

Online Collaborative Education Management Tool

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Abstract

In a multicultural society where physical boundaries have vanished, quick access to resources is more a need than a privilege. E-Learning becomes a much wider field than electronic learning inside a classroom, its accent moving gradually to social networks where intercommunication becomes critical. In addition, the current tools for developing web applications have greatly improved in the last few years, and the developers of e-Learning platforms must make proper use of them and develop web 2.0 environments efficiently to meet teachers' and learners' needs. Education Management Tool (EDM) represents our previously started project – Testing Assistant – extended with new learning and student management modules, developed with the purpose of optimizing the whole process of teaching / learning / testing. EDM promotes collaboration and professional development. Through real time collaborative programming and application development, EDM allows geographically distributed students to contribute concurrently and collaboratively by working on the same application: designing, programming, debugging, testing and documenting. Using general knowledge about social networks through a collaborative programming manner, the users of EDM will have as target not only accelerating problem resolution processes, but will substantially improve the quality of the software applications that they build. We also extend the interactive teaching section by including lessons about algorithms and programming techniques. We will focus on Divide and Conquer and Greedy algorithms, presenting them with the help of interactive Flash files as part of the lessons. Such visual presentation helps the teacher to better explain and the student to easier understand how algorithms work.

Keywords: e-Learning, collaborative, web application, programming techniques

Introduction

The modern and continuous evolution of Information Technology and Communications Systems, the Internet's expansion, has revolutionized the traditional learning system leading to its reorganization. Its purpose is to provide learning opportunities for anyone who is concerned in its long life professional evolution, irrespective of age, sex, geographic area, financial status. In addition, the role of teachers is changing. They should inculcate the lifelong learning concept in the formal teachings of students. Keeping students satisfied is a tough job that requires constant improvement in the teaching / learning / testing process. This should be realized through an attractive and interactive manner based on modern techniques and tools. Using simulators, different software tools, multimedia technology and formative interaction in teaching act became a

real necessity. However, the research studies indicate that the elaboration and supply of educational software are dissatisfactory for important segment of teachers, the biggest impediment being the software acquisition cost problem. Thus, visual applications developed by teachers, individually or through collaborative projects, with and for students, are really valuable and welcomed (Shen and Sun, 2000). In this paper we present Education Management Tool (EDM), our visual and interactive e-Learning solution, dedicated for teaching/learning/testing different computer science topics. We also extend the interactive lesson section, consisting of digital logic circuits in our previous work (Anghel et al, 2010), by including interactive lessons about algorithms and programming techniques. We will focus on Divide and Conquer and Greedy algorithms, presenting them with the help of interactive Flash files as part of the lessons. Such visual presentation helps the teacher to better explain and the student to easier understand how a certain algorithm works, avoiding thus additional descriptive explanatory effort. Our approach is motivated since we teach algorithms and programming techniques but, more than that, we consider this topic with a high degree of difficulty, especially in high school, requiring a more in depth explanation of both theoretical notions and applications that accompany these notions. Besides that, it is free and easy to use, and helps to improve quality and performance in e-Learning, providing the following advantages: flexibility, extensibility, interactivity.

The organization of the rest of this paper is as follows. In section 2 we review the Related Work in software educational domain. Section 3 describes the general structure of EDM tool, whereas section 4 presents what's new in our application. Section 5 presents how we extended the interactive teaching section with lessons about algorithms and programming techniques. Finally, section 6 suggests directions for future works and concludes the paper.

