

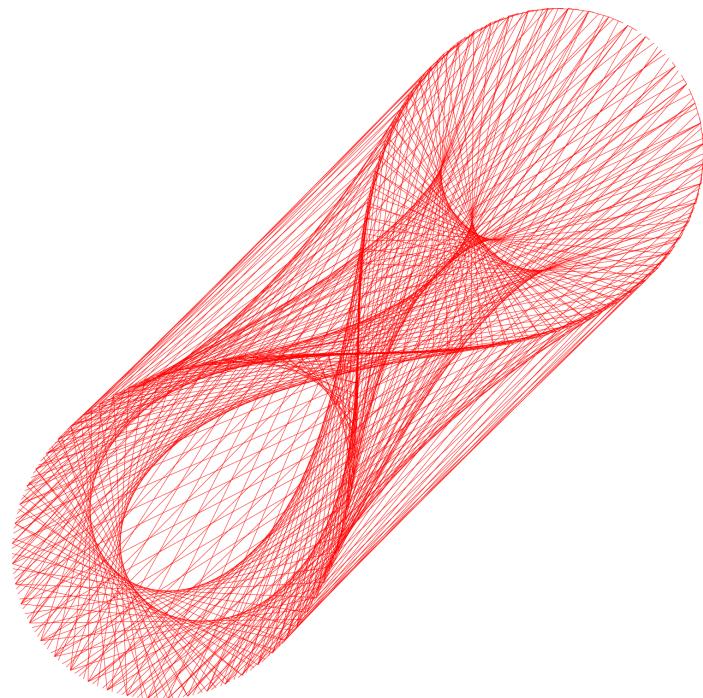
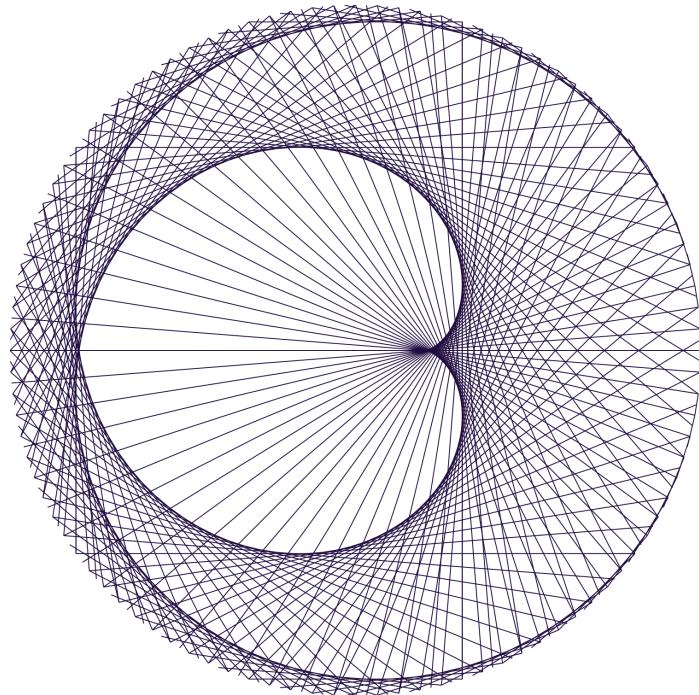
# Curve stitching variations in 2D and 3D

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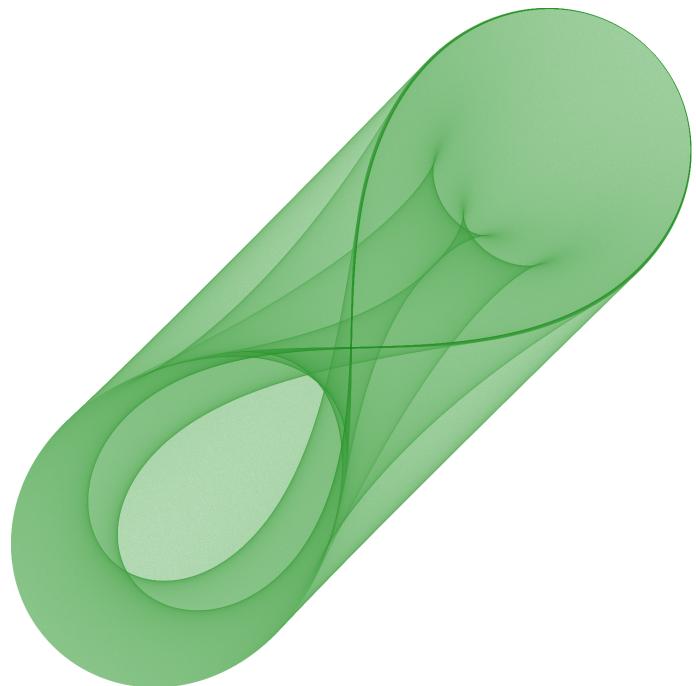
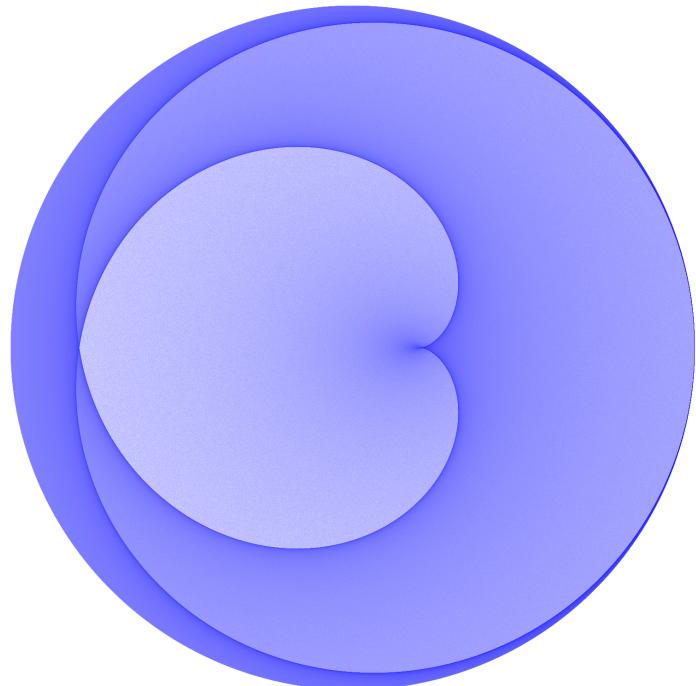
# Introduction

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

# Traditional 2D examples



# Curve stitching density plot



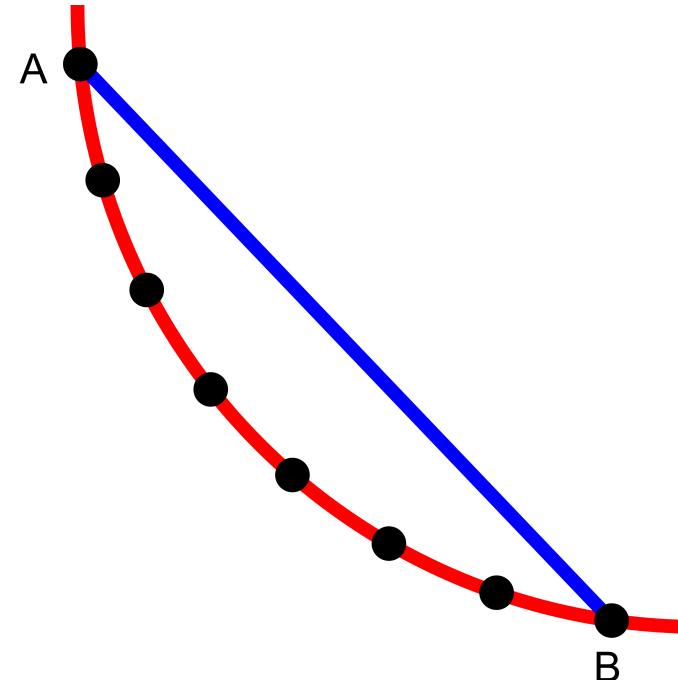
