MOODLE PLUGIN FOR GAME BASED LEARNING

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By

Pankaj Kumar

Roll Number: 10305923

Under Guidance of

Prof. Sridhar Iyer

Computer Science and Engineering

INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

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Pankaj Kumar

10305923

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Pankaj Kumar

Department of Computer Science and Engineering
Indian Institute of Technology, Bombay
Mumbai, Maharashtra
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ABSTRACT

Importance of change in teaching and evaluation methods is required these days because of significant growth of Internet. I explored and proposed why game based learning is important to current methods of teaching. Because of the Internet many students spends their most of the time on playing online games, I decided to develop these games which can be used to motivate and increase involvement of students in learning activities. Moodle platform is used by many reputed educational institutes for managing their curriculum. I developed four educational games as a plugin on moodle to motivate and create more interest in learning activities among the student community. Details of each game including motivation and benefits has been discussed in this thesis.

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Chapter 1
Introduction

The Internet can be seen as a double-edged sword for education purpose. Students and teachers can get benefits from the tremendous amount of information that is easily available to them. Internet has become the fastest and efficient tool for educational and research purpose. However it has many negative effects also. Spending more time on social networking sites, online games, cheating in exam are the main disadvantage of having Internet. Internet has changed the way teaching methods was adopted by classical classroom teaching. Due to 24 * 7 access of this, students can access study materials, online quiz and even online lectures. This has created a problem to teachers, who has their own methods of teaching and grading. Since we can't deny the advantage of Internet, it's teaching and grading method that has to be modified. To make student motivated we have to find some replacement in teaching strategies and evaluation system.

1.1 Proposed solution

Playing games has been considered as the one of of the biggest disadvantage of the Internet. Students are highly likely to attracted towards the some games. This gives an idea why don't design an educational game so that they don't have to sacrifice their hobby and also they can involve themselves into learning activity. That is why I have selected game based learning for my project. Now next question comes what is game based learning?. In simple words we have to design a game with learning outcome. While playing the game student must have gained some sort of knowledge. Let say we have designed such game, then next question is where to deploy those game so that maximum number of users can be get benefit from that.

We need a platform where teacher can interact with students efficiently. Since teacher is the source of knowledge and educational games are going to use those knowledges in their game plan, selection of a platform becomes relevant. Moodle can be such a platform because of it's popularity among the knowledge parks across the globe. So I decided to build the games as a plugin for Moodle. Once platform is finalized we need some tools and technology which can be used to build those games. Since Moodle is a web application written in PHP, I had to find those technologies which are supported by Moodle. We need some coding power to make more attractive and responsive games since plain html and javascript is not that powerful and they are difficult to use when complex game based programming is required. So I decided to use HTML5 and few javascript libraries that are based on javascript but more powerful and rich in different useful functions. I will discuss these while explaining proposed games.

For this project I have developed four games that will be explained later. I have tried to make them such a way that pure game playing skills like: mouse movement, keyboard control don't come into the picture. This is important because our main purpose of the game development is not improving game skills rather gain some knowledge.

1.2 Thesis outline

Chapter-1 is all about the introduction itself. In chapter-2 I have covered designing a stand alone system which is well supported by the all four educational strategies. Then I explained the cons of that system and why we switched to Moodle. Moodle also have a plugin called game. In second section I have done literature survey on Moodle games. Moodle internals are explained in chapter-3. I have also discussed some of moddle features that can be used to implement those games. Proposed games and their design is presented in chapter-4. In this chapter all the details about each game has been covered. After and during development of games I tested my code considering some criteria. All the test cases and debugging steps has been discussed in chapter-5. In chapter-6 future work and conclusion is drawn.

Chapter 2
Related Work

2.1 Earlier attempt to build a system

In first stage I have re-developed a web system that can support these strategies: socratic [1], guided discovery [2], scaffolding [3] and game based learning [4]. This system is based on multiple choice question and answer where first teacher has to create a quiz and then student will attempt the quiz. Details about how these strategies has been implemented can be referred from their thesis. Here I am giving just a overview about strategies and implementation.

1. Socratic : It is a dialogue conversion between teacher and student where teacher will start discussion and based on the response of student he will formulate another question. So structuring of question is very important in this. It is based on a multiple choice questions. Carefully designing a structure of question and their answer can be seen as implementation of this strategy. If student gets a question wrong system will ask for those question that is related with the wrong attempt.

2. Guided discovery : It uses hands-on activities for teaching. Implementation done in [2] gives a pop-up window through which the learner can enter commands and monitor the results.

3. Scaffolding : In scaffolding a proper support is provided to the student at each step in learning. System developed in [3] implements this by providing hint after each wrong answer.

4. Game based learning : Game-based learning (GBL) refers to different kinds of software applications or products that use games for learning or educational purposes[4]. He has developed two games: crossword and code-anagram. Crossword takes different words and form a board where student have to fill the tiles with proper word corresponding to the question asked. Code-anagram is basically reshuffling of texts in order to form the right code for the asked question.

My initial plan was to extend the system by adding more features to it. But, while working on that I decided to use Moodle as a platform to implement the idea of game based learning. Moodle is a learning management system where teacher and student can interact with each other. Details about why I switched to Moodle and features of Moodle has been explained in the next chapter.

2.2 Existing game plugins in Moodle

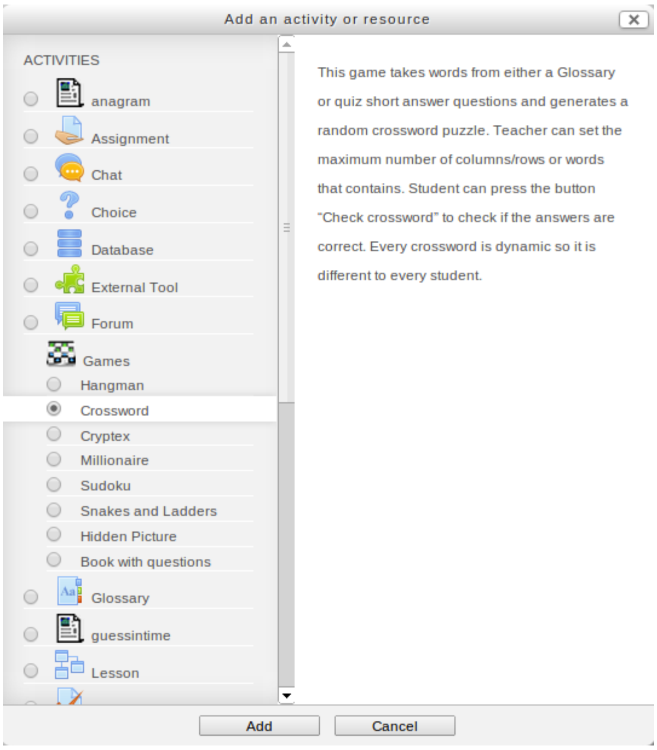
Moodle supports plugin based structure where a new idea can be implemented as plugin. While understanding Moodle and it's features I figured out that some one has developed some games that can be installed as a Moodle plugin. These games take questions from either quiz or glossary to form a board where student can play the game. After finding out this plugin I tried to installed this on my local system. But due to version difference I was not able to install it into latest version of Moodle. Then I started looking into the code itself to fix the problem. That was a challenging task because before that I had no idea about the Moodle code. Later they released the latest version of the game and I was able to install it. Meanwhile I got fair idea on Moodle programming and their functions. There are 8 games[5] available as a plugin for Moodle. Figure-2.1 shows the available plugins supported by Moodle.

2.2.1 Hangman

Source of the words is either from a glossary or short answer questions from selected quiz. Teacher have an option to set the number of words that each game contains. After starting the game corresponding question will be appear at the top as shown in figure. Student have to select an alphabet from the bottom. If that fits into the word it will fill all occurrences of that alphabet. There is an limit on the total attempt. Student interface can be seen in Figure-2.4

2.2.2 Crossword

Source of question is same as hangman and then game generates a random puzzle. Teacher can specify maximum number of rows and columns for the crossword. Student can cross check his answer by clicking on the button. This crossword is dynamic in nature and every student will get different puzzle. Figure-2.2 shows a crossword board where students can enter the answers.



This game takes words from either a Glossary or quiz short answer questions and generates a random crossword puzzle. Teacher can set the maximum number of columns/rows or words that contains. Student can press the button "Check crossword" to check if the answers are correct. Every crossword is dynamic so it is different to every student.

Fig. 2.1: Available games for Moodle

2.2.3 Cryptex

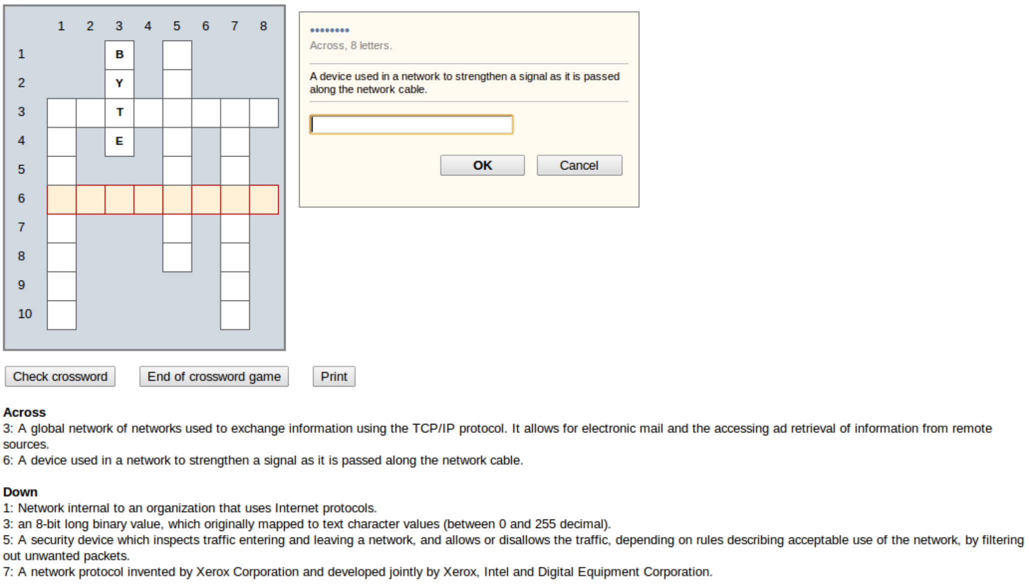
This game is similar to crossword but the answers are already shown randomly in cryptex. For each question there is an attempt button to give the answer. On correct attempt answer will be appear in red from cryptex. There is a cryptex that can be seen in the Figure-2.3. At the bottom there are questions that can be answered through clicking on submit button.

2.2.4 Millionaire

Millionaire is based on famous TV serial that takes questions from multiple choice quiz and generates 15 questions. Student can play this game with three lifelines. They have a option to quit the game or restart the game.

2.2.5 Sudoku

Sudoku gives a standard sudoku puzzle to solve. For every correct answers an additional number is slotted to make it easier. There are some spaces in the Figure-2.5 that can be filled by the game in case students want another number to be filled.



••••••••
Across, 8 letters.

A device used in a network to strengthen a signal as it is passed along the network cable.

Across
3: A global network of networks used to exchange information using the TCP/IP protocol. It allows for electronic mail and the accessing ad retrieval of information from remote sources.
6: A device used in a network to strengthen a signal as it is passed along the network cable.

Down
1: Network internal to an organization that uses Internet protocols.
3: an 8-bit long binary value, which originally mapped to text character values (between 0 and 255 decimal).
5: A security device which inspects traffic entering and leaving a network, and allows or disallows the traffic, depending on rules describing acceptable use of the network, by filtering out unwanted packets.
7: A network protocol invented by Xerox Corporation and developed jointly by Xerox, Intel and Digital Equipment Corporation.

Fig. 2.2: Crossword

2.2.6 The hidden picture

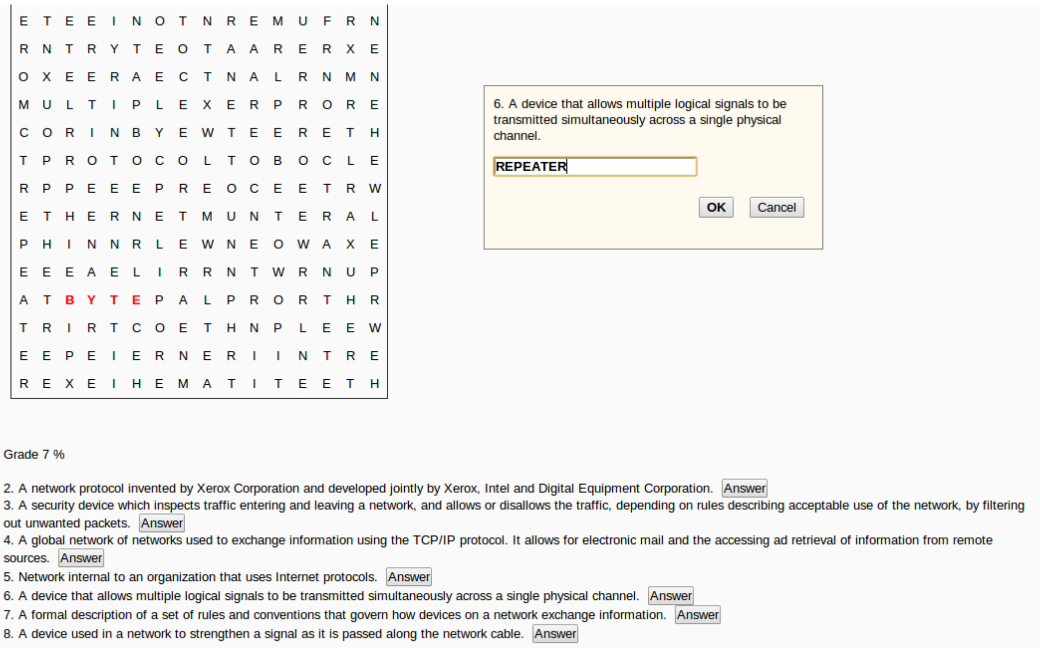
An image is loaded from glossary and only some portion of the image is visible. They also give a question to answer. In case of correct answer some more part of picture appears in the screen. Task is to guess the picture as quickly as you can.

2.2.7 Snakes and ladder

Snakes and Ladders is another standard game where student can proceed only if they give right answer for the asked question. If the game piece is in the bottom of a ladder and the answer is correct, it goes to the top. If the game piece is in head of snake and the answer is wrong, it goes to the tail.

2.2.8 Book with questions

After each correct answer student can go to next chapter of a book uploaded by teacher. It takes question from quiz or glossary and displays on the screen.



