

# Research on Interactive Teaching for Intelligent Algorithm of Engineering Big Data

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**Abstract:** In the process of engineering construction, there are often a large number of engineering construction-related data and the scientific and accuracy of data processing and analysis often directly affect the quality of engineering construction. With the increase of the scale and quantity of construction projects, it is difficult for manual data analysis and processing to meet the current needs of engineering construction. The application of big data intelligent algorithm to scientifically process engineering data information is the main development trend in the future. In this regard, as the main position of training big data talents in the new era, colleges and universities need to actively introduce advanced teaching concepts, improve and innovate the teaching mode of big data intelligent algorithm for the field of engineering construction, and then train more comprehensive engineering big data talents. Based on this, this paper explores interactive teaching strategies. First, it introduces the basic principles of intelligent algorithm of big data in engineering, then deeply analyzes the practical problems faced in the teaching of intelligent algorithm of big data in engineering at present, and finally discusses interactive teaching strategies oriented to intelligent algorithm of big data in engineering in detail for reference.

## 1 INTRODUCTION

With the improvement of China's comprehensive national strength, the scale and quantity of China's infrastructure construction have gradually increased, and the rapid development of infrastructure construction, especially in the field of underground space construction and development, China now ranks in the forefront of the world. The construction environment of urban underground space is usually harsh, the hydrogeological conditions are complex, and the construction process is often affected by the environment and leads to safety accidents. Therefore, it is necessary to make full use of big data intelligent information technology in geological investigation and other links before construction, and fully grasp the project reality, which can provide scientific basis for subsequent project decision-making. In addition, the engineering construction process involves a large amount of design, survey, construction data information, big data technology analysis and processing can make the engineering construction more safe and efficient. In the face of the current social shortage of engineering big data talents, some universities currently offer artificial intelligence algorithm courses and classify artificial intelligence

as one of the basic courses of engineering majors. However, it is found in teaching practice that the theory of artificial intelligence algorithm is not mature for high-dimensional complex data. Therefore, in daily teaching, teachers also need to combine the concept of interactive teaching, and on the premise of completing basic teaching tasks, visually demonstrate the application of intelligent algorithms of big data to students through visual teaching means, so as to deepen students' understanding of knowledge. This paper studies interactive teaching means based on intelligent algorithms of engineering big data.

## 2 PRINCIPLE ANALYSIS OF ENGINEERING BIG DATA INTELLIGENT ALGORITHM

### 2.1 Basic Principles and Methods of Deep Learning

Through practical investigation, it is found that most students of engineering disciplines in colleges and universities have weak algorithm foundation and should strengthen their learning in courses such as

linear algebra and optimization, especially linear equation solving and matrix derivation, which are of great use for the research of engineering big data algorithms (Wenchun Liu, 2022). Compared with the traditional machine learning algorithm, deep learning algorithm is more adaptable to the development needs of the times, but its mechanism is complex and more detailed, and it is not ideal to explain to students only from the formula deduction level. Therefore, it is suggested to start from the deep learning traceability, combined with the explanation of the working mechanism of biological nervous system, and naturally lead to the concept of artificial neural network. To be specific, the first step is to explain the definition of artificial neuron-perceptron clearly, and then derive artificial neural network according to its role and characteristics of multi-layer perception mechanism and applicable scenarios, and highlight the excellent nonlinear fitting performance of artificial neural network combined with visual examples. The principle and mechanism of deep learning are relatively complex and not easy to be understood by students. The above teaching methods can explain the deep learning concept in layers and help students quickly master the basic knowledge of engineering big data.

If deep learning is to achieve the desired effect, some existing problems need to be solved first, including updating parameters, calculating gradients and other contents need to be improved. At present, various schools of thought contend, and research on deep learning has never stopped, and various solutions have been proposed one after another. These fragmented solutions seem to be chaotic and methodical, but as a developing discipline, engineering big data has a great demand for these rich solution proposals and valuable practical experience. Sorting out and summarizing these methods, combined with in-depth research on the underlying motivation and development concept, is of great significance for the subsequent construction of deep learning systems and the sorting out of the development context. It is also conducive to the flexible practical application of deep learning concepts (Guantian Wang, 2022).

