JSXGraph – Dynamic Mathematics Running on (nearly) Every Device

Michael Gerhäuser, Bianca Valentin, Alfred Wassermann
alfred.wassermann@uni-bayreuth.de
Department of Mathematics, University of Bayreuth
95440 Bayreuth, Germany

Abstract

Since Java applets seem to be on the retreat in web application, other approaches for displaying interactive mathematics in the web browser are needed. One such alternative could be our open-source project JSXGraph. It is a cross-browser library for displaying interactive geometry, function plotting, graphs, and data visualization in a web browser. It is implemented completely in JavaScript and uses the vector graphics formats SVG and VML. No further plug-ins are required.

1 Introduction

JSXGraph is a free software library for displaying dynamic, graphical mathematics in a web browser. Its feature set covers dynamic Geometry, function graphs, curves, charts, and turtle graphics.

Usually, JSXGraph is embedded in web pages, for on- or offline viewing, the download size is a mere 80 kByte. JSXGraph enhanced web pages can be viewed with all major web browsers on nearly every hardware platform and operating system. The supported hardware ranges from smartphones and tablet computers running iOS or Android to Desktop PC running Windows, MacOS X or Linux.

At the time of writing, JSXGraph is the only dynamic geometry system that runs on such a broad range of devices and web browsers—without installation of any plug-in or wathsoever additional software. JSXGraph is usable even on devices with limited computing resources, like cheap tablet PCs or outdated Desktop PCs running Microsoft Internet Explorer 6.0.

Thus, this library may prove to be helpful for the introduction of technology in mathematical education in developing countries.

JSXGraph is an open source project hosted by sourceforge, the library is released under the Lesser GNU General Public License (LGPL). In order to use JSXGraph the developer has to include only two files in the HTML file: the JSXGraph code and a CSS file.

The size of the JSXGraph code is about 380 kByte. If the web server delivering the content has data compression enabled (which should be the default anyhow) the size of the transmitted code is

about 80 kByte. To compare it with Java software, for example the size of the GEONE$_X$T archive is about 1 Mbyte. JSXGraph does not rely on any other JavaScript library.

JSXGraph is not meant to be programmed directly by the teacher or student. Rather, it is a software library used transparently in a web page to display geometry resources, or to work internally as the mathematical visualization engine in a Web 2.0 application. For example the successor of GEONE$_X$T will be based on JSXGraph. Nevertheless, for the dauntless teacher having some experience in JavaScript programming, it should be no problem to create constructions with JSXGraph.

2 Requirements

JSXGraph runs on every hardware and operating system which has a graphical web browser. The range of supported hardware thus reaches from Desktop PCs down to tablet computers and smartphones.

All the mainstream web browser are supported, Firefox 3+, Internet Explorer 6+ (including the upcoming version 9), Google Chrome (all versions). Also, the browsers Safari, Opera are supported since at least 2008.

For smartphones the Opera mini is supported but without interactivity. Also Android based devices are supported since the release of the JSXGraph v0.82. The default browser on these devices (at least up to Android 2.2) does not provide SVG or VML graphics. But in the latest version of JSXGraph the use of the HTML canvas element is enabled. Thus, a new range of devices is able to run JSXgraph.

3 Features

3.1 Geometry

Plane geometry with homogeneous or affine coordinates,

3.2 Calculus and function plotting

Function plotting, parametric curves, polar plots. Differential equation solver.

Interpolation: Lagrange interpolation, cubic splines, B-splines, Bezier curves.

3.3 Other topics

Projective transformations, Turtle graphics, charting. Initial attempts to display 3D points.

3.4 Importing file formats

* GEONE$_X$T * Intergeo file format i2geo * GeoGebra * Cinderella (alpha quality) * Arcview (server based)

3.5 Plug-ins

* moodle * wordpress * mediawiki

```
<jsxgraph width="500" height="500">
  var brd = JXG.JSXGraph.initBoard('jxgbox',{boundingbox:[-2,2,2,-2]});
  var p = brd.create('point',[1.5,1.5],{face:'o', size:8});
  brd.create('segment',[[0,0],p],{dash:3});
</jsxgraph>
```

* drupal

3.6 New features

* Bezier curves * Conic sections * LaTeX syntax for labels and texts o ASCIIMathML (falls back to Google chart API) o MathJax (http://www.mathjax.org) * Animations * Flexible layer system

4 JessieScript

* Having to program everything with JavaScript to display math with JSXGraph is a hurdle for using it in classroom with students. * Alternative: JessieScript * JessieScript is a syntax similar to what is taught in schools and can be parsed by JSXGraph. * Examples: P(1,1); Q(-2,2); g=[PQ]; k(P,2); M=1/2(P,Q); ——(g,M); * Easy to learn and use * Fosters algorithmic thinking

5 Conclusion

References

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[4] http://cinderella.de

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[6] http://geogebra.org

[7] Crockford D. (2008) JavaScript: The good parts, Sebastopol, CA, O'Reilly.