CERN SUMMER STUDENT PROGRAMME 2014

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Abstract

This report focuses on the work carried on by Antonis Voulgaridis in his CERN summer student programme which took place from 30th of June 2014 until 12th of September 2014. This internship was centered on the CERN School of Computing 2014 which took place in Braga, Portugal and the main subject of it was developing a web-based application for the final examination of the school, while helping preparing everything needed for the school.

Contents

1 Introduction **2**
- 1.1 Summer Student at CERN . . . 2
- 1.2 CERN School of Computing . . . 2
- 1.3 Project Description . . . 2

2 School Process **2**
- 2.1 Location of the School . . . 2
- 2.2 Generating login usernames and passwords . . . 3
- 2.3 Feedback Questionnaire . . . 3
- 2.4 Preparations for the final examination . . . 3

3 Technologies and application overview **3**
- 3.1 Creating the database schema . . . 3
  - 3.1.1 MySQL . . . 4
  - 3.1.2 PhpMyAdmin . . . 4
- 3.2 Web Application . . . 5
  - 3.2.1 HTML . . . 5
  - 3.2.2 PHP . . . 5
  - 3.2.3 CSS . . . 5

4 School Preparation **5**
- 4.1 Connecting the machines to servers at CERN . . . 6
- 4.2 Setting up the Operating System . . . 6
- 4.3 Assisting students . . . 6

5 Final look at the exam **6**

1 Introduction

1.1 Summer Student at CERN

Working at CERN is one of the most amazing experiences in someone's life considering the history and the "magic" around the place where physics, computing and engineering are combining in a perfect balance in order to answer some of the most fundamental questions of universe existence. Other than the magic containing in one of the birthplaces of science, working in an environment perfectly adapted to every employee's need, with more than adequate equipment, interesting projects and most of all really intelligent people, is a lifetime opportunity, especially as a first working experience of someone's career.

1.2 CERN School of Computing

Since the early 70s CERN has organized the CERN Schools of Computing, which are usually held during August/September and attract post-graduate students from important universities all over the world. Every year the school hosts lecturers from important universities and international organizations, teaching in depth topics related to computing (cryptography, data technologies, secure software development etc) and physics (data analysis, tools and technologies etc). This year, Minho University of Braga in Portugal was selected to host the school.

1.3 Project Description

Part of the CERN School of Computing is an examination, which every student needs to pass in order to get a CSC diploma along with ECTS credits recognized in many European universities from the hosting university. The main objective of the project was to create a PHP-based web application which the students run in order to take the exam in the final day of the school. The students can only take the exam once and they can login with the usernames and passwords that they use in order to login in the laboratory's PCs. These credentials were generated from a script that we created and were sent to each student 2 days before the beginning of the school. This year's examination contained 34 multiple choice questions with four possible answers each. Those questions were written from the lecturers one day before the examination and were imported to the exam's database in order to create the mainpage of the examination.

2 School Process

This section describes the whole process that takes place before, during and after every CERN School of Computing.

2.1 Location of the School

Every year CERN chooses a university in a member state's city, which will held the school of computing. The school takes place in different places across the CERN member states. This year Portugal was selected and the University of Minho in Braga hosted the School.

2.2 Generating login usernames and passwords

Shortly before the beginning of this year's CERN school of computing we generated random credentials that we sent via e-mail to all the participants in order to be able to log in to the desktops of the laboratory. Those credentials - username and password - were used by the students to login during the exercises, as well as at the login page of the web application of the final examination.

2.3 Feedback Questionnaire

At the beginning of the school we created a feedback questionnaire, using Google forms, which we provided to the students in order to get immediate feedback for every aspect of the school, including rating for each lecture and lecturer, exercises, excursions, social activities during the school and so on. The questionnaire was anonymous and the students should submit their feedback in order to help enrich the CSC experience for the next schools to come.

2.4 Preparations for the final examination

Every year at the very ending of each CSC the students have the opportunity to take an examination, in which if they pass they will obtain the CSC diploma of passing the exam. Along with this diploma there is the certificate of attendance, which every student gets at the end of the school, as a proof of participating in the school. To get this certificate a student has to follow every lecture, exercise and social activity during the school. Moreover, every participant gets ECTS credits for attending the school.

