**WEB BASED MATHEMATICS TOOLS**

Aram Abbasi

Shiva Pandey

Shyam Raja Bhetuwal

Oulu University of Applied Sciences

**CONTENTS**

1 INTRODUCTION 3

2 THE WORK ENVIRONMENT 4

3 DEFINITIONS 6

3.1 Number system conversions 6

3.2 Number system outputs 6

3.3 Combinatorics 7

3.4 Truth tables 7

3.5 Random values 7

3.6 Chess knight moves 8

4 PROJECT IMPLEMENTATIONS 9

5 TESTING 13

6 CONCLUSIONS 15

REFERENCES 16

APPENDICES

1 INTRODUCTION

The report is based on our final project work allocated for the evaluation of our knowledges and skills in Developer Basic Skills course. This report presents purpose, scope, objectives, project phases and their schedule of the project works. This report also provides the detailed information on planned activities as well as the work time estimates for each activity during each phases of the project development (see Appendix 1). The main purpose of this project work is to apply the skills and knowledges that has been taught during the lectures on developer basic skills. In addition, it provides detailed information of the project management plan and implementation.

The report is structured into six chapters. Chapter one gives an overall description of the project work and contents of all chapters. It also defines purpose and objective of the project. Chapter two describes the work environment and its relation to outside world. Furthermore, it presents the tools and functions that have been used in the implementation of the project. Similarly, chapter three describes web-based mathematics tools that the user can be able to operate. In this chapter, all the mathematics principles including their basic definition and its purpose is explained. Chapter four provides thorough information about the implementation of the project. In chapter six, writer provides information on how testing has been done before presenting or deploying the project. Furthermore, it describes possibilities of further development of the project. Finally, the last chapter includes conclusion that demonstrates most significant results and essential issues concerning the project work.

The main objective of this project is to design and implement a web based mathematic tools. There will be six different mathematics functionalities for the user to interact with this web-based tools such as number system conversions, number system outputs, combinatorics, truth tables, random values and chess knight moves. This is a group assignment that has been assigned to evaluate the student performance on developer basic skills. We belong to group number 10. The members of this group are Aram Abbasi, Shiva Pandey and Shyam Raja Bhetuwal. The repository address for our project in GitHub is, https://github.com/Aram777/DevBasicSkills2017-10.

2 THE WORK ENVIRONMENT

The work environment is a term that defines the surrounding conditions in which an employee or group of persons operates. It comprises physical conditions such as equipment, for example personal computers. It is also related to work processes or procedures as well as involves the social interactions among the group at the workplace. (Money-zine 2017, date of retrieval 09.12.2017.)

This chapter especially explains the technical environment which specializes technical support and technicality in the project work. It also relates project work with the outside world. In addition, tools and functions used in the project are illustrated. This project is basically a small project that gives us opportunities to use various kinds of tools and controls to design a webpage or even a website.

The project work is related to creating a web-based mathematics tools where user can operate six different mathematics principles as mentioned in the above chapter. To create this, we need to create a dynamic webpage. For this, various kinds of tools are required. Tools such as Visual studio code, GitHub software, Google Chrome, Microsoft project and Balsamiq tool are used. In relation to outside world, we believe that this project will helps us to build bigger projects with acquiring depth-knowledge in applying these tools. Completion of this project certainly adds practical knowledge as well as gives us an idea on designing and creating an authentic website. The detailed explanations of these tools are on the following paragraph.

Visual Studio Code is a source code editor developed by Microsoft which is free and available for Linux, Mac OSX and Windows. It includes built-in support for JavaScript, TypeScript and Node.js and has extensions for other programming languages such as C++, Java, Python and PHP. (Microsoft 2017, date of retrieval 09.12.2017.)

GitHub is a Web-based Git version control repository hosting service which is mostly used for computer code. It has a feature to host source code projects in a diversity of different programming languages. It also helps to track the various changes that has been made to every iteration. In addition, it has several benefits including easier collaboration with teammates. (Bradford 2017, date of retrieval 09.12.2017.)

