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Innovation and Practice on the Course of Artificial Intelligence

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In order to adapt to the rapid development of artificial intelligence technology and cultivate AI talents that meet modernization requirements, considering the interdisciplinary, cutting-edge, and practical nature of the artificial intelligence course, this paper will attempt to explore the teaching of artificial intelligence courses from aspects such as curriculum design, course content, teaching methods, practical courses, and teaching evaluation.

Keywords: artificial intelligence, teach, course

Introduction

With the widespread application of artificial intelligence (AI) across various industries, the demand for AI talent is increasing. In March 2019, the Ministry of Education announced the "Notice on the Publication of the Results of the Filing and Approval of Undergraduate Programs in General Colleges and Universities in 2018", confirming the list of newly approved programs. Among them, 96 institutions added undergraduate programs in Intelligent Science and Technology, and 35 institutions were the first to be approved to establish undergraduate programs in Artificial Intelligence (Ministry of Education, 2019). This reflects the national support and emphasis on the training of AI professionals, as well as the market's demand for AI talent (Luo et al., 2019).

The rapid development of AI has brought challenges and opportunities for the development and innovation of AI programs, and has also set new requirements for the training of AI technical talent (Luo, Wang, Liu, & Li, 2022). Therefore, it is necessary to explore new approaches to AI course instruction.

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Current Status of Traditional "Artificial Intelligence" Course Teaching

Strong Interdisciplinarity, Unreasonable Course Settings

The artificial intelligence (AI) course is a required course offered by the School of Computer Science/School of Artificial Intelligence for junior students majoring in Intelligent Science and Technology and Artificial Intelligence. It also serves as a foundational course for these two disciplines. AI is an interdisciplinary field (Liu, Li, & Xie, 2023) that involves mathematics, computer science, psychology, as well as information theory, cybernetics, automation, bionics, biology, mathematical logic, linguistics, medicine, and philosophy, among many other subjects, covering a very broad range of knowledge points. Therefore, in terms of curriculum design, offering AI courses too early or too late is not conducive to teaching and student learning.

Rapid Development, Slow Course Content Updates

Since the formal introduction of the discipline of artificial intelligence (AI) in 1956, it has rapidly become a cutting-edge science after more than six decades of rapid development. Due to its interdisciplinary nature, the content of AI courses is highly comprehensive, covering a wide range of fields, and the knowledge content iterates quickly. This leads to a swift update of the teaching content in AI courses, making it challenging for classroom instruction to keep pace with the rate of knowledge renewal, thus presenting certain challenges to teaching efforts (Fan, Zhang, & Liu, 2024).

Strong Practical Orientation, Too Homogeneous Laboratory Courses

At the current stage, the teaching of artificial intelligence (AI) courses includes both theoretical and laboratory instruction, with an emphasis on the explanation of knowledge points and insufficient attention to practical operation. Although some courses include laboratory sessions, they are generally theoretical verification experiments, and the proportion of laboratory course grades is small, leading to a lack of emphasis on experiments by both teachers and students. In addition, internships outside of course hours are also relatively simple, with short durations and a lack of systematic structure. Students often rush through these internships to complete tasks, and do not receive effective practical training.

This paper closely follows the theoretical and technological frontiers of the AI field and explores new methods and models for AI course teaching centered around "student-centered, capability-oriented, and output-directed" principles. In the course teaching process, it plans curriculum settings, optimizes course content, improves teaching models, strengthens practical operations, and implements comprehensive assessment and evaluation to enhance the teaching quality of AI courses.

Curriculum Teaching Reform Measures

Reasonable Planning of Curriculum Settings Based on Disciplinary Characteristics

As an interdisciplinary and rapidly developing new discipline, the study of artificial intelligence (AI) requires a theoretical and practical foundation in other disciplines, especially computer science. Therefore, the placement of this course should not be too early, as freshmen have too little theoretical knowledge of computer courses to support them in starting to learn AI; as a new discipline, the course should also not be placed too late, as this would not allow enough class hours for learning, resulting in students only grasping the basics of the course. Thus, during the undergraduate stage, the course can be scheduled in the 5th to 6th semester. On the one hand, junior students have a certain knowledge base in computers and other disciplines, and by paying attention to and understanding the development of AI technologies related to computers while learning other knowledge, their interest in learning AI courses can be enhanced. On the other hand, junior students have a deeper understanding of computer technology, with clear theoretical knowledge and concepts, and stronger practical operation skills, so learning this course on this basis can achieve better results.

