

Web courses content for Bayesian decision making

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I. Introduction

The paper deals with the ideas and problems of the Edukalibre project, in which the author takes part. The basic objective of the project shares the development and exploitation of software components for web-based information systems applied to education as well as organizing of teaching material for them. The Edukalibre work team consists of software developers and teaching content creators and they both need possibility of collaborative editing. The collaborative editing as well as converting the different formats are the points the author tries to apply preparing the material. The paper demonstrates the example of teaching content on Bayesian Dynamic Decision Making Theory.

Nowadays most of educational institutions and universities try to complement traditional teaching techniques with the help of web-based courseware. Web-educational courses give the students a possibility to get the teaching material, assign the papers and have a communication with teachers and other students. Surely such kind of information systems enables fulfilling the main tasks of e-learning, but they are far from perfection because of the functional and economical reasons. The Edukalibre project tries to explore, use and re-use existing software tools and develop the new ones. The courseware to be developed is expected not only to make the teaching material available to the students, but also have a number of possibilities for course creators.

The question of good coordinating collaboration of developers and content creators is at the one of the central positions of the project and should lead to the desired level of software tools quality.

One of the conditions of the project is the use of only libre (free, open source) software. Open source educational and collaborative software tools are believed to attract both the students and teachers all over the world. All the developed tools are going to be located in CVS repository available for further improving and re-using.

Department of Adaptive Systems of the Institute of Information Theory and Automation of the Academy of Sciences of Czech Republic (UTIA AS) is a member of the Edukalibre project group, whose basic task is to prepare the teaching content for courses. The paper treats in details preparing of educational material as well as applying the existing and potential results for collaborating among the institute researchers. The example of teaching material is available.

The group of partner universities works on developing the new software components and re-developing the existing ones as well. Another task of the project participants is testing of the developed software, description of which the paper also gives.

II. Software

The Edukalibre project is a Socrates Minerva Project. As it has been already mentioned above, the main idea of the project is the development of web-based educational software tools as well as improvement of already existing ones and creation of teaching material for web-courses.

1. *Software development*

The project has been only started, but at the first stage both the developers and content creators realized that it is necessary to create such kind of information system, which would satisfy the needs of collaborative work of all subgroups of participants. In the context of project only open source software platform could be used. The set of tools was supposed to provide basic e-learning capabilities, built around the tools for collaborative editing. Those tools should support a broader interaction among groups of professors and students not related to the same institution [1]. After having specified the partner demands the functional requirements to software included:

- Version control of a document;
- Authentication of the users with different privileges;
- Providing the different formats of the document;
- Availability of the document at the Web site;
- Access to the document with the aim of its obtaining in different formats, modifying, uploading as well as downloading and printing according to the privilege of the user.

The functionality, which is strongly necessary at the beginning stage of project, will prove useful both for teachers and students at the exploitation stage in order to provide broader collaboration and interaction.

At the moment the developers concentrate on several courseware tools. The work team from Rey Juan Carlos University in Madrid has produced the demo-version of the conversion platform, while the developers from School of Computing of University of Leeds have demonstrated the groupware. Now it is out of scope of this paper to give the results of those tools testing, especially their comparing because of the early phase of the Edukalibre project. The author only supposes to note that those tools are expected more or less to satisfy to the requirements mentioned above and are directed at achieving the similar functional goals.

As the author belongs to the group of content creators, it seems to be more useful to look to developed software from the creator's point of view. After refining the functional requirements from the position of content creators, as UTIA AS is, the system should provide:

- Version control of a document;
 - Connecting to already existing CVS repository;
- Authentication of the users with different privileges;
 - Capability of simultaneous access to the document of two/several users. Unlocking the document on server;
- Providing the different formats of the document;
 - Support, compilation check and conversion of LaTeX format;
- Availability of the document at the Web site;
 - Capability of user-friendly algorithm running
- Access to the document with the aim of its obtaining in different formats, modifying, uploading as well as downloading and printing according to the privilege of the user;
 - Handling the document inside the same software interface and using multi-file documents.

