

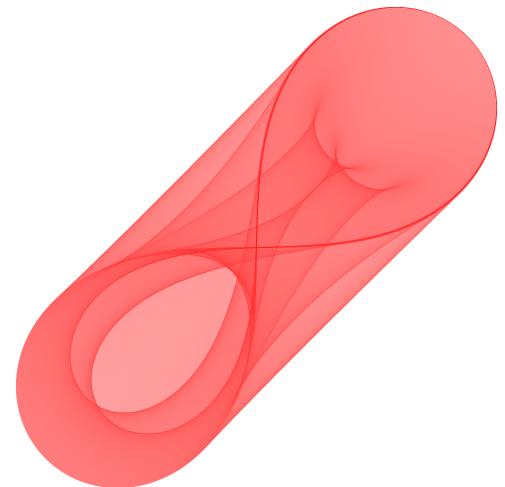
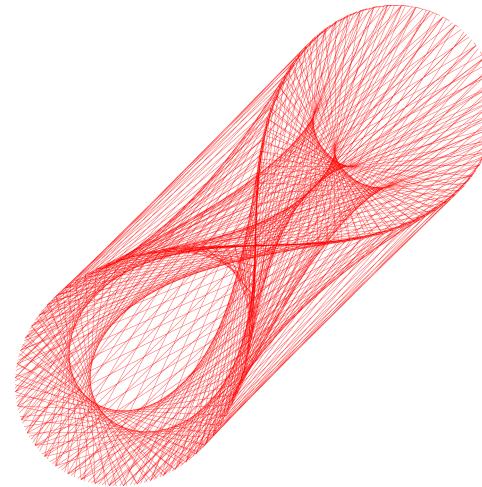
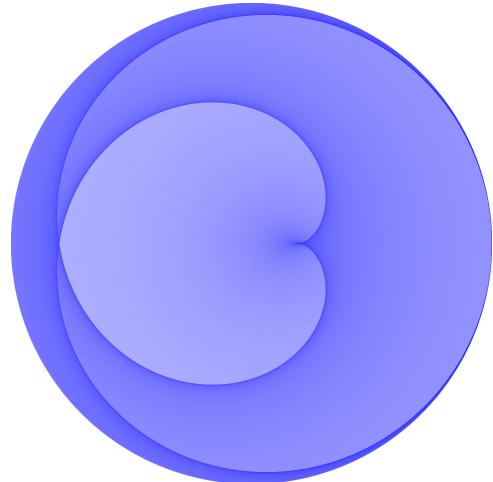
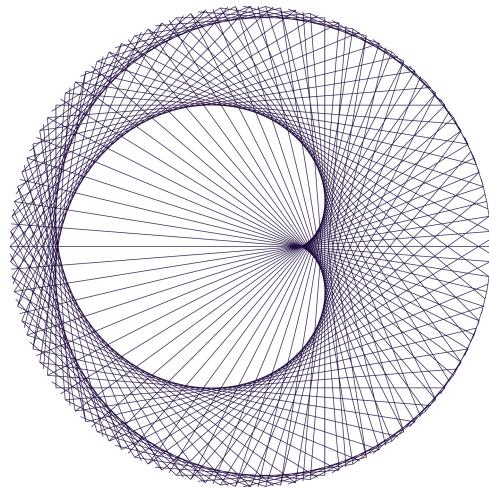
Curve stitching variations in 2D and 3D

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Introduction

- Curve stitching
 - Methods for creating images
 - String art
 - Hand drawing
 - Computational
 - Can be 2D or 3D
- Extend the approach to create related, yet new, types of curve stitching images

Traditional examples

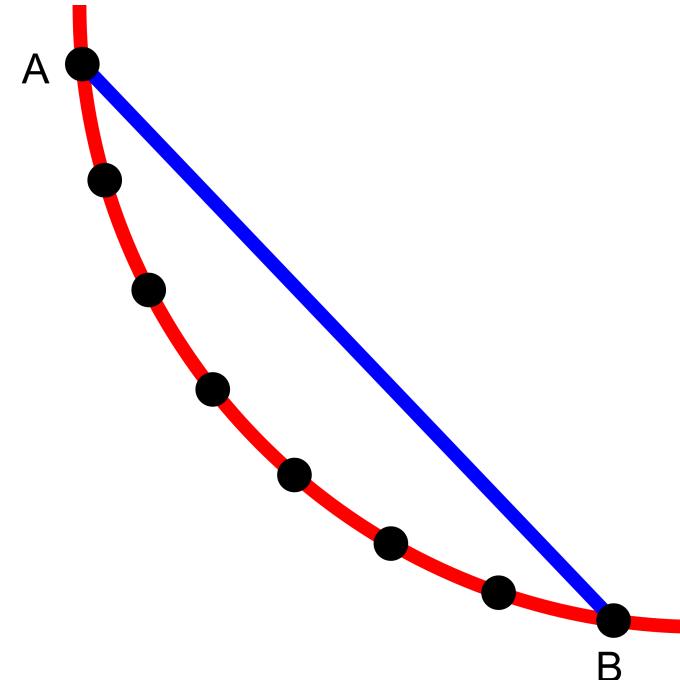


Traditional curve stitching algorithm

- Traditional
 - P is some path or curve, e.g., a circle
 - N is the number of connections to make along P
 - k_A and k_B represent how fast two points, $point_A$ and $point_B$, move along P
 - Curve stitching density plots
 - Variation of traditional algorithm
 - creates a histogram representation
- for i=0..N
 $\theta = \frac{2\pi i}{N}$
 $point_A = computePoint(P, k_A * \theta)$
 $point_B = computePoint(P, k_B * \theta)$
 $drawLineSegment(point_A, point_B)$*

