Pathways for Cultivating Artificial Intelligence Talent in the Context of New Engineering Education Development

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Abstract. Currently, China has proposed the concept of "construction of new engineering disciplines," and new engineering majors, represented by artificial intelligence, have new demands for talents that align with industry development needs. These demands include comprehensive knowledge, practical ability, innovative consciousness, and a forward-looking perspective. This paper constructs an AI talent training system from four aspects: interdisciplinary integration, curriculum system, practical platform, and teaching staff, aiming to cultivate application-oriented, innovative, and compound talents with engineering theoretical capabilities that meet the needs of engineering career development. It is hoped that under the dual drive of the construction of new engineering disciplines and "Double First-Class" initiatives, artificial intelligence technology will contribute to the construction of an innovative country.

Keywords: New Engineering Disciplines; Artificial Intelligence; Talent Cultivation Path

1 Introduction

Faced with the rapid development and widespread application of AI technology, talent cultivation is facing unprecedented challenges and opportunities. Traditional engineering education systems often struggle to cover the interdisciplinary and comprehensive nature of AI talent cultivation, leading to a significant mismatch between talent supply and market demand. Therefore, researching the path of AI talent cultivation under the construction of new engineering disciplines not only helps to promote the improvement of higher education quality but also provides a strong talent guarantee for the development of the AI industry. In today's globalization, the cultivation of AI talents is not only the task of a single country or region but is a global responsibility. This research hopes to promote the innovation and development of AI talent cultivation models through transnational academic exchanges and cooperation, contributing wisdom and strength to building a community of shared human destiny.[1]

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2 Background and Requirements Proposed by the Construction of New Engineering Disciplines

2.1 Demand for Industrial Transformation and Upgrading

With the continuous development of the global economy and the advancement of technological innovation, traditional industries are undergoing profound transformation and upgrading. This transformation raises higher requirements for engineering technical talents, who not only need to possess solid professional knowledge but also require the ability to integrate across disciplines and innovative thinking. The construction of new engineering disciplines was proposed against this backdrop to cultivate engineering technical talents who can adapt to and lead industrial transformation and upgrading. According to statistics from major recruitment platforms such as Lagou, BOSS Zhipin, Liepin, 51Job, and 58.com, there are a total of 472,738 job postings nationwide for AI technology and application fields, with 28,574 postings specifically for AI directions.

After data cleaning and deduplication, considering the impact of multiple resumes for a single job and the duration of employment, the final calculation shows that in 2019, there was a talent gap of 68,580 for AI product managers.

2.2 Science and Technology Innovation as a Development Driver

Science and technology innovation is an important driving force for today's social development. The construction of new engineering disciplines emphasizes leading with scientific and technological innovation to promote the reform and development of engineering education. By strengthening the integration of scientific research and teaching, it cultivates students' innovative consciousness and practical abilities, providing continuous talent support for scientific and technological innovation.

2.3 Requirements for Educational Reform and Innovation

Under the new situation, reform is an important measure to promote educational development. New engineering is a significant content of educational and teaching reform, requiring us to innovate in educational concepts, teaching content, and teaching methods to meet the demands of the new era for engineering technical talents.

3 New Requirements for Talents in Artificial Intelligence Under the Construction of New Engineering Disciplines

3.1 The Integrative Nature of Knowledge

Artificial intelligence is a scientific discipline that mimics human thought and cognitive processes. Although it is not a human being in the true sense, it can imitate human thinking and, to a certain extent, surpass it. Artificial intelligence can be described as the "brain" of a machine, and its study requires knowledge from multiple disciplines,

including computer science, linguistics, and engineering ethics. Take, for example, the 2018 "gene-edited babies" incident, which is a classic case of technology that could be implemented but violated scientific ethics. In addition to its engineering technology, artificial intelligence must also incorporate other disciplines, including humanities and social sciences, to ensure that technology is used correctly. Therefore, AI talents must have a comprehensive knowledge base.[2]

3.2 The Practicality of Skills

The ultimate goal of engineering technology is to transform knowledge into products with economic and social benefits. Currently, China is vigorously advancing new engineering disciplines, especially in the field of artificial intelligence.

3.3 The Innovativeness of Consciousness

In February 2018, the State Council issued the "New Generation Artificial Intelligence Development Plan," which indicated that artificial intelligence is an important force leading the new generation of industrial revolution and that this strategic goal is a "human-centric national strategy." At the same time, it will create new powerful engines, reshaping every link in economic activities such as production, distribution, and consumption. The "New Generation Artificial Intelligence Development Plan" elucidates the strategic posture of current AI development from a new perspective. Therefore, to make AI a new engine of economic growth, one needs the capability to encompass the "five new aspects."

