

Project Report

Intelligent Job Analysis And Recommendation System

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目录

EXECUTIVE SUMMARY.....	2
1 INTRODUCTION	3
1.1 PROBLEM DESCRIPTION	3
1.2 PROJECT OBJECTIVE.....	4
2 PROJECT MODELING.....	6
2.1 KNOWLEDGE ACQUISITION.....	6
2.2 Dataset Preprocessing	8
2.3 Dataset Analysis (Classification Basis).....	8
3 Knowledge representation (screening process).....	11
3.1 Rule visualization.....	11
3.2 system output	11
4 System Architecture and Design.....	13
4.1 system structure.....	13
4.2 Front-end design	14
4.3 Backend Design	16
Figure A reasoning example of backend	19
4.4 Project use case	21
5 SYSTEM EVALUATION	26
5.1 SYSTEM'S FEATURES	26
5.2 LIMITATIONS.....	27
6 CONCLUSION & IMPROVEMENTS	28
7 REFERENCES.....	29
8 appendix	30
APPENDIX A: PROJECT PROPOSAL.....	30
APPENDIX B: three aspects about reasoning system.....	33
APPENDIX C: Installation and User Guide	33
1.2.1 Run backend.....	34
1.2.2 Open Jobviser.....	34
APPENDIX D: INDIVIDUAL contributION	42
APPENDIX E: INDIVIDUAL REPORT	43
WANG MINQI	43
1) Contributions to Project	43
2) What learnt is most useful for you	43
LIANG ZIJIAN.....	43
1) Contributions to Project	43
2) What you have learnt from the project.....	43
Li Qinyuan	44
1) Contributions to Project	44
2) What learnt is most useful for you	44

EXECUTIVE SUMMARY

Work is a major factor affecting people's happiness index. In the World Happiness Report 2017, the United Nations specifically observes the influence of occupational status on happiness from the work dimension in Chapter 6. According to the data of Gallup World Poll 2014-2016, countries and regions with higher unemployment rate have lower public happiness index. Today's job seekers face two common dilemmas. Firstly, under the influence of the COVID-19, the great depression and the high unemployment rate, enterprises have greatly reduced the number of recruitment and raised recruiting standards. For job seekers, the sharp deterioration of the external employment environment has caused job seekers great pressure. The second problem is the self-perception of job seekers. There are quite a lot of job seekers who have biases in their self-awareness. For young graduates, they do not know what type of work their current personal abilities can match, and what type of work their personal characteristics are suitable for, so they are often confused about future career planning; For example, they are often troubled by the problem that the work they are engaged in is not suitable for their personality, so they are often deeply troubled by work anxiety, but they do not know how to break the current deadlock.

To solve the above problems, we have designed a career guidance and analysis system. The system realizes the evaluation of job seekers' personal hard strength and personality characteristics. Therefore, our system can not only provide job seekers with suitable job types according to their own abilities, but also according to users' personal wishes and needs, choose their ideal career type for job seekers. What's more, the system will analyze the differences between the user's suitable occupation and the user's ideal occupation, and provide the user with corresponding employment guidance suggestions. One of the features of our system is the introduction of a personality test section, which can better mine the user's own characteristics, help users match more suitable jobs, and make more targeted and personalized career recommendations for users. This function of the system will help job seekers to deepen their understanding of themselves, have a more adequate plan for their career and improve their success rate in finding a job. The new employment ideas provided by the system provide users with a variety of employment options, and they no longer need to be bound by single experience and narrow cognition.

1 INTRODUCTION

In this part, we will describe the background and reasons of our recommendation system in more detail. The business value of our project and the project goals will be described in detail later.

1.1 PROBLEM DESCRIPTION

a) Pressure from the external employment environment:

In the context of the COVID-19, the employment situation around the world is not optimistic. For example, according to the U.S. Bureau of Labor Statistics, the U.S. unemployment rate was as high as 8.9% in 2020^[1]. In China, the situation is also not optimistic. According to the survey data of Zhi Lian Hiring, 15% of white-collar workers experienced a reduction in recruitment during the epidemic, and 12% of white-collar workers had the experience of being canceled by a company. At the same time, 8.7 million fresh graduates poured into the talent market, the number reaching an all-time high. Under the pressure of the economic downturn, companies generally reduce the number of recruits, and the two factors in the job market have jointly pushed up the recruitment threshold. Survey data shows that during the epidemic, 57.7% of companies raised their talent recruitment standards^[2]. Therefore, under the high-intensity competition, it is particularly important for job seekers to quickly find their own career positioning and improve their competitiveness.

b) Job seekers' self-perception problems:

In addition to the external reason of the severe employment situation, for the vast number of job seekers, there is a very significant problem that currently exists in a number of job seekers, that is, a considerable number of job seekers have serious cognition of their personal abilities. There is no clear understanding of what kind of work is suitable for one's work ability, what type of work is not suitable for, and what type of work is suitable for personal characteristics, so I feel very confused about future career planning.

For young graduates and newcomers who have just worked for a few years, it is difficult to distinguish between the jobs that they are capable of at present, the jobs that are suitable for their development in the future, and their ideal jobs. Therefore, when these people look for jobs, there is often a mismatch between their abilities and needs, which in turn leads to finding a job or finding a job and wanting to change jobs after a long time. For recruiting companies, they also hope that the job seekers they recruit will meet the recruitment standards with their academic and work experience and professional orientation, and their work ability can meet the rigid requirements of the job position. According to the report of Zhaopin.com, 75.6% of companies put forward requirements for work experience and project experience, and 44.4% of companies put forward requirements for the practicality of employee skills. Therefore,

in the process of applying for jobs, job seekers need to know what kind of jobs they are capable of, and need to know the gap between themselves and their ideal jobs.

For many people who have worked for many years, there is a more common problem that plagues them. According to the report of the relevant agency, in the sample survey of working people, more than 40% of the workers said that they have serious anxiety because of work reasons, and in the answers to the reasons for anxiety, more than 30% of the people said that they are now. The work you do does not suit your character. Therefore, the degree of fit between personality and work is now more and more important to enterprises. According to the Zhaopin Recruitment report, 22.2% of enterprises have made requirements on the personality of job applicants. What's more, the reason why a considerable number of applicants fail to apply for employment and the reason for the unemployment of the unemployed is not that the hard conditions such as academic qualifications and technical ability do not meet the requirements of the enterprise, but that the soft power such as personality, pressure resistance, and language ability are not good. In line with the company's requirements for related jobs, it is impossible to successfully obtain a new job. Therefore, how job seekers know what kind of jobs their personality and other personal characteristics are suitable for is also crucial.

Therefore, a system that can provide suitable career recommendations for job seekers is quite important. Most of the existing job-seeking recommendation systems focus on the content analysis of resumes and job descriptions, and are biased towards the hard matching of job-seekers' technical conditions, while our system adds a personality test and other parts to consider job-seekers' soft power factors, in order to better match users with more suitable jobs based on their own personality traits, and make more targeted and personalized career recommendations for users. More details will be explained in the next section.

1.2 PROJECT OBJECTIVE

The main purpose of this project is that we hope to provide new employment ideas and broaden the range of career choices for those who are in difficulty in career planning by giving reasonable advice and planning. We plan to make an offline career guidance and analysis system. One of the highlights of the system is the introduction of personality test as the basis for evaluating job seekers' personal personality traits, and to evaluate the user's soft power, so as to help solve those problems that are not suitable for the original position due to personality traits. The system will give users two different types of job recommendations, one is the job that meets the user's personal abilities and needs, and is most suitable for the current user's job search status, and the other is the job that combines the user's personality factors and is most suitable for the user's future development. Finally, the system will give an analysis result of the user based on the previous evaluation results of the job seeker, referring to the job seeker's personal ability and personal characteristics. The system can also analyze the differences between the two types of work, give users future work plans, make

appropriate suggestions, broaden users' new ideas, and expand users' choices. This system will help job seekers to deepen their understanding of themselves, give full play to their own advantages, avoid their own shortcomings, and greatly improve the success rate of users in finding suitable jobs.

2 PROJECT MODELING

2.1 KNOWLEDGE ACQUISITION

Our information consists of two parts, a dataset containing occupational information and the Myers-Briggs Type Indicator (MBTI) used to describe personality. As shown in the table 3.1 below, we obtained these two aspects of knowledge in a variety of ways, including screening and downloading the datasets that best meet the project needs from the dataset website, obtaining MBTI dimension analysis and occupational personality theory from academic journals, and obtaining sample questions of the occupational personality questionnaire from two of the most commonly used MBTI test sites for reference.

Table 3.1 Knowledge sources and acquisition techniques

Source of information	Knowledge acquisition technique	Insights from information source
kaggle	Download	Get original job dataset
Academic journals	Google and PubMed search	Obtain the subject classification and code table Obtain MBTI assessment dimension analysis Obtain the MBTI Occupational personality theory
16Personalities ^[3]	Record the test questions manually	Obtain the MBTI occupational personality test questions
JUNJUS ^[4]	Record the test questions manually	Obtain the MBTI occupational personality test questions

2.1.1 OCCUPATIONAL INFORMATION DATASET

Our dataset of career information comes from Kaggle. The dataset was created by scraping job listings posted on the CareerBuilder website in 2020. CareerBuilder is

the largest recruitment website operator in North America with more than 2,000 partners spanning 5 continents, providing the largest and most diverse job listings for talent in 55 countries. It is also one of the longest running job search websites with more than 20 years of history. There are more than 1.6 million job openings on the website, and many jobs are posted directly from employer websites or jobs offered directly by businesses. Thus, our dataset has a very wide variety of job types in multiple countries. The data set provides information such as job location, type, industry, company profile, and required experience of the job. The part of dataset analysis will be expanded in Section 3.2.

2.1.2 MYERS-BRIGGS TYPE INDICATOR

The Myers–Briggs Type Indicator (MBTI)^[5] was developed by American author Isabel Briggs Myers and her mother Katherine Cook Briggs A theoretical model of personality types. The indicator is based on the 8 mental types classified by Swiss psychologist Carl Jung, thus putting Jung's theory of mental types into practice, compiled after more than two decades of research into Myers-Briggs Type Indicator. On the basis of Jung's concepts of superior function and inferior function, dominant function and subordinate function, Miles further proposed concepts such as functional hierarchy, and effectively determined the order of functional hierarchy for each type, and proposed Types of lifelong development theories that form four dimensions. As shown in the figure3.1.2 below, they are the energy, information, decision and execution. Sixteen different personalities are formed by the arrangement and combination of eight letters in four dimensions.