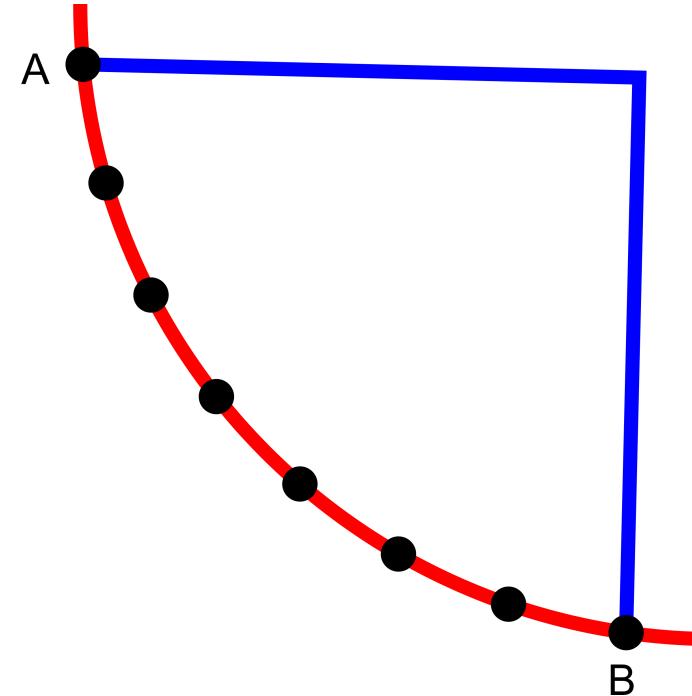
Traditional approach

- Determine two points, A and B, on a curve
- Connect points with a line segment
- Do this for every pair of points on the curve
 - Number of points varies
 - Low in traditional images
 - “High” in density plots



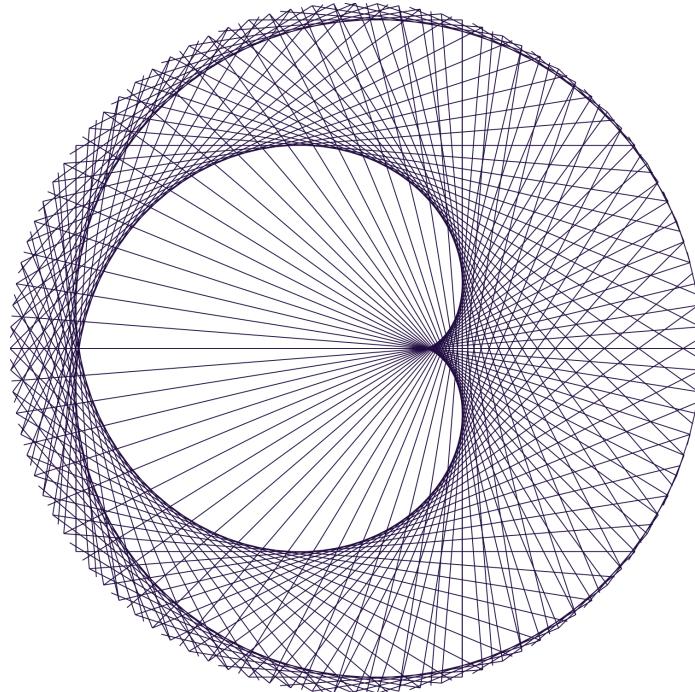
Questions

- Traditionally, a line segment is used because of image history
 - Mary Everest Boole invented curve stitching in the 1800s
 - Took cards meant for painting, and laced thread through areas meant to be painted*
- Why does it have to be a line segment connecting the two points?
- What happens when you connect the points with something other than a straight line segment?

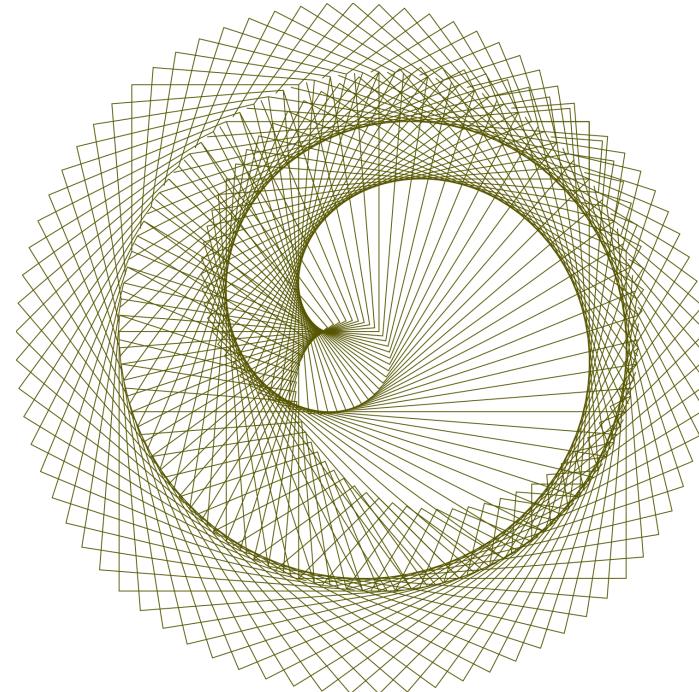


* Innes, S. 2004. Mary Boole and curve stitching: a look into heaven. *Endeavour* 28,1 (Mar 2004), 36-38.

