From: Michael Gage <gage@math.rochester.edu>
Subject: **WeBWorK Applet interface for geogebra and other applets**
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Abstract: A brief description of the WeBWorK Applet interface as currently implemented with suggestions of how it might interact with Geogebra.

Report/Proposal:
We have developed a stable API for embedding both flash and java applets into the online homework system WeBWorK. (Home: http://webwork.maa.org)

In any homework question it is always possible to include the url for an external link to any applet or demonstration. In many cases students either do not follow the link at all or follow it, glance briefly at the demo but do not interact with it in any educationally meaningful way.

Embedding the applet in the homework question increases the interactivity. In particular it makes it possible to maintain the state of the applet (Geogebra in particular) from one invocation of the question to the next.) If the student completes only part of a complicated construction or interaction, the WeBWorK question will remember the applet's state so that when the student returns the Geogebra construction is just as they left it.

Further interaction is possible in the sense that when the homework question is submitted the student's "answer" is read directly from the Geogebra construction.

Here is a brief description of the WeBWorK applet API from
http://webwork.maa.org/wiki/Applets

Applets should respond when called by these functions

1. getXML() - the WW question is asking for an XML description of the applet's state. The description is text -- it is not base64 encoded. The XML description of the applet state should be suitable for use in setXML
2. setXML(state) - the applet is sending an XML description to reset the applet's state. The description is text -- it is not base64 encoded.
3. setConfig(configuration) - the applet is sending an initial configuration for the applet. The description is text -- it is not base64 encoded.
4. getAnswer() -- the applet responds with a string simulating an answer entered by the student. This is typically called when the submit button is pressed.
5. isActive() - a 1 or "true" response by the applet indicates that the applet is loaded, initialized and ready to go.
6. debug() - set when the applet is called from WW. If debug=1 the WW question is in debug mode and if the applet has the ability to issue extra error messages these should be turned on. If debug=0 then these error messages should be turned off.

Demos of applets, including both flash applets, java applets and geogebra applets, can be found at

http://hosted2.webwork.rochester.edu/webwork2/applet_dev

Geogebra already has the appropriate subroutines for preserving the applet's state. The getAnswer() functionality can be simulated by writing a custom javaScript
subroutine "getAnswer" which pulls the appropriate data from the Geogebra applet using the Geogebra javaScript interface and formulates an appropriate
student answer. Alternatively WeBWorK could analyze the XML string representing the entire state of the Geogebra applet to determine the answer, but that will in general be more more work.

Challenges: The main challenge at the moment for using the geogebra applets is that it can be tricky to hook the geogebra applet up to its external configuration file.
Because WeBWorK questions are served dynamically and not from a fixed directory, the applet, the question and the geogebra configuration may all have different
urls. We need to be able to specify the complete url to the configuration file. We also need better error recovery if the configuration file is not found or is corrupted.
Currently the message is "file not found" with no indication of which file or which url was used to search for the file. In addition it is possible for the geogebra applet
to hang at this point -- sometimes with a blank error message (which should contain "file not found") leaving an author no choice but to restart the browser and
begin all over again. A more useful error message and better recovery will allow an author to recover more easily from incorrectly specifying the path to a configuration

file.

For some browsers (Camino for example) Geogebra does always initialize properly. The information is there, but is not drawn on the screen.

Specific geogebra applet examples:
http://hosted2.webwork.rochester.edu/webwork2/applet_dev/GeogebraDemo1/ and
http://hosted2.webwork.rochester.edu/webwork2/applet_dev/PointAndGraph_AppletDemos/6/
http://hosted2.webwork.rochester.edu/webwork2/applet_dev/PointAndGraph_AppletDemos/7/

Other: The next step on our end will be to embed a wider variety of existing Geogebra demonstrations, particularly those related to calculus and higher courses, into
WeBWorK questions. We will evolve the interface as necessary while we do this -- I anticipate that the main additions will be a collection of javaScript subroutines
that make it easier to pull the student's "answer" from the constructions they have made in geogebra.

We will continue to work on improving the stability of geogebra and other applets so that they reliably display on all (or almost all)
browsers without special effort on the part of those writing the WeBWorK questions.

Best regards,

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