E-assessment

• The E-assessment is fundamental in modern teaching/e-learning approaches, in fact it ensures:
  - The deployment of exams in a very fast way, particularly in cases where the number of students are very high
  - A standardization of tests carried out by teachers
  - A simplification in tests deployment procedures
  - A process speed up in publishing the results
LibreEOL

- LibreEOL is a software project started at the end of 90’s as an outcome of a EU Leonardo project.
- Presently it has 10 different types of questions with which the teacher can express questions and responses.
- LibreEOL has been selected to run the EchemTest tests, to assess (and certify) the competencies in the various areas of Chemistry.
**LibreEOL and Echemtest+**

- **EchemTest+** is based on LibreEOL, an open source product developed by Perugia University.

- LibreEOL is a Web application based on open standards **Ajax, HTML5, Javascript,** and **CSS.** The present version runs on a Linux-Apache- MySQL-PHP (LAMP) architecture.

Released under a GPL 2.0 license

Uses Open Source/Freesoftware components

http://www.libreeol.org

Recommended browsers
EOL features

- EOL is a web application that represents a complete environment for performing the **e-assessment** of a **large number** of students who access the system from computer labs, under the control and the supervision of the **examiner/teacher**.

- Each **student** is assigned an **individual** test. Each Exam has associated a univocal **password** the student has to specify to access the test.

- The questions of the test are fished up from a set of questions the teacher defined for the **topics** of the named **subject**, classifying each question according to 3 levels of difficulty (**low**, **medium**, **high**).
EOL features (I)

• It is possible to **force** the **inclusion** in the test of some questions available in the subject

• EOL may support multiple **languages** for each question (For each question is defined in the reference language and related translations)

• Exams are defined with various **settings** (type of students registration automatic/ manual, **topics** selected, evaluation metric, optional bonus, editable score, etc)

• **Reports** may be produced to show trends and results
Data Management

- EOL has been designed according to the current best practices: it has been collected the functional and end-user requirements, then a conceptual scheme of entities and relations has been defined.
- The information are stored in a MySQL (MariaDB) RDBMS.
- An intermediate layer has been created to simplify the migration to other database management systems.
- The pool of questions are kept separated from the results of the tests/exams, which are accessed by the report procedures.
EOL Entity Relation Model
The abstraction layer

- The code is based on the sqlDB method, which allows to abstract the interaction with the RDBMS.
- The abstraction layer is composed by:
  - a set of *public methods* to carry out specific operations: qSubjects, qQuestionDetails, qStartExam, etc.
  - a set of *private methods* to communicate with the DBMS (i.e.: connect, execTransaction, getError, etc).
- The present implementation of the DBMS is based on the popular open source DBMS MySQL (MariaDB).
The algorithm used for fishing-up questions

Retrieval of the exam Settings

- Number of questions
- Distribution of questions among Topics
- Difficulty level of the exam

Number of questions per Topic

Total number of active questions per Topic are extracted, sorted in ascending order by the identifier askedUtil. The first question is the first fished-up.

Subsequent question is selected in order to reach the desired mean difficulty of the test and preferring the questions with a lower askedUtil, until all question for a given Topic have been fished up.

Repeated on all Topics until the TOT number of questions is reached.
The framework

- To facilitate the development of the EOL system a framework has been introduced
- It is based on the Controller/Action/View paradigm
  - The Controller verify the exisistance of the required operations and execute them after having verified the access permissions.
  - The Action is a simple operation required by the User and executed by the Controller
  - The View is represented by the PHP code that shows the portion of the web page
Localization of EOL

- The Administrator can easily add a specific language for the **User Interface** and the **web pages**, using an administration panel. For each added language it will be displayed in the relevant web pages the corresponding flag
- It is a teacher duty to translate in a given language the questions and the related responses
- It is not possible to define a greater number of questions in a given localization than in the reference language
Administrator’s functions

- Manage the web site information
- Create users (manual registration).
- Assign the **roles** of **teacher** or **examiner** to the user, if necessary
- Manage the **localization** of the User interface and of web pages, enabling the teachers to add the localization of questions and responses
- Define the **classrooms** enabled for tests (IP address range used during exams) and used in settings setup by the examiner.
Teacher’s functions:

- Manage **subjects** under her/his control, and per each subject, the related **topics**. EOL do not support sub-topics.

