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Training neural networks to sort: a new approach to classical algorithms

Nina Zdolbitska
Lutsk National Technical University, Lutsk
https://orcid.org/0000-0002-1345-3581
Dmytro Bas
Lutsk National Technical University, Lutsk
Serhii Zdolbitskyi
Lutsk National Technical University, Lutsk

Abstract. *The paper explores a new approach to data sorting based on the use of neural networks. Traditional sorting algorithms work according to rigidly defined rules, while neural networks learn to find patterns in data, which allows them to adapt to complex and unstructured arrays. It analyzes how machine learning models can choose optimal algorithms for specific data or perform sorting independently based on experience. The advantages of such an approach are discussed, including adaptability, potential optimization, and the possibility of parallel processing. The limitations associated with computational complexity and accuracy are also considered. The conclusions indicate that neural network sorting will not replace classical methods, but opens up new prospects for solving non-standard data sorting tasks.*
Keywords*: algorithm, neural networks, data sorting, data science, business analytics.*

In the era of Big Data, where the volume of information is growing exponentially, there's a corresponding need for innovative approaches to data sorting. Traditional sorting algorithms, despite their high speed for numerical and structured data, often struggle with the non-typical tasks that arise when working with unstructured and non-numerical data. The application of neural networks is highly relevant because they can learn from examples, creating adaptive solutions that can outperform classical algorithms in specific situations. This ability to learn from data rather than following fixed rules paves the way for new, optimized algorithms, allowing for the development of more flexible and effective tools for modern computing systems.

The research aims to analyze approaches to data sorting based on neural networks and to compare their efficiency with classical algorithms.

The research's objectives are to analyze classical sorting algorithms and define their application domains, review existing machine learning models that can be applied to data sorting, and examine the architecture of a neural network capable of performing sorting operations. To do this, it is necessary to create a required dataset for training and testing the developed model and to experimentally compare the developed model's performance in terms of execution speed and accuracy against traditional sorting algorithms. The final goal is to determine which neural networks are the most suitable for sorting.

Over the last few years, research has been conducted with the goal of improving neural networks based on optimization methods from classical algorithms.

In the article [1], a review of methods for optimizing algorithms based on artificial neural networks was performed. In order to improve a neural network using optimization algorithms, one can use classical algorithms by adjusting the appropriate parameters to obtain the best template of the neural network structure for solving problems.

The authors of the research paper [2] examine a sorting algorithm based on artificial intelligence, which is adapted for processing Big Data by combining traditional and advanced methods to improve data processing. A critical comprehensive analysis of the performance of comparison-based and non-comparison-based sorting algorithms is proposed, taking into account their effectiveness and suitability for various real-world tasks [2]. An exhaustive comparative analysis is conducted to evaluate their time complexity, stability, adaptability, and memory requirements. The influence of data characteristics such as input size, distribution, and order on the algorithm's performance is also investigated.

The application of data science and artificial intelligence has become particularly useful in business analytics for making data-driven decisions. When making decisions based on modern IT technologies in data processing [3] and business analytics, for example for forecasting [4, 5], the immense capability of artificial intelligence and data science is used to create actionable insights after transforming raw data. The authors of article [3] explore the application areas, advantages, challenges, and methodologies associated with the integration of AI and data science into business analytics.

The creation of self-learning algorithms, the development of neural networks, and the improvement of various methods capable of self-learning are key in the theory of machine learning for various areas of human activity, while helping to improve the quality of products. Artificial intelligence and neural networks help programmers to write software code [7], in tasks of image or sound recognition, detection of moving objects, analysis of big data, and numerical methods in tasks of time series forecasting, etc. [8].

Traditional sorting algorithms work according to hard-coded rules, while neural networks learn to find patterns in data, which allows them to adapt to complex and unstructured arrays.

