

A brief guide to preparing geometric constructions

`(elaboration b)`

Draw elaborating circles, lines, etc. in addition to the arc of the instrument. `b` is either `#t` (true) or `#f` (false).

`(mirroring b)`

Draw mirrored circles, lines, arcs around the y-axis. `b` is either `#t` or `#f`.

`(title m)`

Give a printed title to the drawing.

`(coded-by m)`

Says who prepared the drawing. A good identification.

Points

`(point x y)`

Point with coordinate (x,y) .

`origin`

`(point 0 0)`

`(xcor p)`

`(ycor p)`

x- and y-coordinates of a point `p`.

`(xshift p d)`

`(yshift p d)`

Shift point `p` on the x- or y-axis by distance `d`.

`(mirror p)`

The mirror point to `p` (around the y-axis).

`(distance p1 p2)`

Distance between two points.

`(at p1 p2)`

Synonymous with `(point (xcor p1) (ycor p2))`.

`(xdistance p1 p2)`

`(ydistance p1 p2)`

Absolute value of difference in their x- and y-coordinates.

`(xsquish p m)`

Point `p`, except with x-coordinate `(* m (xcor p))`.

`(ysquish p m)`

Point `p`, except with `y`-coordinate (`* m (ycor p)`).

`(left twopoints)`

`(right twopoints)`

`(bottom twopoints)`

`(top twopoints)`

Given a list of two points, returns the leftmost/rightmost/lowest/highest one.

Vectors

`(vec p q)`

Vector from point `p` to point `q`.

`(vec+ v1 v2)`

Addition.

`(vecneg v)`

Negation.

`(vec- v1 v2)`

Subtraction.

`(scalevec s v)`

Scaling.

Lines

`(line p1 p2)`

The line through points `p1` and `p2`.

`(first-point L)`

`(second-point L)`

The first and second of the points defining the line.

`(mirrorline L)`

The line through the mirrored points defining `L`.

`(linefun l)`

Turns a line into a function: if `L` is a line, then

`((linefun L) 10)` gives the `y`-coordinate of the line at `x=10`.

`(funline f)`

The line defined by the linear function `f`.

`(linefun (funline f))` is just `f`: `linefun` and `funline` are inverses.

`(linefrom m pt)`

The line with slope `m` through point `pt`.

`(horizontal p)`

`(vertical p)`

The horizontal and vertical lines through point `p`.

`x-axis`

`y-axis`

Synonymous with `(horizontal origin)` and `(vertical origin)`.

Circles

`(circle p r)`

Circle with center (a point `p`) and radius `r`.

`(circlefrom p q)`

`(circle p (distance p q))`

`(center c)`

`(radius c)`

The center point and radius of circle `c`.

`(csquish c m)`

Circle `c`, but with radius `(* m (radius c))`.

`(mirrorcircle c)`

Circle with center `(mirror (center c))` and radius `(radius c)`.

`(right-circle circles)`

`(left-circle circles)`

`(upper-circle circles)`

`(lower-circle circles)`

Given two circles, the circle with center furthest (to the right/left, above/below).

`(north c)`

`(south c)`

`(east c)`

`(west c)`

The point on circle `c` that is the highest, lowest, rightmost, leftmost.

`(transpose obj)`

Transpose a point, line, or circle (by transposing its center) by exchanging `x` and `y` axes: `(transpose (point x y))` equals `(point y x)`, etc.

Intersections

`(intersect p q)`

The points on the intersection of p and q (which can be lines or circles). Either a point is returned, a list of two points, or a list of no points.

`(closest p pts)`

The point in list pts that is closest to point p.

`(left twopoints)`

`(right twopoints)`

`(bottom twopoints)`

`(top twopoints)`

Given a list of two (intersection) points, returns the leftmost/rightmost/lowest/highest one.

Arithmetic with a ruler and compass

`(sum a b)` `(difference a b)`

`(product a b)` `(divide y x)` `(reciprocal x)`

`(square-root a)`

Arithmetic, using purely geometric constructions.