Similarly, Google Chrome is used as a web-browser to test and debug the code. Microsoft Project is used to plan the project and track the time sheets of the work and phases. Balsamiq is a wireframing tool that helps to create and design a user interface which helps to overview and find best solutions for the project. Moreover, we have used 365 email to communicate and share the files.

3 DEFINITIONS

This particular chapter provides precise definition and explanation on mathematics principles and how the system works to operate them. The operation of the system is explained on the user’s point of view. The external dependencies to software or hardware is that it is recommended to use Google Chrome browser. In addition, recommended devices would be Windows PC. The definition part of this report includes detailed explanation of the contents of web-based mathematic tools. In addition, it gives information on what the user can do in each section of mathematics principles. It is explained below.

3.1 Number system conversions

A set of values used to represent a set of quantities is known as number system. Binary, Decimal, hexadecimal and Octal number system are different kinds of number system. Binary number system is a numbering system in which two unique digits 0 and 1 represents numeric quantities and number system comes with base 2. Similarly, decimal number system uses base-10 digits that we commonly use. Digits from 0-9 comes under this number system. Likewise, hexadecimal number system uses digits from 0-9 and letters from A-F. It has a base of 16. Octal uses digits from 0-7 and has a base of 8. (Mepits 2017, date of retrieval 10.12.2017.)

In this section of the system that we made, a user can choose one of four number system and write the number that he would like to convert into other number system. To write the number, it contains a number-pad into it so the user has possibilities to choose number from the webpage itself.

3.2 Number system outputs

In this very section of the webpage, it illustrates a table showing the list of values of decimals number system from 0-50 in binary, octal and hexadecimal number systems. This table can help a user to know the exact conversions value of decimals number system to other kinds of number system. User can also clear the table using clear button given on the page.

3.3 Combinatorics

In this section, user can use either combinations or permutations to calculate number of possible ways for the arrangements of objects. A combination is an arrangement of objects where the order of selection does not matter. Unlike combinations, permutation is the arrangements of a given number of objects in every possible order of succession. (Math is fun 2017, date of retrieval 10.12.2017.)

There is a combo box to choose from combinations or permutations. Then he must choose the write the numbers in an input box to calculate them. For the permutations there are two possible choices viz. permutations with repetitions and permutations without repetition.

3.4 Truth tables

A truth table is a logical-based mathematical tabular representation that illustrates possible values the function can attain (TechTarget 2017, date of retrieval 10.12.2017). In this section, user must use “and”, “or”, “not” and “()” to use the logical table. User can choose up to 3 values “p”, “q” and “r” to list the basic logical test. The truth table shows Boolean algebraic results.

3.5 Random values

This section contains a tool that can generate random numbers from probability distribution object. The user has a possibility to input how many random numbers he wants to print out from specified number of objects. It has also a feature that specifies the values. For example, there are 100 numbers i.e. 1-100, then a user can input a number that prints our random numbers between 1-100. If he input 3 then it prints out any three numbers which are between 1 and 100 along with specifying the values.

3.6 Chess knight moves

The Knight moves in a L-shape in any direction in a Chessboard. In this section, a user can have experience to view the number of possible ways a Knight can move to step-in every checkbox of chess. It is recommended to choose a place on the Chessboard where a user would like to initiate the movement of Knight.

4 PROJECT IMPLEMENTATIONS

Project implementation is the phase of the project where the plan becomes reality. In other words, it simply means carrying out the activities that has been portrayed in your work plan. Project execution is done after evaluating, deciding, visioning and planning the resources and tools needed for the project. (Sustainable sanitation and water management 2017.)

As per the system design documents the project work has been executed. The work was divided into modules/units and then actual coding was started. It is the main focus of the developer to generate code. The work was divided into group members as per the skills we produced during the lessons to execute the code and launch it to the webpage. We have used HTML, CSS and JavaScript programming languages to execute the code and functions. This chapter explains the details on styling, coding and designing for each units of the system which are described in the following paragraphs.

