CURRENT EXTENSIONS ON PULSE

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ABSTRACT. Using a learning management system (LMS) is a common practise nowadays. Such instruments are used in educational institutions to enhance and support the teaching act as well as in industry for training purposes. In a computer science department of an university such instrument tends to be a basic requirement. That is because not only it allows a better management of courses and a better communication between students and professors, but can also serve as a perfect instrument for presenting teaching related materials for computer science subjects.

During the years I have created and used several such instruments: a **S**ystem with **I**nteractive ack**N**owledgement and **E**valuation of students work during laboratory sessions (SINE) [8, 9], a **P**hp **U**tility used in **L**aboratories for **S**tudent **E**valuation (PULSE) [6], and PULSE Extended [7]. The aim of this paper is to present the current enhancements of PULSE.

1. INTRODUCTION

Most learning management systems [1, 2, 5, 10, 11, 13] come as a substitute of a human tutor being very well suited for individual study and on-line auto-evaluation based on test-quizzes. Within laboratory sessions, however, the work is more consistent and aims a complex comprehension of new concepts. The evaluation aims to quantify the level of understanding gained by a student as a result of solving the assigned problem. 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. Thus our systems comes as a complementary tool to the tutor's work.

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

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 OLAT (Online Learning And Training) [13] which is a Java-based component oriented application developed by the University of Zurich; Dokeos [5] which is based on per group management; and ILIAS [12] 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.

Examples of commercial LMSs are Apex Learning [1], which offers courses in mathematics, science, English studies, social studies, foreign languages (e.g. French, Spanish), and Advanced Placement; Blackboard [2], which is mainly focused on academic e-learning; and CLIX [11], which offers different packages for enterprizes, 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.

Similar applications to the one described in this paper and to its predecessors[1] have been developed and are used in our department. One such application is called *Assignment Management System (AMS)* [3, 4].

2. Background

SINE (a System with Interactive ackNowledgement and Evaluation of students work during laboratory sessions) [8, 9] was my previous instrument created for acknowledging and evaluating student work during laboratory sessions. It was a Linux-based instrument that recorded all e-mails sent by students (using procmail) and sending back automatic notification e-mails and changing correspondingly a web interface. Private information such as marks, observations and access to assignment sources were restricted by one password (the tutor's password).

This instrument was used, between 2005 and 2006, for four academic semesters during *Operating Systems*[2] and *Computer Architecture*[3] laboratories, at the Faculty of Mathematics and Computer Science of "Babes-Bolyai" University, Cluj-Napoca, Romania.

PULSE (a **P**hp **U**tility used in **L**aboratories for **S**tudent **E**valuation) [6] was the next instrument that replaced SINE. Its main feature consist in per

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[1]The predecessors of the application described in this paper are presented in Section 2.

[2]The number of students that used SINE between 2005 and 2006 during *Operating Systems* laboratories were around 220.

[3]Around 80 students used SINE between 2005 and 2006 during *Computer Architecture* laboratories.

user authentication. The student interface was the main focus of this first version of PULSE, offering details such as: marks, attendances, assignments, theoretical support for new concepts and applicability examples. Tutors interface was the list of students with their marks, attendances and final marks. These lists could be sorted alphabetically, by the average of laboratory marks, by marks of practical exam or by final mark. The tutor's web interface still lacked the administrative part of marking attendances and assignments, which were done by Linux shell scripts.

PULSE was successfully used, between 2007 and 2008, for three academic semesters during *Operating Systems*[4], *Collective Programming*[5] and *Computer Architecture*[6] laboratories and seminars, at the Faculty of Mathematics and Computer Science of "Babes-Bolyai" University, Cluj-Napoca, Romania.

PULSE extended [7] came as an "extension" to the first version of PULSE, focusing on the administrative part of it. Thus, the admin interface contains now a form that allows marking assignment solutions, and another form for marking student attendances to a laboratory session. It also allows creating custom average mark calculation and the input of final exam marks. All these are used in the automatic computation of the final mark. The admin can also post announcements/news in a RSS format in English and/or in Romanian.

Some improvements were done in the student interface as well. Breadcrumbs were added for better navigation. More details are presented in assignment and laboratory session. News are managed as RSS 2.0 feeds which can be accessed by all PULSE actors by viewing them within the PULSE environment, or subscribing to them by using any convenient reader.

