LINGI2255 - Oscar
Report

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6 octobre 2017
Group 05

UCL-EPL

Année académique 2017-2018

1 Team members

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2 Introduction

2.1 Parenthesis on the shared aspect of our project with another team

The algebraic expression engine software project presented in this document is currently being developped by two teams. Our team, and another UCL team. It has been proposed to us to collaborate with this other team in order to present a better product to the customer. After thoughtful consideration, we believe that the cons of reorganizing the project with so many different persons with a project of this scope outweight the pros of a shared workload. As such, we are encline to communicate with this other team on our choices, decisions and technologies but prefer to keep our current ourganization as is.

2.2 Initial situation

Oscar is positioned as a web site for teachers and students from primary and secondary schools.
The website is used to test the mathematical skills of the students.
Oscar is a website which aims elementary and secondary school.
Each skill is divided into several categories. A student have different states for a category. Example : "tested", "not tested", etc. This state is updated every time the student submits an answer.
Resources are available for the students in order to help them to understand the topic.
The site must be user-friendly whatever the size of the screen is.

2.3 Specifications of the module

This section is a resume of the "Case specification - Oscar - 2017" document limited to the algebraic interpretation engine (section 3.1.4).

2.3.1 Summary

In order to test a student's ability to solve an (in)equation, it is desirable not to limit oneself to the solutions alone, but to observe the steps of reasoning. We ask you to create a mathematical expression evaluation engine and (by extension) a mathematical expression comparison engine.

2.3.2 Desired functions

— Validation of the equivalence of two expressions on either side of a symbol "=" ;
— Comparison between two steps of a resolution : is the second step deduced from the first ? ;
— This function has two versions, depending on the use :

1. (Default for student assessments.) The student completes all the steps of his/her resolution of (in)equation on piled up lines. He/she validates at the end and then sees at which step(s) he/she has written incorrect expressions or which are not equivalent to the previous ones.
2. (Default for student training.) The student submits each line of his/her resolution and immediately sees if he/she has made an error, which can then be corrected. Only when one step is correct can the student complete the next step.

— There is a comment in the margin that points the kind of error at stake at that step ;

— This function should cover six question statements :

1. Resolve an equation of the first degree with one unknown (appearing only on one side of the equation)
2. Resolve an equation of the first degree with one unknown (appearing on both sides of the equation)
3. Resolve an inequation of the first degree with one unknown (appearing only on one side of the inequation)
4. Resolve an inequation of the first degree with one unknown (appearing on both sides of the inequation)
5. Resolve a system of two equations of the first degree with two unknowns (each appearing only on one side of each equation)
6. Resolve a system of two equations of the first degree with two unknowns (each appearing on both sides of each equation)

— Extension of the basic function (to be started only after validation of the basic function by Eureduka) : automatic generation of questions of the six types mentioned above. In all these cases, the teacher must be able to define the allowed values of coefficients and/or answers (range and kind : naturals, integers, fractions). The teacher can also change the name(s) of the variable(s), which is/are x (and y) by default. The teacher will finally decide to cover or not impossible or undetermined (systems of) equations.

Technical constraints : This function requires symbolic manipulation. Feel free to use a symbolic manipulation library in Python.

3 Storyline

A student goes to a webpage in order to assess his equation and inequation solving skills. This page can be accessed in two different versions : the first version is the assessment version, and the second one is a training version.
The assessment version shows a series of equations and inequations, with fields for the student to fill. These fields will contain the student's answers with all his resolution steps. Once the student is done with all the answers, he sends them to the system with a clickable button. The system then evaluates the answers and checks if each step is equivalent to the previous step, and if there are no other math errors. If some errors are detected, the system will show where the errors are located, but blocks any modification to the answers. These assessment results are then used to modify the students' global grade.
The training version looks similar when arriving on the page : there are equations and inequations with fields to post the results. The difference here is that the system checks each answer as soon as it's written, if the answer isn't correct, the system shows that this step is incorrect and blocks any attempt to write the next step until the current error is corrected.
In order to generate the questions and answers, the teacher will be able to define the range and kind for the values of the coefficients and answers. The teacher can also change the name of the variables (they're set to x and y by default), and can decide if impossible equations or inequations will be generated. The (in)equations will then be generated automatically, in adequation with the teacher's specifications.

