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# Abstract

In China, the outbreak of COVID-19 has affected everyone's daily study and life, including the elderly, children, office workers, self-employed people, teachers and students. For students, the pandemic has not only brought inconvenience to their lives, but also academic difficulties, one of which is the difficulty of taking offline exams. The epidemic has also made it difficult for teachers to set questions in the office. For schools, enterprises and other institutions, offline examinations cost a lot of time, space, labor and overhead. Aiming at the above problems, this paper develops an English version of the online test system to help people with this need to solve the problem.

The system is presented to students and teachers in the form of web pages. This system will use B/S architecture, use Idea to edit code for the background, the database uses MySQL database, the overall use of Java programming language. In the webpage display part has a very simple display, so that the user convenient operation.

The main functions are registration and login, teachers add questions in the question bank, and the teacher can choose the appropriate questions from the question bank to form a test paper, further add a test, and decide which test paper the examination. Teachers can also check students' exam performance, class pass rates, and other information. Students can log in and take the test within a specified period, and can view the answer record so that they can review their mistakes at any time. Administrators can modify the personal information of students and teachers, delete or add classes, and other operations. Through the mutual influence and cooperation between function modules, the examination function of the online examination system is realized.

This system is simple and practical, beautiful interface, easy to operate. To some extent, it solves the shortcomings of traditional examination.

# Acknowledgement

More than a year slipped by. During this period of study, the college was unable to fully carry out offline teaching due to the COVID-19 pandemic, but I still gained a lot from the online teaching conducted by the college. Graduation design and thesis will be completed soon. I remember the uneasy feeling I felt when I first chose this project. I'm afraid I can't do it myself, but once I've decided on the topic, I really want to do it well.

During the early and late stages of the project, my mentor Asma Irfan gave me some advice, which helped me a lot. In addition, I would also like to thank those students who helped me solve the problems in the project together.

# 1. Introduce

In China, the coronavirus has had a major impact on people's lives. As a student, the epidemic has brought great inconvenience to my study. Teachers have to conduct distance learning on the Internet (Liu 2022). To some extent, people have adapted to distance learning, but the examination after learning has become a difficult problem for teachers and students in some special areas.

For offline exams, teachers are required to set up questions, print, invigilate, and grade. Students can do well on this test. Now, distance learning has become a common phenomenon, it will also become a popular trend in the future. In China, offline testing is not in line with the current situation, which requires more time and energy from teachers and more funds from schools.

Therefore, I want to make an online examination system (Pooja and Yuldashev 2021). Through the computer, teachers can realize the functions of setting questions, forming test papers, and viewing score analysis. The questions raised by the teacher will form a question bank, which can automatically form the test paper and automatically mark the test paper. Students can take online exams, look up past exams and scores.

This will provide great convenience for teachers and students. First, teachers do not need to print out test papers and make hundreds of copies, which can better protect the environment and not waste resources. Second, teachers do not need to manually mark papers, which greatly saves teachers' time. Finally, teachers do not need to record results in the school system or notify students in class. Students simply log in to the exam system to view their grades. After

the exam, the teacher can check the correct rate of each question in order to better understand the students' mastery of knowledge, so as to give some targeted explanations and exercises to the knowledge points that the students have not mastered.

## 2.Aims and objectives

The main purpose of the examination system is to simulate every link in the real examination and realize the automation and intelligence of the examination process, so as to reduce manual intervention and establish an automatic examination platform. This will make it easier for students and teachers to organize and take exams. The overall design objectives of the system are as follows:

1. The system has the function of question bank. The establishment of a high-quality question bank is the foundation of the examination system. The question bank should have some attributes, such as exam content and scores, and it should also ensure that the number of questions in the question bank is sufficient to avoid high repetition rate of knowledge points.
2. The system has the function of intelligently organizing examination papers (Yin 2021). The paper group personnel can realize automatically form test papers according to the different examination subjects.
3. The system should has the function of automatic review. The system can support the single choice questions, multiple choice questions, judgment questions to achieve automatically mark exam papers.
4. The system should has the function of students answering questions. The system can support students to enter the examination independently and answer questions within the specified time. And user can view the previous examinations and test scores.



5. The system can allow some specific users to log in in the background to view the examination status of all students, and the users can also view information such as the number of examinations and the pass rate by class.

## 3. Background and significance

### 3.1 Research Background

With the development of social economy and the comprehensive popularization of network technology, networked training and education has become an important feature of education reform and formed a new impetus for the development of the education industry (Xu 2022). At present, Chinese schools and society in all kinds of examinations mostly adopt the traditional way of learning. In the traditional offline training and examination mode, the organization of a test requires at least several steps, such as question setting, paper printing, examing, paper marking, score evaluation and paper analysis, all of which require human intervention. This method makes time cost, site cost and labor cost high, and it is difficult to ensure its objectivity and impartiality. Obviously, with the increasing types of examinations and the continuous improvement of examination requirements, the workload of teachers will be more and more large. And this work is a very tedious, very error-prone process. The traditional examination method has been unable to completely meet the needs of schools, enterprises and other institutions for examination.

With the development of social economy and the comprehensive popularization of network technology, the traditional education model and examination model have been challenged greatly (Johnson 2021). With the rapid development of computer technology and network technology, middle schools, high schools and universities in many countries have set up distance education. And even social institutions will choose distance training and assessment, through the computer network to achieve long-distance education and training. Students

can complete a series of tasks including listening to the teacher, asking questions, answering questions honestly, taking exams and so on through the Internet at home. Students can do all study and work at home.

The development of computer hardware technology and the Internet has reached a very high level, and the development of distance education software has gradually developed. With the continuous development of various computer technologies, it is necessary to have a better and more perfect software system applied to distance education, which puts forward higher requirements for software developers. Now the Internet is developing very fast, people's life and learning style is changing. Previously, the process of exams in Chinese schools was that students took the exam through paper-based exam papers. To a certain extent, the learning effect cannot be grasped by teachers in time, and it is also not conducive to the difficulties and key points of students' statistical knowledge. Based on the disadvantages of traditional learning way, I design a set of Internet exam system (Pooja and Yuldashev 2021), the system can greatly improve the teaching quality and effect.

### 3.2 Research Significance

The online examination system is a contemporary research and development hotspot. It is an Internet-based application system with easy client configuration, so the examination is not limited by geography. A comprehensive online remote assessment system may prompt users to verify their learning status after online learning, identify flaws, and remedy errors. The learning efficiency is greatly improved and the learning time is saved. Online training and examination can be realized through Internet technology. The online examination system's question design, paper submission, grade reading, and computation may all be

conducted automatically via the network. Examination automation is possible as long as a mature question bank is developed.

This effectively avoids the risk of clustering of offline exams during the pandemic and shields the possibility of human intervention. The work of teachers is greatly reduced. Teachers only need to design questions, maintain the question bank, publish and organize an exam online, which greatly reduces the burden of teachers and has advantages that offline exams do not have. Therefore, in order to adapt to the development of the new situation, after the preliminary requirements collection, channel research, feasibility assessment and other links, I will carry out a series of preliminary design work. I will conduct a preliminary exploration and develop an online examination system, which can provide a better solution to the needs of this scenario. It is hoped that it will play an efficient and convenient role in various exams, relieve teachers from heavy work, and help students take exams more conveniently.

### 3.3 Research Status

Online examination system is an important application of computer technology in the education industry to assist teaching examination. It plays an important role in the reform and development of the education industry and the cultivation of talents (Faraon et al. 2019). At this stage has been more mature and in-depth research, from the point of system architecture, the basic implementation pattern can be divided into C/S (Cong 2014) and B/S (client/server) (browser/server). Based on C/S model of online examination greater dependence on the client software, and it's expensive to maintain and difficult to upgrade, it is not suitable for large-scale examination (Amir 2019); The online examination based on B/S mode does not need the installation and deployment

of the client, which is easy to upgrade, expand and maintain in the later stage. From the point of view of network type, the examination system has the examination system based on local area network and the examination system based on wide area network. At present, the more popular technologies that can be used for the development of online examination system mainly include JSP, ASP, PHP, etc. And its dynamic site planning technology and database access technology based on Web have also become one of the mainstream technologies (Perez 2021).

Due to its strong convenience, flexibility and fairness, online examination system has been widely used at home and abroad after decades of practice exploration and development. Internationally, after the 1960s, the rapid development of computer technology has provided the necessary conditions for the construction of high-capacity and intelligent question banks. After the 1980s, the United States and other countries have continuously strengthened the investment and research in the field of education, and increased the efforts of computer technology in assisting teaching and education. Many large exams have adopted online testing systems to evaluate the subjects of the examination, such as the TOEFL, IELTS, IBM certification test CCNP (Cisco Certified Network Engineer), Microsoft MSCE (Microsoft Systems Engineer Certification), Oracle certification test and so on. The education testing service (ETS) of the United States is currently the largest education examination and evaluation mechanism, the institution since 1993 in graduate entrance examination using the adaptive test mode. Begin from 2003, GRE general test in China to adopt the form of a computer-based test + a paper-based test, analytical writing, take computerized test. Further reduce the offline exams as a basic assessment method.

In China, with the progress of science and technology and the support and

promotion of computer-aided education by the state, the new mode of network examination has become the development trend of higher education examination. Different scholars and research institutions have also conducted in-depth research on the construction of examination paper bank, including the structure of online examination system, model, group strategy of framework, marking method, etc., and they have made different degrees of progress. In recent ten years, driven by the development of modern education, China has developed a series of computer testing systems, such as computer rank examination, Putonghua rank examination, College English testing system, Dynamic Operation Testing System (DTS), etc. The dynamic operation test system is independently developed by ATA, China's largest test and education service provider, which is the pioneer of intelligent service test in China. At the same time, many education and training institutions, enterprises and public institutions have gradually popularized this examination mode internally. For example, AEA examination of the Ministry of Labor and Social Security adopted the online examination mode, and many enterprises and public institutions also adopted the form of computer examination for internal professional title promotion. Online examinations are widely accepted by the public because of their low cost, flexibility and efficiency, which also provide a new impetus for the development of enterprises and the education industry.

## 4.Problems

### 4.1 Feasibility Analysis

The feasibility study is the overall goal of the pre-developed software system, which requires me to propose its functional, performance, reliability, and other requirements. The goal is to determine in as short a time as possible whether the problem can be solved and whether it is worth solving, with the minimum cost. Feasibility analysis is also a necessary link to analyze whether the project is feasible, such as whether the funds are sufficient, whether the technology can be made, what software or hardware facilities are needed, whether the market is available after successful research and development, and whether the project can be profitable. This includes technology, funding, engineering studies, comparative analysis, and prediction of the economic and social environmental impacts upon completion of the project. Therefore, this provides a comprehensive system analysis for the decision basis of whether the project is worth the investment and how to carry out the engineering consultation. The feasibility of this system is analyzed from three aspects as follows:

#### (1) Technical feasibility

This system is an online examination system based on B/S architecture. The background code is mainly written in Java language, the IntelliJ IDEA 2021.3.1 editor is used as the background development software, and MySQL database (Faried et al) is used to store information in the database. The above software can be easily downloaded on the Internet, so there is no difficulty in the software, can be easily satisfied (Hu and Yan 2021).

This system adopts SSM framework to design (Zheng 2022), which is the integration of Spring MVC framework (Hou 2019), Spring framework and MyBatis framework (Ma 2016), which is the standard MVC pattern. Among them, I have a good grasp of Spring MVC, JavaWeb technology and sql statements of MySQL database. I can achieve the functions of adding, deleting, modifying and searching data well. I am skilled in using IntelliJ IDEA and other software, which can support me to complete the implementation of the system. So from the technical level analysis, this system is feasible.

### (2) Economic feasibility

This system does not need extra cost in software, it can use online open source and easy to download software as a development tool. And this system in the hardware aspect also does not need extra overhead, the normal network computer can use this system normally. The online examination system greatly simplifies the traditional examination mode of the questions, forming test papers, marking and other links. This facilitates the change of the examination, and also saves a lot of manpower, material and financial resources.

### (3) Operational feasibility

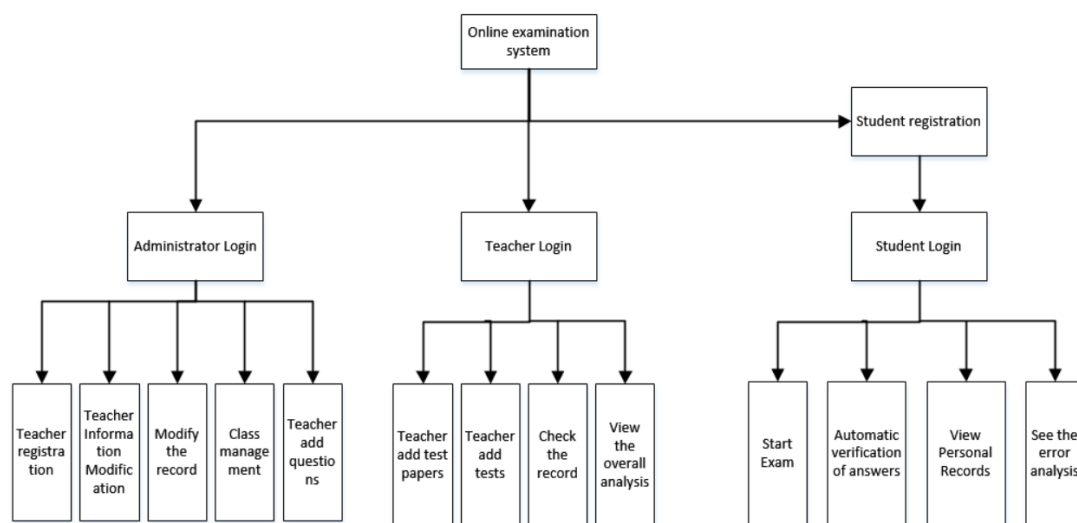
This system design page is simple and clear, users can quickly get started using, all the functions on the page display are very conspicuous, they just need to click the corresponding function according to their own needs. The system in the teacher login, the teacher in the background question bank to generate a test paper, and then add a test, and the generated test paper added to the test. After logging in, students will be able to take the exam, and the exam will be automatically marked in the background. After that, they will be able to view the exam details at any time in the exam record, with errors highlighted in red.



## 4.2 Overall system design

In the process of designing and implementing the online remote examination system, in order to make the system easy to manage and secure, the administrator has the highest authority when editing and designing the administrator role of the examination system. The administrator can control the examination system to add, delete teachers and students. Users who want to use the online exam system must first register and then log in. The teacher sets questions for the examination, and forms a question bank, which can generate papers with the questions in the question bank. The system automatically marks the papers, the teacher can view the examination results, students can view the examination after logging in, take the examination, query the course papers and results.

The design idea of online examination system is to divide the whole system into three roles: administrator role, teacher role and student role. According to these three roles, it is divided into three modules, which are as follows:



## 5. System-related methods

### 5.1 System Development Environment

#### 5.1.1 Tomcat

##### 1. Introduction of Tomcat

This system uses Tomcat as the server, which is a project under Apache company, that is to say, Tomcat is an upgraded version of Apache server, which improves the usability of Apache server and expands the practical functions and user experience of Apache server (Agrawal and Gupta 2014). It's even more convenient for everyone to use. Most importantly, the Tomcat server is completely open source and free, so it is highly used on many non-large systems.

Tomcat is made up of a series of components, with three core components:

- (1) web container: complete the function of web server;
- (2) servlet container: CATALINA for processing Servlet code;
- (3) JSP container: used to translate JSP dynamic web pages into Servlet code.