## 2.2 Deep Learning Based on PyTorch

Deep learning technology is the organic integration of emerging cutting-edge technologies in many fields, involving a variety of course knowledge content. Deep learning has a wide range of functions, although the realization of each function does not rely on the use of esoteric mathematical knowledge, but it is

obviously very difficult to efficiently integrate deep learning modules and apply them in millions and tens of millions of big data. Therefore, for students with weak basic knowledge, integrating each module from zero to one is like a fantasy. Fortunately, through continuous practice and exploration and research, it is no longer a dream to effectively realize the basic module of deep learning. Mature deep learning libraries such as PyTorch and Ten-sorFlow have been put into practice. Students with weak foundation can also start quickly and solve various practical problems (Kunbo Xu, 2022). Especially for engineering students, most of them have poor programming foundation. Courses based on deep learning library will explore the construction of online interactive programming environment based on Jupyter, provide students with relevant learning procedures, and help students explore deep learning methods in practice with visual teaching methods. Thus, the application of deep learning technology can be used more quickly to solve practical problems faced in current engineering construction and improve practical ability.

## 3 THE APPLICATION OF BIG DATA INTELLIGENT ALGORITHMS FOR ENGINEERING

### 3.1 Application of Engineering Big Data Intelligent Algorithm for TBM Tunneling Parameter Prediction and Decision

In tunnel engineering, the application of full-section tunnel boring machine (TBM) is very critical. For long tunnels that are difficult to be successfully excavated by traditional drilling and blasting methods, TBM can reveal multiple advantages such as fast excavation, safety and reliability, and green environmental protection (Bin Liu, 2021). TBM operation requires higher professional quality and experience of operators. If the operation construction process is affected by adverse geological conditions, or encounter lithology mutation, and no timely scientific countermeasures are taken, the TBM will be damaged or inefficient. Combined with a large number of engineering examples, the information of TBM driving parameters is deeply analyzed and studied, and the matching adjustment of TBM driving parameters is carried out according to the geological

and rock mass conditions. It can be seen that in the process of TBM intelligent operation, the rational application of artificial intelligence big data technology to scientifically analyze engineering data information is the key to ensure the efficiency of excavation. Big data algorithms give full play to the role of Bridges and accurately connect TBM intelligent excavation with rock geological information. In this process, with the continuous change of geological rock mass conditions, TBM excavation parameters can also be visually presented, which plays a key guiding role in improving the safety of TBM excavation and is of great significance.

### **3.2 Application of Engineering Big Data Intelligent Algorithm for Tunnel Advance Geological Prediction**

Tunnel advance geological prediction refers to the geological condition report obtained from the exploration of geotechnical bodies of underground engineering combined with advanced modern drilling and geophysical exploration technology, which is an effective exploration means to macro-control the structure of geotechnical bodies and groundwater conditions in front of the construction (Ronghu Cao, 2022). Accurate and reliable tunnel geological prediction plays a guiding role in the subsequent construction, and can effectively prevent the impact of geological disasters such as water gusher and rock burst during the construction process to ensure the smooth construction of the project. Among them, the most commonly used geophysical exploration technology is geophysical inversion, which attempts to reconstruct the geological structure after obtaining effective data information from observation. For this kind of highly nonlinear problem, linear method is often adopted to solve it, which leads to a certain uncertainty and multiple solutions in the solution process. Combined with the comprehensive consideration of historical exploration data and excavation data in previous regions, these valuable experiences can provide a reference basis and sufficient big data constraints for geophysical inversion, and also play a certain role in improving the above problems. It can be seen that the reasonable application of engineering big data in tunnel advanced geological prediction can provide solutions to some problems currently faced by geophysical exploration technology. The application of deep learning method based on big data intelligent algorithm in geophysical inversion has become a feature of current research, and its application also

reflects the advanced nonlinear mapping ability in the face of practical problems.

