Exploration and Construction of Professional Curriculum System in the Field of Intelligent Manufacturing Based on Data Analysis

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Abstract. Intelligent manufacturing is an important means of developing strategic emerging industries and accelerating the formation of a modern industrial system. Currently, many universities are upgrading their related majors or offering new majors such as Intelligent Manufacturing Engineering to provide talent for the field of intelligent manufacturing. Due to the lack of integrated resources between industry and education in the field of intelligent manufacturing, it is difficult for universities to strengthen the correlation between the professional curriculum system and the industry when opening new majors or upgrading majors. With the integration of new generation information technology and manufacturing technology, the country plans to transform traditional enterprises into digital, information-based, and intelligent enterprises, and cultivate innovative, technical, and skilled talents that adapt to the development of intelligent manufacturing. It has become a new development strategy given to vocational colleges by the times. This article first obtains information on professional courses related to intelligent manufacturing and artificial intelligence offered in the region, and then uses Python data analysis technology to conduct statistical analysis on the collected professional courses. The analysis results provide reference and inspiration for universities to offer majors related to intelligent manufacturing.

Keywords: intelligent manufacturing, python, data analysis, professional courses system.

1. Introduction

Intelligent Manufacturing (IM) is a man-machine integrated intelligent system composed of intelligent machines and human experts. It can carry out intelligent activities in the manufacturing process, such as analysis, reasoning, judgment, conception, and decision-making. Through the cooperation between people and intelligent machines, we can expand, extend, and partially replace the mental work of human experts in the manufacturing process. It updates the concept of manufacturing automation, and extends it to flexibility, intelligence, and high integration. With the rise of a new round of scientific and technological revolution and industrial revolution, countries all over the world are faced with opportunities and challenges of industrial transformation and upgrading, and developed countries have introduced "re-industrialization" national strategies with advanced manufacturing as the core. Whether it is the "Industry 4.0" strategy of Germany, the industrial Internet of the United States, or the "New Robot Strategy" of Japan, the main purpose is to promote the intelligent transformation and upgrading of manufacturing industry [1-2].

Intelligent manufacturing technology is an internationally recognized new generation of industrial technology that realizes the transformation and upgrading of the industrial system, which can fundamentally improve the innovation capability and scientific research level of my country's complex products [3]. The "manufacturing" link includes important links and complex management systems such as product planning, concept, scheme, product design, trial production, mass production, delivery completion, and post-delivery operation, maintenance, and decision-making. Intelligent manufacturing is to endow intelligence on the basis of traditional manufacturing, and convert the tasks originally performed by humans to be performed by computers, so as to realize intelligent decision-

making, research and development, process design, batch production delivery, service operation and maintenance and complex management of industrial products. , showing the characteristics of decision-making model innovation, operation model innovation, production model innovation, business model innovation, and enabling technology innovation.

In March 2021, the Chinese Society of Mechanical Engineering issued the "Intelligent Manufacturing Talent Demand Forecast Report" (referred to as the "Report"). The report shows that it is expected that by 2025, the number of intelligent manufacturing talent gaps in China will be close to 3.9 million, of which the number of engineering and technical personnel gaps will be close to 1 million. Therefore, how to cultivate more talents in the field of intelligent manufacturing has become a hot topic of concern for many institutions. In 2021, the Ministry of Education conducted a comprehensive revision of the professional directory for vocational education, including the establishment of the Intelligent Manufacturing Engineering Technology major in in-service undergraduate education, and the establishment of related majors such as Intelligent Manufacturing Equipment Technology and Intelligent Equipment Operation and Maintenance in higher vocational and secondary vocational education. Along with the establishment of new majors, the Ministry of Education also further strengthens the optimization of intelligent manufacturing related majors, providing a continuous stream of talents for the intelligent manufacturing industry through these measures.

At present, more than 200 colleges and universities in China have offered intelligent manufacturing engineering courses, while many other colleges and universities have improved and upgraded their intelligent manufacturing-related courses [4]. There are many professional courses in the field of intelligent manufacturing, and this paper adopts data analysis technology to make statistics on the courses of intelligent manufacturing-related majors, analyze the opening of professional courses in the field of intelligent manufacturing, the names and numbers of core courses, and the differences in the content of similar or similar courses, so as to provide reference and reference for the curriculum of newly opened majors in intelligent manufacturing and improve the quality of intelligent manufacturing talents training.