##### 2. Tomcat request process

- (1) The user inputs the web URL into the browser, and the request is delivered to the local port 8080, which is retrieved by the Connector listening there;

(2) The Connector sends the request to the Engine (Container) of the Service where it is located and waits for the Engine to respond;

(3) The request is called in layers among the four containers Engine, Host, Context and Wrapper, and finally the corresponding business logic and data storage are executed in the Servlet.

(4) The executed request response is sent back through the Context, Host, Engine containers, and finally back to the Connector and through the Connector back to the client.

### 5.1.2 MySQL

#### 1. Summary of MySQL

MySQL database is a database that reflects the relationship between various data attributes. Because its source code is open to the public, it can be downloaded by anyone and set up personalized requirements according to their personal preferences. In terms of database management, it uses a popular database management language, that is, structured query language (SQL) to manage. In database management without complex transaction processing, choosing MySQL database for content management is the best choice.

MySQL has a long history and was first developed by a company in Sweden. In today's market, MySQL is widely spread, because of its low storage occupancy, speed and low cost. Therefore, it is ubiquitous in all kinds of small and medium-sized websites, customer data management module, enterprise data management module.

There are many attractive places MySQL, in addition to the open source database, but also its speed, extraordinary reliability and super adaptability, etc., Those are the reasons you can't refuse.

## 2. MySQL characteristics

(1) Support multithreaded processing, concise statement.

(2) Its performance and scalability are high, which can achieve faster network loading and other operations.

(3) Its security is guaranteed, and each version of the update has a huge improvement in security.

(4) MySQL memory footprint is small, in the laptop only need a few MB of memory.

(5) Support ANSI SQL LEFT OUTER JOIN and ODBC.

(6) MySQL is very portable and can be used on many different platforms.

## 5.1.3 IntelliJ IDEA

### 1. Introduction to IntelliJ IDEA

IDEA is a java language development integrated environment (it can also be used in other languages). IntelliJ is widely regarded as one of the greatest Java development tools available. In particular, it features intelligent code assistance, automatic code libraries, refactoring, JUnit, J2EE support, Ant, CVS integration,

code review, creative GUI design, and more. The flagship version supports HTML, Python, CSS, PHP, MySQL, and other languages. Only Python and a few more languages are supported in the free version (Fu and Li 2021).

## 2. IntelliJ IDEA advantages

### (1) Debugging function

Debugging can be used to debug JavaScript, java code, Ajax, JQuery and other technologies (Das Noyon et al. 2018). You can dynamically Evaluate the value of an expression, for example by using Code Completion to point out the method supported by the class instance (Krill 2020). User can also use the Log on console function to check the performance of multiple threads in the case of multi-thread debugging.

### (2) Project management method

The Project in Idea is identical to the Workspace in eclipse, and the Module is comparable to the project in eclipse. Idea integrates the development modules in the Project for management.

### (3) Efficient development efficiency

It may automatically construct a test class for a class and place it in the test directory. Without utilizing the Debug interface, Idea may also propose suitable values in the code interface, and it can debug JS code in the IDE.

## 5.2 System Architecture

This system is based on B/S architecture, B/S architecture refers to the Browser/Server architecture, is only need to install and maintain a server, and the client uses the browser to run the software. It is rising along with Internet technology, is a change and improvement of C/S structure. It mainly uses WWW browser technology, combined with a variety of scripting languages and new technologies. It can realize the core part of the system function centralized server, which simplifies the development, maintenance and use of the system. It is a brand-new method for building software systems. It simply requires a browser and a database to be installed, it then allows the browser to interact with the database through the Web server.

Advantages of B/S architecture:

- (1) This architecture does not need to install the client. This is instantly executable on the web browser.
- (2) Direct placement of the B/S architecture on the Internet network is possible in order to achieve the goal of regulating multi-client access and interaction mode through the use of certain privileges.
- (3) Because B/S architecture does not need client installation, updating numerous clients and upgrading servers is not an issue.

Disadvantages of B/S architecture:

- (1) In cross-browser, B/S architecture is not the most satisfactory architecture.

(2) A lot of efforts are needed to achieve the degree of C/S program.

(3) In terms of speed and security, it still needs to spend a huge design cost, which is the biggest problem in B/S architecture.

(4) Client-server interaction is request response mode, usually need to refresh the page. That's what customers don't want to see. However, this disadvantage has been alleviated to some extent after AjaxWeb interaction technology emerged and matured.

## 5.3 System Framework

This system employs the SSM framework, which is the Spring MVC framework, the integration of the Spring framework and the MyBatis framework, it is the typical MVC mode, and the entire system is separated into four layers: View layer, Controller layer, Service layer, and DAO layer. Spring MVC is used to manage views and forward requests. Spring supports business object management, and MyBatis serves as the data object persistence engine.

### 1. Spring Framework

Spring framework is an open source programming framework in the field of JavaEE programming (Karthik\* et al. 2020). It is a lightweight Java development framework that emerged in 2003. The early JavaEE platform was developed with EJB as the core, but this development method of EJB has many shortcomings in the actual development and application process. For example, the use of complex, cumbersome code, code intrusive, long development cycle, poor portability and a series of drawbacks. The Spring framework was designed

to solve the complexities of corporate application development as well as the absence of EJBs. Spring builds a high-quality, dependable, and extendable Java application by using fundamental JavaBean to achieve things that were previously only possible with EJBs. Spring's application is not confined to server-side programming. In terms of simplicity, testability, and low coupling, any Java application can use Spring to build an application. In short, Spring supports pluggable development and is a lightweight one-stop framework, an inversion of control and aspect-oriented container framework.

## 2. Spring MVC framework

SpringMVC is a Java-based Web framework to implement MVC design model. It is a lightweight framework of request-driven type. MVC pattern has been widely used in Web application design. SpringMVC takes DispatcherServlet as the core. By separating Model, View and Controller, it can decoupage the Web layer, simplify complex Web applications and reduce errors. SpringMVC implements the MVC pattern by coordinating and organizing the different components to complete the request processing and return the response. It is built into Spring Web Flow. SpringMVC implements Spring features natively, making development simple and standardized.

## 3. MyBatis

MyBatis is a Java-based persistence layer framework that customizes SQL, high-level maps, and stored procedures. MyBatis is a semi-object relational mapping framework, which encapsulates JDBC at the bottom level. When writing code, it only needs to pay attention to SQL statements, and does not need to spend time in the process of loading drivers, creating links, creating statements, etc., which make the process simple and flexible. SQL Maps and



Data Access Objects (DAO) are two of the persistence layer frameworks supplied by iBATIS. MyBatis can setup and map native information using simple XML files or annotations. Most of the JDBC code, manual parameter setting, and result set retrieval are avoided. Statements to be executed are configured by xml files or annotations, and sql statements are mapped by java objects and sql dynamic parameters in the statement. Finally, Mybatis framework executes sql statements and maps the results into java objects and returns them. In simple terms, MyBatis is a framework for managing data addition, deletion, modification and searching.

#### (1) DAO layer

The DAO layer performs the duties of the data persistence layer and contains some of the tasks involved in interacting with the database. The design of the DAO layer starts with creating the DAO interface and then defining the implementation classes in the Spring configuration file. The interface may therefore be used in the module to handle business data without having to worry about which class the particular implementation of the interface belongs to, it resulting in a simple and evident structure.

#### (2) Service layer

The logical application design of the business module is primarily the responsibility of the Service layer. Before i design the class that implements it, I create the interface. Then, i configure the Spring configuration file with association to implement it. To implement the business process, we can do so by calling the Service interface in the application. The Service layer must use the DAO layer's established interface for its particular business. It is advantageous for the independence and reuse of the general business logic to

encapsulate the business logic of the service layer.

### (3) Controller layer

Control of certain business module processes is within the purview of the Controller layer. To govern the business process, the interface of the Service layer is called in this layer. The front end's arguments are used by the controller to carry out business processes, and it then delivers a specific route or data table. For specific application process, there are different controller, control allocation in the Spring configuration file, the specific design process to be able to process abstract induction, the design can be repeated use of the subunit process module. So that we can make the program structure becomes simple, clear, and greatly reduce the amount of code.

### (4) View layer

The View layer and the control layer are closely combined, so they need to be combined to work together. The View layer is mainly responsible for the presentation of the foreground jsp page.

## 4. The SSM process:

(1) The client sends the request to the DispatcherServlet.

(2) Query HandlerMapping for DispatcherServlet Controller to find the controller that handles requests

(3) The Controller calls the Service business logic layer and returns the result after processing.

## 6.Requirements specification

### 6.1 Functional Requirements

This system is an online examination system, which provides teachers to distribute papers, set up test questions, arrange examination time, students to carry out the examination on time, automatic scoring in the background, review of wrong questions and other functions. The following functional requirements are must-haves, shoulds, and misses.

The system must have:

#### 1. User registration and login

Users are divided into three roles: administrator, teacher, and student. The administrator should be the default state, the teacher registration should only be added by the administrator, and the student can register by himself. Distinguish between front and background logins to facilitate user operations.

#### 2. Students take exams

Students can log in the system on time within the specified time for the examination.

#### 3. Teachers add exams

After logging in, teachers can add a test and set the start time and end time of

the test.

#### 4. Teachers can add papers and modify the questions in the papers

The teacher can add new papers after logging in, which can be used to select the papers to be tested when adding the tests, and they should be able to add questions in the modified papers.

#### 5. Add questions

Teachers can add test questions after logging in, and test questions can be added in different types and languages.

#### 6. View records

The test papers that students have taken should be automatically marked, and the results and wrong questions should be stored in the records, so that students can look at the test papers they have done and reflect on the questions they have made. There should be a ranking for each set of papers and each test, showing which students scored higher on the test, and information such as the average score and pass rate for each class.

What the system should have:

(1) Users can change the account passwords.

(2) Users can modify the information left when they register.

(3) Teachers can use random test paper when adding questions.

(4) When searching for the topic, user can search for the corresponding topic by keyword.

(5) Users can not directly enter an interface through the website, which should set filters and other methods to avoid.

(6) User rights, teachers can only modify their own registration information, not others.

(7) Students can join classes, teachers can manage classes, and each class can be managed by only one teacher.

Inadequate:

(1) Users should upload photos when registering.

(2) When students take the exam, they should call the camera to ensure that they are taking the exam.

(3) Students should fix the current page during the exam and cannot jump out of other pages, otherwise they should be given a warning, and the number of times they arrive should be marked as cheating.

(4) If students encounter sudden power failure, network interruption and other non-human failures during the examination, they should resume the questions that have been answered before the failure and continue to answer them when they re-enter the examination.

## 6.2 Non-functional requirements

1. When checking the examination records, students should mark the wrong questions in red to highlight the wrong questions. (Usability)
2. the interface should be simple and efficient. (Usability)
3. The system ought to be able to accommodate different CPU architectures. (Portability)
4. Even when there are many visitors online at once, the system ought always always run well. (Reliability)
5. Information about other users must not be accessible by users without consent. (Security)

## 7.The system design

### 7.1 Use Case design

UML diagrams of use cases are designed according to functional requirements. The UML diagram is divided into six functions. The roles are divided into students, teachers, administrators and teachers.

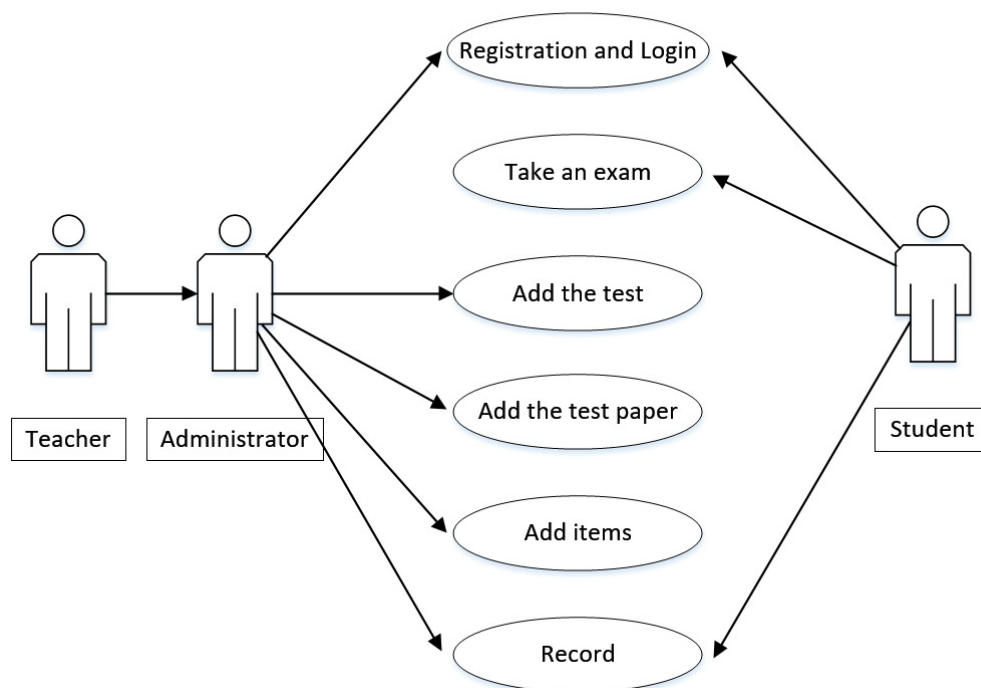


Figure 7.1 System use case diagram

#### 7.1.1 case 1

Registration and Login use cases:

There are two registration functions: student registration and teacher

registration. Students can click on the entry interface of the system and enter their own information to complete the registration. Teachers need to log in with the administrator account and password at the background login, and then they can complete the registration by entering the teacher information in the teacher adding interface. The administrator user is directly designated and cannot be obtained by registration.

The login function has three roles: administrator, teacher, and student. The administrator and teacher need to switch the login status to the background login, enter the background management interface. Students need to log in to the front desk login interface to enter the exam interface.

Operation process:

1. On the initial screen, users select Register now or Login now.
2. Users click the Register now button, fill in personal information, and click Submit button to automatically jump to the login page.
3. If the user logs in on the "Log in test" page, the user logs in as a student. The user can also click The Switch Login button in the upper right to switch to the screen displayed, The backstage entrance screen is displayed. The user can log in to the backstage system using the administrator and teacher account password.
4. The user enters the login account and submits the data.
5. The login is successful.



Optional process:

1. To click the Cancel button on the registration page to enter again.
2. When they filling in personal information on the registration page, if there are any missing items or the email format is wrong, click the submission box to display "This field is not filled in".
3. On registration page, users can click the Return button to return to the login page.
4. If the user does not enter the account password correctly on the login page, the system will prompt "The user name or password is incorrect!".
5. After successfully logging in, the user can click Logout in the upper right corner to logout the current account.

