

JSXGraph Reference Card

Include JSXGraph in HTML

Three parts are needed: Include files containing the software, an HTML element, and JavaScript code.

Include files:

Two files have to be included: `jsxgraph.css`, and `jsxgraph-core.js`.

```
- <link rel="stylesheet" type="text/css"
      href="domain/jsxgraph.css"/>
- <script type="text/javascript"
      src="domain/jsxgraphcore.js"></script>
```

`domain` is the location of the files. This can be a local directory or `http://jsxgraph.uni-bayreuth.de/distrib/`

HTML element containing the construction:

```
<div id="box" class="jxgbox"
      style="width:600px; height:600px;"></div>
```

JavaScript code:

```
<script type="text/javascript">
  var brd = JXG.JSXGraph.initBoard('box',{axis:true});
</script>
```

Initializing the board

```
var brd = JXG.JSXGraph.initBoard('box',{attributes});
```

– *Attributes of the board*

boundingbox: $[x_1, y_1, x_2, y_2]$ user coordinates of the upper left and bottom right corner

keepaspectratio: `true/false` default: `false`

zoomX, zoomY: zoom factor in x/y -axis direction

zoomfactor: overall zoom factor in both directions

axis, grid, showNavigation, showCopyright: `true/false`
show axis, grid, zoom/navigation buttons, display copyright

Properties and methods of the board:

brd.snapToGrid: `true/false` grid mode

brd.suspendUpdate() stop updating (if speed is needed)

brd.unsuspendUpdate() restart updating

brd.addChild(brd2) Connect board `brd2` to board `brd`

Basic commands

```
var el = brd.create('type',[parents],[attributes]);
el.setProperty({key1:value1,key2:value2,...});
```

Point

```
brd.create('point',[parents],[attributes]);
```

Parent elements:

$[x, y]$ Euclidean coordinates
 $[z, x, y]$ Homogeneous coordinates (z in first place)
`[function(){return p1.X();},
function(){return p2.Y();}]` Functions for x, y , (and z)
`[function(){return [a,b];}]` Function returning array
`[function(){return new JXG.Coords(...);}]` Function returning Coords object

Methods

`p.X()`, `p.Y()` x -coordinate, y -coordinate
`p.Z()` (Homogeneous) z -coordinate
`p.Distance(q)` Distance from p to point q

Glider

Point on circle, line, curve, or turtle.

```
brd.create('glider',[parents],[attributes]);
```

Parent elements:

$[x, y, c]$ Initial coordinates and object to glide on
 $[c]$ Object to glide on (initially at origin)

Coordinates may also be defined by functions, see Point.

Line

```
brd.create('line',[parents],[attributes]);
```

Parent elements:

$[p_1, p_2]$ line through 2 points
 $[c, a, b]$ line defined by 3 coordinates (can also be functions)
 $[x_1, y_1], [x_2, y_2]$ line by 2 coordinate pairs

In case of coordinates as parents, the line is the set of solutions of the equation $a \cdot x + b \cdot y + c \cdot z = 0$.

Circle

```
brd.create('circle',[parents],[attributes]);
```

Parent elements:

$[p_1, p_2]$ 2 points: center and point on circle line
 $[p, r]$ center, radius (constant or function)
 $[p, c], [c, p]$ center, circle from which the radius is taken
 $[p, l], [l, p]$ center, line segment for the radius
 $[p_1, p_2, p_3]$ circle through 3 points
Points may also be specified as array of coordinates.

Polygon

```
brd.create('polygon',[p1,p2,...],[attributes]);
[p1,p2,...] The array of points
is connected by line segments and the inner area is filled.
brd.create('regularpolygon',[p1,p2,n],[attributes]);
```

Slider

```
var s = brd.create('slider',[[a,b],[c,d],[e,f,g]],[atts]);
[a,b],[c,d]: visual start and end position of the slider
[e,f,g]: the slider returns values between  $e$  and  $g$ ,
the initial position is at value  $f$ 
snapWidth:num minimum distance between 2 values
s.Value(): returns the position of the slider  $\in [e, g]$ 
```

Group

```
brd.create('group',[p1,p2,...],[attributes]);
[p1,p2,...] array of points
Invisible grouping of points. If one point is moved, the others
are transformed accordingly.
```

Curve

```
- brd.create('functiongraph',[parents],[atts]);
Function graph,  $x \mapsto f(x)$ 
```

```
[function(x){return x*x;},-1,1] function term
optional: start, end
```

```
- brd.create('curve',[parents],[attributes]);
· Parameter curve,  $t \mapsto (f(t), g(t))$ :
```

```
[function(t){return 5*t;},function(t){return t*t;},0,2]
 $x$  function,  $y$  function, optional: start, end
```

