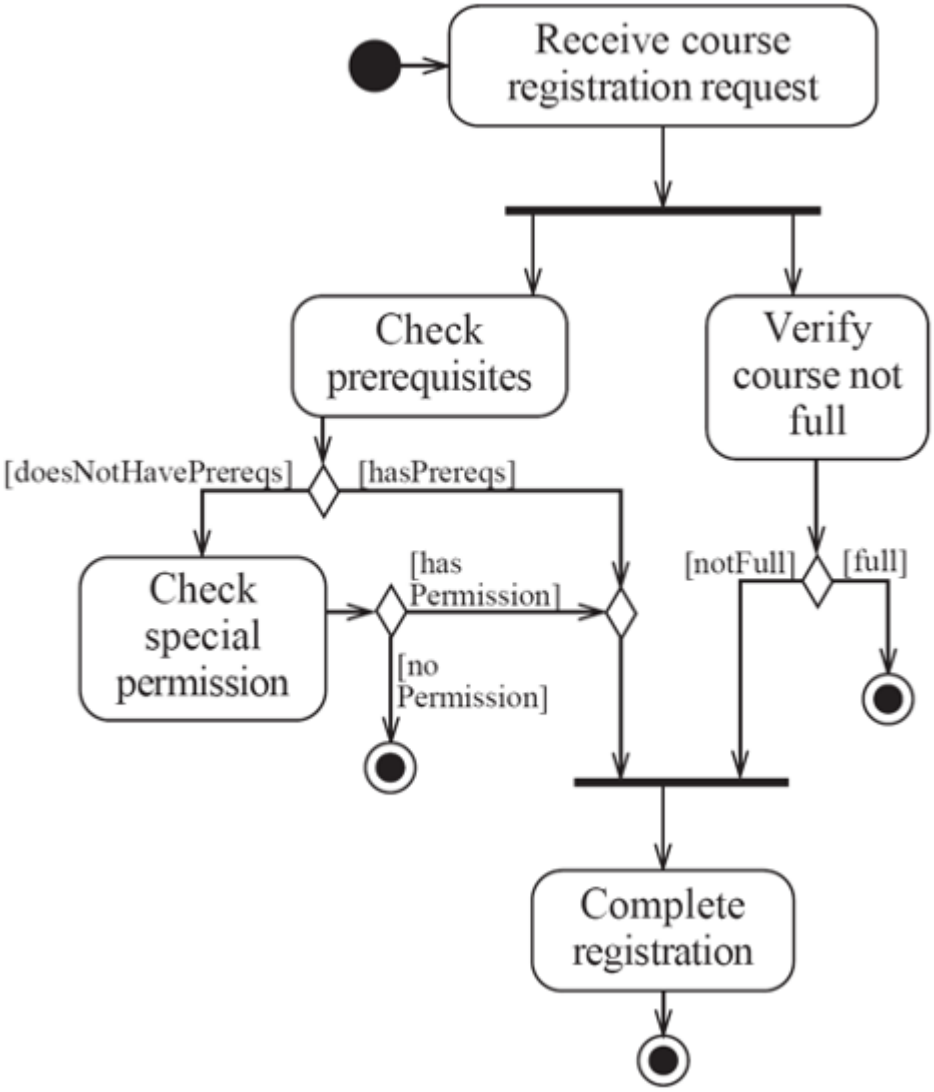
OOPSE Homework 6

- name: 李易庭
- dept.: 資工碩一
- stu. id: P7610 4419

- CLIParse class
- LogFormatter class



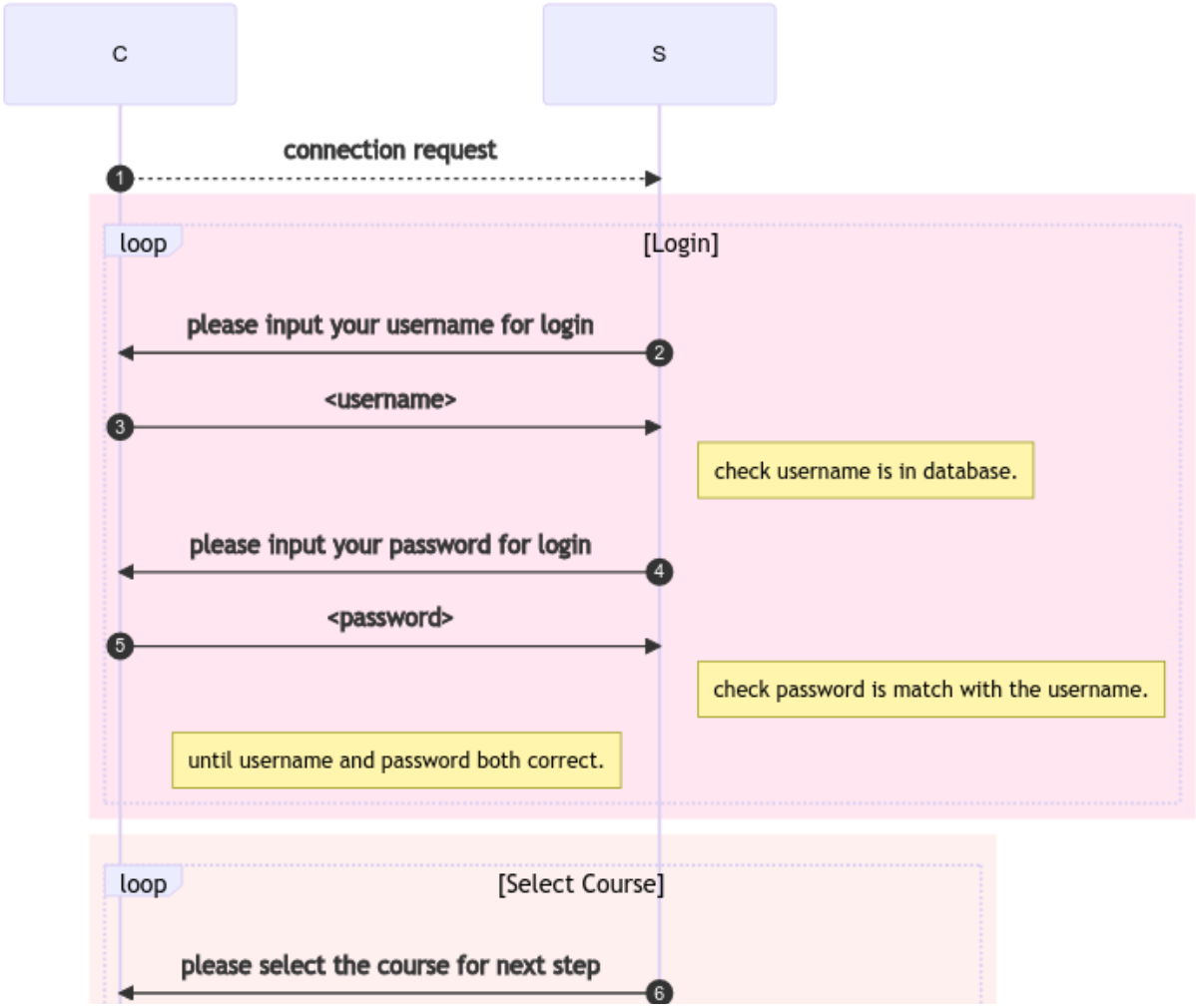
Project Structure

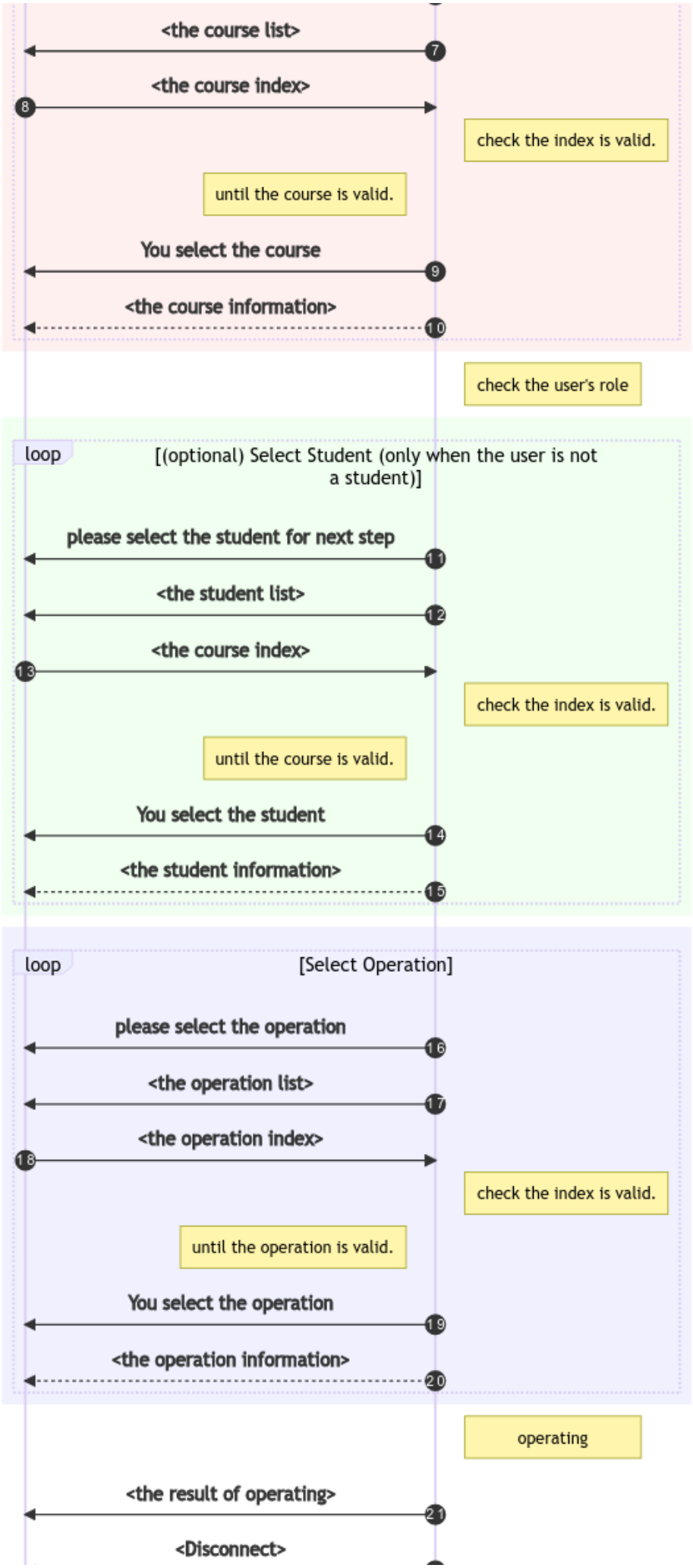
There are 6 packages for this project.

```
.
├── client
│   └── Client.java
├── server
│   ├── ClientHandler.java
│   └── Server.java
├── data
│   └── MockDB.java
├── models
│   ├── course
│   │   └── Course.java
│   ├── exceptions
│   │   ├── AlreadyTakenException.java
│   │   ├── CourseException.java
│   │   ├── IsFullException.java
```

```
│   │   └── NotPassedException.java
│   ├── roles
│   │   ├── AdminRole.java
│   │   ├── RoleBase.java
│   │   └── StudentRole.java
│   └── users
│       ├── Admin.java
│       ├── Student.java
│       └── User.java
├── services
│   ├── AdminService.java
│   └── StudentService.java
└── utils
    ├── CLIParser.java
    ├── LogFormatter.java
    └── securities
        └── Hash.java
```

Sequence diagram




<the course list>
7
<the course index>
8
check the index is valid.
until the course is valid.
You select the course
9
<the course information>
10
check the user's role
loop
[(optional) Select Student (only when the user is not a student)]
please select the student for next step
11
<the student list>
12
<the course index>
13
check the index is valid.
until the course is valid.
You select the student
14
<the student information>
15
loop
[Select Operation]
please select the operation
16
<the operation list>
17
<the operation index>
18
check the index is valid.
until the operation is valid.
You select the operation
19
<the operation information>
20
operating
<the result of operating>
21
<Disconnect>

Illustrations

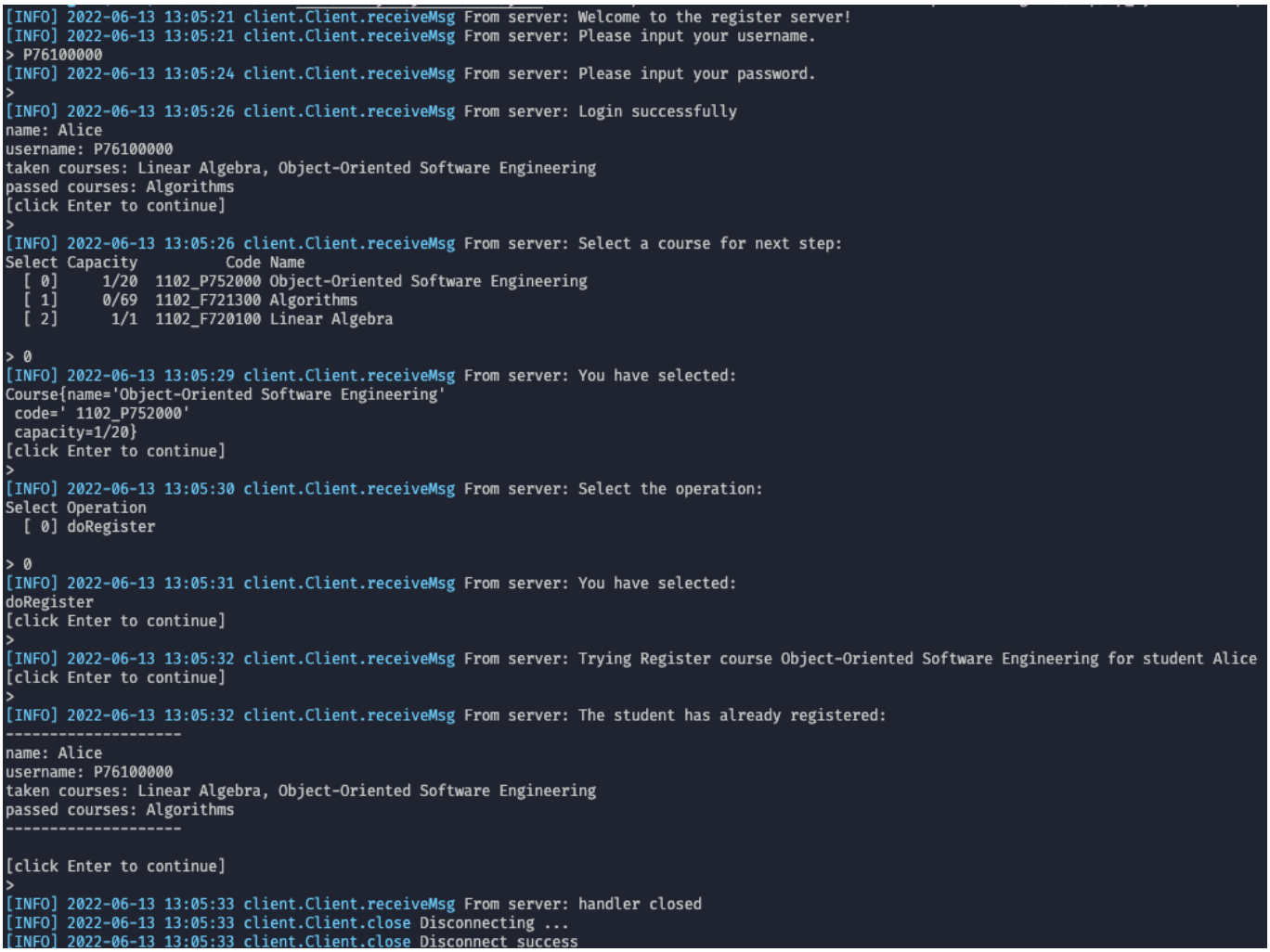
the course is full