Related work

International e-Learning platforms such as IBM Education Assistant (<http://publib.boulder.ibm.com/infocenter/ieduasst/stgv1r0/index.jsp>), Cisco Academies (<http://www.cisco.com/web/learning/netacad/index.html>) and Oracle (<https://academy.oracle.com/>) besides teaching modules, include an evaluation component based on quizzes, partial and final exams, and practice exam in Flash. Although the important names from computer science, Intel (<http://www.intel.com/education/highered/modelcurriculum.htm>), Hewlett-Packard (<http://www.hp.com/education/>), beside the formerly mentioned IBM, Oracle and Cisco, provide different courses (operating systems, microprocessors, parallel programming, business analysis, project management, database design and programming, etc.), the cost of these courses ranges from 500 Dollars to 2000 Dollars. Therefore, EDM – a free software tool – is dedicated for students and teachers from academia especially belonging to “Samuel von Brukenthal” National College and “Lucian Blaga” University, both from Sibiu, eliminating the cost impediment and providing learning opportunities for everyone.

Education Management Tool. General Structure

The EDM project started in the autumn of 2008, first as a stand-alone application to be installed on every PC in the laboratory with the purpose of testing students and delivering results after examination. With time, it grew larger and became a web application that is capable of performing the main tasks provided by more popular e-Learning platforms, having the advantage of being accessible from anywhere and from any type of computing system device, not being restricted to the laboratory.

Consisting of three modules, EDM is designed to meet the basic requirements of an e-Learning environment: learning, testing and management. The learning component consists of courses,

developed by teachers in a manner similar to *Google Docs* and which are easily accessible by students. The courses may contain images and flash movies. The testing module consists of exams, customized and posted by the teacher. When he/she activates it, the students may enter the exam, answer the questions and receive feedback after examination. The management part offers the teacher the ability to manage student grades and presence at courses together with a communication system for delivering messages to specific persons / groups.

What is new in EDM?

Education Management Tool is continuously developed and improved with the purpose of making it more feasible for the everyday needs of teachers and students. New modules have been added to extend the functionality that was already present in the system (Anghel et al, 2010). The system now has a statistics module for delivering relevant information to administrators and teachers. Also, we have implemented a notification and communication system and we added import and export features. Besides that, the visual appearance has been improved together with a brand-new homepage (<http://edmtool.gotdns.com/>).

Statistics module

For a good overview of the data that is stored in any database, charts are the best solution available. They can comprise large sets of data which otherwise would not be easily readable, mostly for taking conclusions or viewing certain trends within the data. As for the current development state, the system can show statistical information in form of charts where statistics are not only a feature, but also a necessity.

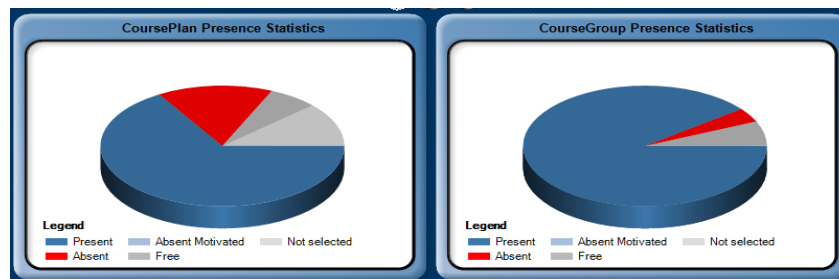


Figure 1. Statistics for presence

In this way, within the presence module, the professor may see the proportions of certain presence markers (present, absent, absent motivated, etc.) of his/her student groups. Thus, teachers can visualize which groups of students show the most interest to their courses. Another important statistical measurement to be implemented is presence evolution in time, displaying how student interest increases/decreases from course to course, informing the teacher about which courses were interesting or if a positive student interest trend could be induced to certain courses.

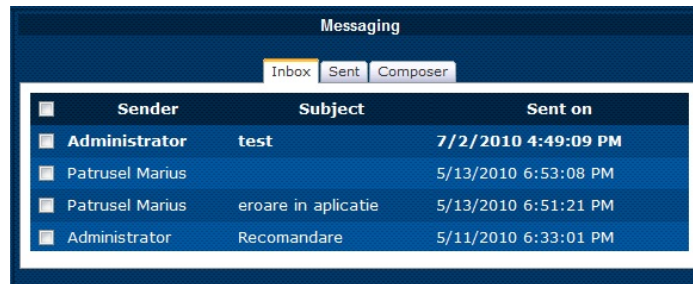
Although statistics are important for teachers to get a grasp about what is happening to their courses, they are significantly more important for administrators. In future, we will develop a platform for displaying and comparing statistics for each teacher to be visualized by the administrative staff, statistics that can indicate student interest for the certain courses, standard deviation of marks and other relevant information.