E	T	E	E	I	N	O	T	N	R	E	M	U	F	R	N
R	N	T	R	Y	T	E	O	T	A	A	R	E	R	X	E
O	X	E	E	R	A	E	C	T	N	A	L	R	N	M	N
M	U	L	T	I	P	L	E	X	E	R	P	R	O	R	E
C	O	R	I	N	B	Y	E	W	T	E	E	R	E	T	H
T	P	R	O	T	O	C	O	L	T	O	B	O	C	L	E
R	P	P	E	E	E	P	R	E	O	C	E	E	T	R	W
E	T	H	E	R	N	E	T	M	U	N	T	E	R	A	L
P	H	I	N	N	R	L	E	W	N	E	O	W	A	X	E
E	E	E	A	E	L	I	R	R	N	T	W	R	N	U	P
A	T	B	Y	T	E	P	A	L	P	R	O	R	T	H	R
T	R	I	R	T	C	O	E	T	H	N	P	L	E	E	W
E	E	P	E	I	E	R	N	E	R	I	I	N	T	R	E
R	E	X	E	I	H	E	M	A	T	I	T	E	E	T	H

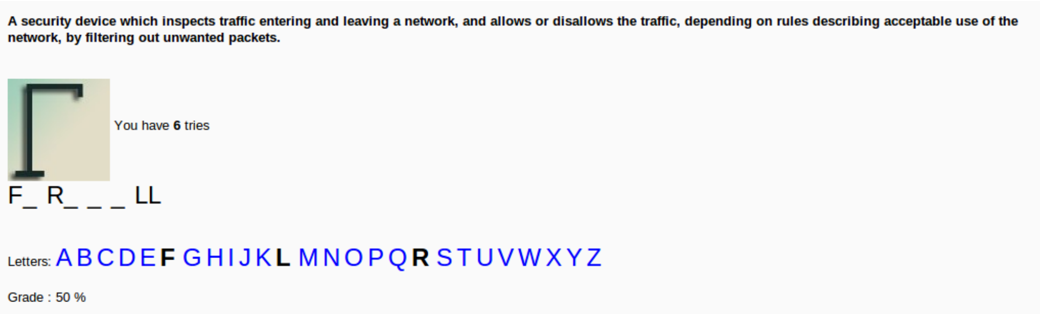
6. A device that allows multiple logical signals to be transmitted simultaneously across a single physical channel.

REPEATER

Grade 7 %

2. A network protocol invented by Xerox Corporation and developed jointly by Xerox, Intel and Digital Equipment Corporation. Answer
3. A security device which inspects traffic entering and leaving a network, and allows or disallows the traffic, depending on rules describing acceptable use of the network, by filtering out unwanted packets. Answer
4. A global network of networks used to exchange information using the TCP/IP protocol. It allows for electronic mail and the accessing ad retrieval of information from remote sources. Answer
5. Network internal to an organization that uses Internet protocols. Answer
6. A device that allows multiple logical signals to be transmitted simultaneously across a single physical channel. Answer
7. A formal description of a set of rules and conventions that govern how devices on a network exchange information. Answer
8. A device used in a network to strengthen a signal as it is passed along the network cable. Answer

Fig. 2.3: Cryptex



A security device which inspects traffic entering and leaving a network, and allows or disallows the traffic, depending on rules describing acceptable use of the network, by filtering out unwanted packets.

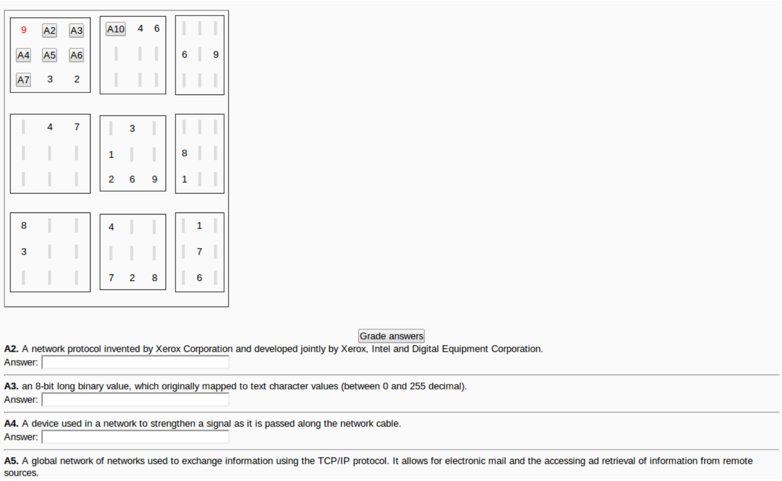
You have **6** tries

F_ R_ _ _ LL

Letters: A B C D E **F** G H I J K **L** M N O P Q **R** S T U V W X Y Z

Grade : 50 %

Fig. 2.4: Hangman



9	A2	A3	A10	4	6			
A4	A5	A6				6		9
A7	3	2						
	4	7		3				
			1			8		
			2	6	9	1		
8			4				1	
3							7	
			7	2	8		6	

A2. A network protocol invented by Xerox Corporation and developed jointly by Xerox, Intel and Digital Equipment Corporation.
Answer:

A3. an 8-bit long binary value, which originally mapped to text character values (between 0 and 255 decimal).
Answer:

A4. A device used in a network to strengthen a signal as it is passed along the network cable.
Answer:

A5. A global network of networks used to exchange information using the TCP/IP protocol. It allows for electronic mail and the accessing ad retrieval of information from remote sources.

Fig. 2.5: Sudoku

Chapter 3
Moodle

3.1 Why we moved from new system to Moodle

Moodle has many other features that our system lacked. Some are news forum, assignment, chat, mailing facility etc[6]. These make Moodle an ideal CMS and that is the reason behind popularity of Moodle among many universities. We have tried to build our own system with core functionality but that is not sufficient enough to make it successful. Giving these extra features requires more time and it will increase complexity of the system. Moodle is open source software that can be modified depending on the need. Though they named their system as an intelligent tutoring system it ended up with a course management system. So designing another CMS is not a good option if we want to implement four strategies based on multiple choice questions. There are many online help available for creating plugins for Moodle. There are dedicated forums for that. So, online help is a big positive point when we add a plugin to Moodle considering big size of Moodle software. Popularity is another reason for moving to Moodle. It is quite popular among student community so idea of implementing these strategies as a plugin will help many students.

3.2 Moodle literature survey

Moodle is a learning management system by which teacher can teach and student can learn a course. Using Moodle teachers can create a course and enroll students. Course can be created in either weekly basis or topic basis depending on need. It also supports uploading resources, creating quiz, news forums and assignments. Enrolled students can access those resources, attempt assignment, quizzes and also ask questions. Other features that can be useful are chat, forum, games etc. In that sense it can also be seen as course management system or virtual learning environment.

It comprises three parts:

1. Main application code, typically resides in a /www/Moodle directory with many subdirectory for other modules. For security reasons it should not be writable by web server.
2. Course materials (lessons, quizzes, grades, user information, logs etc.) reside in a Moodle database, managed by one of the supported RDBMSs.
3. Uploaded and generated files kept an a folder outside the root directory for the security reasons. It should be modifiable by the web server.

The configuration information is kept in the config.php in the root directory. We can modify this file according to our server setting.

Moodle is a web application, so registered users can access this through their web browser using HTTP request.Moodle provides many formats for creating a course. That includes weekly format where teacher can specify start date and total number of weeks a course can run. If teacher is not bother about fixed schedule, topic format is a good option where course is divided into number of topics.

3.2.1 Moodle plugins

There are numerous plugins that performs specific functionality. Physically, Moodle plugin is just a folder of PHP scripts, CSS, JavaScript and images. So when we try to develop our own plugin we just have to create a folder with specific files and put it into mod directory. Details about creating a new plugin will be discussed later.

Activities are foremost basic individual elements that compose a course. Samples of activities include: forums, wikis, quizzes, and assignments. Each activity is put within the mod folder. I am not going in details of all plugins, since I have to develop a new plugin as an activity.

For my purpose I am going to use mainly two plugins: quiz and glossary. Both can be served as knowledge base for games I am proposing in coming chapter.

3.2.2 Adding a plugin at your course

Moodle supports various type of course formats: weekly, topics, social etc. If teacher wants to crate a new plugin he has to click on 'turn editing on' button that is located at the top left corner of course home page. After clicking on that there will be an link 'Add an activity or resource' at the bottom right of each course section. Teacher can click on this after that all installed plugins will be appear in a pop-up box. Selecting a plugin will take him to plugin home page with all the options will be appear as a form. After filling the form there are two action buttons at the end of home page to initialize that plugin. On successful entry into table student will be able to see a new icon. Just by clicking on that icon will be enough to start that plugin. You can refer to the teacher role in chapter-4 to see the illustrative screen shots.

3.2.3 Site administrator

At the bottom left of any page of Moodle there is a drop down list with many options that can be quite useful while developing a new plugin. Figure-3.1 gives all available options that can be used by teachers and admin for development purpose.

- Notification : This option is used when we want to upgrade a new plugin. After clicking on this option all plugins that require upgradation appear in a box. Upgrading can be done by clicking on the upgrade button.
- Users : We can manage users through this option. Inrolling a user, deleting a user, creating a user like features can be accessed from here.
- Course : All course related settings can be done from here.
- Plugins : If we want to delete a plugin we have to go through this link. All installed plugins can be seen by clicking on this link.
- Appearance : We can set different themes from here.
- Development : This is the most useful option for developers. This gives another set of options for managing databases, testing and debugging the code.
- Debugging : This comes under development option. We can set debugger mode on by clicking on this link. This option is very handy when we have to find cause of error. All

errors and logs will appear on the page itself.

- XMLDB Editor : Tis also comes under development option. This is the most used option by any developer. All the database related task can be done from here. After clicking the option all tables under all plugins get loaded. If we want to do any admin related task on table we have to go through this.

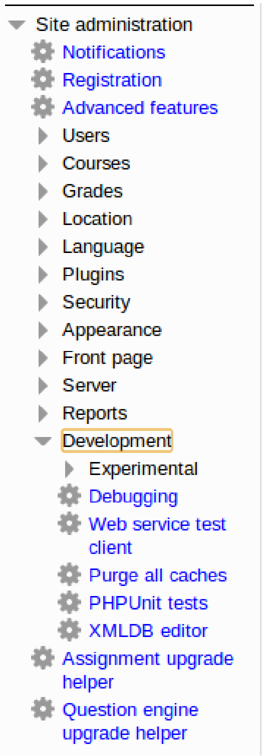


Fig. 3.1: Site administrator options

3.3 How to develop a new plugin

For creating a new plugin[7] we have to create some files and subdirectory within a new plugin folder. Some necessary files are listed here.

1. mod-form.php is the file describing the form you get at the plugin instance creation or at the instance editing time. This will show a form by which we can set plugin parameters. Creating a form element can be done by following some specific instruction. This class extends Moodle form class which can give us methods to create those elements.

2. db/install.xml is a XML file containing all table structure of that plugin. When we use XMLDB Editor this file gets modified.
3. db/upgrade.php is the file that we have to write each time after changing the structure of the tables of this module. We have paste a PHP code that can be seen from XMLDB home page of any plugin.
4. icon.gif is a image file that represents plugin image.
5. index.php is a page to list all instances of the functionality the module provides in a course.
6. lib.php: This file have all the essential functions for creating, updating or deleting any plugin. Using these functions plugin modifies the plugin table.
7. view.php: This is the file for student view. Whenever student clicks on created plugin icon corresponding view.php by default gets called. This file checks permission of user, login and then allow user to see its contains.

Once we created these files we have to move this new plugin folder into the mod directory of Moodle. On refreshing the home page it will show a table with new plugin name. Then Moodle will create necessary tables defined in install.xml. We can see the new plugin in activity module as a drop down item.

Whenever we want to change the database of the table we have to make changes in the 'upgrade.php' and have to increment the version number in 'version.php'. One interesting thing about Moodle database is that there is no foreign key for any table. Every table has it's own set of fields. I also followed the same methodology and my all game tables have no foreign key. That is why in ER Diagrams in chapter-4 there are only tables without the relationship among them.

Chapter 4
Proposed Games

4.1 Proposed games as a Moodle plugin

In this chapter I am proposing four new games as a plugin for Moodle. While playing the game student has to answer some questions to continue the game. Depending on the response, game state gets changed. Since teacher is initiating the game so it's responsibility of teacher to set questions. There are few game parameters for each game that will be set by the teacher. These parameters are different for different games and they will be explained in coming sections. Moodle has 'quiz' and 'glossary' plugin to store the questions. Teacher can easily create a quiz that supports various type of questions like: multiple choice,true false,short-answer,matching etc. On the other hand 'glossary' plugin stores information in two fields: 'concept' and 'definition'. Three out of four games will get questions from these plugins. Fourth game gives teacher an option to store a new type of question that will be discussed later. Names of all four games are listed below.

1. Tic-Tac-Toe
2. The weakest link
3. Guess-in-time
4. Anagram

4.2 Tic-Tac-Toe

Tic-tac-toe is the most famous paper pencil game played by teenagers. Classical 'Tic-Tac-Toe' has a 3 * 3 grid where two players 'O' and 'X' mark their turn by placing their symbol on one of the 9 places. They can do it alternatively until all places are field or one wins. Winning is decided by counting three respective marks in a horizontal, vertical, or diagonal row. Whoever does it first is a winner of that game. It is the popularity and simplicity of this game that made me think about extending this idea and designing it as a plugin for Moodle.

Now coming back to my version of Tic-Tac-Toe game, I have borrowed the name of game plugin same as original game. In next section details of extended version of Tic-Tac-Toe is given and in next chapter illustrative example is presented to explain how it works as a Moodle plugin.

4.2.1 Motivation

Tic-tac-toe is quite a popular game and students are well aware of its rules. Extending the original idea to create a new version of Tic-Tac-Toe will definitely attract them to give it a try. Like any other educational game the main motivation behind this game is to to give students a reason to involve them in educational activity. Moodle have a quiz plugin by which teacher can prepare a set of questions for them to practice their skill. It is an educational activity where they can gain some sort of knowledge while attempting the quiz. But just presenting quiz is not an attractive way to involve all students. So I borrowed the idea of quiz and instead of asking them to attempt a quiz which is just few lines of plane text, I would ask them to play a game which will ask questions during the play. Since questions are presented during the game and they have to attempt those in order to get a score and proceed game they are gaining some knowledge.

4.2.2 About the game

What is Tic-Tac-Toe? I have already explained the classical tis-tac-toe game. It is same as classical Tic-Tac-Toe in terms of number of players. It is a two player game where student will play against computer. Both have to put a mark on board tiles alternatively in order to achieve the same goal of forming consecutive marks.

How it is different from classical Tic-Tac-Toe? This version is different in terms of board size and game strategies. First, there is a variable board size. Teacher can set the size of board as n * n at the time of initializing the game. Value of 'n' can be anything between 2 to 9. So, now we have n * n spaces on board to be marked. Here each space corresponds to a question. Source of question is either quiz or glossary. After selecting a particular tile on the board a question will be appeared on the screen. Student have to answer that question. If answer is correct then a 'X' mark appears on that tile initiating player's move. In case of wrong answer student turn is over and there will be no mark on that tile. After the student turn, computer plays it's turn by marking any one time as 'O' from the list of remaining unmarked tiles.

Second difference is related to scoring system. Teacher can set a number between 3 to 9 which will decide how many consecutive tiles are required in order to give a score. Let say this number is 4, then student have to attempt for marking 4 consecutive tiles in any rows, columns or diagonals in order to increment the score. If student or computer gets first sequence games doesn't end. Unlike classical game it goes on until all tiles are marked. At the end both gets their scores and greater scorer wins the game.