There are numerous things to be considered when styling and designing a webpage. It is important to figure out good solutions for the user interface. With the help of Balsamiq tools we noted different controls and tools to be used in our system. For instances, radio-buttons, buttons, checkbox, text input, spinner, combo-box and overall style of the page were assumed while designing Balsamiq project which are then used in our real project.

The first prerequisite of the webpage is to define or outline the content of the webpage. This can be executed with the usage of a markup language that defines every aspect components of the content materials. The language that is normally used to markup the content is HTML. HTML is a markup language that defines what the content is. The appearance of the webpage is well-defined using CSS (Cascading Style Sheets) that has the potential to specify which media the precise commands are to use with a view to be able to have the content formatted appropriately. With the help of HTML and CSS we create a static webpage. (Chapman 2017, date of retrieval 12.12.2017.)

To implement whole units of the system, three elements of CSS i.e. inline, internal and external CSS are used in styling HTML of each elements of the webpage. Inline CSS is given by using style attribute in HTML elements. Internal style is given by using a <style> element in the <head> section and external CSS style is by using separate CSS file for the HTML page. Fonts sizes, colours and position of the text, tools and controls are implemented by using these two elements. We have used clear and consistent styling of all the pages which allows the users to find and recognize what to do next. All the pages contain little summary that helps the user to know what can be executed in each page.

To make the webpage dynamic and functionable, JavaScript programming language is used. JavaScript adds behaviors to the web-page where the webpage is capable to respond to the actions performed by visitors without needing to load a new brand web-page when processing their request.

Some of the special examples of the code and functions executed in our system are given below:

The main page of the system includes menu items that has been portrayed in the whole system. All the menu items are linked to their specific webpage using HTML code and each page has a Home button to get back to the main page. The code below is one of the example to show how we have linked to the webpage that contains number system conversions.

<button id="but1" class="buttonhome btnmain raise" onclick="window.location.href='NumberSystemConversions.html'">Number system conversions</button>

In the section of random values, we made graphical representation for the distribution of random values with specifying the values in the chart. For this we use external library to show graphical distribution of those numbers.

<script type="text/javascript" src="https://canvasjs.com/assets/script/canvasjs.min.js"></script>

In truth table section of the webpage, there is a special and dynamic input box that defines special characters that the user must input to execute the truth tables. User can write every logical syntax using only these characters such as “p”, “q”, “r” and “()” and Boolean characters “and”, “or” and not. If they write anything extra than this, the program will written an error message. For this, following code has been used to evaluate user input and return the boolean variables True (T) or False(F).

var newCom = "if (" + tmpstr + ") " +

"xxx=1; " +

"else " +

"xxx=0;";

eval(newCom);

One of the most interesting tools that we create in our web-based tools is Knight move in a Chessboard. When a user clicks in one of the cell of the Chessboard where he wants the Knight to initiate its move, it will show the possible ways step in every cell. Here in this chessboard we only illustrate 5\*5 cell. For this we use recursive function and for each cell we have given an ID to all elements of the Chessboard. Recursive function is a function that can call itself inside the body of function. The pseudocode for the recursive functions is as follows.

Let iMax=8 for maximum rows and columns in chess board

Let MaxCount= iMax \* iMax

Define a 2 dimensions array (iMax \* iMax) chessBoard

Create an array nextPosi with [-2, -2, -1, -1, 1, 1, 2, 2] to find next possible position in each row

Create an array nextPosj with [-1, 1, -2, 2, -2, 2, -1, 1] to find next possible position in each column

Declare fCount=0 to count the moves (when it is equal with iMa \* xiMax the loop is over)

Define a function named start\_calc(starti, startj) . we call this function with selected cell on chess board to start calculating from there

Fill all member of array chessboard with 0

Let fCount (our counter) be 0

Call function moveknight(starti, startj) to start.