```
[INFO] 2022-06-13 12:47:47 client.Client.receiveMsg From server: Welcome to the register server!
[INFO] 2022-06-13 12:47:47 client.Client.receiveMsg From server: Please input your username.
> P76100001
[INFO] 2022-06-13 12:47:52 client.Client.receiveMsg From server: Please input your password.
>
[INFO] 2022-06-13 12:47:54 client.Client.receiveMsg From server: Login successfully
name: Bob
username: P76100001
taken courses:
passed courses:
[click Enter to continue]
>
[INFO] 2022-06-13 12:47:55 client.Client.receiveMsg From server: Select a course for next step:
Select Capacity          Code Name
  [ 0]     0/20  1102_P752000 Object-Oriented Software Engineering
  [ 1]     0/69  1102_F721300 Algorithms
  [ 2]      1/1  1102_F720100 Linear Algebra

> 2
[INFO] 2022-06-13 12:47:58 client.Client.receiveMsg From server: You have selected:
Course{name='Linear Algebra'
 code=' 1102_F720100'
 capacity=1/1}
[click Enter to continue]
>
[INFO] 2022-06-13 12:48:00 client.Client.receiveMsg From server: Select the operation:
Select Operation
  [ 0] doRegister

> 0
[INFO] 2022-06-13 12:48:01 client.Client.receiveMsg From server: You have selected:
doRegister
[click Enter to continue]
>
[INFO] 2022-06-13 12:48:02 client.Client.receiveMsg From server: Trying Register course Linear Algebra for student Bob
[click Enter to continue]
>
[INFO] 2022-06-13 12:48:04 client.Client.receiveMsg From server: The course have been fully taken:
--------------------
name: Linear Algebra
code:  1102_F720100
capacity: 1/1
preRequests:
--------------------

[click Enter to continue]
>
[INFO] 2022-06-13 12:48:06 client.Client.receiveMsg From server: handler closed
[INFO] 2022-06-13 12:48:06 client.Client.close Disconnecting ...
[INFO] 2022-06-13 12:48:06 client.Client.close Disconnect success
```

