UNIVERSITY OF
BIRMINGHAM

Software Workshop 2

—

Real Time Multi-User Quiz System

Benjamin Crispin,
Samuel Farmer,
Deedar Fatima,
Rowan Stringer,
Josh Wainwright

Group Osaka

Supervisor: Joe Gardiner

Date: March 2014

Contents

1 Protocol

The protocol for communicating between the different parts of the system is based around objects. There exists an object class that can be created for any of the several message types that could be needed to transfer information from the server to the client, or from the client to the server. Each of these objects implements the `Serializable` interface, allowing them to be converted to bytes and transfered across the socket connection using object streams.

The primary purpose of each of the objects used is desribed below.

`AnswerResponse`
: To respond to a question, the Student selects the desired option. This information is passed to the server using an AnswerResponse object which simply holds the response and the timestamp to indicate when they made the selection.

`DisplayQuestion`
: In order to signify that the allotted time for the current question has ended, and the next question should be displayed, the server sends a DisplayQuestion object to all of the clients and they should move on to the next question in the Quiz object and change the GUI accordingly.

`LoginReply`
: Once a loginRequest has been received by the server, a LoginReply will be sent back. This gives the client the information about the requested login, most importantly if the login was successful, as well as the type of user that made the login, Student or Admin. This information is used to display the correct user interface.

`LoginRequest`
: This is the first object that could be created. It is sent, by the client, to the server and contains the username of the Student that is attempting to login and the `java.lang.String` hash code of the inserted password. Though the security concerns of such a trivial system are non-existent, the password is never stored in plaintext.

`Question`
: There exist several question objects in each Quiz object. They store the information required to present a Student with a question and the possible answers. Again, there is very little functionality as the question only serves as a wrapper for the question text and the possible answers that the user could respond with.

`Quiz`
: This is the most important object. It has very little functionality, simply acting as a wrapper to hold and easily transfer several Question objects.

`QuizRequest`
: When an Admin has successfully logged into the system, they have the option of starting one of the quizzes held in the database. This object is passed to the server and contains information about the quiz that the Admin has chosen to start.

`Score`
: When the quiz has been completed, each of the clients will display the position of it's user relative to the other Students. This object contains the score of all of the users so that each of the clients can work out where they are in the ranking.

`StartQuiz`
: Once the user has successfully logged into the system, the next major event is the start of the quiz. This is signaled by an Admin user who is connected to the server, this information

must then be relayed to each of the connected clients. A StartQuiz object is sent to each of the clients, who, on receiving it, will display the first question to the user.

2 Client

The client exists to accept messages sent by the server, and present them in an order and a format that the user interface can present to the user, as well as accept the information entered by the user into the user interface and pass it to the server.

2.1 System Design

1. **Login**

   When a client is started, a `QuizClient` object is created and starts the main loop. The initial stages set up the connection with the server and waits for the user to login. When the user enters their information, a `LoginRequest` object is created and pass to the server containing the username and password, to be checked against the contents of the database. The client then waits for a reponse from the server to indicate if the login was successfull or not. This comes in the form of a `LoginReply` object. If this says that the login was unsuccessful, the user is asked to re-input their details, otherwise, the display is changed and the options screen is shown.

2. **Student/Admin**

   There exists separate functionality withing the client depending on if the user is a Student user, i.e. going to be answering questions, or an Admin, i.e. the teacher who starts and moderates the quiz. Distinguishing between these two is done by the server by checking the details associated with that user in the database. The `LoginReply` object contains this information and the client can then display the correct interface depending on the type of user that logged in.

3. **Client Listens from Server**

   From here, the user can select the "Start Quiz" option to start the quiz. This causes the display to change to display the waiting screen and the client waits for information from the server.

   From this point on, the client waits for any object to be sent from the server and acts according to what that object was. The possible objects that the client now expects to be able to distinguish between are:

   - `Quiz`
   - `StartQuiz`
   - `DisplayQuestion`
   - `Score`

   `Quiz`
   : This object contains the information about the quiz itself, the number of questions, their contents and the duration that each question should be displayed for. It should only ever be recieved once by the client, at the start of the session, reducing the transfer of information over the connection.

`StartQuiz`
: Once an Admin has logged in, they have control over the start of the quiz. When they decide to start the quiz, this object is sent to each of the listening clients and so the client will procede to show the first question from the `Quiz` object.

`DisplayQuestion`
: The first question is displayed as soon as the `StartQuiz` object is recieved. After this point in the quiz, the questions are changed when this object is received. The value contained verifies which question is to be displayed.

`Score`
: After each question has been answered, the client can display a leader board showing the score of all the clients that have so far answered the current question along with the current client's position in this list. This object tells the client the relevant information for displaying the scores of the other clients.

4. **Sent by Client**

   There are also a number of objects that the client can create and send to the server at different stages of the quiz:

   - `LoginRequest`
   - `QuizRequest`
   - `AnswerResponse`

`QuizRequest`
: This is sent by the client when an Admin is logged in in order to request a particular quiz from the server. Since the server can hold many quizzes, each with their own set of questions and answers, the Admin has the option to choose which of these to play when they log in.

`AnswerResponse`
: This is the object that tells the server what answer the Student gave. It contains their response, so that it can be logged in the database, and the time it took for the Student to make their selection.

3 Server

The server exists to create a link between the database and the quiz program, as well creating connections with, and processing requests from, clients.

3.1 System Design

1. **Initialising the server**

   When the server starts, a `QuizServer` object is created. The object creates a connection with the database by taking advantage of the inbuilt Java Database Connectivity (JDBC) functionality, which allows the server object to retrieve, and update, information contained in the database. In addition to this, a `ServerSocket` object is created, which waits to receive connections from `QuizClient` objects. When a connection from a client is received, a new `ClientThread` object is created.

2. **Database Connectivity**

The server interacts with the database through static methods contained in the `QuizJDBC` class. The class allows the server to establish a connection with the database through a `getConnection` method, which returns a Connection object.

A second method, `isUser`, is called by the server when it receives a `LoginRequest` object from a client thread. The method returns a `LoginReply` object containing the results of the query, which is sent to the client.

The final method, `getQuiz`, is called when the server receives a `QuizRequest` object from a client, and returns a `Quiz` object.

3. **`ClientThread` Objects**

   When the server establishes a connection with a client, a `ClientThread` object is created, spawning a thread which allows interactions to occur between the server and client. The server then waits to receive a `LoginRequest` from the client, and returns a `LoginReply` object upon receiving it. Once the client has logged in, the server distinguishes between Student and Admin users.

4. **Admin Clients**

   If a connection to an Admin has been made, the server waits for a `QuizRequest` object. Once received, the server retrieves the quiz in the database through the `QuizJDBC` class, then distributes this to all connected Student clients.