Consider the advantages of using neural networks over classical algorithms:

– adaptability, neural networks can adapt to complex, unconventional data for which it is difficult to write a simple algorithm. For example, if you need to sort objects by their visual appearance or other non-obvious characteristics, a neural network can find patterns that would be impossible to program manually;

– optimization, in certain cases, a neural network can find a more efficient way to sort than traditional algorithms. It can optimize the number of operations for specific data types, which leads to a faster process;

– parallel processing, some neural network architectures can process data in parallel, which can speed up the sorting process on suitable hardware, such as graphics processing units (GPUs).

Despite its significant advantages, this approach also has its challenges:

– training complexity: training a machine learning model requires a significant amount of data and large computational resources, which makes the process much more complex and resource-intensive than writing a classical sorting algorithm;

– accuracy and predictability: unlike classical algorithms, which always give an accurate and predictable result, a neural network can sometimes make mistakes, especially on data that is very different from the one on which it was trained;

– inefficiency for simple tasks: For simple numerical data, traditional sorting algorithms (such as Quick Sort or Merge Sort) remain unsurpassed in speed and efficiency, since they are optimized specifically for this task.

Training neural networks to sort will not replace classical algorithms in all cases, but it opens up new possibilities for solving complex, unconventional tasks where flexibility and adaptability to data are important.

References

1. Abdolrasol, M.G.M.; Hussain, S.M.S.; Ustun, T.S.; Sarker, M.R.; Hannan, M.A.; Mohamed, R.; Ali, J.A.; Mekhilef, S.; Milad, A. Artificial Neural Networks Based Optimization Techniques: A Review. Electronics 2021, 10, P. 2689. https://doi.org/10.3390/electronics10212689

2. Dr. Qaim Mehdi Rizvi, 1Harsh Rai, 1Ragini Jaiswa. Sorting Algorithms in Focus: A Critical Examination of SortingAlgorithm Performance. Conference: International Conference on Emerging Trends in IoT & Computing Technologies-2023At: Lucknow, India. 2023. P. 1-5.

3. Michael C.I., Ipede O.J., Adejumo A.D., Adenekan I.O., Adebayo D., Ojo A.S., Ayodele P. A. Data-driven decision making in IT: Leveraging AI and data science for business intelligence World Journal of Advanced Research and Reviews, 2024. 23(01). P. 472-480. DOI: 10.30574/wjarr.2024.23.1.2010.

4. N. Zdolbitska, O. Ostapchuk, S. Lavrenchuk, T. Terletskyi, O. Kaidyk and O. Zhyharevych, Business information system for forecasting raw material stocks for the production of flexible packaging, 2024 14th International Conference on Dependable Systems, Services and Technologies (DESSERT), Athens, Greece, 2024, P. 1-8. DOI: 10.1109/DESSERT65323.2024.11122240.

5. Ніна Здолбіцька, Андрій Здолбіцький, Денис Давидюк. Машинне навчання для прогнозування попиту на товари онлайн-замовлень. Проблеми комп'ютерних наук, програмного моделювання та безпеки цифрових систем: матеріали II міжнар. науково-практ. конф. Луцьк, 9–11 червн. 2025 р. Луцьк, 2025. С. 8-9.

6. Shatha Khalafallah and Samy S. Abu-Naser. AI-Driven Sorting Algorithms for Big Data: Techniques and RealWorld Applications. International Journal of Academic Engineering Research (IJAER) ISSN: 2643-9085. Vol. 9 Issue 6 June – 2025. P. 1-10.

7. Здолбіцька Н. В., Жигаревич О. К., Бондарук А. С. Використання штучного інтелекту для написання програмного коду. Математика. Інформаційні технології. Освіта. Луцьк-Світязь. 31 травня – 2 червня 2024 р. С. 114-116.

8. Abdulkadirov, R.; Lyakhov, P.; Nagornov, N. Survey of Optimization Algorithms in Modern Neural Networks. Mathematics 2023, 11, 2466.