Line segment vs alternative

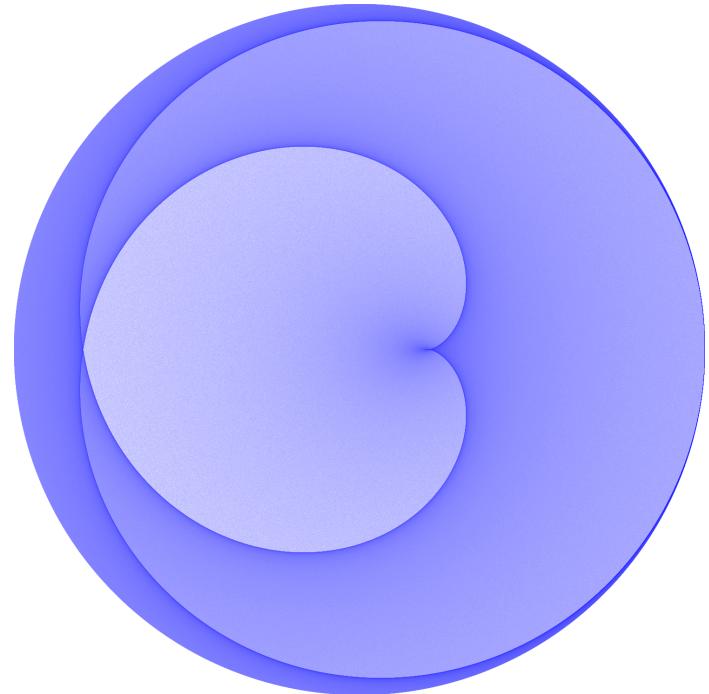


Line segment,
traditional



Right-angle path

Line segment vs alternative as density plots



Line segment,
traditional

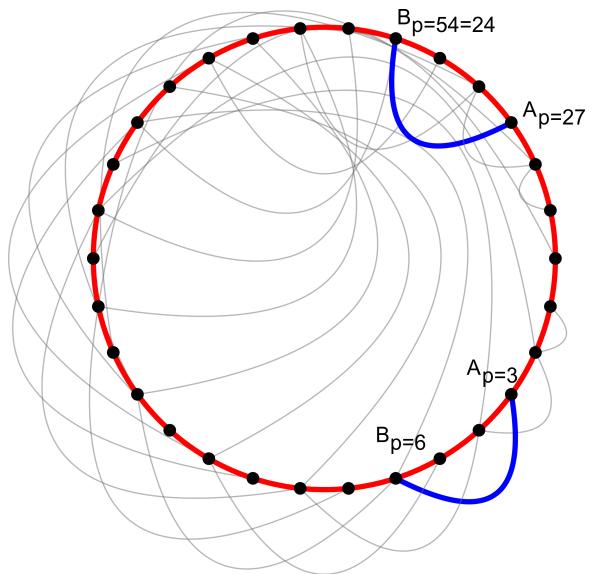


Right-angle path

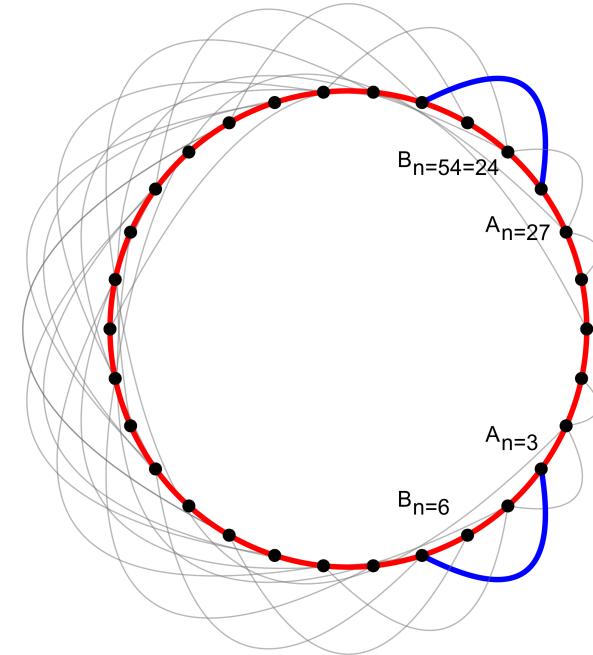
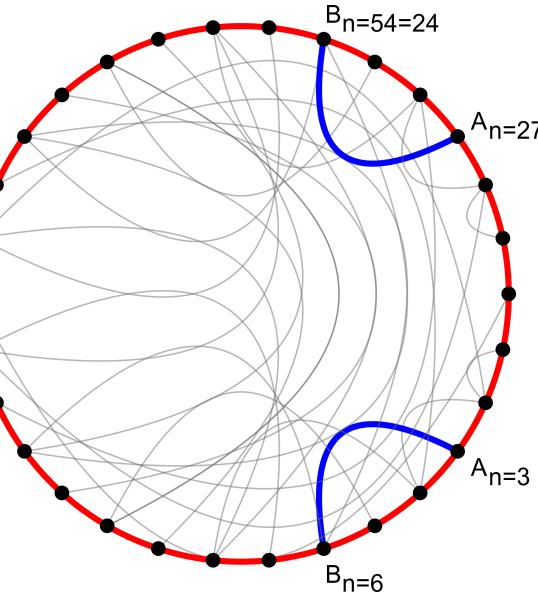
Symmetry and non-symmetry

