

# Research on the Practice System of College Mathematics Classroom Teaching under Computer Artificial Intelligence Technology

Yunna Han

Modern College of Northwest University, Xi'an, Shaanxi, China

## Abstract

The rapid development of artificial intelligence has brought great convenience to people's lives and brought new changes to university mathematics teaching. In the era of big data, artificial intelligence technology is increasingly dependent on applied mathematics. The importance of university mathematics teaching for cultivating innovative talents in the era of big data is self-evident. However, traditional university mathematics teaching content is still far from data-driven artificial intelligence technology. This article illustrates several specific cases in college mathematics teaching. Based on the traditional teaching content, if the school can sort out the essential ideas and methods and the teachers can promote and expand them, it will not only allow students to acquire advanced technologies related to artificial intelligence. It can increase the interest and practicability of teaching content and deepen students' understanding of some essential thinking methods in college mathematics.

## Keywords

Artificial Intelligence; University Mathematics; Research and Practice.

## 1. Background Check

To comprehensively cultivate applied talents that meet the needs of national economic and social development, Chinese universities have introduced the latest artificial intelligence technology to reform curriculum content and reform the modular teaching of university mathematics. The mathematics courses in the university are divided into four modules, namely advanced mathematics, linear algebra, probability theory, and mathematical statistics. When arranging courses, schools will use artificial intelligence to calculate and estimate the basic situation of students and then design courses that meet the actual situation of college students according to the actual situation of students.

As one of the essential contents of college courses, College mathematics is a vital tool for college students to learn professional knowledge and work in the future. Therefore, college mathematics has become a compulsory course in college courses. There are many modules of mathematics knowledge points, and they are relatively trivial. If every student learns the mathematical knowledge points of all modules, it is unrealistic. Therefore, the implementation of college mathematics courses should arrange the course content according to the students' professional knowledge needs. That will help students choose the modules they want to learn and avoid learning too much, which leads to poor learning. Although college math teachers have mastered the mathematical knowledge points, they are not familiar with students' professional knowledge. They cannot help students accurately judge the knowledge they have learned. At this time, artificial intelligence plays a significant role. College math teachers use artificial intelligence[1]. Carry out extensive data analysis to accurately judge the knowledge points of various disciplines. Therefore, artificial intelligence in education is becoming more and more

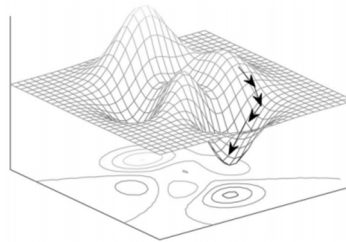
extensive, and artificial intelligence technology is increasingly applied to private application-oriented undergraduate colleges.

## 2. Artificial Intelligence and Mathematics

### 2.1. "Calculus" and Computer Artificial Intelligence

#### a) Slope

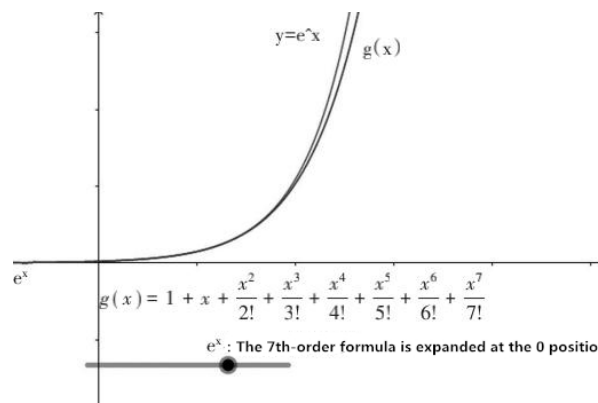
The main idea of artificial intelligence is to find an optimal fitting function for data classification and prediction. Therefore, optimization theory plays a vital role in AI practice. Optimization theory refers to: under certain constraints, finding the optimal value of the objective function is optimal. In artificial intelligence practice, gradient descent is a commonly used optimization algorithm. The core idea is to gradually find the fastest gradient descent direction at the current position to approach the optimal objective function. For example, denote the objective function  $J(w)$  by  $J(w_1, w_2)$ . The corresponding three-dimensional figure is like a mountain. The bottom of the valley corresponds to the minimum value of  $J(w_1, w_2)$ . The slope (the reverse direction) represents the fastest descent direction, see Fig. 1.



