Curves and Filtering

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Filtering

Example:
http://pages.cpsc.ucalgary.ca/~mdoerk/view/explore
Arcs

part of an ellipse

arc(x, y, width, height, start, stop);
Arcs - Exercise

reproduce this using rect, ellipse, and arc

\[ \text{arc}(x, y, \text{width}, \text{height}, \text{start}, \text{stop}); \]

\[
\begin{align*}
&0 \quad 3\pi/2 \\
&\pi/2
\end{align*}
\]
Splines

control points

endpoints

smooth piecewise-polynomial function

Processing curves use Catmull-Rom splines

curve(cpx1, cpy1, x1, y1, x2, y2, cpx2, cpy2);
Splines - Exercise

reproduce this, play with the position of the points

```
curve(cpx1, cpy1, x1, y1, x2, y2, cpx2, cpy2);
```
Bézier Curves

control points

endpoints

smooth curves, great for scaling (vector graphics)

bez(x1, y1, cp1x, cp1y, cp2x, cp2y, x2, y2);

\[
B(t) = (1 - t)^2 P_0 + 2t(1 - t)P_1 + t^2 P_2, \quad t \in [0, 1].
\]

\[
B(t) = (1 - t)^3 P_0 + 3t(1 - t)^2 P_1 + 3t^2(1 - t)P_2 + t^3 P_3, \quad t \in [0, 1].
\]
Bézier Curves - Exercise

replicate this, play with the control points

bezier(x1, y1, cpx1, cpy1, cpx2, cpy2, x2, y2);
Continuous Spline Curves - Exercise

replicate this - dynamically add/move points
use beginShape(), curveVertex(x, y), endShape()
first and last points are control points;
usually also the endpoints
Continuous Bézier Curves - Exercise

replicate this - dynamically add/move points
how to make smooth transitions?

basic structure:
beginShape();
vertex(x, y); // first point
bezierVertex(cpx1, cpy1, cpx2, cpy2, x, y);
bezierVertex(...);
endShape()
Useful Curve Functions

`bezierDetail(detail)` // resolution of Beziers
`curveDetail(detail)` // resolution of curves

// evaluate for x and y separately:
`bezierPoint(p1, cp1, cp2, p2, t)` // Bezier curve at point t

`curvePoint(p1, p2, p3, p4, t)` // curve at point t

`bezierTangent(p1, cp1, cp2, p2, t)` // tangent of Bezier at point t

`curveTangent(p1, p2, p3, p4, t)` // tangent of curve
Subdivision Curves

draw initial points
Subdivision Curves

add vertices at midpoints
Subdivision Curves

“average” all vertices
(i.e. find midpoints again)
Subdivision Curves

draw new line through average points (and endpoints)
Subdivision Curves

iterate until you have a smooth curve
Subdivision Curves - Exercise

create a subdivision curve

draw initial points
add midpoints to set of points
replace points with midpoints
iterate