# Curve stitching algorithm

- Traditional
  - $P$  is some path or curve, e.g., circle
  - $N$  is the number of connections in image
  - $k_A$  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  
    θ =  $\frac{2\pi i}{N}$   
    pointA = computePoint(P, kA*θ)  
    pointB = computePoint(P, kB*θ)  
    drawLineSegment(pointA, pointB)
```

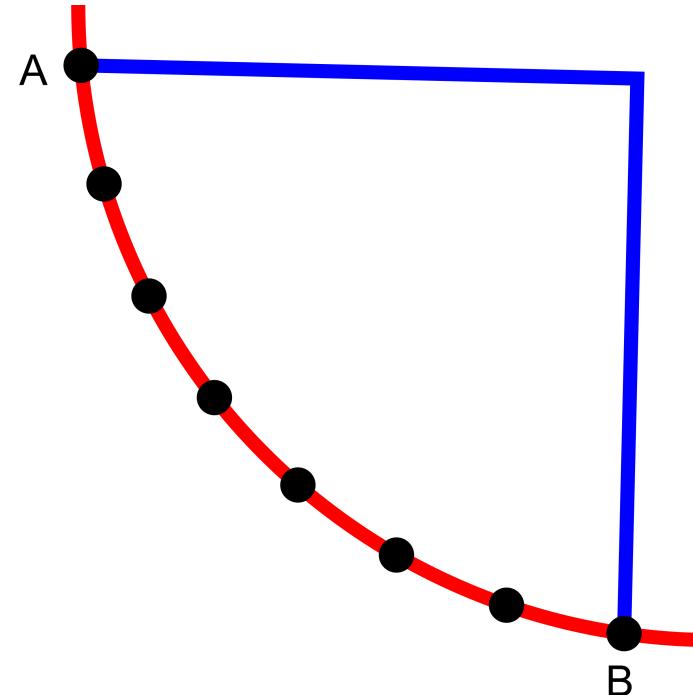
# Traditional approach

- 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