This new version of PULSE was used between 2008 and 2009 during *Web Programming*[7] and *Operating Systems*[8] laboratories, seminars and lectures, at the Faculty of Mathematics and Computer Science of "Babes-Bolyai" University, Cluj-Napoca, Romania.

This paper presents the new improvements to this instrument (that we continue to call PULSE) which were made in the course of the last academic year (i.e., 2009-2010).

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[4]The number of students that used PULSE between 2007 and 2008 during *Operating Systems* laboratories were around 60.

[5]A subgroup (i.e., around 15 students) used PULSE between 2007 and 2008 during *Collective Programming* laboratories.

[6]Around 60 students used PULSE between 2007 and 2008 during *Computer Architecture* laboratories and seminars.

[7]The number of students that used PULSE extended between 2008 and 2009 during *Web Programming* laboratories were around 80.

[8]Both sections of *Mathematics and Computer Science* and *Applied Mathematics* (i.e., around 60 students) used PULSE extended between 2008 and 2009 for *Operating Systems* laboratories, seminars and lectures.

3. New improvements on PULSE

Along with the new layout and the new graphical design, PULSE got improved on all three interfaces corresponding to the tree types of actors. As in the previous versions, there are three types of actors using PULSE:

Students to attend the lab: They are the students that are assigned to attend the specific lecture, seminar and/or laboratory.

Tutors: Persons that are related to that specific lecture, seminar and/or laboratory but they are not students or the lecturer and/or the lab instructor

The admin: Is the lecturer and/or the lab instructor, or the person conducting the lecture, seminar and/or laboratory.

3.1. **The student interface of PULSE.** As depicted in Figure 1, the new layout of PULSE is more compact in design than the previous versions being better viewed on any web browser and any devices from a desktop computer to a mobile device such as a smartphone or tablet PC.

This new layout also contains a 2-layer menu. The first entry on the menu is a shortcut to the student information (e.g., marks, assignments, attendances). The second entry groups the additional information regarding the current subject. The current subject can be changed by using the next entry of the main menu. The forth entry contains specific information regarding that student. The last two entries are a link to the parent page and the logout button.

The new additions in the student interface, highlighted in Figure 1, are:

- Lectures. The second entry on the first submenu leads to a page that contains information and theoretical support for all lectures (held or to be held).
- Subject change. The third entry in the main menu contains a submenu automatically generated by the system which contains all subjects that the current student attended. After selecting one of the academic years, this submenu expands with the actual subjects studied by him/her that year. Selecting one of those subjects results in accessing the information related only to that specific year/subject.
- Lecture papers. The last entry in the last submenu leads to a page containing information about the test papers given during lecture sessions.

Part of the "Lecture" page is presented in Figure 2 and contains in this case the theoretical support for that lecture:

(1) the slides that can be viewed as a .pdf file;
(2) the slides that can be viewed as a webpage;

FIGURE 1. The student interface of PULSE

(3) another link that leads to a webpage containing lecture paper require-
ments and solutions if any such test was given during that lecture.

The "Lecture paper" page is a webpage containing information about lec-
ture papers results/marks for the current student. First, there are presented
general information regarding all given lecture papers, such as:

- the number of lecture papers that were given up to this moment,
- the number of lecture papers that were taken by the current student,
- the average mark obtained by the student,

FIGURE 2. The page containing information about lectures

- how this can help him to the final mark.

Next, for each lecture paper, the student is presented with more information:

- the date in which the lecture paper was given;
- a link to the webpage containing lecture paper requirements and solutions;
- his/her mark, or the message "You did not take this lecture paper!" if no mark exists;
- a *graphical distribution*[9] of marks obtained by students which took the lecture paper.

The graphical distribution of marks helps the student to observe were he/she stands in the case in which he/she took the lecture paper. Otherwise, he/she can see how the other students were able to solve the issues that they were presented with.

3.2. **The tutor interface of PULSE.** Figure 3 presents the menu in the tutor interface of PULSE. The main additions here are somehow similar to the ones in the student interface: the lecture button, the capability of changing the subject tutored by the logged-in person, and a "list" of lecture papers.