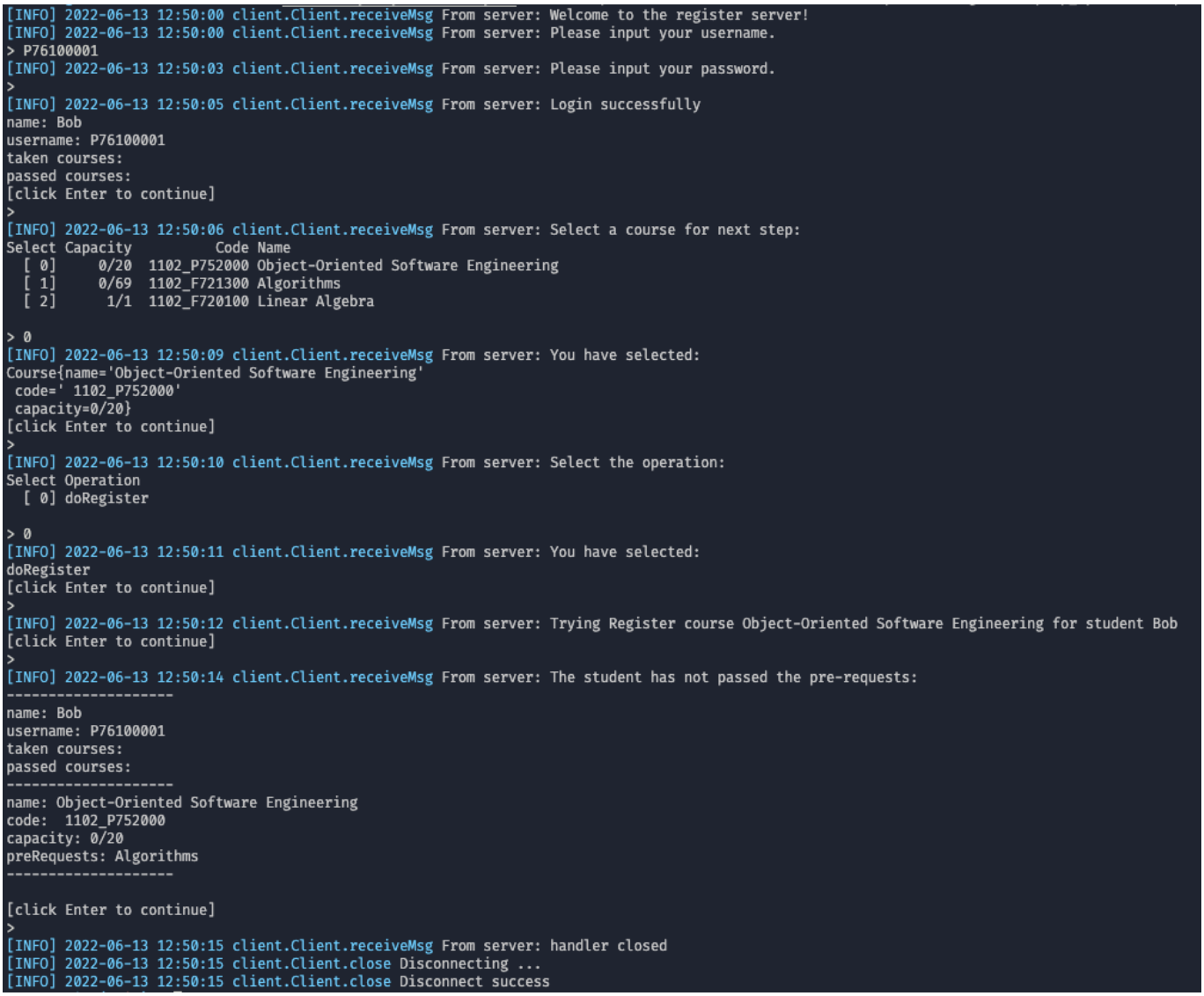
student has passed the course

```
[INFO] 2022-06-13 12:56:45 client.Client.receiveMsg From server: Welcome to the register server!
[INFO] 2022-06-13 12:56:45 client.Client.receiveMsg From server: Please input your username.
> P76100000
[INFO] 2022-06-13 12:56:48 client.Client.receiveMsg From server: Please input your password.
>
[INFO] 2022-06-13 12:56:49 client.Client.receiveMsg From server: Login successfully
name: Alice
username: P76100000
taken courses: Linear Algebra
passed courses: Algorithms
[click Enter to continue]
>
[INFO] 2022-06-13 12:56:55 client.Client.receiveMsg From server: Select a course for next step:
Select Capacity          Code Name
  [ 0]     0/20  1102_P752000 Object-Oriented Software Engineering
  [ 1]     1/69  1102_F721300 Algorithms
  [ 2]      1/1  1102_F720100 Linear Algebra

> 1
[INFO] 2022-06-13 12:57:04 client.Client.receiveMsg From server: You have selected:
Course{name='Algorithms'
 code=' 1102_F721300'
 capacity=1/69}
[click Enter to continue]
>
[INFO] 2022-06-13 12:57:05 client.Client.receiveMsg From server: Select the operation:
Select Operation
  [ 0] doRegister

> 0
[INFO] 2022-06-13 12:57:06 client.Client.receiveMsg From server: You have selected:
doRegister
[click Enter to continue]
>
[INFO] 2022-06-13 12:57:07 client.Client.receiveMsg From server: Trying Register course Algorithms for student Alice
[click Enter to continue]
>
[INFO] 2022-06-13 12:57:07 client.Client.receiveMsg From server: The student has already passed:
--------------------
name: Alice
username: P76100000
taken courses: Linear Algebra
passed courses: Algorithms
--------------------

[click Enter to continue]
>
[INFO] 2022-06-13 12:57:09 client.Client.receiveMsg From server: handler closed
[INFO] 2022-06-13 12:57:09 client.Client.close Disconnecting ...
[INFO] 2022-06-13 12:57:09 client.Client.close Disconnect success
```

student has taken the course



student doesn't meet the pre-requests, and without permission



student doesn't meet the pre-requests, but with permission

```
[INFO] 2022-06-13 12:57:43 client.Client.receiveMsg From server: Welcome to the register server!
[INFO] 2022-06-13 12:57:43 client.Client.receiveMsg From server: Please input your username.
> admin
[INFO] 2022-06-13 12:57:45 client.Client.receiveMsg From server: Please input your password.
>
[INFO] 2022-06-13 12:57:46 client.Client.receiveMsg From server: Login successfully
name: Charlie
username: admin
[click Enter to continue]
>
[INFO] 2022-06-13 12:57:48 client.Client.receiveMsg From server: Select a course for next step:
Select Capacity          Code Name
  [ 0]     0/20  1102_P752000 Object-Oriented Software Engineering
  [ 1]     1/69  1102_F721300 Algorithms
  [ 2]      1/1  1102_F720100 Linear Algebra

> 0
[INFO] 2022-06-13 12:57:55 client.Client.receiveMsg From server: You have selected:
Course{name='Object-Oriented Software Engineering'
 code=' 1102_P752000'
 capacity=0/20}
[click Enter to continue]
>
[INFO] 2022-06-13 12:57:56 client.Client.receiveMsg From server: Select a student for next operation:
Select   Username Name
  [ 0]  P76100000 Alice
  [ 1]  P76100001 Bob

> 1
[INFO] 2022-06-13 12:57:58 client.Client.receiveMsg From server: You have selected:
Student{name=Bob
 registered=Algorithms
 passed=}
[click Enter to continue]
>
[INFO] 2022-06-13 12:57:59 client.Client.receiveMsg From server: Select the operation:
Select Operation
  [ 0] doRegister

> 0
[INFO] 2022-06-13 12:58:00 client.Client.receiveMsg From server: You have selected:
doRegister
[click Enter to continue]
>
[INFO] 2022-06-13 12:58:01 client.Client.receiveMsg From server: Trying Register course Object-Oriented Software Engineering for student Bob
[click Enter to continue]
>
[INFO] 2022-06-13 12:58:02 client.Client.receiveMsg From server: You have successfully registered
--------------------------
name: Bob
username: P76100001
taken courses: Algorithms, Object-Oriented Software Engineering
passed courses:
--------------------------
name: Object-Oriented Software Engineering
code:  1102_P752000
capacity: 1/20
preRequests: Algorithms
--------------------------

[click Enter to continue]
>
[INFO] 2022-06-13 12:58:04 client.Client.receiveMsg From server: handler closed
[INFO] 2022-06-13 12:58:04 client.Client.close Disconnecting ...
```

normally successfully register

```
[INFO] 2022-06-13 12:53:55 client.Client.receiveMsg From server: Welcome to the register server!
[INFO] 2022-06-13 12:53:55 client.Client.receiveMsg From server: Please input your username.
> P76100001
[INFO] 2022-06-13 12:53:58 client.Client.receiveMsg From server: Please input your password.
>
[INFO] 2022-06-13 12:54:00 client.Client.receiveMsg From server: Login successfully
name: Bob
username: P76100001
taken courses:
passed courses:
[click Enter to continue]
>
[INFO] 2022-06-13 12:54:00 client.Client.receiveMsg From server: Select a course for next step:
Select Capacity         Code Name
  [ 0]     0/20  1102_P752000 Object-Oriented Software Engineering
  [ 1]     0/69  1102_F721300 Algorithms
  [ 2]      1/1  1102_F720100 Linear Algebra

> 1
[INFO] 2022-06-13 12:54:02 client.Client.receiveMsg From server: You have selected:
Course{name='Algorithms'
 code=' 1102_F721300'
 capacity=0/69}
[click Enter to continue]
>
[INFO] 2022-06-13 12:54:03 client.Client.receiveMsg From server: Select the operation:
Select Operation
  [ 0] doRegister

> 0
[INFO] 2022-06-13 12:54:04 client.Client.receiveMsg From server: You have selected:
doRegister
[click Enter to continue]
>
[INFO] 2022-06-13 12:54:05 client.Client.receiveMsg From server: Trying Register course Algorithms for student Bob
[click Enter to continue]
>
[INFO] 2022-06-13 12:54:05 client.Client.receiveMsg From server: You have successfully registered
--------------------------
name: Bob
username: P76100001
taken courses: Algorithms
passed courses:
--------------------------
name: Algorithms
code:  1102_F721300
capacity: 1/69
preRequests:
--------------------------

[click Enter to continue]
>
[INFO] 2022-06-13 12:54:09 client.Client.receiveMsg From server: handler closed
[INFO] 2022-06-13 12:54:09 client.Client.close Disconnecting ...
[INFO] 2022-06-13 12:54:09 client.Client.close Disconnect success
→  src git:(main) ✗ /usr/bin/env /usr/lib/jvm/jdk-18/bin/java --enable-preview -XX:+ShowCodeDetailsInExceptionMessages @/tmp/cp_cyuthr68xo0q3d6ik5556glcs.argfile client.Client
[INFO] 2022-06-13 12:55:27 client.Client.receiveMsg From server: Welcome to the register server!
[INFO] 2022-06-13 12:55:27 client.Client.receiveMsg From server: Please input your username.
> P76100001
[INFO] 2022-06-13 12:55:32 client.Client.receiveMsg From server: Please input your password.
>
[INFO] 2022-06-13 12:55:33 client.Client.receiveMsg From server: Login successfully
name: Bob
username: P76100001
taken courses: Algorithms
passed courses:
```