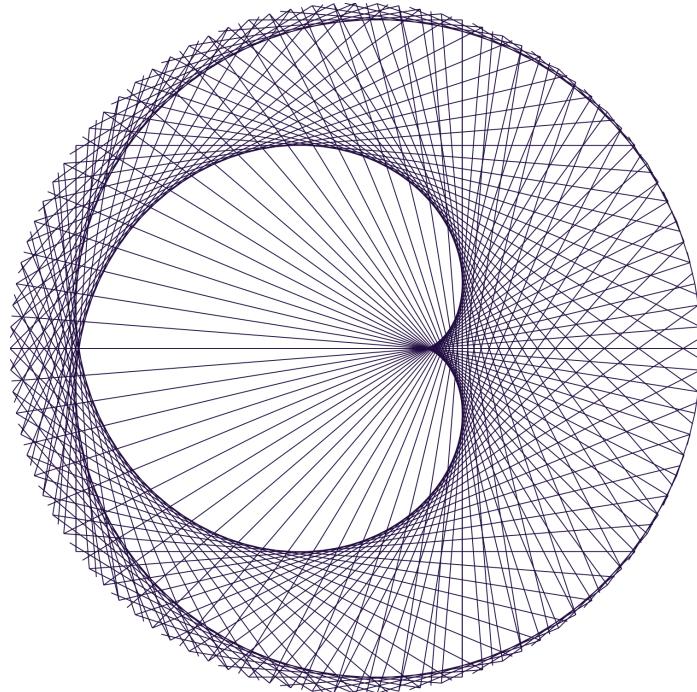
# Questions?

- Traditionally, a line segment 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?

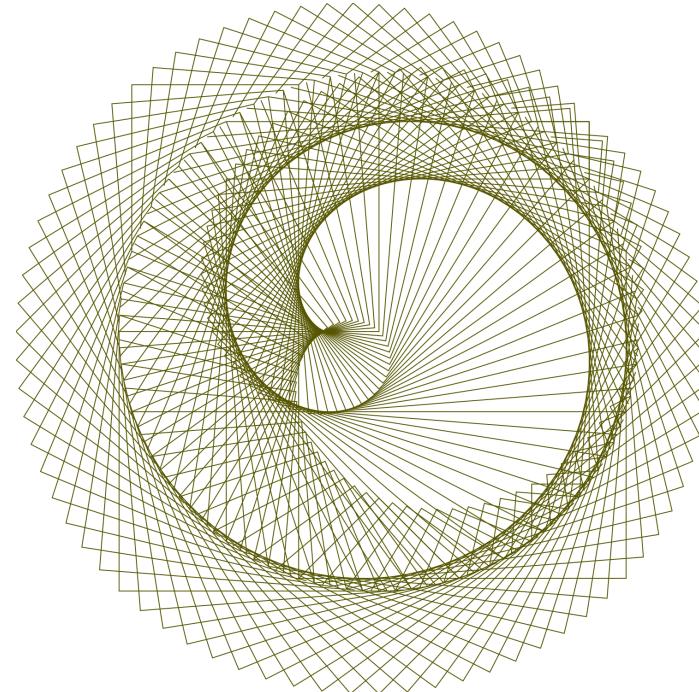


\* Innes, S. 2004. Mary Boole and curve stitching: a look into heaven. *Endeavour* 28,1 (Mar 2004), 36-38.

# Line segment vs alternative

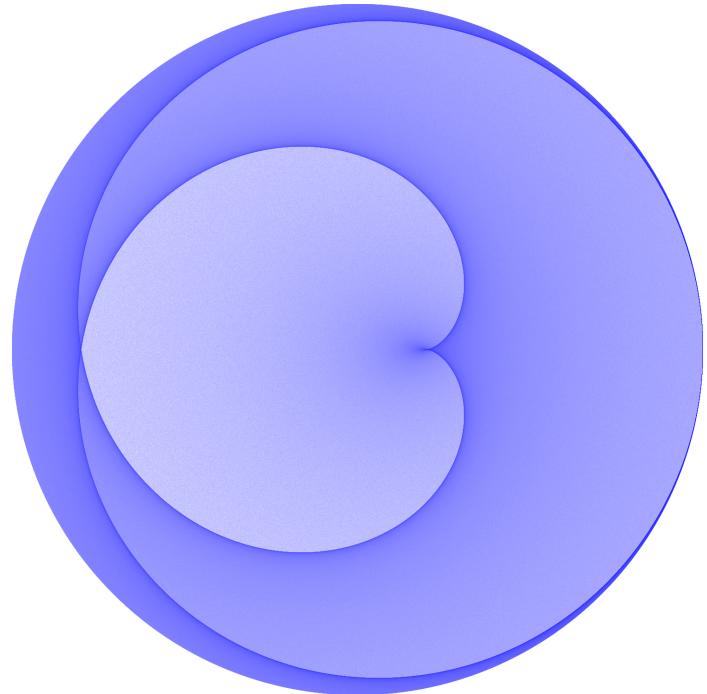


Line segment,  
traditional



Non-line segment