Groups module

A new management module called *Groups* has been added for managing student groups and customizing them for the needs of each university. By customizing we mean that each university may have its own internal way of managing groups of students. In the “Lucian Blaga” University of Sibiu, groups are managed as following: *abc/d*, where *a* is a marker for specialization, *b* is the year number, *c* is the index of the group and *d* is the index of the semigroup. Each university may have its own distinct markers for managing groups of students, requiring flexibility in defining them. In EDM, each *group* is subordinated to a specialization and a year, and the name of the group is inserted inside a text field, thus supporting any naming convention.

Communication module

For ensuring that the system supports peer-to-peer communication, we have developed a module that contains the basic principles of an *e-mail* system. The users can read, write and delete messages to any other user within the system, post attachments and view read/unread messages. Auto-complete features are present as well, offering suggestions as the user types the name of the receiver. With time, this will be extended with capabilities of choosing receiver groups (e.g. sending notification messages to students that study a certain subject) and more advanced management functionality for received/sent messages (customized folders).



Messaging		
Inbox Sent Composer		
Sender	Subject	Sent on
Administrator	test	7/2/2010 4:49:09 PM
Patrusel Marius		5/13/2010 6:53:08 PM
Patrusel Marius	eroare in aplicatie	5/13/2010 6:51:21 PM
Administrator	Recomandare	5/11/2010 6:33:01 PM

Figure 2. The communication module

Notification system

The first step in transforming the application in a real-time communication and notification system was to introduce notifications onto each user’s login. Administrators have the privilege to add/edit/delete notifications, while all other user types can only visualize them. These notifications are targeted to be used for general, system messages, for informing the whole network of users who use the system. If the users need to send notifications to a subset of users, they should use the communication module, detailed above. Thus, when students log into their Education Management Tool account, they will be informed about new lessons introduced by professors or other interesting, important and useful information (newsletters, news and events, conference announcements, exam schedules, etc).

Presence

Presence management has been enhanced to be more user-friendly (in the current version, the professor is able to edit the presence status of each student in an interactive crosstab).

CoursePlan

Filter by Group: 231/1

Legend p: Present a: Absent m: Absent Motivated f: Free -: Not selected

New LessonPlans

LessonPlans	01.03.2010	08.03.2010	15.03.2010	22.03.2010	29.03.2010	05.04.2010	12.04.2010	19.04.2010	26.04.2010	03.05.2010	10.05.2010	17.05.2010
Course students												
Balasete Ionut Cristian	p	p	p	p	p	f	p	p	p	p	p	p
Bancioiu Ioan Camil	p	p	p	p	p	f	a	p	p	p	p	p

Figure 3. Presence management module

Import and Export

The importing technique is very useful in any piece of software when users need to enter large sets of data at once. It has the advantage of not being restricted to completing web forms one at a time, but by entering data in bulk mode. In our case it is very useful for student import as an alternative to entering students one by one. The system permits import from *csv* files, which can be created and edited using any version of Microsoft Excel. The format is simple, in form of a spreadsheet, where columns represent fields and each row represents a student. The user downloads a sample *csv* file, where he/she inserts the needed students, then uploads it back to the server. The system checks the file to make sure it corresponds to the given format and if the data inside it is valid (e.g. no duplicate usernames were inserted for students). If everything is ok, the user is shown a preview and has the option of accepting the inserted data, confirming that the database may be updated with the new students.