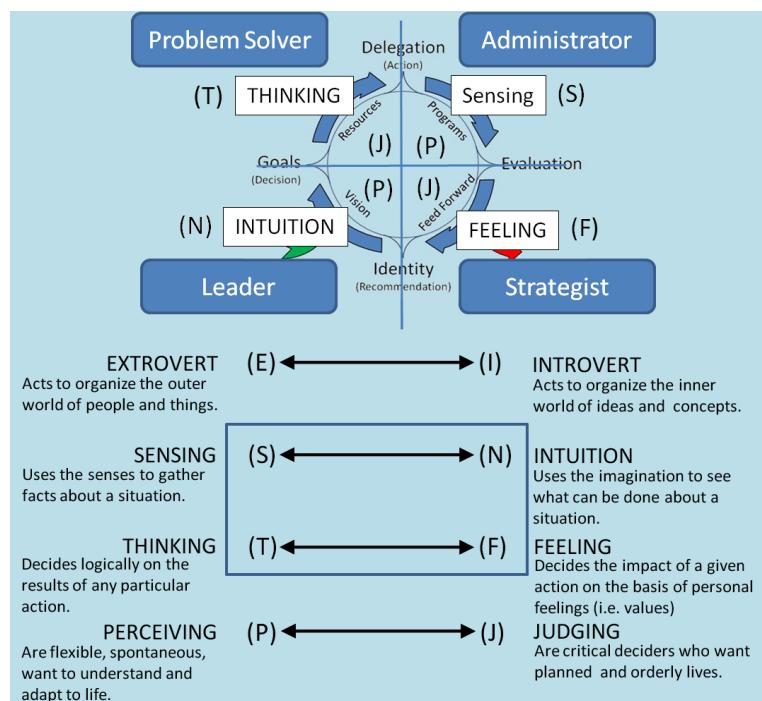


Figure 3.1.2 Myers–Briggs Type Indicator

Since the Myers-Briggs Type Indicator is a very complex assessment system, it is obviously unrealistic to put the official MBTI occupational personality test questions into our project. However, because the professional personality test questions used in most career interviews are not the official standard version, but a new standard based on the analysis of Jung's psychological type theory and company characteristics. Therefore, we will also refer to this theory in our project and summarize the evaluation criteria of personality types with a certain originality.

2.2 DATASET PREPROCESSING

On the one hand, after observing the original data set, we found that some of the work has a special nature. For example, there are strict age restrictions, mainly for learning and training programs for minors under the age of 18. Or the authenticity is difficult to verify. Some jobs provide an abnormal salary range, which is several times higher than the same type of occupation of other companies. According to our project positioning, we choose to exclude data from the dataset that are only provided to special groups or have certain fraudulent suspicions to ensure the applicability of our dataset. On the other hand, our original data set contains a number of information that is less relevant to job hunting, including whether the company has a logo, and whether there is a channel for feedback to the recruiting company, etc. In order to simplify data processing, we also remove these labels.

2.3 DATASET ANALYSIS (CLASSIFICATION BASIS)

The original dataset contains 17,880 occupational data and describes the occupational information in multiple features. From the table below, we can see that there are many features that contain data of more than 5 categories, and some even have thousands of categories. This gives the dataset a broader occupational coverage, but also makes it difficult to reason directly from the raw data. On the one hand, too many categories will make the structure of the reasoning system too complicated; on the other hand, too many options will also reduce the user experience in the interactive interface. So, we classified the dataset according to the characteristics of each feature. We mainly focus on the features with the most two categories: work location and work direction (industry). For the former, we extract country information and classify it into five categories according to the geographical location and development level of the country in which the country is located. The latter refers to the People's Republic of China's subject classification and code summary table, and links the work direction to the relevant majors. Finally, as shown in the figure3.3-1 below, we reclassify all features, which greatly simplifies the content of the dataset.

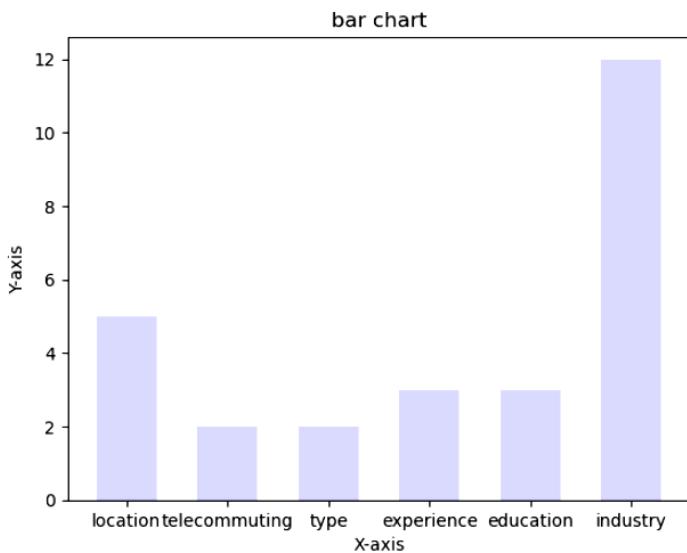


Figure 3.3-1 Bar graph of the number of categories per feature after processing

After that, we use k-means^[6] clustering method to cluster the data set, and analyze the work type of the data set according to the three dimensions of work style, required education, and required work experience.

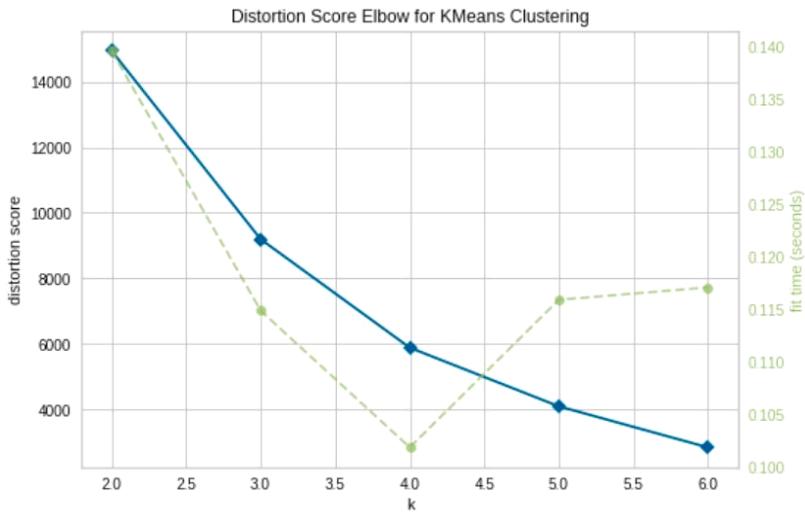


Figure 3.3-2 Distortion score of Elbow method for k-means clustering

According to the Elbow^[7] method in figure3.3-2, it is a better choice to aggregate occupational data into four categories. For the first cluster, most of the jobs are part-time, which have almost no requirements for academic qualifications and work experience. They belong to low-level jobs with lower thresholds. For the second cluster, most of the jobs are full-time, which do not require high work experience, but need higher academic qualifications. They are primary jobs provided for college graduates. The job types of the third cluster are almost all full-time, with high requirements for work experience and almost no requirements for academic qualifications. They belong to advanced jobs for skilled technicians. And for the fourth cluster, nearly all of the job

types are full-time, with higher requirements for work experience and academic qualifications. They are senior jobs for senior executives in the industry, as shown in the figure3.3-3.

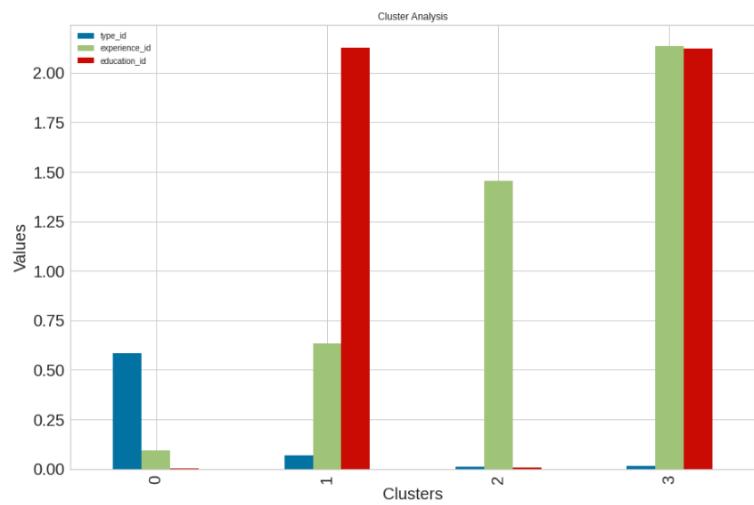


Figure 3.3-3 Job distribution according to clustering

Referring to the data volume of the four clusters, as shown in the table3.3-1, we can also find that the number of the last three types of jobs in the dataset is relatively average, and the number of low-level jobs is higher due to the lower threshold and wider coverage. As a result, our data set already has a high use value.

Cluster	0	1	2	3
type_id	0.58	0.07	0.01	0.02
experience_id	0.09	0.63	1.45	2.13
education_id	0.00	2.13	0.01	2.12
Count	7194.00	3434.00	4102.00	2634.00

Table 3.3-1 Data volume of the four job clusters

3 KNOWLEDGE REPRESENTATION (SCREENING PROCESS)

3.1 RULE VISUALIZATION

Based on the type, location, telecommuting, and industry restrictions required by the user, the system can get the most suitable work in the current work field of the user by intelligent reasoning. Based on the user's personality, education and work experience, the system can get the job that can make the user have better experience in the working place. And in order to make this recommendation more meaningful, the system also conducts a secondary reasoning of the processed job based on the type, location, and telecommuting. And compared and analyzed the two career results inferred to show our recommendation reasons. As shown in the figure 4.1, the intelligent reasoning system of this project is built on the basis of this knowledge system.

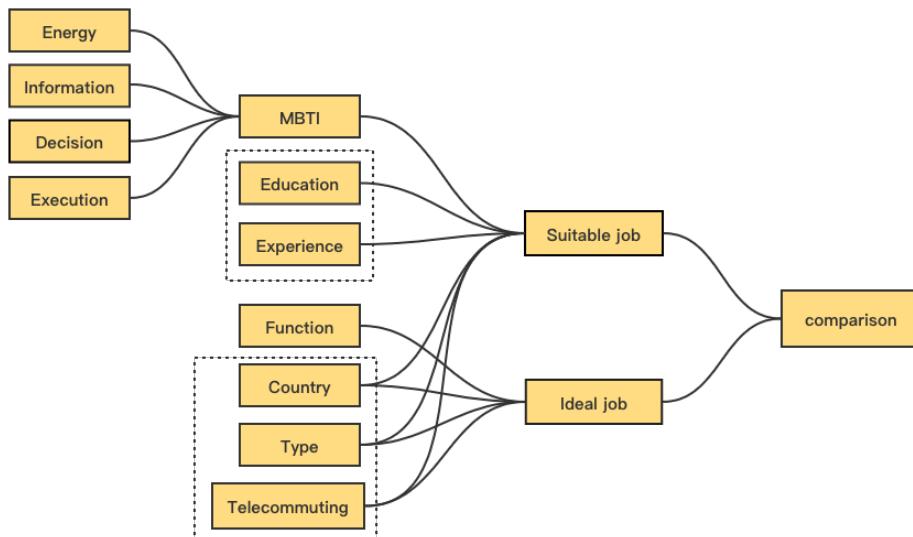


Figure 4.1 Dependency diagram for reasoning system

3.2 SYSTEM OUTPUT

Our system will generate two career recommendation plans, one for the ideal job and one for the suitable job, to provide job inspiration to the user in a way that matches the user's ability and needs as much as possible. In particular, the ideal job is a recommendation based on the user's ability and requirements, which matches the user's current field; while the suitable job is a recommendation based on the analysis of the user's personality characteristics, combining the user's job requirements. This job is a great fit with the user's personality, the user would feel more comfortable if engaged in this direction. The suitable job recommendation is to give the user inspiration about the relevant employment, making the user think about their endless possibilities.

Meanwhile, we give the character analysis of the people who are suitable for these two different jobs to give users more inspiration. By recognizing the different qualities of these two professions, users can better understand their personalities and ways of doing things. Besides, we also understand that from many factors, users cannot abandon their professions and only talk about personality matching to find a job. Therefore, through the two personality analyses, we hope that users can strengthen themselves in the following development to better adapt to the work they are doing.