- Create the text (question and responses, in the supported languages) for the various types of questions:
  - Multiple Response
  - Multiple Choice
  - Yes/No
  - True/False
  - Text Match
  - Numeric
  - Filling blanks
  - Pull-down list
  - Matching
  - HotSpot
Examiner's functions:

- Manage **exams, settings** and **students registration**
- Through the **settings** the examiner may select the type of exam in terms of number of questions, duration of the test (the test has to be completed during the selected interval of time), topics covered, IP address range used, how the score is expressed, bonus, score editable or not.
- Respect to QuestionMark, the examiner selects the topics and the relative distribution in terms of the difficulty of the question
- Perform the **reports** (this part has to be still completed)
- The **Testing Center Managers** will be defined with the **examiner** role
Student's operations

- Register to the system, if new. The authentication is managed by the pairs **email-address** /password. In the automatic registration the email has to be true and working.
- Enroll to the test/exam selecting it from the list of the available tests/exams (automatic registration)
- Execute the text in one of the authorized computer room providing the **univocal password** associated to the test/exam, provided by the **examiner/teacher** during the exam.
Migration of the questions from EchemTest® to Echemtest+

- Emanuele Gragnoli and Elia Catana wrote the procedure to import the questions from QuestionMark to EOL.
- Fortunately QuestionMark made available the export procedure according to the Instructional Management Systems (IMS) (a project of the IMS Global Learning Consortium) the Question and Test Interoperability (QTI) standard, which encodes the info as XML tags.
- The import of the question has been a great success!
# Migration of the questions from EchemTest® to Echemtest+

<table>
<thead>
<tr>
<th>Type of question</th>
<th># of questions</th>
<th># of imported questions in EOL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple choice</td>
<td>7915</td>
<td>7915</td>
</tr>
<tr>
<td>Multiple Response</td>
<td>1836</td>
<td>1836</td>
</tr>
<tr>
<td>Pull-down list</td>
<td>1146</td>
<td></td>
</tr>
<tr>
<td>Hot Spot</td>
<td>874</td>
<td></td>
</tr>
<tr>
<td>Numeric</td>
<td>684</td>
<td>663*</td>
</tr>
<tr>
<td>Text Match</td>
<td>241</td>
<td>230¥</td>
</tr>
<tr>
<td>Filling blanks</td>
<td>108</td>
<td></td>
</tr>
<tr>
<td>True/False</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Matching</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>Ranking</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Knowledge Matrix</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12882</strong></td>
<td><strong>10680</strong></td>
</tr>
</tbody>
</table>

- **Not supported:** Knowledge matrix
- **Not yet implemented:** feedbacks on responses

*: in 21 questions the XML tag related to the response were empty
¥: in the case of 11 questions, the XML parser produced an error parsing the tags and returned an empty string. Such questions are related to the Greek language.
The exam

- The user registered to the exam, once provided the univocal password associated to the exam, will receive on the web page all questions to be responded. The sequence of responses do not matter.
- The responses associated to each question are presented randomly to prevent frauds.
- To submit the responses to the exam, the user has to press the “send” button.
- No feedback is provided to the student about the final score.
A sample teacher desk
List of subjects
List of questions per subject