- Connections between points and how they are manipulated can lead to symmetric or non-symmetric results
 - A line segment between points has one drawing option
 - A parabola has three options
 - Orient curve based on original point order (non-symmetric)
 - Orient curve towards a point, e.g. center of circle (symmetric)
 - Orient curve away from target point, e.g., center of circle (symmetric)

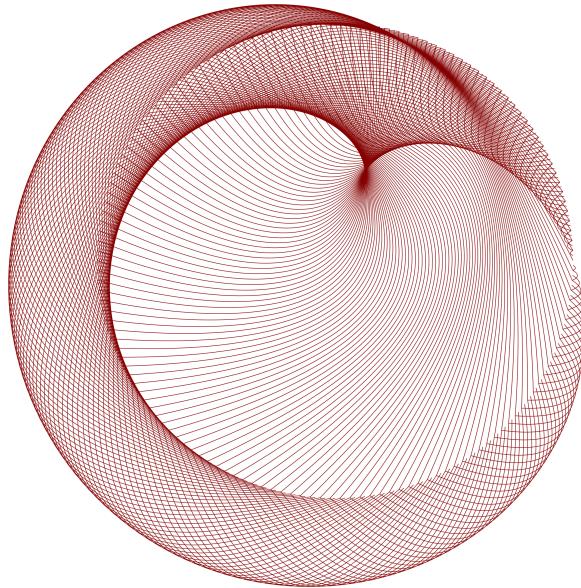
Controlling connection orientation



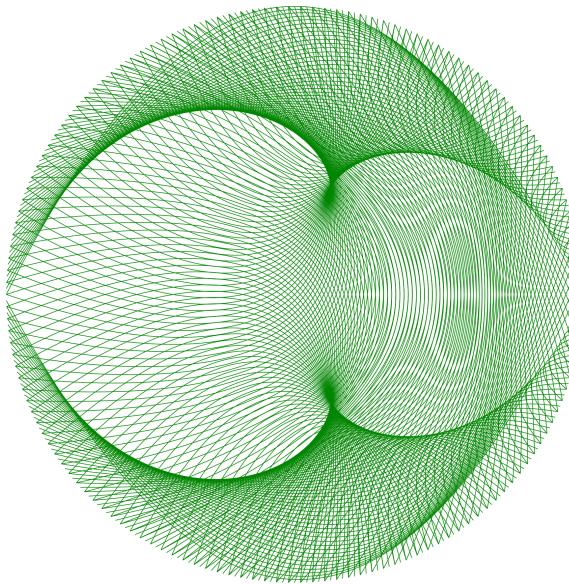
