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Discussion on the Curriculum System of Data Science and Big Data Technology Specialty Based on OBE Concept

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Abstract

The training of data science and big data technology talents has been highly valued by the state. Nearly 480 universities in China have opened data science and big data technology majors. The new engineering discipline puts forward new goals for the training of big data talents, which are to focus on core capabilities and increase industrial integration. Investigate the talent training programs of big data majors in the top universities in the United States and big data-related majors in China, including training objectives, curriculum settings, curriculum content, etc., analyze the problems existing in China's big data professional knowledge system and professional education at this stage, explore professional construction ideas in the construction and implementation of training objectives, curriculum system, training mode, and other aspects, and build reverse design big data professional talent training, decompose professional training objectives, set up executable graduation requirements and ability indicators, build a matching matrix between ability indicators and courses, and form an evaluation system for learning achievements in order to provide basis for teaching reform.

Keywords

OBE, Data Science and Big Data Technology, Course System

1. Research background

Big data has become an important strategic resource of the country. Its application is the trend of future development and an important driving force for industrial development. In fact, the value of big data is mainly reflected in the application of big data. Whether in the fields of education, commerce or government, more and more enterprises and institutions regard big data application as a key stage of development.

At present, China has a large talent gap in the field of big data. On the one hand, big data technology continues to develop and extend, becoming an efficient means of commercial and economic development, as well as an important technology for social development and industrial development; On the other hand, the supply and demand of the talent market is unbalanced, and the demand for high-end talents with big data management capabilities and data mining and analysis capabilities is very urgent, while the supply of talents is relatively scarce. To solve the education problems of big data specialty, the school needs forward-looking decisions, interdisciplinary and interdisciplinary talents' input, and then can establish the OBE mode talent training program with school characteristics (Hou Hongling et al., 2018). This paper takes "Data Science and Big Data Technology" as an example, hereinafter referred to as Big Data.

2. Training of big data professionals in sample American schools

The United States was the first country to put forward big data strategy. It was the first country to study big data

theory and promote the industrial application of big data. The United States has taken a series of positive actions and initiatives to establish its global leading position in the field of big data. At the same time, the leading teaching philosophy and methods of the big data specialty in the United States have promoted it to become a leader. This paper takes the data science and big data technology majors of 5 first-class American universities, including the School of Information Science and Technology of Washington University, the School of Information Science and Technology of Pennsylvania State University, the School of Information Science and Technology of Michigan University, the School of Information and Computer Science of University of California Irvine, and the School of Information and Computer Science of Purdue University in Indianapolis as samples, and analyzes them from the perspective of talent training objectives, curriculum systems, training contents, and training forms, It is expected to provide a basis for the teaching reform of data science and big data technology in China (Wan Yan, Deng Deng, & Gao Feng, 2016).

2.1 The survey results

2.1.1 Training objectives, Cultivate students' ability of data mining, analysis, storage and management

The major of big data at Washington University mainly focuses on data analysts, data architects, data engineers, business analysts, data scientists, quantitative analysts, etc.

2.1.2 Curriculum system

Multidisciplinary integration is the feature of big data specialty, and multidisciplinary joint training is also an important training method for big data specialty. Most of the curriculum systems involve mathematics, statistics, computer, database, natural language processing, information management and other courses, and are combined with the school's characteristic specialty, focusing on big data practice in advantageous professional fields; Most of the required courses or core courses of the major focus on data mining and data analysis; We attach great importance to the joint training of schools and enterprises. Through enterprise practice, we use professional comprehensive knowledge to solve the practical problems of industry and government, and emphasize the importance of practice. Most of the relevant courses offer professional practice projects, and the curriculum setting attaches great importance to practical training; As the world financial center, the United States attaches great importance to the application of big data in financial business (Lin Jian, 2017).

2.1.3 Training content

According to the talent training objectives, we will open relevant courses in mathematical statistics, computing science, data collection, data storage, data analysis, data visualization, domain courses and other disciplines, fill the gap between basic disciplines and big data, and lay a direct foundation for the application of big data in various industries.