# Line segment vs alternative as density plots



Line segment,  
traditional

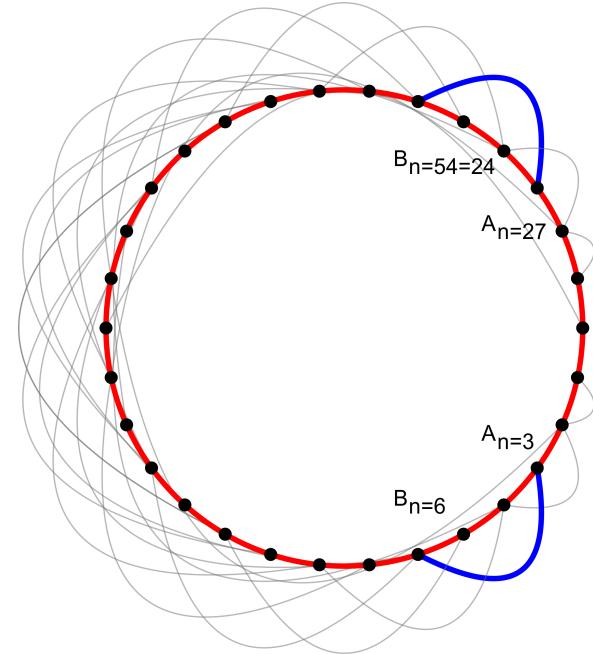
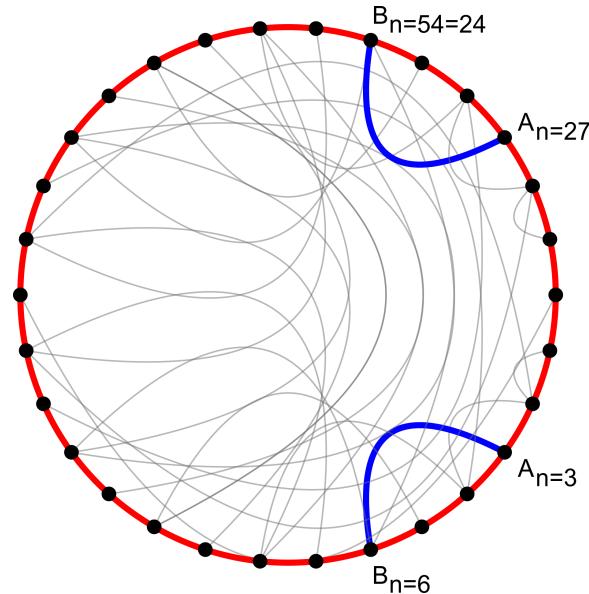
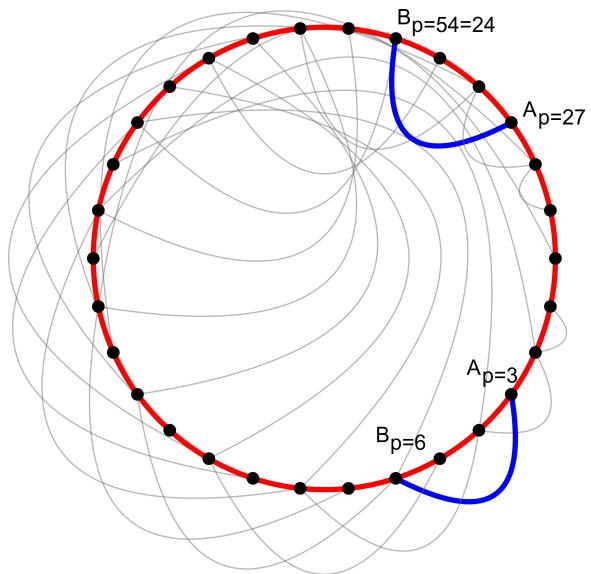


Non-line segment

# Symmetry and non-symmetry

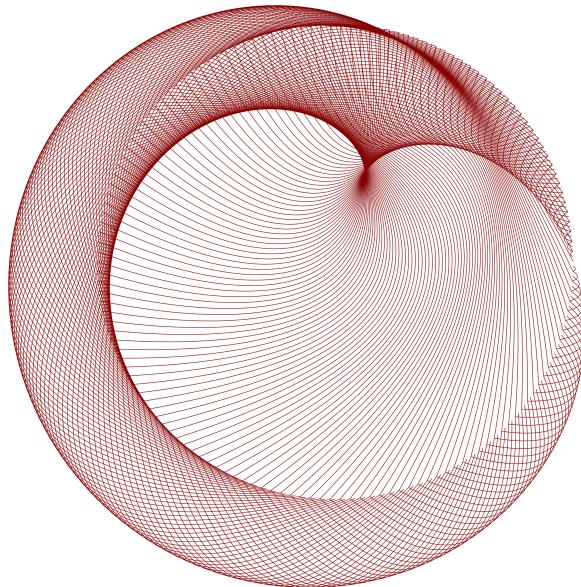
- Connections between points and how they are manipulated can lead to symmetric or non-symmetric results
  - A line segment between points has one drawing option