---

client package

The client package provides the client node's operations.

client.Client class

The client package provides an entry to server, and using console as user interaction interface.

```java
package client;

import java.util.logging.Logger;

import utils.LogFormatter;

import java.io.*;
import java.net.*;


/**
 * The client class.
 */
```

```
public class Client {
    // The logger for this class.
    private final static Logger log =
LogFormatter.getConsoleLogger(Client.class.getName());

    // The client running state.
    private boolean isRunning= true;

    // The client socket
    private Socket socket;

    // The input stream from the client socket.
    private DataInputStream in;

    // The output stream from the client socket.
    private DataOutputStream out;


    /**
     * The constructor of Client.
     * would handle the IOException.
     *
     * @param addr The address of the server.
     * @param port The port of the server.
     */
    public Client(String addr, int port) {
        try {
            setSocket(new Socket(addr, port));
            setIn(new DataInputStream(socket.getInputStream()));
            setOut(new DataOutputStream(socket.getOutputStream()));
        } catch (IOException e) {
            log.warning("Client init error:" + e);
        }
    }

    /**
     * The main method of Client.
     *
     * @param args
     */
    public static void main(String[] args) {
        // Create a client.
        Client c = new Client("localhost", 9090);

        // try to start the client.
        try {
            c.start();

        // if occur any IOException, print the error message
        // and exit with status code -1.
        } catch (IOException e) {
            e.printStackTrace();
            System.exit(-1);
        }
```

```
    }

    /**
     * Start the client.
     *
     * @throws IOException If the client occur any IOException.
     */
    public void start() throws IOException {
        String rec; // Received string
        String res; // responseMsg string

        try {
            rec = receiveMsg();
            // In the following loop, the client and client handle exchange
data.
            while (isRunning()) {
                // get message from server.
                rec = receiveMsg();

                // get response message from user input.
                // here we use a simple console input.
                // you can use a GUI input or others.
                res = getUserInput(rec);

                // send message to server.
                responseMsg(res);
            }

        // close the client.
        } finally {
            close();
        }
    }

    /**
     * Receive the message from the server.
     *
     * @return the message string.
     */
    private String receiveMsg() {
        // check the client is running.
        if (!isRunning()) return null;

        try {
            // try to receive message.
            String rec = in.readUTF();

            // print the received message.
            log.info("From server: " + rec);

            // check if the message is "Exit".
            if (rec.equals("handler closed")) {
                // close the client.
                close();
```

```
                // exit the method.
                return null;
            }

            // return the received message.
            return rec;

        // if receive message error, then close the client.
        } catch (IOException e) {
            log.warning("Receive message error:" + e);
            close();
        }

        return null;
    }

    /**
     * Send the message to the server.
     *
     * @param msg the message to send.
     */
    private void responseMsg(String msg) {
        // check the client is running.
        if (!isRunning()) return;

        // try to send message.
        try {
            out.writeUTF(msg);

        // if send message error, then close the client.
        } catch (IOException e) {
            log.warning("Send message error:" + e);
        }
    }

    /**
     * Get the user input by console.
     *
     * @param rec the received message from server.
     * @return the message.
     */
    private String getUserInput(String rec) {
        // check if the client is running.
        if (!isRunning()) return null;

        // Create a console to get user input.
        Console con = System.console();

        // if password is needed.
        if (rec.equals("Please input your password.")) {
            return String.valueOf(con.readPassword("> "));
        }

        // get user input.
```

```
        String msg = con.readLine("> ");

        // if the user input is "Exit", then close the client.
        if (msg.equals("Exit")) {
            close();
        }

        return msg;
    }

    /**
     * Close the client.
     *
     * This function would do following step:
     * 1. try to send close message for server.
     * 2. close the socket and input/output stream,
     * 3. set isRunning to false.
     */
    private void close() {
        // check the client is running.
        if (!isRunning()) return;

        log.info("Disconnecting ...");

        // try to send close message for server.
        try {
            out.writeUTF("Exit");
        } catch(IOException e) {}

        try {
            // closing resources
            in.close();
            out.flush();
            out.close();
            socket.close();
            setIsRunning(false);
            log.info("Disconnect success");
        } catch (IOException e) {
            log.severe("Client can't be closed");
            e.printStackTrace();
        }
    }

    public DataInputStream getIn() {
        return in;
    }

    public void setIn(DataInputStream in) {
        this.in = in;
    }

    public DataOutputStream getOut() {
        return out;
    }
```

```
    public void setOut(DataOutputStream out) {
        this.out = out;
    }

    public Socket getSocket() {
        return socket;
    }

    public void setSocket(Socket socket) {
        this.socket = socket;
    }

    public boolean isRunning() {
        return isRunning;
    }

    public void setIsRunning(boolean isRunning) {
        this.isRunning = isRunning;
    }
}
```

---

server package

The server package contains 2 classes, ClientHandler and Server.

server.Server class

The server class could be specified the port number and other configurations.

```
package server;

import java.io.*;
import java.net.*;
import java.util.logging.Logger;

import data.MockDB;
import utils.LogFormatter;

/**
 * The server class.
 */
public class Server {
    // The logger for this class.
    private final static Logger log =
LogFormatter.getFileHandlerLogger(Server.class.getName());

    // The server running state.
    private static boolean isRunning = true;
```

```
    // The server socket
    private static ServerSocket socket;

    // The port number of the server.
    private int port = 9090;

    // The database.
    private MockDB db = new MockDB();


    /**
     * The constructor of Server.
     *
     * @throws IOException if the server socket can not be created.
     */
    public Server() throws IOException {
        try {
            socket = new ServerSocket(port);
            log.info("Server is running on port " + port);
        } catch (IOException e) {
            log.severe("Server can't be started on port " + port);
            throw e;
        }
    }

    /**
     * Start the server.
     *
     * @throws IOException if the server socket can not be created.
     */
    public void serving() throws IOException {
        while (isRunning) {
            try {
                Socket clientSocket = null;
                // getting client request.
                clientSocket = socket.accept();
                log.info("Client " + clientSocket + " connected");

                // obtaining input and out streams from client socket.
                DataInputStream in = new
DataInputStream(clientSocket.getInputStream());
                DataOutputStream out = new
DataOutputStream(clientSocket.getOutputStream());

                // starting new thread for client.
                Thread clientHandler = new ClientHandler(clientSocket, in,
out, db);
                clientHandler.start();
            } catch (Exception e) {
                log.severe("Server can't be started on port " + port);
                throw new IOException(e);
            }
        }
```

```
    }

    /**
     * The main method.
     *
     * @param args
     * @throws IOException
     */
    public static void main(String[] args) throws IOException {
        Server s = new Server();
        s.serving();
        s.close();
    }

    /**
     * Close the server.
     */
    private void close() {
        try {
            setRunning(false);
            socket.close();
            log.fine("Server resources are closed");
        } catch (IOException e) {
            e.printStackTrace();
            log.severe("Server can't be closed");
        }
    }

    public int getPort() {
        return port;
    }

    public void setPort(int port) {
        this.port = port;
    }

    public static ServerSocket getSocket() {
        return socket;
    }

    public static void setSocket(ServerSocket socket) {
        Server.socket = socket;
    }

    public static boolean isRunning() {
        return isRunning;
    }

    public static void setRunning(boolean isRunning) {
        Server.isRunning = isRunning;
    }

}
```