5. **Student Client**

   If a student user has logged in, their instance of `ClientThread` on the server will wait until the Quiz has been set to ready by an admin. Once a quiz has been started, the server sends the `Quiz` object to all connected student clients, and then waits to receive an `AnswerReponse` from each of the Student client threads. The `AnswerReposnse` objects contain the clients response to a question, and the time that it took for them to answer it. The server than calculates the clients score, and the results are stored in an ArrayList, which contains the results of all connected Student clients. This ArrayList of scores is sent to the connected clients every time it is updated, allowing users to see an 'updating' results table which contains all student clients scores.

6. **Quiz Time**

   In order to carry out admin tasks on the server without disrupting the main thread which is listening for connecting clients, an inner class `QuizTime` which extends Thread was created. The thread loops through during the quiz session, checking certain conditions, to which it should respond with specific tasks. For example, it checks whether no clients are connected, in which case the quiz stops. It also checks whether the first question of the quiz has finished being asked, in which case further student clients should not be allowed to join the quiz.

4 Graphical User Interface

The Student and Admin users will interact with a graphical user interface to take and run the quiz. The model deals with the data so the GUI can just be a visual interaction and representation of the client model. Instead of having many pop ups for each of the GUI panels, we decided to have one frame per client in which its content panel changes depending on the current part of the quiz.

1. **Model/View Separation**

Originally we decided that the GUI would follow a model/view separation format where the model will be separate from the client. This, however, caused some problems so we decided to not have a separate model and use the client as the model instead. One of the problems we encountered was that the GUI would interact with the model and create an object that needs to be sent to the server. We found it tricky to find a way to send objects from the model to the client and realized that there was a lot of redundancy as objects had to go through the model and the client when really there only needed to be one.

2. **GUI Panels**

Each GUI panel used in the quiz has its own class. When a client is created, each of the GUI panels is instantiated and added to an array. To accomplish this we used inheritance. Each of the GUI panels extends the abstract class `MasterFrame`, and in turn, `MasterFrame` extends `JPanel`. Each of the GUI panels is added to the `guiElements`' `MasterFrame[]`. `MasterFrame` is an abstract class with one abstract method `resetDisplay()`. This method is used to reset the contents of the current panel to an updated version of the model. Whenever the content panel of the frame is changed, the `resetDisplay()` method is called to ensure correct information is displayed.

The overall GUI will display different panels depending on which part of the system is currently being used. The GUI panels are:

`LoginFrame`
: The first panel users will log-in to (both Admin and Student). `LoginFrame` contains a username field, a password field and login button. When the login button is activated, it send the contents of the two fields to the client model to create a `LoginRequest` object using the `requestLogin()` method.

`StudentHomeFrame`
: The panel a Student will see once they have logged in / received successful login reply object. Here they can push the Start quiz button which adds them to a pool of Students ready to start the quiz. This leads them to the `WaitingFrame` panel using the `requestWaitingScreen()` method.

`AdminHomeFrame`
: The panel the Admin will see once they have logged in / received successful login reply object. Here they can see which Students have connected and joined the waiting pool to start the quiz. `AdminHomeFrame` has a `JComboBox` which lists the possible quizzes to run. This uses the `setCurrentQuizID()` method. The Admin can then push the start quiz button which sends the selected quiz to all the waiting Students using the `adminStart()` method.

`WaitingFrame`
: The panel a Student will see when they have pushed start and are waiting for the Admin to start the quiz. Contains a message to the Student letting them know they are waiting for the Admin to start the quiz as well as a JProgressBar in intermediate state.

`QuestionFrame`
: The panel which displays the question to the Students. This panel is Is only displayed for a limited time as each question has a short time limit. The question is displayed in a `JTextPane,` and each of the four possible multiple choice answers is displayed as a `JButton` beneath. To the side there is a countdown timer which visually displays the time to answer the question. As soon as the question is answered or the time has run out, the panel is changed to the `StudentResultsFrame` panel. When a button is pushed, the `setResponseNumber(i)` method is called. If a Student doesn't answer, then the response number is set to -1.

`StudentResultsFrame`
: Once a Student has completed a question, they are displayed with this panel. `StudentResultsFrame` displays the last question with highlighted text for the correct answer and Students answer. It also displays the score received for the last question and current leader board for the quiz where each client is ranked by their total score so far. This panel is shown for a set amount of time before leading back to the `QuestionFrame` for a new question.

`AdminResultsFrame`
: The `AdminResultsFrame` is displayed once the Admin has started the quiz. It displays the current question Students are completing and a live leader board showing the current scores of the Students. The leader board ranks the Students by their current total score from the completed questions so far.

`FinalResultsFrame`
: This is similar to `StudentResultsFrame` but is the final panel the Student sees in the quiz. It shows the correct answers to the previous question and the score for the previous question. It also shows the final leader board rankings. Unlike `StudentResultsFrame,` there is no time limit so the Student can see the final results as long as they wish. There is a back button to return the Student to the `StudentHomeFrame` which uses the `returnHome()` method.

Other GUI components that we have created and used within the GUI panels are:

`CountDownTimer`
: `CountDownTimer` is GUI component that counts down seconds. It shows a `JProgressBar` decrease as the time decreases. Also has a label beneath showing the seconds left to count down. Used in `QuestionFrame`.

`LeaderBoard`
: A table consisting of each Student in the quiz, their position and score. This is updated whenever the `resetDislplay()` method is called in its parent panel (`MasterFrame`). Used in `StudentResultsFrame, AdminResultsFrame` and `FinalResultsFrame`.

5 Database

A database is an important part of any system which is designed to provide a mechanism for storing, managing and retrieving information. PostgreSQL, an object-relational database, was considered for the project. The two reasons behind choosing PostgreSQL were—availability on School's system and familiarity with the database model. The database designer considered business rules and processes during requirements analysis and came up with an initial draft of database model. The model was reviewed with the team and some modifications were done to accommodate the system requirements. The server used to create database was dbteach2. A new database, called osakagp, was created to store the data needed for Edify quiz.

5.1 Tables

The four tables created in osakagp DB are `quiz`, `questions`, `users` and `users_result`.

`Users`
: The user login details are stored in the users table. The user details are inserted into this table when a new user or Admin registers. The login credentials entered by the users are

validated and the users are allowed to login only if the entered credentials exist in the users table.

`Quiz`
The quiz topics are stored in this table. The quiz could be on the following topics—Politics, Sports, History, Geography, Music, and Science and Technology. The Admin chooses the quiz topic from quiz table and fetches the topic-related questions from the questions table.

`Questions`
The questions table contains the questions which are answered in quiz. Question and possible answers are stored as rows in the questions table. The table also contains a separate column for quiz ID. The Admin uses the quiz ID to get the questions for the chosen quiz topic.

`User_result`
This table contains the quiz results for all the Students. It is loaded with quiz result once the quiz is completed. The user can see the result by quiz date, quiz topic, score and quiz status.