  - A parabola has three options
    - Orient curve based on original point order (non-symmetric)
    - Orient curve towards a point, e.g.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

# Controlling connection orientation

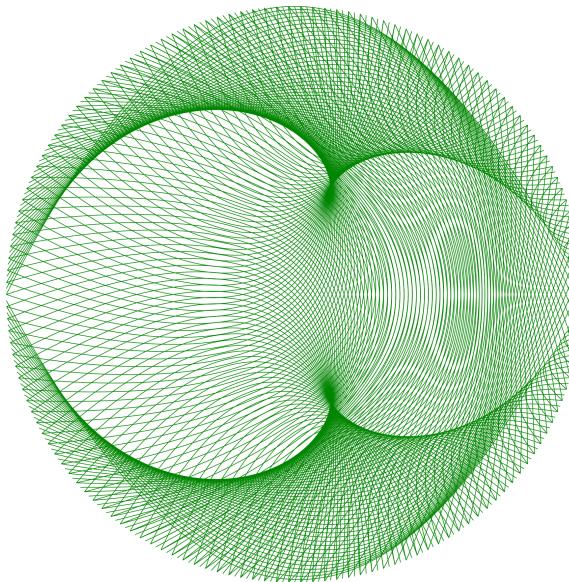


$$N = 30, k_A = 1, k_B = 2$$

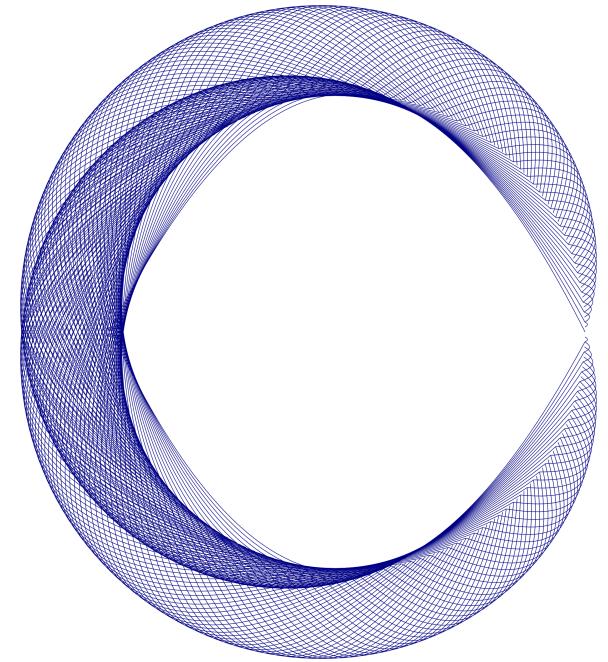
# Controlling connection orientation



Orientation based on  
point order



Oriented towards center