Exams

Exam Evaluation

1 → [Click here to download exported pdf file](#)

Students & Results

Details	Student Name	Student Group	Exam Status	Correction Status	Mark
Is	Patrusel Marius	224/2	Finalized	Not Corrected	10
Is	Anghel I.D. Traian	224/2	Finalized	Not Corrected	7.24

Figure 4. Exporting to PDF

Exporting in a web application is as crucial as importing, because the user may need to store some of the data physically on his/her computer in form of files for future reference or with the purpose of printing. Because printing a web page will also print the menu, the title of the application, the log out button, etc., the teacher may only want to print the data he/she needs. This is why the system offers an “*export to pdf*” option when viewing exam results for a group of students, being useful in situations where the teacher needs to take out the results from EDM and use them for external purposes (e.g. lists of marks that are handed out to the secretaries of the university after exam correction, the presence situation on each course / laboratory).

E-Learning tools centered on algorithms and programming techniques

In this paper we extend the lesson section, consisting of digital logic circuits (Anghel et al, 2010), by including interactive lessons about algorithms and programming techniques. We will focus on *Divide and Conquer* and *Greedy* algorithms, presenting them with the help of interactive Flash files as part of the lessons. Such visual presentation helps the teacher to better explain and the

student to easier understand how a certain algorithm works, thus avoiding additional descriptive explanatory effort.

Divide and conquer technique

The Divide-and-Conquer technique is an important concept in computer science. This algorithm design method breaks down a problem into two or more sub-problems of the same (or related) type which are smaller in size, easier to solve, and combines their results to give the final solution to the original problem (Cormen et al, 2009). An important such algorithm solves the *Towers of Hanoi* problem, proposed by Edouard Lucas. It consists of three rods and a number of disks of different sizes which are initially on one of the rods in descending order. The objective is to move the disks to another rod, obeying the following rules: (1) Only one disk, the upper one, may be moved at one time from a rod onto another, and (2) No disk may be placed over a smaller disk.

To move n disks from A (*source*) to C (*destination*) through B (*auxiliary*):

- Move $n-1$ disks from A to B through C;
- Move one (the last) disk from A to C;
- Move $n-1$ disks from B to C through A.
-

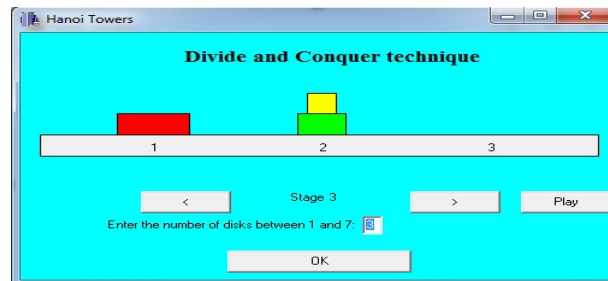


Figure 5. Towers of Hanoi problem

The recursive algorithm is the following:

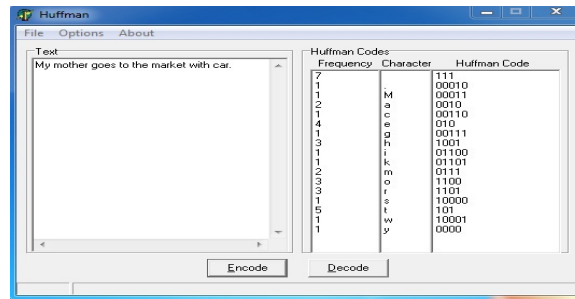
```
HANOI (n, A, C, B)
  if n ≥ 1 then
    HANOI (n-1, A, B, C)
    PRINT (A → C)
    HANOI (n-1, B, C, A)
```

The algorithm can be visually followed step by step with a certain number of disks introduced by the user (see Figure 5).

Greedy Algorithms

The Greedy algorithms make the locally optimal choice at each stage with the hope of finding the global optimum (Cormen et al, 2009). These algorithms are usually fast and provide a good solution, but not always the optimal one. An important Greedy algorithm is Huffman coding, very useful for lossless data compression. Depending on file characteristics to be compressed space saving is between 20% and 90%. The main aim of the algorithm is to use an optimal way to represent each character as a single binary string. The idea is to use variable-length codes based on

the estimated occurrence probability of each symbol: short codes for frequent symbols and longer codes for the rare ones. The optimal encoding, introduced by David A. Huffman, is represented through a frequency-sorted binary tree (similar with that from Figure 7).