5.2 Entity-Relationship Diagram

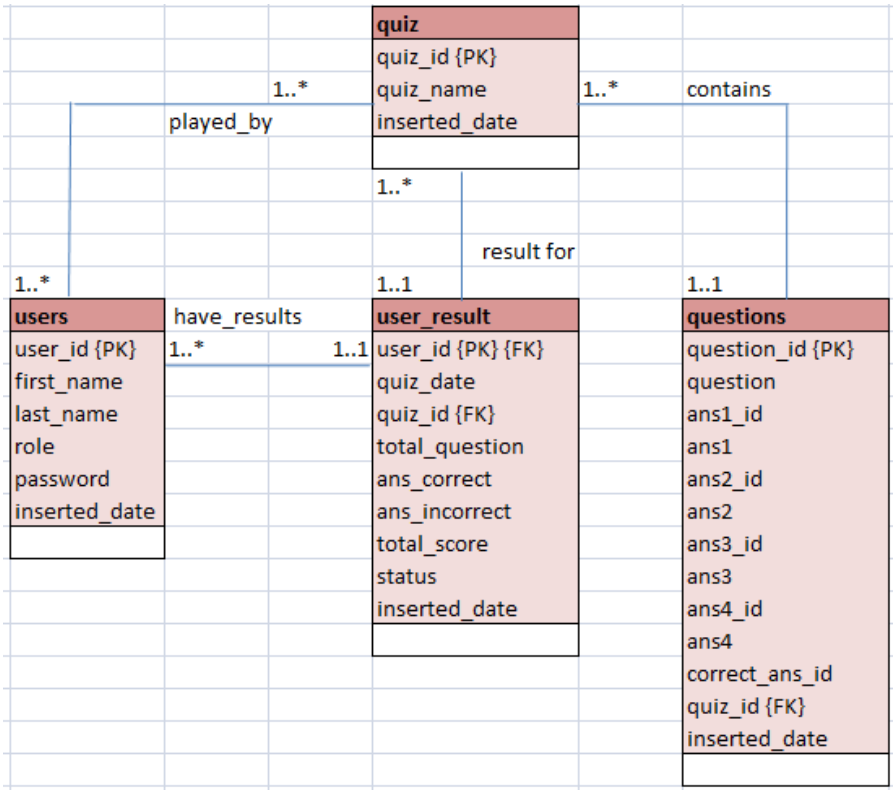


Figure 1: *This is the entity-relationship (ER) diagram for the tables used in Edify quiz. The relationship shared among these tables is explained in Section 5.2.*

5.2.1 One-to-One

- The table questions shares a one-to-one relationship with quiz table. Each question in the questions table can appear only in one quiz category.
- The table `user_result` shares a one-to-one relationship with users and quiz tables.The `user_result` table stores the result of all the quizes played by the Students. Each row in the `user_result` table is linked to one quiz in the quiz table and one user in the users table.
- The `user_result` table shares one-to-one relationship with users table. Each row in the `user_result` table is linked to one user in the users table.

5.2.2 One-to-Many

- The quiz table shares one-to-many relationship with questions table. Each quiz topic has 10 questions in the questions table.
- The quiz table shares one-to-many relationship with `users_result` table. Each quiz topic in the quiz table is linked to multiple rows in the `users_result` table as quiz result is stored for multiple players and can be played on multiple days.
- The quiz table shares one-to-many relationship with users table. One quiz can be played by mutilple users in the users table.
- The users table shares one-to-many relationship with quiz table. Each user in the users table can play one or more quiz in the quiz table.
- The users table shares one-to-many relationship with `user_result` table. Each user in the users table can have one or more quiz results in the `user_result` table.

5.3 Normalization

Data normalization was implemented to reduce and eliminate data redundancy.

First Normal Form
All the tables are in 1NF as they contain only atomic values and there are no repeating groups of data.

Second Normal Form
All tables are in 1NF and all of their non-key attributes are fully dependent on their primary keys. There is no partial dependency of any column on primary key.

Third Normal Form
All the tables are in 1NF and 2NF and all non-key attributes are fully functional dependent only on the primary key.

6 Test Plan

S.No	Category	Description	Expected Result	Actual Result
1	Registration	User is able to register by providing first name, last name, username and password.		
2	Registration	System should display username and password guidelines to users.		
3	Registration	System validates the credentials; dispays an error message if user provides invalid username and password and asks user to choose valid credentials.		
4	Registration	If user enters valid credentials, system checks if the entered credentials already exists in the the users table. If credentials exists, system asks the user to choose different credentials.		
5	Registration	System inserts the credentials in the users table if the user enters valid credentials. A unique ID is created for the user in users table.		
6	Login	System displays the login page where user can enter username and password and login to the system.		
7	Login	System checks the entered credentials in the users table; displays an error message if incorrect credentials are entered and asks user to re-enter credentials.		
8	Login	If correct credentials are entered, user is taken to the Home page.		
9	HomePage-Student	Student homepage should display the buttons – Start, View Result, Update Profile and Quiz rules.		
10	HomePage-Student	Quiz should start when Student clicks on “Start” button.		
11	HomePage-Student	Quiz result should be displayed when Student clicks on “View Result” button. What is shown in View Result page?		
12	HomePage-Student	Profile page should be displayed when Student clicks on “Update Profile” button. User should be able to edit profile; save changes or cancel changes.		
13	HomePage-Student	Quiz rules should be displayed when stuent clicks on “Quiz Rules” button. A new window or a popup screen?		
14	HomePage-Admin	Admin homepage should display the buttons – Start, View Result, Question settings (Add, remove or update questions), Update Profile. (Check the options displayed).		
15	HomePage-Admin	Admin should be able to select a quiz and click on Start to start the quiz.		
16	HomePage-Admin	Quiz result should be displayed when Admin clicks on “View Result” button. What is shown in View Result page?		

17	HomePage-Admin	Admin should be able to add, remove or update questions/answers in questions table in the Question settings page.
18	HomePage-Admin	Profile page should be displayed when Admin clicks on "Update Profile" button. Admin should be able to edit profile; save changes or cancel changes.
19	Play Quiz-Student	The quiz name should be displayed in quiz page.
20	Play Quiz-Student	Each quiz consists of 10 questions.
21	Play Quiz-Student	Each question has a set of possible answers (maximum 4).
23	Play Quiz-Student	Timer is displayed when question appears on screen.
24	Play Quiz-Student	Student is able to choose an answer by clicking on the answer.
25	Play Quiz-Student	When a Student chooses the correct answer before time runs out, timer stops. The other Students should not be able to select an option once the timer stops.
26	Play Quiz-Student	After quiz finishes, the result is inserted into user_result table.
27	Play Quiz-Student	Student should be able to see feedback after quiz finishes.
28	Play Quiz-Student	Student should be able to view result after quiz finishes (and after answering a question?).
29	Play Quiz-Student	Student should b able to view the historical result data from user_result table after quiz finishes.
30	Play Quiz-Student	Student should be able to click on the close buttom to exit the quiz.
31	Play Quiz-Admin	Admin should be able to click on start button to start the quiz once all Students have logged in.
32	Play Quiz-Admin	Admin should be able to see the result after each question is answered.
33	Play Quiz-Admin	Admin should be able to see the result summary after quiz finishes.
34	Play Quiz-Admin	Student should be able to click on the close buttom to exit the quiz.
35	Server-Client	System ensures that all clients and server are synchronised.
36	JDBC	Database connection is established from JDBC.

