

PULSE - a Php Utility used in Laboratories for Student Evaluation

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In our University, during laboratory sessions a student is required to solve a complex problem by using the information provided within corresponding course and seminar. The solution usually consists in a computer program. The execution of this program as well as programming details are presented by each student to the person conducting a laboratory, which is to evaluate the level of understanding of each student. The existing learning management systems are mainly oriented on self-evaluation based on test-quizzes, communication between students (forums, chats) and work sharing. The individual character of the problems assigned to students as well as the time constraint of a laboratory sessions cannot accommodate such applications. In this context, I propose a new system called PULSE (a Php Utility used in Laboratories for Student Evaluation) which best serves our interests. Moreover, in our University laboratories are mandatory. Thus, an attendance record has to be maintained as well.

Keywords

Tools for e-learning, web-based system, learning management systems

1. Introduction

Most learning management systems [1-9] are very complex and mainly oriented on test-quizzes for evaluation. They are very well suited for individual study and on-line auto-evaluation on the information presented on a course. Within laboratory sessions, however, the work is more consistent and aims a complex comprehension of the proposed problems. The deadline for such solutions is one or two laboratory sessions. The end result is in general a computer program. The evaluation aims to quantify the level of understanding gained by a student as a result of solving the assigned problem and not the correctness of the program itself. This is because the solution submitted by a student can have a different source than his/hers own work (i.e. Internet, former students which had the same assignment, friends which 'help' without explaining so that the student understands thoroughly). Thus, the evaluation cannot be done on-line but as a discussion with each student, during which the misunderstood or unacknowledged concepts can still be clarified. In order to assimilate the knowledge required for solving the assignment, a student is provided with a theoretical documentation and a basic example. These are usually presented in an HTML format. Moreover, the person conducting the laboratory offers personal support (upon request) related to the subject of that specific laboratory.

The inconvenient I encountered during laboratory sessions was keeping a record on a notebook, a simple sheet of paper or in an electronic format (e.g. text file, html page, or Excel table) as it is usually done. That is because the notebook or even the electronic file can be misplaced and the students have no access to their personal records (in the Romanian universities, a student is allowed to attend the final examination only if he/she attended the laboratory sessions in proportion of 90% and has an average mark over 5).

Under these circumstances I wrote a new Php-based instrument with a web-interface with which both students and the teacher can interact. This web-interface can also be consulted by the students at any time. Another advantage is that this system can also gather student solutions (in our case these are programs as we are a computer science department) for each task they were assigned for every lab. The collected files can be easily accessed by the teacher.

This paper is structured as follows. Section 2 presents some of the existent learning management systems. Section 3 describes the system and the way it can be used by the students and the teacher. Implementation details are presented in Section 4. The future work on this system along with the conclusions is provided in Section 5.

2. Learning management systems

There is a large number (both open source and commercial) of learning management systems (LMSs). A comprehensive list of them is presented in [10].

2.1. Open source LMSs

Most open source LMSs are web-based, multi-language, cross-platform applications which support learning content management and tools for collaboration, communication, evaluation and assessment. Amongst them are:

- *ATutor* [1] which is mostly acknowledged for its accessibility features (i.e. for visually-impaired and disabled learners);
- *Claroline* [2] which allows hundreds of organizations worldwide (universities, schools, companies, associations) to create and administer courses and collaboration spaces through the web;
- *Dokeos* [3] which is based on per group management;
- *LIAS* [4] which is a complex LMS with multiple features: personal desktop, course management, cooperation (group management, file sharing), communication (internal messages, chat, forum, podcasting), test/assessment (quizzes), evaluation (survey, reporting and analysis) and administration.
- *Moodle* [5] which is mainly aimed to help educators create online courses. Its modular construction allows it to be extended by creating plugins for specific new functionality.
- *OLAT (Online Learning And Training)* [6] which is a Java-based component oriented application developed by the University of Zürich.

2.2. Commercial LMSs

Examples of commercial LMSs are:

- *Apex Learning* [7], which offers courses in mathematics, science, English studies, social studies, foreign languages (e.g. French, Spanish), and Advanced Placement;
- *Blackboard* [8], which is mainly focused on academic e-learning;
- *CLIX* [9], which offers different packages for enterprises, universities and schools.

All these LMSs are complex applications which contain many features, some of which (e.g. work sharing) do not serve our purpose. Therefore, PULSE is a LMS specialized only for supporting the activity during laboratory sessions.