2. Data analysis technology

2.1. Introduction to data analysis

Data, also known as observations, is the result of experiments, measurements, observations, investigations, etc. The data processed in data analysis is divided into qualitative data and quantitative data. Data that can only be classified into a certain category but can't be measured by numerical value is called qualitative data. Qualitative data shows categories, but does not distinguish the order, it is classified data, such as gender, brand, etc. Qualitative data shows the category, but what distinguishes the order is the sequential data, such as educational background, quality grade of goods, etc.

The purpose of data analysis is to concentrate and extract the information hidden in many seemingly chaotic data, to find out the internal law of the object under study. In practical application, data analysis can help people make judgments to take appropriate actions. Data analysis is the process of collecting and analyzing data in an organized and purposeful way, so that it becomes information.

2.2. Data analysis process

The data analysis process is mainly divided into six links, including clear analysis purpose, data procurement, data processing, data analysis, data visualization, summary, and suggestions, as shown in “Fig. 1”

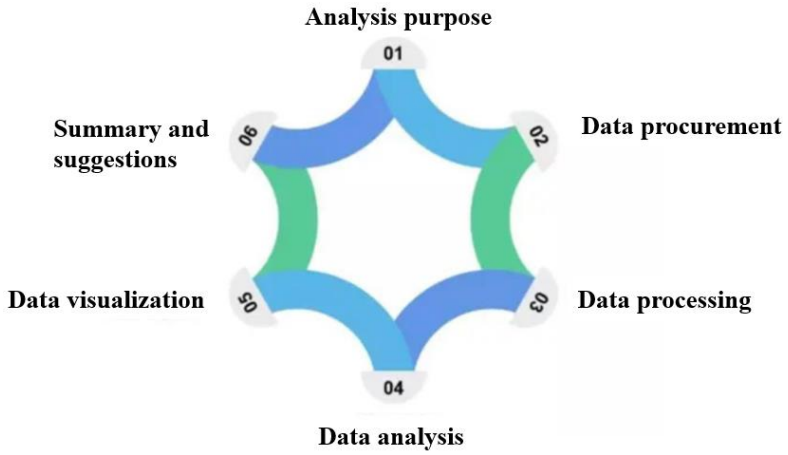

Figure 1. Data analysis process

(1) Analysis purpose. Before data analysis, you need to combine your own business to determine what the goal of data analysis is, split the indicators, and find out the smallest unit that can collect data. Doing so can conduct targeted data analysis, and avoid excessive data collection and waste of useless data.

(2) Data procurement. When the target is determined, it is necessary to collect targeted data. The collected data here includes the whole life cycle data of users collected through buried sites, as well as the data collected online.

(3) Data processing. After collecting the data, it is necessary to sort out the data, especially there are many ways to collect the data, such as buried collection, online collection, manual sorting, etc. Sometimes there will be duplication and confusion, so it is necessary to sort out the data to improve the accuracy of the data as much as possible.

(4) Data analysis. In the process of data analysis, we should combine our own products and choose an appropriate data analysis model. If necessary, we need to define our own analysis model and use it flexibly.

(5) Data visualization. Data analysis results need to be presented visually, usually in the form of charts.

(6) Summary and suggestions. According to the conclusion, the corresponding improvement suggestions are put forward, and the suggestions are pushed to the ground to complete a complete data analysis closed loop.

2.3. Python data analysis core library

Commonly used libraries for Python data analysis include Numpy [5], Pandas [6], Matplotlib [7], SciPy [8] and Scikit-learn [9]. The functions of each library are as follows.

(1) Numpy. NumPy is one of the most basic and powerful numerical calculation libraries in Python. Its main function is to provide high-performance multi-dimensional array objects and a wide range of mathematical functions, enabling efficient performance of various numerical computing tasks when processing large-scale data sets. The core of NumPy is numpy. ndarray, which is an N-dimensional array that supports various mathematical operations, including linear algebra, Fourier transform, etc. NumPy's array operations are much faster than Python's built-in lists, making it the cornerstone of scientific computing, data analysis, and machine learning. Through NumPy, users can perform vectorization operations to improve code running efficiency, and it is the basis for many other data analysis libraries.

Numpy core functions include numpy. array, numpy. zeros, numpy. ones and numpy. random. rand, etc.