<table>
<thead>
<tr>
<th>Topics</th>
<th>Descriptions</th>
<th>Languages</th>
<th>Type</th>
<th>Difficulty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architettura Reti</td>
<td>A che cosa serve il sistema SSL?</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
<tr>
<td>Internet</td>
<td>A che cosa serve IMAP</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
<tr>
<td>Reti locali e geografiche</td>
<td>A che cosa serve SNMP</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
<tr>
<td>TCP/IP</td>
<td>A che cosa serve un Mail User Agent</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
<tr>
<td></td>
<td>A che cosa servono le Basic Encoding Rules (BER)</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
<tr>
<td></td>
<td>A proposito del protocollo ICMP, quali delle seguenti affermazioni è esatta?</td>
<td>IT</td>
<td>Multiple Response</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>AAL definisce le seguenti classi di servizio</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Hard</td>
</tr>
<tr>
<td></td>
<td>Che cosa si intende per firewall</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
<tr>
<td></td>
<td>Che cosa si intende per Packet filtering</td>
<td>IT</td>
<td>Multiple Choice</td>
<td>Easy</td>
</tr>
</tbody>
</table>
Edit questions (teacher)
Exams carried out
## Exam's details

### Registrations

**Showing 6 registered students**

<table>
<thead>
<tr>
<th>Name</th>
<th>E-mail</th>
<th>Time Start</th>
<th>Time End</th>
<th>Time Used</th>
<th>Test Score</th>
<th>Final Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajjaddi Siham</td>
<td><a href="mailto:siham-92@hotmail.it">siham-92@hotmail.it</a></td>
<td>09:51:34</td>
<td>10:31:04</td>
<td>00:39:30</td>
<td>12.3</td>
<td>14</td>
</tr>
<tr>
<td>Ludea Thomas</td>
<td><a href="mailto:thomas.budea@studenti.unipg.it">thomas.budea@studenti.unipg.it</a></td>
<td>09:50:03</td>
<td>10:29:49</td>
<td>00:39:46</td>
<td>21.3</td>
<td>23</td>
</tr>
<tr>
<td>Ciprini Riccardo</td>
<td><a href="mailto:riccardociprini@hotmail.it">riccardociprini@hotmail.it</a></td>
<td>09:55:39</td>
<td>10:10:59</td>
<td>00:15:20</td>
<td>7.65</td>
<td>10</td>
</tr>
<tr>
<td>Gambini Roberto</td>
<td><a href="mailto:kobe_2007@libero.it">kobe_2007@libero.it</a></td>
<td>09:52:52</td>
<td>10:20:47</td>
<td>00:27:55</td>
<td>18.75</td>
<td>21</td>
</tr>
<tr>
<td>Vernata Simone</td>
<td><a href="mailto:simonevernata@yahoo.com">simonevernata@yahoo.com</a></td>
<td>09:57:56</td>
<td>10:35:58</td>
<td>00:38:02</td>
<td>19.2</td>
<td>21</td>
</tr>
<tr>
<td>Valttuoni Saffiro</td>
<td><a href="mailto:safiro91@yahoo.it">safiro91@yahoo.it</a></td>
<td>09:53:03</td>
<td>10:21:21</td>
<td>00:28:18</td>
<td>16.65</td>
<td>19</td>
</tr>
</tbody>
</table>
Organizing the content

• In order to prepare a test on a given discipline, the teacher has to organize the contents in topics, so that he/she can carry out several types of exams (i.e.: pre-exams).

• Questions will be classified by
  - Type
  - Topics
  - Difficulty level
Defining questions

- The Teacher can express questions using 10 different types of questions.
- It is a good practice to assign to each question the same number of responses, in order to minimize the statistical variability of responses.
- During each test the responses are shuffled.
Defining a new question

- The first step for defining a new question for a given Topic is the selection of the question type.
Defining a new question

Once defined the text of the question, one enters the various responses.

Which response is correct?

Description: Which response is correct?

Topic: Internet

Difficulty: Easy
Conclusions

- LibreEOL allows to carry out tests related to exams of various type (University courses, professional certifications, language skill assessment, etc)
- The most crucial part is the definition of the pool of questions from which the system automatically fishes out the questions of each individual test
- Questions have to be classified by topic and difficulty