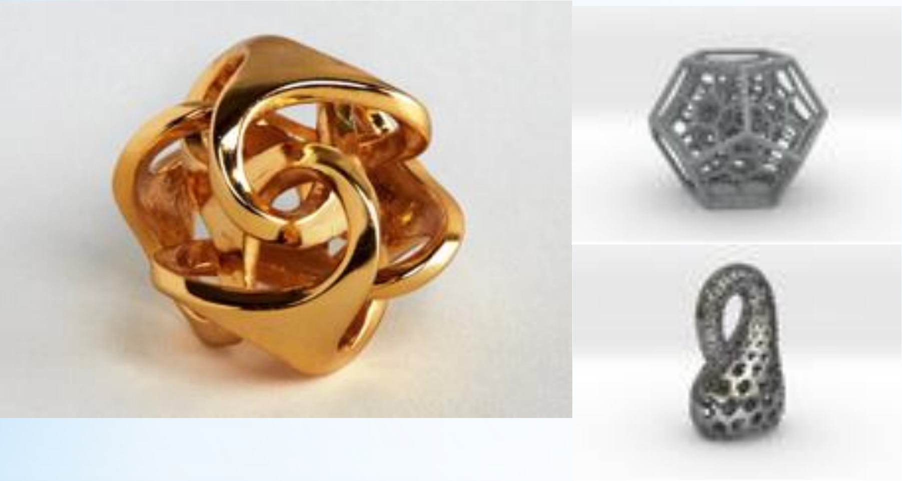
The Making Of Mathematical Art

Christopher R. H. Hanusa

Queens College

Mathematics + Art ?

Bathsheba Sculpture



Mathematics + Art ?

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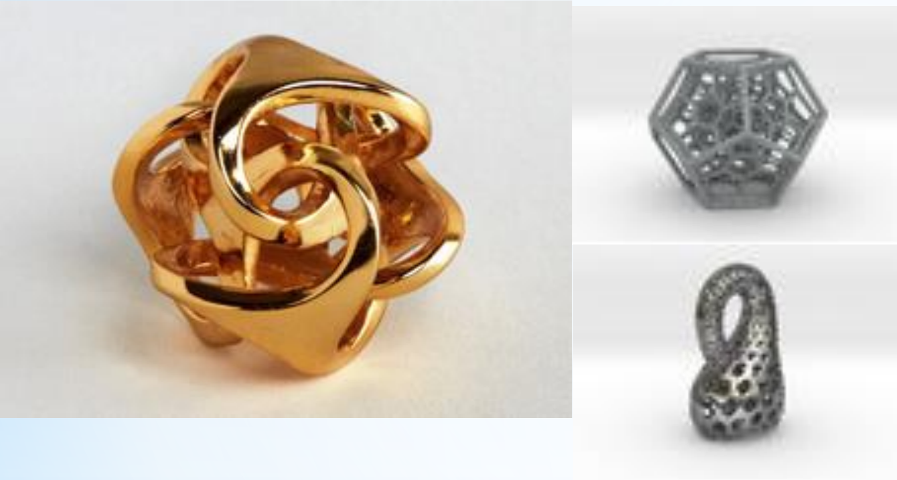
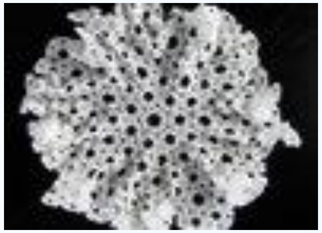
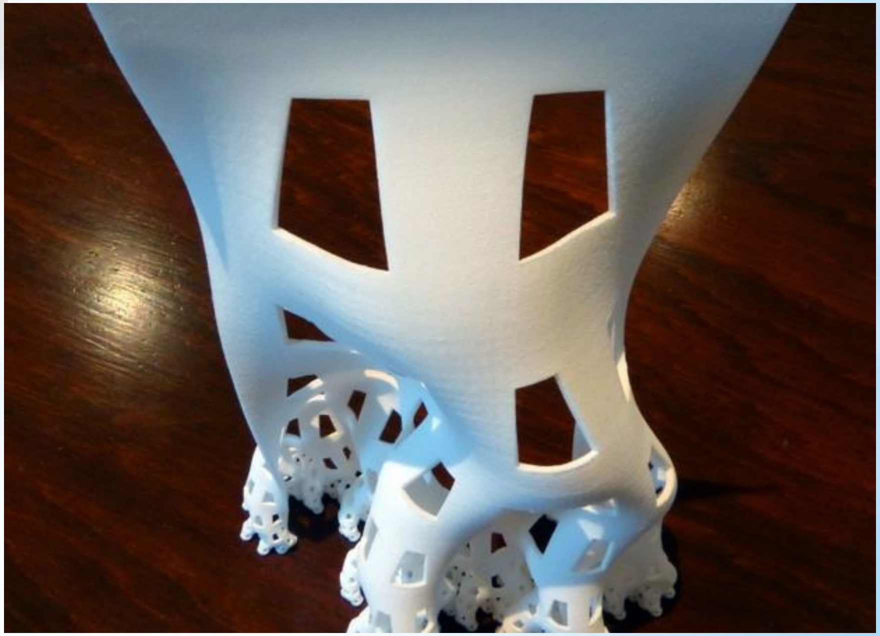


