# Teaching Research on Mechanical and Electronic Engineering Course Based on Artificial Intelligence

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*Abstract*—**In view of the shortcoming that the application of electromechanical students to understand the principles and practical problems of various artificial intelligence methods needs to be improved. This paper comprehensively expounds the teaching plan of artificial intelligence courses for the specific group of electromechanical engineering students from the perspectives of teaching goal formulation, teaching methods and assessment modes. At the same time, suggestions were made on the teaching process and assessment methods. These methods enhance the interest of professional students in learning and the ability to solve practical problems.**

*Keywords*—*artificial intelligence; Electrical engineering; mechanical engineering; teaching reform*

## I. INTRODUCTION

Artificial intelligence is a cutting-edge science involving computer science, applied mathematics, neurobiology, and psychology. Artificial intelligence was originally the main course of computer science students, but in recent years, with the advancement of technology, the technology has gradually demonstrated its powerful role in the field of mechanical electronics. Therefore, many colleges and universities now take artificial intelligence as one of their professional courses. The course requires a high level of mathematics and computer programming. In addition, although the chapters are more independent, they involve a comprehensive application of more pre-requisite courses. If the teaching method of the computer-oriented students is followed, the mechanical and electrical engineering students will feel that the course content is difficult to understand and difficult to adapt, thus losing interest in learning. In order to adapt to the characteristics of the knowledge structure of mechanical and electrical engineering students, it is of great significance to make targeted adjustments to the overall teaching design and methods of artificial intelligence courses.

## II. DEVELOP TEACHING OBJECTIVES TO MEET PROFESSIONAL CHARACTERISTICS

Artificial intelligence is a core research field of computer science. Its research methods use mathematical tools such as discrete mathematics, mathematical logic, and probability statistics. If the teaching of this course follows the method of computer or automatic control professional: focusing on the theoretical derivation and performance analysis of the

algorithm, the learning curve of the mechanical and electrical engineering students with relatively weak mathematics will be too steep, thus losing the learning confidence.

Fortunately, most chapters of artificial intelligence courses are more modular in content and have low coupling between chapters. In addition, the field of mechatronics is more about using artificial intelligence tools to solve practical problems, rather than developing and improving the artificial intelligence tools themselves. At this stage, based on the high-performance artificial intelligence software toolkit (such as scikit-learn), mechanical and electrical engineering students can fully understand the use conditions of various methods of artificial intelligence and their physical meanings. The actual problem does not require an in-depth understanding of the complex mathematical theory support and computational implementation methods behind it. It can be seen that for mechanical and electrical engineering students, it is the key purpose of this course to teach them how to analyze problems, choose appropriate artificial intelligence tools, and make adaptive adjustments to the tools at the system level.

Therefore, the author sets the goal of this course as: on the basis of understanding the history of artificial intelligence, in-depth understanding of the main methods of machine learning, especially the principle and use of neural network methods, can be appropriate for the specific problems in the field of mechanical electronics the algorithm is solved.

## III. CARRY OUT TEACHING ACTIVITIES TO THE CHARACTERISTICS OF PROFESSIONAL STUDENTS

### A. Detailed and appropriate teaching content arrangement

At present, most of the domestic artificial intelligence teaching materials are compiled for computer or automatic control students. The theoretical content is rich, the mathematical reasoning is strict, and the students' mathematics skills are high. The knowledge structure of mechanical and electrical engineering students is quite different from that of students in computer or automatic control. For example, mechanical and electrical engineering students only studied engineering compulsory courses such as advanced mathematics and linear algebra, and did not systematically study probability theory and mathematical statistics and discrete mathematics courses, which greatly increased the difficulty of theoretical teaching of artificial intelligence

courses. In addition, the artificial intelligence course is a professional limited course for mechatronics engineering, and the total amount of class hours is limited (usually 2 hours per week, total hours of 30 hours). It is very difficult to make the theory and application of all aspects of artificial intelligence very thorough under such short time constraints [1].