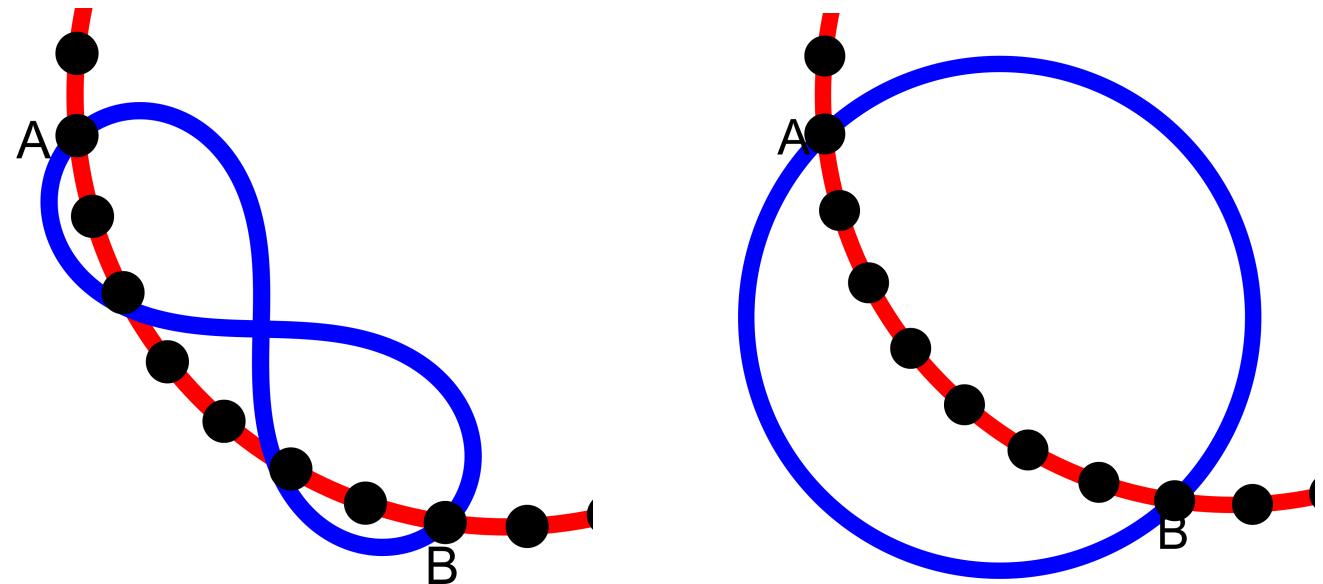


Oriented away  
from center

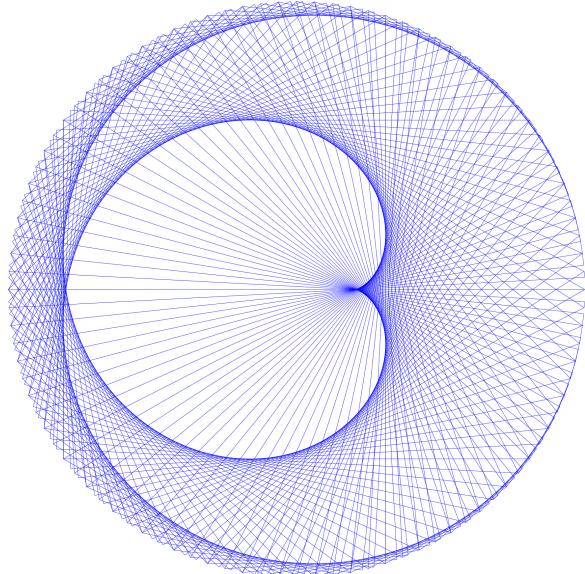
$$N = 300, k_A = 1, k_B = 2$$

# Shapes as connections

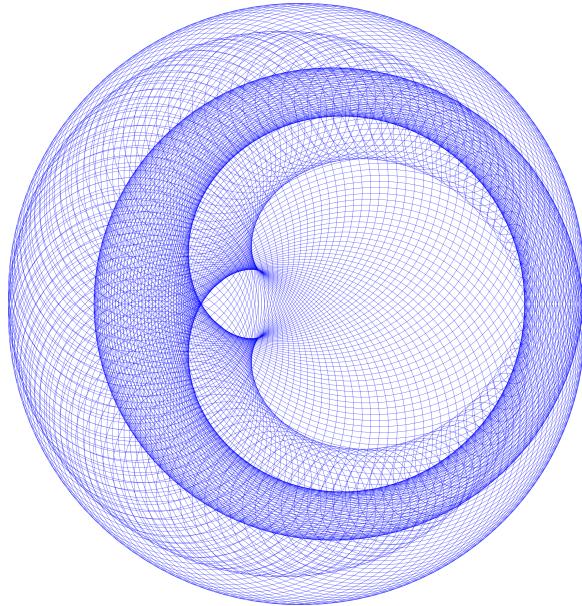
- Connections can be extended to include shapes and closed curves
- Examples
  - Circle
  - Lemniscate



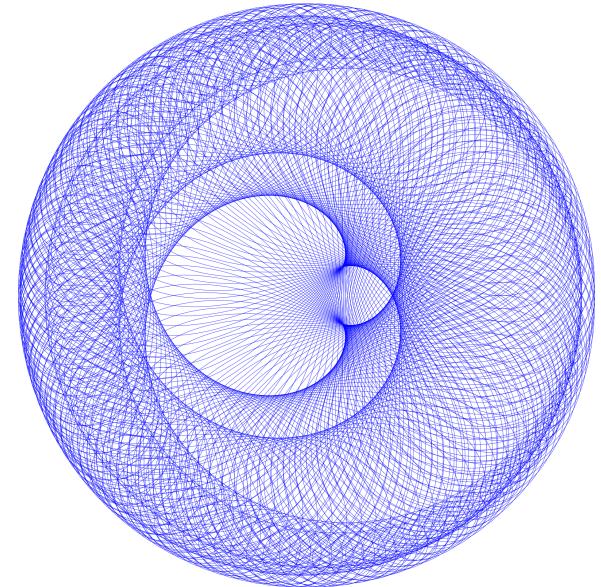
# Comparison with line segment



line segment



circle

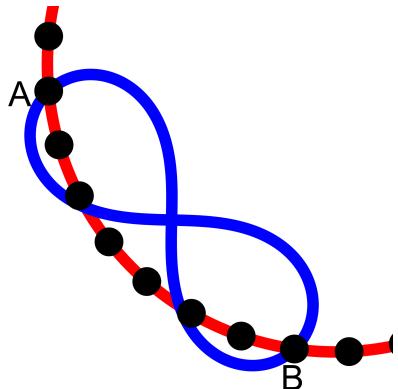