$$N = 30, k_A = 1, k_B = 2$$



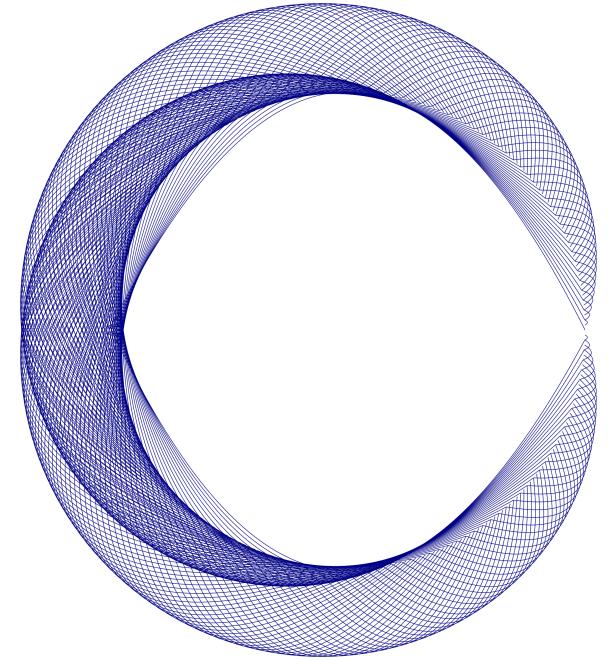
Controlling connection orientation



Orientation based on
point order



Oriented towards center

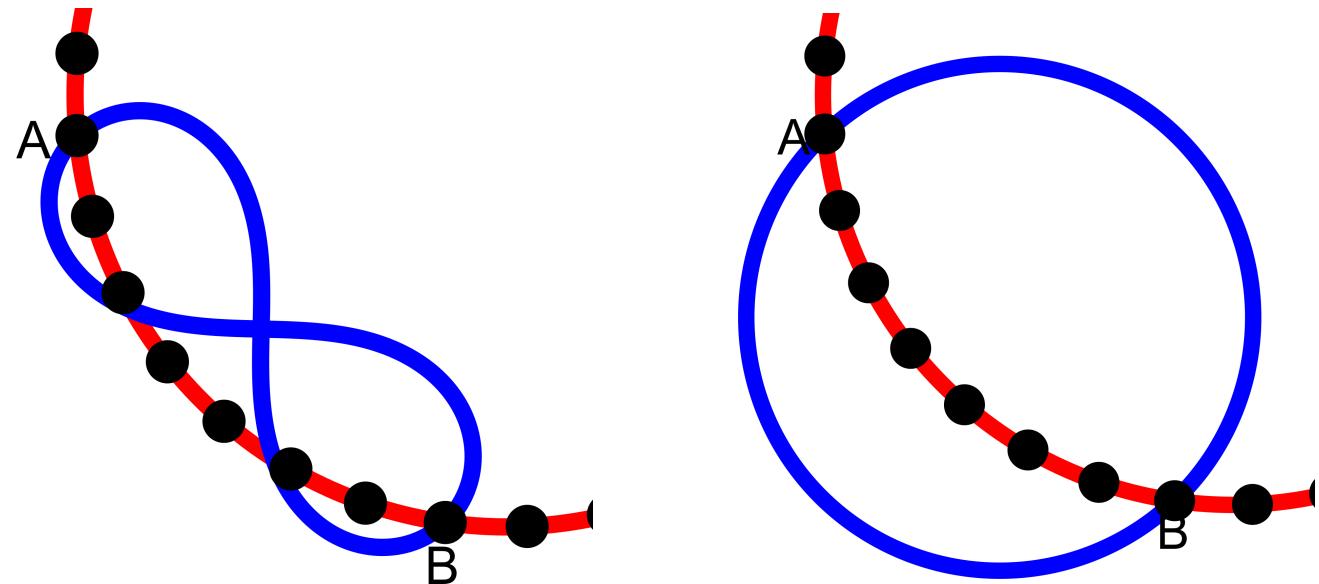


Oriented away
from center

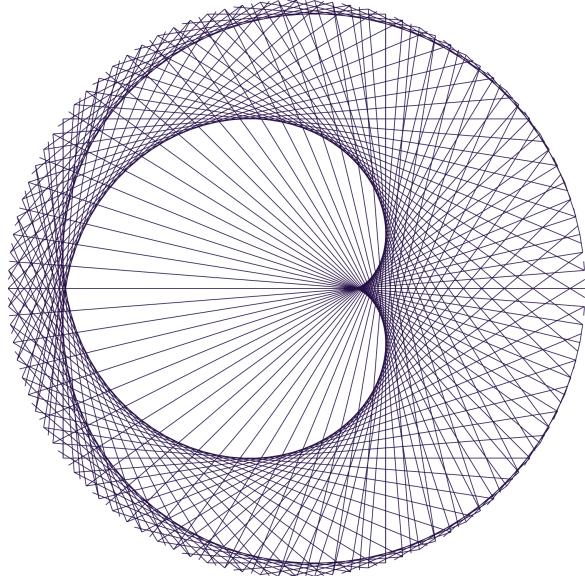
$$N = 300, k_A = 1, k_B = 2$$

Shapes as connections

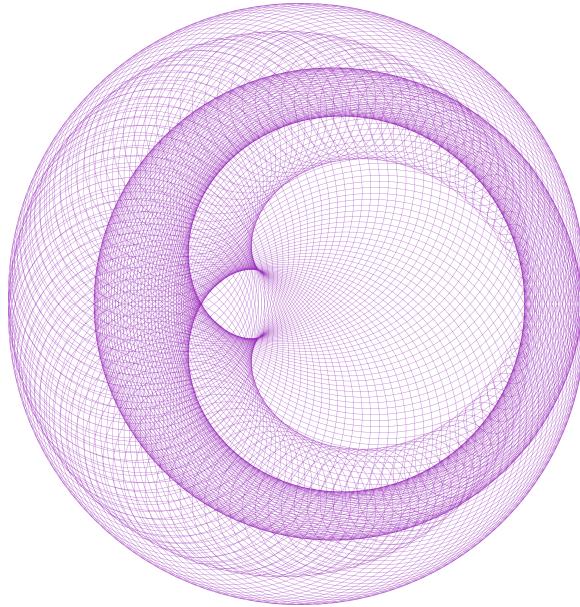
- Connections can be extended to include shapes and closed curves
- Examples
 - Circle
 - Lemniscate