Some generic geometric constructions

`(perpendicular l p)`

The line perpendicular to line l through point p.

`(pointfrom a b t)`

A parameterized point: $t=0$ at a, $t=1$ at b on (line a b)

`(pointfrom a b (: m n))`

Synonymous with `(pointfrom a b (/ m (+ m n)))`.

`(pointfrom a b geometric)`

`(pointfrom a b harmonic)`

`(pointfrom a b subharmonic)`

Geometric sections.

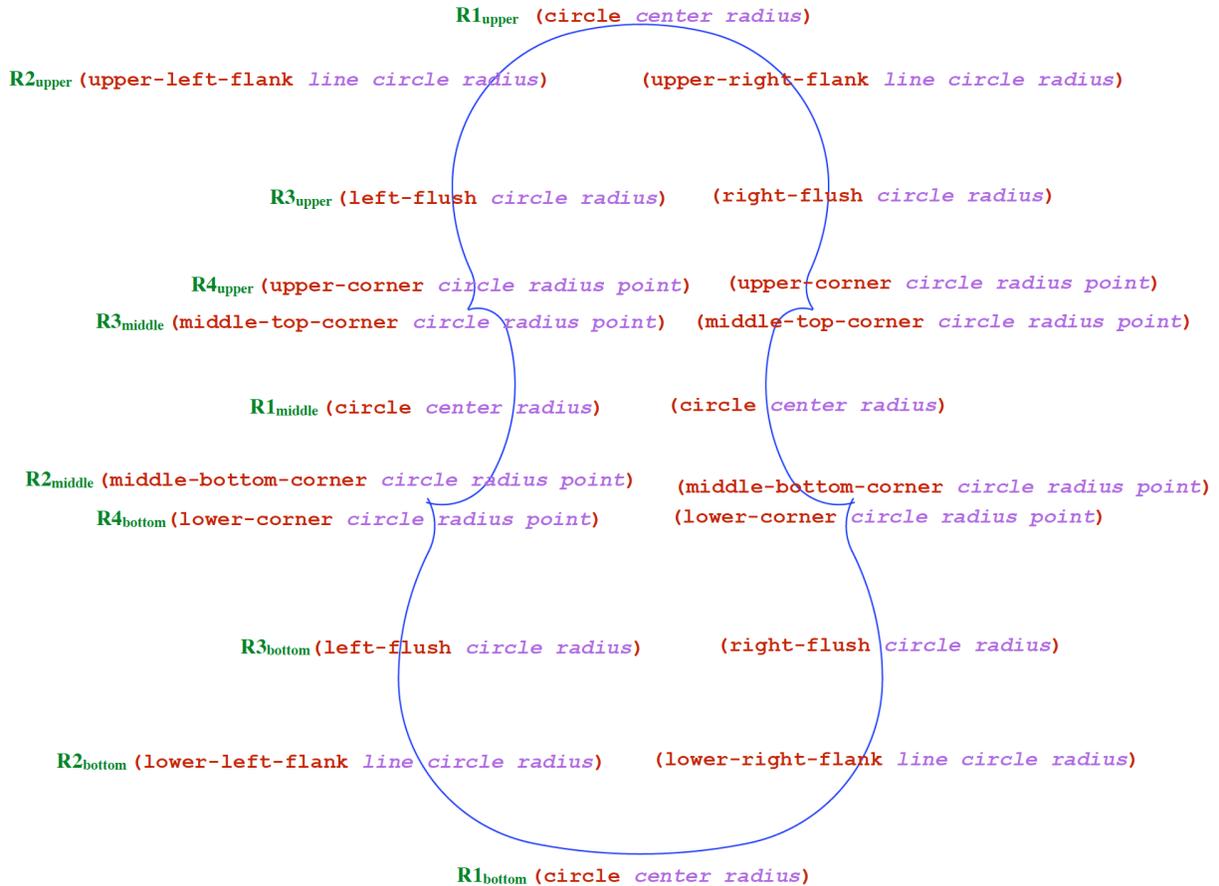
`(midpoint p q)`

The midpoint between points p and q.