In the actual operation process, the author combines the characteristics of professional students and the above teaching objectives to integrate 3 sets of teaching materials and integrate their respective advantages as the main teaching content of this course. Specifically, the distribution of the main chapters of the course and the teaching sequence are carried out using the arrangement of teaching materials, that is, the early techniques of artificial intelligence, including knowledge engineering, reasoning and search technology. This part of the story is mainly to ensure the integrity of the course content, mainly textbooks, teaching time no more than 6 hours. Then it is about the mainstream machine learning technology that has been widely used in the field of mechanical electronics since the 21st century. This part is the core content of this course. Therefore, more professional and timely textbooks are selected as reference. This part of the teaching process is divided into two major modules: supervised and unsupervised learning techniques [2]. Supervised learning techniques focus on support vector machines and integrated learning techniques, and unsupervised learning techniques focus on clustering and feature selection techniques. This part is taught for approximately 14 hours. Secondly, the artificial neural network is described separately. This part is closely related to the most advanced technology in the field of mechanical electronics, which is used in the field of mechatronics, in order to help students get started with the latest technology and have the ability to further self-study later. To this end, the authors selected the latest authoritative textbooks from abroad and selected relevant chapters as textbooks. The teaching time for this part is approximately 6 class hours. Finally, combined with the author's own scientific research practice, the students are told about the application of artificial intelligence in the field of mechanical [3] and electronic engineering. The author takes a specific case as an example, and describes a set of processes from problem definition, data preprocessing to algorithm comparison selection, performance test tuning, etc., especially highlighting the problems and solutions that may be encountered in the process, so that students It has built a bridge between curriculum knowledge and practical application, laying a foundation for stepping into the workplace to solve practical problems in the future. The teaching time for this section is approximately 4 hours.

### B. *Teaching methods that emphasize physical meaning*

Traditional artificial intelligence courses contain a large number of mathematical formula inference processes. For the mechanical and electrical engineering students whose mathematics foundation is relatively weak, the classroom spends a lot of time explaining the details of the mathematical reasoning behind each method, but it will not improve the students' understanding of the course content, but will make students feel fearful and more attack on the course content. Its interest in learning.

For application-oriented artificial intelligence courses, the physical meaning behind each method and parameter of the students is taught to enable them to have a perceptual understanding of different methods and method fine-tuning schemes, so as to enhance students' choice in the future in the face of actual problems. The ability to solve problems. This ability cannot be obtained by rigorous derivation from algorithmic mathematical theory. For example, in the process of teaching support vector machines, we chose the example of two-dimensional space classification. Through the way of picture display, students can intuitively understand that the essence of support vector machine is to find the dividing line with "maximum spacing", which is played down for support. The convex quadratic programming solution process of vector machine is explained. In the process of teaching the kernel function, we use the linear indivisible example of two-dimensional space to visually demonstrate how to transform the points in the two-dimensional space into three-dimensional space to achieve linear separability, thus enhancing the students' nuclear method. Sensual understanding.

### C. *Classroom interactive display based on Jupyter Notebook*

Method principle and programming implementation are the two cores of this course. The programming implementation of various methods of artificial intelligence builds a bridge [4] between theory and application. Therefore, after the completion of the principle of each method, the course will take a special time to interpret the specific implementation of the method code with the students, in order to enable students to solve practical problems after completing the course.

Because the code annotation process, the code and its corresponding theoretical formula, and the visual display of the intermediate results of the code running in the code explanation process, the traditional software integrated development environment cannot meet this requirement. In this course we chose Jupyter Notebook. In the lesson preparation phase, the teacher enters text comments and theoretical formulas and saves the code and running results in a notebook. During the teaching process, the code is executed in the document as a web page through a computer in the classroom. Students can intuitively learn code writing, reference text, formula comments, and observation visualizations on the same web page, greatly improving learning efficiency and learning effectiveness.

