

Research on Teaching Reform of Artificial Intelligence Course Based on CDIO

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Abstract. In view of the problem of how to set up general undergraduate artificial intelligence courses, on the basis of carefully combing and summarizing years of teaching exploration and practice, it is proposed to set Artificial Intelligence (AI) courses in the lower grades of the university. Taking the teaching practice carried out by Liaoning Institute of Science and Engineering as an example, the "12365" principle is proposed based on the CDIO concept, and corresponding teaching reform and practice are carried out.

1 Introduction

Liaoning Institute of Science and Engineering is one of the units that carried out AI education and research earlier in western Liaoning. It has a history of more than ten years. Since the first establishment of the "AI" course in 2009, education and research in the field of AI has once again reached a new level. In terms of AI course construction, Liaoning Institute of Science and Engineering has been continuously promoting exploration and innovation. The teaching reform and practice carried out in the AI courses covered by this project are proposed and promoted in the new context of the development of the AI field.

After several technological breakthroughs, the field of artificial intelligence has begun to enter a period of rapid development, making great progress in both theory and application. In July 2017, the State Council issued "the development plan for the new generation of artificial intelligence", which said that the development of artificial intelligence has become China's national strategy. The milestones include: 1) By 2020, Chinese AI companies at the technical and application levels will be in line with the world's advanced level, with the scale of core output exceeding RMB 150 billion and driving the scale of related industries to exceed RMB 1 trillion. To establish AI ethical norms and policies in some fields. 2) By 2025, China will have made important breakthroughs in basic theories, with enterprises at the technology and application levels approaching the international leading level, the scale of core industries exceeding RMB 400 billion, and driving the scale of related industries exceeding RMB 5 trillion. Initially, AI ethical norms and policy systems will be established, and AI security assessment and control capabilities

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will be formed. 3) By 2030, there will be a comprehensive breakthrough in foundation, technology and application, and China will become the innovation centre of AI in the world.

However, with the rapid development of artificial intelligence, AI has been widely and deeply used in people's lives, the current stage presents an extreme shortage of professional talent. To this end, the Ministry of Education formulated "the Action Plan for AI Innovation in Higher Education" in April 2018, one of whose core objectives is to promote the optimization of the technological innovation system in universities and the talent cultivation system in the field of AI.

Statistics show that within the first 10 months of 2017, the demand for AI talents has reached nearly twice that of 2016 and 5.3 times that of 2015. The demand for talents has skyrocketed with a compound annual growth rate of over 200%. In May 2019, "China New Generation Artificial Intelligence Development Report Plan2019" (Chinese and English versions) was released in Shanghai, and the data show that China has made rapidly progress in several aspects of artificial intelligence. Taking the number of AI companies as an example, statistics show that the global industry scale of artificial intelligence reached \$156.5 billion in 2020, up 12.3% year-on-year. However, due to the impact of the epidemic, the growth rate is lower than that in 2019. In 2020, the scale of China's artificial intelligence industry is \$43.4 billion, with a year-on-year growth of 13.75%, exceeding the global growth rate. In 2020, American AI enterprises accounted for 38.3% of the global total, followed by China, accounting for 24.66%. The number of AI enterprises in China and the United States accounts for more than half of the world, maintaining absolute competitive advantages. The rapid growth of the number of enterprises, on the one hand, reflects that the development of the field of artificial intelligence is still rising, on the other hand, it also reflects the urgency of the market's demand for professionals in the field of artificial intelligence.

Facing the background of AI development and the current situation of shortage of professional talents, "how can university education play its proper role?" has become an urgent issue.

The new engineering strategy implemented by the state not only requires the development of a large number of new engineering majors, but also requires the reform and innovation of engineering. The innovation of engineering education mode triggered by the construction of new engineering disciplines urgently requires the design of a whole set of talent cultivation schemes including education concept, curriculum system and quality assurance system. CDIO education mode was founded by MIT, Royal Swedish Institute of Technology and other four universities in 2004 after years of exploration and practice. This education model is based on the whole life cycle of conception, design, implementation and operation of real products, processes and systems, and on the CDIO syllabus and standards, allowing students to learn and improve their engineering skills in an active, practical and organically linked way between courses, including personal scientific and technical knowledge, lifelong learning ability, communication and team work ability, the ability to work in a socially realistic environment and the ability to build products, processes and systems in a socially realistic environment. Using the CDIO education model to redesign the existing application-based training programs for talents can better align with the needs of the AI industry, better align with the new engineering construction strategy proposed by the Ministry of Education, and more solidly cultivate engineering and technology talents.