The output of our project is shown below as Figure 4.2.

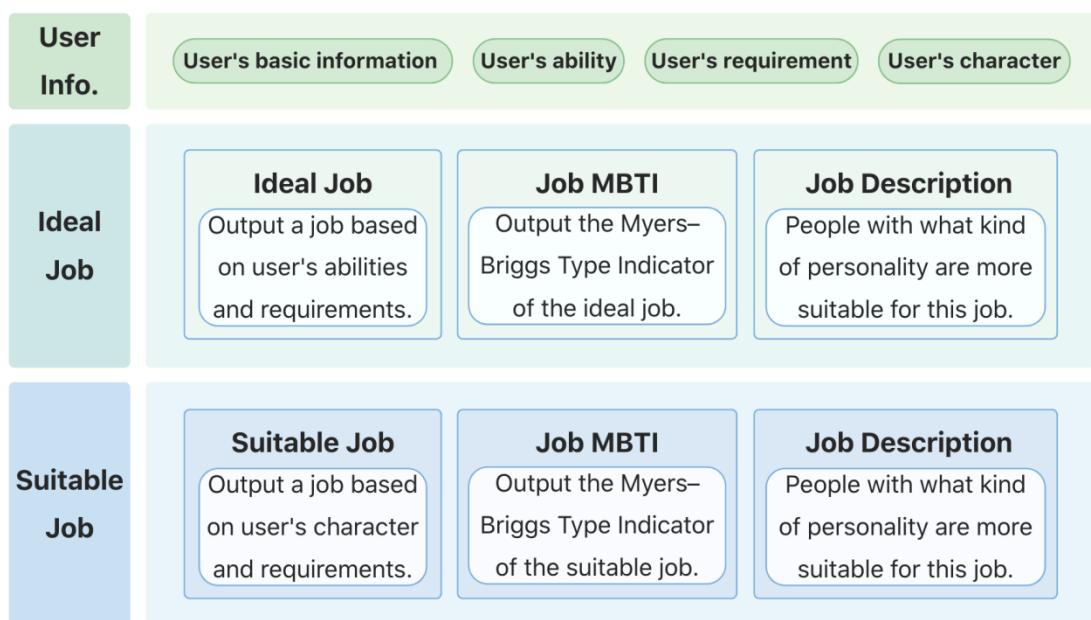


Figure 4.2 Output of the

4 SYSTEM ARCHITECTURE AND DESIGN

4.1 SYSTEM STRUCTURE

Our system consists of two main parts: the frontend and the backend. The frontend webpage is developed using the Vue framework, the backend reasoning system is developed using Python, and the Flask framework is used to connect the frontend and backend to realize a complete system with the separation of front and backend. The whole system architecture of this system is shown in Figure 5.1-1.

When the user enters the reasoning system from the main page, they can fill in their personal basic information through the questionnaire page and then click the submit button to pass parameters through Flask's GET and POST requests. The information obtained from the frontend is packaged and sent to the backend reasoning system to get complete career recommendation information, and then the information generated by the backend is passed back to the frontend output page, parsed and presented to the user.

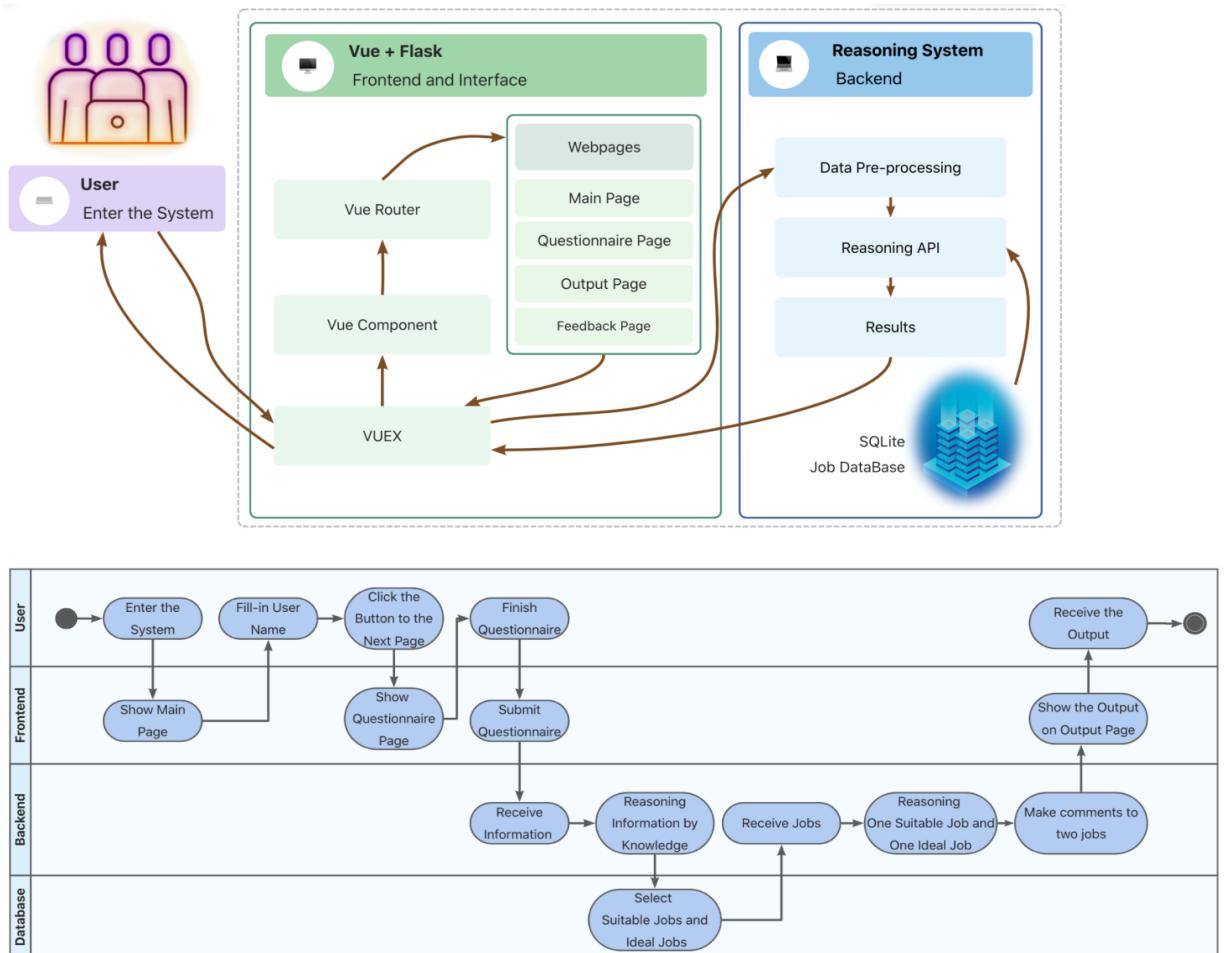


Figure 5.1-1 Overall system architecture

4.2 FRONT-END DESIGN

4.2.1 FRONT-END FRAMEWORK

Our system uses Vue framework to develop the frontend because it is one of the most popular web development tools nowadays. Meanwhile, Vue's progressive framework and bottom-up incremental development design also facilitate integration with third-party libraries, making Vue easier to learn and suitable for rapid development. Our web pages have a large portion filled in by the user, and Vue's core library focuses only on the view, which is more conducive to user experience.

The overall frontend architecture of our system is represented in Figure 5.2.1. The frontend uses the Vue architecture and calls Flask library for GET and POST requests to connect with the backend API to achieve the parameter transfer. Our frontend uses third-party libraries, vuetify, making the framework easier to build. Our system builds four routes, namely main page, questionnaire page, result page and feedback page, through the Vue framework to realize the display of the four pages and the transition between the pages.

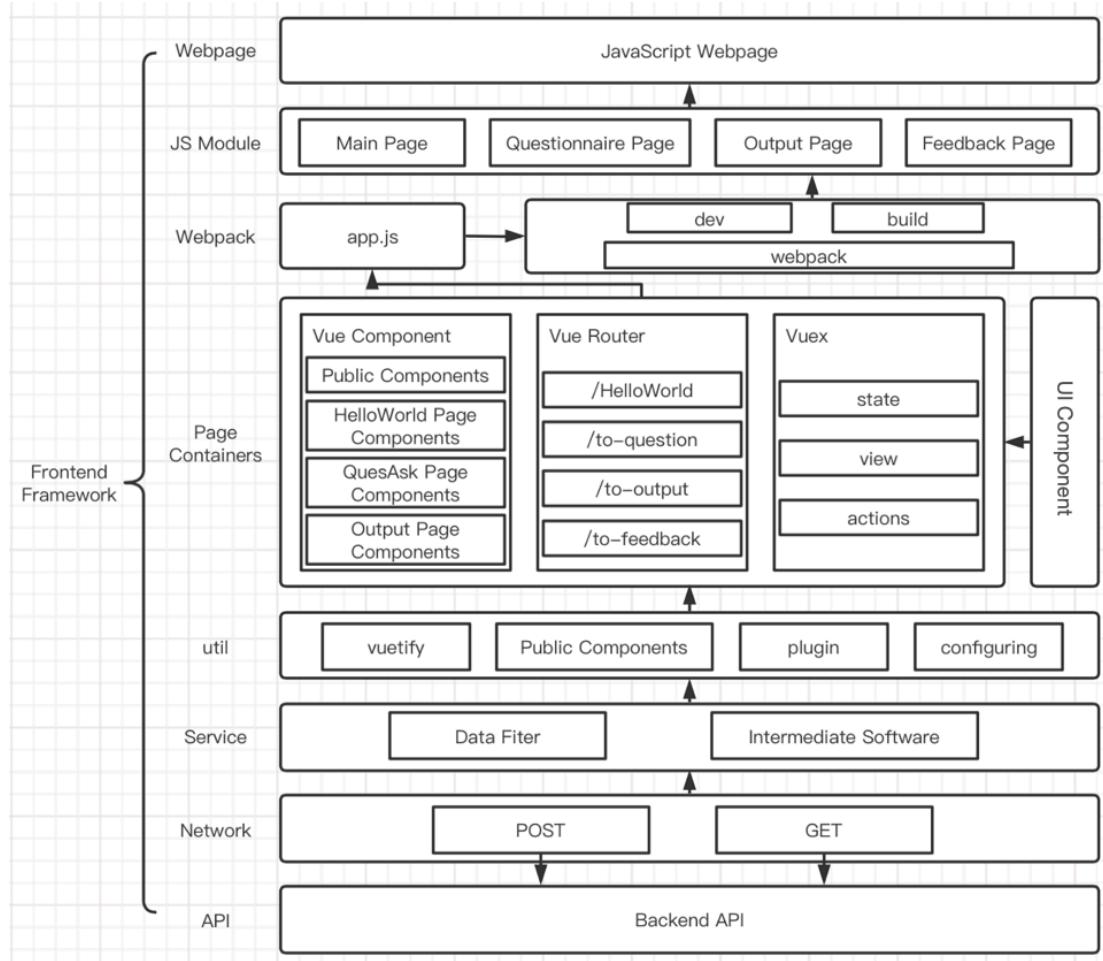


Figure 5.2.1 Overall frontend architecture

4.2.2 WEB DESIGN

Users use this system to get information about recommended careers and career and personality-related information. In the previous section, we showed the general architecture of the frontend, which implements four pages. In this section, we will describe the design of the four pages in detail. The descriptions of pages and their logical relationship are shown in Table 5.2.2.