The final examination was scheduled to take place after the end of the lectures and the exercises. At first, we created one presentation with detailed instructions for the students who decided to take the exam. Then, considering the limited space inside the laboratory (61 participants for 31 desktops), with all the security concerns that might generates, and the limited time of testing the web application, the organizers decided the examination to be carried out paper-based. In order to do that, we designed the exam to be consisted of a question-sheet with all the multiple choice questions and their answers and one answer-sheet that the students should fill out in order to submit their answers. An empty answer-sheet was used in order to recognize correct answers by pattern.

Finally, we created an excel sheet that replaces all the actions of the database we created for the application. The functions needed were calculating each student's final score, the exam's correct answer distribution, the students that passed and failed the exam, each question's answer distribution etc. The data from the examination were submitted in the excel sheet manually and the results were published immediately, showed 95 percent success rate for the exam.

3 Technologies and application overview

3.1 Creating the database schema

At the beginning of the implementation of the application our concern was to create an application that will be used from the CSC not only for this year's

school but for the next years as well. So, we tried to organize the database structure of the exam in a simple way that would be easier for understanding and maintaining during and after the exam.

3.1.1 MySQL

We used MySQL and MySQL Workbench to create the tables and the dependencies needed before we start the basic implementation of the web application. First of all, we designed a database schema of 4 tables: **user, question, option, answer**. Each one of them is connected to the others, when needed, using foreign keys. So the basic structure is as follows:

- **user:** This table is used for the login of the students. It contains all the fields related to the students credentials as firstname (FName), lastname (LName), e-mail (e_mail), username (UserName), password (Password) and moreover an identification field (id_user), and a Boolean field (FinalSubmission), which default value is 0 and when the student press the submit button of the examination it becomes 1. When the value of the submit field in a unique id_user is 1 this student cannot login again as the examination can only be taken once from each student. Finally, there is a char field that stores the IP_Address of the PC that the unique student has logged in, in order to monitor the exact progress of each student using the data from the timestamp per each answer.

- **question:** This table stores the questions of the exam. Each question record contains a unique id (id_question) which identifies a question, a number for each question (no_question), which will be used when enumerating the questions on the main examination page and a varchar(100) field which will store the text of the question (q_text).

- **option:** This table stores all the available options for every question in the examination. This table is connected to the question table with the field id_question being used as a foreign key with one to many relationship. This way every question has many possible options (4) and with that field we can identify which are the possible options for every question. Moreover, every option record has a letter between A to D to identify the number of the possible answer for each question. There is also a field for the text of the option (o_text) and a Boolean identifier if the option is correct or not.

- **answer:** This table is being used for storing the answers of every student. It is connected to the PHP page of the main examination page and storing the following per each answer. Each answer record has a unique number (id_answer), a timestamp which indicates the exact timestamp per each answer submission of every unique student (user) and two foreign keys, id_user and id_option pointing at user and option tables respectively.

3.1.2 PhpMyAdmin

PhpMyAdmin was used to handle the administration of MySQL over the web application created for the exam. The web application uses phpMyAdmin to connect to the project's database called **csc2014** with the structure described in the section above.

3.2 Web Application

We decided to create a PHP-based web application because it would have the same principles with the CSC portal that was created in the previous years and it would have been closer to previous years implementations.

3.2.1 HTML

Every page we created has a basic HTML structure which allows us to use different technologies for the enrichment of the design of the page, such as CSS, and the overall behavior of it, such as JavaScript.

3.2.2 PHP

PHP is a server-side scripting language used widely for web development. It can be simply mixed with HTML code or generate HTML code after being interpreted and executed from a web server. As mentioned before PHP was selected as the basic language for the implementation of the final examination web form. We mostly used PHP as the back-end language of the project, as the main front-end was designed using pure HTML and CSS.

Some of the main actions that we used PHP for was connecting to the database and obtaining access to the necessary fields used for user identification in the login page and generating the exam from questions imported manually in the database. Moreover, we used PHP functions in order to get the answers of the student such as the written text in the text fields of the login as well as the on click submission of every answer on the multiple choice exam as one of the goals of the system was that the administrator of the exam could monitor the progress of every student during the exam, using the IP_address from each unique id_user and this user's answers timestamp.

Finally, using PHP we implemented the whole grading system of the exam and we calculated the results for all the participants using MySQL queries.

3.2.3 CSS

The CSS implementation was the same for the login and logout page, having a simple form in the center of the page in which the user submits the credentials (login) and then pressing a button gets the respective action. Both of those pages have the same header which is the logo of CERN School of Computing in Braga. On the other hand the implementation that concerned the mainpage of the examination was different, while in case of an exam the simplest the best for a participant to watch during an exam.