7 Evaluation

7.1 Team Organisation

The group consists of 5 students. Since there were a number of distinct sections to the project, the different components were distributed among the members of the team with one person in a position of responsibility for that component and another to provide assistance. The allocations were as follows.

Component	Responsible	Assiting
GUI	Benjamin Crispin	Deedar Fatima
Client	Josh Wainwright	Rowan Stringer
Server	Rowan Stringer	Benjamin Crispin
Database	Deedar Fatima	Sam Farmer
Protocol	Sam Farmer	Josh Wainwright

These roles were followed closely during the initial stages of development and through the first round of testing. As the program became more complete and bug fixes were required, the roles were shared more evenly through the team. This has the advantage that all members have a full understanding of all aspects of the project having worked on all parts at some time.

7.2 Evaluation of project work

1. **Correctness and reliability**

   We set out to create an interactive live educational quiz and accomplished a reliable working project. We have had some coding problems throughout the project but worked as team to come up with solutions. One of the major problems we have encountered was updating the student results leader board. Whenever a student answers, their score is added to an array list in the server and this should be distributed to every other student so that their results screen is accurate. The problem when implementing was that the first student to answer would not receive the updated score array list as other students answered.

   This was corrected by having the students constantly listening for new score array lists and insured an up to date leader board. This also lead onto other problems such as students not being synchronised on the same question. The cause of this was as each student requested a new question, the question counter was incremented and students skipped questions. This was solved by having a counter so that the question would only be incremented once all students had requested the new question.

2. **Performance**

   There were issues with performance with a live quiz that we had to be concerned with. After the users have logged in and the quiz has started, the questions must be synchronised so that each student is answering the same question. This is accomplished through the server sending the question to each client, rather than the client being individually responsible for the current question. The questions are reliably sent to all students at the same time so that quiz is synchronised. When a student answers, they are directed to the results screen where they need to see an updated version of the leader board. As mentioned in **Correctness and reliability** above, a solution for this was found and works well.

3. **Usability**

The system works well and is designed so that users find it easy and intuitive to use. We decided on a standardised quiz format where each quiz has 10 questions, and each question has 4 multiple choice answers. The design of the GUI is intuitive so that users don't have to learn how to use the system. A user should immediately recognise how to use the system and not have to rely on previous knowledge to answer quizzes. Originally the GUI for the questions had text boxes displaying the multiple choice answers with buttons next to them. We gave the system to fellow students in the lab to test and found that they tended to want to push the multiple choice text boxes rather than the buttons. Therefore, we decided to scrap the text boxes and put the multiple choice answers directly as the button text.

4. **Substantiates**

   Much the originally functionality that we set out for we have accomplished. The users can successfully log in and are displayed the right screen depending on if they are a student or admin. The admin can register students, and students can view their profile. The admin can select a quiz and this is sent to the student. Students can take the quiz and see a live leader board based on the ranking through out the quiz. The admin can also see a leader board of the students live results. Extra functionality we would wish to include would be for the admin to be able to create quizzes and for these to be stored in the database and to be run for students.

7.3 Evaluation of project process

1. **Management of team work**

   Initially the project was split into five sections with each member of the group volunteering to be responsible for a section. In addition, each member was also assigned a section to assist on. Rather than appointing a team leader to distribute the work amongst the group, the tasks to be completed were discussed during bi-weekly team meetings.

2. **Time keeping and scheduling**

   Group meetings were held twice weekly; one early in the week to discuss and distribute the tasks that were to be completed for the following week, and a second meeting later in the week to discuss the current progress and any problems that were being had. Each task that was to be completed was assigned a deadline. Throughout the duration of the project, these deadlines were adhered to by all group members.

3. **Subdivision of work**

   During the initial stages of the project, each member was assigned specific tasks that were to be completed by a certain deadline. By adhering to these deadlines, the code for each of the five portions were completed within the first two weeks. The remainder of the time was then spent on integrating the code and fixing the bugs that inhibited the system from meeting the software specification. During this time, a list of tasks to be completed was produced and group members would systematically work through this list, either individually or in smaller subgroups consisting typically of two or three members. This required effective communication between each of the group members, which was achieved through regular submissions to subversion and whole group emails.

4. **Integration**

   After the first few weeks of the project we decided to integrate the code each team member had written. This took a while to complete and we realised that some modifications had to be made. Once of the modifications was changing the client/model/view to model/view separation as stated in Section 4. We spent a day integrating different parts of

the project where all group members were present. This had the advantage of all group members knowing about all parts of the system and made the next few weeks of working and communication flow much more smoothly.

References

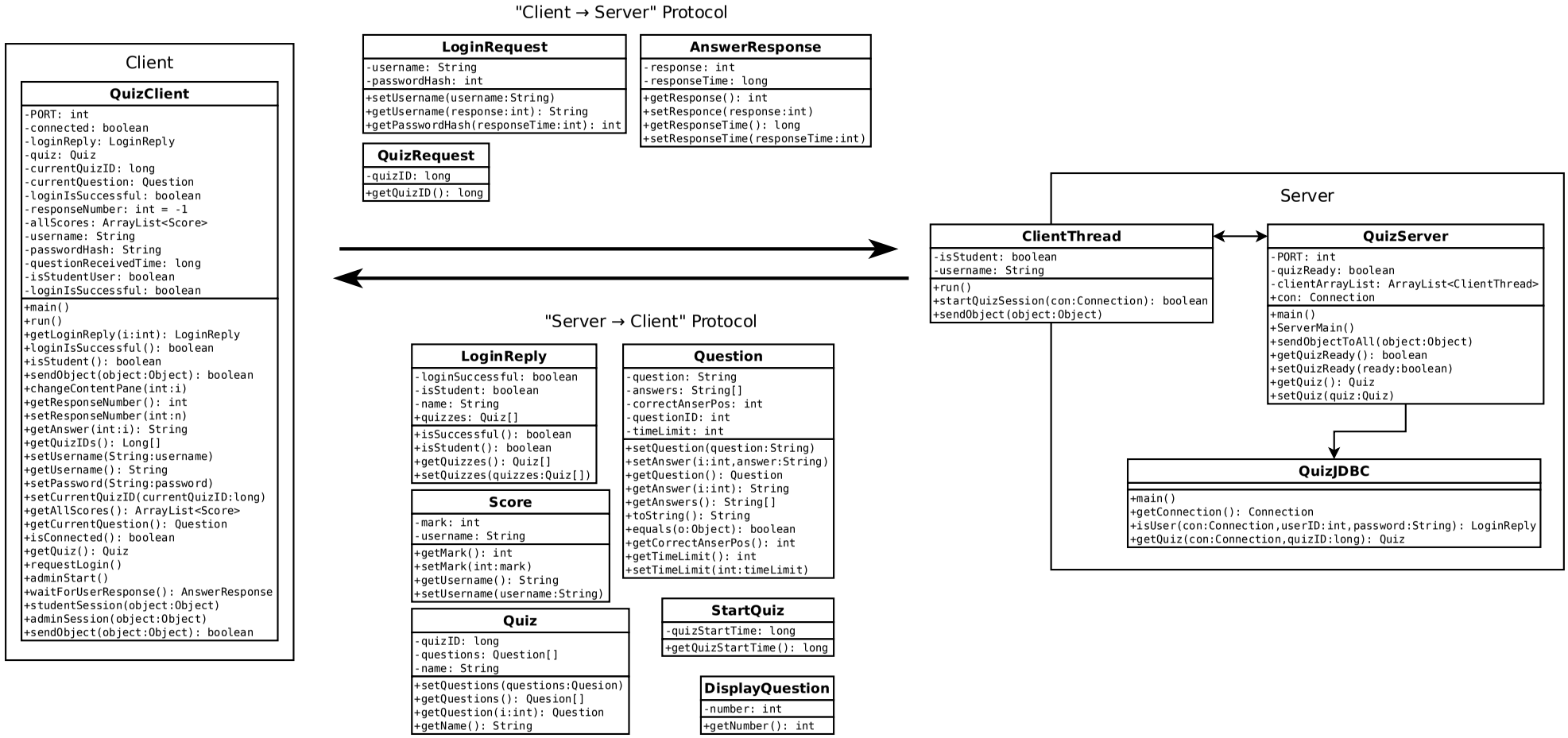
[1] Elliotte Harold. *Java Network Programming*. O'Reilly Media Inc., 2013.