Table 5.2.2 Description of each page

Webpage	description	Logical
HelloWord.vue	The main page, informs the user about the main features of the system and provides a user guide to instruct the user on how to use it.	If the user fills in the user name and knows that Jobviser contains BMTI-related analysis, they can be routed to the QuesAsk page via the button.
QuesAsk.vue	The QuesAsk page is filled out with 11 questions that collect users' information, including basic data of users, their mandatory job requirements, their abilities and their personalities.	Only when all the questions are filled in, the button that jumps to the next screen will be effective, and the user can be routed to the Output page through the button to view the recommended results.
Output.vue	The results page of recommended careers. It displays the user's questionnaire information; the recommended job that matches the user's ability; the recommended job that suits the user's personality; and the personality analysis on what kind of people are suitable for each of the two jobs.	If users are satisfied with the reasoning result, they can return to the main page or click the Feedback button to score our system, or they can return to the questionnaire screen and refill it to expect a different recommendation result.
Feedback.vue	The feedback page to score our system.	After the feedback is finished, users can return to the main page.

4.3 BACKEND DESIGN

4.3.1 FRONT-END AND BACK-END INTERACTIONS

We use the Flask framework to build the front and backend interfaces.

Flask is a WSGI application framework where the entry point of the application is a wrapped network request packet and the exit point is the network response. When we develop with Flask, we do not need to focus on the network side of the operation, but only on the processing logic within this phase. Flask specifies HTTP methods for the routes and matches dynamic URLs.

4.3.2 MBTI RULE

In order to establish a regular connection between the results of the personality test and the occupational data in the database, we refer to the common suitable occupational types corresponding to the personality types given by the official website of MBTI^[8], as shown in the table 5.3.2, and summarize the corresponding personality types of all categories of the industry feature. Since the Myers-Briggs Type Indicator also clearly divides the four dimensions into a total of eight types of occupational personality labels^[9], it also provides a reliable rule basis for our comparative reasoning to obtain occupational results.

Table 5.3.2 Common suitable occupational types corresponding to personality types

ISTJ	Chief Information Systems Executive, Astronomer, Database Manager, Accountant, Realtor, Detective, Administrative Management
ISFJ	Physician, Dietitian, Librarian/Archivist, Interior Designer, Customer Service Specialist, Bookkeeper, Special Education Teacher
INFJ	Special Education Teachers, Architectural Designers, Training Managers, Career Planning Consultants, Psychologists, Website Editors, Writers
INTJ	Chief Financial Officer, Intellectual Property Attorney, Design Engineer, Psychoanalyst, Cardiologist, Media Planner, Network Administrator
ISTP	Information Services Managers, Computer Programmers, Police Officers, Software Developers, Paralegals, Firefighters, Marine Biologists
ISFP	Interior decorators, masseuses, customer service specialists, costume designers, chefs, nurses, dentists, tourism management

INFP	Psychologist, Human Resource Management, Translator, University Teacher (Humanities), Social Worker, Librarian, Costume Designer
INTP	Software Designer, Venture Capitalist, Legal Arbitrator, Financial Analyst, University Teacher (Economics), Intellectual Property Lawyer
ESTP	Entrepreneur, Stock Broker, Insurance Broker, Civil Engineer, Tourism Management, Professional Athlete/Coach, Video Game Developer
ESFP	Preschool teachers, public relations specialists, career planning consultants, tourism management/tour guides, promoters, actors, sales
ENFP	Advertiser Management, Actor, Graphic Designer, Art Director, Corporate Team Trainer, Psychologist, Human Resource Management
ENTP	Entrepreneur, Investment Banker, Advertising Creative Director, Marketing Management Consultant, Studio, Radio and TV Host, Actor
ESTJ	Company CEO, Military Officer, Budget Analyst, Pharmacist, Real Estate Broker, Insurance Broker, Teacher (Trade Business)
ESFJ	Real estate agents, retailers, nurses, tally clerks, purchasing, massage therapists, sports coaches, catering management, tourism management
ENFJ	Advertiser Management, Magazine Editor, TV Producer, Marketing Specialist, Writer, Social Worker, Human Resource Management
ENTJ	Company CEO, Management Consultant, Politician, Property Developer, Educational Consultant, Investment Consultant, Judge

However, because the professional directions corresponding to each personality type are diverse, our reasoning rules are also very complex. The purpose is to allow each personality type to obtain a more comprehensive career choice direction as much as possible. We briefly show the correspondence between some professional directions and the dimensions of the professional personality test, as shown in the figure 5.3.2 below.

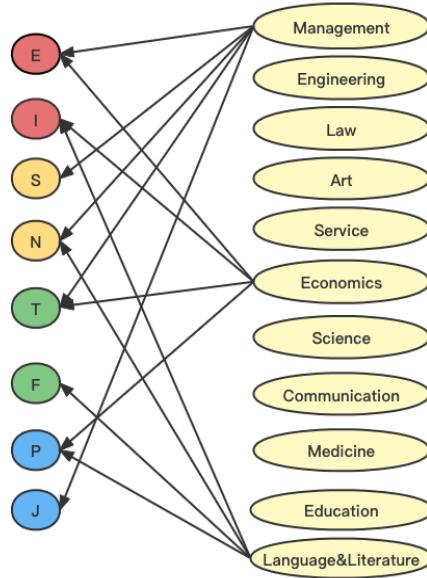


Figure 5.3.2 Visualization of reasoning rules between personality and work

4.3.3 BACKEND STRUCTURE

The backend of our project is mainly composed of data processing, database and intelligent reasoning modules. We first store the raw dataset in the SQLite^[10] database, from which the data processing module can call the data. Afterwards, we use Python to remove the bad data from the dataset, classify and simplify it according to the actual meaning, and re-store the processed new dataset into the database table. After interacting with the front end to obtain the data input by the user, the reasoning module matches and compares the dataset according to the rules, and then returns the result obtained by the intelligent reasoning module to the front end. The code structure of the entire backend is shown in the figure 5.3.3-1 below.

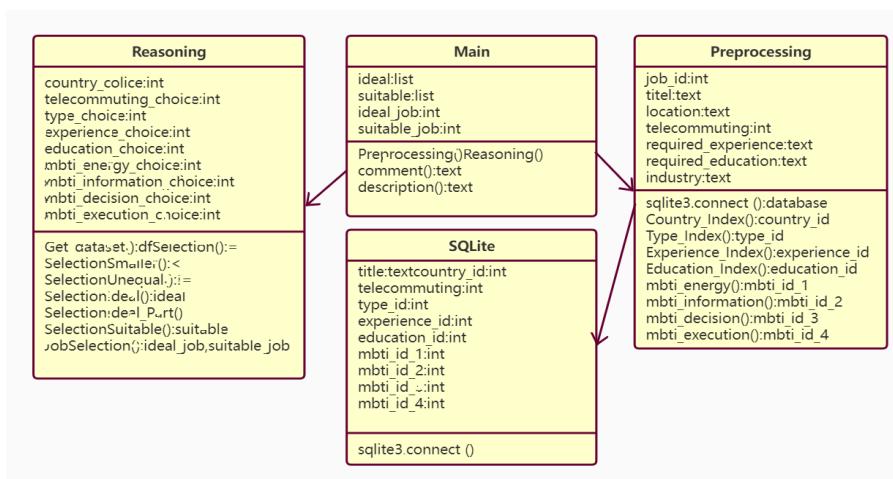


Figure 5.3.3-1 UML class diagram for back-end

In order to make the operation process of our backend more intuitive, we show an example of intelligent reasoning in the backend in the following figure5.3.3-2. It can be seen that the reasoning system processes the conditions passed in from the front end through the calling rules, performs multiple reasoning in the dataset, and finally summarizes it into a complete reasoning result.

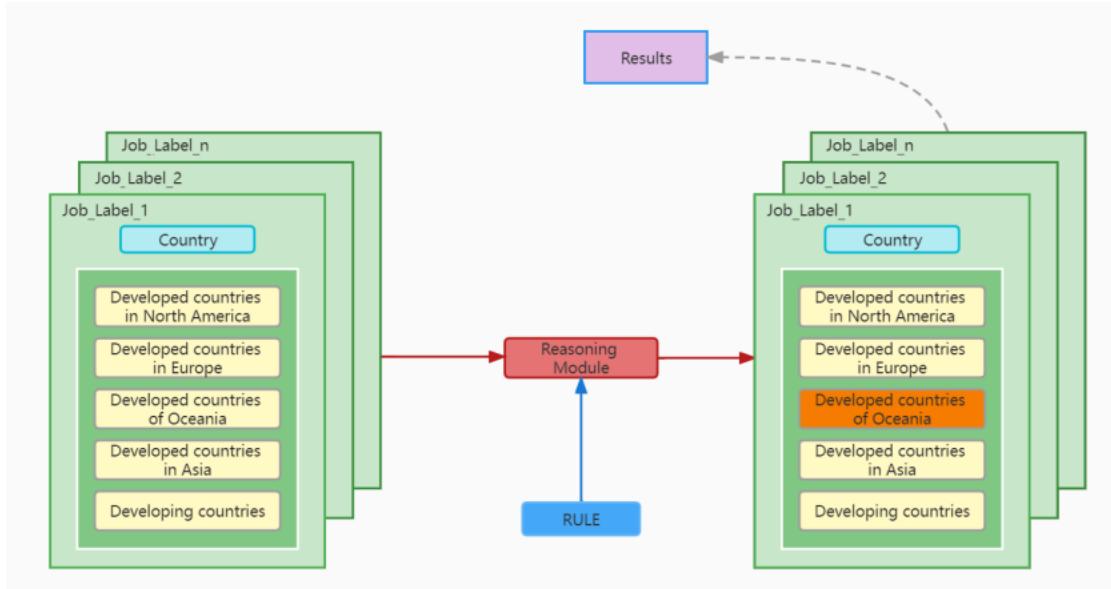


Figure A reasoning example of backend

4.3.4 OPTIMIZATION ALGORITHM

Since our dataset contains multiple features and is not perfectly averaged, the data information is clustered biased across multiple features. As shown in the figure5.3.4-1 below, taking the characteristics of industry and country as an example, the number of circles in the figure represents the number of categories, and the size of the circles is proportional to the amount of data in each category. It can be seen that the industry features in the data set tend to cluster towards the three categories of engineering, management and service, while the location features are mainly clustered in North American developing countries. Such a gap in the amount of category data may lead to two extreme cases after multi-layer reasoning. One is that the number of reasoning results satisfying all rules is greater than 1, and the other is that the number of reasoning results satisfying all rules is 0.