3.4 The Foresight of Vision

In the new era of industrial revolution, knowledge is growing at an exponential rate, and no one can master all knowledge. The "New Generation Artificial Intelligence Development Plan" clearly states that artificial intelligence can be widely applied in various aspects such as education, healthcare, and elderly care. With proper use, it can provide society with more refined services and improve the quality of life for the people. At the same time, by accurately perceiving, predicting, and warning of important trends in the operation of infrastructure and social safety, people can timely grasp changes in public cognition and psychology, and thus respond proactively, significantly enhancing the capacity and level of social governance, which is irreplaceable for maintaining social stability. Therefore, it requires a forward-looking vision, to grasp the direction of social development and strategic trends of industries, allowing it to better serve the development of society.[3]

4 Construction of Course System for Artificial Intelligence Talent Cultivation

4.1 Curriculum System of Artificial Intelligence Majors in Foreign Advanced Universities

Artificial intelligence is a highly complex interdisciplinary field. In its structure, artificial intelligence is built on the basis of cognitive science of the brain. Its main research contents include knowledge expression, knowledge reasoning, machine perception, machine learning, intelligent system construction, etc. According to the classification of artificial intelligence by the National Natural Science Foundation F06, the current artificial intelligence research can be roughly divided into artificial intelligence foundations, machine learning, machine perception and pattern recognition, natural language processing, knowledge representation and processing, intelligent systems and applications, and artificial intelligence based on cognitive and neural systems. Overall, this part of the research can be divided into two parts: one is the research on basic theories, and the other is the realization of intelligence.

Foreign advanced universities started earlier in the construction of artificial intelligence majors. Figure1 shows the curriculum system of the undergraduate major in artificial intelligence at Carnegie Mellon University (CMU).

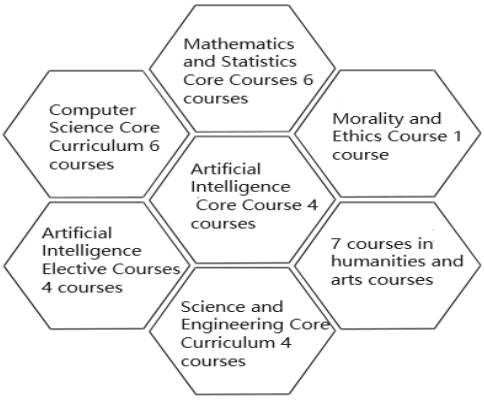

Fig. 1. Course categories of CMU artificial intelligence undergraduate major

Its required courses include:

(1) Mathematics and Statistics Core Courses: Modern Regression; Integration and Approximation; Differential and Integral Calculus; Probability for Computer Scientists; Matrices and Linear Transformations; Mathematical Foundations of Computer Science;

(2) Core Courses in Artificial Intelligence: Concepts in Artificial Intelligence; Introduction to Machine Learning; Introduction to AI Representation and Problem Solving; Introduction to Natural Language Processing or Introduction to Computer Vision;

(3) Core Courses in Computer Science: Freshman Transition Course; Introduction to Computer Systems; Principles of Imperative Computation; Principles of Functional Programming; Great Theoretical Ideas in Computer Science; Parallel and Sequential Data Structures and Algorithms.

4.2 Curriculum System of Artificial Intelligence Majors in Chinese Universities

Under the new needs of the new engineering disciplines construction, on the basis of the reference to the curriculum system structure of foreign advanced universities, combined with the reality of the construction and development of Chinese universities, the curriculum system related to artificial intelligence has been scientifically designed, which is very necessary for cultivating innovative talents with innovation spirit and ability. [4]

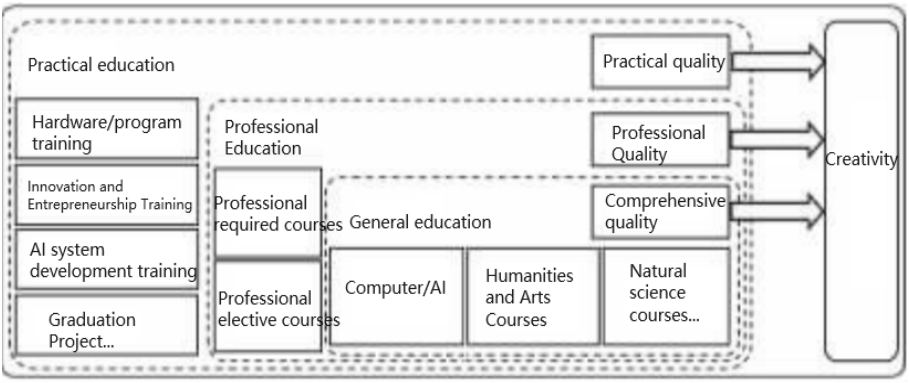

Fig. 2. Relationship diagram between artificial intelligence professional curriculum system and innovation ability cultivation