Establishing Course Objectives and Optimizing Course Content

Course objectives. Setting course objectives that are either too difficult or too easy can lead to a decrease in teaching effectiveness. Therefore, when setting teaching objectives, a phased approach is adopted, with objectives of varying difficulty levels set for each teaching segment. The final course objectives are established as follows: (1) Through the study of this course, students can master the basic principles, methods, and application areas of artificial intelligence; (2) Understand the common knowledge representation techniques, search techniques, and automatic reasoning techniques used in artificial intelligence; (3) Lay a foundation for future work in related intelligent disciplines through the study of expert systems and machine learning; (4) Gain an understanding of the basic methods for implementing artificial intelligence technology principles through course experiments; (5) Combine the frontiers of artificial intelligence development and the history of artificial intelligence development in China to provide students with patriotic and vocational education.

Optimizing the teaching content around the course teaching objectives. The course content is reorganized into two major modules: basic theory and application, with an emphasis on the study of key and difficult points. The course totals 64 class hours, with 48 hours dedicated to lectures and 16 hours for practical operation classes, as shown in Table 1.

The basic theory part mainly includes knowledge modules such as search, constraint satisfaction problems, first-order logic, planning, uncertain reasoning, clustering and dimensionality reduction, genetic algorithms, neural networks, and reinforcement learning. In the design of teaching segments, a problem-guided approach is used to explain the basic theoretical knowledge from the dimensions of mathematical concepts and engineering application concepts. The differences and connections between different concepts are analyzed both longitudinally and horizontally to enable students to deeply understand the basic theories of artificial intelligence.

Table 1

Framework of Artificial Intelligence Course Content

Chapter	Content	Emphasis	Difficulties
(1) Overview	Concept of AI, the research approaches and methods of AI, the research fields of AI, the basic technologies of AI, and the development status of AI	The research fields and the basic technologies of AI	The current situation and development trends of AI
(2) Search Algorithms	Depth-First Search, Breadth-First Search, A* Search, Min-Max Search, Alpha-Beta Search, Monte-Carlo Tree Search Algorithms	Depth-First Search, Breadth-First Search, A* Search and Their Implementations	Implementation of OPEN-CLOSED List, Alpha-Beta Search and Its Implementation, Monte-Carlo Tree Search and Its Implementation
(3) Constraint Satisfaction Problems (CSP)	Definition of CSP, Reasoning and Search in CSP, Structure of the Problems	Methods for Solving CSP	Backtracking Search and Local Search for CSP
(4) Genetic Algorithms	Fitness Functions, Schema Theory, etc.	Genetic Algorithms	Implementation of Genetic Algorithms
(5) First-Order Logic	First-Order Logic and Reasoning in First-Order Logic	Reasoning in First-Order Logic	Syntax, Semantics, and Programming Implementation of First-Order Logic
(6) Planning	Classical Planning Methods	Planning Graphs and Planning Algorithms	Planning Algorithms

Table 1 to be continued

(7) Uncertainty Reasoning	Bayesian Rules, Bayesian Networks and Reasoning, Inference in Temporal Models, Hidden Markov Models Kalman Filtering, Dynamic Bayesian Networks	Various Probability Models	Reasoning in Temporal Models
(8) Neural Networks	Perceptrons, Multi-Layer Feedforward Networks and Their Backpropagation Algorithm, Basic Framework of Deep Learning	Forward Neural Networks and BP Algorithm	Implementation of Forward Neural Networks and BP Algorithm
(9) Unsupervised Learning	Clustering, Dimensionality Reduction	Basic Principles of Clustering and Dimensionality Reduction	Dimensionality Reduction and Its Implementation
(10) Reinforcement Learning	Basic Principles and Typical Applications	TD-Learning Algorithm	Implementation of Basic Reinforcement Learning

In the design of the application phase of teaching, specific application environments are targeted, and discussion and interactive methods are used to lead students to model the problems involved from a problem-solving perspective, construct appropriate mathematical models, and use the theories and algorithms of artificial intelligence and machine learning they have mastered to solve these problems, consciously guide students to apply theoretical knowledge to practical aspects, and cultivate students' basic engineering application abilities.

Adopting diversified teaching models for different knowledge areas. In terms of teaching models, a student-centered approach is adopted, using a blended online and offline teaching model, forming a three-vertical and two-horizontal course teaching model, as shown in Figure 1. For each unit and each knowledge point, we have designed and produced related supporting videos and corresponding learning platforms for students and teachers to learn and interact. Centered on students, an online course preview method is used to strengthen students' "self-learning" ability. Students watch pre-class preview videos and related cutting-edge knowledge materials to gain a preliminary understanding of the knowledge they are about to learn, and then look up relevant materials according to learning tasks to deepen their understanding of the knowledge. By participating in material review, answering questions, raising doubts, exchanging discussions, and defending, students are stimulated to explore and desire to learn about artificial intelligence knowledge.

The presentation of course knowledge points is mainly teacher-led. In the teaching process, teachers introduce modern teaching methods, effectively combining blackboard writing, multimedia courseware, simulation programs, and other teaching methods to intuitively present the development, evolution, and application of dry formulas and theories to students. By fully stimulating students' visual, auditory, and psychological senses, students can have a more intuitive understanding and recognition of knowledge, which helps them to master knowledge faster and more effectively.

