

Sketchometry and JSXGraph: Dynamic Mathematics for Tablets

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There is a hardware revolution going on

- ▶ After Desktop PCs the world now goes mobile



Tablets are well suited for use in class room!

- ▶ Pros:
 - ▶ can be used in class, side by side with paper, printed books
 - ▶ can be used any time
 - ▶ battery life good
 - ▶ affordable
 - ▶ interactive ebooks
- ▶ Cons:
 - ▶ no mouse
 - ▶ no keyboard
 - ▶ not much mathematics software available, yet

Demands

- ▶ (More) math software for the classroom
- ▶ Interactive eTextbooks
- ▶ Authoring tools to produce ebooks and mathlets

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Challenges for software developers

- ▶ multiple hardware and OS platforms
- ▶ no Java plug-in
- ▶ no Flash plug-in



- ▶ no mouse, no keyboard
- ▶ no file system available

New hardware needs new software interfaces

- ▶ This is a good chance to rethink user interaction
- ▶ Use fingers to interact directly
- ▶ Avoid menu and toolbar clicking (tailored for mouse pointers)
- ▶ Support exchange: Storage in the cloud
- ▶ HTML 5 for platform independence



Figure:

Sketchometry: a new dynamic geometry system

- ▶ Tailored for use in classroom by students
- ▶ Runs on tablets, desktop PCs, whiteboards, (smartphones)
- ▶ Euclidean geometry, function plotting
- ▶ Free to use

Construct by finger sketches

- ▶ Finger sketches are analyzed by a mixture of
 - ▶ gesture recognition
 - ▶ sketch recognition
- ▶ previous attempts:
 - ▶ T. Hammond: “Sketch recognition lab” (among others)
 - ▶ U. Kortenkamp, J. Richter-Gebert: “The Interactive Geometry Software Cinderella”
- ▶ Surprise: mouse interaction is also better

Sketchometry

- ▶ Firefox, Chrome, Safari, IE 9, Opera
- ▶ Save constructions in the “cloud”



- ▶ Based on *JSXGraph*
- ▶ Internal file format: *JessieCode*

JSXGraph

- ▶ JavaScript library
- ▶ License: LGPL
- ▶ Many examples from geometry, calculus

Why do we need JessieCode?

- ▶ Sketchometry is based on our JavaScript library *JSXGraph*
- ▶ For security reason, we need a *middle layer*, whenever external people want to collaborate on the web (wiki, forum, ...)
- ▶ In JavaScript *eval()* is considered evil.
- ▶ Filters based on regular expressions are not sufficient
- ▶ Example (A. Cecchetti, Hacker monthly 11 (2011)): valid JavaScript equivalent to `alert(document.cookie)`

```
([$=[$=[]][(_=!$+$)  
[_=~--~--~$]+({}+$)[_/_]+  
($$=($_!= ' '+$)[_/_]  
+$_[+$])))()[_[_/_]+_  
[_+~$]+$_[_]+$$](document.cookie)
```

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- ▶ Interactive eTextbooks
- ▶ *Authoring tools to produce ebooks and mathlets*
 - ▶ *SketchBin* (see Bret Victor - Inventing on Principle)

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Ebooks

- ▶ The ebook file format *epub3* enables interactive math textbooks.
- ▶ It is easy to embed JSXGraph and JessieCode in epub3 books.
- ▶ Alternatively, JSXGraph widgets run with *Apple iBooks Author*.
- ▶ See talk by Carsten Miller

Links

- ▶ <http://sketchometry.org> (project home page)
- ▶ <http://jsxgraph.org> (JSXGraph)

Thank you very much!