server.ClientHandler class

The client handler class provides the services for the client to communicate with the server. It extends the thread class, and implements the run() method.

```
package server;

import java.io.DataInputStream;
import java.io.DataOutputStream;
import java.io.IOException;
import java.net.Socket;
import java.util.ArrayList;
import java.util.logging.Logger;

import data.MockDB;
import models.course.Course;
import models.exceptions.CourseException;
import models.users.Admin;
import models.users.Student;
import models.users.User;
import services.AdminService;
import services.StudentService;
import utils.LogFormatter;

/**
 * The client handler.
 *
 * provides the services for the client to communicate with the server.
 * extends the thread class, and implements the run() method.
 */
class ClientHandler extends Thread {
    // The logger for this class.
    private final static Logger log =
LogFormatter.getFileHandlerLogger(Server.class.getName());

    // A client handler running state.
    private boolean isRunning = true;

    // The client socket
    private Socket socket;

    // The input stream from the client socket.
    private DataInputStream in;

    // The output stream from the client socket.
    private DataOutputStream out;

    // The user that is currently logged in.
    private User user;

    // The database.
```

```
    private MockDB db;

    // Operation provide a tag for student and course relationship
operation.
    private enum Operation {
        doRegister,
        // doUnregister,
        // doPass,
        // doFail,
    };


    /**
     * The constructor of ClientHandler.
     *
     * @param socket
     * @param in
     * @param out
     * @param db
     */
    public ClientHandler(Socket socket, DataInputStream in,
DataOutputStream out, MockDB db) {
        setSocket(socket);
        setIn(in);
        setOut(out);
        setDb(db);
    }

    @Override
    public void run() {
        try {
            // Welcome message.
            responseMsg("Welcome to the register server!");

            // login for next step.
            handleLogin();

            // Get the course, student and operation from the client.
            Course course = selectCourse();
            Student student = selectStudent();
            String operation = selectOperation();

            // handle the operation.
            switch (operation) {
                case "doRegister":
                    doRegisterOperation(student, course);
                    break;

                // We can add more operations here.
                // like following:
                // case "doUnregister":
                //  doUnregisterOperation(student, course);
                //  break;
                // case "doPass":
```

```
                //  doPassOperation(student, course);
                //  break;
                // case "doFail":
                //  doFailOperation(student, course);
                //  break;

            }

        } catch (IOException | NullPointerException e) {
            log.warning(clientString() + " disconnected caused by: " + e);
        } finally {
            close();
        }
    }

    /**
     * Select the operation.
     *
     * @return the operation string.
     * @throws IOException if the client is disconnected.
     */
    private String selectOperation() throws IOException {
        if (!isRunning) return null;
        // get the operation string list.
        ArrayList<String> operations = new ArrayList<>(){{
            for (Operation opt : Operation.values()) {
                add(opt.name());
            }
        }};

        StringBuilder sb = new StringBuilder();
        sb.append(String.format("%6s %s\n", "Select", "Operation"));
        for (int i=0; i<operations.size(); i++) {
            String opt = operations.get(i);
            sb.append(String.format("  [%2d] %s\n", i, opt));
        }

        log.info(operations.toString());

        return selectFromList(
            operations,
            "Select the operation:\n" +
                sb.toString()
        );
    }

    /**
     * Select a course from the list of courses.
     *
     * @return the selected course.
     * @throws IOException if the client is disconnected.
     */
    private Course selectCourse() throws IOException {
        if (!isRunning) return null;
```

```
            return selectFromList(
                db.courses,
                "Select a course for next step: \n" +
                    Course.getCourseListString(db.courses)
            );
        }

        /**
         * Select a student from the list.
         *
         * @return the selected student.
         * @throws IOException if the client is closed.
         */
        private Student selectStudent() throws IOException {
            if (!isRunning) return null;

            return (user instanceof Admin) ?
                // get student to take this course.
                selectFromList(
                    db.getStudents(),
                    "Select a student for next operation: \n" +
                        Student.getStudentLiString(db.getStudents())
                ) :
                (Student) user;
        }

        /**
         * Handle the register course request.
         *
         * @param student the student to register.
         * @param course the course to register.
         * @throws IOException if any error occurs.
         */
        private void doRegisterOperation(Student student, Course course) throws
    IOException, NullPointerException {
            if (!isRunning) return;

            silentResponseMsg(
                "Trying Register course " + course.getName() +
                " for student " + student.getName()
            );

            try {
                if (user instanceof Admin) {
                    AdminService.takeCourse(student, course);
                } else if (user instanceof Student) {
                    StudentService.takeCourse(student, course);
                }
                silentResponseMsg(
                    "You have successfully registered\n" +
                    "--------------------------\n" +
                    student.getInfoString() + "\n" +
                    "--------------------------\n" +
                    course.getInfoString() + "\n" +
```

```
                "--------------------------\n"
            );

        } catch (CourseException ce) {
            silentResponseMsg(ce.getMessage());
        }
    }

    /**
     * provide a generic method for client to select the target from a
list.
     *
     * @param <T> the type of the target.
     * @param list the list to select from.
     * @param prompt the prompt message.
     * @return the target.
     * @throws IOException
     */
    private <T> T selectFromList(ArrayList<T> list, String prompt) throws
IOException {
        if (!isRunning) return null;
        int idx;
        T target;

        // send prompt.
        for (;;) {
            responseMsg(prompt);
            if (!isRunning) return null;

            // get response.
            String rec = receiveMsg();

            // check if the index is valid.
            try {
                // can be parse to int.
                idx = Integer.parseInt(rec);

                // is valid.
                if (idx < 0 || idx >= db.courses.size())
                    throw new NumberFormatException();

            } catch (NumberFormatException e) {
                // send error message to client.
                log.warning(e.toString());
                silentResponseMsg("Invalid select");
                continue;
            }

            // get target
            target = list.get(idx);

            silentResponseMsg(
                "You have selected:\n" +
                target.toString().replace(',', '\n'));
```

```
                return target;
            }
        }

        /**
         * Handle the login request.
         *
         * @throws IOException
         */
        private void handleLogin() {
            if (!isRunning) return;

            String prompt = "Please input your username.";
            responseMsg(prompt);

            for (;;) {
                if (!isRunning) return;

                // receive username from client.
                String username = receiveMsg();

                // check the username is in the database.
                User tmpUser = db.getUserByUsername(username);

                // if the user is not in the database, send error message.
                // and ask the client to input again.
                if (tmpUser == null) {
                    responseMsg("username not found!\nusername: ");
                    continue;
                }

                // if the user is in the database,
                // ask the client to input the password.
                responseMsg("Please input your password.");
                String password = receiveMsg();

                // check the password.
                if (tmpUser.checkPassword(password)) {
                    user = tmpUser;
                    silentResponseMsg(
                        "Login successfully\n" +
                        user.getInfoString());
                    break;
                }

                // the password is not correct,
                responseMsg("Invalid password!\n" + prompt);
            }
        }

        /**
         * Response a message to client.
         *
         * @param msg the message to response.
```

```
     */
    private void responseMsg(String msg) {
        log.fine("Sending message to " + clientString() + ": " + msg);

        // if the handler is not running, then return.
        if (!isRunning) return;

        // try to send message to client.
        try {
            out.writeUTF(msg);

        // if the client is disconnected, then stop the handler.
        } catch (IOException e) {
            log.info(clientString() + " be forced disconnected.");
            close();
        }
    }

    /**
     * Silently response a message to client.
     *
     * @param msg the message to response.
     */
    private void silentResponseMsg(String msg) {
        responseMsg(msg + "\n[click Enter to continue]");
        receiveMsg();
    }


    /**
     * Receive the message from client.
     *
     * @return the message.
     */
    private String receiveMsg() {
        String msg="";
        log.info("Waiting for " + clientString() + " message...");

        // try to receive message.
        try {
            msg = in.readUTF();

        // if the client is disconnected, then stop the handler.
        } catch (IOException e) {
            log.info(clientString() + " be forced disconnected.");
            close();
            return null;
        }

        // show the received message.
        if (msg.equals("Exit")) {
            close();
        }
```

```
            log.info(clientString() + " sent: " + msg);
            return msg;
        }

        /**
         * Close the handler.
         *
         * This function would do following step:
         * 1. try to send close message for client.
         * 2. close the socket and input/output stream,
         * 3. set isRunning to false.
         */
        private void close() {
            log.info(clientString() + " disconnecting ...");
            try {
                out.writeUTF("handler closed");
            } catch(IOException e) {}

            try {
                // closing resources
                in.close();
                out.flush();
                out.close();
                socket.close();
                setIsRunning(false);
                log.info(clientString() + " disconnected.");
            } catch (IOException e) {
                log.severe("Handler can't be closed");
                e.printStackTrace();
            }
        }

        /**
         * Get the login status.
         *
         * @return true if user is login
         */
        public boolean isUserLogin() {
            return user != null;
        }

        private String clientString() {
            return "Client " + socket.getInetAddress() + ":" +
    socket.getPort();
        }

        public DataInputStream getIn() {
            return in;
        }

        public void setIn(DataInputStream in) {
            this.in = in;
        }
```

```
    public DataOutputStream getOut() {
        return out;
    }

    public void setOut(DataOutputStream out) {
        this.out = out;
    }

    public Socket getSocket() {
        return socket;
    }

    public void setSocket(Socket socket) {
        this.socket = socket;
    }

    public MockDB getDb() {
        return db;
    }

    public void setDb(MockDB db) {
        this.db = db;
    }

    public void setIsRunning(boolean isRunning) {
        this.isRunning = isRunning;
    }

    public boolean isRunning() {
        return isRunning;
    }
}
```

---

data package

The data package provides the data repositories and other database operations.