· *Polar curve*: Defined by the equation $r = f(\phi)$.

```
[function(phi){return 5*phi;},[1,2],0,Math.PI]
Defining function, optional: center, start, end
```

· *Data plot*:

```
[[1,2,3],[4,-2,3]] array of  $x$ - and  $y$ -coordinates, or
[[1,2,3],function(x){return x*x;}]
array of  $x$ -coordinates, function term
```

```
- brd.create('spline',[p1,p2,...],[attributes]);
[p1,p2,...] Cubic spline: array of points
```

```
- brd.create('riemannsum',[f,n,type],[atts]);
Riemann sum of type 'left', 'right', 'middle', 'trapezodial', 'upper', or 'lower'
```

Tangent, normal

```
var el = brd.create('tangent',[g],[attributes]);
var el = brd.create('normal',[g],[attributes]);
g glider on circle, line, polygon, curve, or turtle
```

Turtle

```
var t = brd.create('turtle',[parents],[atts]);
t.X(), t.Y(), t.dir position, direction (degrees).
```

Parent elements:

$[x, y, angle]$ Optional start values for x, y , and direction

Methods:

```
t.back(len); or t.bk(len);
t.clean(); erase the turtle lines without resetting the turtle
t.clearScreen(); or t.cs(); call t.home() and t.clean()
t.forward(len); t.fd(len);
t.hideTurtle(); or t.ht();
t.home(); Set the turtle to [0,0] and direction to 90.
t.left(angle); or t.lt(angle);
t.lookTo(t2.pos); Turtle looks to the turtle t2
t.lookTo([x,y]); Turtle looks to a coordinate pair
t.moveTo([x,y]); Move the turtle with drawing
t.penDown(); or t.pd();
t.penUp(); or t.pu();
t.popTurtle(); pop turtle status from stack
t.pushTurtle(); push turtle status on stack
t.right(angle); or t.rt(angle);
t.setPos(x,y); Move the turtle without drawing
t.setPenColor(col); col: colorString, e.g. 'red' or '#ff0000'
t.setPenSize(size); size: number
t.showTurtle(); or t.st();
```

Other geometric elements

– *angle*: filled area defined by 3 points
`e1 = brd.create('angle', [A,B,C], {attributes});`

– *arc*: circular arc defined by 3 points
`e1 = brd.create('arc', [A,B,C], {attributes});`

– *arrow*: line through 2 points with arrow head
`e1 = brd.create('arrow', [A,B], {attributes});`

– *arrowparallel*: arrow parallel to arrow *a* starting at point *P*
`e1 = brd.create('arrowparallel', [a,P], {atts});` or `[P,a]`

– *bisector*: angular bisector defined by 3 points, returns line
`e1 = brd.create('bisector', [A,B,C], {atts});`

angular bisector defined by 2 lines, returns 2 lines
`e1 = brd.create('bisectorlines', [l1,l2], {atts});`

– *circumcircle*: circle through 3 points (deprecated)
`e1 = brd.create('circumcircle', [A,B,C], {atts});`

– *circumcirclemidpoint*: center of circle through 3 points
`e1 = brd.create('circumcirclemidpoint', [A,B,C]);`

– *midpoint*: midpoint between 2 points or the 2 points defined by a line
`e1 = brd.create('midpoint', [A,B], {atts});` or `[line]`

– *mirrorpoint*: rotate point *B* around point *A* by 180°
`e1 = brd.create('mirrorpoint', [A,B], {atts});`

– *parallel*: line parallel to line *l* through point *P*
`e1 = brd.create('parallel', [l,P], {atts});` or `[P,l]`

– *parallepoint*: point *D* such that *ABCD* from a parallelogram
`e1 = brd.create('parallepoint', [A,B,C], {atts});`

– *perpendicular*: line perpendicular to line *l* through point *P*
`e1 = brd.create('perpendicular', [l,P], {atts});` or `[P,l]`

– *perpendicularpoint*: point defining a perpendicular line to line *l* through point *P*
`e1 = brd.create('perpendicularpoint', [l,P], {});` or `[P,l]`

– *reflection*: reflection of point *P* over the line *l*. Superseded by transformations
`e1 = brd.create('reflection', [l,P], {atts});` or `[P,l]`

– *sector*: circle sector defined by 3 points ???
`e1 = brd.create('sector', [A,B,C], {atts});`

– *semi circle*: defined by 2 points *p1* and *p2*.
`brd.create('semicircle', [p1,p2], {atts});`

– *intersection*: of 2 objects (lines or circles).
Returns array of length 2 with first and second intersection point (also for line/line intersection).
`brd.create('intersection', [o1,o2,n], {atts});`

Text

Display static or dynamic texts.

```
e1 = brd.create('text', [x,y, "Hello"]);
e1 = brd.create('text', [x,y,f]);
```