[2] Harvey Deitel and Paul Deitel. *Java: How to Program*. Pearson, 2002.

[3] Scott Oaks and Henry Wong. *Java Threads*. O'Reilly Media Inc., 1999.

[4] Xingchen Chu Rajkumar Buyya, S Thamarai Selvi. *Object-Oriented Programming with Java*. Tata McGraw Hill, 2009.

[5] Kenneth L. Calvert and Michael J. Donahoo. *TCP/IP Sockets in Java*. Morgan Kauffman, 2001.


Client
QuizClient
-PORT: int
-connected: boolean
-loginReply: LoginReply
-quiz: Quiz
-currentQuizID: long
-currentQuestion: Question
-loginIsSuccessful: boolean
-responseNumber: int = -1
-allScores: ArrayList<Score>
-username: String
-passwordHash: String
-questionReceivedTime: long
-isStudentUser: boolean
-loginIsSuccessful: boolean
+main()
+run()
+getLoginReply(i:int): LoginReply
+loginIsSuccessful(): boolean
+isStudent(): boolean
+sendObject(object:Object): boolean
+changeContentPane(int:i)
+getResponseNumber(): int
+setResponseNumber(int:n)
+getAnswer(int:i): String
+getQuizIDs(): Long[]
+setUsername(String:username)
+getUsername(): String
+setPassword(String:password)
+setCurrentQuizID(currentQuizID:long)
+getAllScores(): ArrayList<Score>
+getCurrentQuestion(): Question
+isConnected(): boolean
+getQuiz(): Quiz
+requestLogin()
+adminStart()
+waitForUserResponse(): AnswerResponse
+studentSession(object:Object)
+adminSession(object:Object)
+sendObject(object:Object): boolean
"Client → Server" Protocol
LoginRequest
-username: String
-passwordHash: int
+setUsername(username:String)
+getUsername(response:int): String
+getPasswordHash(responseTime:int): int
AnswerResponse
-response: int
-responseTime: long
+getResponse(): int
+setResponce(response:int)
+getResponseTime(): long
+setResponseTime(responseTime:int)
QuizRequest
-quizID: long
+getQuizID(): long
Server
ClientThread
-isStudent: boolean
-username: String
+run()
+startQuizSession(con:Connection): boolean
+sendObject(object:Object)
QuizServer
-PORT: int
-quizReady: boolean
-clientArrayList: ArrayList<ClientThread>
+con: Connection
+main()
+ServerMain()
+sendObjectToAll(object:Object)
+getQuizReady(): boolean
+setQuizReady(ready:boolean)
+getQuiz(): Quiz
+setQuiz(quiz:Quiz)
QuizJDBC
+main()
+getConnection(): Connection
+isUser(con:Connection,userID:int,password:String): LoginReply
+getQuiz(con:Connection,quizID:long): Quiz
"Server → Client" Protocol
LoginReply
-loginSuccessful: boolean
-isStudent: boolean
-name: String
+quizzes: Quiz[]
+isSuccessful(): boolean
+isStudent(): boolean
+getQuizzes(): Quiz[]
+setQuizzes(quizzes:Quiz[])
Question
-question: String
-answers: String[]
-correctAnserPos: int
-questionID: int
-timeLimit: int
+setQuestion(question:String)
+setAnswer(i:int,answer:String)
+getQuestion(): Question
+getAnswer(i:int): String
+getAnswers(): String[]
+toString(): String
+equals(o:Object): boolean
+getCorrectAnserPos(): int
+getTimeLimit(): int
+setTimeLimit(int:timeLimit)
Score
-mark: int
-username: String
+getMark(): int
+setMark(int:mark)
+getUsername(): String
+setUsername(username:String)
StartQuiz
-quizStartTime: long
+getQuizStartTime(): long
Quiz
-quizID: long
-questions: Question[]
-name: String
+setQuestions(questions:Quesion)
+getQuestions(): Quesion[]
+getQuestion(i:int): Question
+getName(): String
DisplayQuestion
-number: int
+getNumber(): int