Frequency	Character	Huffman Code
7	.	1111
1	!	00010
1	,"	00011
2	M	0010
1	a	00110
1	c	001110
4	e	010
1	g	00111
1	h	1001
3	i	01100
1	k	01101
1	s	0111
2	m	1100
3	o	1101
3	r	10000
1	t	101
5	l	10001
1	w	101
1	y	0000

Figure 6. Huffman coding

The construction of the Huffman tree consists of the following steps:

- (1) Start with as many leaves as symbols, having as initial weights their frequencies.
- (2) Enqueue all leaf nodes into the queue.
- (3) While there is more than one tree in the queue:
 - (3.1) Dequeue the two trees (initially leaves) with the lowest weights.
 - (3.2) Enqueue a new tree with the subtrees selected at step 3.1 as children and the sum of their weights as the new weight.
- (4) In the final tree the leaves are the symbols and the binary code of each symbol is the path from the root to the corresponding leaf, representing a movement to the left child with 0 and a movement to the right child with 1.
- (5)

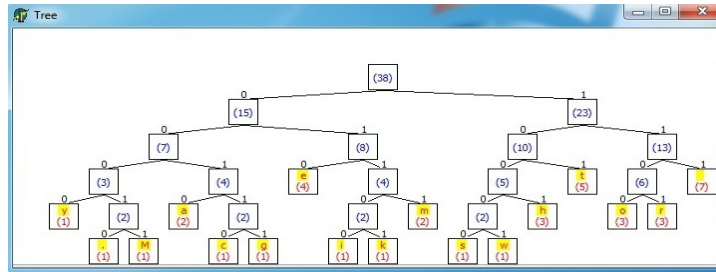


Figure 7. Visualization of Huffman tree

The included Flash file allows to generate the Huffman codes for a certain text and to visually follow the corresponding Huffman tree. In this example we encoded the text “*My mother goes to the market with car.*” As it can be observed, the most frequent characters, like space, have the shortest codes, whereas the rarest characters, like dot, have the longest codes. The interactive Flash file allows also the reverse operation: decoding binary sequences.

Conclusions and further work

Considering that the future in education will be based mainly on the freedom of choosing an accessible way of studying according to the necessities of each person, which is to eliminate the

physical and mental borders, the development of e-Learning platform certainly becomes a priority of the modern education. The new technologies allow the full documentation of those interested in any studying field, without being necessary to leave their houses, by consulting virtual libraries which have elaborated courses and electronic materials accessible remotely in any corner of the world.

In this paper, we present new modules added to our EDM tool that extend functionality of the e-Learning system. We have developed modules for managing statistics and groups of students, and extended other modules with importing and exporting capabilities. Besides that, the main page has been enhanced to present slideshows which contain general presentations of the system, snapshots, related articles, etc. Currently, we are developing components for supporting collaborative assignments for students which will be interpreted and quantified by professors. In future phases of the project, we will extend the system with new modules for more advanced communication (RSS feeds, personal blogs, forum, wikis, podcasts and other powerful web tools for learning). Improving the application security by approaching more sophisticated encryption algorithms such as *md5* or *sha-1* are on our wish list as well, together with more rigorous scalability testing.

The third-party lessons want to be used by students in order to assimilate the notions connected with the programming techniques, to create some new applications which are to be integrated into the e-Learning platform, and also to test the acquired knowledge. The didactic materials can be further extended, so that they cover other scientific fields too. We have sought an interactive implementation, based on visual elements in programming techniques, wanting to improve the didactic process based on blackboard and chalk only. The dynamics of the area imposes the planning of teaching approach adapted to the continuous evolution/formation of students, developing their skills to work with projects in collaborative manner.

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