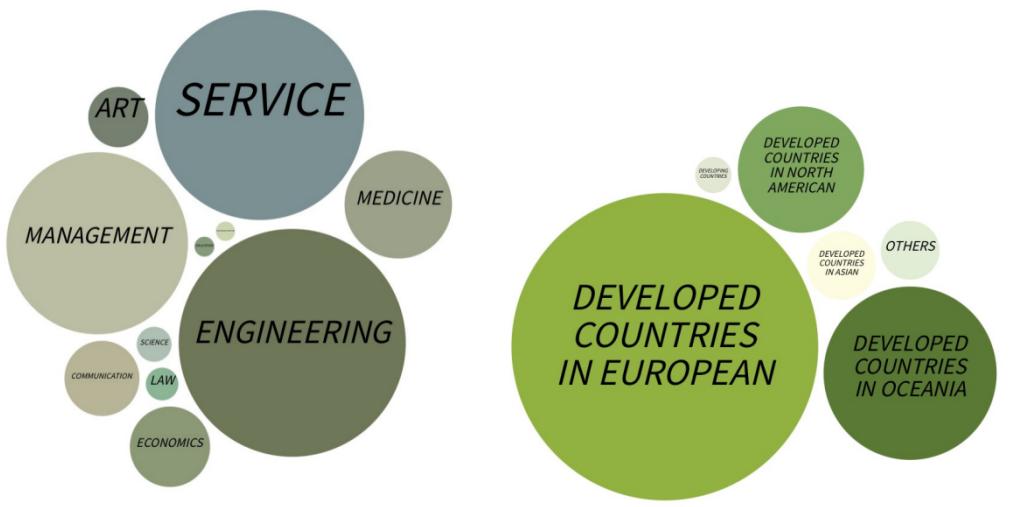


Figure5.3.4-1 Category data distribution of features: industry (left), location (right)

To achieve the uniqueness of the output results, we improve the reasoning system. Since the results obtained in the first case have no more filtering basis, all results meet the filtering conditions, which means that we cannot continue to compare the quality of all results. In this case, we choose to use the function to pick one of the results as the output. In the second case, we need to go back to the penultimate level of reasoning or higher. However, due to the large number of parallel rules, we cannot quickly locate which rule has an empty reasoning result, and we cannot assign weights to the system by subjectively judging the importance of the rules. In the end, we split the progressive reasoning structure into parallel structures.

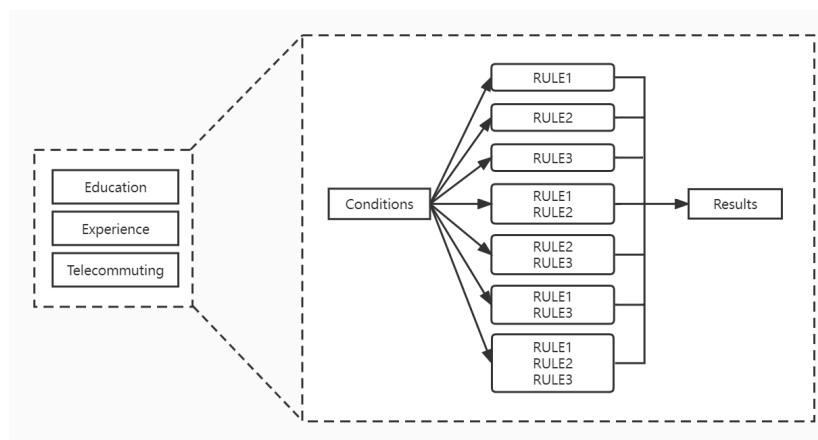


Figure 5.3.4-2 Optimization algorithm structure visualization

As shown in the figure5.3.4-2, after many tests, we found that it is easy to cause the problem of empty output results when performing phased reasoning on the three

features of user requirements. Therefore, instead of reasoning according to the rules of three features in turn, we demand the reasoning system to obtain reasoning results based on 1 rule, 2 rules and multiple rules at the same time, and take the sequence with the length greater than 0 and the smallest among all the result sequence. Then refer to the first case to get the unique result and return it to the front end.

4.4 PROJECT USE CASE

4.4.1 LOGIN INTERFACE

The main page is shown in Figure 5.4.1, where users can learn about Jobviser's system function and how to use Jobviser through the user guide. users can access the questionnaire page after inputting their user's name and agreeing to the terms.



Figure 5.4.1 Main page

4.4.2 QUESTIONNAIRE INTERFACE

We collected user information by setting 11 questions, and users can see the progress of filling out the questionnaire through the progress bar at the top of the page. After answering all 11 questions, users can click the button to view the results.

Hello Lucky7 ^^

Please complete the Questionnaire.

Your Year of Birth
2000

Question 2 | What is your ideal working place?

- A. Developed Countries in North American
- B. Developed Countries in European
- C. Developed Countries in Oceania
- D. Developed Countries in Asian
- E. Developing Countries

Question 3 | What type of job do you want?

- A. Full-time job with contract
- B. Part-time Job / Internship

Question 4 | Do you want to work from home?

- A. Yes
- B. No

Hello Lucky7 ^^

Please complete the Questionnaire.

B. No

C. Both are similar

Question 10 | Do you usually measure things by emotional value rather than practical value in life?

- A. Yes
- B. No
- C. Both are similar

Question 11 | Do you want to have good social values more than unique personalities?

- A. Yes
- B. No
- C. Both are similar

CLICK TO SEE THE OUTPUT

Figure 5.4.2 Questionnaire page

4.4.3 OUTPUT INTERFACE

The following figure shows the contents displayed on the output page, which has four routers. Figure 5.4.3-1 shows the user information, the first half is the user's demand for work and personal capability, and the second half is the user's personality analysis. Figure 5.4.3-2 shows the user's ideal job recommended according to the user's professional major and job demand and gives the personality of people who are suitable for the job. Figure 5.4.3-3 shows the user's suitable job recommendation based on the user's personality and job demand, and also gives the personality of the people who are

suitable for this job, so as to give the user a career recommendation from different perspectives. Figure 5.4.3-4 shows the websites to analyze personality, which allows those interested to better understand their own personality.

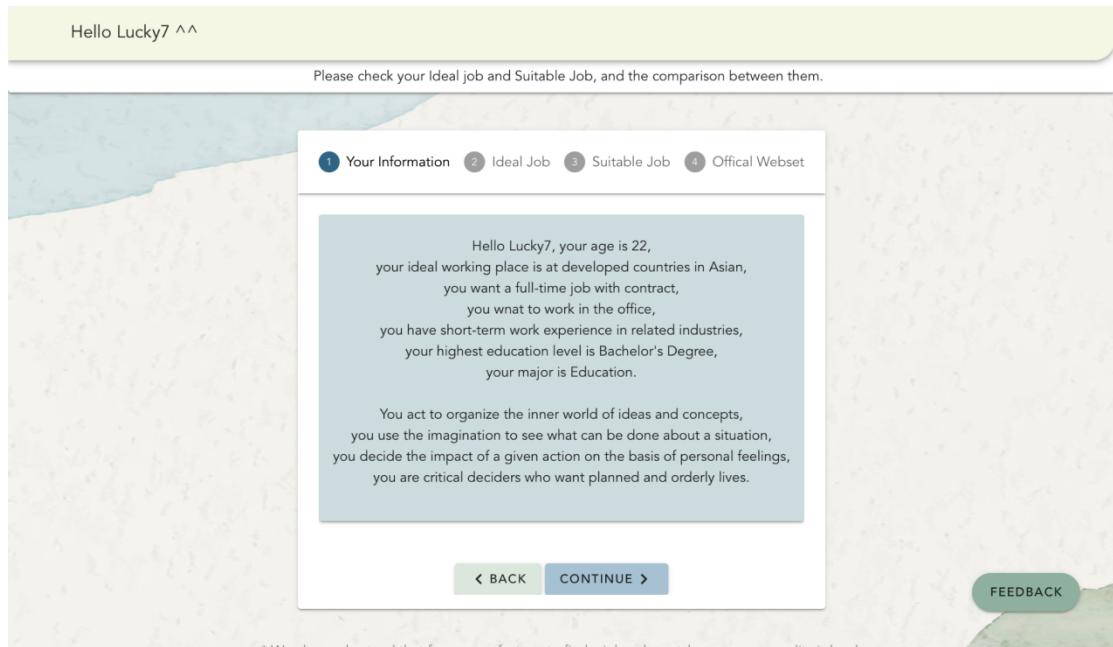


Figure 5.4.3-1 First output page

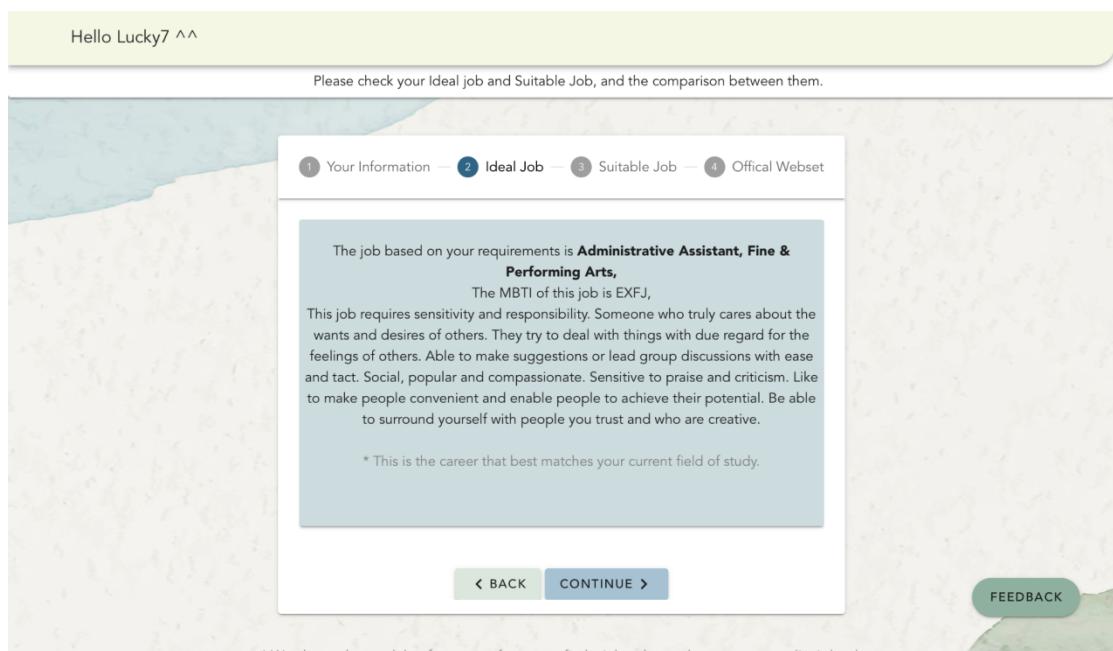


Figure 5.4.3-2 Second output page

Hello Lucky7 ^^

Please check your Ideal job and Suitable Job, and the comparison between them.

① Your Information — ② Ideal Job — ③ Suitable Job — ④ Official Webset

The job that makes you feel comfortable is **Production Designer**,
The MBTI of this job is INFJ,
Focusing on working with numbers or words and focuses on analyzing the characteristics of objective things will save a lot of awkwardness in interpersonal interactions. How you perceive determines how you perceive what's going on in the world. That's what this job requires. The way you judge determines which dimension you are more used to measuring the value of things. It will be very useful in this work place. Work habits determine whether you will be more suited to creative work or more disciplined in your work, and this job is exactly what you want.

* This is the career that matches your characteristics. We want to give you some employment inspiration, so that you can find your own endless possibilities.