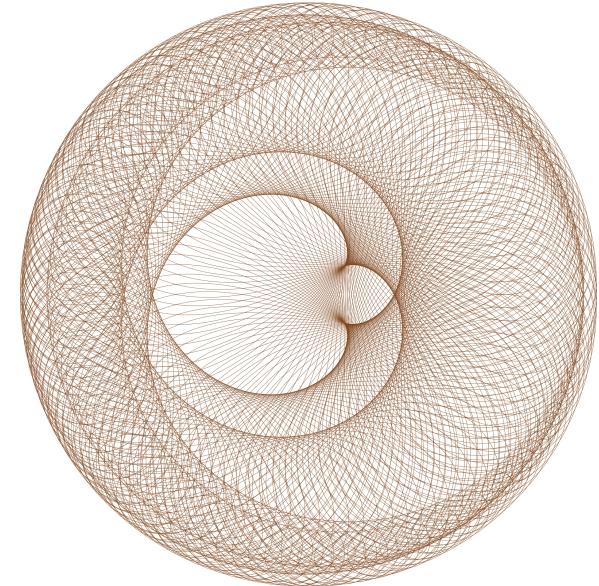
Comparison with line segment



line segment



circle

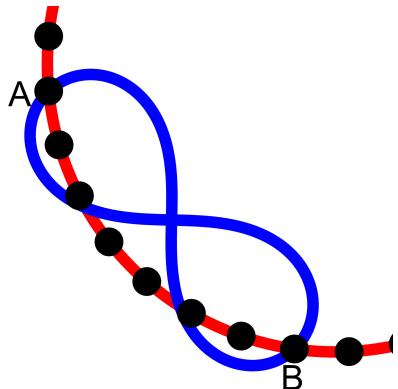


lemniscate

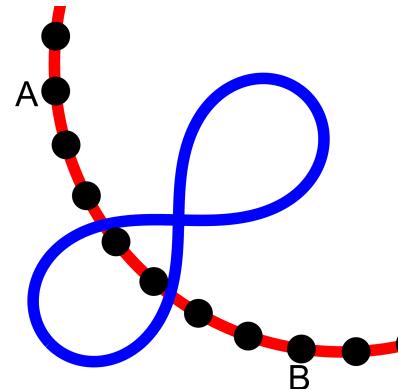
$$N = 300, k_A = 1, k_B = 2$$

Orienting connections

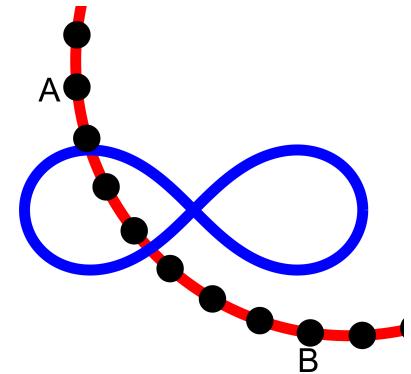
- Connections are traditionally connected to points A and B
- Variations can use A and B as control points



Connected to
A and B

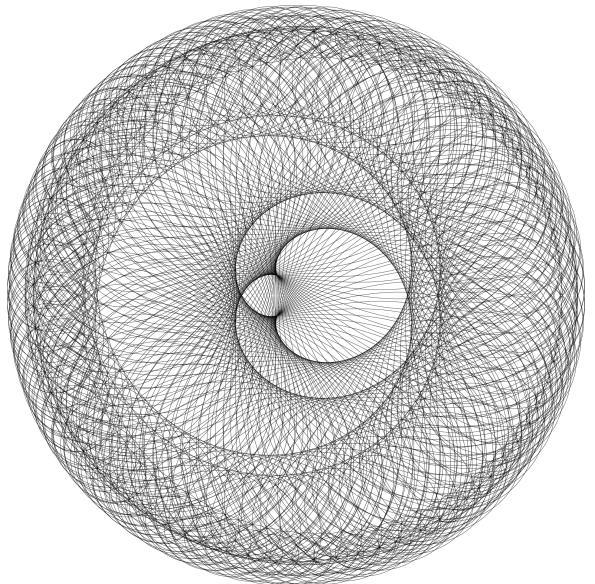


Rotated 90 based
on angle of A and B

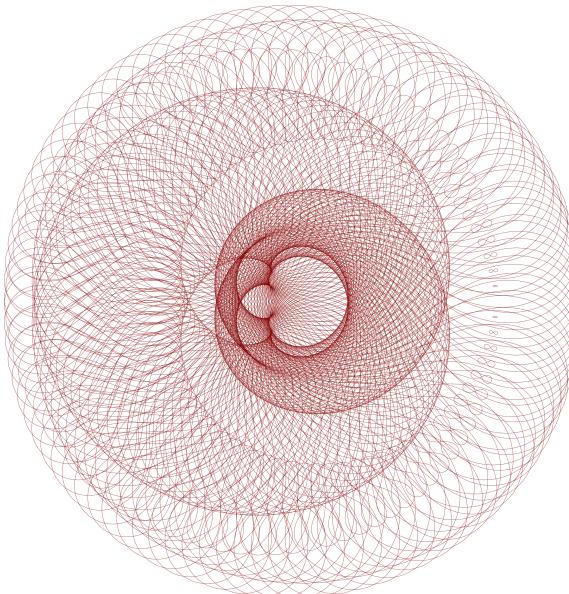


Positioned between
A and B; always
horizontal

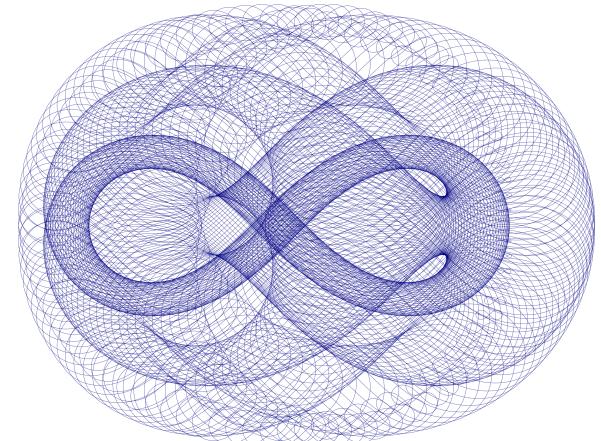
Orienting connections: lemniscate example