This overview of creator requirements is not in conflict with overall ones; it only makes them more precise.

2. *Software improvement*

As a platform for further re-using and a tool for online course creating the project group chose the Moodle learning environment [2]. Moodle is a software package for producing internet-based courses and web sites. It is Open Source software, which runs on any computer that can run PHP, and can support many types of database. One of the advantages of Moodle over other systems is a

strong grounding in social constructionist approach [3]. The author does not try to judge or test this philosophy of the Moodle environment, but in author's opinion this paper will describe the advantages and functional capabilities of Moodle.

Moodle is a powerful software package, which has, from the point of author's view, a number of the potential functional purposes. Speaking about Moodle as a Learning Management System (LMS) or Virtual Learning Environment (VLE) really means it provides most of capabilities of e-learning and is primarily aimed at the use in teaching. But this statement does not exhaust the list of its possible applications. As a matter of fact, after installation of Moodle the user obtains the prepared web site that only has default settings to use it for e-learning. Actually the Moodle site has the same structure as the sites created with the help of it. Moodle is a really user-friendly system and the teacher, who is going to use it for his classes, almost does not feel a need in the help of administrator after installation. It is enough for him only to upload the files necessary for classes as well as add whatever blocks and activities (assignment, quiz, lesson, resource etc) and the teacher has his own course and can use it as he likes. Moodle enables to have a great amount of courses. Under the name of each course a further web site is hidden. The objectives of the courses can be as different as possible. One can use Moodle as a tool for making a personal web page. The work team from the Department of Adaptive systems of UTIA tries rather to apply Moodle as a management system, which would contribute to collaboration of the member of group. Although Moodle still has not the module for collaborative editing in such way that would satisfy to all requirements of content creators and the developers are working on the problem, in author's opinion it is possible now to use the functionality of Moodle at least as the tool for making information available in Web. The idea that could work states that every creator could have his own course with the rights of teacher, while the rest of creators could have only student rights for this course. In this case it enables applying the activities of Moodle, such as assignment, for versioning the document among creators. The combination of privileges is assumed to contribute to coordinating the work process.

Now the participants of the project primarily use Moodle separately of each other. The question of the single shared Moodle site was brought up, but it was not succeeded basically because of significant difference in a quantity of students of the partner universities and institutions. Moreover, for coordinating the work the Edukalibre project members already have a web site [4], which is running on server at University in Madrid. The project documentation, software demo, deliverables as well as information about the project partners are available at the main Edukalibre web site.

Moodle continues supporting the policy of different privileges for the course access. The combinations of the course access types also contributes to a good level of interaction between professor and students. It happens because of a number of built-in activities of Moodle (assignment, for example), which only a student is able to do, while only a teacher can see a subject of this assignment.

Coming back to the position of the content creator and the multi-functionality of Moodle one has to point several features essential for preparing the educational material. Moodle allows opening the document from server with the help of automatically loaded needed application, modifying it as well as uploading. From the author's point of view Moodle seems to be powerful flexible system to use it for handling the web sites and publishing the information on the Internet. It has many initial features necessary for collaborative work but the collaborative editing and version control modules. If it had those modules, Moodle would be software enough to support both creating and updating the course content.

As Moodle is Open Source courseware, it is free for developing and modifying. The work at this direction is never stopping. The partner team from the School of Engineering of the University of Porto suggested the Wiki-module for Moodle. Wiki allows collaborative editing, but only at a level of editing web pages. It does not support the LaTeX format and correspondingly is not effective to write mathematical material. The team from UTIA AS strongly needs the software, which would unite all the requirements of content creator in the same system for effective producing the educational material

as well as collaboration among the researchers.

