

JSXGraph Reference Card

Include JSXGraph in HTML

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

Include files:

Three files have to be included: `jsxgraph.css`, `jsxgraphcore.js` and either `prototype.js` or `jquery.js`.

```
- <script type="text/javascript"
  src="domain/prototype.js"></script>
or - <script type="text/javascript"
  src="domain/jquery.min.js"></script>
- <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*

<code>unitX, unitY:</code>	number of pixels of one unit in <i>x/y</i> -axis direction
<code>originX, originY:</code>	the coordinates of the origin in pixel coordinates
<code>zoomX, zoomY:</code>	zoom factor in <i>x/y</i> -axis direction
<code>zoomfactor:</code>	overall zoom factor in both directions
<code>axis:true/false:</code>	show axes
<code>grid:true/false:</code>	show grid

Properties and methods of the board:

```
brd.snapToGrid:true/false:      grid mode
brd.suspendUpdate()             stop updating (if speed is needed)
brd.unsuspendUpdate()           restart updating
```

Basic commands

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

Point

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

Parent elements:

<code>[x,y]</code>	Euclidean coordinates
<code>[z,x,y]</code>	Homogeneous coordinates (<i>z</i> in first place)
<code>[function(){return p1.X();}, function(){return p2.Y();}]</code>	Functions for <i>x,y</i> , (and <i>z</i>)

Methods

<code>p.X()</code> , <code>p.Y()</code>	<i>x</i> -coordinate, <i>y</i> -coordinate
<code>p.Z()</code>	(Homogeneous) <i>z</i> -coordinate
<code>p.Distance(q)</code>	Distance from <i>p</i> to point <i>q</i>

Glider

Point on circle, line or curve.

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

Parent elements:

<code>[x,y,c]</code>	Initial coordinates and object to glide on
<code>[c]</code>	Object to glide on (initially at origin)

Coordinates may also be defined by functions, see Point.

Line

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

Parent elements:

<code>[p1,p2]</code>	line through 2 points
<code>[c,a,b]</code>	line defined by 3 coordinates (can also be functions)
<code>[x1,y1],[x2,y2]</code>	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.createElement('circle',[parents],[attributes]);
```

Parent elements:

<code>[p1,p2]</code>	2 points: center and point on circle line
<code>[p,r]</code>	center, radius (constant or function)
<code>[p,c],[c,p]</code>	center, circle from which the radius is taken
<code>[p,l],[l,p]</code>	center, line segment for the radius
<code>[p1,p2,p3]</code>	circle through 3 points

Points may also be specified as array of coordinates.

Polygon

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

Slider

```
var s = brd.createElement('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
s.Value(): returns the position of the slider  $\in [e,g]$ 
```

Group

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

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

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

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

Tangent, normal

```
var el = brd.createElement('tangent',[g],[attributes]);
var el = brd.createElement('normal',[g],[attributes]);
g circle, line, polygon, or curve to glide on
```

Turtle

```
var t = brd.createElement('turtle',[parents],[atts]);
```

The turtle has a position and a direction (always in degrees).

Parent elements:

<code>[x,y,angle]</code>	Optional start values for <i>x</i> , <i>y</i> , and direction
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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
`el = brd.createElement('angle', [A,B,C], {attributes});`

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

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

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

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

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

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

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

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

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

– *parallelpoin*t: point D such that $ABCD$ from a parallelogram
`el = brd.createElement('parallelpoin', [A,B,C], {atts});`

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

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

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

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

Text

Display static or dynamic texts.

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

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

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

Attributes of geometric elements

Generic attributes:

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

Attributes for point elements:

`style`: point style: 0,1,...,12
`fixed`: 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

Transform

Affine transformation of objects.

`t = brd.createElement('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 to one: $t := t \cdot s$

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`.

`brd.angle(A,B,C)` angle ABC

`brd.cosh(x), board.sinh(x)`

`brd.pow(a,b)` a^b

`brd.D(f,x)` compute $\frac{d}{dx}f$ numerically

`brd.I([a,b],f)` compute $\int_a^b f(x)dx$ numerically

`brd.root(f,x)` root of the function f .

Uses Newton method with start value x

`brd.factorial(n)` computes $n! = 1 \cdot 2 \cdot 3 \cdots n$

`brd.binomial(n,k)` computes $\binom{n}{k}$

`brd.distance(arr1,arr2)` Euclidean distance

`brd.lagrangePolynomial([p1,p2,...])`

returns a polynomial through the given points

`brd.neville([p1,p2,...])` polynomial curve interpolation

`brd.riemannsum(f,n,type,start,end)` Volume of Riemann

sum, see *Curves*

– Intersection of objects:

`brd.intersection(el1,el2,i,j)` intersection of the elements
 el_1 and el_2 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 el_1 and el_2 , resp.

Todo list

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

Chart

To do ...

Links

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