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Reflections on Construction of Computer Professional Knowledge System in The Background of Emerging Engineering Education

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Abstract: In the context of emerging engineering education, there are issues such as tight class hours and an increase in new knowledge courses in the training process of computer professional knowledge system, this article focuses on this issue. Consider how to build a scientific and reasonable knowledge curriculum system, the philosophy upheld in this article is to streamline theoretical courses, broaden professional directions, and emphasize the intersection of other professional knowledge. By analyzing the characteristics of the existing professional knowledge courses and public basic knowledge courses in computer science, and the characteristics of the new professional direction knowledge courses and cross disciplinary expanded knowledge courses that have emerged with development of computer technology. By arranging various knowledge courses reasonably, the training process will meet the needs of various basic knowledge and the needs of professional development, and establish a balanced curriculum knowledge system between deep theoretical foundation, broad professional direction knowledge, and cross disciplinary knowledge of other majors.

Keywords: Knowledge System; Curriculum Design; Computer Major.

1. Introduction

Advances in technology promote social development, and social development demands technological updates. Both social development and technological updates necessitate talent, and university education is the most important means to address the demand for talents. University education continuously adjusts itself in response to social development, and China has continuously introduced various policies and measures to facilitate education's adaptation to society. Among these, the implementation of "Emerging Engineering" is a crucial initiative [1].

Higher education should strive to develop "Emerging Engineering". "Emerging Engineering" refers to innovation in current engineering disciplines. On the one hand, due to the emergence of new technologies and industries, undergraduate education needs to adapt to these requirements and establish new corresponding majors. On the other hand, the new development and application of existing majors drive their own professional transformation, and existing majors need to constantly innovate to meet the educational needs of the new situation [2].

To adapt to the development needs of the new era and support professional graduation requirements, undergraduate education in computer science at universities should continuously adjust to cultivate talents who meet these requirements. Undergraduate education fosters talents in an all-round way, encompassing ideological education, humanities knowledge, and natural knowledge. The establishment of a knowledge system is the key of talent cultivation in undergraduate education [3]. The setting of knowledge curriculum system primarily aims at the knowledge and ability needs of professionals for their future work [4,5]. After years of teaching experience, our major has formed a knowledge system construction approach characterized by "precise theory, broad direction, and emphasis on intersectionality". A better-established knowledge system can provide students with a more solid preparation for their future work and career.

2. Streamline Theoretical Courses

In the construction of the "Emerging Engineering" program, computer science and technology is one of the most important majors in terms of innovation among all engineering majors. Given the rapid development of computer technology and the demand for high-tech talents under the new situation, the innovative construction of the computer major is an unavoidable challenge. The innovation in the computer major must be based on the existing foundation of the computer major, with the essence of theories being consolidated and theories that are not suitable for the new situation being simplified. The knowledge system of the computer major is mainly composed of the courses offered. The professional knowledge system mainly includes public basic knowledge courses, information discipline basic knowledge, computer major basic knowledge, and computer major core knowledge. These four aspects of knowledge correspond to public basic courses, information discipline basic courses, computer major basic courses, and computer major core courses.

The courses in the four aspects of the computer professional knowledge system can be divided into theoretical courses and applied courses. The approach for theoretical courses in the construction of new engineering education is to simplify them. On the one hand, theoretical courses should be distilled to their essence, better reflecting the needs of computer development. On the other hand, they should be simplified, focusing on the cultivation orientation of talents and the needs required for computer development.