III. Web courses content

The team from UTIA AS is a participant of the Edukalibre project, who works primarily on the educational material creating. The conceptual idea of organizing the teaching content lies on using the set of files as the flexible system of hyperlinks developed with the libre software tools. The content of courses is expected to:

- depend heavily on underlying math and its presentation;
- deal with numerically solved examples;
- have math-like structure with top-down way of explanation of underlying notions;
- be built with math-oriented tools (Octave, LaTeX).

Surely the material should satisfy requirements from the point of view of user friendliness. The general theoretical part of Bayesian Decision making [5] is now reachable as a book, but obviously such approach does not suit the principles of e-learning. The chapters of the book are expected to be supplied with a great amount of examples applied to specific case studies - models with normal and binomial distribution. On these simple models the individual tasks of simulation, parameter estimation, prediction and control will be demonstrated. These examples are believed to be the basic tools for the students to use. Each example is generally a package of files with the source codes in LaTeX and Octave. A version of the example ready for a student to use will be converted basically to Portable Document Format. The examples demonstrating the task of simulation, parameter estimation, prediction and control will be fulfilled in math-oriented tool Octave. While running example, Octave will suggest to student the user dialog, in which it is possible to change parameters and a graph to see results. The content creators worked out a number of requirements to the form of examples:

- all the packages with examples are written in a similar way, they are supposed to be standard;
- the hyperlinks have the defined color for each target;
- every variable is a hyperlink itself to its description.

1. Example of teaching content

The Edukalibre project is only at the beginning phase of the project and the work team tries to find the optimal way of organizing the structure of example as well as of the whole teaching content. The links to the examples are available both from the general theoretical part, i.e. from the corresponding chapters, and from the table of contents, which is the list of existing case studies. Each case study must have the same structure, which is supposed to contain:

- *Aim* explains the task of the example, meaning what kind of the new knowledge a student is believed to obtain with the example.
- *Description* gives the very short description of the problem posed and points out what a branch of Bayesian Decision Making the case study is applied to. The links to the detail theory are green and direct to the corresponding chapters and sections in the book. Description also says briefly about the principles of the algorithm functioning and mentions the results to be obtained.
- *Specification* consists of several items, namely: System, Decision, Experience, Ignorance, Admissible strategies, Loss function. They give the data necessary for specifying the case study. The items are the links themselves to the definitions of the terms applied to Bayesian Decision Making Theory. The links to definitions are red.
- *Recommended experiments* give practically step-by-step instruction what manipulations are recommended trying to a student in the given example. The system behavior is briefly mentioned. The variables, met in the text, direct to their description.
- *Comments and References*. It is assumed that each case study is an individual task, which needs some comments. The item explains the characteristic properties of the task and gives some advices.

```

One step prediction for known
      model parameters
=====
Input variables
--- system -----
Size of data sample   -> ndat=20;
Parameters
(P(1|u(t),y(t-1))) -> th1 =
      u(t)=1  y(t-1)=1    0.1
      u(t)=1  y(t-1)=2    0.2
      u(t)=2  y(t-1)=1    0.9
      u(t)=2  y(t-1)=2    0.8
Initial output       -> y(1) = 1;
-----
Do you want to change variables ?
ENTER = no, or type a command: >

```

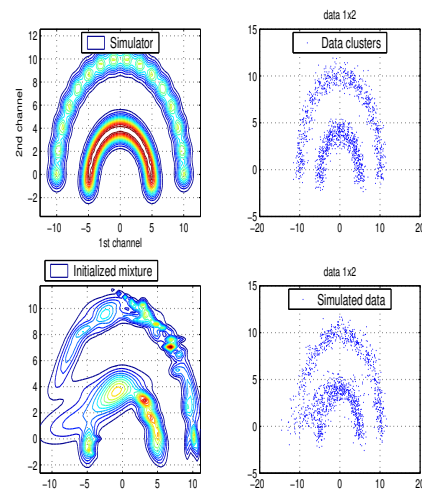


Figure 1: Octave dialog and example of results with default values

In the bottom of the example main page a number of hyperlinks is given. A number of links can vary sometimes, but the basic ones remain the same and are worth mentioning. The name of the link "Run example" is self explanatory. It starts the associated application and runs the program. In the context of the Edukalibre project only free software can be used, so the work team chose the Octave application for this purpose. The hyperlinks connected with Octave are blue.