4 usage scenarios

Context : The student has to resolve an algebraic expression. He starts an exercise :

1. In training, the student introduces an algebraic expression that is not equal at the both side of the "="
   (a) the student introduces his answer
   (b) the student submits his answer
   (c) the system informs the user that the answer is wrong
   (d) the system invites the student to reintroduce another answer

2. In training, the student introduces an algebraic expression that is equal at both side of the "="
   (a) the student introduces his answer
   (b) the student submits his answer
   (c) the system informs the user that the answer is correct
   (d) the system invites the student to go to the next question

3. The student has to resolve an equation step by step. He is in a training exercise and he has a correct development and correct answer.
   (a) the student introduces the first step of his reasoning
   (b) the student has to submit his answer
   (c) the system informs the student that the answer is true
   (d) the student is invited to continue his reasoning
   (e) the student continues to introduce his development and system to give him a feedback
   (f) the student introduces the final answer
   (g) the system informs the student that the answer is true
   (h) the system invites the student to go to the next question

4. The student has to resolve an equation step by step. He is in a training exercise and he has a correct development but a wrong answer.
   (a) the student introduces the first step of his reasoning
   (b) the student has to submit his answer
   (c) the system informs the student that the answer is true
   (d) the student is invite to continue his reasoning
   (e) the student continues to introduce his development and system to give him a feedback
   (f) the student introduces the final answer
   (g) the system informs the student that the answer is wrong
   (h) the system invites the student to reintroduce a new answer for the question
   (i) the student introduces a new answer and submit it
   (j) the system informs the student that the answer is true
   (k) the system invites the student to follow up on the next question

5. The student has to resolve an equation step by step. He is in a training exercise and he has a wrong development and a correct final answer.
   (a) the student introduces the first step of his reasoning
   (b) the student has to submit his answer
   (c) the system informs the student that the answer is wrong
   (d) the system invites the student to reintroduce a new answer
   (e) the student introduces the next step of his reasoning
   (f) the student submits his new answer
   (g) the system informs the student that the answer is true
   (h) the system invites the student to introduce the next step of his reasoning
   (i) the student continues to introduce and to submit his reasoning while the system gives feedbacks
   (j) the student introduces the final answer for the question
   (k) the system informs the student that the answer is true
   (l) the system invites the student to follow up on the next question

6. The student has to resolve an equation step by step. He is in a training exercise and he has a wrong development and a wrong final answer.
   (a) the student introduces the first step of his reasoning
   (b) the student has to submit his answer
   (c) the system informs the student that the answer is wrong
   (d) the system invites the student to reintroduce a new answer
   (e) the student introduces the next step of his reasoning
   (f) the student submits his new answer
   (g) the system informs the student that the answer is true
   (h) the system invites the student to introduce the next step of his reasoning
   (i) the student continues to introduce and to submit his reasoning while the system gives feedbacks
   (j) the student introduces the final answer for the question
   (k) the system informs the student that the answer is wrong
   (l) the system invites the student to reintroduce a new answer for the question
   (m) the student introduces a new answer and submit it
   (n) the system informs the student that the answer is true
   (o) the system invites the student to go to the next question

7. The student has to resolve an equation step by step. He is in an assessment and he has a correct development and a correct answer.
   (a) the student introduces the steps of his reasoning
   (b) the student introduces the final answer
   (c) the student submits his answer
   (d) the system informs the student that the final answer and the reasoning are true
   (e) the system invites the student to go to the next question

8. The student has to resolve an equation step by step. He is in an assessment and he has a wrong development and a wrong answer.
   (a) the student introduces the steps of his reasoning
   (b) the student introduces the final answer
   (c) the student submits his answer
   (d) the system informs the student that the final answer and the reasoning are wrong
   (e) the system invites the student to follow up on the next question

9. The student has to resolve an equation step by step. He is in an assessment and he has a wrong development but a correct answer.
   (a) the student introduces the steps of his reasoning
   (b) the student introduces the final answer
   (c) the student submits his answer
   (d) the system informs the student that the final answer is true but the reasoning is wrong
   (e) the system invites the student to follow up on the next question