Source of questions:

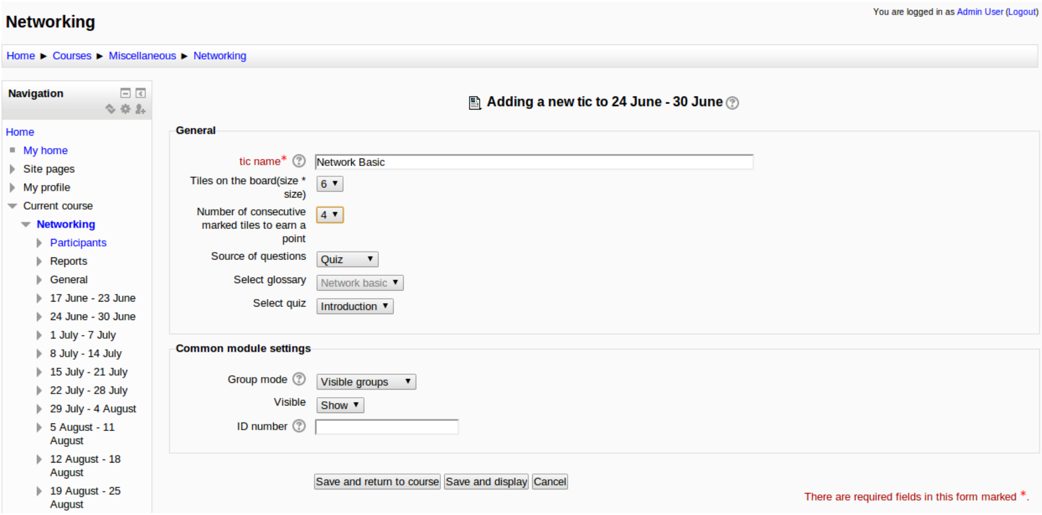
1. Quiz module
2. Glossary module

4.2.3 Teacher role

As explained before teacher can create a quiz or form a glossary using quiz plugin and glossary plugin as seen in the Figure-4.1. These plugins come with Moodle package itself. Once it is created teacher can select that quiz or glossary from the drop down menu. When student starts a game, game engine will fetch these questions from the database and present him during the play. There are other parameters like board size and block size(used to evaluate scores) which has to set by teacher during game creation. Once these parameters are stored into database a game icon will be appear on the home page of that course. Clicking on that icon will be enough to start the game.

4.2.4 Student role

To play the game student has to click on the game icon under course category. In Figure-4.2 we can see the rules and game board from where student can start the game by clicking on the play button. Once clicked game engine will fetch all the game parameters set by teacher and initiate the game state. You can see the question on the right side in the Figure-4.3. During the play these game states will be change depending on the student move. Details about the various functions and data tables are explained in design section. Once game is finished a summary page will be displayed regarding the score of student. In next chapter I have given the various screen-shots that will explain the game as an end user point of view.



Adding a new tic to 24 June - 30 June

General

tic name*: Network Basic

Tiles on the board(size size)*: 6

Number of consecutive marked tiles to earn a point: 4

Source of questions: Quiz

Select glossary: Network basic

Select quiz: Introduction

Common module settings

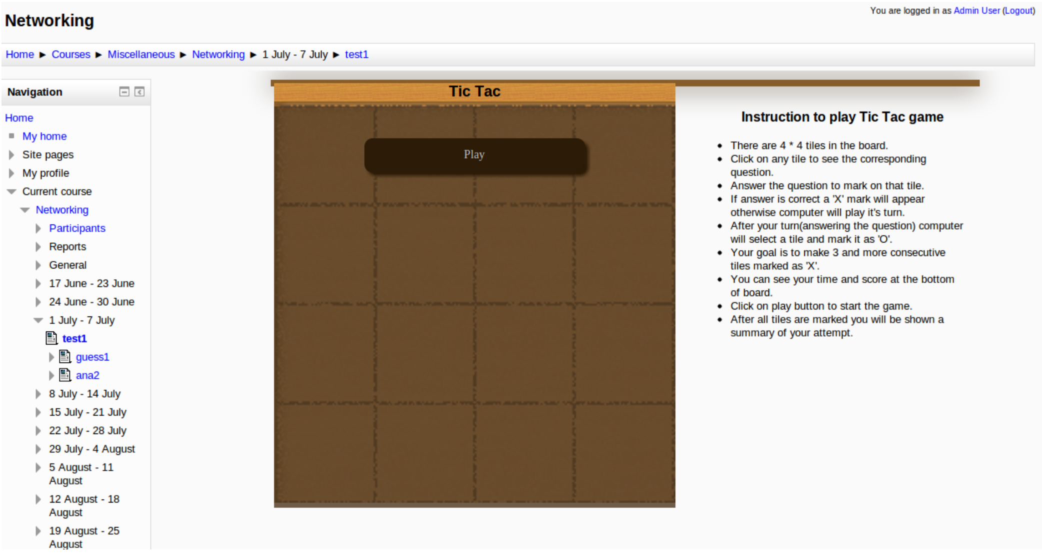
Group mode: Visible groups

Visible: Show

ID number:

There are required fields in this form marked *.

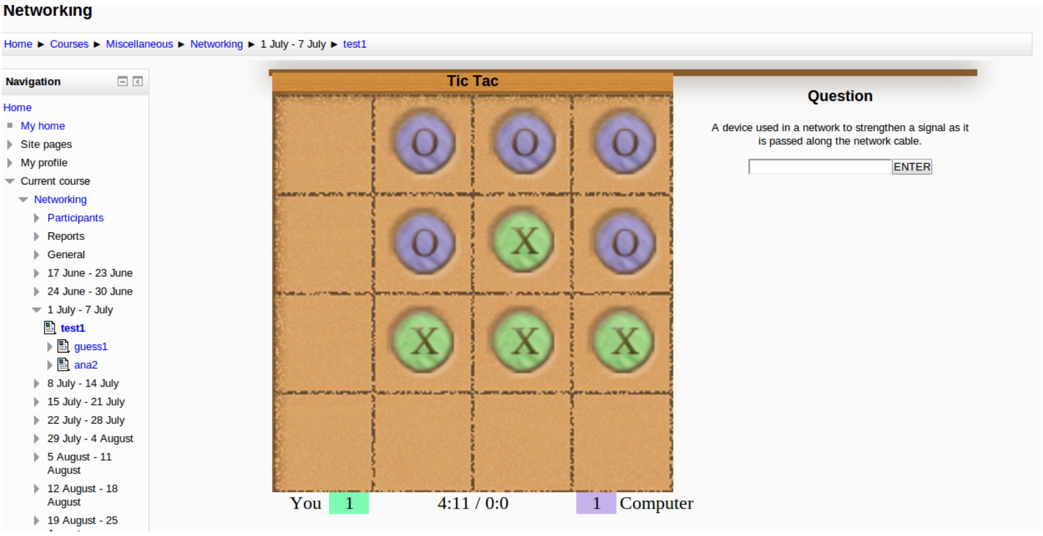
Fig. 4.1: Creation of Tic-Tac-Toe



Instruction to play Tic Tac game

- There are 4 * 4 tiles in the board.
- Click on any tile to see the corresponding question.
- Answer the question to mark on that tile.
- If answer is correct a 'X' mark will appear otherwise computer will play it's turn.
- After your turn(answering the question) computer will select a tile and mark it as 'O'.
- Your goal is to make 3 and more consecutive tiles marked as 'X'.
- You can see your time and score at the bottom of board.
- Click on play button to start the game.
- After all tiles are marked you will be shown a summary of your attempt.

Fig. 4.2: Home page of Tic-Tac-Toe

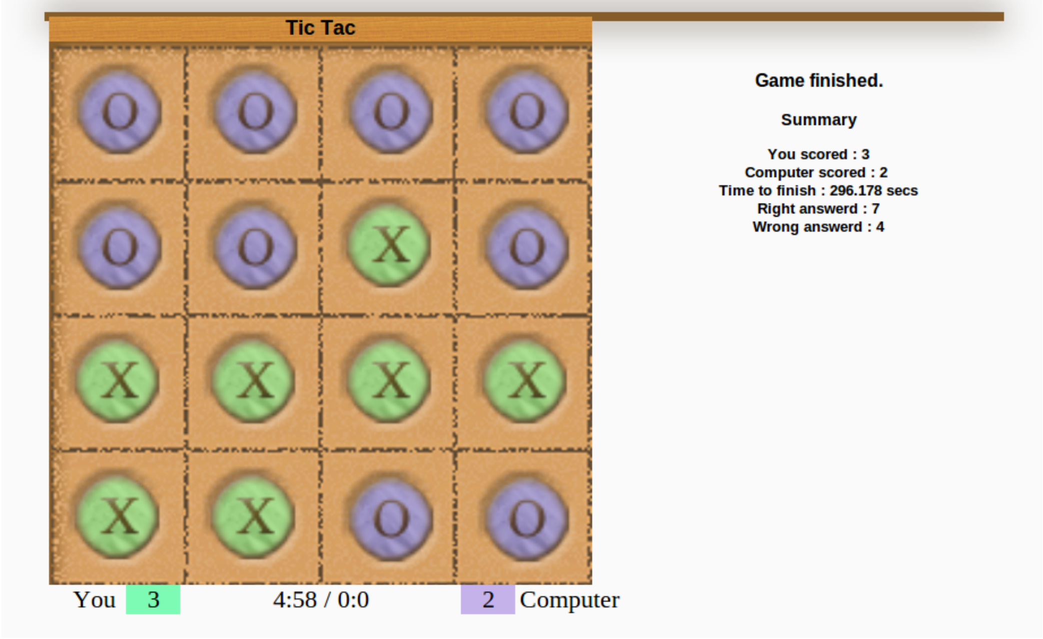


Question

A device used in a network to strengthen a signal as it is passed along the network cable.

ENTER

Fig. 4.3: Question corresponding to tile clicked



Game finished.

Summary

You scored : 3
Computer scored : 2
Time to finish : 296.178 secs
Right answerd : 7
Wrong answerd : 4

Fig. 4.4: Summary page of Tic-Tac-Toe

At the end of the game a summary page with scores and time taken displayed as shown in Figure-4.4.

4.2.5 Rules to play the game

1. Select any tile by clicking on that. Corresponding question will be appear on the right side of the board

2. If want to attempt answer the question and click on submit button, otherwise select other tile
3. If you get the correct answer a 'X' mark will appear on that tile and tile will be disabled otherwise and your turn is over and computer will make a 'O' mark on it's choice of tile
4. Try to mark consecutive tiles in row or column or diagonal in order to get a point
5. Play until all tiles are marked

4.2.6 Goal

Goal of the game is to maximize the score by forming a certain number of consecutive tiles marked as 'X'. Each another marked tile after certain number of consecutive tiles marked as 'X' will give another point to player. For example if student has already marked 3 consecutive tiles as 'X' in a particular row to get the first point, he can target 4th tile in that row to get another point since it is sufficient for game engine to calculate another set of 3 tiles that has been marked as 'X'. At the end of game a summary page will be displayed like Figure-4.4

4.2.7 Design details

Data flow diagrams

1. Game creation by the teacher : Figure-4.5 explains the data flow when teacher creates the instance of the game.
2. Game played by the student : Figure-4.6 explains the data flow when student starts the Tic-Tac-Toe game.

Database design

In Figure-4.7 we can see the various tables used by the game engine. There are three database tables created for this plugin.

- mdl-tic : It is used for storing game parameters like size of the board, source of the questions and ids of the quiz or glossary instance. Only teacher have access to this table. He can delete or modify game parameter any time he wants.