data.MockDB class

The MockDB class provides a mock data for illustrate the project, you also could replace it by your own database.

```
package data;

import java.util.ArrayList;

import models.course.Course;
import models.exceptions.CourseException;
import models.users.Admin;
```

```
import models.users.Student;
import models.users.User;
import services.StudentService;

/**
 * This class is used to store all the mock data of the application.
 * You could replace it by a real database or a file.
 */
public class MockDB {
    public ArrayList<User> users = new ArrayList<User>(){
        {
            // Add student users.
            add(new Student(0, "Alice", "P76100000", "abc123"));
            add(new Student(1, "Bob", "P76100001", "abc123"));

            // Add admin user.
            add(new Admin(0, "Charlie", "admin", "admin"));
        }
    };

    public ArrayList<Course> courses = new ArrayList<Course>(){
        {
            try {
                // Add some classes.
                add(new Course("Object-Oriented Software Engineering", "
1102_P752000", 20));
                add(new Course("Algorithms", " 1102_F721300", 69));
                add(new Course("Linear Algebra", " 1102_F720100", 1));
            } catch (IllegalAccessException e) {
                e.printStackTrace();
            }
        }
    };

    public MockDB() {
        Student alice = (Student) users.get(0);
        Course oose = courses.get(0);
        Course algo = courses.get(1);
        Course la = courses.get(2);

        // Set algorithms as pre-requests of oose.
        oose.setPreRequests(new ArrayList<>(){{add(algo);}});

        // Set Alice passed algorithms.
        StudentService.passCourse(alice, algo);

        // Set Alice taken linear algebra.
        try {
            StudentService.takeCourse(alice, la);
        } catch (CourseException e) {}
    }

    public User getUserByUsername(String username) {
        for (User user : users) {
```

```
            if (user.getUsername().equals(username)) {
                return user;
            }
        }
        return null;
    }

    public Course getCourseByCode(String code) {
        for (Course course : courses) {
            if (course.getCode().equals(code)) {
                return course;
            }
        }
        return null;
    }


    public ArrayList<Student> getStudents() {
        ArrayList<Student> students = new ArrayList<>();
        for (User user : users) {
            if (user instanceof Student) {
                students.add((Student) user);
            }
        }
        return students;
    }

    public String getStudentList() {
        StringBuilder sb = new StringBuilder();
        int idx = 0;
        for (Student student : getStudents()) {
            sb.append(++idx + ' ').append(student.getUsername()).append("
").append(student.getName()).append("\n");
        }
        return sb.toString();
    }

    public Student getStudentByUsername(String username) {
        for (Student student : getStudents()) {
            if (student.getUsername().equals(username)) {
                return student;
            }
        }
        return null;
    }
}
```

---

models package

The models package provides all the data schemes and models.

models.course package

This package provide all the course models, but in this project we only implement a class, Course class.

models.course.Course class

This class provides a model and scheme for course.

```
package models.course;

import java.util.ArrayList;

import models.users.Student;

/**
 * The Course class.
 */
public class Course {
    private ArrayList<String> allCourses = new ArrayList<String>();
    private ArrayList<Course> preRequests = new ArrayList<>();
    private ArrayList<Student> students = new ArrayList<>();
    private String name;
    private String code;
    private int maxStudents;

    /**
     * The constructor of Course.
     *
     * @param name The name of the course.
     * @param code The code of the course.
     * @param maxStudents The maximum number of students in the course.
     * @throws IllegalAccessException If the course code is already in use.
     */
    public Course(String name, String code, int maxStudents) throws
IllegalAccessException {
        this.setName(name);
        this.setCode(code);
        this.setMaxStudents(maxStudents);
    }

    /**
     * The constructor of Course.
     *
     * @param name The name of the course.
     * @param code The code of the course.
     * @param maxStudents The maximum number of students in the course.
     * @param preRequests The pre-requests of the course.
     * @throws IllegalAccessException If the course code is already in use.
     */
    public Course(String name, String code, int maxStudents,
ArrayList<Course> preRequests) throws IllegalAccessException {
        this(name, code, maxStudents);
```

```
        setPreRequests(preRequests);
    }

    @Override
    public String toString() {
        return "Course{" +
                "name='" + name + '\'' +
                ", code='" + code + '\'' +
                ", capacity=" + capacityString() +
                '}';
    }

    /**
     * Return a formatted string of the course information.
     *
     * @return A formatted string.
     */
    public String getInfoString() {
        return "name: " + name +
               "\ncode: " + code +
               "\ncapacity: " + capacityString() +
               "\npreRequests: " + getCourseString(preRequests);
    }

    /**
     * Return all courses' names.
     *
     * @param courses The courses.
     * @return A formatted string.
     */
    public static String getCourseString(ArrayList<Course> courses) {
        ArrayList<String> response = new ArrayList<>();
        for (Course course: courses) {
            response.add(course.getName());
        }
        return String.join(", ", response);
    }

    /**
     * Return a formatted string of the courses' information.
     *
     * @param courses The courses.
     * @return A formatted string.
     */
    public static String getCourseListString(ArrayList<Course> courses) {
        StringBuilder sb = new StringBuilder();
        sb.append(String.format("%6s %8s %13s %s\n", "Select", "Capacity",
"Code", "Name"));
        for (int i=0; i<courses.size(); i++) {
            Course course = courses.get(i);
            sb.append(String.format("  [%2d] %8s %13s %s\n", i,
course.capacityString(), course.getCode(), course.getName()));
        }
        return sb.toString();
```

```
    }

    /**
     * Return a formatted string of the course capacity.
     *
     * @return The formatted string.
     */
    public String capacityString() {
        return students.size() + "/" + maxStudents;
    }

    public ArrayList<Course> getPreRequests() {
        return preRequests;
    }
    public void setPreRequests(ArrayList<Course> preRequests) {
        this.preRequests = preRequests;
    }
    public ArrayList<Student> getStudents() {
        return students;
    }
    public void setStudents(ArrayList<Student> students) {
        this.students = students;
    }
    public String getName() {
        return name;
    }
    public void setName(String name) {
        this.name = name;
    }
    public String getCode() {
        return code;
    }
    public void setCode(String code) throws IllegalAccessException {
        // Check if the course code is valid.
        if (allCourses.contains(code)) {
            throw new IllegalArgumentException("Course code already
exists.");
        }
        this.code = code;
    }
    public int getMaxStudents() {
        return maxStudents;
    }
    public void setMaxStudents(int maxStudents) {
        this.maxStudents = maxStudents;
    }
}
```

models.exceptions package

This package provides all custom exceptions for this project.

models.exceptions.CourseException class

This class provides a elementary exception for course operations.

```
package models.exceptions;

public class CourseException extends Exception {
    /**
     * Constructs an {@code CourseException} with the specified detail
message.
     */
    public CourseException() {
        super();
    }

    /**
     * Constructs an {@code CourseException} with the specified detail
message.
     *
     * @param message The detail message.
     */
    public CourseException(String message) {
        super(message);
    }

    /**
     * Constructs an {@code CourseException} with the specified detail
message
     * and cause.
     *
     * <p> Note that the detail message associated with {@code cause} is
     * <i>not</i> automatically incorporated into this exception's detail
     * message.
     *
     * @param message
     *        The detail message (which is saved for later retrieval
     *        by the {@link #getMessage()} method)
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public CourseException(String message, Throwable cause) {
        super(message, cause);
    }

    /**
     * Constructs an {@code CourseException} with the specified cause and a
     * detail message of {@code (cause==null ? null : cause.toString())}
     * (which typically contains the class and detail message of {@code
cause}).
```

```
     * This constructor is useful for IsFull exceptions that are little
more
     * than wrappers for other throwables.
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public CourseException(Throwable cause) {
        super(cause);
    }
}
```

models.exceptions.AlreadyTakenException class

This class extends the `models.exceptions.CourseException` class would be thrown if the student has taken the course.

```
package models.exceptions;

public class AlreadyTakenException extends CourseException {
    /**
     * Constructs an {@code AlreadyTakenException} with the specified
detail message.
     */
    public AlreadyTakenException() {
        super();
    }

    /**
     * Constructs an {@code AlreadyTakenException} with the specified
detail message.
     *
     * @param message The detail message.
     */
    public AlreadyTakenException(String message) {
        super(message);
    }

    /**
     * Constructs an {@code AlreadyTakenException} with the specified
detail message
     * and cause.
     *
     * <p> Note that the detail message associated with {@code cause} is
     * <i>not</i> automatically incorporated into this exception's detail
     * message.
     *
     * @param message
```

```
     *        The detail message (which is saved for later retrieval
     *        by the {@link #getMessage()} method)
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public AlreadyTakenException(String message, Throwable cause) {
        super(message, cause);
    }

    /**
     * Constructs an {@code AlreadyTakenException} with the specified cause
and a
     * detail message of {@code (cause==null ? null : cause.toString())}
     * (which typically contains the class and detail message of {@code
cause}).
     * This constructor is useful for IsFull exceptions that are little
more
     * than wrappers for other throwables.
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public AlreadyTakenException(Throwable cause) {
        super(cause);
    }
}
```

models.exceptions.IsFullException class

This class extends the `models.exceptions.CourseException` class would be thrown if the course has been fully taken.

```
package models.exceptions;

public class IsFullException extends CourseException {
    /**
     * Constructs an {@code IsFullException} with the specified detail
message.
     */
    public IsFullException() {
        super();
    }

    /**
     * Constructs an {@code IsFullException} with the specified detail
```

```
message.
     *
     * @param message The detail message.
     */
    public IsFullException(String message) {
        super(message);
    }

    /**
     * Constructs an {@code IsFullException} with the specified detail
message
     * and cause.
     *
     * <p> Note that the detail message associated with {@code cause} is
     * <i>not</i> automatically incorporated into this exception's detail
     * message.
     *
     * @param message
     *        The detail message (which is saved for later retrieval
     *        by the {@link #getMessage()} method)
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public IsFullException(String message, Throwable cause) {
        super(message, cause);
    }

    /**
     * Constructs an {@code IsFullException} with the specified cause and a
     * detail message of {@code (cause==null ? null : cause.toString())}
     * (which typically contains the class and detail message of {@code
cause}).
     * This constructor is useful for IsFull exceptions that are little
more
     * than wrappers for other throwables.
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public IsFullException(Throwable cause) {
        super(cause);
    }
}
```