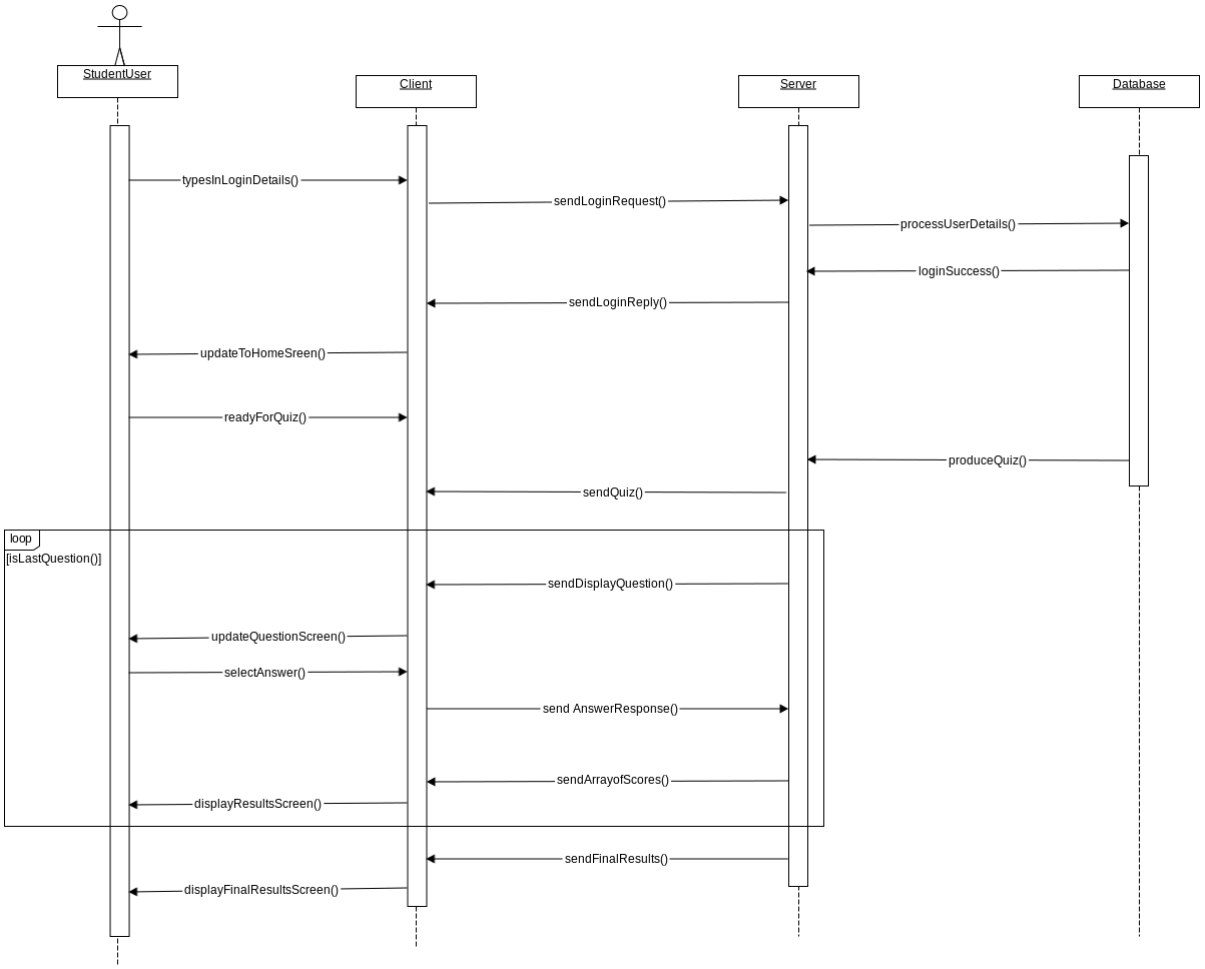


Figure 2: *Student scenario diagram.*

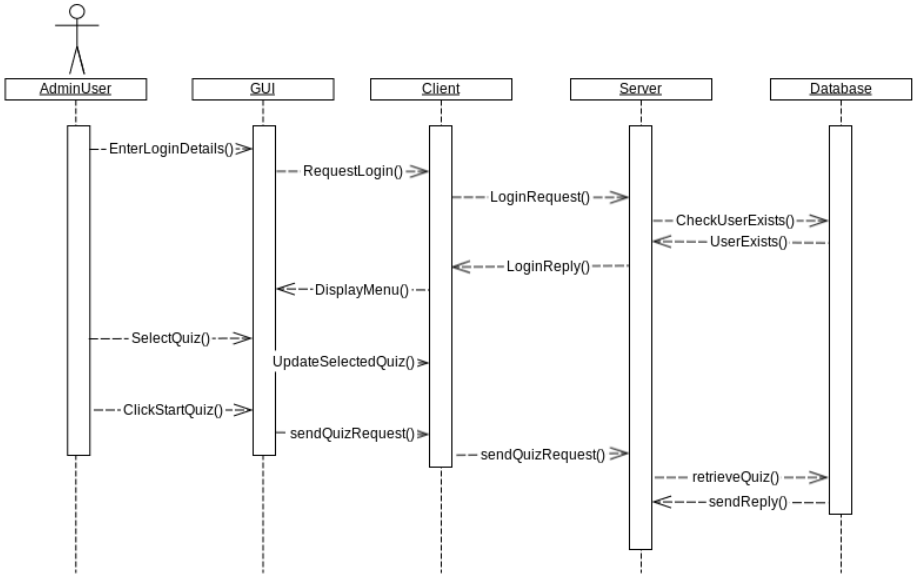


Figure 3: *Admin sequence diagram.*

Table name	users			
Attribute	**Description**	**Type**	**Nullability**	**Example of values**
user_id	Unique ID of admin/student	BIG INT	NOT NULL	Between 1 and 9223372036854775807
first_name	First name of admin/student	VARCHAR (20)	NULL	Mary
last_name	Last name of admin/student	VARCHAR (20)	NULL	Ande
role	Role of user	VARCHAR (20)	NULL	admin or student
password	Password entered by admin/student to access the tool	VARCHAR (10)	NULL	
inserted_date	Timestamp of the transaction	TIMESTAMP	NOT NULL	DEFAULT is the current timestamp.
Primary Key	user_id			
Foreign Key				
Index	user_id			

Table name	quiz			
Attribute	**Description**	**Type**	**Nullability**	**Example of values**
quiz_id	Unique ID of quiz	BIG INT	NOT NULL	Between 1 and 9223372036854775807
quiz_name	Topic of quiz	VARCHAR (40)	NULL	Politics, Sports
inserted_date	Timestamp of the transaction	TIMESTAMP	NOT NULL	DEFAULT is the current timestamp.
Primary Key	quiz_id			
Foreign Key				
Index	quiz_id			

Table name	questions			
Attribute	**Description**	**Type**	**Nullability**	**Example of values**
question_id	Unique ID of question	BIG INT	NOT NULL	Between 1 and 9223372036854775807
question	The question to be answered by students	VARCHAR (200)	NULL	In which country is the Albert canal?
ans1_id	ID of first possible answer	INT	NOT NULL	DEFAULT is 1
ans1	First possible answer	VARCHAR (40)	NULL	Spain
ans2_id	ID of second possible answer	INT	NOT NULL	DEFAULT is 2
ans2	Second possible answer	VARCHAR (40)	NULL	Belgium
ans3_id	ID of third possible answer	INT	NOT NULL	DEFAULT is 3
ans3	Third possible answer	VARCHAR (40)	NULL	Canada
ans4_id	ID of fourth possible answer	INT	NOT NULL	DEFAULT is 4
ans4	Fourth possible answer	VARCHAR (40)	NULL	Portugal
correct_ans_id	The ID of correct answer	INT	NOT NULL	2
quiz_id	The ID of quiz	BIG INT	NOT NULL	4
inserted_date	Timestamp of the transaction	TIMESTAMP	NOT NULL	DEFAULT is the current timestamp.
Primary Key	question_id			
Foreign Key	quiz_id			
Index	question_id, quiz_id			