(2) Pandas. Pandas is a data analysis library built on NumPy, providing two main data structures: Series and Data Frame. Series is a one-dimensional labeled array, like NumPy's one-dimensional arrays, but with labels and can be indexed by labels. Data Frame is a two-dimensional table that can

be regarded as a container for Series, providing flexible data operation and processing tools. The functions of Pandas cover all aspects of data cleaning, reshaping, merging, slicing, indexing, etc., allowing users to easily process and analyze complex structured data. This makes Pandas one of the preferred tools for data scientists and analysts.

Pandas core functions include pandas. Series, pandas. Data Frame, Data Frame. groupby, etc.

(3) Matplotlib. Matplotlib is one of the most popular plotting libraries in Python, used to generate high-quality two-dimensional charts, including line charts, scatter plots, bar charts, etc. The design of Matplotlib is inspired by MATLAB. It has high flexibility and users can customize the appearance of graphics by adjusting various parameters. The functions of Matplotlib are not limited to static graphics, but can also generate animations, interactive graphics, etc. As an important tool for data visualization, Matplotlib provides data scientists with an intuitive and clear display method to help them better understand data and share analysis results.

Matplotlib core functions include matplotlib. pyplot. plo, matplotlib. pyplot. scatter, matplotlib. pyplot. hist, etc.

(4) SciPy. SciPy is a scientific computing library built on NumPy, providing many advanced mathematical, scientific, and engineering computing functions. It contains many modules for optimization, numerical integration, linear algebra, statistics, signal processing and other fields. The advantage of SciPy is that it provides many efficient algorithms and tools, allowing users to easily solve complex problems in various scientific and engineering fields. For example, you can use SciPy for optimization, equation solving, signal filtering, image processing, etc. At the same time, SciPy is also well integrated with other scientific computing libraries (such as Matplotlib), allowing users to easily work in different fields and efficiently process large-scale data.

SciPy itself does not directly contain core functions related to data analysis. However, SciPy is often used in conjunction with NumPy, Pandas, and other data analysis modules to provide more comprehensive data science tools.

(5) Scikit-learn. Scikit-learn is a Python library for machine learning, data mining and data analysis. It is built on NumPy, SciPy and Matplotlib and provides simple and efficient tools for data mining and data analysis. Scikit-learn contains various machine learning algorithms, including classification, regression, clustering, dimensionality reduction, etc., and provides functions such as data preprocessing, feature engineering, and model evaluation. It's simple API design and rich documentation enable users to get started quickly and easily conduct model training, evaluation, and deployment. Scikit-learn is not only suitable for machine learning experts, but also provides a good learning platform for novices, making machine learning technology more widely used in solving practical problems.

The core functions of Scikit-learn include KMeans, StandardScaler, SVC and Decision Tree Classifier, etc.

3. Analysis of courses related to intelligent manufacturing evaluation

3.1. Experimental environment

The hardware platform used in this experiment is Huawei MateBook 13, configured as CPU: Intel(R) Core (TM) i5-8265U, 4 cores, clocked at 1.6GHz, graphics card: Nvidia GeForce MX1502, video memory 2GB, memory 8GB, operating system: Windows 10 (64-bit). The software platform uses Python3.7, Numpy1.21.0, Pandas1.3.3, Matplotlib3.4.3, SciPy1.7.3 and Scikit-learn0.24.2.

3.2. Data Sources

To make the data obtained more targeted, under the guidance of experts from enterprises and universities, crawler technology was used to crawl the websites of universities in developed areas to search for core courses in intelligent manufacturing-related majors to form the data set for the data analysis experiment of this article. The data set contains There are 3550 professional course information. Part of the professional and course information are shown in "Fig. 2".

Artificial data set processing, distributed computing and storage technology, machine learning, deep learning, intelligent perception and understanding, natural language processing, product marketing and service, etc. Practice in the application of artificial intelligence development framework, data set making, natural language processing, speech and image recognition, etc.

Figure 2. Professional course information

3.3. Analysis of professional courses

Based on the functions of Numpy, Pandas, SciPy and scikit-learn, the program of data analysis is written in Python, and finally displayed visually in Matplotlib. The analysis results of courses of intelligent manufacturing specialty are shown in Table 1 and "Fig. 3".