models.exceptions.NotPassedException class

This class extends the `models.exceptions.CourseException` class would be thrown if the student doesn't passed the pre-requests of the course.

```
package models.exceptions;

public class NotPassedException extends CourseException {
    /**
     * Constructs an {@code NotPassedException} with the specified detail
message.
     */
    public NotPassedException() {
        super();
    }

    /**
     * Constructs an {@code NotPassedException} with the specified detail
message.
     *
     * @param message The detail message.
     */
    public NotPassedException(String message) {
        super(message);
    }

    /**
     * Constructs an {@code NotPassedException} with the specified detail
message
     * and cause.
     *
     * <p> Note that the detail message associated with {@code cause} is
     * <i>not</i> automatically incorporated into this exception's detail
     * message.
     *
     * @param message
     *        The detail message (which is saved for later retrieval
     *        by the {@link #getMessage()} method)
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public NotPassedException(String message, Throwable cause) {
        super(message, cause);
    }

    /**
     * Constructs an {@code NotPassedException} with the specified cause
and a
     * detail message of {@code (cause==null ? null : cause.toString())}
     * (which typically contains the class and detail message of {@code
cause}).
```

```
     * This constructor is useful for IsFull exceptions that are little
more
     * than wrappers for other throwables.
     *
     * @param cause
     *        The cause (which is saved for later retrieval by the
     *        {@link #getCause()} method).  (A null value is permitted,
     *        and indicates that the cause is nonexistent or unknown.)
     */
    public NotPassedException(Throwable cause) {
        super(cause);
    }
}
```

models.roles package

This package provides all interfaces of each role, so all files in this package must be a interface.

models.roles.RoleBase abstract interface

This abstract interface defines all methods of a role should be implemented.

```
package models.roles;

public abstract interface RoleBase {
    public abstract void setId(int paramInt);

    public abstract int getId();

    public abstract void setName(String paramString);

    public abstract String getName();

    public abstract void setUsername(String paramString);

    public abstract String getUsername();

    public abstract void setPassword(String paramString);

    public abstract boolean checkPassword(String paramString);

    public abstract void setPermission(int paramInt);

    public abstract int getPermission();
}
```

models.roles.AdminRole interface

This interface extends the `models.roles.RoleBase` interface and it provides the characteristic methods for the `model.users.Admin` class.

```
package models.roles;

public interface AdminRole extends RoleBase {

}
```

models.roles.StudentRole interface

This interface extends the `models.roles.RoleBase` interface and it provides the characteristic methods for the `model.users.Student` class.

```
package models.roles;

public interface StudentRole extends RoleBase {

}
```

models.users package

This package provides all classes of each user, so all files in this package must be a class.

models.users.User abstract class

This abstract class defines all attributes of a user should have.

```
package models.users;

import java.security.spec.InvalidKeySpecException;

import models.roles.RoleBase;
import utils.Hash;

/**
 * The User class.
 */
public abstract class User implements RoleBase {
    // The id of the user.
    private int id;

    // The name of the user.
    private String name;

    // The username of the user.
```

```
    private String username;

    // The hashed password of the user.
    private byte[] password;

    // The role of the user.
    private int permission;

    /**
     * The constructor of User.
     *
     * @param id The id of the user.
     * @param name The name of the user.
     * @param username The username of the user.
     * @param password The password of the user.
     * @param permission The permission of the user.
     */
    public User(int id, String name, String username, String password, int
permission) {
        setId(id);
        setName(name);
        setUsername(username);
        setPassword(password);
        setPermission(permission);
    }

    // A abstract method to get formatted string of user information.
    public abstract String getInfoString();

    @Override
    public void setId(int paramInt) {
        this.id = paramInt;
    }

    @Override
    public int getId() {
        return id;
    }

    @Override
    public void setName(String paramString) {
        name = paramString;
    }

    @Override
    public String getName() {
        return name;
    }

    @Override
    public void setPassword(String paramString) {
        try {
            password = Hash.hash(paramString);
        } catch (InvalidKeySpecException e) {
```

```
            e.printStackTrace();
        }
    }

    @Override
    public boolean checkPassword(String paramString) {
        try {
            return Hash.check(paramString, password);
        } catch (InvalidKeySpecException e) {
            e.printStackTrace();
        }
        return false;
    }

    @Override
    public void setPermission(int paramInt) {
        permission = paramInt;
    }

    @Override
    public int getPermission() {
        return permission;
    }

    @Override
    public String getUsername() {
        return username;
    }

    @Override
    public void setUsername(String username) {
        this.username = username;
    }
}
```

models.users.Admin class

This class extends the `models.users.User` class and it provides the characteristic abstract for the Admin user. It also implements all interfaces of `models.roles.AdminRole`.

```
package models.users;

import models.roles.AdminRole;

/**
 * The Admin class.
 */
public class Admin extends User implements AdminRole {
    /**
     * The constructor of Admin.
```

```
     * the admin would have permission status of 1.
     *
     * @param id The id of the admin.
     * @param name The name of the admin.
     * @param username The username of the admin.
     * @param password The password of the admin.
     */
    public Admin(int id, String name, String username, String password) {
        super(id, name, username, password, 1);
    }

    @Override
    public String getInfoString() {
        return "name: " + getName() +
               "\nusername: " + getUsername();
    }
}
```

models.users.Student class

This class extends the `models.users.User` class and it provides the characteristic abstract for the Student user. It also implements all interfaces of `models.roles.StudentRole`.

```
package models.users;

import java.util.ArrayList;

import models.course.Course;
import models.roles.StudentRole;

/**
 * The Student class.
 */
public class Student extends User implements StudentRole {
    // The courses that the student has registered.
    private ArrayList<Course> register = new ArrayList<>();

    // The courses that the student has passed.
    private ArrayList<Course> passed = new ArrayList<>();

    /**
     * The constructor of Student.
     *
     * @param id The id of the student.
     * @param name The name of the student.
     * @param username The username of the student.
     * @param password The password of the student.
     */
    public Student(int id, String name, String username, String password) {
        super(id, name, username, password, 0);
```

```
    }

    @Override
    public String toString() {
        return "Student{" +
                "name=" + getName() +
                ", registered=" + Course.getCourseString(register) +
                ", passed=" + Course.getCourseString(passed) +
                '}';
    }

    /**
     * Return a formatted string of the student information.
     *
     * @return A formatted string.
     */
    public String getInfoString() {
        return "name: " + getName() +
               "\nusername: " + getUsername() +
               "\ntaken courses: " + Course.getCourseString(register) +
               "\npassed courses: " + Course.getCourseString(passed);
    }

    /**
     * Return a formatted string of the students' information.
     *
     * @param students The students.
     * @return The formatted string.
     */
    public static String getStudentLiString(ArrayList<Student> students) {
        StringBuilder sb = new StringBuilder();

        sb.append(String.format("%6s %10s %s\n", "Select", "Username",
"Name"));

        for (int i=0; i<students.size(); i++) {
            Student student = students.get(i);
            sb.append(String.format("  [%2d] %10s %s\n", i,
student.getUsername(), student.getName()));
        }

        return sb.toString();
    }

    public ArrayList<Course> getPassed() {
        return passed;
    }

    public void setPassed(ArrayList<Course> passed) {
        this.passed = passed;
    }

    public ArrayList<Course> getRegister() {
        return register;
```

```
    }

    public void setRegister(ArrayList<Course> register) {
        this.register = register;
    }
}
```

---

services package

This package provides all relationship operations for models.

services.AdminService class

This class provides all operations to admins and courses.

```
package services;

import models.course.Course;
import models.exceptions.AlreadyTakenException;
import models.exceptions.CourseException;
import models.exceptions.IsFullException;
import models.users.Student;

/**
 * The service for Admin.
 */
public class AdminService {
    /**
     * Make a student to take a course.
     *
     * @param student The student.
     * @param course The course.
     * @throws CourseException If the course is full.
     * @throws CourseException If the student has already registered.
     */
    public static void takeCourse(Student student, Course course) throws
CourseException {
        if (course.getMaxStudents() <= course.getStudents().size()) {
            throw new IsFullException(
                "The course have been fully taken:\n" +
                "--------------------\n" +
                course.getInfoString() + "\n" +
                "--------------------\n"
            );
        }
        if (student.getRegister().contains(course)) {
            throw new AlreadyTakenException(
                "The student has already registered:\n" +
                "--------------------\n" +
```

```
                student.getInfoString() + "\n" +
                "--------------------\n"
            );
        }
        if (student.getPassed().contains(course)) {
            throw new AlreadyTakenException(
                "The student has already passed:\n" +
                "--------------------\n" +
                student.getInfoString() + "\n" +
                "--------------------\n"
            );
        }
        // without pre-requests
        student.getRegister().add(course);
        course.getStudents().add(student);
    }
}
```