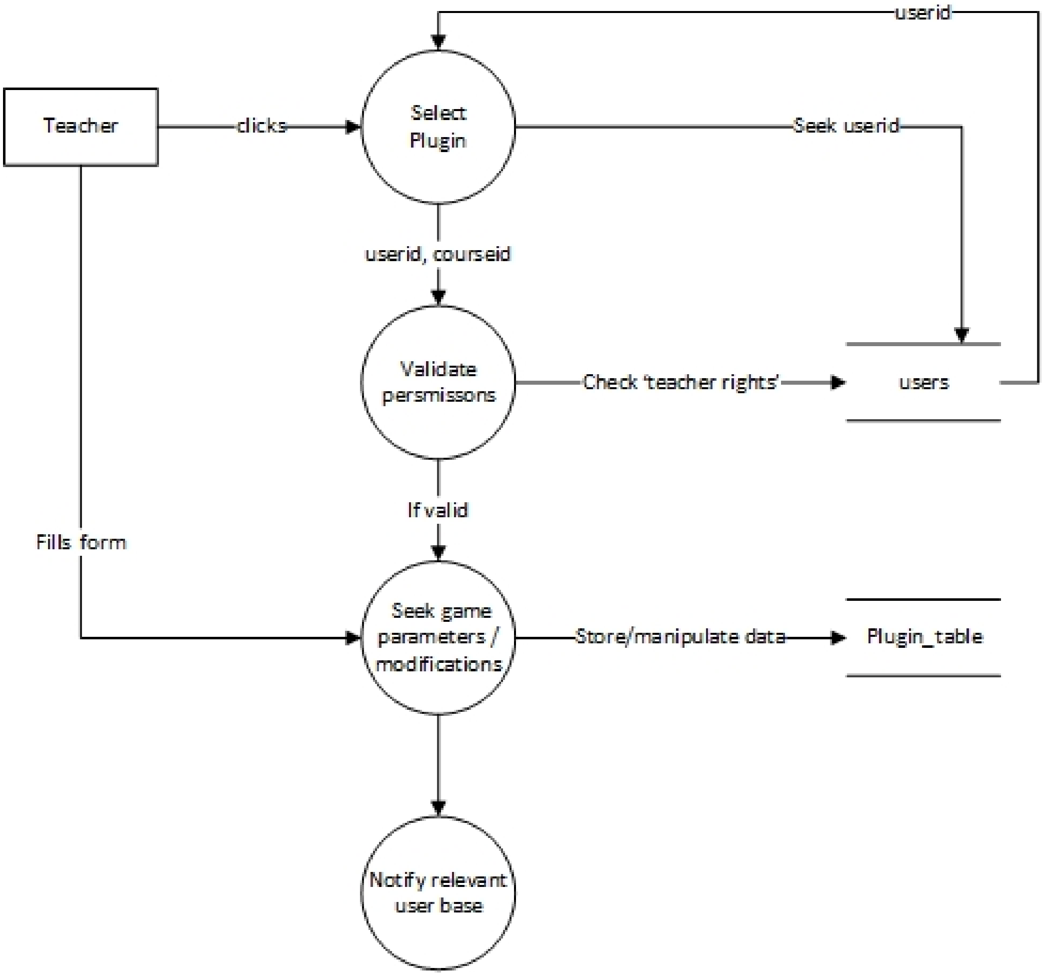


Fig. 4.5: Data flow diagram of teacher creating the game

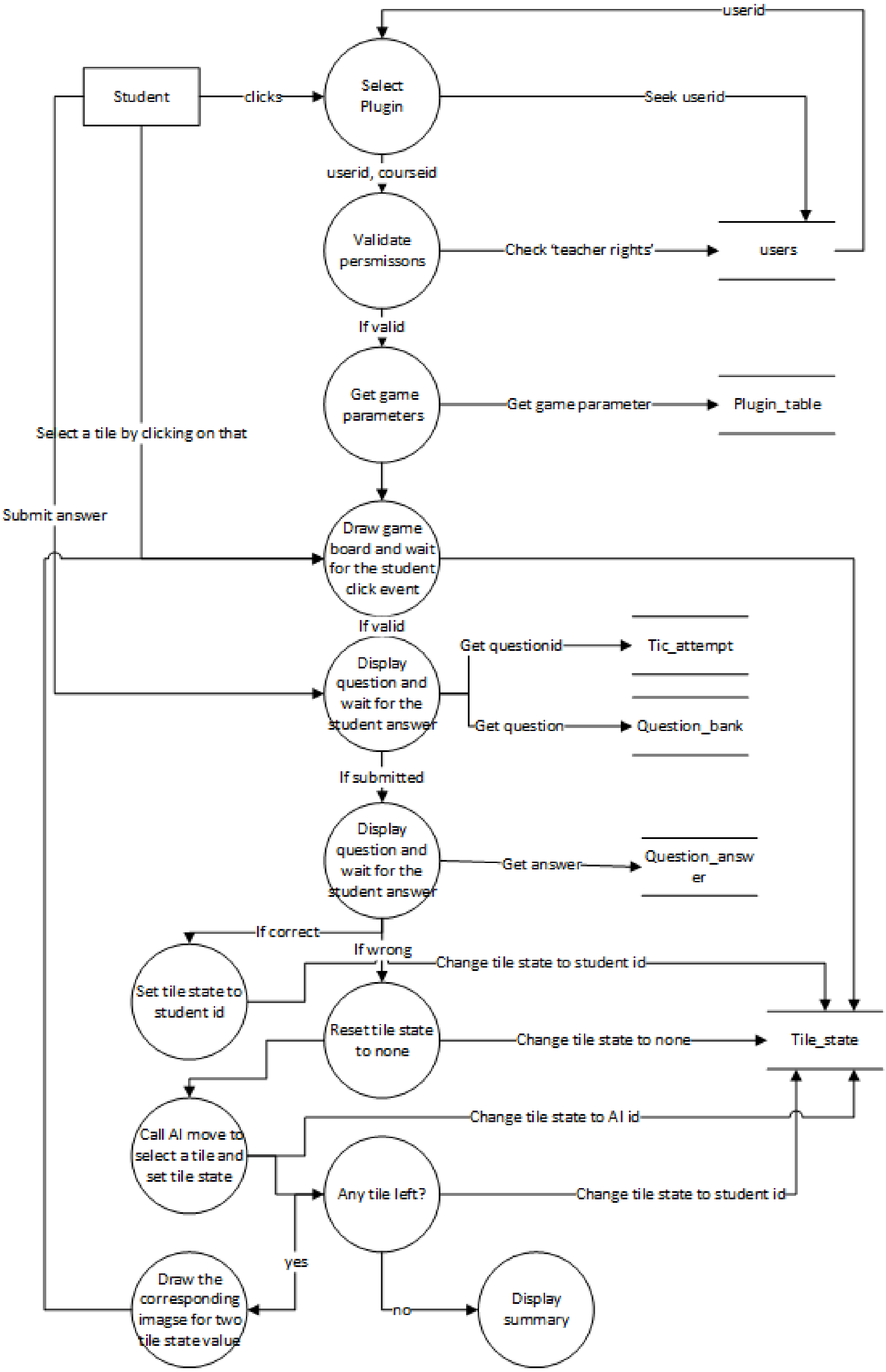

userid
Student
clicks
Select Plugin
Seek userid
userid, courseid
Validate persmissons
Check 'teacher rights'
users
If valid
Get game parameters
Get game parameter
Plugin_table
Select a tile by clicking on that
Submit answer
Draw game board and wait for the student click event
If valid
Get questionid
Tic_attempt
Display question and wait for the student answer
Get question
Question_bank
If submitted
Display question and wait for the student answer
Get answer
Question_answer
If correct
If wrong
Change tile state to student id
Set tile state to student id
Reset tile state to none
Change tile state to none
Tile_state
Call AI move to select a tile and set tile state
Change tile state to AI id
Any tile left?
Change tile state to student id
yes
Draw the corresponding imagse for two tile state value
no
Display summary

Fig. 4.6: Data flow diagram of student playing the game

- mdl-tic attempt : Whenever any student plays this game, a separate entry is entered in order to count his attempt number, his current game state etc. On the completion of the game all others parameters like score, time taken, status are updated.
- mdl-tic question attempt : This table is used for storing students attempt of each question. Since we have to display a summary about correct or wrong questions, this table is useful.

List of functions used

- submitAndReturnToCourse : sends the form parameter to libclass for storing it into database and returns to course page
- submitAndDisplay : sends the form parameter to libclass for storing it into database and starts the game by calling gameview class
- cancel : cancels the game creation
- addInstance(formData) : stores the form parameter into database
- updateInstance(formData) : modifies the form parameter into database
- deleteInstance(formData) : delete the game instance
- setupJqueryHandlers(boardSize) : reset the game
- loop() : calls other functions 30 times in a second
- update() : updates the game state
- draw() : draws the game board
- check answer() : sends user response to question class for answer checking
- reset() : resets the game state
- updateScore() : updates score
- calTime() : updates time taken by user
- aiMove() : calculates AI move
- initGame() : setting user attempt and questions

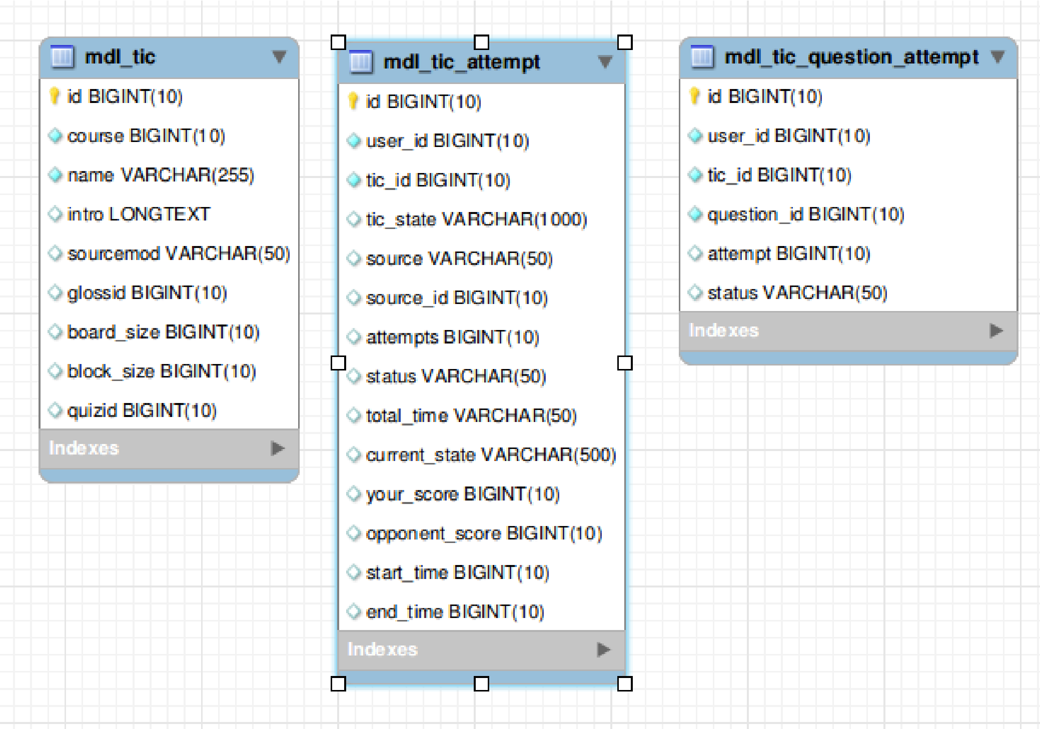


Fig. 4.7: ER Diagram of Tic-Tac-Toe

- playGame() : loads javascript class and shows initial board
- getQuestion(tile) : returns question for corresponding tile
- checkAnswer() : checks answer and store it into database for summary

4.2.8 Challenges

Main challenge behind this game was extending the original game to fit into category of educational game. Initially I thought of many version of the game in terms of playing rule. If student makes a wrong attempt what to do next. First I thought of presenting another question until he gives a correct answer. But eventually we will sort of questions and game would not be able to finish. So, creating a proper rule was the main challenge. Some other challenges were related with understanding Moodle modules and user interface design. But those were common for all the games. Designing a nice, attractive user interface is a key feature of any game so that it can attract students.

4.3 Guess in time

4.3.1 Motivation

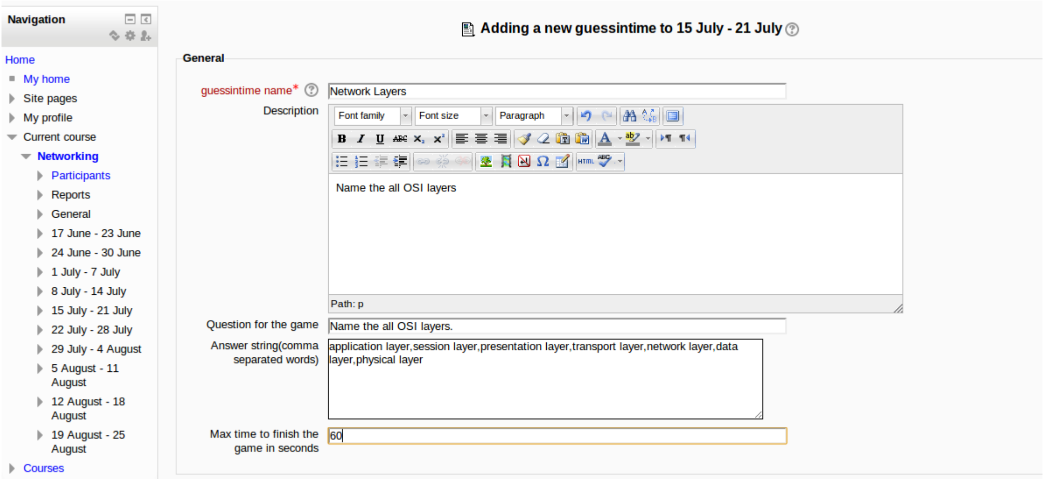
Quiz plugin of Moodle supports many type of question like: multiple choice, true false, short answer, matching, some special type for mathematics related questions. Consider about the question like: Name the all layers of TCP?IP model, Name the all tags used by HTML5 etc. If we have to fit this type of question into Moodle quiz we won't be sure which category to select. We have the option for selecting multiple choice question with more than one correct answers, but size of options will be much more in some cases. So teacher can ask this type of question as an assignment and he can check it manually. But we don't avoid manual work. So this gave me an idea of creating a new type of question and system should be smart enough to accept correct answers. Based on this I have created this game where student have to name all the words related to the question and game engine will check for the correctness of words. To make it more interesting I am proposing a time limit by which student has to guess all the possible words.

4.3.2 About the game

As discussed this is a memory game where task is to guess a set of words in specific time. Teacher will set a question and also all the possible words separated by comma. Student has to guess all words entered by teacher. He will be provided a text area where he can guess the answer by typing in a text area. If text given by student is correct against the text entered by teacher, game engine will automatically decrement the number of words to be guessed.

4.3.3 Teacher role

Since I am introducing a new question type it is teacher's responsibility to set a question and corresponding answer through the interface provided by the plugin. At the time of game creation he can enter question. All the words that form a answer set must be entered in the text area separated by comma. There is an another field time where teacher can set maximum time allowed for answering the question. He has to give this in terms of number of seconds. Once provided all the details will be stored into the table. He can also add or remove the words at any point of time by clicking on modify symbol besides plugin symbol. In Figure-4.8 teacher can



Adding a new guessintime to 15 July - 21 July

General

guessintime name* Network Layers

Description

Name the all OSI layers

Path: p

Question for the game Name the all OSI layers.

Answer string(comma separated words) application layer,session layer,presentation layer,transport layer,network layer,data layer,physical layer

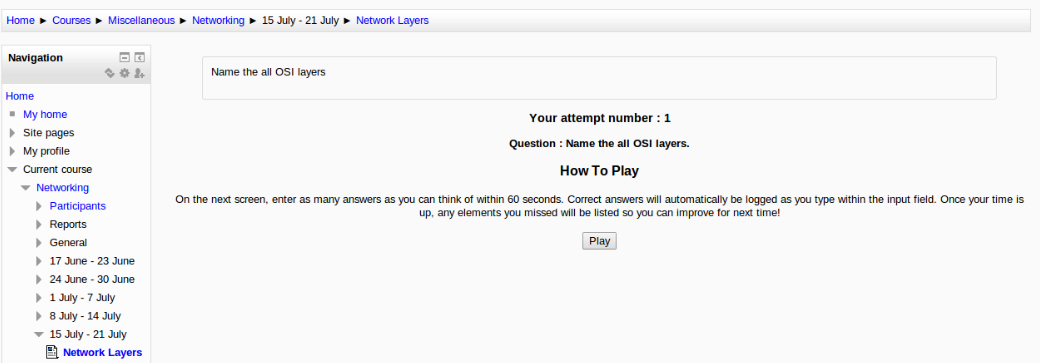
Max time to finish the game in seconds 60

Fig. 4.8: Teacher interface for guess in time game

see all the options available for creating this game.

4.3.4 Student role

After starting the game as shown in Figure-4.9 student can enter words in given area. There is a clock initialized by game engine to keep track of time remaining. Once entered word is correct total word count is decremented by one and he can enter another word. Game can be terminated either on time out or when all the words are entered. You can see the game board in Figure-4.10. At the end of game as shown in Figure-4.11 student can see the time taken by him to finish the game. In case of time out he will be shown set of words he corrected and set of words he missed. He has make another attempt by clicking on replay button. In that case his attempt will be considered as fresh attempt. Since this is a single player game winner will be decided by less time taken by a student in one attempt.



Name the all OSI layers

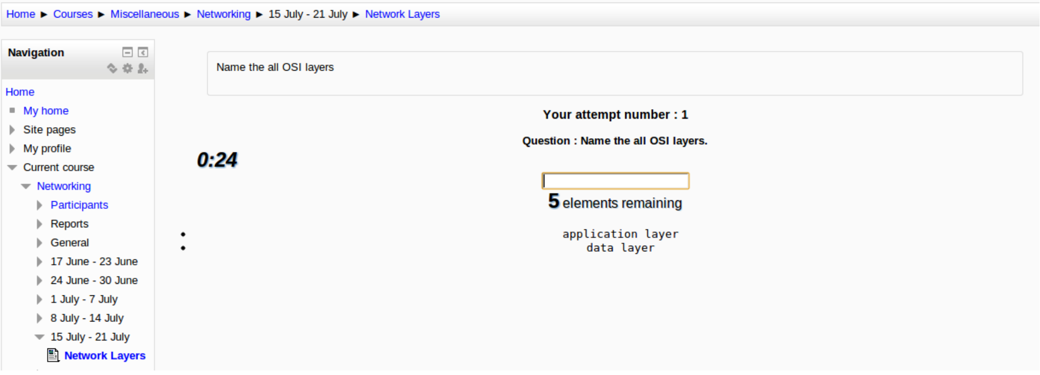
Your attempt number : 1

Question : Name the all OSI layers.

How To Play

On the next screen, enter as many answers as you can think of within 60 seconds. Correct answers will automatically be logged as you type within the input field. Once your time is up, any elements you missed will be listed so you can improve for next time!