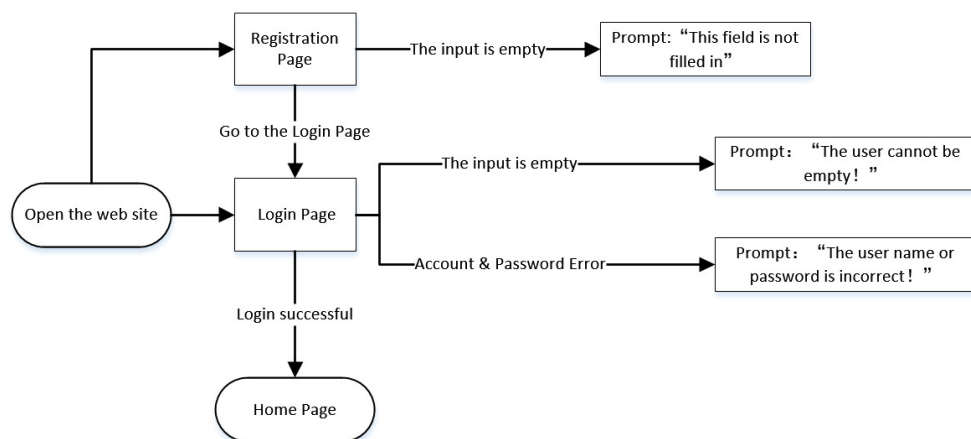


Figure 7.1 Registration and login process

## 7.1.2 use case 2

Student test use case:

After successful login, students can take the test on the test page. During the test, students can see the current time in real time and hand in the paper when they arrive at the specified time. After submitting the test paper, the background system will immediately automatically mark the paper, and the record will be saved in the record data sheet, this is a very fast way to save the manpower of the exam to mark the paper.

Operation process:

1. students log in to the home page, click the Exam button.
2. To click Start to enter the exam. When the answer is complete, students click Submit button to submit.
3. To click the Record button, students can view the test papers have been done.

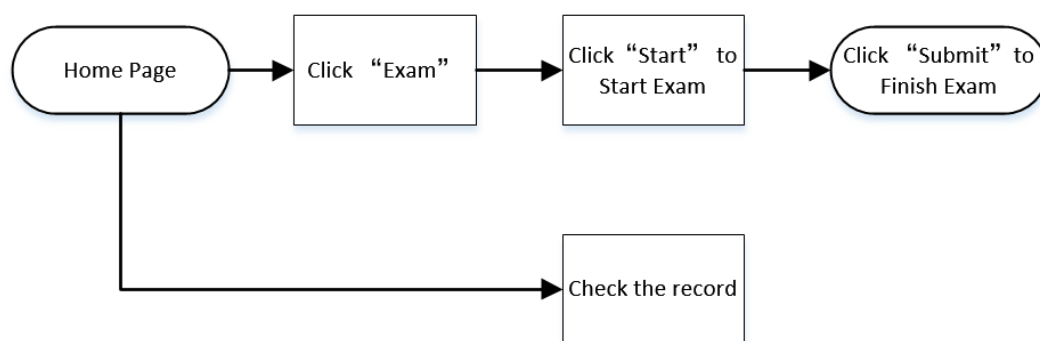


Figure 7.2 Student examination flow chart

### 7.1.3 case 3

Add Test use case:

After a teacher or administrator successfully logs in to an exam, The user can

add an exam and set its start time, end time, and test paper. Note: The test time must be set correctly. If the time is set incorrectly, students cannot enter the test after logging in.

Operation process:

1. teachers or administrators to log in to the background home page, click the left button in the Exam management.
2. Users click Add Exam to add an exam and select an appropriate exam Paper, or click the Paper management page to create an exam paper.
3. To select the test start time and end time, and click Add to add the test successfully.

Optional process:

1. The user can delete the added test.
2. The Over mark will be displayed for the test that has been taken.

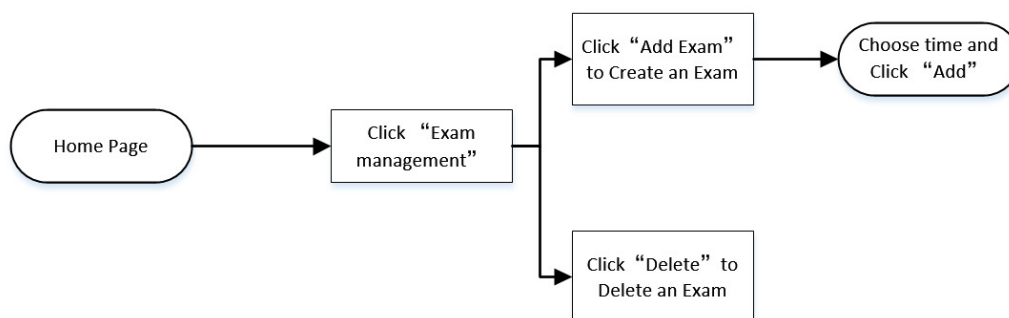


Figure 7.3 Flowchart of adding an exam

#### 7.1.4 case 4

Select Test Paper use case:

After logging in successfully, the teacher or administrator can add or modify the test paper, and also modify the questions in the test paper. After adding the test questions to the test paper, the user can choose a test paper to be tested when adding the test. Similarly, the questions in the test paper can also be modified or deleted.

Operation process:

1. After the teacher or administrator logs in, enter the background homepage and click the Paper management button on the left.
2. If the user choose to Add a new test Paper, click the "Add Paper" button; If the user choose to modify the name and question type of an existing paper, click the "Edit" button; If the user choose to modify the existing questions in the existing papers, click the "Management of test questions" button.
3. "Add Paper" : fill in the name of the test paper, single choice score, multiple choice score and judgment score, and click the "Add" button.
4. "Edit" : modify the name of the paper, single choice score, multiple choice score, and judgment score. Click the Add button at last.
5. "Management of test questions": to modify the questions in the examination paper, click "Artificial Add" to manually Add questions or select "Random Add" to random questions.

6. If manual addition is selected, to click "+" in Operation at the end of the page to add the test questions, and the column will display "!".

7. If they select "Generate Paper", first select Java, C or Python on The page, and then enter the added number in the "The title number" box. The number cannot exceed the total number of each type displayed at the bottom of the page.

Optional process:

1. The user can delete the questions in the test paper.
2. "not input" is displayed if they do not add the number when they set the question.

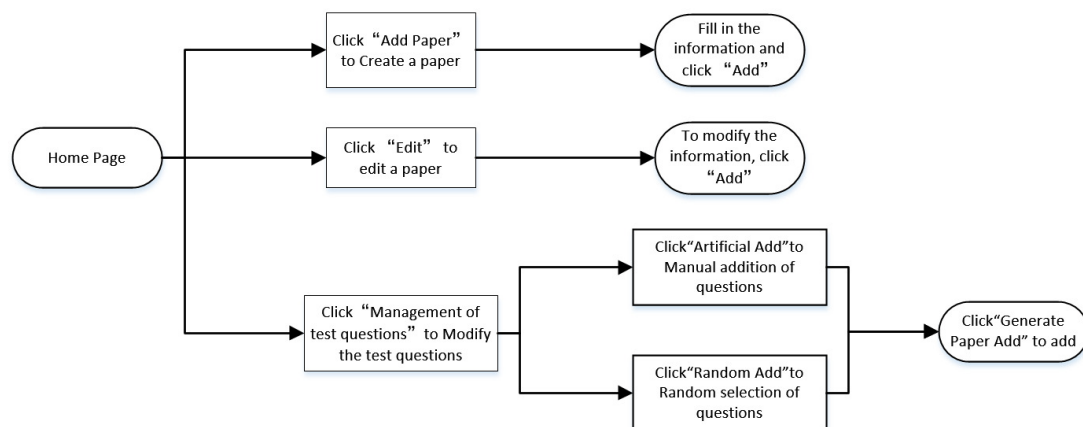


Figure 7.4 Flowchart of selecting test paper

### 7.1.5 use case 5

Add questions use case:

After a teacher or administrator successfully logs in, he or she can add or modify questions. The questions can be displayed according to the type of questions (single choice, multiple choice, and judgment), or according to the type of questions (C, Java, and Python), and the options of modifying or deleting questions can be displayed.

Operation process:

1. After the teacher or administrator logs in, enter the background homepage and click the Question management button on the left.
2. Users click the "Add Question" button, enter the information, and click the "Add" button to add the question.
3. To click the "Edit" button to modify the information. Click the "Edit" button to modify the test questions.

Optional process:

1. In the homepage of adding test questions, the user can search a certain type or a certain type of test questions in the search box.

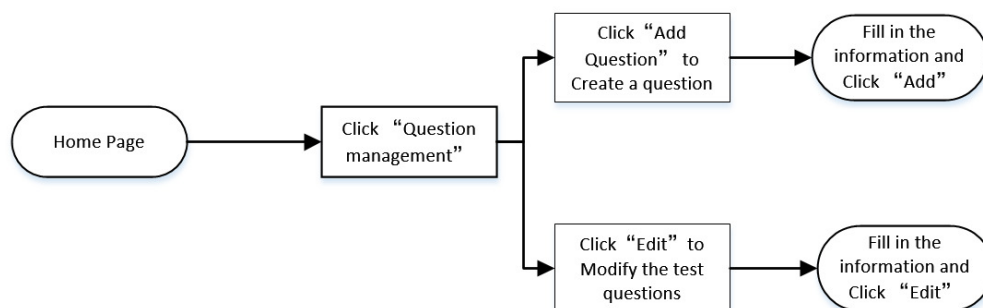


Figure 7.5 Flowchart of adding test questions:

### 7.1.6 case 6

To view the record:

After the teacher or administrator successfully logs in, they can view all the test records. They can display records according to each test, and they can also view statistical records according to the class. It will show the number of people who took the test, the number of people who passed and the pass rate.

Students can log in and check the record of the exam after the exam, which will show their own choices and correct choices in the exam paper, and reflect on their mistakes.

Operation process:

1. After the teacher or administrator logs in successfully, click Record management.
2. When all test records are displayed, click the "Class pass rate" button.
3. according to the class display record.
4. After students log in, click "Record" button.
5. To display all the tests the user have passed. Click "Detail" to display the details of the test.

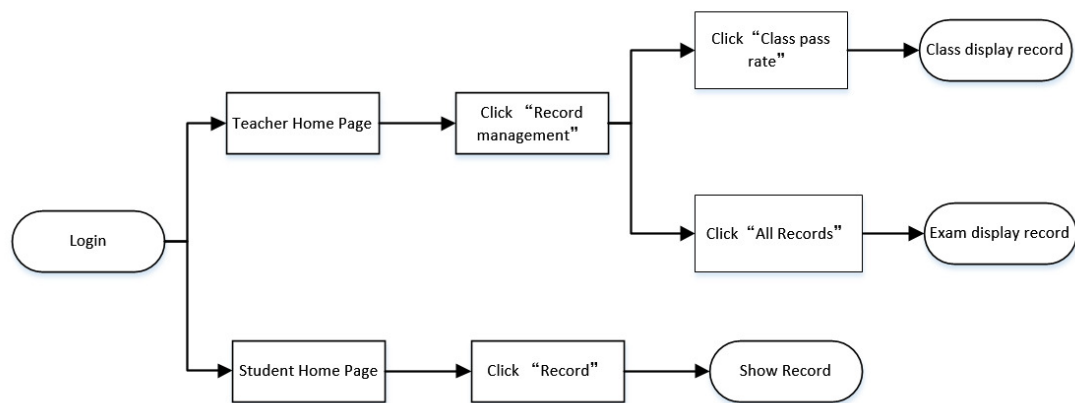


Figure 7.6 Viewing the record flow chart

## 7.2 Page Design

The front-end page of this system is designed using Bootstrap and JQuery framework, and the system background interface is simple and easy to understand. AJAX is also used to create fast dynamic web pages.

### 7.2.1 home page

The main page displays the registration and login button, and three columns of information are displayed at the bottom of the page:

1. Total number of students and teachers.
2. The number of questions in the database.
3. The total number of examination papers.



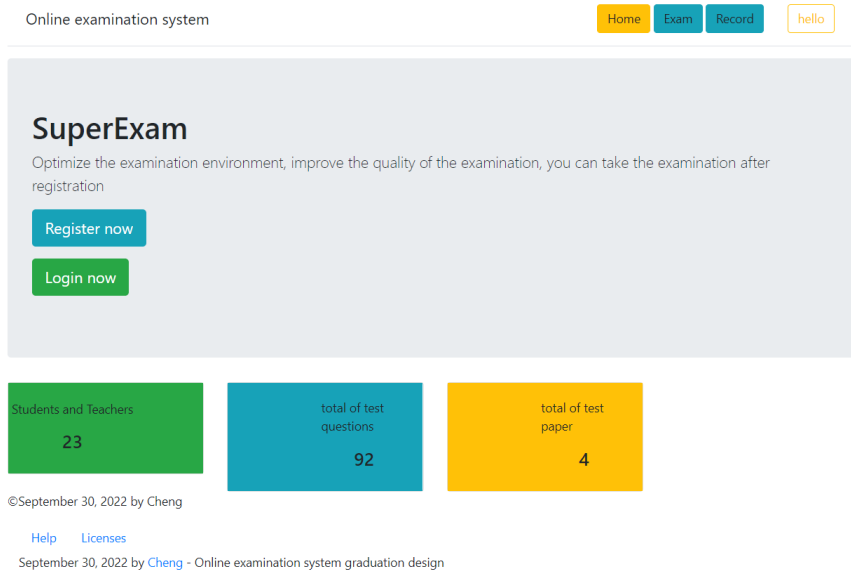
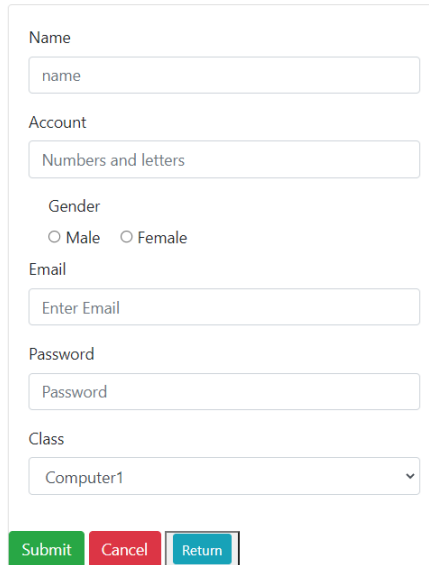


Figure 7.7 Main page

## 7.2.2 Student Page

### 1. Registration page

The student registration interface is mainly simple, requiring users to enter only their name, account number, gender, password, email address and class. The student login interface is mainly gray, and the background login interface is mainly blue to distinguish it from the foreground login interface. The registration page is as follows:

**Student Registration Interface**

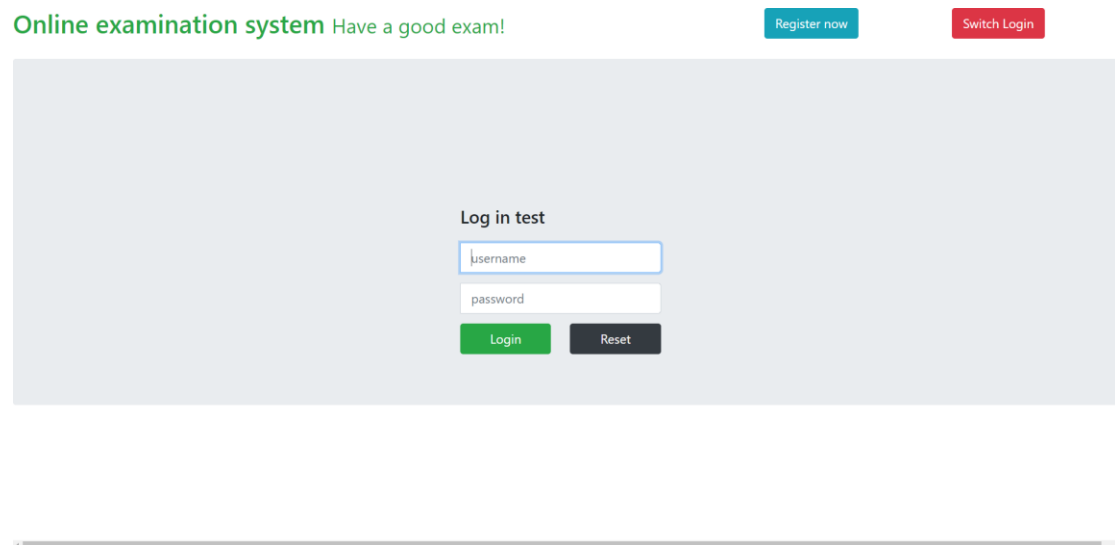
The registration form is titled "Student Registration Interface". It contains the following fields and controls:

- Name:** A text input field with the placeholder text "name".
- Account:** A text input field with the placeholder text "Numbers and letters".
- Gender:** Two radio buttons labeled "Male" and "Female".
- Email:** A text input field with the placeholder text "Enter Email".
- Password:** A text input field with the placeholder text "Password".
- Class:** A dropdown menu with "Computer1" selected.
- Buttons:** Three buttons at the bottom: "Submit" (green), "Cancel" (red), and "Return" (blue).