Example for a dynamic text: return the *x* coordinate of the point *p*.

```
f = function(){ return p.X(); }
```

Image

Display bitmap image (also as data uri).

```
e1 = brd.create('image', [uri-string, [x,y], [w,h]]);
```

Optional: `[x,y]` top-left position, `[w,h]` width, height

Attributes of geometric elements

Generic attributes:

<code>strokeWidth:</code>	number
<code>strokeColor, fillColor, highlightFillColor,</code>	
<code>highlightStrokeColor, labelColor:</code>	color string
<code>strokeOpacity, fillOpacity, highlightFillOpacity,</code>	
<code>highlightStrokeOpacity:</code>	value between 0 and 1
<code>visible, trace, draft:</code>	true, false
<code>dash:</code>	dash style for lines: 0, 1, ..., 6

Attributes for point elements:

<code>face:</code>	point style: '[]', 'o', 'x', or '+'
<code>size:</code>	number
<code>fixed:</code>	true, false

Attributes for line elements:

`straightFirst, straightLast, withTicks:` true, false

Attributes for line and arc elements:

`firstArrow, lastArrow:` true, false

Attributes for polygons elements:

`withLines:` true, false

Attributes for text elements:

`display:` 'html', 'internal'

Color string:

HTML color definition or HSV color scheme:

`JXG.hsv2rgb(h,s,v)` $0 \leq h \leq 360, 0 \leq s, v \leq 1$
returns RGB color string.

Transform

Affine transformation of objects.

```
t = brd.create('transform', [data, base], {type: 'type'});
```

`base`: the transformation is applied to the coordinates of this object.

Possible types:

- translate: `data=[x,y]`
- scale: `data=[x,y]`
- reflect: `data=[line]` or `[x1,y1,x2,y2]`
- rotate: `data=[angle,point]` or `[angle,x,y]`
- shear: `data=[angle]`
- generic: `data=[v11,v12,v13,v21,...,v33]` 3×3 matrix

Methods:

`t.bindTo(p)` the coordinates of *p* are defined by *t*

`t.applyOnce(p)` apply the transformation once

`t.melt(s)` combine two transformations into one: $t := t \cdot s$

`p2 = brd.create('point', [p1,t], {fixed:true});`
Point *p2*: apply *t* on point *p1*

Mathematical functions

Functions of the intrinsic JavaScript object *Math*:

`Math.abs, Math.acos, Math.asin, Math.atan, Math.ceil,`
`Math.cos, Math.exp, Math.floor, Math.log, Math.max,`
`Math.min, Math.random, Math.sin, Math.sqrt, Math.tan`

`(number).toFixed(3)`: Rounding a number to fixed precision

Additional mathematical functions are methods of `JXG.Board`.

<code>brd.angle(A,B,C)</code>	angle <i>ABC</i>
<code>brd.cosh(x), board.sinh(x)</code>	
<code>brd.pow(a,b)</code>	a^b
<code>brd.D(f,x)</code>	compute $\frac{d}{dx}f$ numerically
<code>brd.I([a,b],f)</code>	compute $\int_a^b f(x)dx$ numerically
<code>brd.root(f,x)</code>	root of the function <i>f</i> .
	Uses Newton method with start value <i>x</i>
<code>brd.factorial(n)</code>	computes $n! = 1 \cdot 2 \cdot 3 \cdots n$
<code>brd.binomial(n,k)</code>	computes $\binom{n}{k}$
<code>brd.distance(arr1,arr2)</code>	Euclidean distance
<code>brd.lagrangePolynomial([p1,p2,...])</code>	returns a polynomial through the given points
<code>brd.neville([p1,p2,...])</code>	polynomial curve interpolation
<code>c = JXG.Math.Numerics.bezier([p1,p2,...])</code>	Bezier curve
<code>p2, p3, p5, p6, ...</code>	are control points. <code>brd.create('curve', c);</code>
<code>f = JXG.Math.Numerics.regressionPolynomial(n,xArr,yArr)</code>	Regression pol. of deg. <i>n</i> : <code>brd.create('functiongraph', f);</code>
<code>brd.riemannsum(f,n,type,start,end)</code>	Volume of Riemann sum, see <i>Curves</i>

– Intersection of objects:

`brd.intersection(e11,e12,i,j)` intersection of the elements *el1* and *el2* which can be lines, circles or curves

In case of circle and line intersection, $i \in \{0,1\}$ denotes the first or second intersection. In case of an intersection with a curve, *i* and *j* are floats which are the start values for the path positions in the Newton method for *el1* and *el2*, resp.

Todo list

'axis', 'integral', 'ticks'.

Chart

To do ...

Links

Help pages are available at <http://jsxgraph.org>