### D. *Multimedia after-school learning activities centered on AI celebrity interviews*

Artificial intelligence has experienced more than 60 years of development history, and in this historical process, there have been many experts who have played a major role in promoting artificial intelligence. Their shared experiences and perspectives can give students a sense of enthusiasm, enhance students' understanding of the whole field and current status of AI, and the future development trend, and enhance students' interest in learning. To this end, the course distributes an easy-to-use AI celebrity interview video for students to arrange for

their own viewing during their spare time. For example, the author selected Stanford University professor Wu Enda to interview G. Hinton, a professor at the University of Toronto, and Lin Yuanqing, director of the Baidu Deep Learning Laboratory, to provide students with multiple dimensions of thinking and perspective from academia and industry perspectives.

## IV. DESIGNING A MULTI-DIMENSIONAL ASSESSMENT MODEL TO MEET THE TEACHING OBJECTIVES

Focusing on the above teaching objectives, the author designed three types of assessment modes in the course of teaching: software programming small project operation, paper reading report and final period surface test.

### A. Software project operation with mechanical fault diagnosis as the application scenario

Considering that the software programming ability of mechanical and electronic students is relatively weak, the project programming language of this course uses the easy-to-learn Python language. In order to make the professional students more close to the professional field application in the study, the author closely follows the common scene of the mechanical and electrical profession in the homework topic: mechanical equipment vibration fault diagnosis [5] to set the problem. In addition, in terms of job content, each software project program does not allow students to build the entire software system from scratch, but is implemented by the teacher in advance.

The framework design of the entire software, students only need to write software implementation of key algorithm modules. In this way, students can withdraw from the software programming details that are not related to the curriculum and the profession, and solve the core knowledge points of the course content to realize the problem, improve the learning efficiency and reduce the burden on the students. In the actual operation process, the author generally arranges two project operations, which involve artificial neural network and K-means clustering, respectively, corresponding to supervised and unsupervised learning techniques. Such an arrangement can cover the mainstream of artificial intelligence more comprehensively, enabling students to grasp the core content of the course in a solid manner.

### B. Reading report for the purpose of broadening horizons

The time in class is limited, and the content of textbooks is not always comprehensive. In order to encourage students to delve deeper into the content of their interest, the author arranged a paper reading report writing assignment in the course. The main content is: select a sub-problem of interest in the field of artificial intelligence, and write a report through literature research in the network database. This assignment will enable students to have a deeper understanding of a sub-area of artificial intelligence, thus stimulating their interest in learning. More importantly, the assignment enhances students' ability to access and write literature, laying the foundation for further work, especially further study.

### C. Final test plan for the purpose of examining application capabilities

Because this course is rich in examination methods and not only depends on the final face-to-face test, the final test supplemented by the above two methods is more inclined to examine the students' understanding of the basic concepts and the analysis of the actual problems and system architecture capabilities. Relatively diluting the calculation of specific method details. Based on the above principles, the final roll test is mainly divided into multiple choice questions and brief description questions. The multiple-choice questions mainly examine students' mastery of the key knowledge points and basic principles of the course; the brief questions mainly focus on practical application issues, and require students to describe the specific system architecture schemes and reasons for specific problems, without involving too much detail calculation.

Through the different assessment methods in the above 3, the students can master the system architecture ability of the actual problem, and learn the software implementation method of the specific core detail module, and open up the whole process of solving the problem by using the artificial intelligence method.

## V. CONCLUSION

Artificial intelligence is a course that requires high mathematical theory and is closely related to the application. It plays an important role in the knowledge structure of electromechanical professionals in the new era. It is a challenging subject for the electromechanical students to understand the principles of various methods of artificial intelligence and the application of practical problems. This paper comprehensively expounds the teaching plan of artificial intelligence courses for the specific group of electromechanical engineering students from the perspectives of teaching goal formulation, teaching methods and assessment modes. It is expected to play a role in attracting jade. Through further summarization and exploration, the author believes that it will inevitably be able to cultivate more mechanical and electrical [6] professionals in the new era that meet the needs of society.

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