Figure 2 illustrates the influence of the curriculum system on the development of students' creativity. As the new engineering disciplines are just starting, there is still much exploration. Large-scale adjustments would be dangerous. To ensure the stability of talent cultivation, the overall settings are not easy to change much. At this stage, while maintaining the complete curriculum framework of "general education + professional education + practice", artificial intelligence related courses should be integrated into the entire curriculum system, and corresponding settings should be made according to the related courses of artificial intelligence, so as to be more stable and more reasonable.

General education undertakes the teaching of basic and stable disciplinary knowledge of intellectual science disciplines. General education contains three main general courses, namely natural sciences, humanities and arts, and computers and artificial intelligence.

(1) Natural science majors cultivate students' basic scientific quality and lay a solid foundation for future scientific and technological development and scientific research.

Although artificial intelligence has been classified into the category of engineering from the very beginning, the development of science and technology has always been based on natural sciences. Without the support of these disciplines, technology would become a rootless tree. Natural science usually includes traditional advanced mathematics, linear algebra, probability theory, and physics. In recent years, with the rapid development of deep learning technology, research in the field of computer vision has also been developing rapidly, and the demand for talents in the field of computer vision has been increasing. "Matrix Analysis", a mathematical discipline that is closely related to computer vision, should be added in general education teaching.

(2) Humanities and art related disciplines (such as Principles of Marxism, Outline of Mao Zedong Thought, Ideological and Moral Cultivation, University Chinese and Physical Education, etc.) have a very unique position in general education, and these courses play a crucial role in shaping the values and world outlook of young students. Therefore, due attention should be paid. Since most graduates of artificial intelligence majors are engaged in engineering industries, it is particularly important to give them correct technical education. By introducing important ethical events in computer disciplines, students are guided to use the scientific and technological knowledge they have learned to make contributions to society. For this purpose, "Computer Ethics" should be included in the teaching content of humanities and arts.

(3) Artificial intelligence is an important branch of computer science. Computer/artificial intelligence related basic courses need to contain basic knowledge of computer science, such as computer introduction, computational thinking, etc. As mentioned earlier, an introductory course on artificial intelligence - "Introduction to Artificial Intelligence" should also be added in general education teaching.[5]

4.3 The Cultivation Path of "Undergraduate-Master-Doctoral" Artificial Intelligence Talents

On October 31 this year, the 9th plenary session of the Political Bureau of the CPC Central Committee was held on the development status and trends of artificial intelligence. The meeting made it clear to strengthen basic research, break through key core technologies, increase application efforts, and increase talent cultivation to promote the healthy development of a new generation of artificial intelligence. To achieve these 4 goals, it is necessary to cultivate high-level artificial intelligence talents at multiple levels. At present, some universities, especially 985 project universities, have actively explored the integrated cultivation model of bachelor-master-doctoral degrees. It should be noted that what is currently more common in postgraduate training is less implemented in undergraduate education. Therefore, establishing an "undergraduate-master-doctoral" artificial intelligence talent training path is the key to cultivating high-level innovative talents Figure 3.