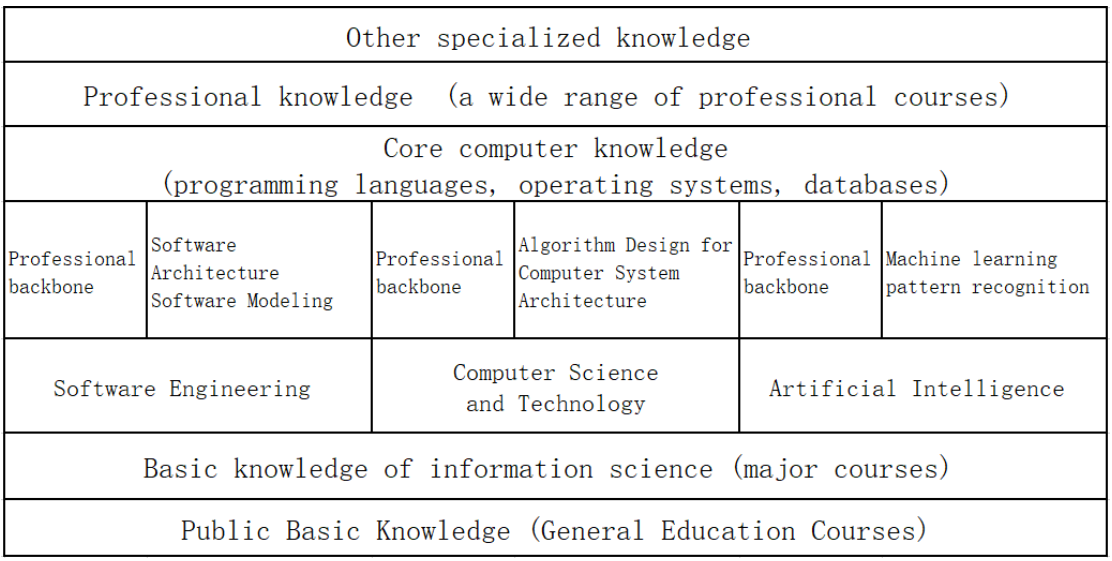

Fig 1. Curriculum System of Computer Science

2.1. Construction of Theoretical Courses on Non-Specialized Knowledge

Public basic knowledge primarily encompasses natural science knowledge such as mathematics and physics, as well as humanities knowledge, which are essential for computer science majors. Such courses are necessary for the cultivation of undergraduate talents and are not unique to computer science majors. Computer science majors have inherent needs and knowledge level requirements for mathematics courses and foreign language courses within the public basic knowledge. Mathematics is the essence of computer programs, while English is the display form of computer programs. Computer programs are the concrete manifestation of mathematical abstractions, and computer programming languages and software language habits are close to English. Therefore, how to determine the depth and breadth of mathematics courses, and how to resolve conflicts between the class hours of mathematics and English courses and other courses, are the main issues faced in public basic knowledge. Currently, the general requirements for computer mathematics courses are slightly lower than those for mathematics and mechanics majors in science, and the credit settings and requirements for English courses are relatively flexible. This curriculum setting basically meets the requirements of undergraduate education for talent cultivation, but considering the individual situations and different focuses of different universities, the settings of these two types of courses should be further improved. For example, some computer science technologies such as webpage creation do not require highly difficult mathematical knowledge. Undergraduates' own English proficiency has also greatly improved.

In the construction process of "New Engineering", regarding the overall theoretical knowledge system, our major adheres to the concept of simplifying theoretical courses. There are two aspects to simplifying theoretical courses. On one hand, the essence of theoretical courses should not be weakened but strengthened; on the other hand, some theoretical courses should be reduced in terms of class hours. In terms of specific implementation measures, the minimum class hours requirement should be set for essential courses, and more class hours should be allocated. For simplified courses, class hours can be reduced based on actual learning conditions through graded teaching methods or pass-style assessments. The pass-style assessment refers to a system where students who pass a recognized advanced exam automatically pass the lower-level exam for the same course. For example, if a student passes the College English Test Band 4, they will automatically pass the College English course assessment and receive corresponding credits.

The basic knowledge courses in information science encompass courses on basic programming languages and basic hardware knowledge, among others. These courses cultivate the knowledge necessary for information science. The basic courses in information science are divided into two categories: one is the basic courses in information science, which are the fundamental knowledge for all information-related majors. The other is the basic courses in computer science branches, which are closely related to computer science. In terms of the basic courses in computer science branches, most institutions focus on software-related courses.

Currently, due to time constraints, the curriculum for information-related basic knowledge courses is primarily focused on software-based fundamental courses within computer science branches. Furthermore, there is a trend towards reducing the proportion of hours allocated to information science foundation courses. In the construction of the "New Engineering" framework, regarding the overall theoretical knowledge system, our major adheres to the concept of simplifying theoretical courses. We emphasize the proportion of computer software-based fundamental courses. In terms of specific implementation measures, we strengthen courses related to our school's positioning and simplify those unrelated. Most institutions emphasize software-based fundamental courses and simplify hardware-based ones.