### **3.3 Application of Engineering Big Data Intelligent Algorithm for Geological Sketch**

The main object of geological sketch is the field geological image, and the geological form and spatial structure are described in detail with the help of sketch method, including geological structure, geomorphic landscape and other aspects. For complex geological phenomena that are difficult to express in words, geological sketch can be visually presented in the form of sketch, which can not only improve work efficiency, but also provide a complete reference for subsequent construction. Geological sketch can be simply divided into two parts: field work and interior work. First, field work refers to the investigation of the regional geological conditions where underground Wells and alleyways are located, the collection of lithology, structure and other data information, and then the collation and analysis of the data information collected by field work, the description of the geological conditions investigated in accordance with relevant regulations and design proportions, and the annotation of key points (Wenjia Li, 2022). The whole process of geological sketch drawing is very complicated and cumbersome, which requires very high professional ability and comprehensive quality of staff. The application of engineering big data algorithm in this process is expected to reduce manual intervention and enable geological sketch to develop in the direction of automation. At the same time, it can also play a key role in mining the complex relationship between geological sketch and previous photos.

## **4 PROBLEMS EXISTING IN THE TEACHING OF INTELLIGENT ALGORITHM OF ENGINEERING BIG DATA**

### **4.1 Problems Existing in the Course Setting of Engineering Big Data Intelligent Algorithm Teaching**

In recent years, with the improvement of China's comprehensive national strength, China's construction industry is developing rapidly, and the scale and quantity of construction projects are

increasing day by day. After more than ten years of development, China's construction engineering field has accumulated a lot of valuable practical experience and stored massive engineering data (Wenchang Yu, 2022). Currently in the rapid development of the information age, in this context, the application of big data has obviously become the key to the progress and development of major industries. However, in the college education system, although the courses on big data and artificial intelligence algorithms continue to be offered, the courses on practical application cases are very scarce. Students are often familiar with the knowledge and skills of artificial intelligence algorithms, but they are unable to start when facing the data information in real engineering. It can be seen that the biggest problem in the current teaching of engineering big data intelligent algorithm in colleges and universities is that engineering data processing and artificial intelligence algorithm teaching are independent of each other and not closely related, only as independent teaching content to teach students relevant knowledge, the teaching concept is not forward-looking and advanced, and the lack of effective combination with actual cases. In addition, the teaching of cutting-edge methods of artificial intelligence algorithm and engineering data processing needs to set pre-courses, which is also relatively lacking in most colleges and universities at present, resulting in students' lack of understanding of cutting-edge knowledge of artificial intelligence algorithm, limiting the cultivation of students' creativity, and the application of engineering big data in practical projects, which lacks innovation in solving problems (Caiyun Yang, 2021).

#### **4.2 Problems in Teaching Methods of Engineering Big Data Intelligent Algorithm Teaching**

For different types of subjects, there should be some differences in teaching methods. Take urban underground engineering teaching as an example, the course content involves geotechnical engineering, exploration, engineering mechanics and other related knowledge content, the teaching content is relatively fixed, and the teaching method is also based on traditional teaching, with teachers explaining in class and students practicing independently after class. Compared with the teaching of urban underground engineering, there are obvious differences in the teaching methods of artificial intelligence. Daily teaching of artificial intelligence involves the processing and analysis of massive high-dimensional data, and it is difficult to explain clearly the

mechanism and principle contained therein only through the text presentation of textbooks and the oral explanation of teachers. At the same time, the subject of artificial intelligence has certain particularity. Artificial intelligence technology, including deep learning, has been widely used in various industries in society. The current theoretical research is relatively backward, and it has been unable to meet the practical application needs of artificial intelligence technology (Mingyang Deng, 2021).