Connected to
A and B



Rotated 90 based
on angle of A and B
 $N = 300, k_A = 3, k_B = 4$



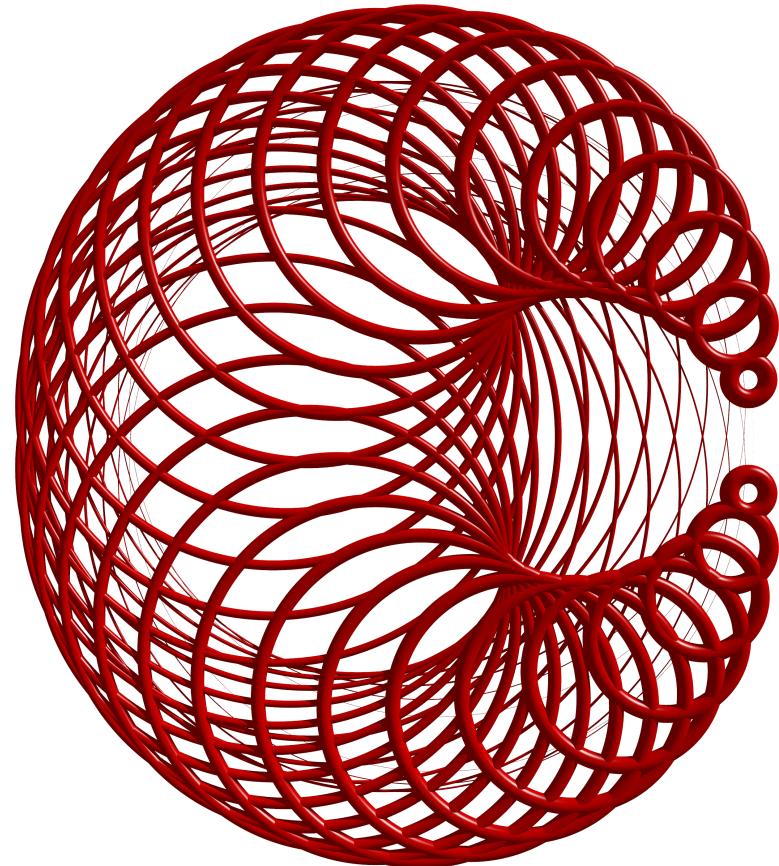
Positioned between
A and B; always
horizontal

Curve stitching in 3d with variations

- Curve stitching can be performed in 3d, and the previously applied variations can be applied as well
- Following slides demonstrate curve stitching variations when applied to 3d

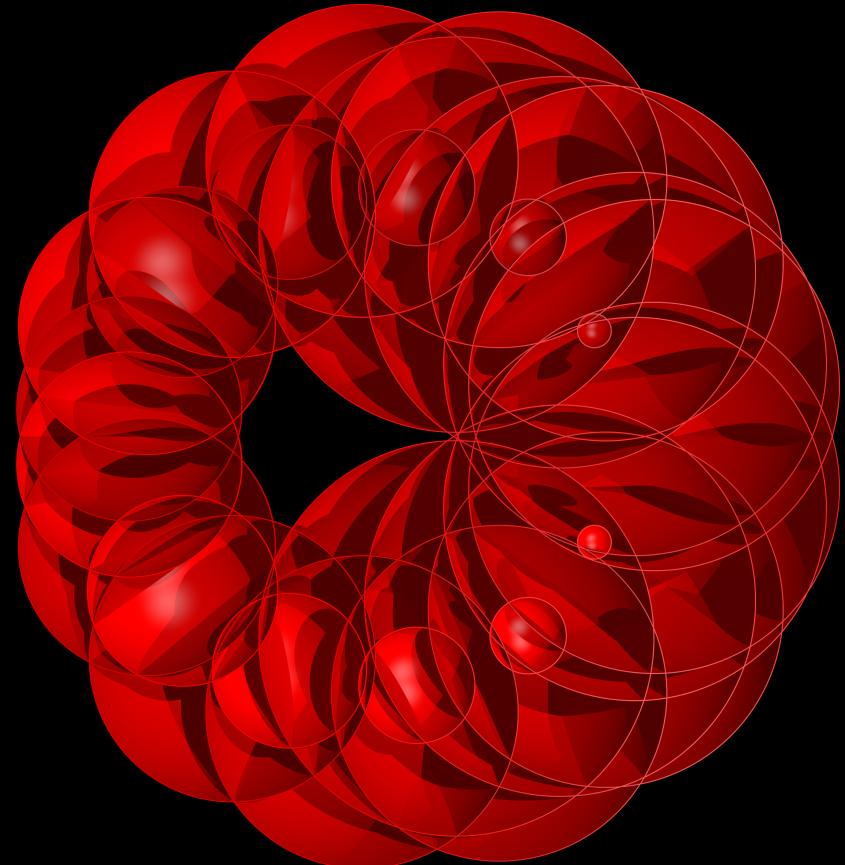
Example 1

- Path: circle
- Connection: torus 
- $N = 51$
- $k_A = 1$
- $K_B = 2$
- Note: torus major and minor radii are determined by distance from A to B