`(bisector p q)`

The line of points equidistant from points p and q, or (synonymously) `(perpendicular (line p q) (midpoint p q))`.

Complex curves for string instrument outlines



The sequences of arcs forming the upper, middle and lower bouts are (following Denis) called $R1$, $R2$, etc. Here are constructions for forming some of those arcs.

(upper-left-flank l c r)

The highest of the two circles with radius r that are tangent to the right side of line l (on the left side of the drawing) tangent to the interior of circle c .

(upper-right-flank l c r)

Dually, the highest of the two circles with radius r that are tangent to the left side of line l (on the right side of the drawing) tangent to the interior of circle c .

(lower-left-flank l c r)

The lowest of the two circles with radius r that are tangent to the right side of line l (on the left side of the drawing) tangent to the interior of circle c .

`(lower-left-flank l c r)`
Dually on the right side.

`(left-flush c r)`
`(right-flush c r)`

The circle with radius `r` that is tangent to the interior of circle `c` at its leftmost (resp., rightmost) point.

`(upper-corner c r p)`

The lowest of two circles with radius `r` that are tangent to point `p` and to the exterior of circle `c`.

`(lower-corner c r p)`

The highest of two circles with radius `r` that are tangent to point `p` and to the exterior of circle `c`.

`(middle-top-corner c r p)`

The lowest of two circles with radius `r` that are tangent to point `p` and to the interior of circle `c`.

`(middle-bottom-corner c r p)`

The highest of two circles with radius `r` that are tangent to point `p` and to the interior of circle `c`.

Computing tangents

`(tangent-circle-point c p)`

The line tangent to circle `c` closest to point `p` that is perpendicular to the line from `p` to the center of `c`

`(tangent-circle-line c l)`

List of two tangent lines, as in `tangent-circle-point`, when the points are `(intersect c l)`.

`(tangent? l c)`

Is line `l` tangent to circle `c`? Returns `#t` if true, `#f` if false.

`(tangent small big)`

The two "inner" lines tangent to both `c1` and `c2`, assuming `c1`, `c2` do not intersect.

`(reverse-curve inner-circle outer pt)`

Roll a circle of radius `outer` along exterior of `inner-circle` and find the positions of its center making it tangent with point `pt`.

`(inscribe c1 c2 r)`

The circles tangent to insides of circles `c1`, `c2` of radius `r`.

`(outscribepoint c p r)`

Circles of radius r tangent to inside of c , and point p .

`(outscribe c1 c2 r)`

Circles tangent to outsides of $c1$, $c2$ of radius r .

`(inoutscribe c1 c2 r)`

Circles tangent to inside of $c1$, outside of $c2$, of radius r .

Inscribing squares around circles

`(outscribesquare circ)`

The outside square.

`(inscribesquare circ)`

The inside square

`(rotated-outscribesquare circ)`

`(rotated-inscribesquare circ)`

The same, but with the previous square (with horizontal and vertical lines) rotated 45 degrees.

`(geometric-section p q)`

The geometric section between p and q .

Drawing on the screen

`(hruler x y d)`

Horizontal ruler at (x,y) distance d .

`(vruler x y d)`

Vertical ruler starting at $(x y)$ distance d .

`(label s p)`

Label point p with a name s for when it is drawn.

`(makearc x y c)`

Draw the arc on circle c from point x to point y .

`(makeseg x y)`

Segment from point x to point y .

`(sketch instrument)`

Draw the instrument: a list of (list of ... etc.) lines, circles, points, and arcs.

`(make-curve p q L)`

Draw a curve with starting point `p` and ending point `q`; the curve is defined by a list `L` of circles and lines, each of which intersects with successive objects on the list. This procedure is used to define the curve of the lower, middle, and upper bouts.

`(polygon p1 p2 ... pn)`

The polygon with these successive points.

`(segments L)`

The sequence of segments defined by the successive points in list `L`.

`(end-drawing)`

End the drawing and close the PDF file.