Figure 7.8 Registration page

**2. Login page**

The student login page is as follows:



The login page is titled "Online examination system" with the tagline "Have a good exam!". It features a navigation bar with "Register now" and "Switch Login" buttons. The main content area is a light gray box containing a "Log in test" section with the following elements:

- Log in test:** A heading for the login section.
- username:** A text input field.
- password:** A text input field.
- Login:** A green button.
- Reset:** A dark gray button.

Figure 7.9 Login page

**3. Student homepage**

The student homepage displays the exam declaration, exam button and view record.

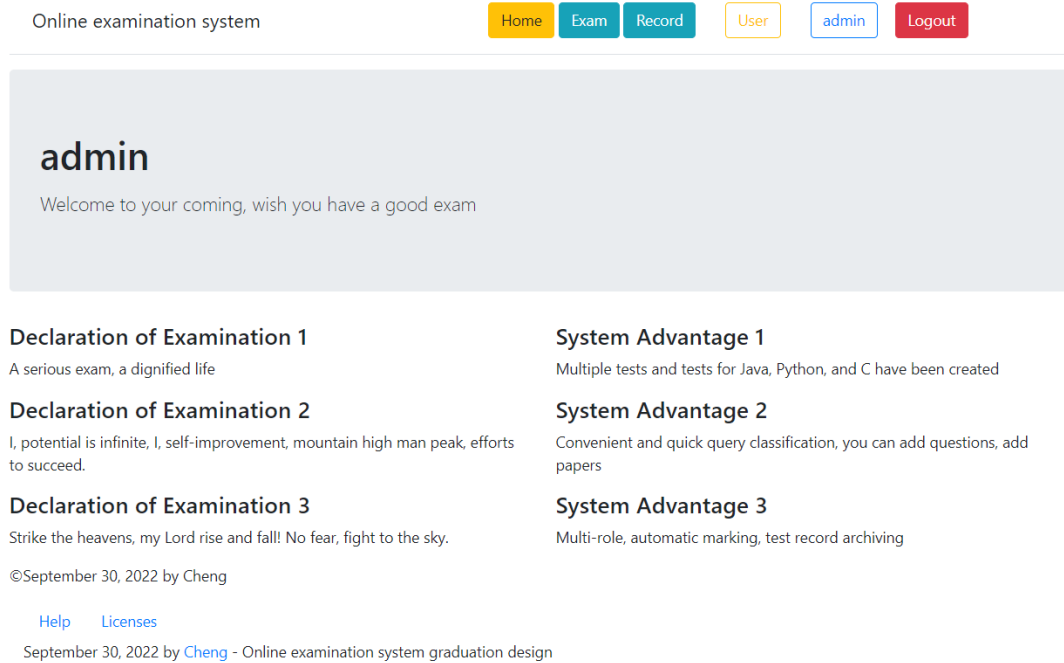


Figure 7.10 Student homepage

## 4. Test page

The current time and end time are displayed on the left side of the exam page, and the submit button is displayed in the middle. The overall interface is simple and elegant, which is convenient for students to concentrate on answering questions.

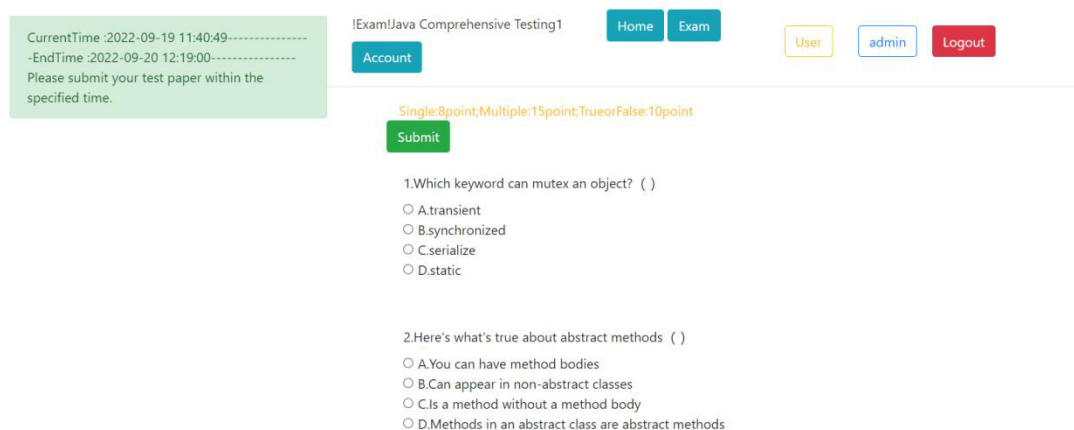


Figure 7.11 Taking the test page

## 5. Check the exam record page

The page displays the test questions, the answers chosen by the students themselves, and the correct answers. The wrong answers are marked in red to help students locate the wrong questions.

---

Online examination system

[Home](#) [Exam](#) [Record](#) [User](#) [admin](#) [Logout](#)

---

1.Which keyword can mutex an object? ( ) ———Your answer: A ——— Correct answers: B

A.transient  
B.synchronized  
C.serialize  
D.static

2.Here's what's true about abstract methods ( ) ———Your answer: A ——— Correct answers: D

A.You can have method bodies  
B.Can appear in non-abstract classes  
C.Is a method without a method body  
D.Methods in an abstract class are abstract methods

3.Which object can be used to get the request sent by the browser? ( ) ———Your answer: A ——— Correct

A.HttpServletRequest  
B.HttpServletResponse  
C.HttpServlet  
D.Http

4.An expression which of the following values is not true? ( ) ———Your answer: C ——— Correct

A."john" == "john"

Figure 7.12 Viewing the exam record

## 7.2.3 Administrator Page

### 1. The teacher and administrator login page is displayed

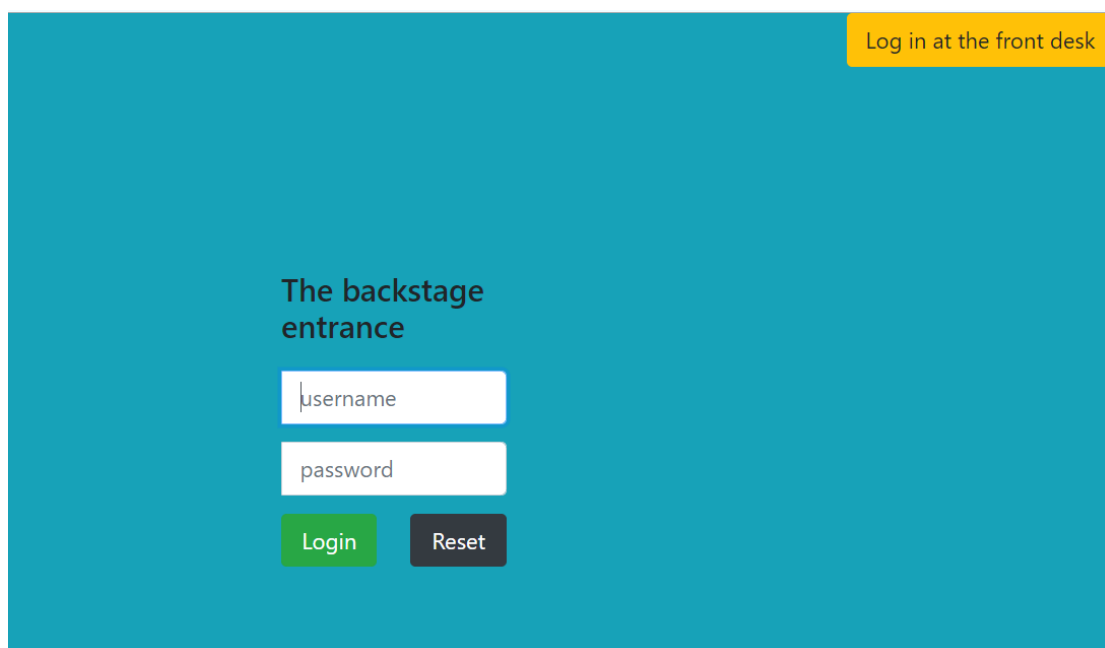


Figure 7.13 Teacher and student login page

## 2. Student management page

Student management page displays each student's personal information, administrator login can be modified.

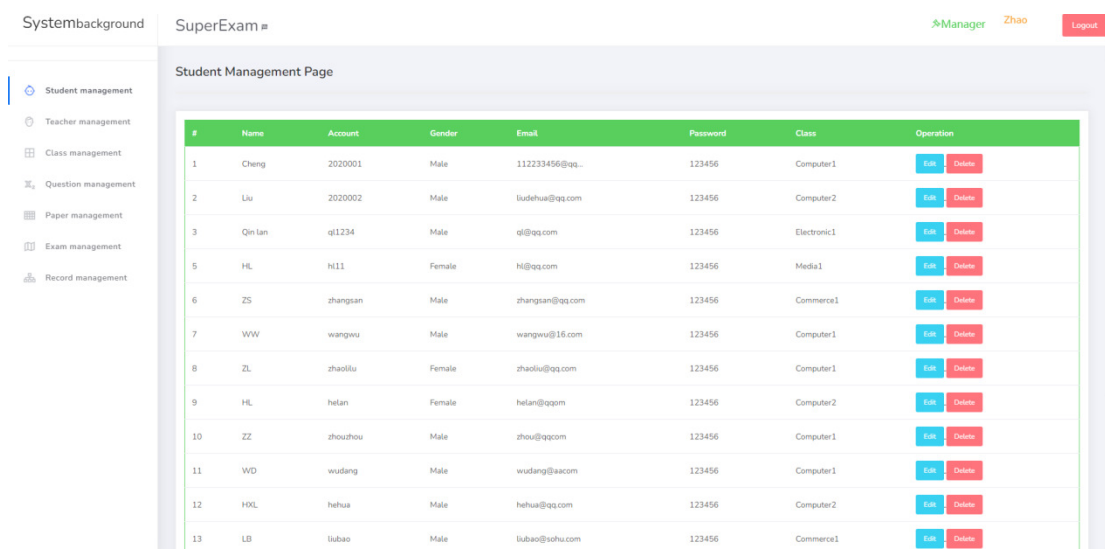


Figure 7.14 Student Management page

## 3. Teacher management page

The administrator can log in and modify the teacher information. On the modify

page, the administrator can click to display the password.

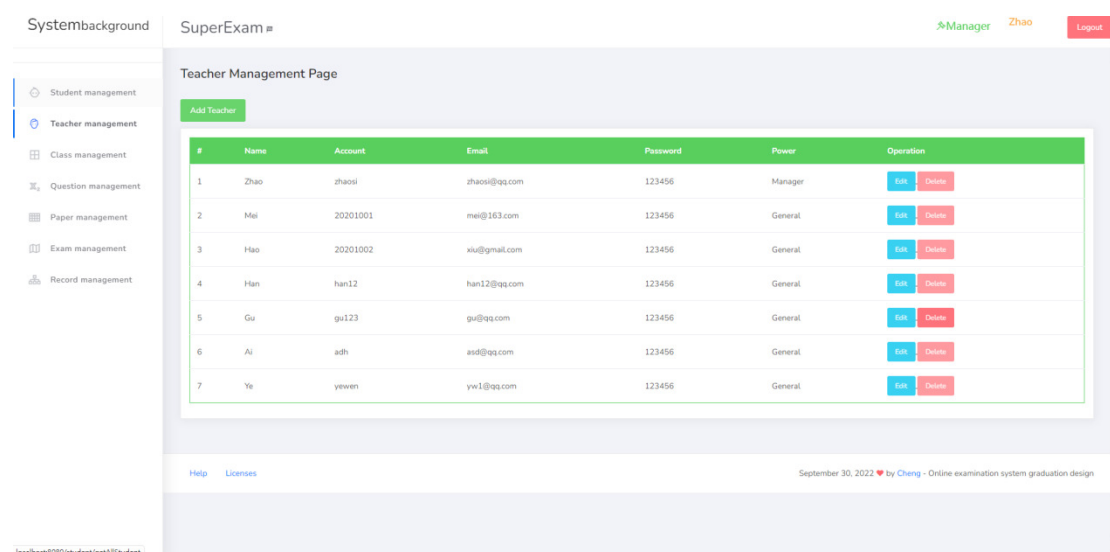


Figure 7.15 Teacher management page

#### 4. Modify page

Teacher Management Page

Name:

Account:

Email:   
Your email. I won't give it away

Password:

[Show the password](#)

[Edit](#) [Return](#)

Figure 7.16 Modify Information page

#### 5. Class management page

After the administrator logs in, he can choose to add a course, modify a course teacher, and delete a course on the course management page.

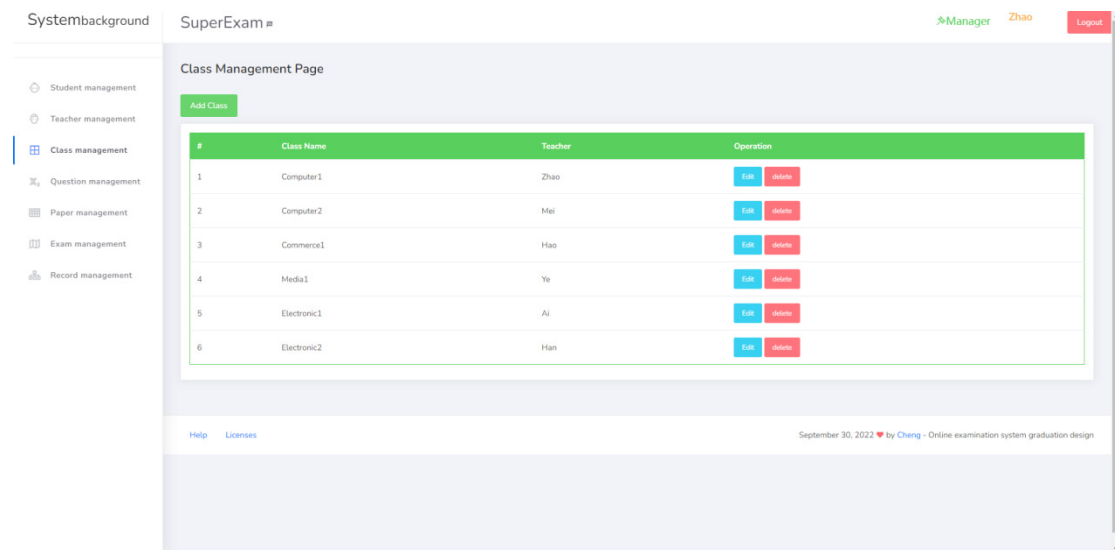


Figure 7.17 Class management page

## 7.2.4 Teacher Page

### 1. Teacher homepage

In the middle of the teacher's homepage, the score list will be displayed. The teacher can choose which subject list to view, so as to understand the learning situation of students, which is helpful for targeted teaching of students. Teachers can also inform students, so as to encourage them to do well in exams and try to get on the league tables.