FIGURE 3. The menu in the tutor interface of PULSE

[9]This *graphical distribution* is similar with the one presented at the bottom of Figure 4.

The most important improvement here is the page containing the list of lecture papers as presented in Figure 4.

Grupa	Nume	30.03	13.04	20.04	27.04	04.05	11.05	25.05	Nr. Lucrari	Media	Puncte
321	Brindusan Adela-Ioana	6		7		8	8		4	7.67	1.92
321	Chender Oana-Liliana	7		8	10	7.5	9		5	9	2.25
321	Cozma Melania-Iulia	7		8	10	8	10	9	6	9.67	2.42
888	Chioar Ioan-Augustin		10	5	10		9.90		4	9.97	2.49
888	Ginsca Oana			3.75	8				2	3.92	0.98
27 studenti din 63:		17	7	15	14	18	21	10			
		7.09	8.86	7.58	9.86	8.54	8.99	8.08	4 L/St	7.78	1.95

LUCRAREA DE LA CURSUL 13 DIN DATA DE 25.05.2010

Vedeti enunturile, rezolvarile si punctajul la sectiunea de CURSURI.

Distributia notelor a fost:

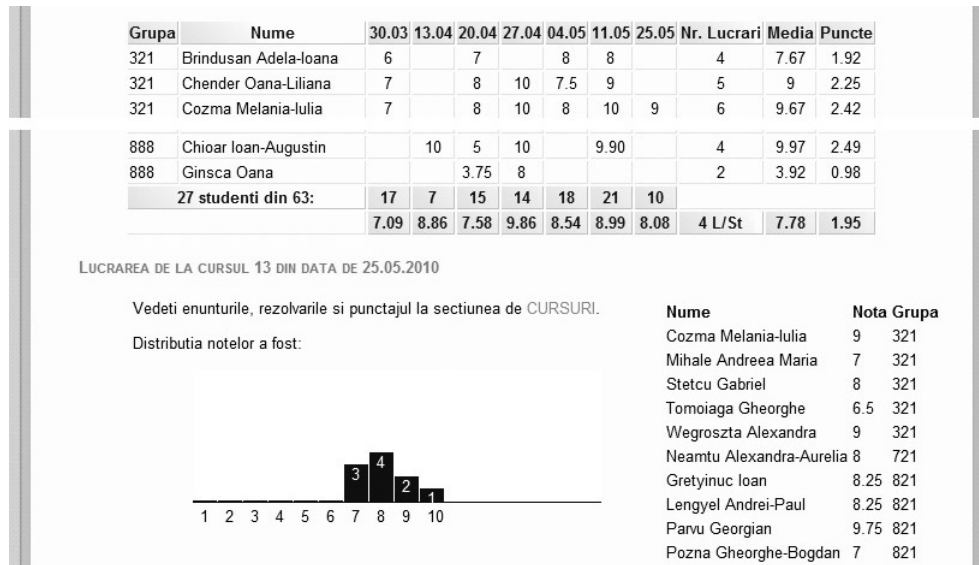| Nume	Nota	Grupa
Cozma Melania-Iulia	9	321
Mihale Andreea Maria	7	321
Stetcu Gabriel	8	321
Tomoiaga Gheorghe	6.5	321
Wegroszta Alexandra	9	321
Neamtu Alexandra-Aurelia	8	721
Gretyinuc Ioan	8.25	821
Lengyel Andrei-Paul	8.25	821
Parvu Georgian	9.75	821
Pozna Gheorghe-Bogdan	7	821

FIGURE 4. Sections from the webpage containing details about the lecture papers

The first element on this webpage is a table containing all the students that took at least one lecture paper. The information in the columns of this table are: the group, the name of the student, the mark for each[10] lecture paper given by that student, the number of lecture papers taken by the student, the average mark, and the points for final mark. The last two lines on this table contain:

- the number of students that took at least one lecture paper and the number of all students registered for the current subject,
- the number of students and the average mark for each lecture paper,
- the average number of lecture papers taken per student,
- the average of students average marks,
- and the average of the points obtained.

Then, for each lecture paper, there is presented the same graphical distribution of marks obtained by students which took the lecture paper as in the student case, and the list of students that took that lecture paper along with their marks.