10. The student has to resolve an equation step by step. He is in a assessment and he has a correct development but a wrong answer.
    (a) the student introduces the steps of his reasoning
    (b) the student introduces the final answer
    (c) the student submits his answer
    (d) the system informs the student that the final answer is wrong but the reasoning is true
    (e) the system invites the student to follow up on the next question

Context : The professor want to create, modify or delete a question :

11. The professor creates a new question
    (a) the professor inserts the question
    (b) the professor inserts the answer to the question
    (c) the professor submits his form
    (d) the system informs the professor that the question has been added

12. The professor modifies a question
    (a) the professor selects the question to modify
    (b) the professor modifies the question and the answer
    (c) the professor submits his form
    (d) the system informs the professor that the question has been modified

13. The professor deletes a question
    (a) the professor selects the question to delete
    (b) the professor deletes the question
    (c) the system informs the professor that the question has been deleted

Context : The professor want to create a assessment or a training

14. The professor creates a new assessment
    (a) the professor has a list of the questions for this course
    (b) the professor chose the questions that he wants in his assessment
    (c) the professor submits his form
    (d) the system informs the professor that the assessment has been added

15. The professor creates a new training
    (a) the professor has a list of the questions for this course
    (b) the professor click for create the training
    (c) the system chose randomly questions for the students
    (d) the system informs the professor that the training has been added

5 user stories

1. As a student, I want to get a feedback after each line during an exercise so that I can correct my faults. (scenarios 1, 2, 3, 4, 5, 6)
2. As a student, I want to correct a wrong line during an exercise so that I can reach the correct answer. (scenarios 1, 4, 5, 6)
3. As a student, I want to get a feedback after submitting an answer so that I can know my grade for this question. (scenarios 7, 8, 9, 10)
4. As a student, I want to be able to train without being graded in order to hone my skills.(scenarios 1, 2, 3, 4, 5, 6)
5. As a teacher, I want to be able to control which range of variables the system will use in order to create a question.
6. As a student, I want to see if an (in)equality is false in order to get a feedback.(scenarios 1, 4, 6, 8, 10)
7. As a student, I want to see if the reasoning between two lines is correct in order to get a feedback(scenios 5, 6).
8. As a professor, I want an automatic correction for equations of first degree with one unknown (on one or both side) so that my students can train or can be evaluated.
9. As a professor, I want an automatic correction for inequations of first degree with one unknown (on one or both side) so that my students can train or can be evaluated.
10. As a professor, I want an automatic correction for systems of two equations of first degree with one unknown (on one or both side) so that my students can train or can be evaluated.

6 time estimate of user stories

In order to implement the different user stories, we'll need to have the core of our module up and running. We estimate and aim 1 week of development to program the core.
The core will be composed of functions that will allow us to solve equations and inequations as well as manage the solving steps.

1. First user story : 4h.
2. Second user story : 4h.
3. Third user story : 6h.
4. Fourth user story : 15h.
5. Fifth user story : 8h.
6. Sixth user story : 2h.
7. Seventh user story : 2h.
8. Eighth user story : 4h.
9. Ninth user story : 4h.
10. Tenth user story : 4h.

