AGILMAT – a Web Application for Math Education (story board)
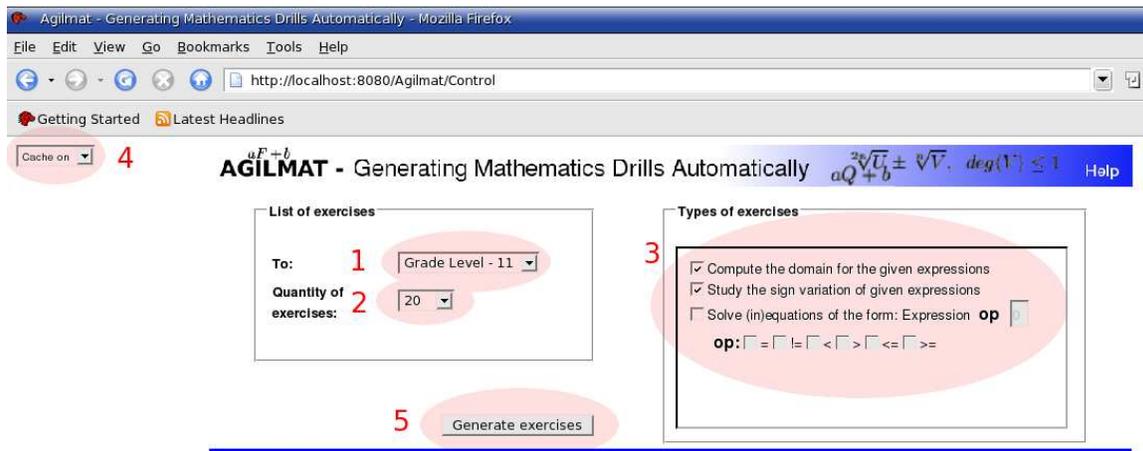
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The purpose of this demonstration is to show how AGILMAT can be used to produce a set of math drills. AGILMAT's frontend is a web application that collects a set of options that will control the generation of exercises.

1 Generating Exercises

Figure 1 presents AGILMAT initial interface where the user can generate a set of exercises defining only a minimal set of options.

Figure 1: Screen of the main interface of AGILMAT tool.

The location of these options in the users interface is highlighted in Figure 1. Each one is numbered and its purpose is described below.

Option 1 - Defines a profile of exercises that will be generated, set to "Grade Level - 11" in the example. This makes the system initialize the range of each parameter of AGILMAT's backend with suitable default values. These values may correspond not only to grade levels but also to specific topics of the curricula. The advantage of this option is to allow novice users to generate exercises for their particular needs without having to set a large number of parameters.

Option 2 - Defines the quantity of exercises that will be generated, set to "20", in the figure.

Option 3 - Defines the types of exercises that will be generated. The user can use this option to choose the types of exercises that he/she does want, such as "Compute the domain for the given expressions", "Study the sign variation of given expressions" and "Solve (in)equations". Exercise sheets may contain several different types of exercises. We set the option to "Compute the domain for the given expressions" and "Study the sign variation of given expressions".

Option 4 - Turns on and off the cache system. On "Cache on" the system gets exercises from the ones cached, if there are some. Otherwise, AGILMAT will generate fresh exercises.

Option 5 - Finally, if we press "Generate exercises", some exercises will be displayed in the bottom of the screen, as we show below.

2 Refining the Exercises

The user can refine exercise generation by setting different values for particular parameters of AGILMAT's backend. After the first step, the header of AGILMAT's interface changes to present a comprehensive set of parameters that control variables in AGILMAT's backend. The parameters, their range and default values depend on the basic profile defined previously. With the selections made in Figure 1, the parameters that would be made available are presented in Figure 2.

Figure 2: Screen of AGILMAT tool to refine the exercises generated.

Option 1 - Allows the user to change the quantity and difficulty of each sub-expression that can appear in exercises. There are currently supported three difficulty levels: easy, medium and hard. Table 1 presents the set of default values for the quantity and difficulty level of some subexpressions, and an example of a refinement.

Option 2 - To generate exercises again, the user presses the button "Generate exercises". The refined exercises are showed in Figure 3 (red elipse).

Option 3 - The user can return to the initial interface by pressing the button "Go back to start".

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Table 1: Quantity and dificult values of the sub-expressions before and after refining.

	Before refining		After refining	
Sub-expressions	Quantity	Dificulty	Quantity	Dificulty
Affine Function	20	Easy	20	Medium
Quadratic Function	4	Easy	4	Medium
Bisquare Function	2	Medium	0	Medium
Absolute Value	3	Medium	3	Hard
Nth Root	3	Hard	0	Hard
Nth Power	4	Medium	0	Medium
Sum of Functions	2	Hard	0	Hard
Product of Functions	2	Hard	1	Hard
Quotient of Functions	1	Hard	0	Hard

Figure 3: Screen of AGILMAT tool with the exercises refined.

Option 4 - Generated exercises can be saved in different formats by pressing "Save exercises". Formats currently supported are HyperText Markup Language (HTML), Portable Document Format (PDF) and PostScript (PS), but extensions to XML - Question & Test Interoperability (XML - QTI) are in planned.

3 Target users/public

This demo will be of interest to two types of audience:

A demo for the public in general. AGILMAT is directed to high school students and mathematics teachers (grade levels 10 to 12). The current prototype allows users to create hundreds of examples and their one-line solutions, about univariate functions. It is planned that by December the prototype may also produce step by step solutions, with pedagogic interest (i.e., that go beyond correct formula manipulation). In an educational perspective, we explore the advantages of this tool as a means for learning fundamental notions. For example, by making students understand and justify why the one-line solutions produced by the system are correct. The possibility of using the system for this purpose was validated in two recent demos of the system to high-school students.

A demo for researchers and math and informatics students. challenging aspects that may be interesting to discuss include:

Knowlegde representation the symbolic representation and manipulation of numbers, sets, constraints and problems, sheets of exercises;

Application domains the abstraction of problem templates and their formal description;

Customization providing different initial settings by parametrizing the interface, generator and solver; giving the user the possibility to further refine some of these parameters, to customize the exercises (to which extent?);

The system's architecture designing an architecture that caters for extensions and reformulations with minimal interference with the overall system;

Complexity issues decidability of problems, termination of solvers, writing step by step solutions in natural language, . . . ;

Implementation the integration of different technologies and programming languages.