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[10]There is a column for each lecture paper. Each cell of those columns contains the corresponding mark.

3.3. **The admin interface of PULSE.** The admin interface of PULSE contains all the information in the tutor interface. In addition it also contains the administrative capabilities. As shown in Figure 5, the main difference from the two previous interface is the "Add Assignments" entry from the last submenu.

FIGURE 5. The menu in the admin interface of PULSE

In each laboratory session a new concept can be introduced. In order to assimilate the new concepts, students are given assignments. Each concept has a pool of assignments from which one (or more) are randomly chosen for each student. The pool of assignments for each new concept are stored in distinct XML files. PULSE detects the existence of such file and creates the page presented in Figure 6, where are listed all laboratory sessions along with the new concepts they introduce and the number of assignments existing in the pool for that concept.

The penultimate column of the table presented here contains the number of students to which an assignment was already assigned. The actual assignment is performed when there is a pool of assignments[11] and not all student are assigned with one[12]. In this situation the last column contains a '+' sign. If this sign is selected the students that do not have an assignment are automatically assigned a randomly chosen one from the pool.

The content in the previous two columns can also be selected if that number is greater than zero. The links in the "Assig" column lead to webpages that contain corresponding assignment pools (i.e., the requirements). The links in the penultimate column lead to webpages that present the actual assignments of elements from the corresponding pool to each student.

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[11]If the number in the "Assig" column is greater than zero.

[12]This is the case when the number in the penultimate column is less than *the total number of students* registered for the current subject. *The total number of students* registered for the current subject is presented in the table head of this column.

	Lab	Week	Assig	Set/63	Add
1	Comenzi Unix de lucrul cu fisiere Comenzi Unix de lucru cu fisiere	22.02 - 26.02	0	0	
2	Comunicatii: ftp, mail, telnet, ssh Comunicatii: ftp, mail, telnet, ssh, XWindow	01.03 - 05.03	0	0	
3	Programe Shell (I) Programe Shell (I)	08.03 - 12.03	14	63	
4	Utilitarele sed si grep Utilitarele sed si grep	15.03 - 19.03	24	63	
5	Utilitarul awk Utilitarul awk	22.03 - 26.03	15	63	
6	Programe Shell (II) Programe Shell (II)	29.03 - 02.04	16	63	
7	Programe C de lucru cu fisiere Unix Programe C de lucru cu fisiere Unix	12.04 - 16.04	16	63	
8	Probleme client-server	19.04 - 23.04	0	0	
9	Procese Procese Unix (I)	26.04 - 30.04	13	63	
10	Comunicaţii între procese Unix: pipe Blocari de fisiere	03.05 - 07.05	21	63	
11	Comunicaţii între procese Unix: FIFO Comunicatii intre procese: pipe, FIFO	10.05 - 14.05	21	63	
12	Blocări de fişiere Unix (facultativ) Procese Unix (II)	17.05 - 21.05	7	63	
13	Incheierea activitatii de laborator	24.05 - 28.05	0	0	
14	Examen practic	31.05 - 04.06	0	0	

FIGURE 6. Add assignments in the admin interface

3.4. **The feedback interface of PULSE.** Another new element in PULSE is its feedback interface which can be accessed before and/or after login. General or specific information about PULSE can be inserted here.

General information refers to the level of satisfaction that PULSE offers to its users, while specific information refers to the notification of a bug, observations regarding the content of the site, suggestions, and so on. Sending the feedback generates an e-mail that is sent to the administrator while also retaining that information in a database for further processing.

4. CONCLUSIONS

The current version of PULSE as well as its predecessors are created with the aim to support any professor that uses them to provide high quality education for a large number of students[13] in a field of rapid changes and practical aspects. Therefore these instruments were successfully used but constantly monitored and adapted to the needs of their users.

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[13]"Babes-Bolyai" University (BBU) is offering more that hundred majors and has a student population of over 50 000.

The future work on PULSE consists in extending its capabilities by implementing an editor for new concepts and editing and running test-quizzes. Moreover, due to the fact that we used in parallel more such applications (e.g., PULSE and AMS) in our department, a new such instrument is developed. It is built by students and professors and intends to have all advantages of existing tools.

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