7 development methodology

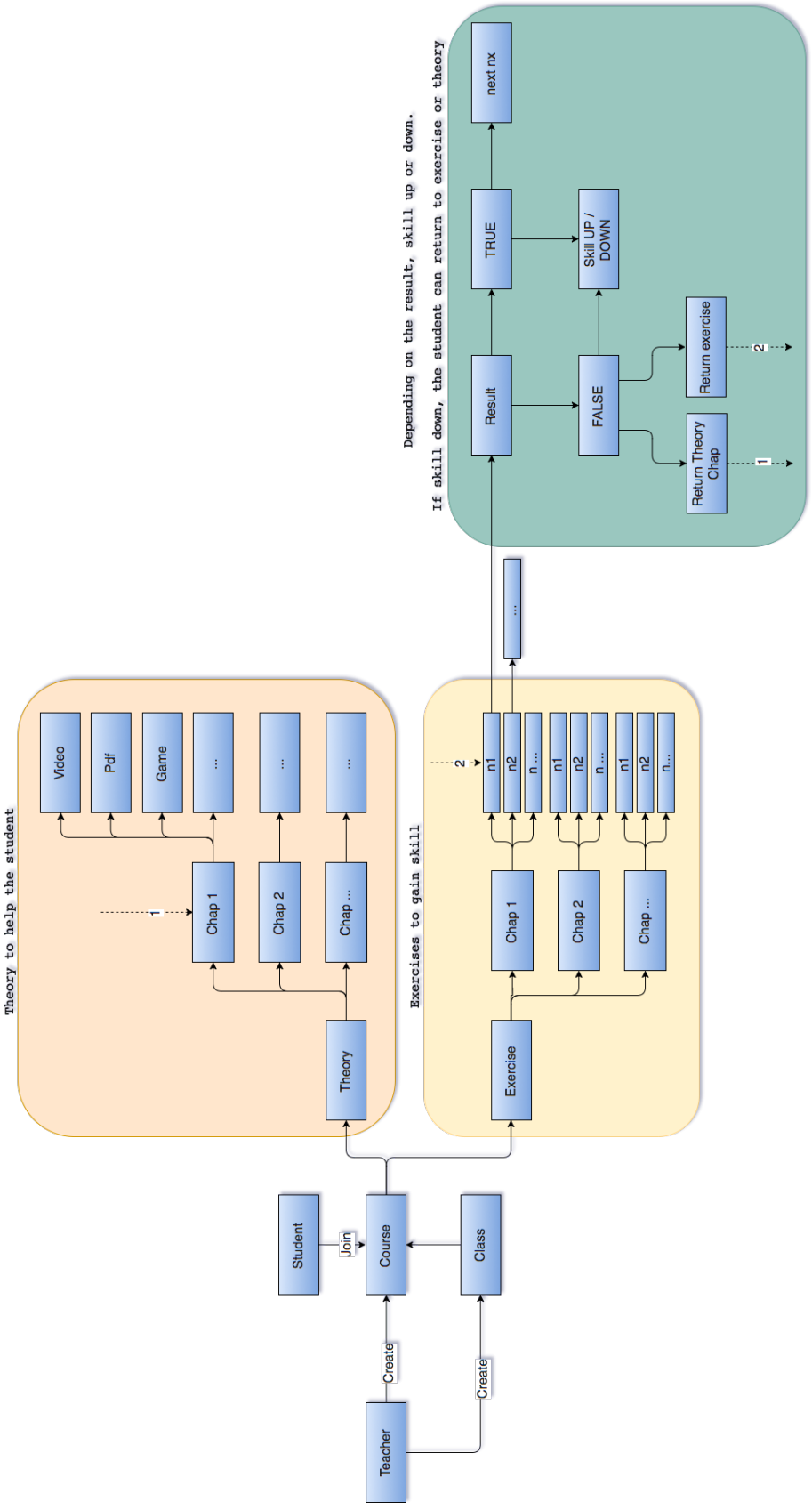
We have planned to use the agile method. Indeed, we believe that it has interesting advantages compared to other methods. Among these, we can count on :

- We proceed in small maturities, which allows :
  - To the customer to adapt his request as the project progresses (regular feedback to ensure that we are going in the right direction)
  - Easily review priorities during development
- Agile methods also reduce the amount of documentation, which facilitates communication between members and regular meetings.
- By proceeding not short cycles, this allows to have a functional rendering to show much more quickly.
- Another principle of agile methodology, is to minimize a maximum unnecessary work.

8 Work methodology

Our team being composed of 7 members, we plan to divide the different tasks and assign those to two or three students. These tasks, their state, progres and implementation are to be discussed in weekly meetings. We plan to entrust the unit tests to two persons, develop two modules in parallel with each two people to realize and one person for the report. We would change the roles each sprint for everyone to have the opportunity to touch everything and have an overview of the developed module.

9 use case


Teacher
Create
Create
Student
Join
Course
Class
Theory to help the student
Video
Pdf
Game
...
...
...
1
Chap 1
Chap 2
Chap ...
Theory
Exercises to gain skill
2
n1
n2
n ...
n1
n2
n ...
n1
n2
n...
...
Chap 1
Chap 2
Chap ...
Exercise
Depending on the result, skill up or down.
If skill down, the student can return to exercise or theory
Result
FALSE
Return exercise
2
Return Theory Chap
1
TRUE
Skill UP / DOWN
next nx