**Fig 1.** 3D Gradient Descent Diagram

#### b) Taylor series

The power of artificial intelligence lies in its computational efficiency and precision. When artificial intelligence solves practical problems, it often needs to use specific mathematical models. The most significant advantage of Taylor's formula in calculus is that it approximates a complex function as a linear superposition of a set of simple power functions, convenient for comparison, derivation, integration, solving differential equations, etc. As shown in Fig. 1, the Taylor expansion of orders 3 and 7 for  $y=e^x$  is shown.



**Fig 2.** Taylor approximation diagram

"Calculus" is one of the most outstanding achievements in the history of human mathematics and one of the most outstanding achievements in human thinking. From the gradient and series

examples above, students through AI can go straight to the starting point of the main idea of calculus.

### 2.2. Linear Algebra, Matrix Theory, and Artificial Computer Intelligence

Linear algebra and matrix theory is the basic mathematical foundations of artificial intelligence learning. For massive data, scholars usually express them as vectors or matrices. Scholars abstract specific things into mathematical objects or combinations of specific features and describe their static and dynamic characteristic vectors. Essentially a stationary point in n-dimensional linear space, a linear transformation describes a change in a vector or coordinate system. This matrix transforms the vector description from one set of bases (sets of axes) to another. For example, "Linear Algebra" students will find it boring because it does not have a large number of application examples like "Advanced Mathematics," nor does it require abstract concepts like "Linear Algebra," and students do not know how to apply it[2]. That requires artificial intelligence technology to help students learn this module in mathematics.

Model:

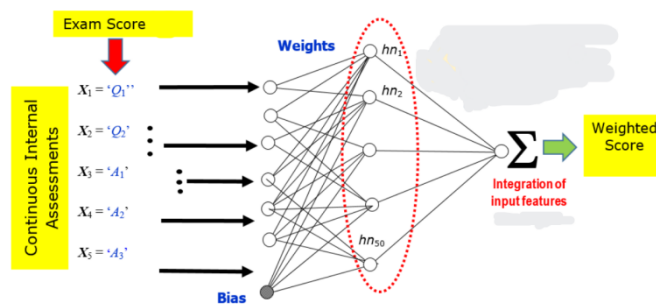
S is a set of clauses, and A is one of its coefficient matrices. If a clause C can be logically deduced by S, then there exists a coefficient vector c of C such that  $A \vdash c$ .

Proof: Let  $C_1, \dots, C_k = C$  be an inductive inference of C, which induction can prove.

(1) If  $k=1$ , then  $C_1=C \in S$ , indicating that there is a coefficient vector whose row is C in A.

(2) Let this result hold when  $k < h$ , considering  $k=h$ , if  $C=C_h$  is in C, it is the same as the primary case. Otherwise, for  $i, j < h$ , C is the digestion of  $C_i$  and  $C_j$ .

Without loss of generality, suppose some variable y,  $C_i = C'_i \cup \{y\}$ ,  $C_j = C'_j \cup \{\neg y\}$ ,  $C = C'_i \cup C'_j$ . That means  $C \cap \{y, \neg y\} = \emptyset$ . For any variable x, if  $x \in C'_i$ , then  $\neg x \notin C'_j$ . Conversely, if  $x \in C'_j$ , then  $\neg x \notin C'_i$ , this means that for any variable x, if it appears in both  $C'_i$  and  $C'_j$ , it is either a positive literal in both  $C'_i$  and  $C'_j$ , or a negative literal in both  $C'_i$  and  $C'_j$ . See Figure 3.