2.1.4 Training form

The survey results of sample schools show that the training form of big data major is mainly graduate level education, accounting for about 70%; The training time of most of the sample schools is shorter than that of China, and most full-time majors spend one to two years; Full time study time and part-time study time are different for different colleges and universities. Generally, part-time study time is longer, which is about twice as long as full-time study time. Various teaching forms, including theoretical study, case study, team cooperation, practical training, etc., highlight the importance of team projects and improve students' application ability to solve practical problems.

2.2 Big data professional knowledge system

The big data specialty is an emerging specialty with multi-disciplinary intersection, which requires multi-disciplinary knowledge and puts forward high requirements for talent cultivation. The training model of sample schools is used for reference to analyze the basic knowledge system that big data practitioners need to master.

2.2.1 Fundamentals of Mathematics

Big data talents need to have big data collection, analysis, processing, application and other skills, mainly including mathematical statistics, data analysis, data cleaning, natural language processing and professional knowledge in related fields. Mathematics is the basic theoretical guarantee for big data analysis. Among them, advanced data and linear algebra are the necessary basic knowledge for college students. Probability theory, mathematical modeling and discrete mathematics are the basic courses for mathematics majors. Data statistics is the top priority of data analysis and an important thinking logic to realize data cleaning, classification, dimension reduction, smoothing, prediction and other functions. Optimization technology is widely used in engineering, artificial intelligence, finance, aerospace and other algorithms, and in genetic algorithms Neural network model, clustering analysis, ant colony algorithm and other fields

are widely used. The algorithm analysis will also involve the basics of topology, algebraic number theory, functional analysis, parallel computing, multivariate statistics, intelligent computing, etc (Zhao Chenyang, 2016).

2.2.2 Computer knowledge

From the perspective of the computer field, it covers basic theory, data management, data analysis, development language, data computing and other courses. Compulsory courses include operating system, database, program design, data structure, etc. Distributed database and distributed operating system are the basic platform for big data analysis. Data mining, data storage and retrieval, data collection and cleaning, algorithm analysis and design are highly specialized courses, and are also the core courses of big data specialty. Python and Java are mainstream data analysis languages and open source tools for data science. In addition to these core courses, the professional field of big data should also include cloud computing, machine learning, big data analytics, data analysis and visualization, exploratory data analysis, data product development, causal analysis, optimization based data analysis and other subdivision courses. After the professional compulsory courses, the practice link is particularly important. In practice, practical problems are solved through interdisciplinary knowledge.

2.2.3 Humanities courses

This kind of course mainly involves the moral, privacy, legal, economic and social impacts related to big data, and explains non-technical and engineering issues in big data research and practice. Such as data ethics and privacy, data traceability and reproduction, data management and long-term preservation, moral issues in large-scale collaboration, user experience and usability testing of big data, data communication and social impact.

2.2.4 Industry domain knowledge

Establish appropriate models and algorithms for data in different fields and different needs. Data analysis is inseparable from knowledge in relevant professional fields. From the perspective of engineering application, knowledge and courses in professional fields are required.

2.2.5 Comprehensive training

This kind of course focuses on cultivating students' practical ability, emphasizing that students solve practical problems in the industry through professional theories, methods, technologies and tools in the form of team work and based on real industry data.

3. Analysis of the current situation of data science and big data technology in sample universities in China

Analyze the training plan of domestic big data professionals, take mathematical statistics and computer science as the basic disciplines, and take management, biology, economics, environmental science, medicine, etc. as the expanding application disciplines, focusing on the core professional skills of big data acquisition, storage, analysis, application, management, etc. Based on the talent training program of big data specialty, the curriculum system of five sample schools is analyzed, and it is concluded that the training of big data specialty in China pays more attention to the training of application-oriented talents, including technology application and practice; The professional construction and curriculum system are not yet mature, and there are even misunderstandings.