2.2. Theoretical Course Construction of Professional Knowledge

Public basic knowledge mainly refers to natural science knowledge such as mathematics and physics, as well as humanities knowledge required for computer majors. The computer major has inherent demands and knowledge level requirements for mathematics and foreign language courses in the public basic knowledge. Mathematics is the essence of computer programs, while English is the manifestation of computer programs. Computer programs are the embodiment of mathematical abstraction in reality, and the programming

language and software language habits of computers are close to English. Therefore, how to determine the depth and breadth of mathematics courses, and how to resolve conflicts between mathematics courses, English courses, and other courses in terms of class hours are the main issues faced in the public foundation? Currently, the credit setting and requirements for computer mathematics courses are fixed, while the credit setting and requirements for English courses are flexible. This course setting basically meets the requirements of undergraduate education for talent cultivation, but considering the individual situation and emphasis direction of different universities, the setting of these two types of courses can be improved according to the situation.

No matter how the application software supported by the platform develops, it cannot change the need for undergraduate students to understand the computer platform itself. Table 1 summarizes the core courses of computer science majors in six universities. The curriculum for computer science majors in various universities is similar, but there are three courses that are included in the main curriculum of all schools. They are high-level programming languages, operating systems, and database principles. The public attention in the field of computers has always been focused on software applications, while the theory of computers themselves has somewhat disappeared. However, why are these three fundamental theoretical courses commonly adopted as core courses by various universities?

Table 1. Main Courses in Computer Science

University	Main Core Courses
A university in Shandong	Introduction to Computer Systems, Fundamentals of Programming, Discrete Mathematics, Object-Oriented Programming, Fundamentals of Computer Hardware, Data Structures and Algorithms, Algorithm Design and Analysis, Principles of Computer Organization, Operating Systems, Microcomputer Principles and Applications, Principles of Database Systems, Principles of Compilation, Python Programming, Computer Networks, Software Engineering, IT Project Management.
A university in Guizhou	Advanced Language Programming, Object-Oriented Programming, Data Structures, Principles of Computer Organization, Operating Systems, Principles of Databases, Software Engineering, Computer Networks, Algorithm Design and Analysis, Computer System Architecture.
A university in Shaanxi	Introduction to Computer Science, Fundamentals of Computer Circuits, Computer Organization and System Structure, Discrete Mathematics, Data Structures, C Language Programming, Object-Oriented Programming, Operating Systems, Computer Networks, Database Systems, Microcomputer Interface Technology, Compilation Principles, Building Information Modeling and Applications.
A university in Hunan	Programming, Algorithms and Data Structures (I), Introduction to Software Engineering, Assembly Language, Algorithms and Data Structures (II), Principles and Techniques of Databases, Foundations of Artificial Intelligence(AI), Algorithms and Data Structures (III), Python Programming, Principles of Computer Organization, Discrete Structures, Java Programming, Operating Systems, Introduction to Information Science, Digital Circuit and Logic Design, Principles and Techniques of Compilation, Principles and Techniques of Computer Networks, Embedded Systems.
A university in Shanxi	Discrete Mathematics, Data Structures and Algorithms, Object-Oriented Programming, Principles of Computer Organization and System Structure, Principles and Applications of Databases, Operating Systems, Computer Networks, Algorithm Analysis and Design, Principles of Compilation, Software Engineering, Web Application System Development, Project Management, Python Programming, Introduction to AI, Mobile Internet Application Development, Cloud Computing, Principles and Applications of Big Data.
A university in Liaoning	Fundamentals of Programming (C Language), Data Structures, Operating Systems, Principles and Techniques of Databases, Linux System Programming, Distributed Architecture Technology, High-Performance Service Development Technology (C++), Computer Networks, Principles of Computer Organization, Introduction to AI, Software Engineering.
Key professional core courses	Data Structures, Operating Systems, Principles of Database Systems, Principles of Computer Organization, Circuits and Electronics, Digital Logic, Computer Networks, Advanced Language Programming, Software Engineering, Management Information Systems, etc.