3. PULSE

As most LMSs, PULSE is a web-based application in order to facilitate "anytime, any place, any pace" access to learning content. Its main characteristics are:

- Different type of users: students and professors
- Password-based authentication
- Personal profiles
- Laboratory Description: explain the objectives, methodology, laboratory material, assessment methods to the students, calendar of laboratory sessions
- Documentation per each laboratory session:
 - internal (description of required notions and basic example)
 - links to external sites
- Announcements: important messages for students
- Assignments manager
- General reports for professors

This instrument allows restricted access to individual information (see Figure 1). Every student in our university has a student account on a Linux server during the period of their study. Student authentication is made by using the login information (login name and password) from these accounts. A student can access PULSE only if he/she is a student (has a student account) and it is recorded in the database of the specified laboratory. Therefore, each student has his/her "PULSE account" in which to get information regarding only him/her.

This information includes:

- the recording of his/her attendances to the laboratory
- details for tasks assigned for each laboratory
- the mark representing the evaluation for each solved task and the reason for that mark (if any)

(a) Password required

| Lab | Descrierea Temei | Nr.Probleme | Nota | Obis. | Punct. |
|---|--|-------------|------|------------------------|--------|
| Lab 1 | Introducere in Java | 0 | | da | |
| Lab 2 | Programa Hello World | 1 | 10 | da | |
| Lab 3 | Exercitii suplimentare: Interfata user si grup | 4 | 10 | da | |
| Lab 4 | Interfata user | 1 | 10 | da | |
| Lab 5 | Programa Hello World | 1 | 10 | da | |
| Lab 6 | Interfata User: Programarea C de la baza la Operare | 1 | 8 | 0 saptamana intarziere | da |
| Lab 7 | Programa Hello | 1 | 10 | da | |
| Lab 8 | Comenzi de date si procesare: Interfata pentru program | 1 | 8 | 2 saptamana intarziere | da |
| Lab 9 | Comenzi de date si procesare: Interfata pentru program | 1 | 10 | da | |
| Lab 10 | Interfata de Operare Hello | 0 | | da | |
| Lab 11 | Interfata de Operare HelloWorld | 0 | | da | |
| Lab 12 | Programa HelloWorld | 0 | | da | |
| Lab 13 | Interfata de Operare HelloWorld | 0 | | da | |
| TOTAL PUNTELE & MEDIA NOTELOR DE LA LABORATOR | | | 9.67 | | 12/12 |
| EVALUAREA PRACTELOR | | | 9.5 | | |
| NOTA FINALĂ LABORATORUL & PRACTICĂ & SERVICIU | | | 9 | | |

(b) Details about a student

Figure 1 Restricted access to confidential information.

Along the individual information, a student can access within his/her PULSE account (as depicted in Figure 1(b)) also general information (i.e. laboratory description, documentation (see Figure 2), announcements) viewable by all students attending this laboratory.

A student can also interact with PULSE by sending mails to record his/her attendance to the current lab, or to send a task solution to be evaluated and marked. These e-mails are acknowledged automatically by PULSE which sends a confirmation reply e-mail. If such e-mails are send outside the time frame of a laboratory they will be ignored by PULSE.



(a) The theoretical presentation



(b) An example of a solution

Figure 2 A PULSE lesson.

The person conducting the lab or any other professor authenticates with the login name and password from the professor's server, after which he/she has access to all the individual information for each student attending this lab and can also get general reports consisting in:

- the alphabetical list of students (see Figure 3(a)),
- the list of students ordered by the average of their laboratory marks (see Figure 3(b)),
- the list of students ordered by the marks from the practical exam,
- the list of students ordered by the final mark.