Fig. 4.9: Start page of guess in time game



Name the all OSI layers

Your attempt number : 1

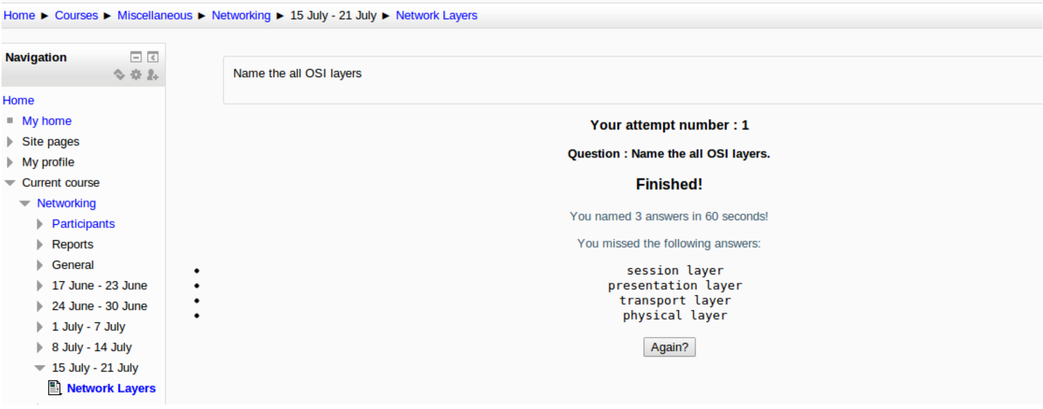
Question : Name the all OSI layers.

0:24

5 elements remaining

```
application layer
   data layer
```

Fig. 4.10: Intermediate state in guess in time game



Name the all OSI layers

Your attempt number : 1

Question : Name the all OSI layers.

Finished!

You named 3 answers in 60 seconds!

You missed the following answers:

```
   session layer
presentation layer
  transport layer
  physical layer
```

Fig. 4.11: Summary of guess in time game

4.3.5 Rules to play the game

1. Click on play button
2. Enter the words
3. System will automatically accept correct words
4. Finish the game earlier than time limit. In case of time limit summary will be shown with total time taken and total guessed words list
5. Click on replay if you want another attempt

4.3.6 Design details

Data flow diagrams

1. Game creation by the teacher : Figure-4.5 explains the data flow when teacher creates the instance of the game.

2. Game played by the student : Figure-4.12 explains the data flow when student starts the game.

Database design

In Figure-4.13 we can see the tables used by the game engine. There are only two tables : mdl-guessintime is used for storing all the parameters required by the game itself and mdl-guessintime attempts stores all the informations related to game state like attempt number, correct words guessed, words not guessed and time taken by the student to finish the game.

List of functions used

- submitAndReturnToCourse : sends the form parameter to libclass for storing it into database and returns to course page
- submitAndDisplay : sends the form parameter to libclass for storing it into database and starts the game by calling gameview class
- cancel : cancels the game creation
- addInstance(formData) : stores the form parameter into database
- updateInstance(formData) : modifies the form parameter into database
- deleteInstance(formData) : delete the game instance
- initGame() : setting user attempt and questions
- playGame() : loads javascript class and shows initial board
- buildQuiz() : getting question and answer from the database
- startquiz() : starts the game and showing time remaining
- stopquiz() : stops the quiz and shows guessed and missed words

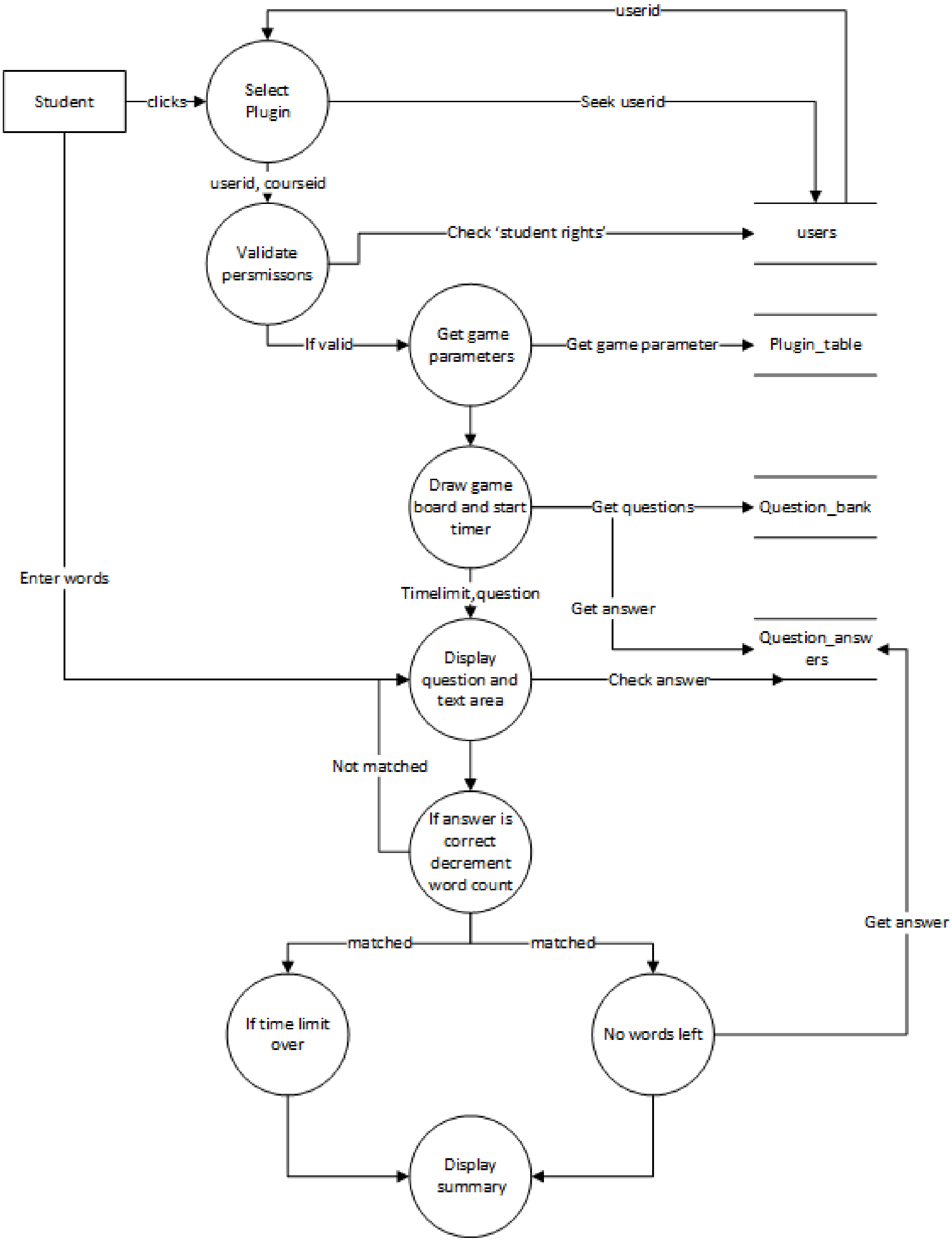
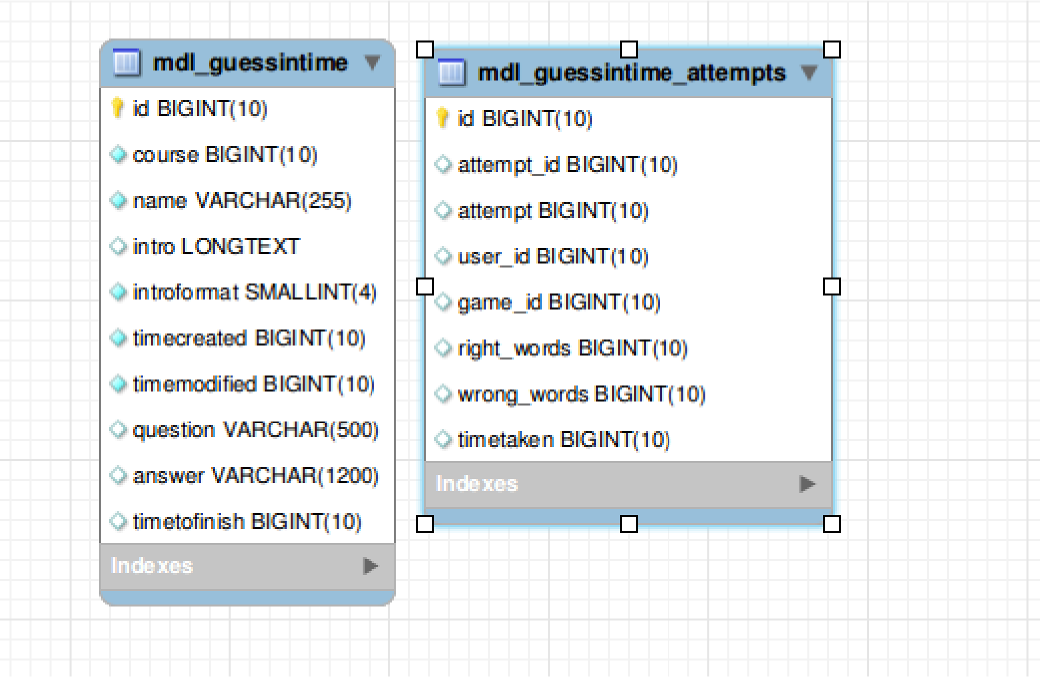


Fig. 4.12: Data flow diagram of student playing guess in time



mdl_guessintime

- id BIGINT(10)
- course BIGINT(10)
- name VARCHAR(255)
- intro LONGTEXT
- introformat SMALLINT(4)
- timecreated BIGINT(10)
- timemodified BIGINT(10)
- question VARCHAR(500)
- answer VARCHAR(1200)
- timetofinish BIGINT(10)

Indexes

mdl_guessintime_attempts

- id BIGINT(10)
- attempt_id BIGINT(10)
- attempt BIGINT(10)
- user_id BIGINT(10)
- game_id BIGINT(10)
- right_words BIGINT(10)
- wrong_words BIGINT(10)
- timetaken BIGINT(10)

Indexes

Fig. 4.13: ER Diagram of Guess in time

4.4 The weakest link

4.4.1 Motivation

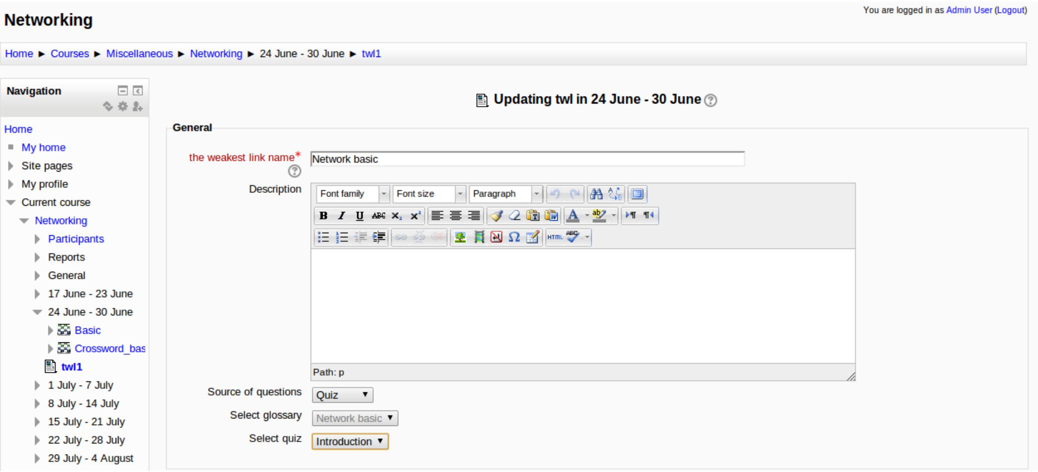
If we see normal grading methods adopted by Moodle, we will find that it is the total marks obtained by a student in that particular quiz. Since all the questions within a quiz have a equal weight, students are willing to attempt all the questions in case of less negative marking. So key idea behind this game is to adopt a new grading method so that students can attempt a series of questions to improve accuracy. This game is loosely based on the famous game show 'who wants to be a millionaire'. In that game a person don't have a second choice if we don't consider the lifelines. Person have to be accurate enough to win maximum amount. Suppose he is not sure about the answer he can quit any time and take the money. Adopting the same strategy I have proposed a new game where students have to form a sequence of maximum number of correct answers. He can quit at any time and get a fresh start from there in order to maximize his winning. The idea is quite interesting because now student have to think about the selection of questions he can attempt or he can quit. Since winning amount after each correct question gets double, he gets involve in selection of questions and that makes the game interesting. After every wrong attempt he will loose all earned money. Details about the game will be discussed in coming chapter. But definitely the game creates some sort of interest among the students compared to attempting a text based game. Involvement is learning activity is the main goal of any education game, so it justify the criteria to come under category of educational game.

4.4.2 About the game

Before naming the game I was not able to find a suitable name that can justify the game itself. As discussed in the motivation chapter the goal of this game is to maximize your earnings by forming a longest possible chain of correct answers. A single wrong answer can take your earning to zero. So in that sense 'the weakest link' justifies it's name. Students have to avoid the tough questions initially to get a maximum points. Now coming to game, it takes questions from either quiz or glossary and present them to students as a set of pictures. Initially all the questions are in unattempted state. Student can click on any picture to get corresponding question. After that question will be presented to them. If he wants to select another question he is free to click on any picture. Once he is sure about the questions it totally depends on him how to form a sequence such that he can maximize his accuracy. If he is not comfortable with the question he has a choice to skip the question and attempt another one or click on bank button to save his earnings. Once he clicks on bank button game engine reset the state and he has to form another sequence. Since current winning amount gets double after each correct answer he has to think twice before attempting those questions for which he is not sure. After clicking on bank button the game state is get reset, now he can take a risk since winning amount is not much and he has already saved the earlier points. So it's trade off between safety and risk.

4.4.3 Teacher role

Teacher role for this game is same as Tic-Tac-Toe in the sense that both get question from either quiz module or glossary. So as described earlier there will be three fields for the teacher: select a source of question from quiz and glossary, once selected there will be all instances of quiz and glossary created by teacher to choose from them as shown in Figure-4.14. He can select any one instance to provide source of questions that can be presented to students for playing the game.