Body of function moveknight(iim, jjm)

If fCount = MaxCount (it means just on cell is left)

Add 1 to fCount

Fill the chessboard[iim][jjm] with fCount

End if

If fCount >= MaxCount

Go out from function

Else

For ii=0 to ii< nextPosi.length and ii++

Find next row position with nexti = nextPosi[ii] + iim;

Find next column position with nextj = nextPosj[ii] + jjm;

If next position of row and column are between 0 and 7

If new position address is empty in chess board (chesBoard[nexti][nextj] == 0)

Add 1 to fCount

Fill chesBoard[iim][jjm] with fCount

if (fCount < MaxCount) {

call moveknight again with new position (nexti, nextj)

if (fCount >= MaxCount) (it means we already done)

go out from loop

In this way, we implemented this project. Implementation is a step that helps the team to realise the plans and activities described in the strategy paper. There was an issue in time management since some of the sections of the system was really difficult and time consuming.

5 TESTING

Testing is an important aspect of project development. It is done with the intent to find bugs in the system as well as validate and verify that the system meets the criteria of design specification. Testing is done throughout the project development. This chapter explains what kind of testing we did in our project. In addition, some issues faced, and their solution are listed in a tabular form along with further development of the project.

In this project development, a dynamic testing has been done which includes unit testing, integrating testing and system testing. We did unit testing to test each element of every webpage such as functions, classes, procedures and interfaces. In this testing process, individual source codes are tested to make sure it meets design and requirement specification and ensure that each individual parts are working correctly. It is done during the run-time of a function and code in HTML, CSS and JavaScript. Similarly, integration test is done to tests integration or interfaces between the modules or file system. There are seven different webpages in our web-based system. The main page and other six pages consisting mathematics functionalities. System testing was done to test the behaviour of the whole system as defined in the scope of project development. The table below illustrates some of the main issues faced during and after the project implementation.

*Table 1. Issues faced during and after the implementation of the project.*

|  |  |  |
| --- | --- | --- |
| **Function** | **Test Result** | **Issues and Suggestions** |
| Number system Conversions | Working nicely | Input validation is not clear. Textboxes in left are smaller and more empty space in left. |
|  |  |  |
| Number system outputs | Good functioning. | It would be nice if we put larger buttons with background color for creating and clearing table |
| Combinatorics | It is functional well | We can improve styling of page |
| Truth Table | Functioning | It would be better if we can calculate results for other expects too like P or Q or R, P and Q and R like that. |
| Chess | It is functioning well. | Need some explanation sometimes it shows 0 in every box. |
| Random numbers | It is functioning as required | It shows just number between 1 to 100 it would be better if user can input ranges of numbers from one number to other. |

There were numerous issues faced during or after the implementation of the project. Table 1 illustrates some of them. After finding these issues, we checked again the functions and codes to correct and modify the elements of the page.

For the further development of the project, we need to use more mathematics functionalities or tools targeting students. We can use more graphic design to attract the users since the graphic design is most important part in web designing.

6 CONCLUSIONS

A web-based mathematics tools is developed for the completion of Developer Basic skills course. This web-based tool provides a good platform for the students which can be useful for their studies. Although it’s a small project, it is the important part of our studies. This kind of project is useful in developing our practical knowledge and skills. Moreover, a team-project is very important to build up our skills in working with other team members.

In conclusion, this project has helped us in improving our skills in web-based project development. We now have a basic idea on planning, designing and developing a project. Furthermore, we have learnt what kinds of problems are created during or after the project development and what can be the solutions for them. We recommend that we should have more of this kind of project in our studies.

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**PROJECT PHASES APPENDIX 1**

A project includes several phases to be accomplished. After the discussion in our group we have listed the following phases including activities to be done during each phase. The table below shows the list of projects phases and work time estimates for each activity during each phase**.**

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