2 Reform objectives

The course of artificial intelligence involves many concepts, principles, methods and technologies, which aims to enable students to further understand and master the relevant fundamental theories and typical application directions in the field of artificial intelligence.

In order to respond to "the National Development Plan of New Generation Artificial Intelligence" and "the Action Plan of Artificial Intelligence Innovation in Higher Education", the Network Engineering Department of Electronics and Information Technology of Liaoning Institute of Science and Engineering has set up a teaching team consisting of eight teachers to promote teaching reform and teaching practice in order to optimize and improve the personnel training system in the field of artificial intelligence. However, AI course as a frontier interdisciplinary subject, the course content is abstract in concept and extensive in knowledge. The traditional unchanging course teaching content and teaching methods cannot meet the students' desire and demand for knowledge in the new era, which hinders the realization of teaching objectives and is not conducive to the achievement of professional ability cultivation.

2.1 Sinking of the course offering year

In consideration of the many negative effects of offering the AI course in the 5th semester of the third year of college, the course was moved down to the 4th semester of the second year of college. This makes it possible to fundamentally solve the above problems, and it also brings new problems, the most immediate of which is the difficulty in fully satisfying the prerequisite knowledge required for the AI course.

For this reason, based on the comprehensive consideration of the strong theoretical, extensive knowledge and high practical requirements of AI courses, the curriculum was reorganized with the concept of "focusing on the basic, inspirational, broad vision and systematic nature of the curriculum" as the guide. The goal is not only to maintain the core foundation of AI courses, but also to ensure that the teaching content is reasonably designed without being too difficult in the absence of some prerequisite knowledge: The former mainly emphasizes not losing the "big vision and systemic" of the course, so that students can have a comprehensive and systematic basic understanding of the whole AI field, clarify the coherent relationship between the professional courses of the course cluster, and enhance the relevance and initiative of learning the relevant professional courses of the subsequent course cluster. The latter emphasizes the "basic and inspiring" orientation of the course. The latter emphasizes the "basic and inspiring" orientation of the course. The latter emphasizes the "basic and inspirational" orientation of the course, by adding some of the preparatory knowledge of the prerequisite courses, clarifying the key basic concepts and basic ideas, carefully sorting out the logical structure of the course, setting reasonable teaching contents, and implementing heuristic teaching for the contents beyond the existing knowledge structure in order to achieve post-course extension and subsequent learning.

2.2 Design of course content

Based on the above course objectives and basic ideas, the course teaching content is designed (Table 1). The course has a total of 16 sessions, including one midterm exam and one final exam each, one semester group project presentation, and 10 teaching content.

Table 1. Design of teaching content of AI Curriculum

Time	Course content	Period
1	Brain and Cognition	2
2	Agent	2
3	Mathematics Foundation of AI	2
4	Search-based Problem Solving	2
5	Machine Learning	2
6	Artificial Neural Network	2
7	Deep Learning	2
8	Midterm exam	2
9	Algorithm	2
10	Logic and Reasoning	2
11	Knowledge Graph	2
12	Planning	2
13	AI Ethics	2
14	AI Expectation	2
15	report and exchange	2
16	Final exam	2

From the perspective of comprehensiveness and systemic coverage of the curriculum, the course content should include not only the basic content of artificial intelligence, but also preparatory knowledge of mathematics, brain and neuroscience, psychology and cognitive science, philosophy, ethics and other related content. For this reason, the course content is designed to include "Mathematical Fundamentals of AI", "Brain and Cognition", and "AI Ethics". In the section of "Mathematical Fundamentals of AI", the content of complexity analysis of algorithms, basic concepts of linear algebra, preliminary knowledge of probability theory, and the main ideas of mathematical statistics are taught as preparatory knowledge.

3 Implementation

The scheme design follows the principle of "12365": The "1" means an educational concept -- following the concept of CDIO engineering education; the "2" means two main lines of implementation -- the main line of AI practical education and software design ability training; the "3" means three technology platforms -- Python platform, application platform and algorithm platform; the "6" means six practical directions -- game AI, computer vision, computer audition, natural language processing, data intelligence, Robotics; the "5" denotes five learning methods -- problem-based learning, project-based learning, case-based learning, do-it-yourself learning, and experience-based learning.