lemniscate

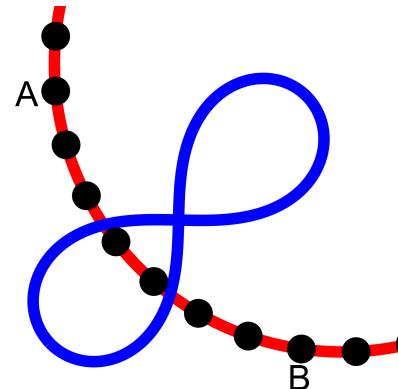
$$N = 300, k_A = 1, k_B = 2$$

# Orienting connections

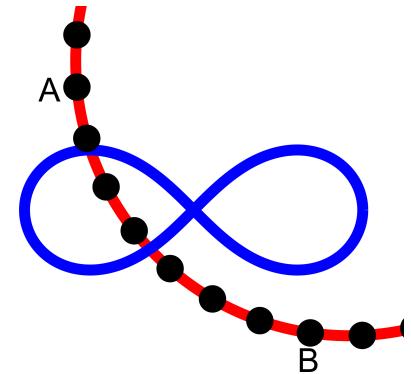
- Connections are traditionally connected to points A and B
- Variations can use A and B as control points



Connected to  
A and B

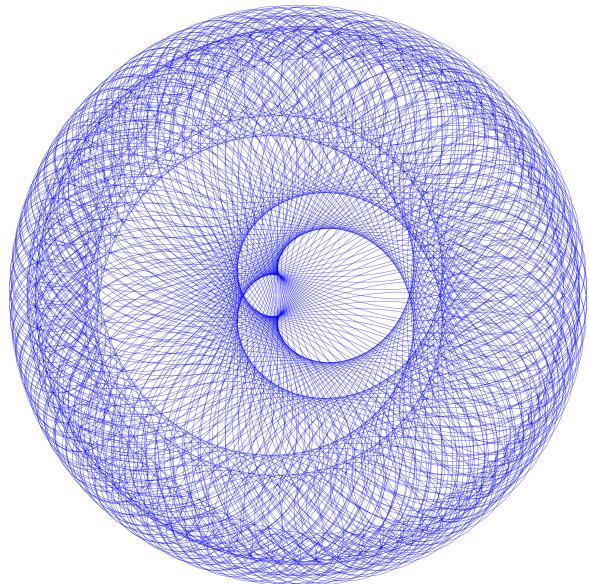


Rotated 90 based  
on angle of A and B

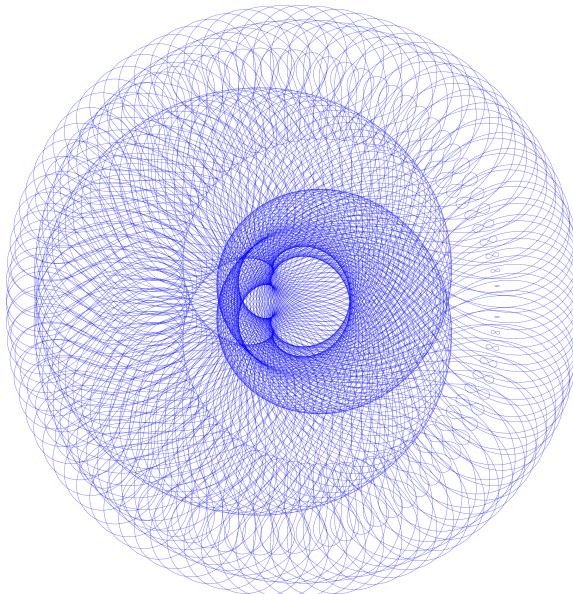


Positioned between  
