[CrossRef](#)]
12. Mergulhao, M.; Palma, M.; Costa, C.J. A Machine Learning Approach for Shared Bicycle Demand Forecasting. In Proceedings of the 2022 17th Iberian Conference on Information Systems and Technologies (CISTI), Madrid, Spain, 22–25 June 2022; pp. 1–6. [[CrossRef](#)]
13. Neves, F.T.; de Castro Neto, M.; Aparicio, M. The Impacts of Open Data Initiatives on Smart Cities: A Framework for Evaluation and Monitoring. *Cities* **2020**, *106*, 102860. [[CrossRef](#)]
14. Samadani, S.; Costa, C.J. Forecasting Real Estate Prices in Portugal: A Data Science Approach. In Proceedings of the 2021 16th Iberian Conference on Information Systems and Technologies (CISTI), Chaves, Portugal, 23–26 June 2021; pp. 1–6. [[CrossRef](#)]
15. Hoy, M.B. Alexa, Siri, Cortana, and More: An Introduction to Voice Assistants. *Med. Ref. Serv. Q.* **2018**, *37*, 81–88. [[CrossRef](#)] [[PubMed](#)]
16. Göpfert, J.; Kuckertz, P.; Weinand, J.; Kotzur, L.; Stolten, D. Measurement Extraction with Natural Language Processing: A Review. In *Findings of the Association for Computational Linguistics: EMNLP*; Association for Computational Linguistics: Abu Dhabi, United Arab Emirates, 2022; pp. 2191–2215.
17. Costa, C.J.; Aparicio, J.T. POST-DS: A Methodology to Boost Data Science. In Proceedings of the 2020 15th Iberian Conference on Information Systems and Technologies (CISTI), Seville, Spain, 24–27 June 2020; pp. 1–6. [[CrossRef](#)]
18. Górriz, J.M.; Ramírez, J.; Ortíz, A.; Martínez-Murcia, F.J.; Segovia, F.; Suckling, J.; Leming, M.; Zhang, Y.-D.; Álvarez-Sánchez, J.R.; Bologna, G. Artificial Intelligence within the Interplay between Natural and Artificial Computation: Advances in Data Science, Trends and Applications. *Neurocomputing* **2020**, *410*, 237–270. [[CrossRef](#)]

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.