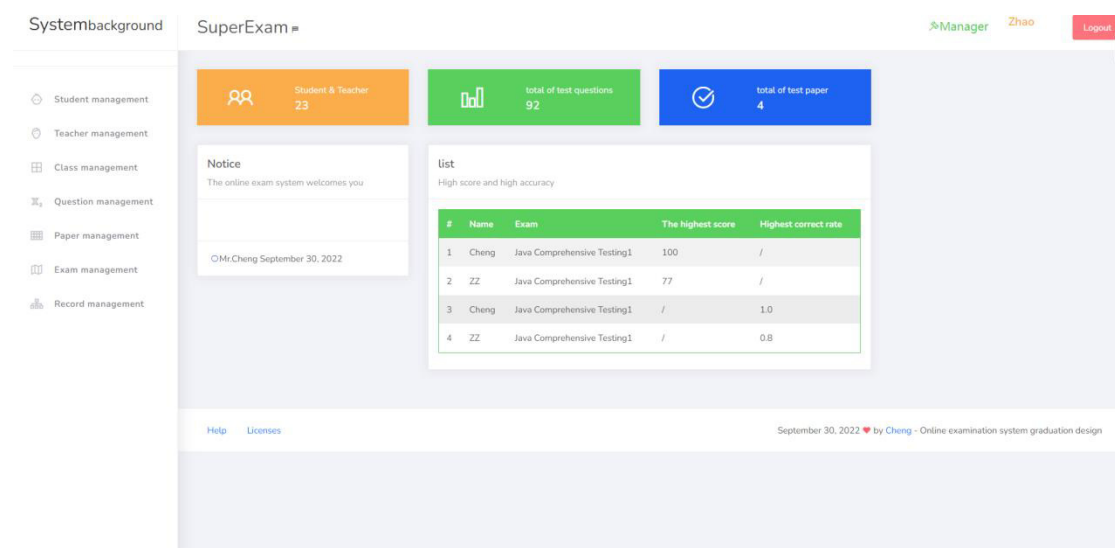


Figure 7.18 Teacher home page

## 2. Question management page

The main page of test question management displays the existing test questions according to four pages per page. The page of adding test questions is simple, and users can enter the questions, options and correct options.

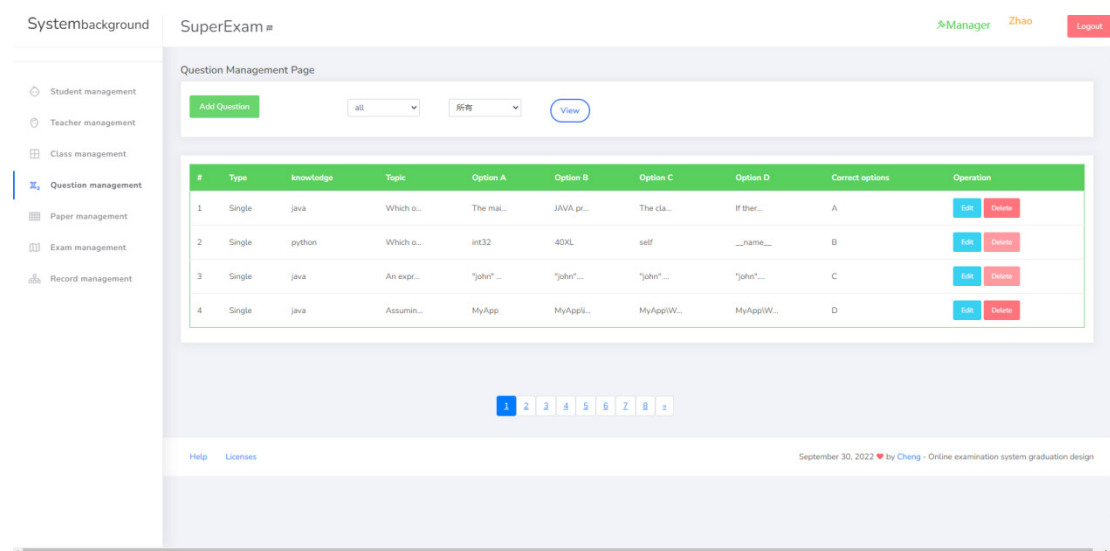


Figure 7.19 Question management main page

Page for adding questions:

Question Management Page

knowledge: java

Type: Single

Topic: Topic

Option A: Option content

Option B:

Option C:

Option D:

Correct answer:

[Add](#) [Return](#)

Figure 7.20 Question adding page



### 3. Paper management page

Examination paper management home page shows the existing examination paper, simple operation, easy to understand. Test paper add interface need to enter the name of the test paper and a variety of questions can be scores. The question management page of the test paper displays the questions of the current test paper. The user can see the question, type of test and correct answer. The user can also choose to remove the question. The upper part of the question management page of the examination paper selects manually add questions or randomly add questions.

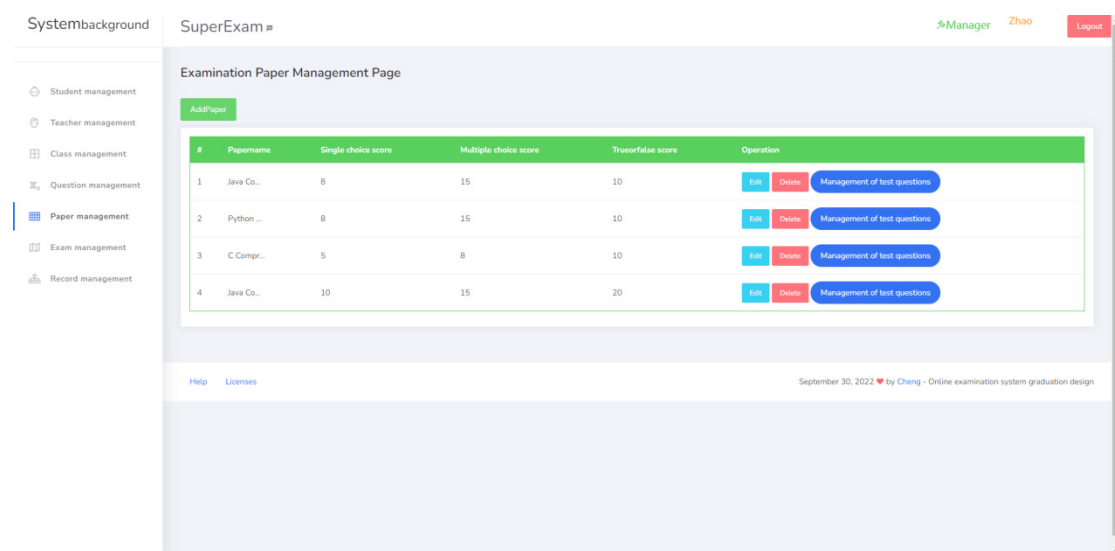


Figure 7.21 Test Paper management home page

Add test paper:

Paper Management Page

Name of test paper

Single choice score

Multiple choice score

Trueorfalse score

[Add] [Return]

Figure 7.22 Add Test paper

The question management page of the test paper:

Java Comprehensive Testing1Paper—Question

Artificial Add Random Add Return

| Batch delete               | #  | Type        | Knowledge | Topic   | Correct options | Operation              |
|----------------------------|----|-------------|-----------|---|-----------------|------------------------|
| <input type="checkbox"/> - | 1  | Single      | java      | Which object can be used to get the request sent by the browser?  | A               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 2  | Multiple    | java      | Which of the following statements is false?   | ACD             | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 3  | Multiple    | java      | Which matches the characteristics of the Java language?   | AB              | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 4  | TrueorFalse | java      | Java supports multiple inheritance  | F               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 5  | Single      | java      | An expression which of the following values is not true?  | C               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 6  | Single      | java      | What is a function called when there can be two functions of the same name in the definition of a class | C               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 7  | Single      | java      | Which keyword can mutex an object?  | B               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 8  | Single      | java      | Here's what's true about abstract methods   | D               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 9  | TrueorFalse | java      | The two elements that describe an object are properties and methods                                     | T               | <a href="#">Remove</a> |
| <input type="checkbox"/> - | 10 | TrueorFalse | python    | The elements in a tuple are immutable   | T               | <a href="#">Remove</a> |

FIG. 7.23 Test question management page

Manually created test papers:

Java Comprehensive Testing1Test Papers - Add a test page

A key to add Return all All View

| # | Type   | Knowledge of test question | Topic      | Option A   | Option B   | Option C   | Option D   | Correct options | Operation         |
|---|--------|----------------------------|------------|------------|------------|------------|------------|-----------------|-------------------|
| 1 | Single | java                       | Which o... | The mal... | JAVA pr... | The cla... | If ther... | A               | <a href="#">+</a> |
| 2 | Single | python                     | Which o... | int32      | 40XL       | self       | __name__   | B               | <a href="#">+</a> |
| 3 | Single | java                       | An expr... | "john" ... | "john"...  | "john" ... | "john"...  | C               | <a href="#">-</a> |
| 4 | Single | java                       | Assumin... | MyApp      | MyAppli... | MyApplW... | MyApplW... | D               | <a href="#">+</a> |

1 2 3 4 5 6 7 8 9

FIG. 7.24 Manual composition of the test paper

Randomly formed test papers

Java Comprehensive Testing1---Test paper - Pages with questions

Choose the number of questions in the course

Return  The title number

|                    |    |
|--------------------|----|
| Totalnumberproblem | 92 |
| java               | 37 |
| python             | 27 |
| c                  | 28 |

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Figure 7.2 Random composition of the test paper

#### 4. Exam management page

The test administration page displays all existing tests, and tests that have been taken are marked Over. The test Add page requires the user to enter the test name, start time, and end time.

Exam Management page:

Systembackground SuperExam # Manager Zhao Logout

Exam Management Page

Add Exam

| # | Test paper                    | Start Time       | End Time         | Operation |      |
|---|-------------------------------|------------------|------------------|-----------|------|
| 1 | Java Comprehensive Testing1   | 2022-02-01 10:00 | 2022-02-01 12:00 | Delete    | Over |
| 2 | Python Comprehensive Testing1 | 2022-02-01 10:00 | 2022-02-01 12:00 | Delete    | Over |
| 3 | C Comprehensive Testing1      | 2022-02-01 13:30 | 2022-02-01 15:00 | Delete    | Over |
| 4 | Java Comprehensive Testing1   | 2022-02-09 10:00 | 2022-02-09 11:00 | Delete    | Over |
| 5 | Python Comprehensive Testing1 | 2022-02-09 11:00 | 2022-02-09 13:00 | Delete    | Over |
| 6 | Java Comprehensive Testing2   | 2022-02-09 15:00 | 2022-02-09 16:00 | Delete    | Over |
| 7 | C Comprehensive Testing1      | 2022-03-05 12:00 | 2022-03-05 13:30 | Delete    | Over |
| 8 | Java Comprehensive Testing1   | 2022-03-05 12:00 | 2022-03-05 14:00 | Delete    | Over |
| 9 | Java Comprehensive Testing1   | 2022-09-20 12:19 | 2022-09-20 12:19 | Delete    |      |

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Test add page:

Question Management Page

Test paper  
Java Comprehensive Testing1

Start Time  
年/月/日 --:--

End Time  
年/月/日 --:--

Add Return

## 5. Record the page

The home page of the record page shows the answering status of each test, accurate to personal data. The teacher can also click on the Class pass rate to check the class situation.

## Record Page Home Page:

Systembackground SuperExam # Manager Zhao Logout

Examination Paper Management Page

Class pass rate

| #  | Name    | Examination record paper | Answer                      | Correct | The total score | Operation |
|----|---------|--------------------------|-----------------------------|---------|-----------------|-----------|
| 1  | Cheng   | Java Co...               | D.A.C.C.B.A.C.D.A.B.T.F.T   | 1.0     | 100             | Delete    |
| 2  | Liu     | Java Co...               | A.C.C.D.B.A.B.C.C.T.F.T     | 0.5     | 46              | Delete    |
| 3  | Cheng   | Python ...               | A.B.C.B.C.C.D.B.C.D.T.F.T   | 0.6     | 66              | Delete    |
| 4  | Liu     | Python ...               | B.B.C.B.C.A.C.B.C.D.T.F.T   | 0.6     | 59              | Delete    |
| 5  | Qin lan | Java Co...               | C.C.B.C.C.B.C.D.A.B.F.T.T   | 0.7     | 69              | Delete    |
| 6  | Qin lan | Python ...               | B.B.C.B.A.C.D.A.B.C.D.T.F.T | 0.5     | 51              | Delete    |
| 7  | WW      | Java Co...               | C.C.B.B.C.A.B.C.A.B.T.F.T   | 0.5     | 49              | Delete    |
| 8  | WW      | Python ...               | B.B.B.B.C.A.C.B.C.T.F.F     | 0.6     | 54              | Delete    |
| 9  | ZL      | Java Co...               | A.C.B.B.C.C.A.B.F.T.T       | 0.6     | 61              | Delete    |
| 10 | ZL      | Python ...               | B.C.C.C.C.A.B.C.B.T.F.T     | 0.5     | 44              | Delete    |
| 11 | ZZ      | Java Co...               | C.C.B.A.A.C.A.B.F.T.T       | 0.8     | 77              | Delete    |
| 12 | ZZ      | Python ...               | C.C.A.B.C.B.C.B.T.F.T       | 0.6     | 63              | Delete    |