Networking

You are logged in as Admin User (Logout)

Home ► Courses ► Miscellaneous ► Networking ► 24 June - 30 June ► twl1

Updating twl in 24 June - 30 June

General

the weakest link name*: Network basic

Description

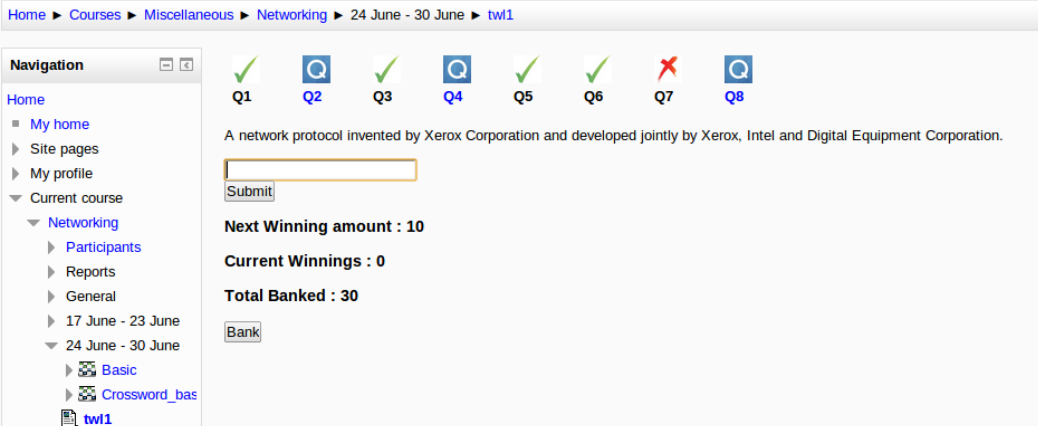
Path: p

Source of questions: Quiz

Select glossary: Network basic

Select quiz: Introduction

Fig. 4.14: Teacher interface for the weakest link



Home ► Courses ► Miscellaneous ► Networking ► 24 June - 30 June ► twl1

A network protocol invented by Xerox Corporation and developed jointly by Xerox, Intel and Digital Equipment Corporation.

Next Winning amount : 10

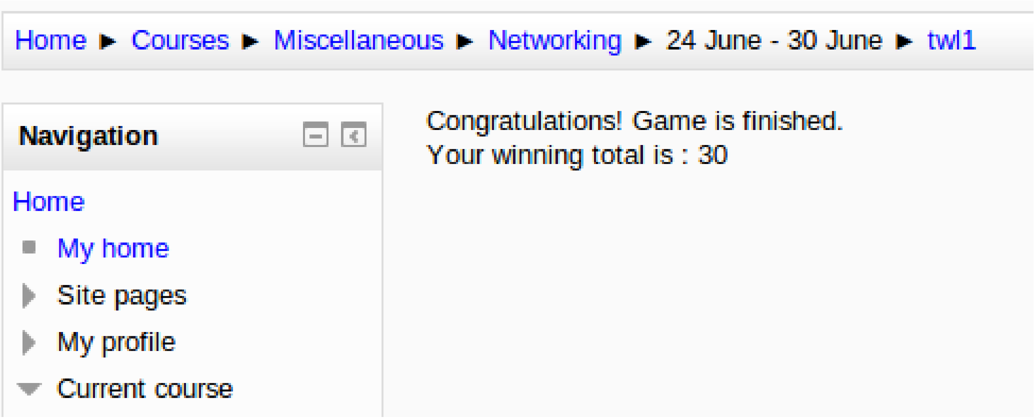
Current Winnings : 0

Total Banked : 30

Fig. 4.15: Intermediate state in the weakest link

4.4.4 Student role

Once teacher has created the game, student can start the game by clicking on plugin symbol. After start a series of pictures will appear on the game board. Initially all pictures represent a unattempted question. Student can see the content of the question by clicking on any one of the image. He can free to select any other question by clicking another picture. Once he is sure that he can attempt the question he can submit the response by clicking on submit button. Game will check the answer against the respective table and mark it as either correct or wrong. Once attempted student don't have a choice to re-attempt the same question. There are other parameter like current winning, next winning and bank amount. current winning is 0, next winning is 10 and bank amount is 0. After each correct answer current next winning will be added to current winnings and next winning amount will be doubled. There is an another


Home ▶ Courses ▶ Miscellaneous ▶ Networking ▶ 24 June - 30 June ▶ twl1
Navigation
Home
My home
Site pages
My profile
Current course

Congratulations! Game is finished.
Your winning total is : 30

Fig. 4.16: Summary of the weakest link

button 'bank' that can be used when student is not sure about the correct answer and he don't want to loose current winnings. In that case he can click on bank button to add his current winning to the bank. After that current winnings will be set to 0, next winnings will be set to 10 and bank total will be displayed as the total amount earn by the student till that move. In case of wrong answer game variables will be reset. Goal of the game is to earn as much possible amount. Figure-4.15 demonstrate the intermediate state of the game. At the end of the game a summary page like Figure-4.16 will be displayed with the bank amount student earn during the play.

4.4.5 Rules to play the game

1. Click on any picture 'Q' to get corresponding question
2. Attempt the question to increase the next winning amount
3. In case of right answer next amount will be doubled otherwise it will be reset
4. If not sure about the answer one can click on bank button to add the current winnings to the bank. After that game variables will be reset.

4.4.6 Design details

Data flow diagrams

1. Game creation by the teacher : Figure-4.5 explains the data flow when teacher creates the instance of the game.

2. Game played by the student : Figure-4.17 explains the data flow when student starts the game.

Database design

In Figure-4.18 we can see the various tables used by the game engine. Database used by this game is very similar to the Tic-Tac-Toe game where three table is being used : first for storing game parameters, second for student attempts and third for storing student response for each question in each attempt.

List of functions used

- tiles : For storing tile state
- Score : For storing scores of user and computer
- submitAndReturnToCourse : sends the form parameter to libclass for storing it into database and returns to course page
- submitAndDisplay : sends the form parameter to libclass for storing it into database and starts the game by calling gameview class
- cancel : cancels the game creation
- addInstance(formData) : stores the form parameter into database
- updateInstance(formData) : modifies the form parameter into database
- deleteInstance(formData) : delete the game instance
- initGame() : setting user attempt and questions
- playGame() : loads javascript class and shows initial board
- fetchCurrentState(twl) : fetches current state
- checkAnswer(qid, ans) : takes question id and user answer and returns the correctness
- endGame() : calls the summary after no question is left
- fetchAllQuestions(twl) : getting all questions
- bank() : add current amount to banktotal

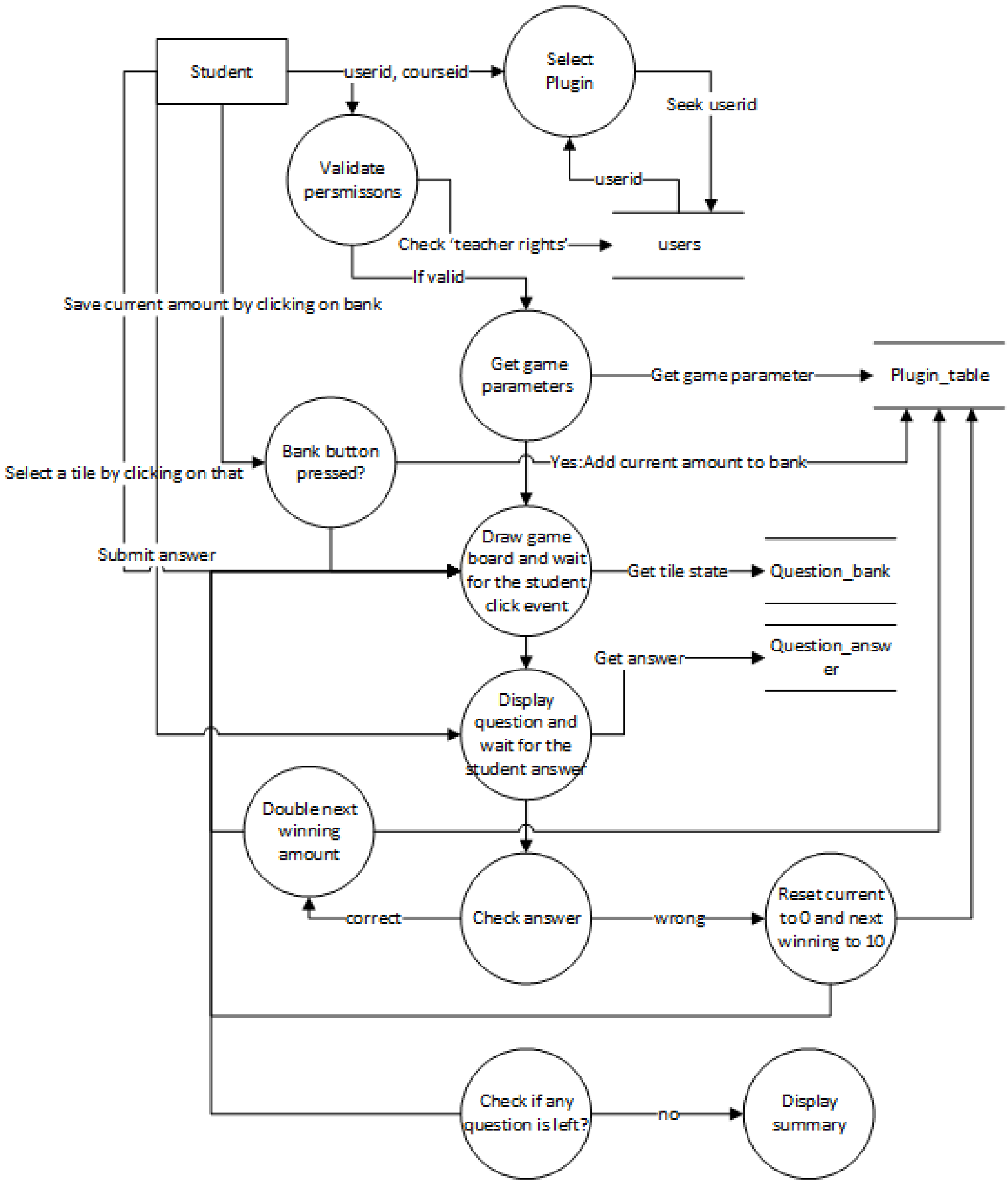

Student
userid, courseid
Select Plugin
Seek userid
Validate persmissons
userid
Check 'teacher rights'
users
If valid
Save current amount by clicking on bank
Get game parameters
Get game parameter
Plugin_table
Bank button pressed?
Select a tile by clicking on that
Yes:Add current amount to bank
Draw game board and wait for the student click event
Submit answer
Get tile state
Question_bank
Get answer
Question_answer
Display question and wait for the student answer
Double next winning amount
correct
Check answer
wrong
Reset current to 0 and next winning to 10
Check if any question is left?
no
Display summary

Fig. 4.17: Data flow diagram of student playing the weakest link

4.4.7 Challenges

Key challenge behind the game was in getting the idea of new method of grading. We can introduce some other ideas like giving life line to the student if he is not sure about the answer. But introducing the idea of saving the current amount is itself a big life line. Implementation was not very challenging since I could use the libraries for getting and checking the questions.

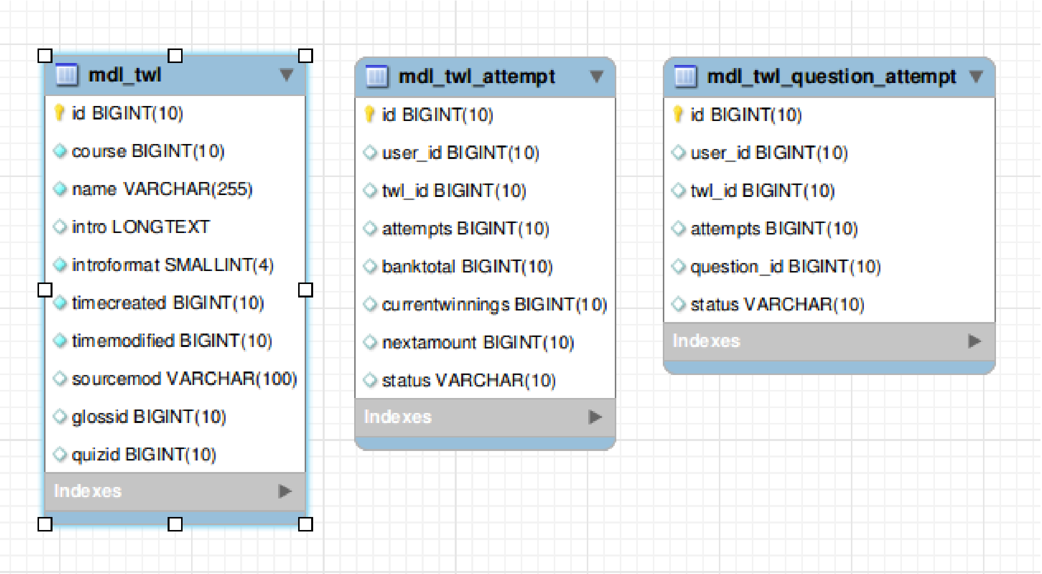


Fig. 4.18: ER Diagram of Guess in time

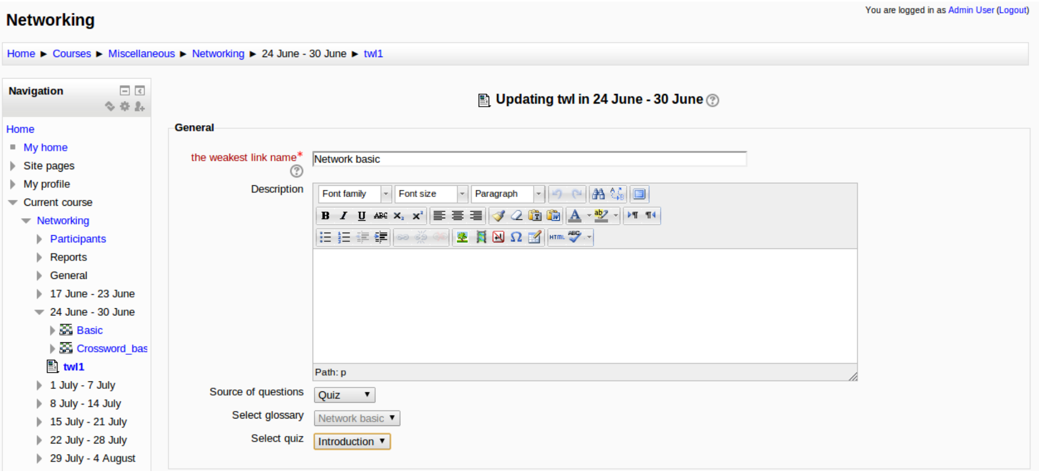
4.5 Anagram

4.5.1 Motivation

The key motivation behind this game is to provide a nice user interface for answering the questions. After evolution of HTML5 web developers has got many powers to create nice, beautiful interfaces. Using some javascript library we can create a nice draggable html element. I take the idea of dragging feature and applied to this game. Using this power student can swap two elements by just using mouse. As name suggest task is to rearrange something to make it in proper order. Overall idea is to create questions and answer as a box and rearrange them by drag and swap.

4.5.2 About the game

The game is all about rearranging some structure to make it in proper sequence. Again question can be taken from either quiz or glossary. Question and corresponding answer will be shown as a box in some random order. Goal of this game is to shuffle the game board such that answer of a particular answer will be adjacent to it.



Updating twl in 24 June - 30 June

General

the weakest link name*: Network basic

Description:

Source of questions: Quiz

Select glossary: Network basic

Select quiz: Introduction

Fig. 4.19: Teacher interface for anagrams

4.5.3 Teacher role

It is similar to Tic-Tac-Toe game where teacher has to set source of question: either quiz or glossary. Once source is selected all possible instance of that source will be shown in a drop down list that can be seen in Figure-4.19. Teacher has to select one instance. After submit game is ready to be played by students. Students can see the game by entering in the course.