Table name	user_result			
Attribute	**Description**	**Type**	**Nullability**	**Example of values**
user_id	ID of user	BIG INT	NOT NULL	Between 1 and 9223372036854775807
quiz_date	Date on which quiz is played	TIMESTAMP	NOT NULL	DEFAULT is Current Timestamp
quiz_id	ID of quiz played by the student	BIG INT	NOT NULL	Between 1 and 9223372036854775807
total_question	Number of questions displayed in a quiz	INT	NULL	10
ans_correct	Number of questions answered correctly before any other student	INT	NULL	Between 0 and 10
ans_incorrect	Number of questions answered incorrectly	INT	NULL	Between 0 and 10
total_score	Number of questions answered correctly before any other student	INT	NULL	Between 0 and 10
status	If a student won or lost the quiz	VARCHAR(10)	NULL	WON or LOST
inserted_date	Timestamp of the transaction	TIMESTAMP	NOT NULL	DEFAULT is the current timestamp.
Primary Key	user_id			
Foreign Key	user_id, quiz_id			
Index	user_id, quiz_id			

Minutes of the

Team Osaka Project Meeting

UG04, Computer Science

March 04, 2014; 11:00-12:00

Minutes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright
5. Deedar Fatima

Minutes

1. We need to hand in a more detailed written specification.
2. Get a paragraph on each section and splice together – add paragraph to Subversion as .txt file, Sam will splice together.
3. We need an object diagram.
4. We need a class diagram.
5. Deedar is responsible for JDBC (database connection) and Prepared Statements.
6. JDBC will be carried out in a separate server thread.
7. 4 responses possible for questions – so arrays will be used instead of ArrayLists.
8. Share ERD + document on databases on Subversion.
9. Short meeting for Thursday will be held at 14:30-15:00, like last week.
10. Sam will help out with JDBC
11. Deedar will form the SQL for the Prepared Statements.
12. Rowan is responsible for passing the quiz object to the client (clarifications):
    - Server notified with a question object
    - Client carries out timing
    - Server listens for results object (including username, answer, time)
    - Tell client to end connection their end, close connection, close thread.

Action Summary			
Action Specifics	**Responsible**	**Deadline**	**Status**
Hand in a more detailed written specification	Sam		**Open**
Get a paragraph on each section and splice together	All		**Open**
Create object diagram	-		**Open**
Create class diagram	-		**Open**
Give system JDBC functionality	Deedar, Sam		**Open**
Create PreparedStatements	Deedar		**Open**
Share ERD + document on databases on Subversion.	Deedar		**Open**

*** End of Minutes ***

Tutorial Notes

Team Osaka Project Meeting

245, Computer Science

March 06, 2014; 16:00-16:30

Notes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright
5. Deedar Fatima
6. Joe Gardiner (Tutor)

Notes

- Protocols must be documented
- Testing must be planned
    - Using JUnit
    - Manual tests where JUnit is inappropriate
- Testing must be logged
    - Recording whether test cases were successful / failed
    - Recording what bugs were fixed
- Working system by next Wednesday.
- 2 weeks until report submission.
- Need 1 week for testing / bug fixing.

Work Status

- Deedar:
    - Completed Actions:
        - Database is working
    - Upcoming Actions
        - JUnit test cases
        - JDBC / Prepared Statements
- Sam:
    - Completed Actions:
        - Server connections
        - Server searching through database
    - Upcoming Actions
        - Server obtaining quiz object
        - Aside note: On query, pass connection and close / leave open based on result of condition
        - JUnit testing should be done by only one person

- Josh:
  - Completed Actions:
    - Client talks to server
    - Client passes and receives objects
  - Upcoming Actions
    - Document protocol
    - Communication with GUI (ensuring right information is available)
- Ben:
  - Completed Actions:
    - Some GUI screens are sorted
  - Upcoming Actions
    - All GUI screens will be done by Saturday (08/03/2014)
    - Communication with connected Client
- Rowan:
  - Completed Actions:
    - Client side server code written to pass quiz data obtained from the server-database connection.
  - Upcoming Actions
    - Enforcing synchronisation between connected clients during quiz mode.
    - Passing on client result information to the server-database connection to be stored in the database.

- SVN repository currently in use was setup on Josh's account as project SVN repository was unavailable at the start of the project:
  - Ideally the project should be migrated to the new project repository
    - Logs should be exported as .txt files
    - Actual files should be copied not the SVN bit
- Command line will be supported (vs Eclipse plugins)
- Joe will provide support regarding connections to the database through Eclipse (check project setup)
- For connecting to the database from outside the school, use university VPN connection.
- Extra testing (MSc only):
  - Detailed test plan (document) is required, that is formal and comprehensive.
  - Tests must be carried out and results logged.
- Format of presentation:
  - 10 minute presentation / 20 minute demonstration / 10 minutes deciding mark
- See Joe Tuesday to check in with an update of project
- Add own work to Subversion, and provide log messages when committing (can do this by writing note in TortoiseSVN / writing note in line above in cmd line while committing/ can use –n flag to write note in cmd line)

Action Summary			
Action Specifics	**Responsible**	**Deadline**	**Status**
Protocols must be documented.	-	13/03/2014	**Open**
Test plan must be documented	-	?	**Open**
Testing according to the plan must be logged	-	?	**Open**
System must be working	All	12/03/2014	**Open**
Report must be submitted	All	(Two weeks)	**Open**
Migrate project SVN directory to one provided	-	?	**Open**
Presentation must be prepared	All	?	**Open**
See Joe Tuesday to check in with update of project	-	11/03/2014	**Open**

*** End of Notes ***

Tutorial Notes

Team Osaka Project Meeting

245, Computer Science

March 13, 2014; 16:00-16:30

Notes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright
5. Deedar Fatima
6. Joe Gardiner (Tutor)

Notes

- Wait / Notify vs while loop
- Could do a read while in the while loop condition to make it wait
- Answers should update on the server
- GUI needs some work – "pretty"
- Colour change on admin when students answer
    - Countdown screen (big)
    - Control screen + who has answered
- Students see updating leaderboard
- Report due by Monday + prepare presentation
- Reallocate work
    - If database done, give that person new work
    - If connections done, get that person to work on the GUI
- Comment code
- Stability is important
    - Shows good testing has been implemented
    - A crash during the presentation can impact heavily on marks
- Documentation
    - Design:
        - Write what you did
        - Technologies you used
        - How it works
    - Testing:
        - JUnit
        - Manual
- Joe is absent Tuesday until Friday next week
- Short meeting with Joe Monday next week

*** End of Notes ***

Minutes of the

Team Osaka Project Meeting

UG04, Computer Science

February 21, 2014; 10:00-11:00 (approved on February 22)

Minutes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright

Agenda

1. Extra team member
2. Project documentation
3. Scoping out project and idea
4. Research
5. Allocations
6. Selection of Software Engineering Paradigm
7. Project Outline
8. Next Meeting
9. Any Other Business
10. Time of Meeting End

Minutes

1. **Extra team member:**
    - Notify Deedar about meeting.
    - Send Deedar the minutes.
    - Add Deedar to WhatsApp group.
2. **Project documentation:**
    - Write down project proposal down as soon as possible to avoid losing a week. Deadline of Monday.
    - Use latex for final deliverables (to give ability to use version control like subversion), if possible.
    - Team will use UML where appropriate.
3. **Eliciting project requirements:**
    - Creating a *use case diagram* as a team to determine broad system requirements.
    - Brief system description: the system is a live educational quiz in which students compete in real time to answer questions correctly. It will implement a client-server model with connected computers. There will be two user classes, henceforth referred to as Admin and Student. The system will implement sockets and threads (which avoid races/deadlocks) where appropriate and will have a graphical user interface (GUI).