3.1 Some schools generally attach importance to data analysis and mining

While the courses of data preprocessing, big data computing mode, big data visualization, data privacy and security, such as big data collection, storage, management, etc., are relatively weak. The weakness of big data acquisition and storage courses will lead to a weak data foundation in the big data system. The data foundation is the key to data analysis and application, and it is urgent to reform the curriculum system; Big data engineering must have supporting technical measures to form efficient development, application and service. Computing mode and big data visualization are not highly valued, which directly affect the application of big data; Data privacy and security courses include data encryption, data desensitization, ethics and regulations, not only including technical issues, but also including common sense such as laws and regulations to help students have a deeper understanding of big data privacy and security. The big data specialty is not purely a science and engineering discipline. The big data specialty curriculum design of some domestic universities should not overemphasize technical issues, but ignore humanistic management (Liu Guirong, Qin Chunrong, & Lin Yi, 2018). From the perspective of foreign professional training courses, it should involve moral, legal and value issues.

3.2 The combination of big data expertise and related disciplines in the industry is not deep enough

It can be seen from the elective courses of the sample schools that, except for many economic and financial elective courses, they do not provide students with courses in more fields or disciplines, lack the integration and depth between big data technology and an industry field, and the industry oriented big data talent training features are not obvious.

3.3 The comprehensive training link is not paid enough attention

Whether engineering and technical talents or research talents, big data majors should focus on project practice, competition and other industry-oriented engineering practices. They must rely on school enterprise cooperation projects and industry university research cooperation projects to carry out practical operations in the professional field, cultivate students' team spirit, and solve practical engineering problems. From the talent training programs of sample schools, the emphasis on comprehensive training links is not enough.

3.4 The training objective of big data specialty overemphasizes data correlation analysis

The big data major of the sample school focuses on data correlation analysis such as data analysis and mining, but lacks data cause and effect analysis. Cause and effect analysis courses are common in foreign big data majors, reflecting the diversity of data and the importance of cause and effect analysis.

3.5 The big data profession should not only focus on the management of data itself

Some sample schools' talent training programs for big data majors aim at training data workers, focusing on the management of data itself. However, big data majors should "manage based on data" rather than "manage data itself", and the training goal should be data analysts. The weakness of data computing and data visualization courses makes big data projects lack of relevant technical support.

3.6 Big data professional training objectives should not converge.

The training objectives of big data major in some domestic colleges and universities tend to be homogeneous. Based on the disciplinary and professional advantages of different schools, special courses should be offered. There are differences in talent training objectives and positioning.

4. Based on the OBE concept, build the big data professional curriculum system from the professional needs of students

4.1 Curriculum system reform based on students' professional needs

According to different school positioning, the training objectives of big data specialty are different. Application oriented universities should focus on the application and analysis of big data combined with the industry, cultivate the ability to analyze, model, design and implement algorithms for engineering problems, and meet the industry's needs for big data application analysis. Starting from the core business types of the industry and the career needs of students, the curriculum system of big data specialty should be analyzed. It should be based on computer technology and mathematical statistics, with data science and analysis mining as the core, and based on the characteristics and advantages of the school, it should be a cross discipline of applied and expanded disciplines.

4.1.1 Diversification of field related courses, highlighting the deep integration of big data and industry fields

The big data specialty is industry oriented. Through the elective course platform, it enriches the relevant courses in the field, enabling students to choose from a variety of low-level and high-level courses in each field, and meeting the wide range of industry needs of students; Secondly, through the elective course platform, it provides students with high-level courses in data science, and makes choices based on students' interests and their own characteristics to meet students' needs for in-depth learning in a certain field; Emphasize the combination of industry domain knowledge and data science, and improve students' ability to engage in data analysis in a certain field (Xu Anjian & Zou Yang, 2019).

4.1.2 Strengthen practice and highlight the construction of practice platform

Big data technology is very practical, and its data science and engineering literacy must be strengthened with the help of practice platforms. In hardware platform construction, you can rent Alibaba Cloud computing and Amazon cloud platforms to virtualize multiple or single machines into resource pools; In the construction of software platform, Hadoop big data software computing platform is used to solve storage and analysis. Through VMware virtual construction of server, cloud storage and network resources, based on Hadoop platform, students can understand the details of indus-

try based big data science and technology.