| NrCrt | NUME | prez | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Media | Practic | Final | e-mail |
|-------|---------------------------|-------|----|-----|-----|-----|-----|----|----|----|---|----|----|----|----|-------|---------|-------|---------|
| 1 | Dabes Diana | 10/12 | 10 | 0 | 0 | 5 | 0 | 4 | | | | | | | | 5.90 | 6 | 4 | bd30019 |
| 2 | Bucbancu Hilda-Iulia | 12/12 | 10 | 10 | 10 | 10 | 9 | 10 | 8 | 10 | | | | | | 9.63 | 8.5 | 9 | bd30021 |
| 4 | Cioloșca Daniel-Alexandru | 12/12 | 5 | 5 | 7 | 7 | 5 | 7 | | | | | | | | 5 | 8 | 5 | cd30025 |
| 5 | Costea Doina-Stefania | 12/12 | 10 | 9 | 10 | 9 | 0 | 0 | 9 | | | | | | | 0.13 | 6 | 7 | cd30027 |
| 6 | Cupcea Beana | 8/12 | 6 | | | | | | | | | | | | | 2.5 | | | cd30033 |
| 7 | Dobritolu Ana-Maria | 11/12 | 8 | 6.5 | 6 | 5 | 6 | 7 | 6 | | | | | | | 5.91 | 5 | 3 | cd30744 |
| 8 | Dragomir Iulia-Elena | 12/12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | | | 9.88 | 10 | 10 | cd30823 |
| 9 | Gilgor Dorcel-Codrut | 12/12 | 10 | 9 | 9 | 9 | 9 | 10 | 10 | | | | | | | 9.5 | 8.25 | 9 | cd30040 |
| 11 | Boaie Stefan-Ioan | 10/12 | 10 | 8 | 10 | 7.5 | 6 | 9 | 9 | | | | | | | 7.59 | 8.75 | 7 | is30842 |
| 12 | Luhodachi Iliana-Maria | 11/12 | 10 | 8 | 10 | 9 | 9 | 9 | 10 | 10 | | | | | | 9.38 | 10 | 10 | is30848 |
| 14 | Mateas Adina | 11/12 | 10 | 9 | 10 | 9 | 9 | 9 | 9 | | | | | | | 9.25 | 10 | 9 | ma30050 |
| 15 | Merca Iuliana-Alexandru | 9/12 | 10 | 9 | 8 | 7 | 8 | 9 | | | | | | | | 8.88 | 5.25 | 7 | ma30051 |
| 16 | Miclans Monica-Georgiana | 12/12 | 10 | 10 | 9 | 10 | 9 | 10 | 9 | | | | | | | 9.5 | 8.25 | 9 | mm30052 |
| 17 | Miron Daniela-Maria | 11/12 | 10 | 8 | 10 | 10 | 7.5 | 8 | 9 | | | | | | | 8.09 | 7.5 | 8 | md30054 |
| 18 | Mihitean Ancuta-Silvia | 12/12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | | | 10 | 9.25 | 10 | ma30055 |
| 19 | Muresan Panda-Gabriela | 12/12 | 10 | 10 | 10 | 7 | 10 | 9 | 10 | | | | | | | 9.38 | 8 | 9 | mp30053 |
| 20 | Petrica Alexandra-Ioana | 11/12 | 9 | 7 | 8.5 | 6 | 8 | 7 | 9 | | | | | | | 8.19 | 6.75 | 8 | pa30058 |
| 21 | Racolta Augustina-Iliana | 9/12 | 6 | 6 | 9 | 5 | 7 | 8 | 9 | | | | | | | 7.13 | 7.5 | 5 | rp30079 |
| 22 | Rasa Petruta-Maria | 12/12 | 6 | 8 | 7 | 8 | 8 | 9 | | | | | | | | 6.25 | 5 | 7 | rs30076 |
| 23 | Rata Petruta-Maria | 12/12 | 6 | 8 | 7 | 8 | 8 | 9 | | | | | | | | 8.25 | 5 | 5 | rs30079 |
| 24 | Rat Razvan-Legian | 1/12 | | | | | | | | | | | | | | 2 | | | rp30053 |
| 25 | Rusu Maria-Florina | 12/12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | | | 9.88 | 10 | 10 | ms30080 |