4 School Preparation

The beginning of the school was scheduled for the 24th of August so our team had to prepare everything including the laboratory in which the exercises and the examination will be held as well as every organizing detail with the lectures, the events etc. The organizing team had to travel to Braga some days before the arrival of the students (21st of August). The organizing team was the following:

Organizing team	
School Director	Alberto Pace
School Administrative Manager	Yasemin Hauser
Former Administrative Manager	Fabienne Baud-Lavigne
School Technical Manager	Giuseppe Lo Presti
Assistant to Technical Manager	Antonis Voulgaridis

4.1 Connecting the machines to servers at CERN

Setting up the computer environment of the school was the first thing that has to be done in order to get access to the CERN servers. This part was essential for the exercises that followed the lectures that required access to the CERN servers. We manually configured the connection for every desktop and tested the connection afterwards. We also copied an RSA key over all machines in order to have a password-less ssh connection.

4.2 Setting up the Operating System

The final thing needed to be done was to install the operating system in every desktop of the laboratory. Following the same model of previous years, a set of USB sticks was burnt with a preconfigured Linux (fedora 20) live image, which was then booted in all 31 nodes. Finally, we changed the boot order of each machine manually, in order for them to boot from the live image.

4.3 Assisting students

During the school and especially at the beginning of it, there were some questions about the login process, the modification of students' registration forms and in general about the use of the school's website and the remote servers at CERN. The technical department of the school solved those issues and tried to be as helpful as possible with the students during the exercises as well.

5 Final look at the exam

Let's take a final look at the exam through these screenshots (1, 2, 3)

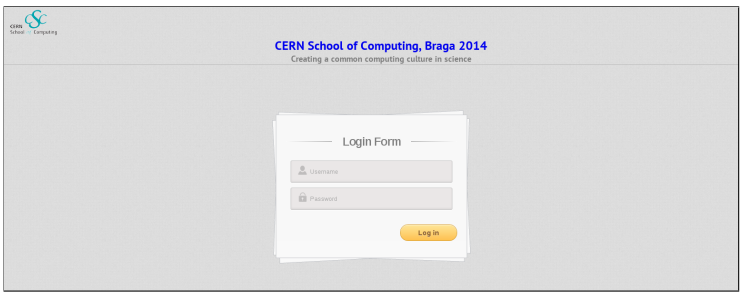


Figure 1: This is the index-login page of the web application. Each student has to use the credentials provided by the organizers in order to login to the examination.

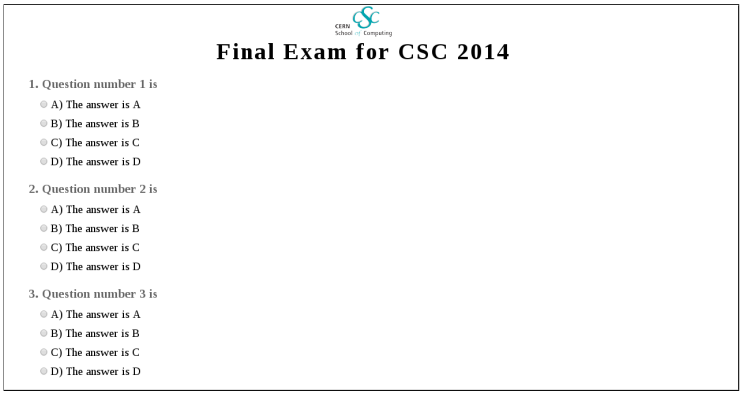


Figure 2: This is a sample of the mainpage of the exam. The questions are given to the organizers one day before the exam in order to fill the database with them and populate the exam.

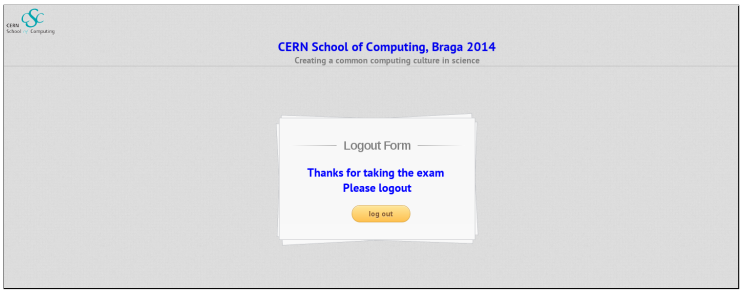


Figure 3: This is the logout page shown with the submission of the aswers of the exam. When the student logs out can not return to the submission page because the FinalSubmission field in the user table has changed on click and does not allow the same credentials to login again.