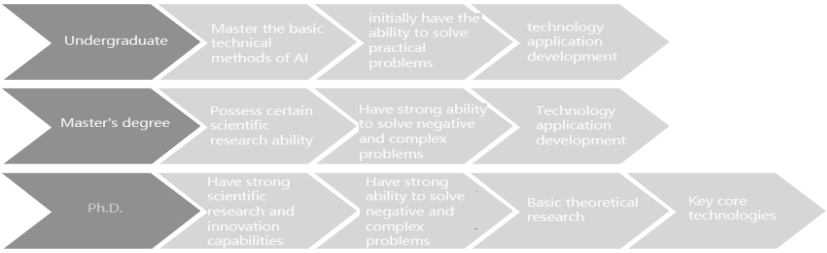

Fig. 3. Undergraduate-Master-Doctor Training Path

1. Undergraduate Training of Artificial Intelligence Talents

At the university stage, the focus is to enable students to better understand the development history, research fields, basic technologies, etc. of artificial intelligence, and focus on laying a solid foundation for students' majors. In this process, we can also cultivate students' learning interest, so that they can find the subdivided fields of artificial intelligence that they are interested in, so that they can take the initiative to learn, and enable them to master the ability to use artificial intelligence technology to solve practical problems in a short time, thus providing them with a basic support in the process of entering enterprises or continuing their studies. One is to conduct a comprehensive investigation of colleges and universities with master's training qualifications, select a group of artificial intelligence professional core courses suitable for China's national conditions based on local realities, and set up relevant courses among undergraduates; The other is to implement the "double tutor system" teaching model for undergraduates. In addition, a very good school-enterprise cooperation mechanism should be constructed in professional artificial intelligence companies and other industries that have a great need for artificial intelligence, so as to send students to enterprises through the establishment of internship bases and other effective cooperation modes. There, they can better understand the needs of the industry, thereby enhancing their practical working ability and improving their talent training level. At the same time, during the internship of students, enterprises can train interns according to needs, and interns can also enter the enterprise to work after graduation, which not only helps enterprises recruit qualified employees, but also reduces recruitment costs and improves recruitment efficiency.

2. At present, among the practitioners in the artificial intelligence industry, those with master's degrees account for the vast majority. Therefore, at the postgraduate stage, the focus should be on strengthening the learning of basic knowledge in subdivided fields related to artificial intelligence, paying attention to the foundations of mathematics, programming, strengthening the development of technology applications, and enabling students to better use artificial intelligence technology to solve complex problems on the basis of mastering certain scientific research capabilities. The postgraduate education implements the supervisor responsibility system. After graduation, most postgraduates will continue to study in the same research direction, even if they pursue a doctoral degree. At this stage, even if your university does not have a doctoral degree qualification, as long as you can solidify your engineering practice ability and

theoretical knowledge in the research field, you can well combine the postgraduate training with the requirements of the doctoral stage.Each stage of talent training needs to lay a solid foundation for the next step of development, deliver more talents, and establish a virtuous education system. Only by establishing an "undergraduate-post-graduate-doctoral" training path and building a "trinity" long-term training system on this basis can we cultivate innovative artificial intelligence talents and provide lasting impetus for the healthy development of artificial intelligence.[6]

4.4 Development of Practical Platforms

The goal of AI is to make more reasonable and intelligent decisions by processing data to produce outcomes, referred to as models. In essence, AI seeks to establish the best-performing models based on input data.

The process of building AI models typically involves the following three steps:

First, define the input-output relationship of the model as $y = f(w, x)$;;

Second, describe the deviation using a loss function L(w);

Third, solve for the optimal parameter values, that is, $w^* = \text{argmin L}(w)$.

In the context of new engineering education, the construction of practice platforms is critical for the cultivation of artificial intelligence (AI) talent. To effectively integrate resources from schools, governments, and enterprises for practical teaching, the following construction pathways can be adopted:

(1) Clarify Practical Teaching Objectives and Needs

Before constructing a practice platform, it's necessary to clarify the objectives and needs of AI practical teaching. This includes developing students' practical operation skills, innovative thinking, teamwork abilities, and problem-solving capabilities. At the same time, the content and curriculum system of practical teaching must be determined to ensure that practical teaching is effectively integrated with theoretical teaching, achieving the best educational outcome.

(2) Establish School-Government-Enterprise Cooperation Mechanisms

Schools, governments, and enterprises should establish a cooperative mechanism to share resources and complement each other's strengths. Specifically, cooperation agreements can be signed, and joint practice bases can be established to clarify the responsibilities and rights of all parties and jointly promote the construction of the practice platform.

(3) Integrate Internal and External Practical Teaching Resources

Schools should fully utilize their own laboratories, teaching equipment, and other resources, while actively seeking cooperation with external enterprises and research institutions to jointly conduct practical teaching.

(4) Build a Practical Teaching Curriculum System

On the basis of integrating internal and external resources, a complete practical teaching curriculum system needs to be constructed. This includes formulating practical teaching outlines, compiling practical teaching materials, and designing practical projects. Additionally, it is necessary to establish a practical teaching evaluation system to provide an objective and comprehensive assessment of students' practical outcomes.

(5) Promote the Interface of Practical Teaching with Industry

To better cultivate students' practical and innovative abilities, it is necessary to promote the interface of practical teaching with industry. [7]

5 Conclusion

Against the backdrop of universities entering the stage of new engineering education construction, artificial intelligence technology has vast development prospects within this domain. This sets higher demands for the comprehensive knowledge, practical abilities, innovative consciousness, and forward-looking vision of talents. This project aims to leverage the dual propulsion of the new engineering discipline and the "Double First-Class" initiative, utilizing artificial intelligence technology to make a due contribution to building an innovative country for China.

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