4.5.4 Student role

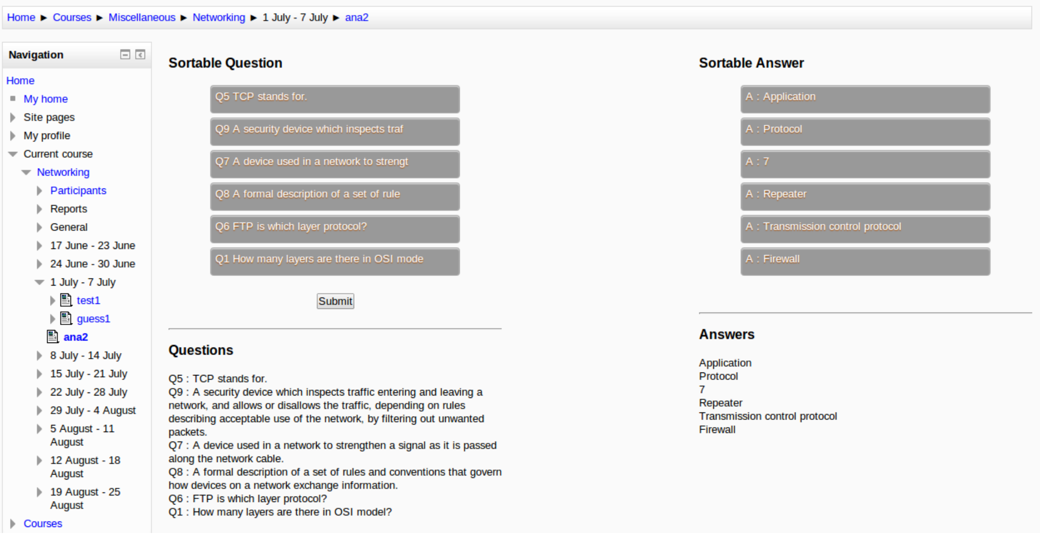
This is a straight forward game where all questions and their answers will be visible as a boxes. As shown in Figure-4.20 left side boxes correspond to questions and on the right side there are randomly placed answer boxes. There is a partial text written on each boxes. Full question text as well as answer text is given below the corresponding line. Task is to rearrange them using drag and swap feature of the game. Once student is sure about the order he can click on submit button.

After checking the answers a summary page Figure-4.21 will be shown to students about their attempt.

4.5.5 Rules to play the game

1. Click on plugin

2. See the corresponding question or answer written as a text



Sortable Question

Q5 TCP stands for.
Q9 A security device which inspects traf
Q7 A device used in a network to strengt
Q8 A formal description of a set of rule
Q6 FTP is which layer protocol?
Q1 How many layers are there in OSI mode

Sortable Answer

A : Application
A : Protocol
A : 7
A : Repeater
A : Transmission control protocol
A : Firewall

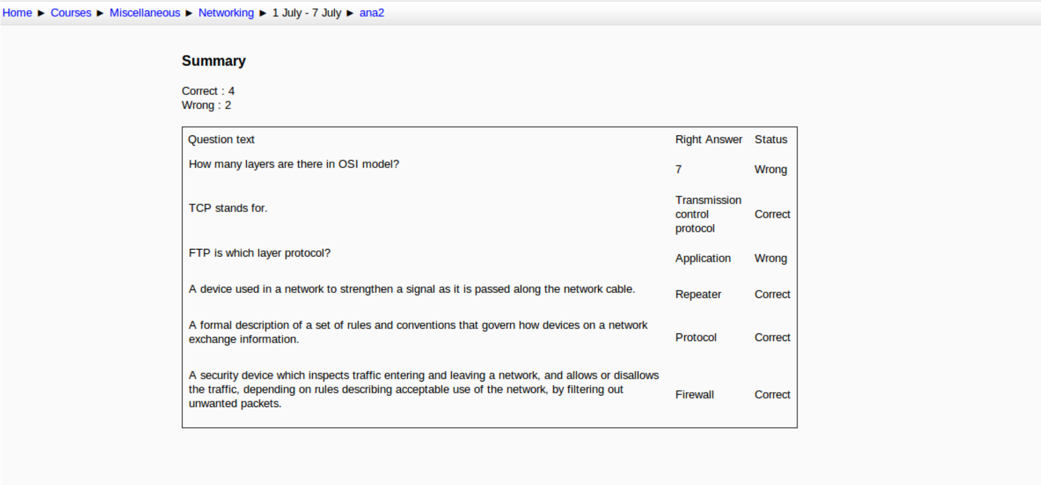
Questions

Q5 : TCP stands for.
Q9 : A security device which inspects traffic entering and leaving a network, and allows or disallows the traffic, depending on rules describing acceptable use of the network, by filtering out unwanted packets.
Q7 : A device used in a network to strengthen a signal as it is passed along the network cable.
Q8 : A formal description of a set of rules and conventions that govern how devices on a network exchange information.
Q6 : FTP is which layer protocol?
Q1 : How many layers are there in OSI model?

Answers

Application
Protocol
7
Repeater
Transmission control protocol
Firewall

Fig. 4.20: Intermediate state in anagram


Home ▸ Courses ▸ Miscellaneous ▸ Networking ▸ 1 July - 7 July ▸ ana2

Summary

Correct : 4
Wrong : 2

Question text	Right Answer	Status
How many layers are there in OSI model?	7	Wrong
TCP stands for.	Transmission control protocol	Correct
FTP is which layer protocol?	Application	Wrong
A device used in a network to strengthen a signal as it is passed along the network cable.	Repeater	Correct
A formal description of a set of rules and conventions that govern how devices on a network exchange information.	Protocol	Correct
A security device which inspects traffic entering and leaving a network, and allows or disallows the traffic, depending on rules describing acceptable use of the network, by filtering out unwanted packets.	Firewall	Correct

Fig. 4.21: Summary of anagram

3. Click on the box you want to swap. Scroll up or down with holding left click of mouse. Box can be seen as moving up or down. Drop the box on another box.

4. Student can see the two boxes are swapped.

5. Repeat the process until arrangement is not proper

6. Click on submit to see the summary page

4.5.6 Design details

Data flow diagrams

1. Game creation by the teacher : Figure-4.5 explains the data flow when teacher creates the

instance of the game.

2. Game played by the student : Figure-4.22 explains the data flow when student starts the game.

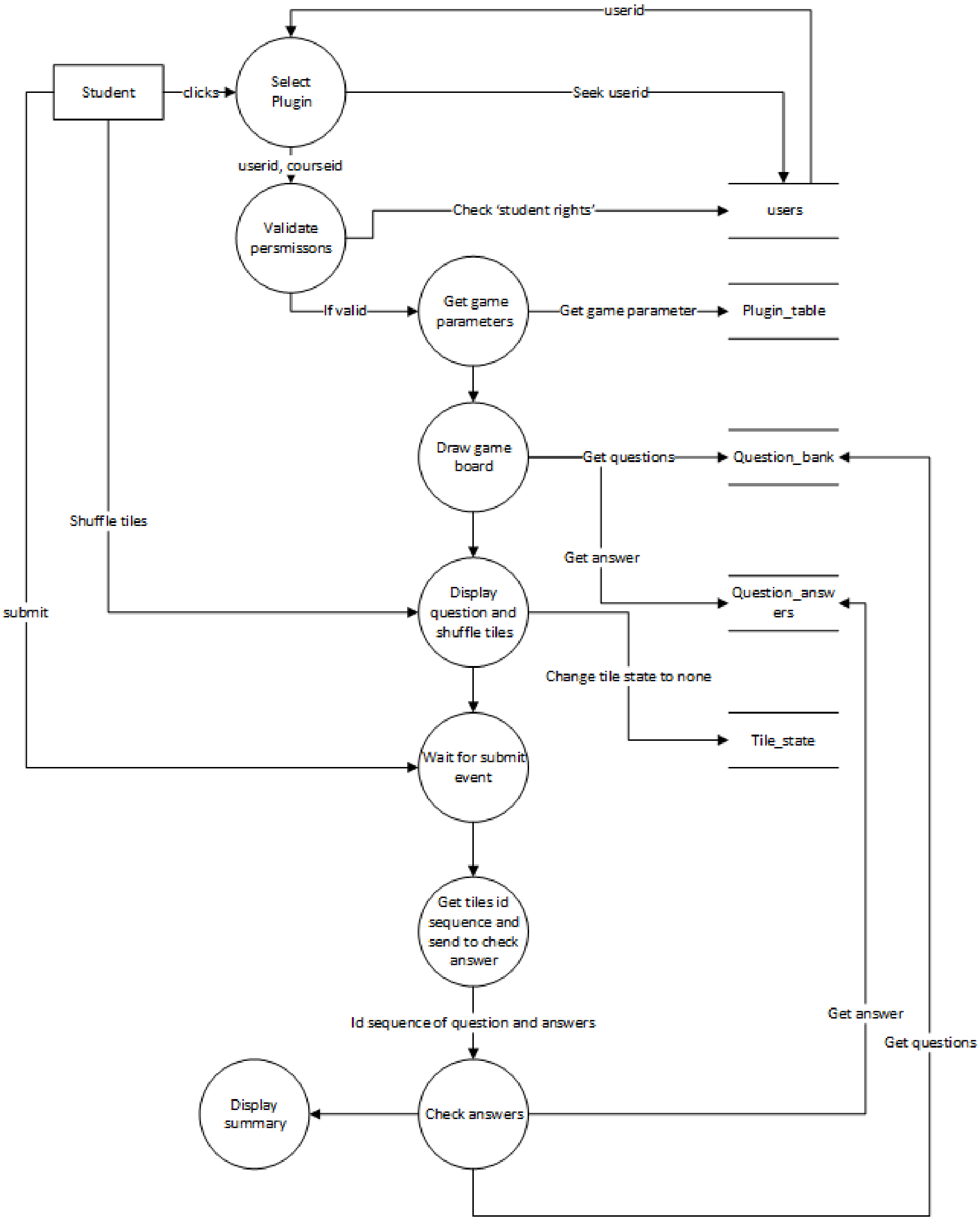


Fig. 4.22: Data flow diagram of student playing anagram

Database design

In Figure-4.23 we can see the various tables used by the game engine.

- mdl-glossary-entry : All the entry in the form of concepts and their definitions can be accessed from this table. This table is updated on creating or modifying any glossary plugin.

- mdl-questions : When teacher creates a quiz Moodle stores all questions in this table. Our game uses this table for extracting questions and presenting to the students.

- mdl-question-answers : We can find correct answer of any question from this table.

- mdl-anagram : This table is used for storing all the parameters related to the game.

- mdl-anagram-attempt : Whenever any student plays this game, a separate entry is entered in order to count his attempt number, his current game state etc. On the completion of the game all others parameters like score, time taken, status are updated.

- mdl-anagram-question-attempt : This table is used for storing students attempt of each question. Since we have to display a summary about correct or wrong questions, this table is useful.

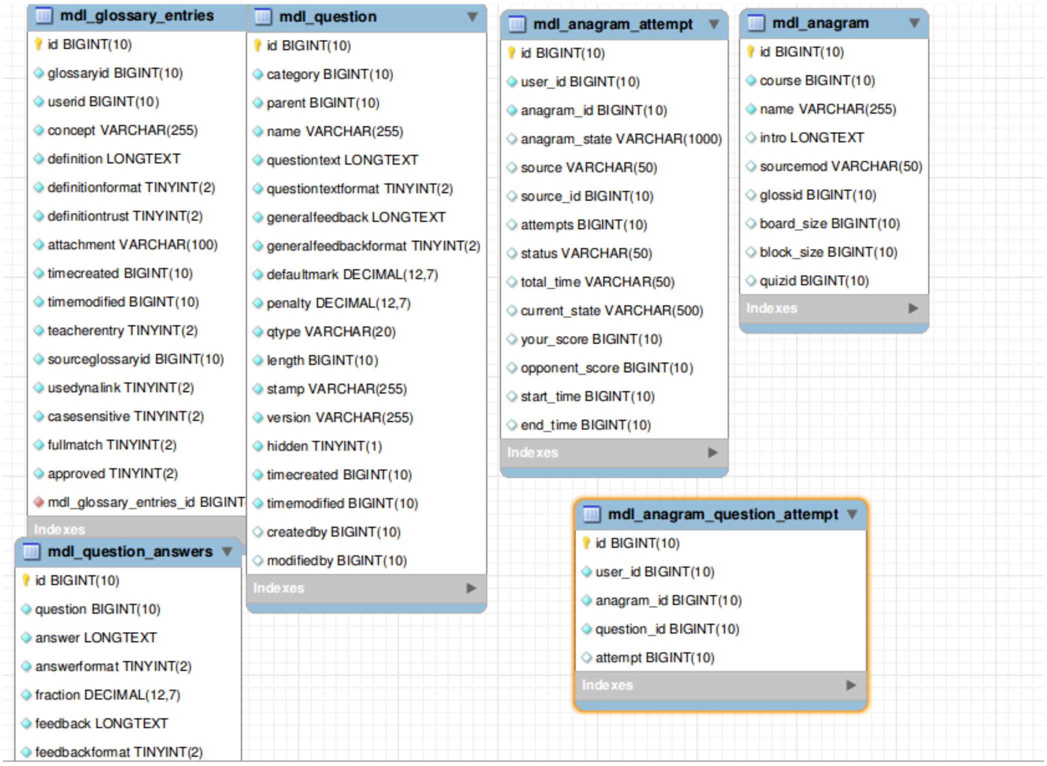


Fig. 4.23: ER Diagram of anagram

List of functions used

- submitAndReturnToCourse : sends the form parameter to libclass for storing it into database and returns to course page
- submitAndDisplay : sends the form parameter to libclass for storing it into database and starts the game by calling gameview class
- cancel : cancels the game creation
- addInstance(formData) : stores the form parameter into database
- updateInstance(formData) : modifies the form parameter into database
- deleteInstance(formData) : delete the game instance
- initGame() : setting user attempt and questions
- playGame() : loads javascript class and shows initial board
- summaryGame() : summarises student's attempt in form of correct and wrong attempts for each question

4.6 Summary

I have created four games as a Moodle plugin and details about each game is already given. During the project I faced few challenges that has been covered under challenge section of each game. Overall main challenge that I faced was to getting the idea of such games that can be used by students to increase their involvement in educational activity. After conceptualizing the game main challenge was to identify the technologies which can be helpful in implementing the games. HTML5, some javascript libraries, webGL, flash were the some of those technologies used by web game developers. I went through some of them to pick right one for my purpose. Later I discovered that Moodle community is not a big fan of flash that I figured out by going through various forums. So I picked HTML5 and few other javascript libraries for development purpose. Hopefully students would like these games and able to involve themselves in the learning process.

Chapter 5
Integration with Moodle: Testing and Debugging

Moodle provides plugin support by which any developer can create his own plugin. How to create a new plugin has already been discussed in the chapter-3 while exploring moodle internals. I have followed same methodology for creating these four games. Though following some set of instructions can't guarantee bug proof application, I have tested each game plugin based on different test criteria. Different test scenario for different games has been presented in each game sections. Some key logical problems occurred for each game and their debugging procedure has been highlighted in individual game section.

Following are the different type of testing that I am performing on game plugins:

- Functionality testing : This is also called 'Component testing' where we are checking if all components are working properly or not. Different functions and their behavior, all the external and internal links available in the pages and web form testing is done in this type.
- Compatibility testing : This is a non-functional testing in which we test how the system is behaving in different environment like different browser and different operating systems.
- Database testing : All queries are executing is desired way, behavior of deletion, modification and insertion by the teacher is tested in this type.
- Security testing : Checking user capability and whether he has been logged in or not when accessing those plugins.