◀ BACK CONTINUE ➤

FEEDBACK

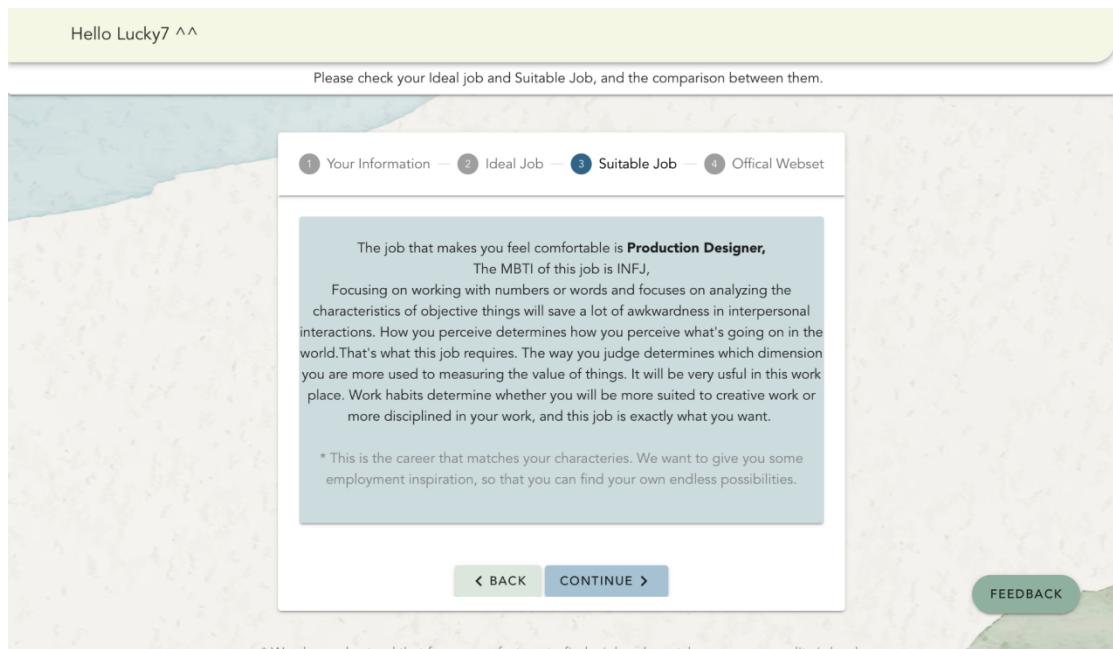


Figure 5.4.3-3 Third output page

Hello Lucky7 ^^

Please check your Ideal job and Suitable Job, and the comparison between them.

① Your Information ② Ideal Job ③ Suitable Job ④ Official Webset

If you would like to learn more about your personality characteristics, you can take a professional **MBTI Test** by visiting the following webpage.
This webpage is FREE, NO REGISTRATION required, and a systematic questionnaire is used to test your personality type.
[THE MYERS-BRIGGS TYPE INDICATOR PERSONALITY TEST](#)

If you would like a more detailed personality analysis, you can visit the following webpage to take a professional **Jungus Test**, which divides your personality type into eight more detailed dimensions.
This webpage is FREE, NO REGISTRATION is required, but note that the test is only available in Chinese.
[JUNGUS PERSONALITY TEST](#)

◀ BACK CONTINUE ➤

* We also understand that from many factors, to find a job only matches your personality is hard, so we give you the personality analysis of the employees who are suitable for these two different careers, and hope you can get some development inspiration.

◀ BACK TO QUESTIONNAIRE PAGE BACK TO MAIN PAGE ↑ FEEDBACK

FEEDBACK

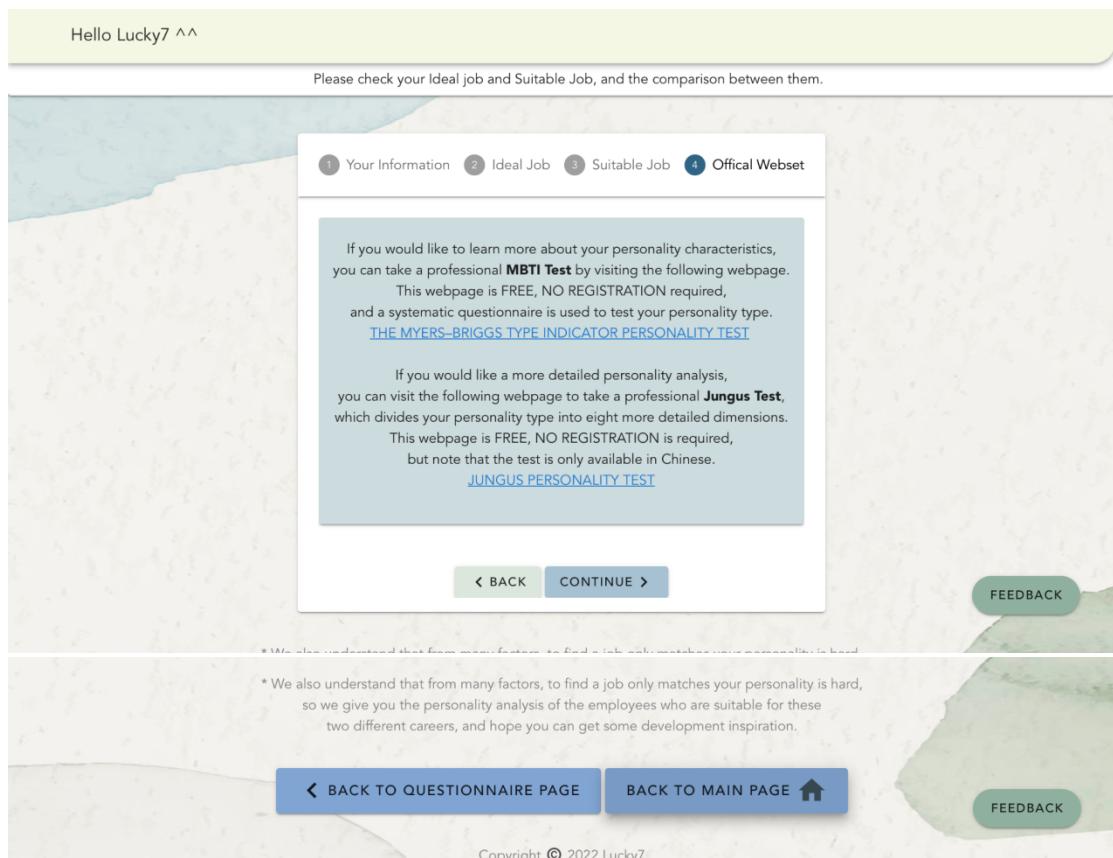


Figure 5.4.3-4 Fourth output page

4.4.4 FEEDBACK INTERFACE

Finally, users can score Jobviser with the page shown in Figure 5.4.4.

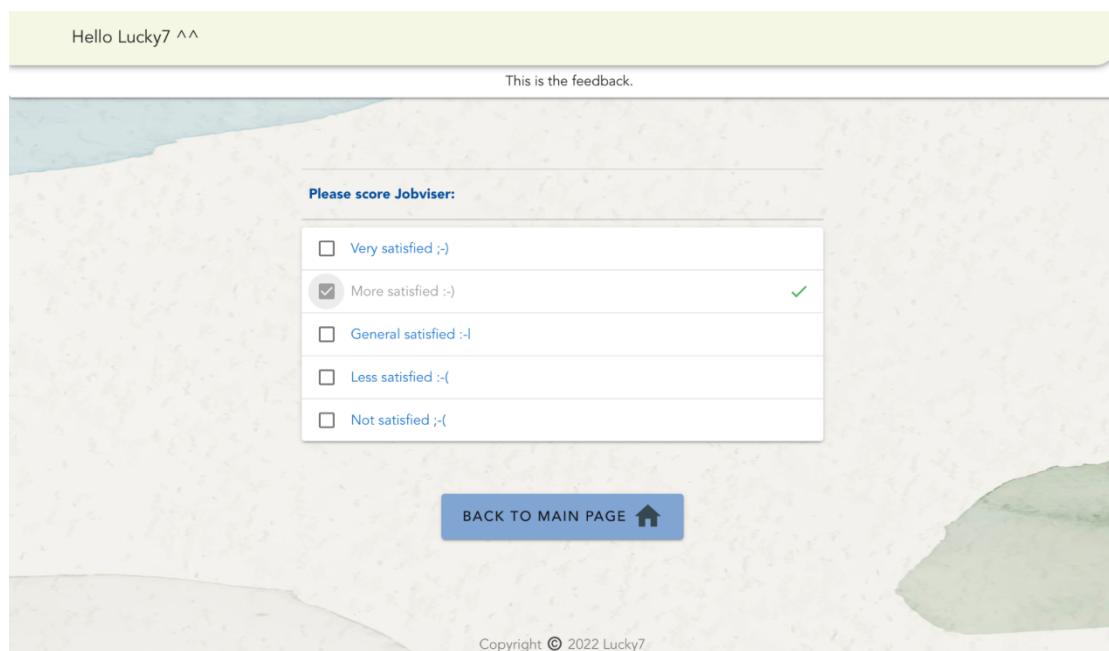


Figure 5.4.3-1 Feedback page

5 SYSTEM EVALUATION

In this section, we will analyze and evaluate the overall structure of the system. Several features of the system will be described in detail in section 6.1 and the drawbacks of the system will be analyzed in section 6.2.

5.1 SYSTEM'S FEATURES

a) Applicable to a wide range of people:

The target audience of this recommendation system is job seekers of all ages, and the system is very friendly to new job seekers. In addition to the lack of awareness of personal abilities, newcomers in the workplace have neither enough life experience nor knowledge and understanding of the relevant background knowledge for the wide variety of jobs in the market, so they often feel at a loss for their future career plans. However, our recommendation system can provide relevant analysis and guidance based on the relevant information filled in by users to guide newcomers in the workplace and explore more jobs that can develop their advantages.

b) High commercial value:

In the era of the COVID-19, the world is facing more severe economic problems, so the employment pressure of contemporary job seekers has become particularly large. There is also a growing need for a system that can guide job seekers to quickly find a job that suits them. One of the highlights of our system is the introduction of a personality test section, which incorporates user personality characteristics into one of the factors for consideration in job recommendation. The evaluation of user capabilities includes not only the analysis of professional and technical hard capabilities, but also the consideration of soft capabilities such as personal personality. Secondly, our system will give users a recommendation for employment guidance by analyzing the difference between the two different types of job recommendation results, so as to help them rationally plan their career development. Therefore, our employment analysis and guidance system has huge market prospects and competitive advantages.

c) Moderate amount of questions:

The system is designed to be quite concise in the questionnaire for user information collection, and the questions asked in the collection of information are also to the point, concise and precise, so users do not need to spend a lot of time to fill in personal information, which is very convenient and easy for users.

d) Good interactivity and fun:

Our user interface is designed to be very elegant and the color scheme is very harmonious. The questionnaire part of the personality test is also designed to be very

interesting and attractive to users. And a user feedback module has been added to help us better understand user experience and feelings.

5.2 LIMITATIONS

Our data set was collected from the recruitment website before. There are about 18,000 job information posted by companies, and the size of the data set is relatively small. In terms of positions, there are more positions suitable for newcomers and job seekers who have just worked for a few years, and more jobs suitable for the industrial and commercial service industry, that is, the data set has a certain bias. In addition, the number of questions in our personality test is relatively small, which will slightly affect the accuracy of the user's personality assessment.

6 CONCLUSION & IMPROVEMENTS

a) Offline system online:

In the future, we can change this offline guidance system into an online system, and collect the latest job postings of major recruitment websites with real-time connections, and recommend the latest suitable jobs for users.

b) More accurate personality test:

On the basis of the original test questions, the number of questions of the user's personality test is increased. For several different dimensions of the MBTI, each dimension moderately increases the number of questions, and sets up multiple questions to prevent users from filling in options that go against the facts, which has a great impact on the results of the personality test, thereby reducing the deceptiveness of the answer.

c) Enhance interactivity:

In the front-end part, some interactive parts are designed to increase interest and guide users to fill in the user information part more seriously, and the system can better explore the user's personal characteristics through the interaction with users, and transmit this information to the system. On the back end, a more accurate analysis of user characteristics is performed on the back end.