## **5 INTERACTIVE TEACHING STRATEGY FOR ENGINEERING BIG DATA INTELLIGENT ALGORITHM**

### **5.1 Establish Engineering Big Data Artificial Intelligence Algorithm Course Group**

Based on the above discussion of the current difficulties in the teaching of engineering big data intelligent algorithm in colleges and universities, this paper proposes the establishment of engineering big data artificial intelligence algorithm course group. First of all, for the integration of artificial intelligence and engineering big data, establish a new curriculum system and add pre-courses. Taking urban underground engineering teaching as an example, the basic knowledge of artificial intelligence applied in the teaching process is integrated and analyzed, and integrated into the existing course design, a comprehensive classroom teaching courseware is made, and a pre-course is set up based on these elements to help students quickly master the basic knowledge related to the intelligent algorithm of big data engineering. Secondly, the engineering data processing course and the artificial intelligence course contain some common elements, and teachers can analyze and process these common elements in the pre-class design, and introduce the frontier knowledge of artificial intelligence into the actual teaching (Fan Li, 2021). Taking the teaching of geophysical exploration as an example, this course involves many theories of artificial intelligence knowledge, such as artificial neural networks, which are relatively backward in the context of the new era. Relevant contents of artificial intelligence courses can be introduced into the teaching of geophysical exploration, and cutting-edge knowledge of artificial intelligence algorithms can be fully integrated into the teaching of engineering big data to form a new

teaching model. Update the teaching content. Finally, the rapid development of artificial intelligence in recent years, as a multi-disciplinary interdisciplinary integration of composite technology science, artificial intelligence closely follows the pace of development of The Times, widely used in all fields of society, especially in the construction of construction engineering reflects valuable application value. Therefore, teachers should timely follow up to understand the latest development of artificial intelligence, master cutting-edge knowledge, and combine other disciplines and related engineering examples to skillfully integrate these knowledge into daily teaching to create a new type of engineering big data artificial intelligence algorithm course. Through the teaching of cutting-edge technology and the necessary practical guidance, students can apply their knowledge to solve the problems faced by practical engineering construction and inspire their innovation. The engineering big data artificial intelligence algorithm course group can be divided into three parts: advance course, basic course and innovation course. The content of advance course includes basic artificial intelligence introduction, geophysical inversion introduction and TBM application mentioned above. Basic courses include principles of seismic exploration, basic principles and basic methods of deep learning, etc. The innovative course content includes deep reinforcement learning, deep learning practice based on PyTorch, etc. (Cheng Wan, 2021).

## 5.2 Rational Application of Interactive Teaching Means

With the in-depth analysis of the characteristics of artificial intelligence algorithms, in addition to the basic knowledge content such as the flow of artificial intelligence algorithms, teachers can also adopt visual and interactive teaching methods to visually present obscure knowledge concepts in the daily teaching process. It is of great significance for students to deeply understand the principles behind artificial intelligence algorithms and achieve the expected teaching effect. It is especially beneficial for students with weak information foundation. First of all, for the pre-course repeatedly mentioned in this paper, teachers can strengthen the application research of artificial intelligence visualization means in the pre-course, so as to provide help for students to intuitively understand the application of artificial intelligence algorithms. Secondly, in order to facilitate students to consolidate knowledge network and verify theoretical concepts, teachers can conduct interactive simulation

experiment training and appropriate programming exercises in class for the relevant basic theoretical basis involved in the engineering big data artificial intelligence course (Hongqing Song, 2021). Finally, as we all know, innovation ability is the basic requirement for talent training in the new era. As the main position of talent training, colleges and universities should take the cultivation of students' innovation ability as the main educational goal.

In the innovative practice class, teachers should focus on guiding students to think about the practical ideas, motivations, means, etc. of artificial intelligence algorithm application examples in engineering big data, and continuously strengthen guidance in the teaching process, appropriately throw out reasonable problems, and guide students to find problems while taking appropriate means to solve problems. All in all, the application of interactive teaching strategies in the classroom of engineering big data artificial intelligence algorithms can intuitively display artificial intelligence-related algorithms and processes to students with the help of advanced interactive technology, simplify artificial intelligence algorithms, facilitate students' learning and understanding, and then quickly master artificial intelligence algorithms and apply them to engineering practice.

## 5.3 Build a Two-Way Interaction Mechanism Between Artificial Intelligence Algorithm Teaching and Engineering Big Data Practice

The main goal of the research on engineering big data processing and analysis technology is to solve the problems faced in the process of engineering construction in the new era. The latest artificial intelligence algorithms that have been continuously studied, are also implemented in actual projects, and the reliability of the algorithm can only be verified after application experiments (Xiang Li, 2021). The research object of artificial intelligence algorithms is numbers, is data information, but deep research purpose and connotation, is still a scientific and technological means to serve the actual engineering, artificial intelligence algorithm research must not be separated from the practical application of engineering, otherwise it is only the spiritual carnival of scientific researchers, self-entertainment. The in-depth mining of engineering big data information, as well as the research and utilization of artificial intelligence algorithms, need to be based on practical applications, and need to be improved, optimized, verified and upgraded in continuous practice. In this

way, it can fully reflect the application value of engineering big data and promote the application of artificial intelligence technology to the direction of automation and complexity.