A and B; always  
horizontal

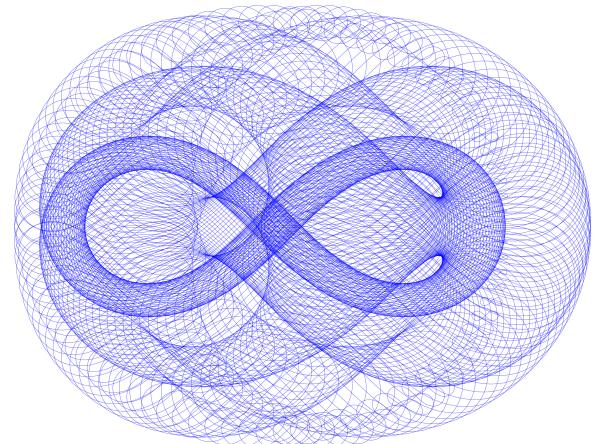
# Orienting connections



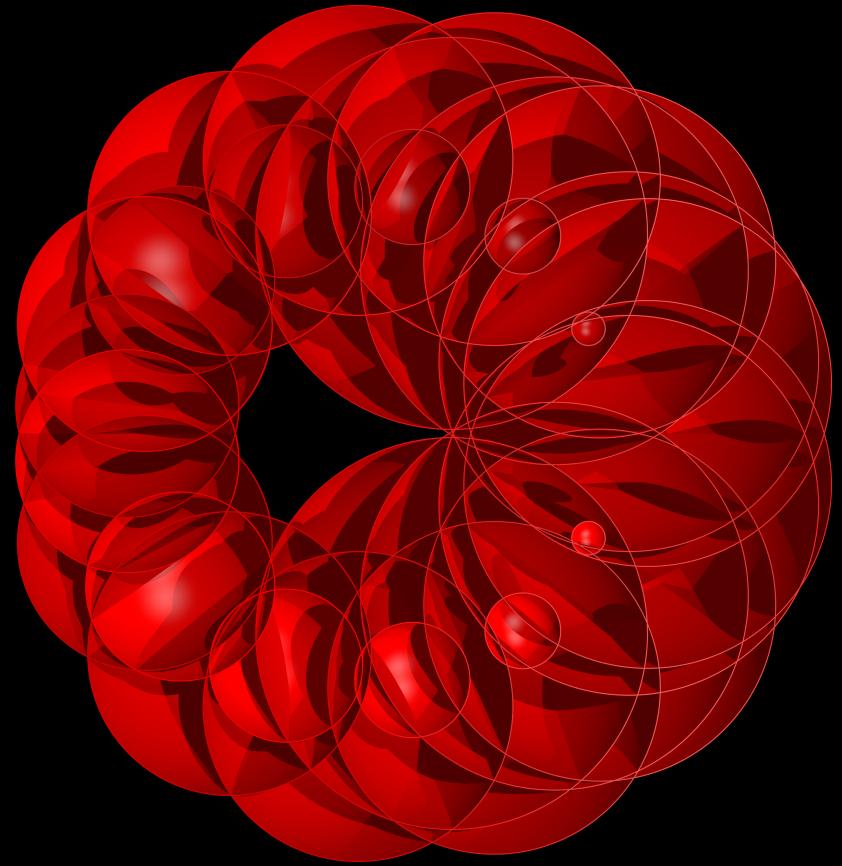
Connected to  
A and B

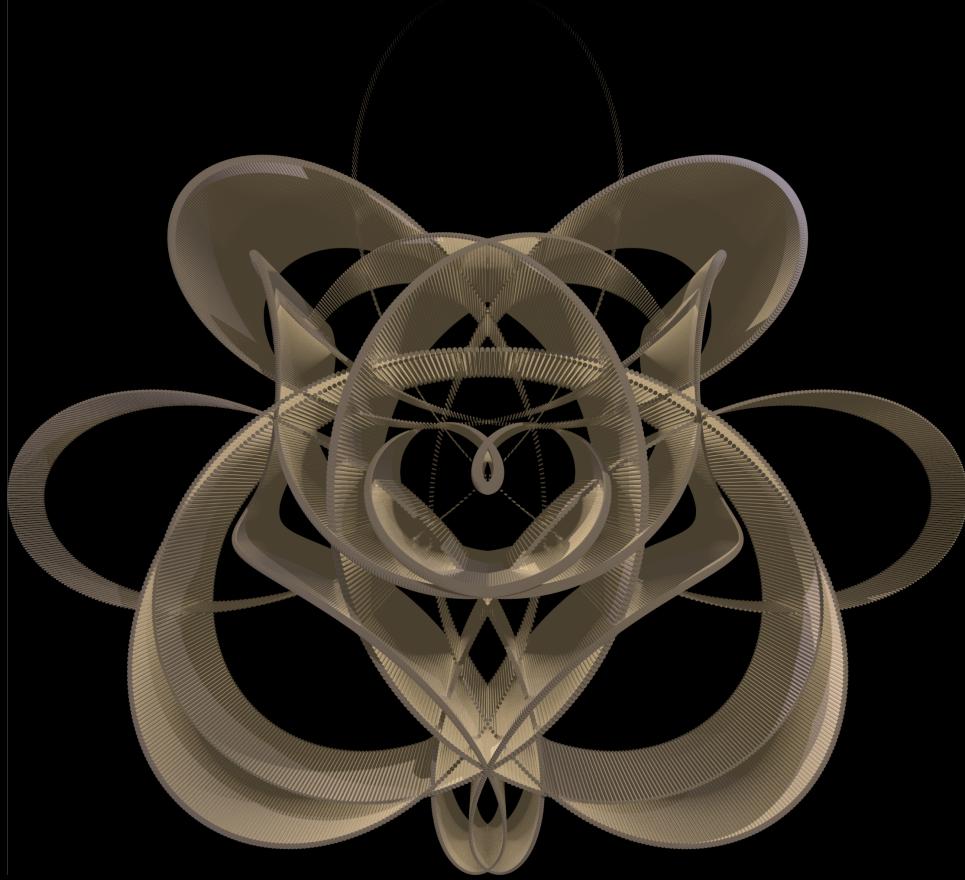


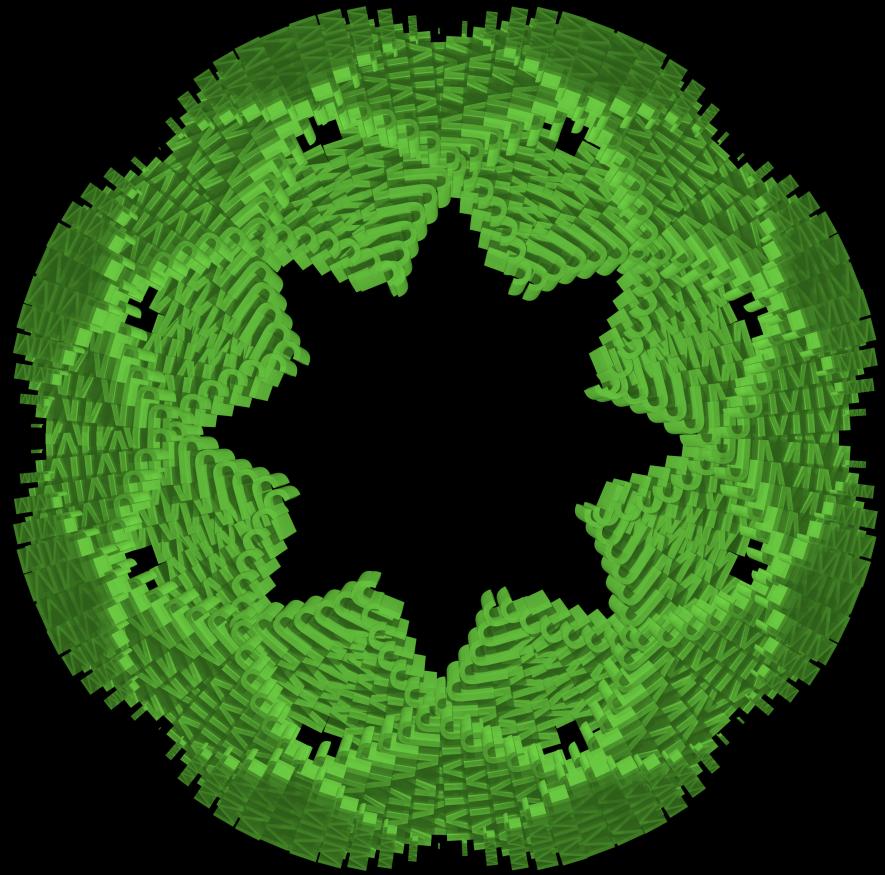
Rotated 90 based  
on angle of A and B  
 $N = 300, k_A = 3, k_B = 4$



Positioned between  
A and B; always  
horizontal







# 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>