In next section I am giving the details of each test cases that has been performed on each game.

5.1 Test cases

Test id : G01

Test name : Verification of plugin icon in list of plugin

Game : Tic-tac-toe

Test type : Functionality testing

Test procedure : Steps to be followed

- Login as teacher for the course
- Click on 'Turn editing on' button on the course page
- Click on add plugin link
- See if an icon with game name is present or not

Expected output : There should be a icon with name 'tic'

Actual output : Icon is there

Status : Passed

Test id : G02

Test name : Verify if teacher can see game form

Game : Tic-tac-toe

Test type : Functionality testing

Test procedure : Steps to be followed

- Login as teacher for the 'Networking' course
- Click on 'Turn editing on' button on the course page
- Click on add plugin link and select 'tic'
- See if a form with game parameter input is present or not

Expected output : There should be a form with board size, source of questions, block size, ids of glossary or quiz

Actual output : Form with mentioned input is there

Status : Passed

Test id : G03

Test name : Verify if game parameters has been stored into database

Game : Tic-tac-toe

Test type : Database testing

Test procedure : After submitting the game form go to the table and manually verify for the expected data

Expected output : All data should be inserted into mdl-tic table

Actual output : Error message

Status : Failed

Comment : How I fixed this bug has been given in Bugid-B01 in next section

Test id : G04

Test name : Verify if student can play the game from the course page

Game : Tic-tac-toe

Test type : Functionality testing

Test procedure : Steps to be followed

- Login as student and select 'Networking' course
- Check in the course format if a new plugin 'tic' appears or not
- Click on 'tic' icon
- See if a game board with how to play appears or not

Expected output : There should be a game board with how to play instruction

Actual output : Can't see the board. After one click nothing happens

Status : Failed

Comment : How I fixed this bug has been given in Bugid-B02 in next section

Test id : G05

Test name : Check if student can get a question after clicking on the tile

Game : Tic-tac-toe

Test type : Functional and Database testing

Test procedure : Place mouse on the tile. Click on different tiles and verify if different questions appear on the right side or not

Expected output : Once mouse is placed on any tile, its color should be change to red. Once clicked corresponding question should be visible

Actual output : Can see the behavior as expected

Status : Passed

Test name : Check behavior of board after answering a question

Game : Tic-tac-toe

Test type : Functional and Database testing

Test procedure : Steps to be followed

- Start the game by clicking on the 'tic'
- Select any tile by clicking on that
- First give correct answer and then for next move give wrong answer

Expected output : For correct answer there should be a 'X' mark on that tile only. After that a 'O' mark should be there to confirm computer's move. For wrong answer there should be no 'X' mark but 'O' mark should be there

Actual output : As expected

Status : Passed

Test id : G06

Test name : Verify behavior of a marked tile

Game : Tic-tac-toe

Test type : Functional testing

Test procedure : Steps to be followed

- Play the game by answering the question
- Click on some marked tile

- If nothing happens select unmarked tile and repeat the step till the end

Expected output : After clicking on a marked tile nothing should happen but unmarked tile clicking should fetch question from the database
Actual output : As expected
Status : Passed

Test id : G07
Test name : Verify behavior of game board by submitting the question without giving answer
Game : Tic-tac-toe
Test type : Functional testing
Test procedure : Steps to be followed

- Play the game
- Click on some unmarked tile
- Click on submit button without giving answer to the question

Expected output : A message should appear telling that attempt the question
Actual output :A pop-up appears with message: Attempt the question
Status : Passed

Test id : G08
Test name : Verify behavior of the game after last marked tile
Game : Tic-tac-toe
Test type : Functional testing
Test procedure : Steps to be followed

- Play the game by answering the question
- For last tile first give correct answer and see what happens.
- In another attempt give wrong answer and see whether computer mark 'O' on last tile or not

Expected output : After last marked tile, summary table should appear on the right side and all tiles should be disabled

Actual output : Summary page comes but last tile gets unmarked

Status : Failed

Comment : How I fixed this bug has been given in Bugid-B03 in next section

Test id : G09

Test name : Check behavior of board after answering a question

Game : Guess in time

Test type : Functional and Database testing

Test procedure : Steps to be followed

- Start the game by clicking on the 'guess'
- Enter correct word in the text area
- Try some arbit words

Expected output : For correct answer text area should be reset and total words remaining count should be decremented by one. For wrong answer nothing should be happen

Actual output : As expected

Status : Passed

Test id : G10

Test name : Check behavior of board after time out

Game : Guess in time

Test type : Functional and Database testing

Test procedure : Steps to be followed

- Start the game by clicking on the 'guess'
- Play the game by entering words into text area
- See if clock is working properly or not by waiting till the time out

Expected output : On time out a summary page should be appear

Actual output : As expected

Status : Passed

Test id : G11

Test name : Check behavior of game images

Game : The weakest link

Test type : Functional and Database testing

Test procedure : Steps to be followed

- Start the game by clicking on the 'twl'
- Click on 'Q' images to check whether questions are appearing or not
- Try clicking on 'right' and 'wrong' images

Expected output : Question should appear for each 'Q' images. For other two images nothing should happen

Actual output : As expected

Status : Passed

Test id : G12

Test name : Check if bank button working properly or not

Game : The weakest link

Test type : Functional and Database testing

Test procedure : Steps to be followed

- Start the game by clicking on the 'twl'
- Click on 'Q' images to check whether questions are appearing or not
- Answer some correct answers
- Click on bank button in order to save your current winning amount

Expected output : Next winning amount gets doubled on each correct answer. For incorrect answers current winning should be equal to bank amount and next winning amount should be reset to 10

Actual output : As expected

Status : Passed

Test id : G13

Test name : Verify access of not enrolled student

Game : Tic-tac-toe

Test type : Security testing

Test procedure : Steps to be followed

- Login as different user that is not registered in the 'Networking' course
- Try to access 'tic' game by changing url that contains same id of 'Networking' course
- Set plugin id as 'tic' id

Expected output : Error message should appear

Actual output : Message : 'you don't have access to this course'

Status : Passed

Test id : G14

Test name : Verify access of game without login

Game : Tic-tac-toe

Test type : Security testing

Test procedure : Steps to be followed

- Logout from the moodle
- Try url with course id as 'Networking' and plugin id as 'tic'

Expected output : User should not be able to see the game

Actual output : Redirected to login pages

Status : Passed

Test id : G15

Test name : Verify compatibility with different browsers

Game : Tic-tac-toe, The weakest link, Guess in time, Anagram

Test type : Compatibility testing

Test procedure : Tried firefox and google-chrome for playing all four games

Expected output : Game should behave correctly on all browsers

Actual output : All games except tic-tac-toe works perfectly. Firefox was not able to paint selected tile with red color

Status : Failed

Possible reason : Since I have used some inbuilt functions of HTML5 to draw images, it is possible that those functions are not supported by the browser

Test id : G16

Test name : Verify compatibility with different operating system

Game : Tic-tac-toe, The weakest link, Guess in time, Anagram

Test type : Compatibility testing

Test procedure : Tried Ubuntu-12.04 and Windows-8 installing game plugins

Expected output : Game should behave correctly on both operating system

Actual output : As expected, though execution time in windows-8 was slow

Status : Passed

Test id : G17

Test name : Check behavior of board after starting the game

Game : Anagram

Test type : Functional and Database testing

Test procedure : Steps to be followed

- Start the game by clicking on the 'anagram'
- Count total number of questions tiles and answer tiles
- Check with different type of question source

Expected output : Tiles count should be equal for both question and answers

Actual output : For those quiz which have multiple correct answers, answer tiles exceed in number than question tile

Status : Failed

Comment : How I fixed this bug has been given in Bugid-B04 in next section

5.2 Debugging

During the development I found some bugs/problems that took some time to debug. In this chapter I am giving the bug/problem details and how I was able to debug them.

Problem name : Problem in changing table structure through XMLDB Editor
Game : Tic-tac-toe, The weakest link, Guess in time, Anagram
Problem details : Managing database tables had a real problem when I started integration of the game into the moodle as a plugin. Moodle don't allow us to manage it's table directly. Instead it has its own manager called XMLDB Editor. Suppose we want to change one field type of any table. For that we have to go through the manager and after selecting appropriate table we can use some options available for database modification. It first stores all changes in the form of XML file that can be found in 'install.xml'. Since moodle is writing into this file we have to make sure that write permission is there for this file. Due to this I was not able to proceed. Once it is done, we have to manually enter some code in 'upgrade.php' that can be found in 'db' directory of each plugin. Sample code can be found from the manager. Creating a new field, table was not a big problem. But when I tried to change field of a table, it flashed some error. I was wondering because same procedure was working perfectly with creating a new table or field. Now I am giving the steps to solve this problem.
Debugging Steps : First problem was arrived because of the file permission. When I gave write permission to 'install.xml' it started working. Second problem was due to mismatch found in 'install.xml' and actual database table. When we edit something through XMLDB Editor it only changes xml file. But code generated by this will take fields from xml file that is changed field. But in database field is unchanged. So we have to enter correct code manually.
Status : Fixed

Bug id : B01
Bug name : Inserting game parameters into the database
Game : Tic-tac-toe, The weakest link, Guess in time, Anagram
Bug details : Moodle provides moodle-form class that handles all form related tasks. Even all

elements of a form have to made using this class methods. Due to this reason I was not able to pass correct parameter to a function that I wrote for inserting these data into the table.

Debugging Steps : Later I figured out that all data with their 'name type' is sent in an associative array. After going through the code I figured out some more functions by which we can perform some sort of java-script functioning. For an example in three games, they take source of question as a game parameter. If source is selected as 'glossary' I had to disable 'select input' corresponds to quiz ids and enable 'select input' which shows all created glossary for that course. It took some time to figure out those functions.

Status : Fixed

Bug id : B02

Bug name : Problem in rendering initial game board

Game : Tic-tac-toe

Bug details : Before integrating this game to moodle I designed it without considering questions. For that I created two functions 'update' and 'draw' which are being called 30 times in a second. Code was working perfectly on my local system. But when I integrated this on moodle I had to change some functions such that student cant proceed without answering a question. Initially I moved update function out of the loop and instead I created a new function that called update function only when it gets students response. When I run this game behaved differently and rendering got stopped after one click.

Debugging Steps : Reason behind this bug was that I was updating tiles state in 'update' function and this information was used by draw function for rendering the game board. But now update function is not in the loop it halted rendering process. After figuring out this problem I changed the logic of 'update' function. Now I am assigning three states:'0' for student tiles, '1' for computer tiles and '2' for current selected tile. Then I moved 'update' function back into the loop. On successful attempt tile state gets changed to '0' and rendered automatically take cares of rest.

Status : Fixed

Bug id : B03

Bug name : Problem in rendering at the end of game

Game : Tic-tac-toe

Bug details : After last move renderer was unable to draw mark corresponding to last player. Though summary section was visible, board was showing one unmarked tile.

Debugging Steps : This bug was there because I had not checked end move properly. I have one more function that checks if all tiles are marked or not. If marked it changes game board state to 'finished' and that there are no subsequent functions calls after that. Due to give some animation I maintained two array for storing tile state. One array simply stores '0' or '1' or '-1' for student, computer and unattempted tiles respectively. Other array is used to store 'X', 'O', 'toX' and 'toO' in order to give some animation. If student gets a sequence of correct answer it blinks for few seconds to give him impression that he got one point. I called another 'update' function from main 'update' function which does the task of creating a new state for each tile. Due to this we need to call update function separately. After end turn execution of main 'update' function halts and so my new 'update' is not called. After moving this new update function out of the main 'update' function and moving it inside the main loop I am able to see all tiles as marked.

Status : Fixed

Bug id : B04

Bug name : Handling more than one correct answers of a question

Game : Anagram

Bug details : This bug was there because of poorly written sql query. Quiz plugin allows teacher to enter more than one correct answers. Because of this feature question table has one field called 'fraction' which decides whether answer in correct or wrong. When I wrote a query to fetch correct answers, all answers appeared in the result. Due to this there was a mismatch in terms of total number of question tiles and corresponding answer tiles. In some cases when there are more than one correct answer, number of answer tiles exceeded.

Debugging Steps : By correcting the query I was able to match equal number of tiles for questions and answers.

Status : Fixed

Chapter 6
Conclusion and Future work

6.1 Conclusion

During the development of educational game as an plugin I realized that game based learning is a good option to involve students into the the learning process. These games has been developed as an plugin for Moodle. So instead of presenting some text based quiz If we ask them to attempt those quiz through the game, that will definitely create some sort of interest. Gaming has became quite popular among the youth. So we can't deny the fact that transforming some games into educational game can be the solution as far as Internet based teaching and evaluation is concern. Keeping the benefits of game based learning I have developed four games that can be integrated into the moddle as a plugin. Since there is a lot of scope for contribution in this field I have proposed some suggestions in the future work chapter.

6.2 Future work

I have developed four games keeping in mind of Moodle quiz and glossary module. Since these plugin can serve as source of questions, I was not worried about creating a knowledge base. Though I have proposed a new type of question in 'Guess in time' game it is possible to explore a new way to create a knowledge base that can be used by the other games. My main goal was to create a generic game that can be used by any available course. During the project I thought of some games that can be very handy in a particular course like physics and mathematics. So my suggestion is to get the idea of those games that can be specially design for a course. For example we can create a math game that can show a curve and ask for corresponding mathematical equation. This is one example, but we can think of many such games that can give better feeling and interest among students for a specific course.

6.2.1 Tic-tac-toe

My version of tic-tac-toe doesn't allow student to mark on tile in case of wrong attempt. In some sense this is not fair because now computer's chance of winning gets high. So one modification can be done like ask another question if student gives a wrong answer and reshuffle the board. I am proposing reshuffling as a cost of wrong attempt. Because he has given a wrong answer, put tougher questions on those tiles that student wants to target to get a point. But there is a disadvantage of this version. In case of limited number of questions and if student gets the most of the question wrong, at the end there will be no question to ask and tiles will be left unmarked. But we can put some other constraint like maximum number of wrong attempt allowed to avoid missing your turn. Another suggestion is related with AI of computer. We can always write a better AI to make it tougher for the student.

Since classical tic-tac-toe is a two player game we can implement a network version of this where any student can challenge other student in the course. Moodle allow group formation within a course so we can take advantage of this feature where students can play in a group. This can clearly increase motivation among the students because now they are competing against the same level of opponent. And this gives the idea that network based games can be fall under future work.

6.2.2 Network games

After evolution in Internet technology more and more students are spending their time on Internet. A healthy amount of the time is spent on playing games. Since these network based games are quite attractive we can think about transforming those games into educational game. One of the biggest factor of their passion is lie behind their opponent. They want to compete against their same level of skill. Students in a course are more or less at the same level of knowledge. Those who are not good in studies chances are high that they will be good in games. By designing a education game that requires some game skill as well as knowledge about the course can be used as a motivation factor to involve in game activity. Now weaker students can also show more enthusiasm because they are good in gaming skill. So I personally believe that network based educational games can be used as method to involve students in education activity.

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