(a) Alphabetical list of all students

| NrCrt | NUME | prez | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Media | Practic | Final | e-mail |
|-------|---------------------------|-------|----|-----|-----|-----|-----|----|----|----|---|----|----|----|----|-------|---------|-------|---------|
| 18 | Mihitean Ancuta-Silvia | 12/12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | | | | | | 10 | 9.25 | 10 | ma30055 |
| 25 | Rusu Maria-Florina | 12/12 | 10 | 10 | 10 | 10 | 9 | 10 | 10 | 10 | | | | | | 9.88 | 10 | 10 | ms30080 |
| 8 | Dragomir Iulia-Elena | 12/12 | 10 | 10 | 10 | 10 | 10 | 10 | 9 | 10 | | | | | | 9.88 | 10 | 10 | cd30823 |
| 2 | Bucbancu Hilda-Iulia | 12/12 | 10 | 10 | 10 | 10 | 9 | 10 | 8 | 10 | | | | | | 9.63 | 8.5 | 9 | bd30021 |
| 16 | Miclans Monica-Georgiana | 12/12 | 10 | 10 | 9 | 10 | 9 | 10 | 9 | 9 | | | | | | 9.5 | 8.25 | 9 | mm30052 |
| 9 | Gilgor Dorcel-Codrut | 12/12 | 10 | 9 | 9 | 9 | 9 | 10 | 10 | 10 | | | | | | 9.5 | 8.25 | 9 | cd30040 |
| 19 | Muresan Panda-Gabriela | 12/12 | 10 | 10 | 10 | 7 | 10 | 9 | 10 | | | | | | | 9.38 | 8 | 9 | mp30053 |
| 12 | Luhodachi Iliana-Maria | 12/12 | 10 | 8 | 10 | 9 | 9 | 9 | 10 | 10 | | | | | | 9.38 | 10 | 10 | is30848 |
| 14 | Mateas Adina | 11/12 | 10 | 9 | 10 | 9 | 9 | 9 | 9 | | | | | | | 9.25 | 10 | 9 | ma30050 |
| 26 | Samsodan Lavinia-Marcela | 12/12 | 8 | 9 | 8 | 8 | 8 | 8 | 8 | 9 | | | | | | 8.25 | 7 | 8 | is30881 |
| 20 | Petrica Alexandra-Ioana | 11/12 | 9 | 7 | 8.5 | 6 | 8 | 7 | 9 | | | | | | | 8.19 | 6.75 | 8 | pa30058 |
| 5 | Costea Doina-Stefania | 12/12 | 10 | 9 | 10 | 9 | 8 | 8 | 9 | | | | | | | 8.13 | 6 | 7 | cd30827 |
| 17 | Miron Daniela-Maria | 11/12 | 10 | 8 | 10 | 10 | 7.5 | 8 | 9 | | | | | | | 8.09 | 7.5 | 8 | md30054 |
| 11 | Boaie Stefan-Ioan | 10/12 | 10 | 8 | 10 | 7.5 | 6 | 9 | 9 | | | | | | | 7.69 | 8.75 | 7 | is30842 |
| 21 | Racolta Augustina-Iliana | 9/12 | 6 | 6 | 8 | 5 | 7 | 8 | 9 | | | | | | | 7.13 | 7.5 | 8 | ra30076 |
| 15 | Merca Iuliana-Alexandru | 9/12 | 10 | 9 | 8 | 7 | 8 | 9 | | | | | | | | 8.88 | 5.25 | 7 | ma30051 |
| 7 | Dobritolu Ana-Maria | 11/12 | 8 | 6.5 | 6 | 5 | 6 | 7 | 6 | | | | | | | 5.91 | 5 | 3 | cd30744 |
| 4 | Cioloșca Daniel-Alexandru | 12/12 | 5 | 5 | 7 | 7 | 5 | 7 | | | | | | | | 5 | 8 | 5 | cd30025 |
| 6 | Cupcea Beana | 8/12 | 6 | | | | | | | | | | | | | 2.5 | | | cd30033 |

(b) The list of students ordered by the average or their marks

Figure 3 Student lists - PULSE information for the person leading the lab.

At the beginning of each new lab, the person conducting the lab has to assign new tasks for each student. This is done automatically by PULSE, which determines the current lab based on the current date and assigns randomly one or more tasks corresponding to the current lab session to each student. The actual task selection is performed randomly from a database of 15 to 30 different tasks so that a task is to be assigned to as less students as possible.

During the lab, PULSE provides two lists for the person conducting the lab:

- the list of students sending attendance e-mails;
- the list of students sending e-mails with the completed task solutions.

These lists are used by the person conducting the lab in order to validate the actual attendees and mark the task solutions. After this step, PULSE assimilates (i.e. includes the new data to the current database) these new data, which then can be viewed on the web-based interface.

4. Implementation details

Like *Claroline* [2] and *Dokeos* [3], PULSE is written in [PHP](#), using [MySQL](#) as database backend.

From its user's point of view, PULSE has two distinct parts: the "visible" part and the "not-so-visible" part, which will be both detailed in the following subsections.