4. **Research:**
    - The team should research other existing systems in order that the project solution can improve on and differ from currently existing systems.
    - It is important to keep log of bibliography references during the project as this will be a useful resource at the end of the project.
5. **Allocations:**
    - Rowan (rjs305@bham.ac.uk) will act as the team email liaison with the tutor.
6. **Selection of Software Engineering Paradigm:**
    - Due to the project multiple streams running concurrently, and unclear initial requirements, an iterative model (such as an Iterative Waterfall Model) will be adopted to reduce the amount of planning required and allow changing requirements to be met in a natural progression.
7. **Project Outline (in bullet point form):**
    - A real-time educational team quiz system
    - The system allows Students to logs into a user account
    - The system allows logged in Students to compete in a many on many in a multiple choice / simple answer quiz
    - The system gives a set number of questions per quiz (as per the admin)
    - The system ensures synchronicity between all clients and the server
    - The system allows users to log on with past question results
    - The system displays a leader board and some feedback about the question to the Student
    - The system displays a basic statistical information during the quiz to the Admin
    - The system displays a summary report of statistical information at the end of the quiz to the Admin
    - The system will allow the Admin to add or remove questions
    - The system will log information about the Student's quiz session
8. **Next Meeting:**
    - Next meeting will be arranged via WhatsApp group in response to the Joe's feedback.
9. **Any Other Business: – NIL.**
10. **Time of Meeting End:**
    - The meeting was adjourned at 11:00.

Action Summary				
ID	**Action Specifics**	**Responsible**	**Deadline**	**Status**
1	Send a project outline (bullet points) to Joe	Josh	24/02/2014	**Open**
2	Notify Deedar about meeting, send her the minutes, add her to WhatsApp group	Rowan	21/02/2014	**Open**
3	Arrange next meeting via WhatsApp group in response to the Joe's feedback	Rowan	27/02/2014	**Open**
4	For the next meeting, have a bibliography reference about sockets and/or threads	All	Next Meeting	**Open**

*** End of Minutes ***

Minutes of the

Team Osaka Project Meeting

Student Common Room, Computer Science

February 24, 2014; 14:30-14:55 (approved on February 24)

Minutes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright
5. Deedar Fatima
6. Joe Gardiner (Tutor)

Agenda

1. Present an informal project outline to tutor
2. Any Other Business
3. Time of Meeting End

Minutes

1. **Present an informal project outline to tutor (outcomes)**
    - An outline time schedule must be created for the project
    - Animations in GUI should be considered in design, such as:
        i. a digital countdown to each question start
        ii. a leader board that that updates in real time
    - Either threads or a push-data model can be considered in order to provide 'real-time' feedback functionality
    - Students should receive more points for faster answers
    - The server should be designed to be robust in the circumstances of client connections dropping out, i.e. session should continue
    - Division of labour:
        i. JDBC and socket programming should done by all group members to some extent
        ii. No more than 2 people per task.
    -
2. **Any Other Business:**
    - Next Meeting to be arranged for tomorrow.
3. **Time of Meeting End:**
    - The meeting was adjourned at 14:55.

Action Summary				
ID	**Action Specifics**	**Responsible**	**Deadline**	**Status**
5	Time Plan (which includes testing) must be created	All	27/02/2014	**Open**
6	Some sketches for GUI must be created (this task could be split over modules of project with couple sketches each)	All	27/02/2014	**Open**
7	Arrange next meeting for 25/02/2014	Rowan	25/02/2014	**Open**

*** End of Minutes ***

Minutes of the

Team Osaka Project Meeting

UG04, Computer Science

February 27, 2014; 14:30-15:00 (approved on February 24)

Minutes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright
5. Deedar Fatima

Agenda

1. Discuss GUI Sketches (that have been made)
2. Any Other Business
3. Time of Meeting End

Minutes

1. **Discuss GUI Sketches**
    - Creating a list of GUI screens required for sketching:
        i. Login Screen – same for student and admin – Ben
        ii. Create quiz for admin – Ben
        iii. Home Screen for Admin - Deedar
        iv. Home Screen for Student - Deedar -> Keep frames to a minimum unless simple functions. Need a lobby for connected clients to wait in before quiz starts. Begin with harder user coding – need to know question IDs to delete them
        v. Question Screen – 4 multiple choice options, with countdown timer, with an example question – Rowan -> just word question and answer to begin with. Randomise answers.
        vi. Immediate results (Student) - Sam
        vii. Immediate results (Admin) – Sam
        viii. Final results (Student/Admin) – Sam
2. **Any Other Business:**
    - Tutorial meeting in rm 245(?)
    - How everyone is getting on with subversion.
    - Next Meeting to be arranged via doodle poll for Friday.
3. **Time of Meeting End:**
    - The meeting was adjourned at 14:53.

*** End of Minutes ***

Tutorial Notes

Team Osaka Project Meeting

245, Computer Science

February 27, 2014; 16:30-17:00

Notes Taker: Rowan Stringer

Attendance

1. Rowan Stringer
2. Benjamin Crispin
3. Sam Farmer
4. Josh Wainwright
5. Deedar Fatima
6. Joe Gardiner (Tutor)

Notes

Division of Labour should be (for creating and testing):

- Server – Control, most complex, need two people
- Database / JDBC
- Client – local state, connect with GUI
- GUI

Project is given a mark, and then a division of work document explains how team worked together.

A report of install instructions, troubleshooting document is required.

Want low latency in system.

Need to rework time plan if GUI will be created from the start, with a week to test.

When client logs in, something (like a string) will be required to facilitate the connection.

Server acknowledges, and can send back information.

Need a protocol which says what functionality component must provide – what situations will occur, and how component should act.

Need to plan test cases – not necessarily JUnit testing. Some will be set up a system, and check system behaviour. (E.g. might not want closing one window to close all Java windows). What happens if the client dies, server dies.

Run tests a few times to check for undefined behaviour.

Demonstrations will be on lab machines.

Project will be handed in with 3 paper copies of the report and subversion link – might be easier for us to give Uday and Joe access to our subversion rather than movement across to another subversion account.

No office hour on Monday – and Joe is out of contact all day Friday (this week).

Action Summary				
ID	**Action Specifics**	**Responsible**	**Deadline**	**Status**
19	Written specification needs to be written for next week.	-	06/02/2014	**Open**

*** End of Notes ***