The key to learning artificial intelligence is practice. Course experiments and practices are carried out in a team-based manner, and the teaching objectives are achieved through students' practical operations. Students are divided into several groups to experience the diverse effects brought by different algorithms and program designs through independent design and exploration. This not only stimulates students' interest in learning but also cultivates their ability to independently acquire knowledge, discover problems, analyze problems, and solve problems, while promoting the improvement of students' comprehensive application of knowledge and innovation ability.

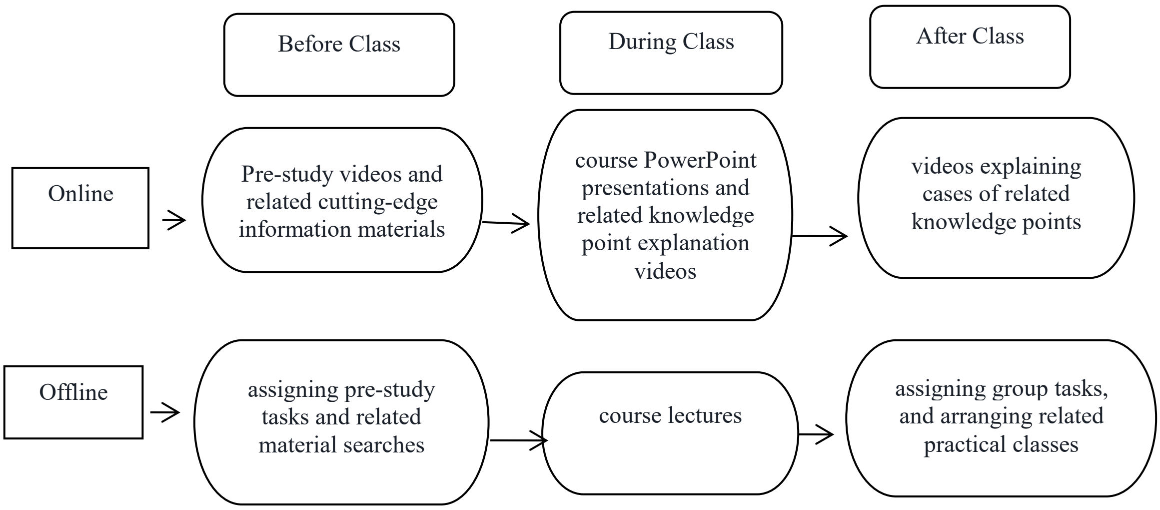

Figure 1. Teaching models.

Setting Up Specialized Tasks to Strengthen Practical Teaching

Each chapter includes specialized tasks that students complete in groups through topic discussions and project design tasks. The course sets up 10 specialized tasks. For each topic, several questions are pre-designed, and students are recommended to consult relevant reference books and literature. Based on reading the reference materials, students organize their reading notes. In the topic discussion class, students engage in discussions under the guidance of the teacher, who then summarizes and generalizes the discussion. The teacher assigns several topics related to the specialized tasks for students to choose from. Students select specialized tasks in groups, with the group leader responsible for coordination and division of labor to complete the practical teaching tasks. Each group submits an experimental report based on their completion and presents it using PPT. Questions and discussions are held based on the presentation, and the teacher summarizes and concludes.

Changing the Assessment Model for Comprehensive Evaluation

Focusing on the teaching objectives, a comprehensive assessment and evaluation system is implemented that combines classroom teaching with extracurricular self-study. The "student-centered" teaching model not only assesses the learning outcomes but also emphasizes the learning process. Therefore, the course assessment adopts a comprehensive evaluation system that combines in-class teaching with extracurricular self-study. The course assessment grade consists of regular performance (60%) and the final exam (40%). The regular performance is made up of classroom participation (50%), literature search (10%), in-class and out-of-class assignments (10%), topic discussion (10%), task design phase (10%), and two quizzes (10%). The comprehensiveness and completeness of the assessment methods effectively promote the achievement of the course's teaching objectives.

Conclusions

The rapid development of artificial intelligence has made it a very important discipline. This paper discusses the innovation and practice of artificial intelligence course teaching, which is a meaningful exploration based on reasonable course design, optimized teaching content, diversified teaching models, effective experimental teaching, and comprehensive assessment. The course consciously guides students to apply theoretical knowledge to practical aspects, cultivates students' basic engineering application abilities, and achieves an organic combination of knowledge learning and ability development. The study of artificial intelligence courses is challenging and can cultivate students' abilities for self-learning, self-motivation, and self-exploration. It is hoped that through the study of this course, students will be able to face new environments, new knowledge, and new problems with confidence and be able to tackle various difficulties and challenges.

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