4.1.3 Strengthen comprehensive training and highlight the construction of school enterprise cooperation platform

The comprehensive training of big data specialty is a very important training method to achieve the teaching goal. Without a large number of industry and school enterprise cooperation platforms, the teaching effect of this specialty cannot reach the teaching goal. Through the development of enterprise training projects, based on the core elements of the industry, we will deepen the practical application of analytical language, the learning of mainstream frameworks, the form of data presentation, etc., meet the needs of society and the market, give play to the respective advantages of schools and enterprises, and jointly cultivate big data talents required by the market.

4.2 Reverse design of big data professional curriculum system based on OBE concept

4.2.1 Determine talent training objectives and graduation requirements according to the needs of regional economic development

Based on the OBE concept, according to the social needs and the career development of students five years after graduation, and in line with the principle of serving the regional economic development, the talent training objectives are established: to cultivate the ability to comprehensively use computer science to process large-scale datasets; Cultivate big data thinking and analysis ability based on industry characteristics; Cultivate the ability to integrate industry field with big data technology; Cultivate the ability to mine valuable information from complex data and obtain the relationship between data; Cultivate application-oriented talents with moral character, respect for data privacy, certain legal knowledge, based on normative technology and abstract methods, and facing specific problems in the industry for data collection, data analysis, data modeling and data management.

4.2.2 Reverse construction of curriculum system under the guidance of graduation requirements

Taking the actual needs of regional economy and students' needs as the starting point, the reverse construction of the curriculum system is formed, the talent training objectives and graduation requirements are determined, and then the curriculum system corresponding to the ability indicators is reverse constructed. On the one hand, based on the talent training objectives and graduation ability requirements, the core curriculum system of the major is set up in the principle of "wide caliber, thick foundation"; On the other hand, under the guidance of the overall trend of industrial development, talent training is implemented in different directions and multi-dimensional professional directions are set; Secondly, pay attention to comprehensive training, the integration of theoretical links and practical links, and improve the team cooperation ability and the ability to solve practical problems.

4.2.3 Translate competency requirements into curriculum objectives

Under the guidance of graduation requirements, a curriculum system should be established to support various ability indicators of graduation requirements. Each curriculum can support multiple different indicator points. Follow the OBE concept, take graduation requirements and ability requirements as the starting point, reverse design teaching objectives and teaching content, and achieve curriculum objectives through teaching implementation. Emphasize interdisciplinary methods, and integrate social economics, management, computer science, biology, statistics, law and other multi-disciplinary knowledge into the curriculum; Highlight the explanation of data science itself, and focus on the improvement of key skills based on data storage, data cleaning, data mining, data visualization and moral privacy; Emphasize project cooperation and enterprise practice, provide students with an enterprise data platform, and improve their ability to use a variety of tools and methods to solve practical problems.

4.2.4 Build a multi-dimensional curriculum evaluation system

The evaluation and feedback of the curriculum is the guarantee to promote the curriculum reform. Establish a result oriented and problem oriented backward force mechanism to sort out, implement reverse design, and take knowledge, ability and quality as the objective dimensions of the curriculum achievement evaluation. Build an assessment and evaluation system that pays equal attention to ability and knowledge, pay attention to the monitoring and feedback of students' developmental evaluation, establish a feedback mechanism based on industrial demand and discipline characteristics, rely on project practice, take innovation ability and comprehensive application ability as the main evaluation indicators, form a chain of links, and continuously improve the curriculum group and training objectives.

5. Conclusion

The construction of big data specialty for OBE is an emerging field. At present, the development of big data and big data specialty in China is at the initial stage, and talent training has a long way to go. The planning and development of

the profession should be based on the actual needs of the society. It needs to carry out top-level design, gradually refine and improve, increase the practice of enterprise cooperation projects, and cultivate big data professionals who combine theory with practice.

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