## Class examination Status:

Systembackground SuperExam Manager Zhao Logout

Test paper class pass rate page

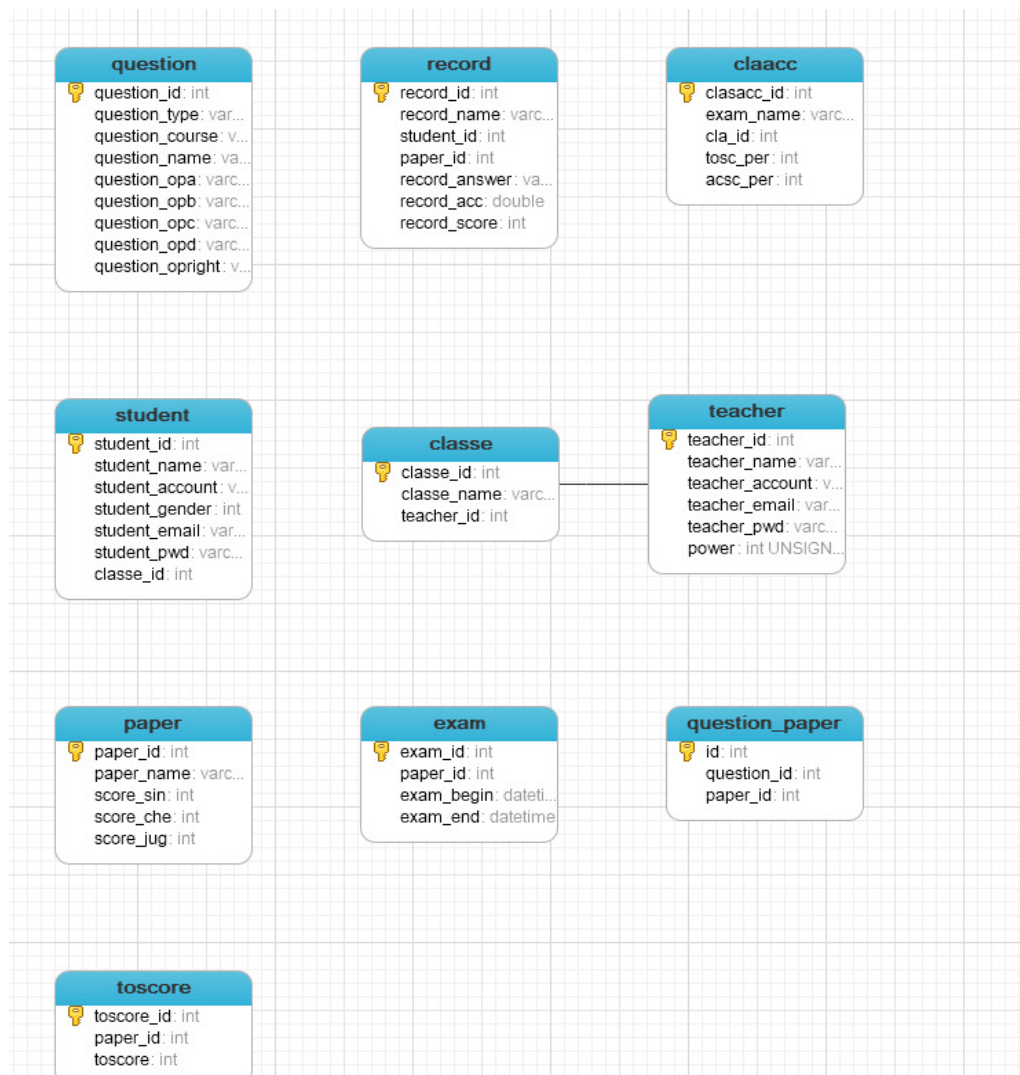
All Records

| #  | Exam       | Class       | The reference number | Number of passers | Pass rate |
|----|------------|-------------|----------------------|-------------------|-----------|
| 1  | Java Co... | Computer1   | 13                   | 4                 | 0.31      |
| 2  | Java Co... | Computer2   | 2                    | 0                 | 0.0       |
| 3  | Java Co... | Electronic1 | 1                    | 1                 | 1.0       |
| 4  | Python ... | Computer1   | 6                    | 1                 | 0.17      |
| 5  | Python ... | Computer2   | 2                    | 0                 | 0.0       |
| 6  | Python ... | Electronic1 | 1                    | 0                 | 0.0       |
| 7  | C Compr... | Computer1   | 5                    | 5                 | 1.0       |
| 8  | C Compr... | Computer2   | 3                    | 1                 | 0.33      |
| 9  | C Compr... | Commerce1   | 1                    | 1                 | 1.0       |
| 10 | Java Co... | Computer1   | 1                    | 0                 | 0.0       |

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## 7.3 Database design

Database structure diagram:



### 7.3.1 Class Table

Class tables are used to store classes and the teachers who manage them.

| Name        | Type    | Length | Primary<br>Key | Whether<br>is empty |
|-------------|---------|--------|----------------|---------------------|
| classe_id   | int     | 11     | √              | ×                   |
| classe_name | varchar | 255    | ×              | √                   |
| teacher_id  | Int     | 11     | ×              | √                   |

### 7.3.2 Exam Table

The test sheet is used to store information about the test.

| Name       | Mean              | Type     | Length | Primary<br>Key | Whether<br>is empty |
|------------|-------------------|----------|--------|----------------|---------------------|
| exam_id    |                   | int      | 11     | √              | ×                   |
| paper_id   |                   | int      | 11     | ×              | √                   |
| exam_begin | The start<br>time | Datetime | 11     | ×              | √                   |
| exam_end   | The end<br>time   | Datetime | 11     | ×              | √                   |

### 7.3.3 Paper Table

Test sheet is used to store information about test papers.

| Name     | Type | Length | Primary<br>Key | Whether<br>is empty |
|----------|------|--------|----------------|---------------------|
| paper_id | int  | 11     | √              | ×                   |

|            |         |     |   |   |
|------------|---------|-----|---|---|
| paper_name | varchar | 255 | × | √ |
| score_sin  | int     | 11  | × | √ |
| score_che  | int     | 11  | × | √ |
| score_jug  | int     | 11  | × | √ |

### Sections 7.3.4 Question Table

Question sheets are used to store information about questions

| Name             | Type    | Length | Primary<br>Key | Whether<br>is empty |
|------------------|---------|--------|----------------|---------------------|
| question_id      | int     | 11     | √              | ×                   |
| question_type    | varchar | 255    | ×              | √                   |
| question_course  | varchar | 255    | ×              | √                   |
| question_name    | varchar | 255    | ×              | √                   |
| question_opa     | varchar | 255    | ×              | √                   |
| question_opb     | varchar | 255    | ×              | √                   |
| question_opc     | varchar | 255    | ×              | √                   |
| question_opd     | varchar | 255    | ×              | √                   |
| question_opright | varchar | 255    | ×              | √                   |

### 7.3.5 Question\_Paper Table

Test papers \_ List of questions used to relate test papers to test questions.

| Name | Type | Length | Primary<br>Key | Whether<br>is empty |
|------|------|--------|----------------|---------------------|
|------|------|--------|----------------|---------------------|

|             |     |    |   |   |
|-------------|-----|----|---|---|
| Id          | int | 11 | √ | × |
| question_id | int | 11 | × | √ |
| paper_id    | int | 11 | × | √ |

### 7.3.6 Record Table

A record sheet is used to store exams that have already been taken.

| Name          | Type    | Length | Primary Key | Whether is empty |
|---------------|---------|--------|-------------|------------------|
| record_id     | int     | 11     | √           | ×                |
| record_name   | varchar | 255    | ×           | √                |
| student_id    | int     | 11     | ×           | √                |
| paper_id      | int     | 11     | ×           | √                |
| record_answer | varchar | 255    | ×           | √                |
| record_acc    | double  | 255    | ×           | √                |
| record_score  | int     | 11     | ×           | √                |

### 7.3.7 Student Table

The Student table is used to store students' personal information.

| Name         | Type    | Length | Primary Key | Whether is empty |
|--------------|---------|--------|-------------|------------------|
| student_id   | int     | 11     | √           | ×                |
| student_name | varchar | 255    | ×           | ×                |



|                 |         |     |   |   |
|-----------------|---------|-----|---|---|
| student_account | varchar | 255 | × | × |
| student_gender  | int     | 11  | × | √ |
| student_email   | varchar | 255 | × | √ |
| student_pwd     | varchar | 255 | × | √ |
| classe_id       | int     | 11  | × | × |

### 7.3.8 the Teacher Table

The teacher table is used to store the personal information of teachers.

| Name            | Type    | Length | Primary<br>Key | Whether<br>is empty |
|-----------------|---------|--------|----------------|---------------------|
| teacher_id      | int     | 11     | √              | ×                   |
| teacher_name    | varchar | 255    | ×              | ×                   |
| teacher_account | varchar | 255    | ×              | √                   |
| teacher_email   | varchar | 255    | ×              | √                   |
| teacher_pwd     | varchar | 255    | ×              | √                   |
| power           | int     | 11     | ×              | √                   |

### 7.3.9 Toscore Table

The total score table is used to store the total score of the paper.

| Name       | Type | Length | Primary<br>Key | Whether<br>is empty |
|------------|------|--------|----------------|---------------------|
| toscore_id | int  | 11     | √              | ×                   |
| paper_id   | int  | 11     | ×              | √                   |

|         |     |    |   |   |
|---------|-----|----|---|---|
| toscore | int | 11 | × | √ |
|---------|-----|----|---|---|

---

## 8. System implementation

### 8.1 Configuring the Environment

#### 8.1.1 Maven

Maven is a build tool that not only automates builds, but also abstracts the build process and provides build task implementations; Maven is a tool for managing dependencies and projects in addition to being a tool for building. It provides a central repository that helps us download components automatically. Using Maven, we can easily import dependency packages.

Pom. XML file:

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>2.2.2.RELEASE</version>
    <relativePath/> <!-- lookup parent from repository -->
  </parent>
  <groupId>com.zhao</groupId>
  <artifactId>quiz</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <name>quiz</name>
  <description>Demo project for Spring Boot</description>

  <properties>
    <java.version>1.8</java.version>
  </properties>

  <dependencies>
    <dependency>
      <groupId>org.springframework.boot</groupId>
      <artifactId>spring-boot-starter-jdbc</artifactId>
    </dependency>
    <dependency>
      <groupId>org.springframework.boot</groupId>
```

#### 8.1.2 Mybatis

MyBatis is a top-notch persistent layer framework that supports stored

procedures, customizable SQL, and sophisticated mapping. It avoids almost all JDBC code and manually setting parameters and getting result sets. So we can use it to interact with the database level.

### Student Mapper:

```
<?xml version="1.0" encoding="UTF-8" ?>
<!DOCTYPE mapper
  PUBLIC "-//mybatis.org/DTD Mapper 3.0//EN"
  "http://mybatis.org/dtd/mybatis-3-mapper.dtd">
<mapper namespace="com.zhao.quiz.mapper.StudentMapper">
  <resultMap id="studentResult" type="com.zhao.quiz.domain.Student">
    <id property="studentId" column="student_id" />
    <result property="studentName" column="student_name"/>
    <result property="studentAccount" column="student_account"/>
    <result property="studentGender" column="student_gender"/>
    <result property="studentEmail" column="student_email"/>
    <result property="studentPwd" column="student_pwd"/>
    <result property="classeId" column="classe_id"/>
    <association property="classe" column="#" javaType="com.zhao.quiz.domain.Classe" resultMap="classeResult"/>
  </resultMap>
  <resultMap id="classeResult" type="com.zhao.quiz.domain.Classe">
    <id property="classeId" column="classe_id"/>
    <result property="classeName" column="classe_name"/>
  </resultMap>
  <!-- 查询所有学生信息包括班级 -->
  <select id="queryAll" resultMap="studentResult">
    select * from student left join classe on student.classe_id = classe.classe_id
  </select>
  <!-- 根据id查询学生信息也包括班级 -->
  <select id="getStudentById" resultMap="studentResult" parameterType="Integer">
    select * from student left join classe on student.classe_id = classe.classe_id
    where student_id =#{id}
  </select>
</mapper>
```

## 8.2 Register

I use "input" to get the form data entered in the front-end interface, instantiate it as a "Student" object, put it in "LoginController.java" for processing, and then call the "studentService.AddStudent()" method, which corresponds to Mybatis. The "StudentMapper.xml" file is stored in the database.

The code of the student registration page is as follows: "required" means that if the input box is empty, a prompt will be displayed: "This field is not filled in".

```

class="card">
<div class="card-body">
  <div class="form-group">
    <label for="name">Name</label>
    <input type="text" class="form-control" required oninvalid="setCustomValidity('This field is not filled in');" oninput="setCustomValidity('');" nam
  </div>
  <div class="form-group">
    <label for="name">Account</label>
    <input type="text" class="form-control" required oninvalid="setCustomValidity('This field is not filled in');" oninput="setCustomValidity('');" nam
    <small id="accounthelp" class="form-text text-muted"></small>
  </div>
  <div class="form-check">
    <label>Gender</label><br>
    <label class="form-radio-label">
      <input class="form-radio-input" type="radio" name="studentGender" value="1">
      <span class="form-radio-sign">Male</span>
    </label>
    <label class="form-radio-label ml-3">
      <input class="form-radio-input" type="radio" name="studentGender" value="0">
      <span class="form-radio-sign">Female</span>
    </label>
  </div>
  <div class="form-group">
    <label for="email">Email</label>
    <input type="email" class="form-control" required oninvalid="setCustomValidity('This field is incorrectly filled in');" oninput="setCustomValidity('');" nam
    <small id="emailhelp" class="form-text text-muted"></small>
  </div>
</div>

```

StudentService. AddStudent () method:

```

//添加具体操作
@RequestMapping("/preexam/AddStudent")
public String AddStudent(Student student){
    studentService.AddStudent(student);
    return "redirect:/foreLogin";
}

```

StudentMapper.xml. Write data to the database:

```

</select>
<!--添加学生，注册-->
<insert id="AddStudent" parameterType="com.zhao.quiz.domain.Student">
    insert into student
        (student_name,student_account,student_gender,student_email,student_pwd,classe_id)
    values
        ({studentName},{studentAccount},{studentGender},{studentEmail},{studentPwd},{classeId})
</insert>

```

## 8.3 The login

The data processing process of the student login page is as follows: I use "input" to get the form data entered in the front-end interface, instantiate it as a

"Student" object, put it in "LoginController.java" for processing, and then call "studentService.check( )" method, which corresponds to the "StudentMapper.xml" file under Mybatis to query the database, and finally returns a "Student" object, if it is not queried, it returns "null". This is made to determine whether or not the login can be performed.

Student login page code:

```
</div>
<div class="jumbotron">
  <form action="LoginServlet" th:action="@{/foreLogin/check}" method="post" class="form-signin" style="...">
    <div class="row">
      <div class="form-group col-lg-4 input-group input-group-lg">
        <h3 class="form-signin-heading">Log in test</h3>
      </div>
    </div>
    <div class="row">
      <div class="form-group col-lg-4 input-group input-group-lg">
        <label for="username" class="sr-only">Username</label> <input
          type="text" id="username" class="form-control"
          placeholder="username" required autofocus name="studentAccount">
        </div>
      </div>
    </div>
  </form>
</div>
```

studentService.check ( ) method code:

```
//前台学生登录考试
@ResponseBody
@RequestMapping("/foreCheck/check")
public Object foreCheck(Student student, HttpServletRequest request){
    AjaxResult result=new AjaxResult();
    HttpSession session=request.getSession();
    Student stud=studentService.check(student);
    if(stud!=null){
        session.setAttribute("loger",stud);
        result.setSuccess(true);
    }else {
        result.setSuccess(false);
    }
    return result;
}
```

In the StudentMapper.xml file, query the database using the following code:

```
<!-- 检查登录 -->
<select id="check" parameterType="com.zhao.quiz.domain.Student" resultType="com.zhao.quiz.domain.Student">
  select * from student where student_account=#{studentAccount} and student_pwd=#{studentPwd}
</select>
```

## 8.4 Submitting an Exam

After students log in, enter the exam page, click the submit button when the exam is completed, and the background data processing is as follows:

It is processed in the "ExamController.java" file. First, each question of the test paper is obtained in the background according to the "test paper ID", and an "ArrayList" is generated, which contains the answer of each question under the test paper, and then each question submitted by the student is stored in the "ArrayList", and the correct answer to each question is also stored in an "ArrayList". Finally, after traversing all the questions, check whether the correct answer of each question is consistent with the submitted answer in order. If they are consistent, then judge whether the question is a single-choice question, a multiple-choice question or a judgment question, and finally calculate the total score according to the score. Instantiate the data as a "Record" object, call the "recordService.addRecord()" method, and store it in the database corresponding to the "RecordMapper.xml" file under Mybatis.

Test page front desk code:

```
<div class="row">
  <div id="timemachine" class="alert alert-success col-3 fixedNav fixed-top m-lg-4" role="alert" th:text="currentTime :'+#{dates.format(new java.util....}}>
  <div class="col-md-3"></div>
  <form th:action="@{/exam/submitExam}" method="post">
    <div class="col-md-18 text-warning" th:text="'Single: '+#{questionPapers.get(0).paper.getScoreSin()}+'point; Multiple: '+#{questionPapers.get(0).paper.getSc...}>
    <button class="btn btn-success" th:text="Submit"></button>
    <!-- 提交试卷id, 学生id -->
    <input type="hidden" name="paperId" th:each="qb,qbStat:${questionPapers}" th:value="${qb.paperId}">
    <input type="hidden" name="studentId" th:value="${session.loner.studentId}">
    <div>
      <div class="row form-check" th:each="qb,qbStat:${questionPapers}">
        <div class="col-xs-12 col-lg-12">
          <!-- 分三种题型显示以及提交值 -->
          <label th:if="${qb.question.questionType=='y'}" th:text="${qbStat.count}+' ('+#{Multiple}+')'+#{qb.question.questionName}+' ('+#{ })' "></label><br>
          <label th:if="${qb.question.questionType=='y'}" th:text="${qbStat.count}+' ('+#{Multiple}+')'+#{qb.question.questionName}+' ('+#{ })' "></label>
          <br th:if="${qb.question.questionType=='y'}">
          <label class="form-radio-label" th:if="${qb.question.questionType=='x'}">
            <input class="form-radio-input" type="radio" th:name="optionsSelect'+#{qb.question.questionId}" value="A">
            <span class="form-radio-sign" th:text="A'+#{qb.question.getQuestionOpa()}></span><br>
            <input class="form-radio-input" type="radio" th:name="optionsSelect'+#{qb.question.questionId}" value="B">
```

Answer code:

```
//提交试卷
@RequestMapping("/submitExam")
public String submitExam(Integer paperId, Integer studentId, HttpServletRequest request){
    List<QuestionPaper> questionPapers = paperService.paperQueryAllQuestionByIdOrderByType(paperId);
    ArrayList<String> ans=new ArrayList<>();
    List<String> RightAns=new ArrayList<>();
    for (QuestionPaper qb:questionPapers){
        RightAns.add(qb.getQuestion().getQuestionOpright());
        String parameter="";
        String []parameters;
        if(qb.getQuestion().getQuestionType().equals("y")){
            parameters= request.getParameterValues("optionsSelect" + qb.getQuestionId());
            if(parameters == null){
                ans.add("N");
                continue;
            }
            for(String s:parameters){
                parameter=s;
            }
        }
    }
}
```

Calculate the score code:

```
for (QuestionPaper qb:questionPapers){
    //判断答过的题有几个，让K不能大于这个数，否则引起数组越界
    if(k >= ans.size()){
        break;
    }
    //若为单选题则正确+单选题分数
    if(qb.getQuestion().getQuestionType().equals("x")){
        if(ans.get(k).equals(RightAns.get(k))){
            score+=qb.getPaper().getScoreSin();
            y++;
        }
        a++;
        k++;
    }else if(qb.getQuestion().getQuestionType().equals("y")){
        if(ans.get(k).equals(RightAns.get(k))){
            score+=qb.getPaper().getScoreChe();
            y++;
        }
        b++;
        k++;
    }
}
```

Save answer record code:



```
//保存答题记录
String answer = String.join( delimiter: ",", ans);
Paper paper = paperService.queryPaperNameById(paperId);
String paperName = paper.getPaperName();
Double recordAcc=y/k;
int recordScore=score;
Record record=new Record();
record.setRecordName(paperName);
record.setStudentId(studentId);
record.setPaperId(paperId);
record.setRecordAnswer(answer);
record.setRecordAcc(recordAcc);
record.setRecordScore(recordScore);
recordService.addRecord(record);
return "redirect:/exam/toExam";
```

RecordMapper.xml file stored record code:

```
<!--添加记录-->
<insert id="addRecord" parameterType="com.zhao.quiz.domain.Record">
    insert into record
        (record_name,student_id,paper_id,record_answer,record_acc,record_score)
    values
        (#{recordName},#{studentId},#{paperId},#{recordAnswer},#{recordAcc},#{recordScore})
</insert>
```

## 8.5 Manual composition of test papers

After the administrator or teacher is logged in, to click "Paper management" to enter the test paper management page, click "Management of test questions" to enter the test question adding page, and then click "Artificial Add" to enter the manual adding test question page. Click "+" in the next column. The background data processing is as follows:

To click the added question in the "AddQuestion.html" file, and transfer the information of the question: "PaperId", "questionId", "questionType" and other information to the "PaperController.java" file for processing, and then call the

"paperService" "" AddQuestionToPaperById()" method for processing, corresponding to the "QuestionMapper.xml" file under Mybatis to store in the database.

Manually add the question foreground code:

```
<td th:text="${que.questionUpright}"></td>
<td>
    <button class="btn btn-sm btn-info" th:href="@{/paper/AddQuestion/}+${(que.questionId)}" th:if="!${quesds.contains(que.questionId)}"></button>-->
    <button class="btn btn-sm btn-danger" th:href="@{/paper/AddQuestion/}+${(que.questionId)}" th:if="${quesds.contains(que.questionId)}" disabled=""></button>
    <a class="btn btn-sm btn-info" th:href="@{/paper/AddQuestion?paperId=${(paperId)}&quesId=${(que.questionId)}&pageNum=${(pageInfo.pageNum)}&questionCourse=${(que.questionCourse)}" th:if="!${quesds.contains(que.questionId)}"></a>
    <button class="btn btn-sm btn-danger" th:if="${quesds.contains(que.questionId)}" disabled=""></button>
</td>
</tr>
```

The AddQuestion method code in PaperController.java file:

```
//为试卷添加试题
@RequestMapping("/AddQuestion")
public String AddQuestion(Integer paperId,Integer quesId,Integer pageNum,String questionCourse,String questionType){
    QuestionPaper questionPaper=new QuestionPaper(quesId,paperId);
    paperService.AddQuestionToPaperById(questionPaper);
    return "redirect:/paper/toAddQuestion/"+paperId+"?pageNum="+pageNum+"&questionCourse="+questionCourse+"&questionType="+questionType;
}
```

QuestionMapper.xml file to add question code:

```
<!--添加试题-->
<insert id="addQuestion">
    insert into
        question
        (question_type,question_course,question_name,question_opa,question_opb,question_opc,question_opd,question_opright)
    values
        (#{questionType},#{questionCourse},#{questionName},#{questionOpa},#{questionOpb},#{questionOpc},#{questionOpd},#{questionOpright})
</insert>
```

## 8.6 Randomly add questions to test papers

After the administrator or teacher is logged in, click "Paper management" to enter the test paper management page, click "Management of test questions" to enter the test question adding page, and then click "Random Add" to enter the random adding test question page, select the type and question to add. number, click the "GeneratePaper" button to add random questions. The background data processing is as follows:

After clicking the "GeneratePaper" button, pass the question type and number of questions to the "RandomADDQuestion()" method of the "PaperController.java" file for operation. First, use the "questionService.queryAllQueIdNotInPaperById()" method to find all unassigned questions in the test paper. , and then randomly select the test questions from the unassigned test questions according to the quantity parameter, then call the "questionService.AddAllQues()" method to add the selected test questions to the test paper, corresponding to the "QuestionMapper.xml" file under Mybatis to store in the database middle.

Add test page codes randomly:

```
<form class="col-md-8" th:action="@{/paper/RandomADDQuestion/}+${paperId}">
  <div class="row">
    <div class="col-md-2">
      <div class="form-group">
        <select class="form-control form-control-sm" name="questionCourse">
          <option th:each="quecou:${questionCourses}" th:if="${quecou.getQuestionCourse()}=='all'" name="ques">
            <option th:each="quecou:${questionCourses}" th:if="${quecou.getQuestionCourse()}!='all'" name="ques">
          </select>
        </div>
      </div>
    <div class="col-md-4">
      <div class="form-group">
        <input type="text" class="form-text text-muted" required oninvalid="setCustomValidity('not input!');" on
      </div>
    </div>
    <div class="col-md-2">
      <div class="form-group">
        <button class="btn btn-primary btn-border btn-round" th:text="GeneratePaper"></button>
      </div>
    </div>
  </div>
</div>
```

In the PaperController.java file:

```

//去往随机组题页面
@RequestMapping("/toRandomQuestion/{id}")
public String toRandomQuestion(@PathVariable ("id") Integer papid,Question question,Model model){
    List<Question> questionCourses=questionService.queryAllCourse();
    questionCourses.add(new Question( questionType: "bug", questionCourse: "all"));
    //查找所有题目课程和所有类型，且去重
    //用于条件查询题库中尚未分配的题有多少道
    int TotalQuestionNums=questionService.queryAllQuestionNums();
    List<Map> maps = questionService.queryNumOfQuestionType();
    List<String> course=new ArrayList<>();
    List<Integer> count=new ArrayList<>();
    for (Map map:maps){
        for (Object key : map.keySet()) {
            if(map.get(key) instanceof String){
                course.add(map.get(key).toString());
            }else{
                count.add(Integer.parseInt(map.get(key).toString()));
            }
        }
    }
    Paper paperName=paperService.queryPaperNameById(papid);
    model.addAttribute( s: "paperName",paperName.getPaperName());
    model.addAttribute( s: "count",count);
    model.addAttribute( s: "course",course);
    model.addAttribute( s: "TotalQuestionNums",TotalQuestionNums);
    model.addAttribute( s: "paperId",papid);
    model.addAttribute( s: "questionCourses",questionCourses);
    return "paper/RandomQuestion";
}

```

QuestionMapper.xml file randomly add question code:

```

// 去往随机组题页面
@RequestMapping("/toRandomQuestion/{id}")
public String toRandomQuestion(@PathVariable("id") Integer papid, Question question, Model model){
    List<Question> questionCourses=questionService.queryAllCourse();
    questionCourses.add(new Question( questionType: "bug", questionCourse: "all"));
    // 查找所有题目课程和所有类型，且去重
    // 用于条件查询题库中尚未分配的题有多少道
    int TotalQuestionNums=questionService.queryAllQuestionNums();
    List<Map> maps = questionService.queryNumOfQuestionType();
    List<String> course=new ArrayList<>();
    List<Integer> count=new ArrayList<>();
    for (Map map:maps){
        for (Object key : map.keySet()) {
            if(map.get(key) instanceof String){
                course.add(map.get(key).toString());
            }else{
                count.add(Integer.parseInt(map.get(key).toString()));
            }
        }
    }
    Paper paperName=paperService.queryPaperNameById(papid);
    model.addAttribute( s: "paperName", paperName.getPaperName());
    model.addAttribute( s: "count", count);
    model.addAttribute( s: "course", course);
    model.addAttribute( s: "TotalQuestionNums", TotalQuestionNums);
    model.addAttribute( s: "paperId", papid);
    model.addAttribute( s: "questionCourses", questionCourses);
    return "paper/RandomQuestion";
}

```

QuestionMapper.xml file to add question code:

```

<!-- 随机批量增加 -->
<insert id="AddAllQues" parameterType="java.util.List">
    insert into question_paper
        (question_id,paper_id)
    values
        <foreach collection="list" item="item" index="index" separator=",">
            (#{item.questionId},
             #{item.paperId})
        </foreach>
</insert>

```

## 9. System Testing

### 9.1 Introduction to System Testing

System test is the integrated software of testing, is a part of the computer system, usually together with other parts. The purpose is to find some problems in the system, find out and solve it. It is an indispensable part of a mature system, without it, it is very likely to occur system failure, system collapse. It is mainly divided into two contents:

1. Functional testing. The purpose is to test whether the functional modules of the system are normal, whether they can be used by users normally, mainly based on the requirements document part, it must meet the needs of users and to ensure that the function is not wrong, this content is the most important aspect, it can ensure the correctness of the system.

2. Robustness testing. The purpose is to test whether the function module of the system can run normally when it is wrong. The key is to detect the fault tolerance of the system function.

### 9.2 System Test Procedure

1. Module test: To test whether the separate functions of each module are normal;

2. Assembly test: To test whether the interface between modules can be used normally;

3.Confirmation test: To test whether the whole system can meet user requirements.

## 9.3 Test Cases

### 9.3.1 Registration

| Registration  |  |  |             |
|---|--|--|-------------|
| Administrator: Account zhaosi Password 123456                                 |  |  |             |
| Teacher: Account yewen Password 123456  |  |  |             |
| Student: Registration is generated  |  |  |             |
| To verify that the user can use the registered account and password to log in |  |  |             |
| Input   | Expected Result                                      | Actual result  | Test result |
| Account:<br>admin1<br>Password: 111   | Successfully<br>login to the<br>student home<br>page | Successfully<br>login to the<br>student home<br>page | Correct     |
| Account:<br>admin2<br>Password:<br>123123                                     | Successfully<br>login to the<br>student home<br>page | Successfully<br>login to the<br>student home<br>page | Correct     |
| Account:<br>admin3<br>Password: 1567  | Successfully<br>login to the<br>student home<br>page | Successfully<br>login to the<br>student home<br>page | Correct     |

### 9.3.2 login

|       |
|-------|
| login |
|-------|

| Administrator: Account zhaosi Password 123456         |   |   |             |
|---|---|---|-------------|
| Teacher: Account yewen Password 123456                |   |   |             |
| Student: Account admin Password admin                 |   |   |             |
| To verify that the login account matches the password |   |   |             |
| Input   | Expected Result   | Actual result   | Test result |
| Account: admin<br>Password:<br>admin                  | Successfully<br>login to the<br>student home<br>page          | Successfully<br>login to the<br>student home<br>page          | Correct     |
| Account: admin<br>Password: 111                       | Display "The<br>user name or<br>password is<br>incorrect! "   | Display "The<br>user name or<br>password is<br>incorrect! "   | Correct     |
| Account: zhaosi<br>Password:<br>123456                | The<br>administrator<br>home page is<br>correctly<br>accessed | The<br>administrator<br>home page is<br>correctly<br>accessed | Correct     |
| Account: yewen<br>Password:<br>123456                 | Access to the<br>teacher's home<br>page                       | Access to the<br>teacher's home<br>page                       | Correct     |

### 9.3.3 Test Functions

|                    |  |
|--------------------|--|
| Function<br>module | Students take an exam  |
| The<br>premise     | The student has completed registration, the teacher has added the test, and the current time is within the test time |



|                   |   |  |  |             |
|-------------------|---|--|--|-------------|
| condition         |   |  |  |             |
| Test purposes     | To verify that the test can proceed normally and the answer is submitted successfully |  |  |             |
| The serial number | Input   | Expected Result  | Actual result  | Test result |
| 1                 | Account: admin1<br>Password: 111  | Successfully login to the student home page  | Successfully login to the student home page  | Correct     |
| 2                 | Click the Exam button, select any exam and click Start to start the exam              | To enter the exam answer page, the current time and end time are displayed on the upper left | The exam page is displayed. The current time and end time are displayed in the upper left corner | Correct     |
| 3                 | Choose any answer and click the Submit button   | Go back to the exam page and display the Record  | Go back to the exam page and display the Record  | Correct     |
| 4                 | Click the Record button to view the record  | To displays the answer in Action 3, highlighting the wrong answer                            | The answer selected in Operation 3 is displayed successfully with the correct answer. The        | Correct     |

|  |  |  |  |  |
|--|--|--|--|--|
|  |  |  | wrong answers<br>are highlighted<br>in red |  |
|--|--|--|--|--|

### 9.3.4 Teacher Management

|                             |   |  |  |                |
|-----------------------------|---|--|--|----------------|
| Function<br>module          | Teacher Management  |  |  |                |
| The<br>premise<br>condition | The administrator logs in normally                                    |  |  |                |
| Test<br>purposes            | To verify whether a teacher can be added, modified, or deleted        |  |  |                |
| The serial<br>number        | Input   | Expected Result  | Actual result  | Test<br>result |
| 1                           | Account: zhaosi<br>Password:123456                                    | Successfully Login<br>to the<br>administrator<br>home page                 | Successfully<br>Login to the<br>administrator<br>home page | Correct        |
| 2                           | Click the Teacher<br>management<br>button on the left<br>of the page. | Displays<br>information about<br>existing teachers.                        | Displays<br>information<br>about existing<br>teachers.     | Correct        |
| 3                           | Click Add Teacher<br>and enter the<br>information.                    | The teacher page<br>is displayed and<br>the information<br>about the added | The teacher<br>page is<br>displayed and<br>the information | Correct        |

|   |   |  |  |         |
|---|---|--|--|---------|
|   |   | teacher is displayed   | about the added teacher is displayed   |         |
| 4 | Click the Edit button to modify the teacher information   | Return to the teacher page and modify the teacher information successfully                                     | Return to the teacher page and modify the teacher information successfully                                     | Correct |
| 5 | Click the Delete button to delete the newly added teacher | After confirming the deletion, the teacher page is jumped to and the selected teacher is deleted successfully. | After confirming the deletion, the teacher page is jumped to and the selected teacher is deleted successfully. | Correct |

### 9.3.5 Class management

|                       |  |
|-----------------------|--|
| Function module       | <b>Class management</b>  |
| The premise condition | The administrator logs in normally   |
| Test purposes         | To verify that classes can be added, class information can be modified, and classes can be deleted |

| The serial number | Input  | Expected Result  | Actual result  | Test result |
|-------------------|--|--|--|-------------|
| 1                 | Account: zhaosi<br>Password:123456                             | Successfully Login to the administrator home page  | Successfully Login to the administrator home page  | Correct     |
| 2                 | Click the Class management button on the left side of the page | he existing class information is displayed.  | he existing class information is displayed.  | Correct     |
| 3                 | Click Add Class and enter the information                      | Returns to the class page and displays the added class information                                 | Returns to the class page and displays the added class information                                 | Correct     |
| 4                 | Click the Edit button to modify class information              | Return to the class page and modify the class information successfully                             | Return to the class page and modify the class information successfully                             | Correct     |
| 5                 | Click the Delete button to delete the class you just added     | After confirming the deletion, jump to the teacher page and delete the selected class successfully | After confirming the deletion, jump to the teacher page and delete the selected class successfully | Correct     |

## 9.3.6 Test Question Management

|                             |   |   |  |                |
|-----------------------------|---|---|--|----------------|
| Function<br>module          | test question management  |   |  |                |
| The<br>premise<br>condition | The administrator logs in normally and the teacher logs in normally   |   |  |                |
| Test<br>purposes            | To verify that the user can add questions, modify question information, delete questions, and quickly query questions |   |  |                |
| The serial<br>number        | Input   | Expected Result   | Actual result  | Test<br>result |
| 1                           | Account: zhaosi<br>Password:123456  | Successfully Login<br>to the<br>administrator<br>home page                                      | Successfully<br>Login to the<br>administrator<br>home page   | Correct        |
| 2                           | Click the Question<br>management<br>button on the left<br>of the page   | The existing test<br>information is<br>displayed  | The existing test<br>information is<br>displayed   | Correct        |
| 3                           | Click Add<br>Question and<br>select Single.<br>Other information<br>can be filled in<br>freely                        | Returns to the test<br>page and displays<br>the test the user<br>just added on the<br>last page | Returns to the<br>test page and<br>displays the test<br>the user just<br>added on the<br>last page | Correct        |

|   |   |  |  |         |
|---|---|--|--|---------|
| 4 | Click Add Question and select Multiple. Other information can be filled in at will    | Returns to the test page and displays the test the user just added on the last page  | Returns to the test page and displays the test the user just added on the last page  | Correct |
| 5 | Click Add Question and select TrueorFalse. Other information can be filled in at will | The page options change to two. When added, it returns to the test page and displays the newly added test on the last page | The page options change to two. When added, it returns to the test page and displays the newly added test on the last page | Correct |
| 6 | Select single choice on the test page and click the view button                       | The question page displays all single choice questions, and on the last page is the new question added in Step 3           | The question page displays all single choice questions, and on the last page is the new question added in Step 3           | Correct |
| 7 | Select multiple choice on the test page and click the view button                     | The question page is all multiple choice, and on the last page is the new question added in Step 4                         | The question page is all multiple choice, and on the last page is the new question added                                   | Correct |

|    |   |  |  |         |
|----|---|--|--|---------|
|    |   |  | in Step 4  |         |
| 8  | Select the judgment question and click the view button      | The questions page is full of judgment questions, and on the last page are the new questions added in Step 5 | The questions page is full of judgment questions, and on the last page are the new questions added in Step 5 | Correct |
| 9  | Click the Edit button to modify the question information    | Return to the test page and successfully modify the test information   | Return to the test page and successfully modify the test information   | Correct |
| 10 | Click the Delete button to delete the three added questions | Return to the question page and delete the question successfully   | Return to the question page and delete the question successfully   | Correct |

### 9.3.7 Test Paper management

|                       |   |
|-----------------------|---|
| Function module       | Examination paper management  |
| The premise condition | The administrator logs in normally and the teacher logs in normally |

|                   |   |   |   |             |
|-------------------|---|---|---|-------------|
| Test purposes     | To verify that the user can add a test paper, modify test paper information, delete a test paper, add questions to a test paper, and delete existing questions from a test paper. |   |   |             |
| The serial number | Input   | Expected Result   | Actual result   | Test result |
| 1                 | Account: zhaosi<br>Password:123456  | Successfully Login to the administrator home page                                       | Successfully Login to the administrator home page                                       | correct     |
| 2                 | Click the Paper management button on the left of the page   | Displays information about an existing test pape  | Displays information about an existing test pape  | correct     |
| 3                 | Click Add Paper and enter information   | Returns to the test paper page and displays the newly added test paper in the last line | Returns to the test paper page and displays the newly added test paper in the last line | correct     |
| 4                 | Click Edit to modify the information  | Return to the test paper page and update the modified test paper                        | Return to the test paper page and update the modified test paper                        | correct     |
| 5                 | Click Management of the questions,  | The Add test page is displayed successfully   | The Add test page is displayed  | correct     |



|   |   |  |  |         |
|---|---|--|--|---------|
|   |   |  | successfully   |         |
| 6 | Click the Artificial Add and then the "+" button in Operation   | The current page is refreshed, and the Operation column of the test question just clicked changes to "!" | The current page is refreshed, and the Operation column of the test question just clicked changes to "!" | correct |
| 7 | Click the Return button, locate the newly added question on the test page, and click Remove                 | The test page is refreshed, and the newly added test is successfully deleted                             | The test page is refreshed, and the newly added test is successfully deleted                             | correct |
| 8 | Click Random Add, change the selection box to Java, enter the number 10, and click the GeneratePaper button | Return to the question page and display 10 more Java questions   | Return to the question page and display 10 more Java questions   | correct |

### 9.3.8 Examination management

|                 |  |
|-----------------|--|
| Function module | examination management                                     |
| The             | The administrator logs in normally and the teacher logs in |

|                      |  |  |  |                |
|----------------------|--|--|--|----------------|
| premise<br>condition | normally   |  |  |                |
| Test<br>purposes     | To verify that tests can be added or deleted                             |  |  |                |
| The serial<br>number | Input  | Expected Result  | Actual result  | Test<br>result |
| 1                    | Account: zhaosi<br>Password:123456                                       | Successfully Login<br>to the<br>administrator<br>home page                                       | Successfully<br>Login to the<br>administrator<br>home page                                       | correct        |
| 2                    | Click the Exam<br>management<br>button on the left<br>of the page        | The existing test<br>information is<br>displayed   | The existing test<br>information is<br>displayed   | correct        |
| 3                    | Click Add Exam,<br>enter a name, and<br>select the start<br>and end time | Return to the<br>exam page and<br>display the exam<br>the user just<br>added on the last<br>line | Return to the<br>exam page and<br>display the<br>exam the user<br>just added on<br>the last line | correct        |
| 4                    | Click Delete to<br>delete the test<br>the user just<br>added             | Refresh the paper<br>page and delete<br>the test successfully                                    | Refresh the<br>paper page and<br>delete the test<br>successfully                                 | correct        |

### 9.3.9 Record Management

|                       |   |  |  |             |
|-----------------------|---|--|--|-------------|
| Function module       | Record management   |  |  |             |
| The premise condition | The administrator logs in normally and the teacher logs in normally   |  |  |             |
| Test purposes         | To verify whether the user can view the test record normally, delete the test record, check the number of students passing the test in each class |  |  |             |
| The serial number     | Input   | Expected Result  | Actual result  | Test result |
| 1                     | Account: zhaosi<br>Password:123456  | Successfully Login to the administrator home page                              | Successfully Login to the administrator home page                              | correct     |
| 2                     | Click the Record management button on the left side of the page   | Successful display of all exam records correctly                               | Successful display of all exam records correctly                               | correct     |
| 3                     | Click Delete to delete an exam record   | The Refresh record page does not display the exam record that was just deleted | The Refresh record page does not display the exam record that was just deleted | correct     |

|   |  |   |   |         |
|---|--|---|---|---------|
| 4 | Click the Class pass rate to check the class pass rate | The page displays the passing status of the class, showing the number of people taking the exam, the number of people passing the exam, and the pass rate | The page displays the passing status of the class, showing the number of people taking the exam, the number of people passing the exam, and the pass rate | correct |
|---|--|---|---|---------|

## 9.4 Test Cases

From the coverage of test cases, all functions have been completely covered. According to the test results, a total of 9 test cases were tested. Nine test cases have been passed, which represents a 100% pass rate for the test cases. It also means that the whole project is a success and a good online examination system has been developed.

## 10 Conclusion

From the full text, I have introduced all the work, design and implementation in more detail. From the beginning, there is only a general idea to the design that considers all the requirements; from the module analysis of the test system to the final implementation; from the design of the test system requirements to the design and implementation of the database; To master the use of various tools and functions; from the blank of the initial page to the final constructed detailed page layout; from the beginning of a simple design to the final complete testing process.

This system is always designed and developed with the theme of "Online Exam". The main functions I have developed are: registration and login, teachers adding test questions, teachers can select appropriate questions from the test question bank to form a test paper, further add a test and decide which test paper to examine in this test, teachers can also view Students' exam status, class pass rate and other information. Students can take the test within a specified time after logging in, and can view the answer record so that they can review their mistakes at any time.

So far, a successful project has been preliminarily completed. It can already realize the interaction between teachers and students in exams, so that students can take exams normally. The basic functionality of the project has been completed, but there is still a long way to go. There is still a lot of room for improvement in this project. In the future, I can try to add new question types, such as programming questions, short answer questions, etc. Programming questions can provide test cases in the background to run the code written by the candidates to determine the pass rate of the test cases to judge the score.

I may add new functions to the system in the future, and constantly improve it to make it an excellent online examination system.

# 11 Reflections

Examination is an assessment method that has existed since ancient times. It is the simplest method to test the learning situation. Its importance in the field of education is self-evident. When some unpredictable problems come, offline exams are likely to be postponed or postponed, such as the current new crown pneumonia. It has been going on for three years. In China, it has affected every aspect of our lives. Classes and teaching have changed from offline to online, and exams have changed from offline to online. But also thanks to the rapid development of the Internet, we can learn on the Internet. At the same time, I am also thinking, why not try to make an online examination system, which is convenient for teachers to set questions and students to conduct examinations. As a non-commercial website, I believe it can bring teachers and students a good experience.

Before embarking on the project, the pandemic was so severe that many students in China were unable to study offline or access library materials. Before I decided to do this project, I considered many similar ideas, but the implementation of these ideas requires a certain amount of knowledge and programming skills as the basis. Therefore, during the vacation before the project, I concentrated on learning the knowledge needed for development. I chose to watch the knowledge about Web development on the website, which made me learn a lot: Java, JavaScript, CSS, Html, MySQL, Idea and so on, also learned the knowledge of the framework, which really gave me a big blow at the beginning of SpringBoot, at the beginning of many of the knowledge I do not know, In the study period also have to look up about SpringMVC, MyBatis and other different knowledge. In the process of watching videos and typing code day after day, my knowledge reserve is gradually increasing, and my

coding technology is also improving bit by bit. In the process of learning, I also encountered knowledge that was really difficult to understand. When I did not understand it myself, I would discuss with my friends and ask them related questions to learn and make progress together.

After my dissertation topic and project were determined, I began to conceive the functions of the exam website and determined the most basic functions: student registration and login, students taking exams, teacher registration and login, and teachers adding exams. At that time, my thoughts were really simple. I only thought about the most basic ones, and I didn't consider how to deal with the test papers after the students finished the test, where to get the test paper after the teacher added the test, where to get the test questions, check the test records, etc. And other issues. In the background research of this paper, I checked a lot of literature, but there are still deficiencies in this regard, and most of the time is still spent on the design and development of system functions.

In the process of project development, each function of the website must correspond to other functions. For example, students can take the test only when they are within the test time added by the teacher. It took me a long time to design the database. Sometimes when developing new functions, I suddenly found that a field was missing, and then I had to go to the database to add fields, and then I had to modify the code involved in the database. , so this made me realize how critical the database design is. Sometimes it is better to design one more field than one less field. The design integrity of the database directly determines the efficiency of development.

I was very impressed with the "students take the test" feature. At the beginning of the design, I did not consider that students might not choose all the answers and hand in the "blank paper". My original design idea is only that students



submit the test paper after filling in the answer, and the background processing will record the ID of the test paper, and get the correct answer of the current test paper according to the ID of the test paper. The identification of single choice is "x", the identification of multiple choice is "y", and the identification of judgment question is "z". Finally, it stores the correct answers in an ArrayList, and then stores the student's submitted answers in another ArrayList. Finally, the for loop goes through it to compare the answers, adding the score of the single choice to the total score if the single choice is correct, and the other two are the same. Finally, in the test phase, I found a problem when I submitted an examination paper without answering one of the questions: if I did not answer, the background data would be null, so the traversal would first appear out of bounds, and secondly, it would make every subsequent answer corresponding to the wrong score, and finally get the wrong score. In the end, my solution uses a simple idea: If there is no answer, the background data will be null. In this case, the data will still be added to the ArrayList, but a judgment will be added. If null, the default answer of this option is "N", which ensures that the size of the two arrays is the same, and will not affect the judgment of subsequent options.

After the completion of the project, my mentor also gave her own suggestions, and I also found some loopholes in the function. It also reminded me how important it is to do thorough testing. Don't just assume that a feature is OK, test lots of input data, and test everything carefully.

In general, during the process of doing this project, I have gained a lot and basically achieved the goal of the project set at that time. In my opinion, the whole system has been a relatively perfect system, but there must be some shortcomings. I will also consider improving it and adding features over time. I believe that any project can be successful as long as we try our best to explore and learn, and develop with a serious attitude and rigorous thinking.

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