After starting the Octave proposes to a student a dialog, with help of which he is able to see the input variables, size of data sample and decides whether he wants to change variables or not. The Fig.1 shows an example of Octave dialog. Depending on actions of user, Octave is supposed to plot the results of experiment with default values. The example of graph can be seen at Fig.1.

After getting results with default values the student is able to run further experiments on and sees the next dialog that Octave offers. The dialog gives three possibilities to vary. The user can continue experimenting with current setting as well as try with initial values and stop experiments.

As it has been mentioned above, a number of links varies, the content creators group still works on optimizing the navigation of material. The link "read theory" can be also available to a student, it leads to more general part of theory. Actually "read theory" is applied to the case study, but rather at the level of chapters than of sections or subsections of chapters what is more specialized. Also the possibility to go the the guide to program tools, the examples are build on, are expected to be among the hyperlinks. It is worth mentioning about the "view code" link, which is believed to help a student to understand better the mechanism of the experiment inside from the programming code. Surely it is possible to go to table of contents from each example's page. The idea of the Edukalibre project is the teaching material will be available for the students at Moodle-created web courses, while all the source files will be located at CVS repository.

IV. Conclusion

The author believes that this paper gives an idea of the project as the experimentation with the uses and procedures of libre software in the creation of content suitable to be used as the material for education. Surely the project partners do not pretend to absolute uniqueness in solving the problems existed in field of education and e-learning, in particular. However, the project has the certain originality of its objectives. Combination of exploring and using the existing software tools and developing the new

packages is believed to let the work team to produce the courseware available to the public in general in useful ways. Educational material are usually produced by small group of creators with little or no interaction with users of material, and with other groups producing similar material. The collaborative work principle along with version control, different format conversion and high level interaction among developers, creators as well as students is believed to bring the appreciable results to producing the teaching content.

At the end of paper it should be mentioned that the project team is really distributed geographically and includes the participants from six countries. The different approaches to work as well as different languages constitute more productive and stimulative atmosphere for creating both the software system and educational material. The Moodle environment offers the modules in forty languages, but the official language of the Edukalibre project is English and all documentation is expected to be available in English.

As regards the multi-lingual support of teaching material, this question has been also brought up. At the present phase of the project it was spoken only about uploading and testing the conversion of documents containing the specialized language symbols or simply multi-lingual documents. The conversion and subsequent compilation of those documents in LaTeX format is planned. Obviously, the development at this direction is permanently going on and the next project of UTIA AS intends to support the multi-lingual educational courses content.

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References

- [1] V. Dimitrova and C. Tebb, "Edukalibre groupware tools," *Deliverables to Edukalibre: Libre Software Methods for E-Education*, 2004, URL: <http://edukalibre.dat.escet.urjc.es/>.
- [2] M. Dougiamas, *Moodle - a web application for building quality online courses*, 1999, URL:<http://moodle.com>.
- [3] K. Tobin and D. Tippins, "Constructivism as a referent for teaching and learning," in *The Practice of Constructivism in Science Education*, K. Tobin, Ed., pp. 3–21. Lawrence-Erlbaum, 1993.
- [4] *Edukalibre Project*, 2003, URL: <http://edukalibre.dat.escet.urjc.es/>.
- [5] M. Kárný, J. Bóhm, T. Guy, L. Jirsa, I. Nagy, P. Nedoma, and L. Tesař, *Optimized Bayesian Dynamic Advising. Theory and Algorithms*, Springer, 2005, to appear.