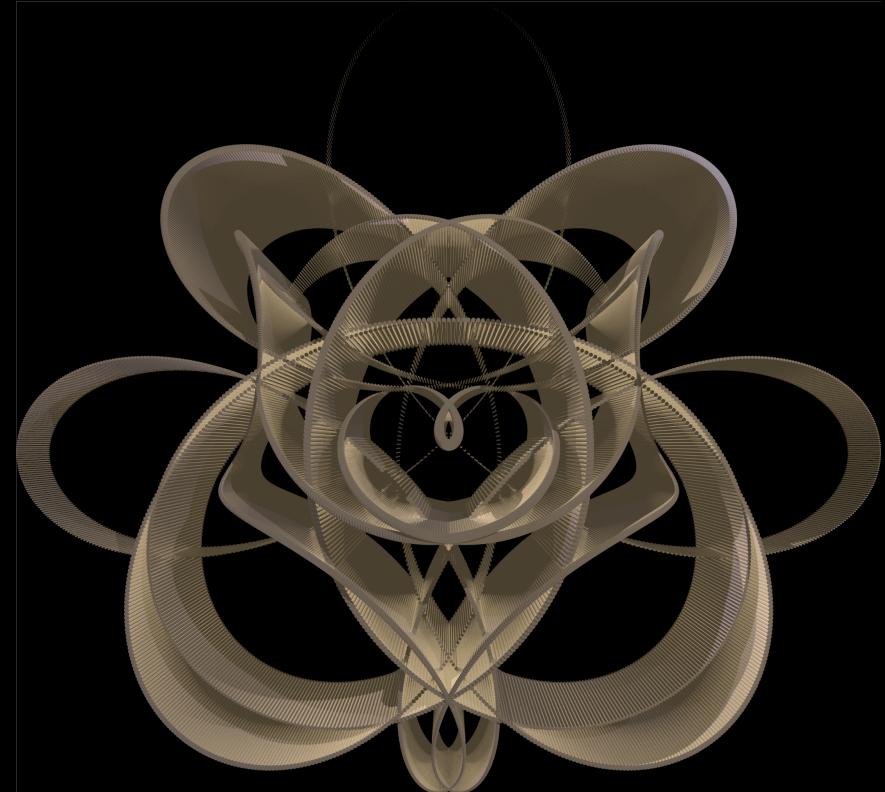
Example 2

- Path: circle
- Connection: hemisphere 
- $N = 31$
- $k_A = 2$
- $K_B = 3$
- Note: hemisphere positioned at midpoint of AB and moved away from center of circle path



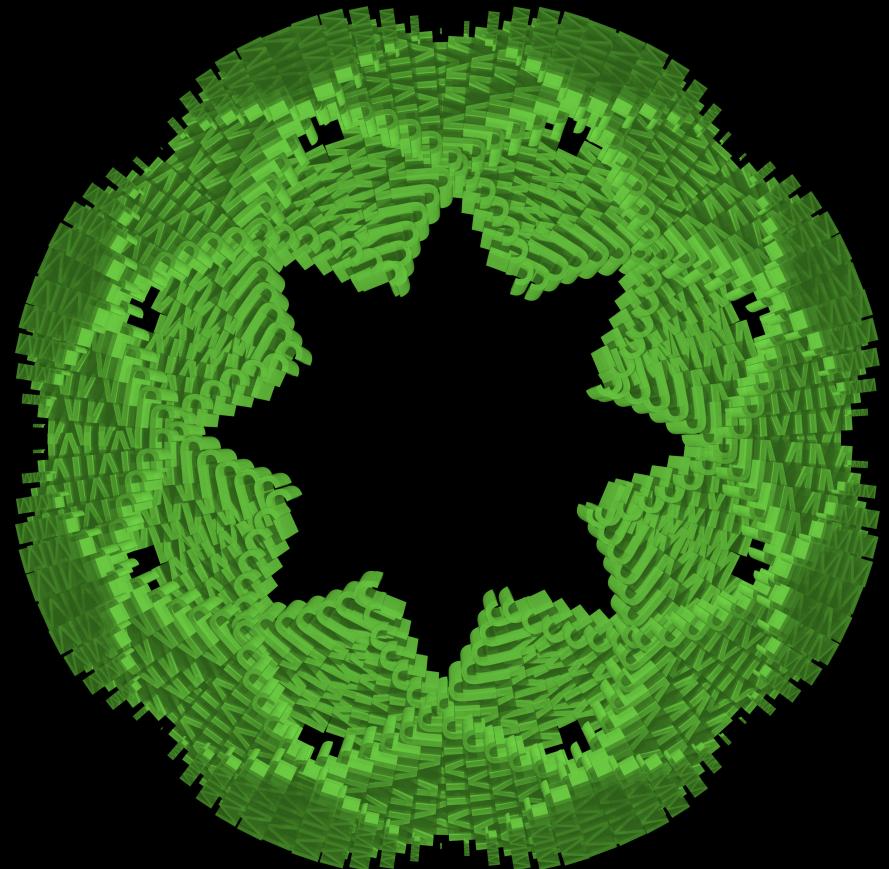
Example 3

- Path: four-petal rose curve
- Connection: cylinder
- $N = 5001$
- $k_A = 4$
- $K_B = 5$
- Note:
 - cylinder perpendicular to path plane
 - cylinder placed at midpoint of AB
 - Size of cylinder determined by distance of AB



Example 4

- Path: circle
- Connection: extruded text 
- $N = 301$
- $k_A = -1$
- $K_B = 7$
- Note:
 - Text size based on distance from A to B
 - Text rotated based on angle of midpoint AB to center



Conclusion

- While non-traditional, line segments are not the only options for connections when creating curve stitching images
- Slides and code used to make images available at:
<https://github.com/nicholsonja/JMM2020>