**Fig 3.** The artificial intelligence system can perceive and record various state calculations of students

By the inductive hypothesis, there are two vectors  $\omega^1$  and  $\omega^2$ , composed of non-negative numbers, representing the two coefficient vectors  $c^1$  and  $c^2$  of  $C_i$  and  $C_j$ , respectively, there are:

$$\omega^1 X = c^1, \omega^2 X = c^2 \tag{1}$$

Now suppose  $A \vdash 0$ , there exists a non-negative w such that  $wA = 0$ , and according to the sign of A, let  $\omega = (\omega_1, \dots, \omega_m)$ , thus:

$$\sum_{i=1}^{m^+} \omega_i a_i = \sum_{j=m^{++1}}^{m^-} \omega_j a_i \tag{2}$$

$$\sum_{i=1}^m \omega_i X_{ih} = 0 \quad 1 \leq h \leq n \tag{3}$$

Declare a non-negative number  $\omega_{ij}$  such that:

$$\omega_i a_i = \sum_{j=m^++1}^{m^-} \quad 1 \leq i \leq m^+ \quad (4)$$

$$\omega_j a_j = \sum_{i=1}^{m^+} \quad m^+ + 1 \leq j \leq m^- \quad (5)$$

Assuming this holds, for every  $1 \leq h \leq n$ , one can write:

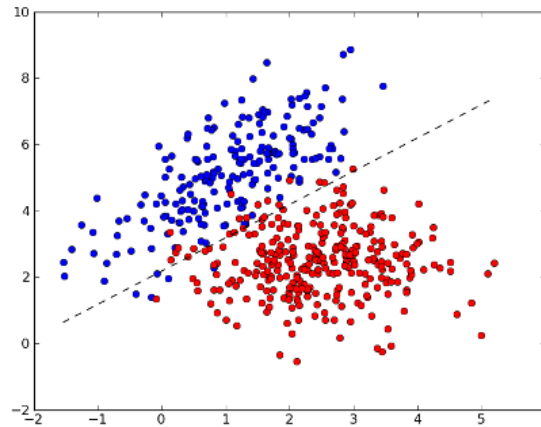
$$\sum_{i=1}^{m^+} \sum_{j=m^++1}^{m^-} \omega_{ij} (X_{ih}/a_i + X_{jh}/a_j) + \sum_{k=m^-+1}^m = 0 \quad (6)$$

### 2.3. Probability Theory, Mathematical Statistics, and Computer Artificial Intelligence

Probability theory includes mathematical statistics unary random variables and their distributions, random variables and their distribution functions; joint random variable distributions; conditional probability and Bayes' theorem; data exploration and distribution estimation for feature engineering, multivariate random vectors and their distributions, Random multidimensional variable, multivariate normal distribution, probability theory refers to the relationship between random variables. Mathematical statistics can infer the properties of the population by observing samples; the inference tool is statistics, and parameter estimation analyzes unknown parameters by randomly sampling samples, including point estimation and interval estimation. Whether it is a deep learning model, image recognition, or natural language processing, it is inseparable from the fundamental theorems in probability and statistics. Artificial intelligence training is booming, and it must be ensured that it is stable before it can be applied to artificial intelligence. Basic statistical theory can explain machine learning algorithms and data mining results. Only by correctly interpreting data can the value of data be reflected.

### 3. The Application of Artificial Intelligence in College Mathematics Teaching

The traditional mathematics classroom teaching model has also changed with the continuous development of artificial intelligence technology in the new era. It organically combines the rich artificial intelligence platform with mathematics classroom teaching. Further, it optimizes the traditional mathematics classroom teaching environment, and The teaching mode gives full play to the role and value of artificial intelligence-assisted teaching. To improve the quality of college mathematics teaching, the school uses artificial intelligence technology to enable students to conduct mathematics learning in various ways so that students can obtain and enrich teaching materials to enrich their learning content. The modern education system should rely on artificial intelligence to realize that mathematics teaching videos and teaching materials are not limited by time and place. Teachers can share these with students anytime, anywhere, improving the quality of college mathematics teaching. See Figure 4.

