JSXGraph: recent developments

Versions v1.9 - v1.11

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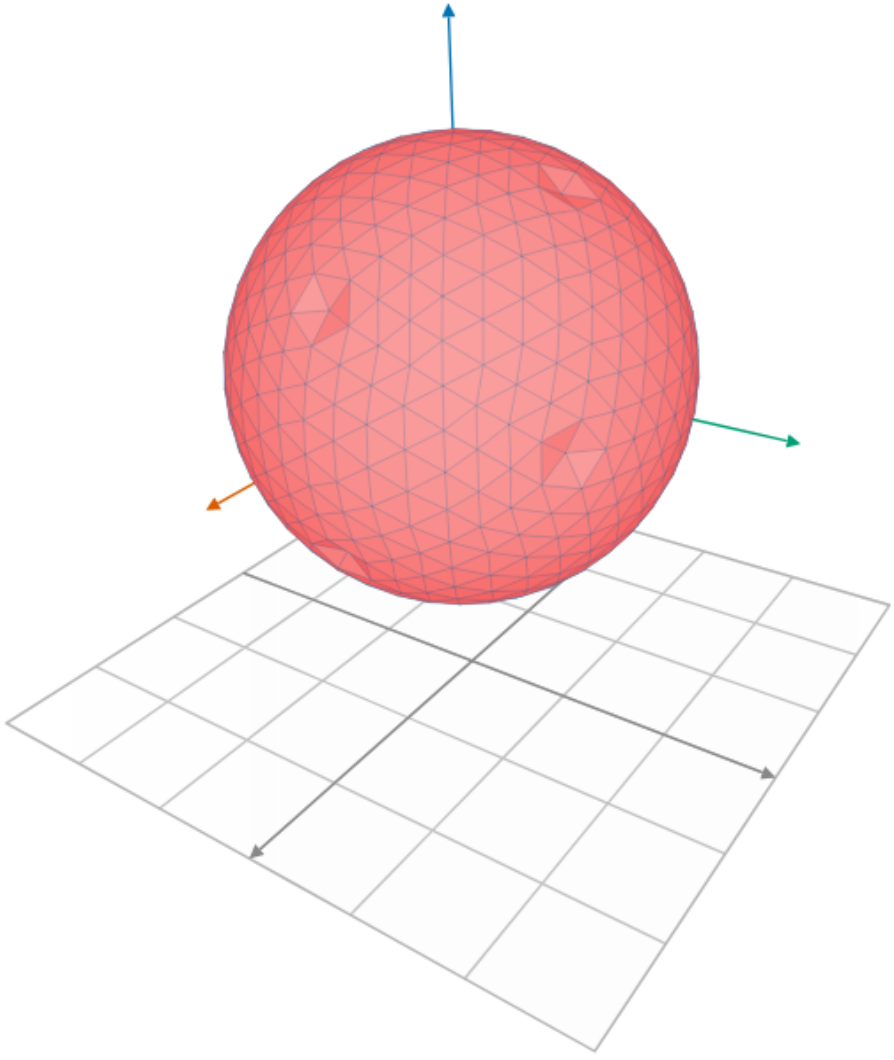

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JSXGraph

A few words in advance

- JSXGraph is a low-level, but very powerful JavaScript library
- Parts of the presentation are a bit technical and are directed to advanced users.
- In case, just enjoy the pictures
- Carsten will show prefactored, adaptable assessment examples
- There will be a beginners' workshop tomorrow at noon

More information on JSXGraph

- JSXGraph homepage https://jsxgraph.org/
- JSXGraph forum https://forum.jsxgraph.org/
- API reference https://jsxgraph.org/docs

Recent developments

Version history

- First release: 2008
- Amberg 2024: v1.8
- Durham 2025: v1.11

Selected topics

- 3D
- Attribute handling / ARIA
- New Math functionality
- CSS classes

3D support

JSXGraph's 3D rendering

- started in Erasmus+ project IDIAM
- is programmed from scratch
- is based on 2D graphics with SVG or canvas
- has its limits
- Nevertheless, the results are surprisingly good

New:

- New elements: `polyhedron3d`, `sphere3d`, `circle3d`, `intersectionline3d`, `polygon3d`, `text3d`, `ticks3d`
- `point3d` may "glide" on lines and curves
- 3D transformations
- Depth ordering
- Central or parallel projection
- Virtual trackball for 3 degrees of freedom
- Shader
- 3D axes position `'border'`

New element *polyhedron3d*

- A *polyhedron* is defined by list of *vertices* and a list of *faces*
  - A *vertex* is an array of coordinates or a *point3d*
  - A *face* is defined as a list of vertices, given by index or key
- Faces by vertex keys
- Faces by vertex indices
- Dynamic vertices
- Depth ordering is done “layer-wise”

Shading

- https://jsfiddle.net/z2cj5uLt/
- Subdivided icosahedron

3D transformations

- 3D transformations are supported for the elements *point3d*, *line3d*, *plane3d*, *curve3d*, *surface3d*, *polyhedron3d*
- At the time being, the following transformation types are supported:
  - `translate`
  - `scale`
  - `rotate`
  - `rotateX`
  - `rotateY`
  - `rotateZ`
- Transformation of surfaces
- Transformation of polyhedra

Attribute functions with parameter

- Demo example

```
board.create('point', [0, 0], {
  size: (self) => 2 * Math.abs(self.X())
});
```

- Heat map example

ARIA

- ARIA: Accessible Rich Internet Applications
- ARIA attributes are supported in all JSXGraph elements
- One can supply all attributes starting with *aria-*
- Example that sets the attribute *aria-label*:

```
var p = board.create('point', [2, 3], {
  name: 'B',
  aria: {
    enabled: true,
    label: (self) => `${self.name} is at ${self.X()} ${self.Y()}`,
    live: 'polite'
  }
});
```

Attention: this feature is for SVG only

Math functionality

`otherintersection`

- Example: elliptic curves group law

Convexity

- Convex hull
- Test for convexity

Statistics

- Checkout the API docs for random number generators for various distributions

Label positioning

- Label position on 1-dim objects

CSS classes for all elements

- CSS classes can be added to all JSXGraph elements
- Before, this was only possible for text elements
- This allows the use of SVG filters
- Applications:
  - Accessibility (e.g. color blindness)
  - Improved referencing
  - Fun
- Example (by Carsten Miller)

Let’s work together

- Join the discussion in the new forum at https://forum.jsxgraph.org
- Come to the next JSXGraph online conference at https://jsxgraph.org/conf2025 on 7.-9. October 2025 and share your work

> Thank you very much for your attention!