Both the foundational knowledge and core knowledge of computer science courses cannot be overlooked, but they must follow a streamlined approach. In terms of knowledge about operating systems and databases, the position of operating systems in the computer system is crucial, as they are a complex collection of knowledge. The knowledge of operating systems cannot be comprehensively considered within limited teaching hours, so this knowledge should be simplified according to the talent cultivation positioning of one's own school. In terms of database knowledge, databases have undergone significant changes with the development of storage hardware and technological advancements, but the demand for computer data storage has never changed, and the requirements for data storage are becoming increasingly strong. Database courses should be refined and simplified in the way of essence basic theory simplifying outdated application technology.

3. Broaden Professional Directions

With the continuous development of the information revolution, profound changes have taken place in society. The Internet is the most prominent contact with the people. The supporting node of the Internet is computers, so there are many branches of computer science. Important branch directions include mobile Internet development direction, big data analysis direction, blockchain development direction, computer application direction, computer network direction, software development and embedded development direction, as well as the very hot AI direction. In the innovative construction of computer science, the emergence of new technologies means the emergence of new directions or innovation in existing directions. Due to the wide range of computer science majors, even if universities adopt elective courses to expand their professional directions, undergraduate education in computer science cannot cater to all directions. In addition, with the development of the times and the advancement of technology, new branch directions will emerge, existing branch directions will decline, and there will be changes in the research focus of branch directions. In terms of professional knowledge, this major adheres to the construction idea of expanding professional directions. Set up multi disciplinary knowledge courses in a guiding manner.

In terms of professional direction construction, a broad professional direction should be the idea of building a new engineering discipline in computer science. In order to enable students to keep up with the needs of the times, curriculum design can be based on the school's conditions and select several directions as the main focus of professional development. On the other hand, the curriculum can be continuously updated to provide courses that are more in line

with the needs.

Artificial intelligence(AI) direction among the many directions of computer science can be said to be the main direction of computer science. Since its birth, the ultimate goal has been to replace human labor with computers. The development process of computers is moving in this direction. The ups and downs of the development process of AI are a true reflection of the development of computers. Since the emergence of computers, the goal of AI has never disappeared, never been achieved, and never changed.

4. Emphasize Intersection of Other Professional Knowledge

The current state of computer development has clearly demonstrated the breadth and importance of computers in today's society. Moreover, in the information society, the collection, transmission, and processing of information all rely on computers. The Internet has solved the problem of the speed and scope of data transmission. But the raw data alone does not have a significant impact. Information is attached to data, and the processing of information is of utmost importance. With the development of informatization, computers will increasingly intersect with various industries. With the deepening of computer technology in the industry, the specialization of computer programs required by the industry will inevitably become higher, and the corresponding service programs in computers will also become more industry-specific.

The emphasis on cross disciplinary knowledge in computer science is the idea of building "Emerging Engineering" discipline in computer science. Industrialized programs and the industry specialization of programs mean that the knowledge contained in the program requires not only computer knowledge but also knowledge of the industry. In the process of informationization in the industry, three issues must be considered: firstly, how to convert the technical requirements of the industry into computer programs; Secondly, how industry knowledge is reflected in computer programs; Thirdly, how the system formed by the integration of computers into the industry operates and is maintained.

From the perspective of computer majors, computer knowledge needs to be integrated with knowledge from other industries. From the perspective of social development, all industries require a certain level of computer knowledge. In summary, the wider the development direction of computers, the closer the integration between computers and various professions. The more important the specialization level of other industry knowledge required for computer majors.

5. Conclusion

In the context of the construction of "Emerging Engineering" disciplines, the establishment of a knowledge system for computer majors mainly reflects the rationality of the curriculum arrangement. In the case of fixed undergraduate education hours, new knowledge will inevitably occupy the hours previously occupied by non essential knowledge. How to adapt the talent knowledge system to the development of the new situation should be considered from three aspects. Firstly, theoretical courses need to be simplified to determine the roots and backbone of the big tree of computer science. Secondly, the professional knowledge system should be broad, extending branches in all directions for this big tree. Finally, pay attention to cross disciplinary knowledge and ensure that every branch of this big tree is covered with green leaves. In a word, the computer professional knowledge system should be based on essence professional core knowledge, supplemented by professional expansion knowledge, and integrated and scientific construction in the way of multi guidance of cross knowledge.

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