services.StudentService class

This class provides all operations to students and courses.

```
package services;

import models.course.Course;
import models.exceptions.AlreadyTakenException;
import models.exceptions.CourseException;
import models.exceptions.IsFullException;
import models.exceptions.NotPassedException;
import models.users.Student;

/**
 * The service for student.
 */
public class StudentService {
    /**
     * Take a course.
     *
     * @param student The student.
     * @param course The course.
     * @throws CourseException If the course is full.
     * @throws CourseException If the student has already registered.
     * @throws CourseException If the student has not passed the pre-
requests.
     */
    public static void takeCourse(Student student, Course course) throws
CourseException {
        if (course.getMaxStudents() <= course.getStudents().size()) {
            throw new IsFullException(
                "The course have been fully taken:\n" +
```

```
                    "--------------------\n" +
                    course.getInfoString() + "\n" +
                    "--------------------\n"
                );
            }
            if (student.getRegister().contains(course)) {
                throw new AlreadyTakenException(
                    "The student has already registered:\n" +
                    "--------------------\n" +
                    student.getInfoString() + "\n" +
                    "--------------------\n"
                );
            }
            if (student.getPassed().contains(course)) {
                throw new AlreadyTakenException(
                    "The student has already passed:\n" +
                    "--------------------\n" +
                    student.getInfoString() + "\n" +
                    "--------------------\n"
                );
            }
            if (!checkPreRequests(student, course) ) {
                throw new NotPassedException(
                    "The student has not passed the pre-requests:\n" +
                    "--------------------\n" +
                    student.getInfoString() + "\n" +
                    "--------------------\n" +
                    course.getInfoString() + "\n" +
                    "--------------------\n"
                );
            }
            student.getRegister().add(course);
            course.getStudents().add(student);
        }

        /**
         * Check if the student has passed the pre-requests.
         *
         * @param student The student.
         * @param course The course.
         * @return True if the student has passed the pre-requests.
         */
        public static boolean checkPreRequests(Student student, Course course)
    {
            for (Course preRequest : course.getPreRequests()) {
                if (!student.getPassed().contains(preRequest)) {
                    return false;
                }
            }
            return true;
        }

        /**
         * Pass a course.
```

```
     *
     * @param student The student.
     * @param course The course.
     */
    public static void passCourse(Student student, Course course) {
        // We don't need to check if the student has taken the course.
        // We check at {@code StudentService.takeCourse} already.
        student.getPassed().add(course);
    }
}
```

---

utils package

This package provides some independent tools for others.

Hash class

This class provides hash and check functions for sensitive data.

```
package utils;

import java.security.NoSuchAlgorithmException;
import java.security.spec.InvalidKeySpecException;
import java.security.spec.KeySpec;

import javax.crypto.SecretKeyFactory;
import javax.crypto.spec.PBEKeySpec;

/**
 * This class is used to generate/check a hash code for a string.
 */
public class Hash {
    private static byte[] salt = new byte[16];

    public Hash() throws NoSuchAlgorithmException {
    }

    /**
     * Generate a hash code for a string.
     *
     * @param password The string to generate a hash code for.
     * @return The hash code of the string.
     * @throws InvalidKeySpecException If the password is invalid.
     */
    public static byte[] hash(String password) throws
InvalidKeySpecException {
        try {
            SecretKeyFactory factory =
SecretKeyFactory.getInstance("PBKDF2WithHmacSHA1");
```

```
            KeySpec spec = new PBEKeySpec(password.toCharArray(), salt,
65536, 128);
            byte[] encoded = factory.generateSecret(spec).getEncoded();

            return encoded;
        } catch (NoSuchAlgorithmException e) {
            e.printStackTrace();
            throw new RuntimeException("Error while hashing password", e);
        }
    }

    /**
     * Check if a hash code is valid for a string.
     *
     * @param password The string to check the hash code for.
     * @param hash The hash code to check.
     * @return True if the hash code is valid for the string.
     * @throws InvalidKeySpecException If the password is invalid.
     */
    public static boolean check(String password, byte[] hash) throws
InvalidKeySpecException {
        byte[] test = hash(password);
        if (test.length != hash.length) {
            return false;
        }
        for (int i = 0; i < test.length; i++) {
            if (test[i] != hash[i]) {
                return false;
            }
        }
        return true;
    }
}
```

CLIParse class

This class provides a more elegant methods to get system arguments.

```
package utils;

import java.util.HashMap;
import java.util.HashSet;
import java.util.ArrayList;
import java.util.Arrays;
import java.util.List;
import java.util.Set;

/**
 * A command line parser.
 */
```

```
public class CLIParser {
    List <String> args = new ArrayList<>();
    HashMap<String, List<String>> map = new HashMap<>();
    Set<String> flags = new HashSet<>();

    public CLIParser(String arguments[])
    {
        this.args = Arrays.asList(arguments);
        map();
    }

    /**
     * Parse the arguments and put them in a map.
     *
     * @return the map
     */
    public Set<String> getKeys()
    {
        Set<String> argumentNames = new HashSet<>();
        argumentNames.addAll(flags);
        argumentNames.addAll(map.keySet());

        return argumentNames;
    }

    /**
     * Check if flag is given
     *
     * @param flag the flag name
     * @return true if flag is given
     */
    public boolean getFlag(String flagName)
    {
        return flags.contains(flagName);
    }

    /**
     * Return argument value for particular argument name
     *
     * @param argumentName the argument name
     * @return the argument value if it exists, null otherwise
     */
    public String getVal(String argumentName)
    {
        return map.containsKey(argumentName) ?
            map.get(argumentName).get(0) :
            null;
    }

    /**
     * Map the flags and argument names with the values
     */
    public void map()
    {
```

```
        for (String arg: args) {
            if (arg.startsWith("-")) {
                if (args.indexOf(arg) == (args.size() - 1)) {
                    flags.add(arg.replace("-", ""));

                } else if (args.get(args.indexOf(arg)+1).startsWith("-")) {
                    flags.add(arg.replace("-", ""));

                } else {
                    //List of values (can be multiple)
                    List<String> argumentValues = new ArrayList<>();
                    int i = 1;
                    while (args.indexOf(arg)+i != args.size() &&
!args.get(args.indexOf(arg)+i).startsWith("-")) {
                        argumentValues.add(args.get(args.indexOf(arg)+i));
                        i++;
                    }

                    map.put(
                        arg.replace("-", ""),
                        argumentValues
                    );
                }
            }
        }
    }

    public void print()
    {
        System.out.println("Flags: " + flags);
        System.out.println("Arguments: " + map);
    }
}
```

LogFormatter class

This class provides a colorful and cleaner logger formatter.

```
package utils;

import java.text.SimpleDateFormat;
import java.util.Date;
import java.util.logging.ConsoleHandler;
import java.util.logging.FileHandler;
import java.util.logging.Formatter;
import java.util.logging.LogRecord;
import java.util.logging.Logger;
import java.util.logging.SimpleFormatter;

/**
 * The LogFormatter class.
```

```
 *
 * provides a custom formatter for the logger.
 */
public class LogFormatter extends Formatter {
    // ANSI escape code
    public static final String RESET = "\u001B[0m";
    public static final String BLACK = "\u001B[30m";
    public static final String RED = "\u001B[31m";
    public static final String GREEN = "\u001B[32m";
    public static final String YELLOW = "\u001B[33m";
    public static final String BLUE = "\u001B[34m";
    public static final String PURPLE = "\u001B[35m";
    public static final String CYAN = "\u001B[36m";
    public static final String WHITE = "\u001B[37m";
    public static final String BOLD = "\033[1m";

    // Here you can configure the format of the output and
    // its color by using the ANSI escape codes defined above.

    // format is called for every console log message
    @Override
    public String format(LogRecord record) {
        // This example will print date/time, class, and log level in
yellow,
        // followed by the log message and it's parameters in white .
        StringBuilder builder = new StringBuilder();
        switch (record.getLevel().getName()) {
            case "SEVERE":
                builder.append(RED);
                break;
            case "WARNING":
                builder.append(YELLOW);
                break;
            case "INFO":
                builder.append(BLUE);
                break;
            case "FINE":
                builder.append(GREEN);
                break;
            default:
                builder.append(WHITE);
                break;
        }
        builder.append("[");
        builder.append(record.getLevel().getName());
        builder.append("] ");
        builder.append(calcDate(record.getMillis()));
        builder.append(" ");
        builder.append(record.getSourceClassName());
        builder.append(".");
        builder.append(record.getSourceMethodName());
        builder.append(WHITE);
        builder.append(" ");
        builder.append(record.getMessage());
```

```
            builder.append(RESET);
            builder.append("\n");
            return builder.toString();
        }

        private String calcDate(long ms) {
            SimpleDateFormat date_format = new SimpleDateFormat("yyyy-MM-dd
    HH:mm:ss");
            Date resultDate = new Date(ms);
            return date_format.format(resultDate);
        }

        public static Logger getConsoleLogger(String name) {
            Logger log = Logger.getLogger(name);
            log.setUseParentHandlers(false);

            ConsoleHandler handler = new ConsoleHandler();

            Formatter formatter = new LogFormatter();
            handler.setFormatter(formatter);

            log.addHandler(handler);

            return log;
        }

        public static Logger getFileHandlerLogger(String name) {
            Logger log = Logger.getLogger(name);

            log.setUseParentHandlers(false);

            try {
                FileHandler handler = new FileHandler(name + ".log");
                Formatter formatter = new SimpleFormatter();
                handler.setFormatter(formatter);
                log.addHandler(handler);

                return log;
            } catch (Exception e) {
                e.printStackTrace();
                System.exit(-1);
            }
            return null;
        }
    }
```