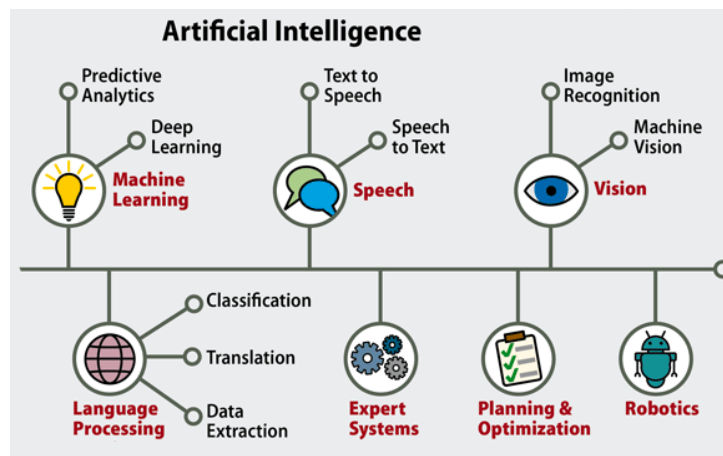


**Fig 4.** From the above modeling analysis, it can be concluded that the analysis red is the teaching efficiency of artificial intelligence technology, and the blue is not adopted

### 3.1. AI Teaching Can Connect Teachers and Students Closely

Artificial intelligence teaching has the characteristics of informatization and intelligence. Teachers can interact with students in artificial intelligence classrooms to improve students' participation in learning. Teachers can give targeted knowledge explanations to students according to the students' self-preview before class, help students consolidate knowledge, and fill in gaps, to achieve students' more profound understanding and mastery of mathematical knowledge. Teachers can comment on students based on their actual situations in class discussions and pre-class previews in university AI classes[3]. At the same time, group work can effectively improve students' teamwork ability and improve students thinking ability and problem-solving abilities.

### 3.2. The Artificial Intelligence System can Perceive and Record Various Status Information of Students



**Fig 5.** The Application of Artificial Intelligence in College Mathematics Teaching

Due to teaching, scientific research, and other reasons, college teachers often cannot accurately remember the basic situation of each student in the class. The information recorded in the school's student database is limited. It is impossible to record students' professional needs, detailed attendance, homework completion progress, etc. It is impossible to understand students' mastery and adjust teaching arrangements promptly. Since the basic theoretical system of mathematics has been established through the efforts of several generations, these situations have led to some teachers not being motivated to understand the needs and changes of teaching, so the teaching methods and teaching content of teachers have not changed for

decades. The artificial intelligence system can collect real-time data through many sensors, network login, and other information for queries and calls. Teaching materials and teaching planners can use these data to understand the demand for mathematics talents at home and abroad and make timely adjustments to teaching materials and plans. See Figure 5.

### **3.3. Artificial Intelligence Systems that can Actively Analyze Data and Provide Decision-Making Recommendations**

On the one hand, the artificial intelligence system can analyze students' homework conscientiousness, attendance, test scores, and even changes in sports, interests, and social activities to guide auxiliary teachers through questions, exchanges, rewards, and punishments. On the other hand, by analyzing students' personality characteristics, the artificial intelligence system can enable students to develop their talents better, enhance their self-confidence, and guide them towards Professional and compound talents. In addition, the artificial intelligence system can grasp the changes in students' psychological state and even emotional fluctuations, detect students' evil thoughts in time, and provide essential materials for the psychological counseling department to prevent the deterioration of mental diseases and prevent adverse events consequences.

## **4. Analysis of Artificial Intelligence Model in College Mathematics Teaching**

Artificial intelligence gives students the enthusiasm and autonomy of self-learning, improves the convenience of students' learning, and realizes the overall development of students. These advantages can ultimately serve students. That is the ultimate goal of artificial intelligence in the field of education. In short, the application of artificial intelligence in college mathematics teaching can significantly improve the coverage of "teaching according to aptitude" and enhance students' initiative and initiative in learning.