In Table 1, only 26 hours of lectures were actually taught, in addition to the 4 hours taken up by exams. The course content is designed based on the premise that first-year undergraduates are missing some of their prerequisite knowledge, emphasizing the basic and systematic nature of the course.

In order to enlighten students' knowledge extension, enhance their interest in learning, and build up their understanding of the field of artificial intelligence with a "big vision", I designed a teaching model of "large class + practical class". In addition to the 13 lectures of the "large class", a 6-hour "practical class" (in the form of after-school activities and pre-research for science and technology competitions) was added as another important step in this teaching reform.

The main goal of the additional "practical classes" is to make the artificial intelligence course cover the main environmental perception means of intelligent bodies, intelligent body environmental interaction strategies, data intelligence related to the analysis and processing of perceptual information, AI gaming, fusion perception, etc. To this end, six

practical classes have been designed, including game AI, computer vision, computer hearing, natural language processing, data intelligence, and intelligent robotics.

4 Practical assessment

In the previous "large class + small practical class" teaching model, the "small practical class" is mainly to synchronize the teaching content of the "large class", so that students can deeply understand. The "small practicum class" includes not only the teaching contents of the "large class", but also the specific teaching contents, practical topics, special teaching platform and additional specialized skills to supplement the knowledge of each "practical class". The teaching model of the newly designed "large class + small practical class" is characterized by the different focus, distinction, and distinctiveness of each of the six practical trainings. The reformed AI course is offered to undergraduate students of Liaoning Institute of Science and Engineering. Students voluntarily choose to be evenly distributed among the six practical courses, which means that there are nearly 50 students in each practical course. In order to avoid academic overload, the six practical classes are offered at exactly the same time, each student can only take one practical class. This is in line with what I had in mind at the beginning of the course design.

Based on a clear definition of the core concepts of AI, the logical structure of the course needs to be carefully sorted out. The course not only includes an analysis of the interconnectedness of each chapter of the "large class" course, but also the orientation of the six specifically set practical sessions. The practical class is introduced by the purpose of the intelligent body to "perceive and interact with the environment", and the 13 sessions of the "large class" are introduced by the purpose of the intelligent body: "how to achieve". The design of the thirteen courses is divided into three levels: Lesson 1 and Lesson 14 are the first and last lessons, which are "AI Overview" and "AI Prospects" respectively, forming the first level of "global grasp", reflecting the overall grasp of the content of the course as a whole. Lessons 2 and 3, representing "Intelligent Bodies" and "Mathematical Foundations of AI", constitute the second level of "Basic Preparation" and represent the foundation for some of the required but missing prerequisite courses. The remaining 10 classes constitute the second level of "Basic Preparation", which represents the foundation for some of the missing prerequisite courses. The remaining 10 lessons constitute the third level, "Specific Breakdown", and represent the main content of the course. The remaining 10 classes constitute the second level of "basic preparation" and represent the foundation for some of the missing prerequisite courses. The remaining 10 lessons constitute the third level of "Specific Breakdown", and reflect the main content of the course. In the third level of "concrete decomposition", the purpose of "perceiving and interacting with the environment" is based on the motivation of the intelligence "Problem Solving" or "Task Fulfilling", and the four basic implementation strategies, "Searching", "Reasoning", "Planning", and "Learning" are introduced into the setting of a specific lesson. We will set up a group project topic on our own, and use Oral Presentation and Poster Presentation for group communication activities. Project design should follow the following principles: 1) the project comes from a real project or is transformed from a real project, and is in line with the latest technology applied in society; 2) the domain knowledge combined with the project should not be too simple, but should have a certain degree of complexity; 3) the project should be targeted to strengthen the learning of relevant technologies or knowledge points; 4) the project should be moderately difficult; 5) it should be combined with fun.

5 Conclusion

The combination of multiple teaching methods can effectively change the situation in which teachers lecture and students passively listen in traditional mode, and enhance students' subjectivity and initiative. At the same time, the new teaching mode corresponds to a new assessment method, which can evaluate the students' performance through the combination of the usual seminar results, the results of major assignments and the results of closed-book exams, thus reflecting more comprehensively the students' understanding and mastery of knowledge and the level of practical application.

Authors' contributions

The contributions of the authors of this article are equal.

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