Table 1. Top Ten Course Name Keywords

Course name
python, mechanical drawing, motor and electricity, robot, machine vision, Linux, control system, robot operating system, single chip microcomputer, sensor

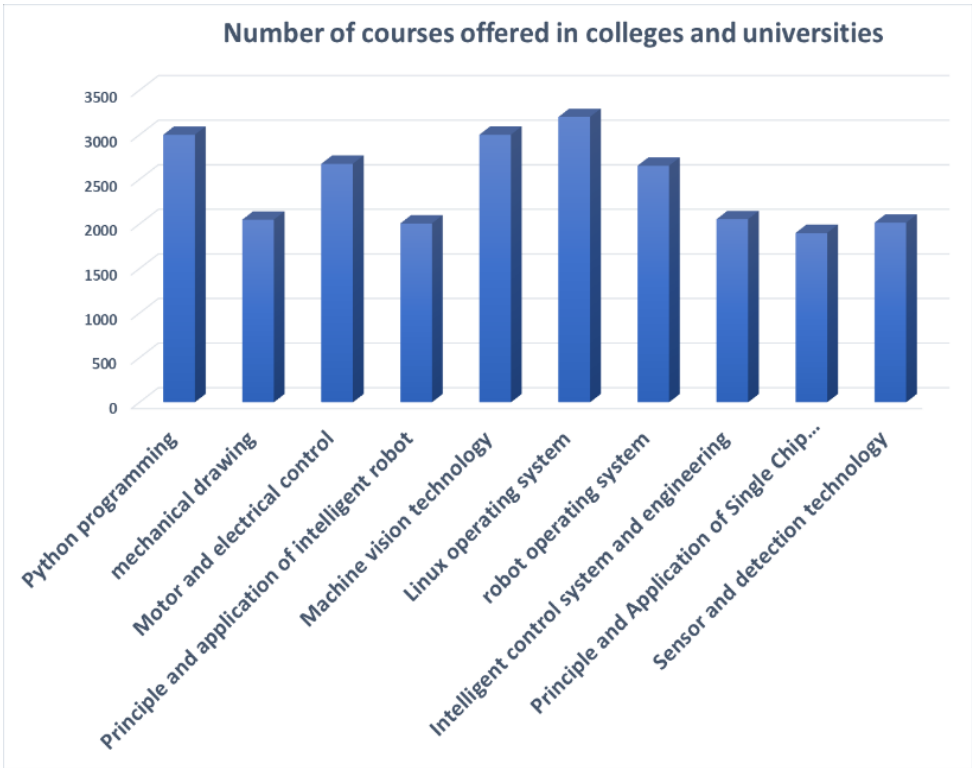

Figure 3. Number of universities offering top ten professional courses

As can be seen from Figure 3, the top ten professional courses include 10 keywords such as Python, Mechanical Drawing, Motor and Electric, Robot, Machine Vision, etc., which shows that intelligent manufacturing presents a multi-disciplinary comprehensive development trend, especially intelligent robot, and visual perception.

4. Reflection and experience

The research on professional curriculum system is a continuous exploration process, and a curriculum analysis, assessment and evaluation system based on data analysis is conducive to the

construction of the intelligent manufacturing professional curriculum system. In the process of exploration and implementation, there are two experiences.

1) Periodic data analysis can timely understand the alignment between the construction of professional curriculum system and the current situation of talent cultivation, as well as the demand for intelligent manufacturing talents in enterprises. Schools and teachers can continuously optimize the curriculum system by providing stage data.

2) At present, the curriculum system for cultivating intelligent manufacturing talents in China lacks industry guidance and support, and the cooperation between schools, enterprises, research institutions, etc. is poor. This is the main problem facing talent cultivation in schools. At present, many universities in our country lack research or application experience in intelligent manufacturing, and even some universities have a relatively vague concept of intelligent manufacturing, especially some applied undergraduate and vocational education colleges with weak foundations. Their professional construction ideas are still consistent with traditional specialties, resulting in a relatively single training goal for the final professional curriculum system, which cannot well adapt to the needs of different types of engineering talents in the industry. [10] The lack of quantitative basis in the evaluation of professional curriculum system is not conducive to a reasonable evaluation of the connection between professional curriculum system and actual industry demand, which will be detrimental to the construction of a better professional curriculum system in the field of intelligent manufacturing.

5. Conclusion

In this paper, Python, Numpy, Pandas, Matplotlib and other data analysis technologies are used to study the curriculum system of intelligent manufacturing-related majors, and the top ten professional curriculum names and keyword information of intelligent manufacturing-related majors are obtained. It is concluded that intelligent manufacturing is the core development trend of intelligent robots and vision, which can provide reference for universities to set up intelligent manufacturing-related majors.

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