Artificial intelligence helps teachers improve teaching efficiency. The ratio between teachers and students is seriously unbalanced, and a teacher may have to undertake teaching tasks for multiple classes. A large amount of teaching tasks leads to teachers not having enough energy to grasp the basic situation of students, so it is difficult for teachers to adjust the course teaching in time. In addition, many teachers' teaching methods may be immutable for primary mathematics. With the continuous development of the Internet and big data technologies, teachers can obtain and collect data through sensors and other methods for future reference[4]. In addition, teachers also can use artificial intelligence to correct homework online, let artificial intelligence replace manual problems to solve error-prone problems, and improve teaching efficiency.

## **5. The New Demand for Artificial Intelligence for Mathematical Knowledge, Teaching Methods, Mathematical Thinking, and Mathematical Application Ability**

### **5.1. Puts Forward New Requirements for the Content of University Mathematics Teaching**

With the rapid development of emerging industries such as artificial intelligence and big data, the application of information technology is becoming more and more extensive. Traditional and classical mathematical knowledge can no longer meet the development needs of new engineering majors, and the demand for mathematical knowledge in related industries and majors has also increased. At the same time, the importance of the application requirements of some traditional classical mathematical content has also declined.



## 5.2. The Public has Higher and Higher Requirements for the Cross-Application of Mathematical Knowledge

Today's world is in a period of interdisciplinary development, high-tech development, and accelerated cross-border integration and reconstruction of industries.

## 5.3. College Mathematics Teaching Should Focus on Cultivating Students' Innovative Thinking and Practical Ability

The construction of new engineering is a reform action plan implemented by Chinese higher education to adapt to the national innovation-driven development.

## 5.4. Improve the Ability of Mathematics to Solve Complex Engineering Problems

After China joined the "Washington Accord," how to improve students' ability to solve complex engineering problems has become the difficulty and key of engineering education. Mathematical knowledge innovation plays a fundamental and critical role in solving complex engineering problems.

## 6. Shortcomings of Existing Artificial Intelligence Technology in College Mathematics Classroom Teaching

(1) China's academic monographs are of high level, covering a wide range of depth, breadth, and background. These monographs are mainly aimed at senior practitioners who have been rooted in the industry for many years and at least need to have an undergraduate degree or even graduate and doctoral students. The knowledge level is not a good starting point for vocational education students.

(2) China's artificial intelligence textbooks, mainly introductory theoretical textbooks, are too rigorous and professional and should not be directly applied to artificial intelligence courses. Such textbooks often like to list many mathematical reasoning and calculus proof processes. Those students with poor mathematical foundation and good perceptual knowledge only know that they must do it but do not know why.

(3) Compared with other countries in the world, the learning materials in the world pay more attention to guiding students. However, there will be a specific discount in expression due to translation, plus the authors' writing style in the world and domestic students; therefore, the world's artificial intelligence learning materials are not suitable for Chinese students to learn directly[5].

To sum up, no matter whether online, offline, in China or in the world, although there are many artificial intelligence learning materials, there are very few artificial intelligence teaching materials that are genuinely suitable for the learning characteristics of college students. This realistic problem of artificial intelligence technology is a complex transition process for college mathematics teaching classrooms.

## 7. Endings

The ultimate goal of college mathematics teaching is to cultivate students' mathematical thinking ability and logical thinking ability and cultivate students' ability to raise, analyze and solve problems independently. In the era of big data, artificial intelligence technology based on data has penetrated all fields of society. The development of applied mathematics is increasingly dependent on the progress of applied mathematics. That requires students to study probability theory, mathematical statistics, discrete mathematics, and other courses in addition to mathematical analysis, advanced algebra, and other courses. Python software is one

of the most widely used AI practical programming languages. It is recommended that colleges and universities list the learning of this software as a required course or an elective course. Schools should include the core courses of digital media technology, such as computer graphics, digital image processing technology, etc., as professional elective courses to fully reflect the professional characteristics of contemporary university mathematics and artificial intelligence; schools should set up centralized experimental links to improve students' hands-on ability; Schools should combine their teaching reform practice to discuss how to introduce cutting-edge artificial intelligence technology to students from the primary mathematics content, improve the interest and practicality of mathematics course teaching, and deepen students' application and understanding of mathematics in the field of artificial intelligence.

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