7 REFERENCES

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8 APPENDIX

APPENDIX A: PROJECT PROPOSAL

Date of proposal:

25 Oct 2022

Project Title:

ISS Project – An Intelligent Employment Analysis And Guidance System 统的名称

Group ID (As Enrolled in LumiNUS Class Groups):

Group 7 (Lucky_7)

Group Members (name , Student ID):

LI QINYUAN A0261801N

LIANG ZIJIAN A0262016R

WANG MINQI A0261978L

Sponsor/Client: (*Company Name, Address and Contact Name, Email, if any*)

NONE

Background/Aims/Objectives**Background**

Under the influence of the covid-19, the global economy's situation is severe , and the unemployment rate is soaring. Many companies have significantly reduced their recruitment plans and increased their recruitment requirements. The competition pressure of job seekers when looking for jobs has increased greatly, and they need to have adequate career planning. Improve your chances of finding a job.

At present, quite a lot of job seekers have the problem of insufficient self-awareness. For young graduates who have just worked for a few years, they do not have a clear understanding of what type of work their current personal abilities are capable of, and what type of work their personal characteristics are more suitable for. Therefore, they have no clear understanding of the future career planning. For many job seekers with many years of work experience, they are also deeply troubled by a relatively common problem, that is, they find that the work they are doing is not suitable for their personality. It is not that their academic and technical requirements cannot meet the requirements of the job, but their

personal characteristics are not suitable for the current working environment, so they often have serious anxiety problems at work. But they are confused and don't know how to break the current deadlock, and don't know how to change.

Aims/Objectives

In this project, we hope to implement an employment analysis and guidance system that can help those people who are facing career choices by giving reasonable advice and planning for job hunting.

1. Let job seekers have a clear understanding of their existing personal abilities, understand what positions are suitable for them in the current market, and submit resumes according to the types of positions that suit their abilities, which will greatly improve their competitiveness in the job market.
2. Let job seekers have a deeper understanding of their own personality traits and understand what kind of jobs they have certain character advantages in. Job seekers can work hard in that direction and do a good job planning with the help of this system.

Requirements Overview

- **Research ability**
- **Data processing ability**
- **Programming ability**
- **System integration ability**
- **Language expression ability**

Project Descriptions :

We are committed to providing new employment ideas and broadening the range of career choices for those people who are struggling with career choices by giving sound advice and planning.

system function

1. The system introduces the function of evaluating characteristics of job applicants

The system introduces the personality test part, and uses the results as the basis for the user's personality assessment.

2. The system will provide users with two types of job recommendations according to the user's professional direction.

Users only need to input their own answers according to the preset questions, and the system will automatically match a career result that the user is capable of and an ideal career result from the database.

3. The system will give job recommendations based on the results of the user's personality test.

The system matches the user's personal ability from the database to the professional result that the user can be competent for, which is the recommendation given by referring to the user's personality traits.

4. Give users corresponding employment planning and guidance.

The system will give corresponding employment guidance suggestions according to the difference between the occupation that matches the user's ability and the ideal occupation of the user. And our system will better dig out the user's own characteristics according to the introduced personality test part, and give the user's personal analysis results.

Dataset :

Our dataset comes from kaggle. The dataset was created by collecting job listings posted on the CareerBuilder website in 2020. CareerBuilder is the largest recruitment website operator in North America and one of the longest running job search websites with more than 20 years of history. There are more than 1.6 million job openings, and many jobs are posted directly from employer websites or jobs offered directly by businesses.

CareerBuilder also works with many local news organizations to post local job advertisements. CareerBuilder is a global online recruitment platform with more than 2,000 partners spanning 5 continents, providing the largest and most diverse job listings for talent in 55 countries. Therefore, our data set has a very large variety of job types in multiple countries, and provides information such as job location, department, salary range, company profile, and demand for recruiting talents.

System technology used:

Front-end: vue architecture, two third-party libraries, vuety and axios

Backend: sqlite3, python

APPENDIX B: THREE ASPECTS ABOUT REASONING SYSTEM

Decision automation:	We make human personality judgments and people's needs for work into rules. Based on the rules we set, our system automatically performs the reasoning process. We use rules to represent knowledge and automate decision-making.
Business resource optimization:	Our knowledge is knowledge discovery using documented Knowledge, and our working data set was initially very uneven, we performed a more fine-grained and averaged approach to this data by clustering or setting rules for classification. Classification has greatly optimized our data, so that the knowledge stored in our system can have effective output for most users.
Knowledge discovery & (big) data mining techniques:	For nearly 20,000 occupations, and each occupation has a text description of hundreds of characters, this data set is undoubtedly huge. We have performed NLP processing on the text part and extracted occupational information, which is helpful for us to carry out the next classification and analysis. At the same time, we use the SQLite database for data storage and invocation, so that the information stored in the inference system can meet the inference requirements and speed up the inference.

APPENDIX C: INSTALLATION AND USER GUIDE

1 INSTALLATION

1.1 ENVIRONMENT SETTING

Vue Environment:

```
Node.js      14.20.1
npm          8.19.2
Vue          2.9.6
node-sass    4.14.1
sass-loader  7.3.1
```

Backend Environment:

```
Flask        2.2.2
Flask-Cors   3.0.10
numpy        1.23.4
pandas       1.5.0
pysqllite3  0.4.7
```

1.2 BACKEND INSTALLATION

1.2.1 Run backend

```
pip install flask
pip install flask-cors
pip install numpy
pip install pandas
pip install pysqllite
cd my-project
python backend/main.py
```

1.2.2 Open Jobviser

```
cd dist
open index.html
```

1.3 LOCAL COMPILATION

If you want to compile the project, you can install the environment as below:

Install Node.js v14.20.1 at the official website

```
npm install vue@2.9.6
```

```
npm install sass-loader@7.3.1
```

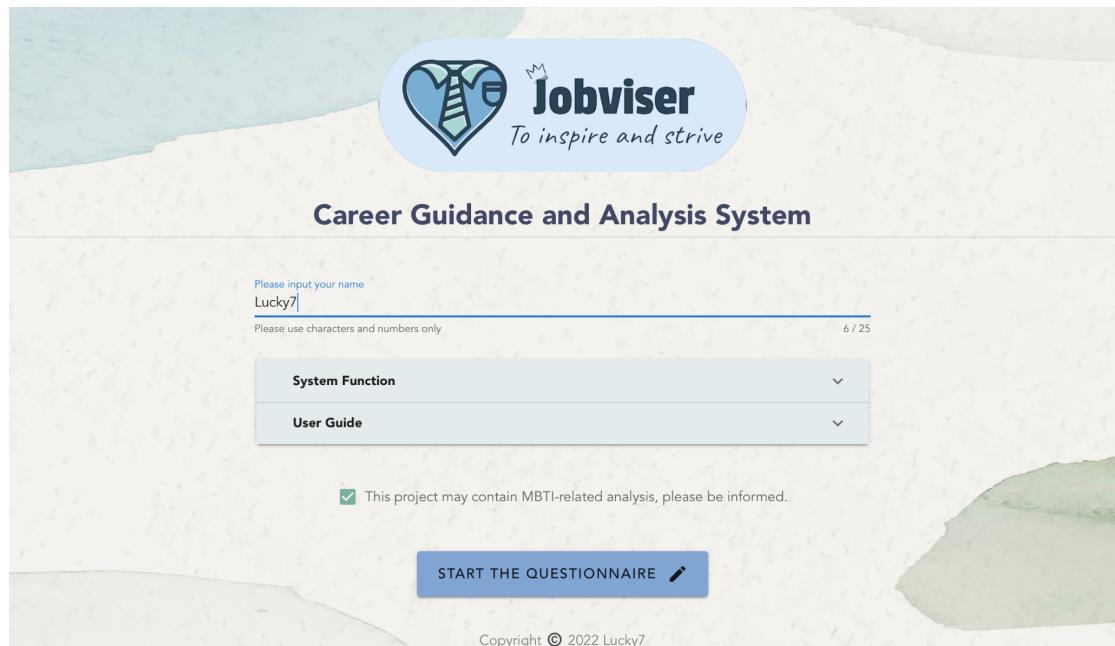
```
npm install node-sass@4.14.1
```

```
npm install lvuetify
```

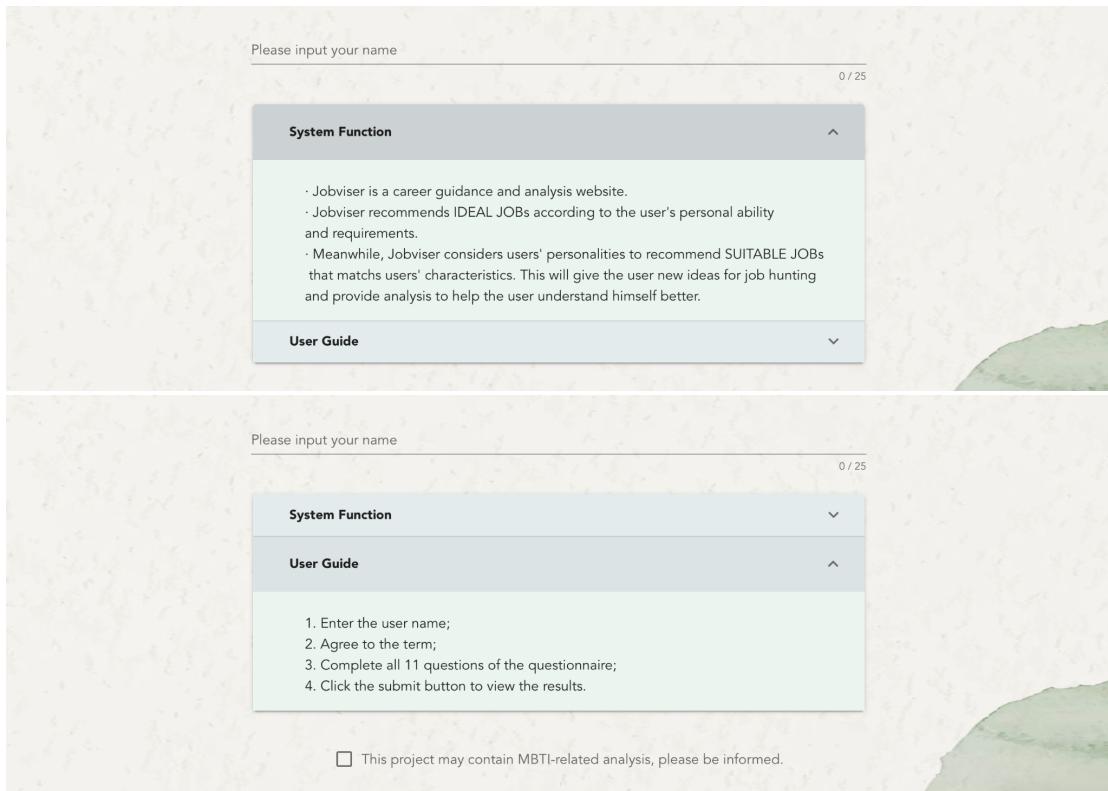
2 USER GUIDE

2.1 MAIN PAGE

The main page is the one where users can know what Jobviser will do. Users can access the questionnaire page after inputting their user name and agreeing to the terms.



Jobviser's system function and user guide is on this page, so that user can learn what they can get from Jobviser and how to use Jobviser.