4.1. The "visible" part of PULSE

This part refers to the web-based interface, which is created, using PHP 5.1.6 [11], HTML 4.01 specifications [12], and Cascading Style Sheets, level 2 revision 1 (CSS 2.1) specifications [13], and contains the following components:

- Password-based authentication
- Personal profiles
- Laboratory description
- Documentation per each laboratory session
- Announcements
- Assignments manager
- General reports for professors

The implementations of two of these components will be detailed next. They are: the authentication process and the assignments manager. All the other components have straight-forward implementations.

4.1.1. The authentication method

As already mentioned in Section 3, each student has an user account on the student server. In the rest of this paper I will refer to this server with the generic name "*student.bbu.ro*". The code used for determining if a student entered a valid login name and password for this server is:

```
$ip_host = gethostbyname("student.bbu.ro");
$con = ftp_connect($ip_host) or die("Cannot connect to
student.bbu.ro!");
$log = ftp_login($con, $login, $pass);
ftp_close($con);
```

A connection is made to our server. If this connection is successful, the PHP command `ftp_login` tries to login to the server with the `$login` and `$pass`, which are the strings of characters introduced by a student in the form shown in Figure 1(a). This command returns `TRUE` upon success or `FALSE` when the login name or/and the password are incorrect. If the connection is unsuccessful, the execution of the code stops with the error message.

If the execution of this code results in `$log` being `TRUE` then the login name has to exist also in the student database (which contains students to attend that specific laboratory) in order for PULSE to display its personal profile.

4.1.2. The assignment manager

The assignment manager has two main tasks:

- to associate an assignment to each student for the current lab session.
- to present a random list of all the other assignments in case students want to solve them all.

The process of associating one assignment per student starts from an initial list of assignments extracted from the assignments database. One random assignment is selected for each student then, this assignment is deleted from the list. This process repeats until there are no more students. If the list of assignments is empty, the process continues with the initial list of assignments.

Along with the mandatory assignment for one laboratory session, a student has a list of optional assignments that can help him for a better preparation for the final and the practical exam. Each student has the optional assignments list ordered randomly. This random order is obtained based on the position of the mandatory assignment in the initial list. However, this list has to remain in the same order within different accesses from the same student. The following code shows how this was done:

```
// $val= ... the position of the mandatory assignment in the initial list;
$ind=$val; // counter evolving below $val
$NP=count($assignment); // the total number of assignments
$cont=$NP+1; // counter starting from the end of the list
echo '</ul><h5>Optional assignments</h5><ul>';
for($i=$val+1;$i<=$NP;$i++){ // $i - counter evolving above $val
    if(isset($assignment[$i])) {
        echo '<li>'.$assignment[$i]['text'];
        unset($assignment[$i]);
    }
    $ind--;
    if(isset($assignment[$ind])){
        echo '<li>'.$assignment[$ind]['text'];
        unset($assignment[$ind]);
    }
    elseif(isset($assignment[$cont])){
        echo '<li>'.$assignment[$cont]['text'];
        unset($assignment[$cont]);
        $cont--;
    }
}
// list all remaining assignments
foreach($assignment as $ind=>$val){
    echo '<li>'.$val['text'];
    unset($val);
}
```

4.2. The “not-so-visible” part of PULSE

This part refers to the interaction between PULSE and the students or the person conducting the lab. It is “not-so visible” because is made through e-mail or other required processing, but it is not invisible because its results can be viewed in the “visible” part of PULSE (i.e. the web interface).

4.2.1. Student interaction with PULSE

Student interactions with PULSE are made through e-mail. Thus, the procmail [14] utility is used to filter relevant mails automatically, so that when a student sends an attendance e-mail

or an e-mail with the documented solution, a reply will be sent automatically to acknowledge that his/hers e-mail will be taken into account. If the student does not receive any reply it means that:

- The e-mail has been sent outside the time limit of the lab
- There is no student recorded which corresponds with the sender ID
- The e-mail has not been received. This can occur due to an error to the sender or because of some technical issues connected to the network communication

