WebTeach: an Integrated Web-based Cooperative Environment for Distance Teaching

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ABSTRACT
We present the WebTeach system, currently used at the Engineering Faculty, University of Florence, Italy. The system is composed by three parts: WebCheck, a web database interface for test management; WebText, a multiple-choices quiz generation system and WebWrite, a collaborative web publishing tool.

1. WEBCHECK
WebCheck is used for managing subscriptions to tests and publication of results. It allows teachers to organize exam sessions and students to consult the results of their tests by a web interface.

This tool is based on a set of perl [1] scripts interacting with an SQL-database [2] where all data are stored. This leads to good performance in accessing information and a certain level of robustness of the system. There are three classes of users in WebCheck: administrators, teachers and students.

Administrators have full powers and can register other administrators, teachers and (when needed) students.

After having asked to an administrator to be registered into the system, teachers have to activate a course for a given academic year, activate a test for a given course, and eventually publish the results for a given test. Teachers can also extract cumulative reports for each course.

From a student’s point of view the first thing to be done is registration. In the University of Florence, each student is assigned a unique id number, which is used as the identifying id in our database. However, in the past years we discovered that freshmen’s data are entered in the central database with a certain delay, so that the new students cannot register for their first examinations. Moreover, we were asked to manage also pre-entrance tests, i.e. to deal with users external to the central database.

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In order to distribute this administrative task, we chose to let teachers enter students’ registration, either one at a time (for example collecting their id during lessons) or massively after a test using a simple text file. Moreover, we used the unique fiscal code (assigned to everybody by the Italian government) as an alternative identification id. After being authenticated, a student can edit his/her personal data, register for a test, or read the corresponding results.

In case of last minute change in the scheduled tests or some other important information to be broadcasted, teachers can send email messages to students using the addresses inserted by students themselves. In case of no address, students are notified as soon as they enter the system.

There is no supervised check on data stored in the database, since we use an approach based on “community reputation”, which is reasonably enforced by the identification requested when logging into the system.

Recently, we have adopted a cookie-based authentication method with time-tickets, at the level of the httpd server. This permits to use the WebCheck authentication mechanism for any web application. In particular, it is used by WebWrite, as illustrated in the next section.

2. WEBWRITE
The implementation of WebCheck is rather classic: a web interface to a database. The drawback of this kind of approach is that any change in the database structure or in the front-end requires a certain amount of “qualified” work, that cannot be delegated to teachers (or students).

We therefore decide to consider a more flexible approach, based on the WikiWikiWeb [3] concept. WebWrite is an implementation of the TWiki [4] system (a particular WikiWikiWeb), which appears as a web site where all pages can be edited using a simple syntax, resembling e-mail text. Moreover, files can be appended to pages like e-mail attachments, and there is a versioning control system. WebWrite is used for publishing didactic material and will become the generic interface-managing tool of the WebTeach system.

Topic contents are stored as text files, allowing the use of normal UNIX tools like grep to perform searches, RCS for version control and so on. In the source file the formatting elements are kept at minimum: emphasized text is simply surrounded by asterisks or underscores (an e-mail convention), bullet lists are marked by whitespaces followed by an asterisk and a space, URLs are just plainly written, and so
on. Authors are allowed (but discouraged) to use HTML formatting.

During the visualization phase, the text is elaborated in order to format it as HTML, inserting bold, italics, bullet lists, hyperlinks, etc. There is the possibility of inserting “dynamic” commands to include other topics; insert the user's name or the date of the day, and so on. In particular, web indices are plain pages containing just a dynamic command. The text is then embedded into a template, which furnishes the appropriate “skin” including buttons for navigation, searches, editing, etc. The templates are just text files with several dynamic commands.

When editing, a simple text area with the source is presented, so that the author is not distracted by formatting tags. This favors focusing on contents rather than on appearance.

Each topic can be classified by means of several category indices, e.g., lesson, course, prerequisites, related topics. The student can find his/her way through the didactic material both by doing full-text searches or by following the category links. TWiki allows a very easy definition of new categories: it is sufficient to edit a particular page and add the new term. A web can contain multiple category schemes applicable to a topic. This allows both a rough form of workflow and a finer classification of each topic.

All topics can have files attached, i.e. uploaded to the server. This makes simple the distribution of didactic material. The uploaded files can be linked in the topic text, thus allowing the inclusion of images/multimedia files in the page shown.

TWiki allows the definition of access rights at the level of site, web-wide and at single page level. The TWiki authorization mechanism relies on the server “Basic” authentication scheme. We replaced this mechanism by a custom handler based on cookie and the WebCheck database, in order to integrate the two systems without even touching the TWiki sources.

Thanks to its free-software approach, we decided, in accordance with the TWiki development pool, to design a generic plugin API (which is now part of TWiki) that permits to selectively include new features.

Currently, WebWrite implements plugins for managing \LaTeX{} fragments in the topic text, 2D and 3D plots, threaded discussions and a calendar of important events.

3. WEBTEST

Traditional written tests are handled through a series of open questions. The marking task is quite heavy, and this prevents the usage of supervised tests for monitoring classroom uniformity of learning and homework.

We started developing a system for the generation and automatic correction of multiple-choices quizzes, named WebTest. Since all of former users of the WebTeach system were either physicists or mathematicians, one of the first requirements was that of using \LaTeX{} sources. Moreover, many teachers had already developed \LaTeX{} databases using another handmade software, and we tried to maintain compatibility with it.

For bureaucratic reasons our teachers prefer to handle tests on paper, rather than online. Moreover, computer rooms are not common in our University.

The quiz database is a \LaTeX{} file with special tags that marks the beginning of groups of questions, of questions themselves, of right and wrong answers. A group is composed by homogeneous questions (same difficulty), generated by hand or dynamically from a template using the Template Toolkit [5] tool.

In the presently developing version, the database is specified by an XML file, which can be generated starting from a \LaTeX{} source. This allows a much easier checking of \LaTeX{} syntax than starting directly from an XML source.

The actual test is defined by a specification file, which is a text file specifying the total number of different tests, the number of questions to be sampled from each group, and a number of other variables to be interpolated into the test template. The syntax of this file is compatible with WebWrite.

By combining the database, the specification file and a template (using the Template Toolkit tool), the system generates a \LaTeX{} file, from it the paper printout. It is possible, by using a different template, to generate on-line tests using PDF (and the Acrobat eEducation bundle). The system checks for duplicated answers, missing right answers, etc.

Teachers can exploit the WebCheck tool to generate a number of tests that matches the registered students, and even generate test personalized for every student (for instance, having the name of the student pre-printed on the paper sheet).

The answers to the tests are specified using a string of characters, which has to be copied on a text file by teachers. Marks are computed and optionally inserted into the WebCheck database in a semi-automatic way.

It is already possible to use WebWrite for sharing the database of questions among teachers. We are working to use it also as a graphical front-end to the WebTest suite.

4. SURVEY OF WEBTEACH USAGE

The system is currently used in the Engineering Faculty of the University of Florence, managed by the Department of Applied Mathematics [6].

WebCheck is used by more than 70 teachers for about 130 courses, 450 tests (each with an average participation of 25 students), and a total of about 4500 students. Its use is steadily growing.

A previous version of the WebWrite tool was used to produce documentation for three courses (computer science, advanced geometry and calculus) and as a “virtual lab” of dynamical systems and statistical mechanics. This material is being migrated to the present version (which uses the new plugins described above) together with new material in the Physics field.

The WebTest tool is currently used by more than 20 teachers, and served for the entry test to all freshmen in the Florentine Engineering faculty (about 1000 tests).

5. REFERENCES