## 6 INTERACTIVE TEACHING EXAMPLE FOR ENGINEERING BIG DATA INTELLIGENT ALGORITHM

### 6.1 Visual Explanation of Basic Principles Interactive Teaching Examples

The artificial neuron mentioned above is also called the perceptron, which is a simulated neuron based on the biological neuron mechanism, capable of binary classification, operation logic and or not (Jingyan Wang, 2021). A multi-layer perceptron MLP with powerful nonlinear mapping ability can be formed by superposition of multiple artificial neurons. According to the universal approximation theorem, if the multi-layer perceptron has a hidden layer, all the complex functions can be fitted successfully when there are enough artificial neurons. Take some interactive small programs as examples, artificial neurons are freely combined into small Bump. Through appropriate adjustment of Bump parameters, it can be made to fit part of the function, of course, if there are enough neurons, it can accurately fit any complex function. On this basis, the multi-layer perceptron expands into a six-layer artificial neural network. Then the problem of double helix line classification is an example to carry out interactive teaching practice, visualize the response characteristics of neurons and the update of weights, and intuitively present the working mechanism of artificial neural network to students, which is convenient for students to understand.

### 6.2 Interactive Teaching Examples of Intuitive Interpretation of Gradient Backpropagation

As a key learning point of deep learning technology, gradient backpropagation is the basic technology that can effectively update the gradient of artificial neural network. Gradient backpropagation learning divides into two forms: pure mathematical derivation and computational graph assisted derivation. For students with engineering background, the derivation mode

based on computational graph is more intuitive and practical, and two key points of computational graph and chain rule should be paid attention to in the application process (Rangsheng Gong, 2021). With the help of the calculation diagram, the calculation process of various operations can be visually presented by graphical method. The application of calculation diagram and chain rule enables neural network calculation to be solved quickly and efficiently by using automatic differentiation. At present, all major deep learning libraries adopt auto-grad automatic differentiation system, so there is no need to pay too much attention to gradient calculation, and only need to pay attention to the definition of network layer structure, as well as input and output operations. This undoubtedly provides convenient conditions for users to build deep learning neural networks. Figure 1 shows the gradient backpropagation operations corresponding to several complex network layer operations.

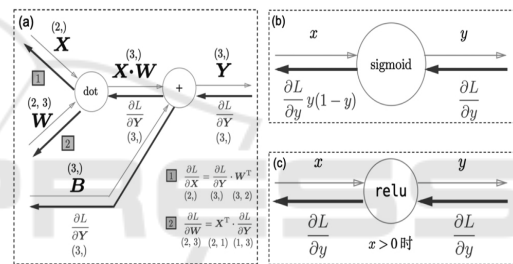


Figure 1. Gradient backpropagation operations corresponding to complex network layer operations.

## 7 CONCLUSION

To sum up, in order to promote the upgrading of China's industrial structure and become a world transportation competing nation, colleges and universities should carry out the reform of engineering talent training mode, since they are the main positions of talent training. The solutions includes the curriculum design, teaching concept and teaching means. In recent years, China's continuous development and construction has accumulated a large number of engineering data and valuable practical experience. According to the summary and analysis of these data, combined with the demand for intelligent algorithms of engineering big data, teachers can introduce interactive teaching methods to design relevant courses to guide students to deepen their understanding of the application of artificial intelligence algorithms. Under the interactive teaching mode oriented to the intelligent algorithm of

engineering big data, a large number of talents in the field of artificial intelligence have emerged in colleges and universities. More latest technological achievements have appeared in various competitions, which cannot only help solve practical engineering problems, but also lay a solid foundation for the cultivation of talents in the field of intelligent construction.

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