2.2 QUESTIONNAIRE PAGE

We collected user information by setting 11 questions, all the questions are shown as below.

Users can see the progress of filling out the questionnaire through the progress bar at the top of the page.

We also have a button to quickly get to the top of the page.

After answering all 11 questions, the button to get the results will enable.

Hello Lucky7 ^^

Please complete the Questionnaire.

Question 1 | Please select your year of birth:

Your Year of Birth
2000

Question 2 | What is your ideal working place?

- A. Developed Countries in North American
- B. Developed Countries in European
- C. Developed Countries in Oceania
- D. Developed Countries in Asian
- E. Developing Countries

Question 3 | What type of job do you want?

- A. Full-time job with contract
- B. Part-time Job / Internship

Hello Lucky7 ^^

Please complete the Questionnaire.

Question 4 | Do you want to work from home?

- A. Yes
- B. No

Question 5 | Do you have work experience in related industries?

- A. Have management experience
- B. Have long-term work experience
- C. Have short-term work experience
- D. None

Question 6 | What is your highest education level?

- A. Graduate and above
- B. Bachelor's Degree
- C. Vocational Degree
- D. High School and below



Hello Lucky7 ^^

Please complete the Questionnaire.

Question 7 | Your major direction?

- A. Management
- B. Engineering
- C. Law
- D. Art
- E. Service
- F. Economics
- G. Science
- H. Communication
- I. Medicine
- J. Education
- K. Language & Literature
- L. Others

Question 8 | Do you prefer to deal with people rather than process information?

- A. Yes
- B. No
- C. Both are similar

Question 9 | Do you prefer to experience joy in real life rather than being immersed in an imaginary world?

- A. Yes
- B. No

Hello Lucky7 ^^

Please complete the Questionnaire.

Question 10 | Do you usually measure things by emotional value rather than practical value in life?

- A. Yes
- B. No
- C. Both are similar

Question 11 | Do you want to have good social values more than unique personalities?

- A. Yes
- B. No
- C. Both are similar

CLICK TO SEE THE OUTPUT

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2.3 OUTPUT PAGE

The output page has four main contents.

Firstly, shows the user information, the first half is the user's demand for work and personal capability, and the second half is the user's personality analysis. Based on the answers to the questionnaire, Jobviser can briefly analyze your attitude towards people and things.

Hello Lucky7 ^^

Please check your Ideal job and Suitable Job, and the comparison between them.

The screenshot shows a user profile page from Jobviser. At the top, there are four tabs: 1 Your Information, 2 Ideal Job, 3 Suitable Job, and 4 Official Webset. The second tab, 'Ideal Job', is selected. Below the tabs, there is a large text box containing the user's profile information:

Hello Lucky7, your age is 22,
your ideal working place is at developed countries in Asian,
you want a full-time job with contract,
you want to work in the office,
you have short-term work experience in related industries,
your highest education level is Bachelor's Degree,
your major is Education.

You act to organize the inner world of ideas and concepts,
you use the imagination to see what can be done about a situation,
you decide the impact of a given action on the basis of personal feelings,
you are critical deciders who want planned and orderly lives.

At the bottom of the page are two buttons: '< BACK' and 'CONTINUE >'. To the right, there is a green 'FEEDBACK' button.

Secondly, shows the user's ideal job recommended according to the user's professional major. Jobviser also shows users what kind of people is easier on handling this job. If user want to continually work on this career, they can try to strengthen themselves to adjust to the job.

The screenshot shows a user profile page from Jobviser. At the top, there are four tabs: 1 Your Information, 2 Ideal Job, 3 Suitable Job, and 4 Official Webset. The third tab, 'Suitable Job', is selected. Below the tabs, there is a large text box containing the recommended job information:

The job based on your requirements is **Administrative Assistant, Fine & Performing Arts**.
The MBTI of this job is EXFJ.
This job requires sensitivity and responsibility. Someone who truly cares about the wants and desires of others. They try to deal with things with due regard for the feelings of others. Able to make suggestions or lead group discussions with ease and tact. Social, popular and compassionate. Sensitive to praise and criticism. Like to make people convenient and enable people to achieve their potential. Be able to surround yourself with people you trust and who are creative.

* This is the career that best matches your current field of study.

At the bottom of the page are two buttons: '< BACK' and 'CONTINUE >'. To the right, there is a green 'FEEDBACK' button.

Thirdly, shows the user's suitable job recommendation based on the user's personality and job demand, and also gives the personality of the people who are suitable for this job, so as to give the user a career recommendation from different perspectives. A recommendation for your suitable job is to inspire users and make them think about their endless possibilities.

Hello Lucky7 ^^

Please check your Ideal job and Suitable Job, and the comparison between them.

1 Your Information — 2 Ideal Job — 3 Suitable Job — 4 Official Webset

The job that makes you feel comfortable is **Production Designer**,

The MBTI of this job is INFJ,

Focusing on working with numbers or words and focuses on analyzing the characteristics of objective things will save a lot of awkwardness in interpersonal interactions. How you perceive determines how you perceive what's going on in the world. That's what this job requires. The way you judge determines which dimension you are more used to measuring the value of things. It will be very useful in this work place. Work habits determine whether you will be more suited to creative work or more disciplined in your work, and this job is exactly what you want.

* This is the career that matches your characteristics. We want to give you some employment inspiration, so that you can find your own endless possibilities.

< BACK

CONTINUE >

FEEDBACK

Lastly, shows the other websites that can analyze personality, which allows those interested to better understand their own personality.

Hello Lucky7 ^^

Please check your Ideal job and Suitable Job, and the comparison between them.

1 Your Information 2 Ideal Job 3 Suitable Job 4 Official Webset

If you would like to learn more about your personality characteristics, you can take a professional **MBTI Test** by visiting the following webpage.

This webpage is FREE, NO REGISTRATION required, and a systematic questionnaire is used to test your personality type.

[THE MYERS-BRIGGS TYPE INDICATOR PERSONALITY TEST](#)

If you would like a more detailed personality analysis, you can visit the following webpage to take a professional **Jungus Test**, which divides your personality type into eight more detailed dimensions.

This webpage is FREE, NO REGISTRATION is required, but note that the test is only available in Chinese.

[JUNGUS PERSONALITY TEST](#)

< BACK

CONTINUE >

FEEDBACK

* We also understand that from many factors, to find a job only matches your personality is hard, so we give you the personality analysis of the employees who are suitable for these two different careers, and hope you can get some development inspiration.

< BACK TO QUESTIONNAIRE PAGE

BACK TO MAIN PAGE

FEEDBACK

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2.4 FEEDBACK PAGE

Finally, users can score Jobviser with the page.

Hello Lucky7 ^^

This is the feedback.

Please score Jobviser:

Very satisfied :)

More satisfied :-(



General satisfied :-l

Less satisfied :-(

Not satisfied :-(

BACK TO MAIN PAGE

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APPENDIX D: INDIVIDUAL CONTRIBUTION

Official Full Name	Student ID	Work Items (Who Did What)
Li Qinyuan	A0261801N	<ul style="list-style-type: none"> 1. Provided the overall direction of the project; 2. Implemented the frontend with Vue; 3. Implemented the front and backend interfaces with Flask; 4. Packaged the project; 5. Wrote the User guide; 6. Edited the final report; 7. Edited the promotion video
Liang Zijian	A0262016R	<ul style="list-style-type: none"> 1. Provided the initial topic of the project; 2. Completed data set processing and clustering; 3. Investigated and designed business rules; 4. Built a back-end intelligent reasoning module; 5. Realized the storage and calling of database data; 6. Designed and edited the final technical introduction video
Wang Minqi	A0261978L	<ul style="list-style-type: none"> 1. Participated in the discussion about the theme of the project; 2. Completed simple data processing; 3. Investigated the business value of the project; 4. Wrote reports; 5. Wrote proposal; 6. Made promotion videos

APPENDIX E: INDIVIDUAL REPORT

WANG MINQI

1) Contributions to Project

I participated in the discussion and designed the theme and content of the project. I carried out some data processing work, and visualized the data. I have Investigated and researched the background of the project to find the business value of the project. Participated in the writing of the final report, I also directed and edited the marketing video for the final system.

2) What learnt is most useful for you

I have acknowledged how the basic knowledge and technology learned in the class can be applied to an intelligent recommendation system. Also, I have learned how to make commercial promotion videos, and mastered certain writing skills.

3) How you can apply the knowledge and skills in other situations or your workplaces

Some basic data processing skills and data visualization skills learned in the project are the skills required to become a product manager in the future. And how to investigate the background and business value of the research project, as well as some writing skills and abilities, are also indispensable for a product manager. The second is to cultivate the production ability of publicity videos, which will help future product publicity work.

LIANG ZIJIAN

1) Contributions to Project

1. Provided the initial direction of the project
2. Completed data set processing and clustering
3. Investigated and designed business rules
4. Built a back-end intelligent reasoning module
5. Realized the storage and calling of database data
6. Designed and edited the final technical introduction video

2) What you have learnt from the project

In this project, I reviewed and practiced many techniques learned in class, including but not limited to data set processing and analysis, intelligent reasoning system design and construction, database invocation and storage, etc. I have learned how to apply what I have learned to solve problems encountered and turn technical theory into practical projects with commercial value. Also learned how to work effectively in groups, as well as some project reporting and presentation skills.

3) How you can apply the knowledge and skills in other situations or your workplaces

I will use the experience of this project flexibly in my future work and study, using technology flexibly when dealing with problems, actively discussing and collaborating with others. For example, it is possible to use clustering method to analyze customer group characteristics, use databases to monitor network status in real time, use reasoning knowledge to design recommendation systems, and so on.

LI QINYUAN

1) Contributions to Project

I am the leader of our group, and in this project, I am mainly responsible for writing the frontend framework and use Flask to integrate the whole project. As the group leader, I coordinate everyone's work and control the progress of the project. I often met with my team members at UTown to discuss the project's implementation plan, share the project's schedule, and make progress together.

2) What learnt is most useful for you

I learned a lot from this project. I've done game recommendation algorithms with collaborative classification before, but that was just the backend programming, whereas this time I was building a whole project, from frontend to backend.

The first thing I learned was how to build a large project, we did research, wrote a flowchart for the overall software framework, considered the business value of the project, and so on. I was involved in the whole process of the project from prototype

to full implementation, it was not just an assignment, it was not just a piece of code, because there were various social factors to consider, the project became real.

Secondly, as a person who has not dealt much with frontend before, in this project I mainly realized the frontend building and the packaging and merging of the whole project, which was a new challenge for me. I used Vue to build the frontend and Flask to implement the interface between the front and backend, which improved my frontend skills significantly.

Finally, as the leader of the project team, I think I have improved my ability to coordinate the project and have a better understanding of both front-end and back-end frameworks.

3) How you can apply the knowledge and skills in other situations or your workplaces

First of all, the knowledge related to reasoning, which I think is meaningful for me to build any reasoning system in the future. In this project, we tried a lot of what we learned in class up front, such as NLP methods, categorizing jobs based on descriptive columns of the dataset, and also tried using decision trees. Although we didn't use these methods in the end, we used them in practice and gained experience for us.

Secondly, I learned a lot about frontend development, which will not only benefit me to build other frontend frameworks in the future, but also to implement backend code, and I will have a better understanding of how I should implement backend interfaces to be more beneficial to the whole project.

Finally, my grasp of the concept of the system and the analysis of the business value will be beneficial for me to work in any project in the future.