A sample of procmail filtering instructions I wrote for PULSE is presented below:

```
1 # Preliminaries
2 FGREP=/bin/fgrep
3 FROM=`formail -x From:`
4 DATE=`formail -x Date:`
5 SUBJECT=`formail -x Subject:`
6 SEND_TO=`formail -rt -xTo:`
7 # Determining a time interval
8 TIME=`date +%H%M`
9 ISGT=`expr ${TIME} \> 0800`
10 ISLT=`expr ${TIME} \< 1000`
11 #setting log files
12 ATT_FILE=${HOME}/procmail/att_OS1.`date +%Y-%m-%d`
13 SOL_FILE=${HOME}/procmail/sol_OS1.`date +%Y-%m-%d`

14 :0
15 * ? (echo "$FROM" | $FGREP -i -f ${HOME}/PULSE/2006-2007/SO1/321)
16 * ? (echo "$DATE" | $FGREP -i "Mon")
17 * ISGT ?? ^^1^^
18 * ISLT ?? ^^1^^
19 {
20     :0
21     * > 2000
22     {

23         :0 c
24         ${HOME}/mail/UBB/SO1/321/solutions

25         :0 c
26         | echo "${FROM} solution 321 ${DATE}-${TIME} :
${SUBJECT}" >> ${SOL_FILE}

27         :0
28         | echo -e "This is an automatic reply to confirm
receiving the solution e-mail having the subject -${SUBJECT}-, sent on -
${DATE}-." | mail ${SEND_TO} -s "Confirm receiving solution: ${SUBJECT}
29     }

30     :0 E
31     {
32         :0 c
33         ${HOME}/mail/UBB/SO1/321/attendance
```

```

34             :0 c
35             | echo "${FROM} attendance 321 ${DATE}-${TIME}" >>
${PREZ_FILE}

36             :0
37             | echo -e " This is an automatic reply to confirm
receiving the attendance e-mail having the subject -${SUBJECT}-, sent on
-${DATE}-." | mail ${SEND_TO} -s "Confirm attendance: ${SUBJECT}
38             }
39         }
40 # Accept all the rest to your default mailbox
41 :0:
42 ${DEFAULT}

```

The actual filter is specified within the lines 15-18, where it selects all e-mails that are sent by a sender who has an ID which exist in the file `/${HOME}/PULSE/2006-2007/SO1/321` (line 15). The mail has to be sent on a Monday (line 16) and it has to be sent between 8 am and 10 am (lines 17-18). For such e-mails, if the content is larger than 2Ko (line 21) it means that it represents a solution to an assignment and three actions are performed:

- this mail is saved in another mail directory (see line 24)
- it is logged into a file that this mail was received (see line 26). Such file will be used to further processing.
- An automatic reply is send back to the sender to confirm the successful receiving of his e-mail (see line 28)

If the content is no larger than 2Ko, it means that the mail is an attendance mail and it is treated accordingly (see lines 32-37). All the other e-mails which do not verify the initial solutions (i.e. lines 15-18) are treated by default (see line 42).

4.2.2. Other required processing

The person conducting the lab interacts with PULSE by confirming the attendances and marking a student.

Technically, the attendances can be recorder automatically while students send attendance e-mails. However, the person conducting the laboratory has to make sure that all students that are sending attendances e-mail are physically present. The student database will be updated with the new attendance list.

A student will be marked only after “defending” his/her work and sending an e-mail with the requested documentation. After each evaluation, the person conducting the laboratory prepares an electronic *mark-list* containing for each evaluated student:

- the login ID,
- the number of the laboratory for which the solution was presented,
- the assessment mark,
- the motivation for this mark, if any, so that the student will know why he/she received that mark.

At the end of a lab, a PHP script processes the list with the students which have sent solution e-mails and the *mark-list* in order to do the required modification in the student database.

5. Conclusions

Teaching computer science in high schools and universities requires computer laboratory sessions. However, there is no generic tool for collecting and evaluating students work. Therefore, in this article we proposed an interactive instrument for student evaluation during laboratory sessions, called PULSE. The instrument has a PHP-based web interface that automatically records any interaction made by students or teacher during the laboratory session.

This system is small, robust and safe, being used by the author for the current academic semester during Operating Systems (1) and Collective Programming laboratories. Its predecessor, the SINE instrument presented in [15], was used successfully for three entire academic semesters during Operating Systems (1) and Computer Architecture laboratories, at the Faculty of Mathematics and Computer Science of "Babes-Bolyai" University, Cluj-Napoca, Romania. The disadvantage of latter compared with PULSE is that students were not able to authenticate in order to see their marks, and all the information a student could see was public, while the person conducting the lab could access private information (e.g. student marks) via http access.

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