Henry Segerman





Mathematics + Art ?

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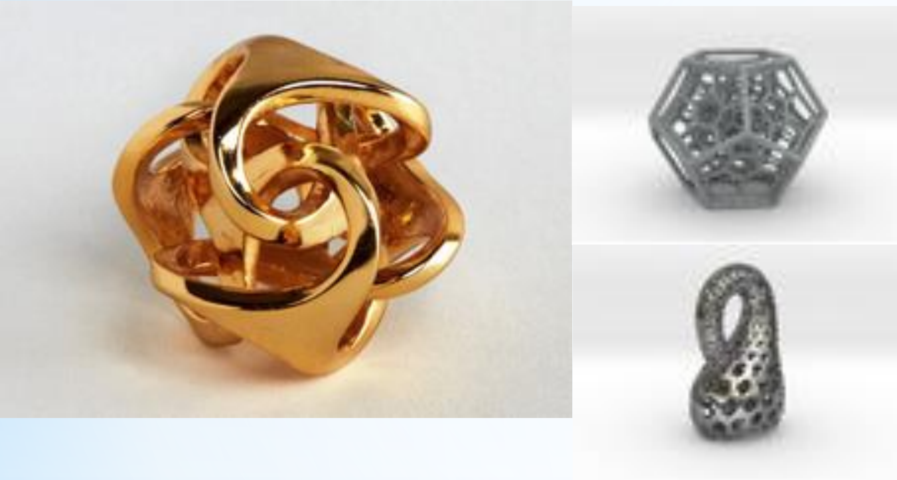

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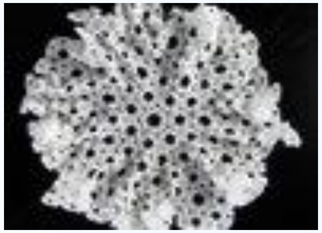
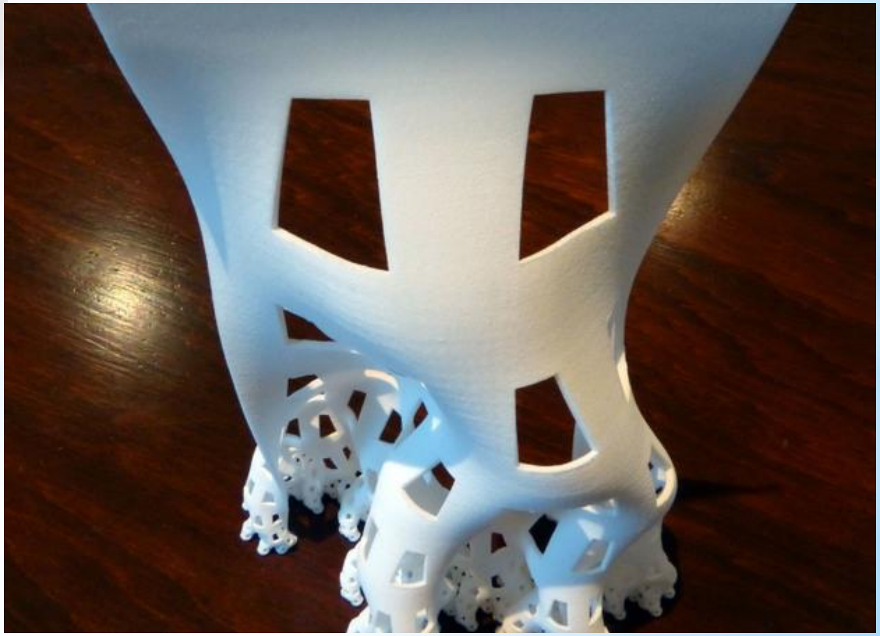




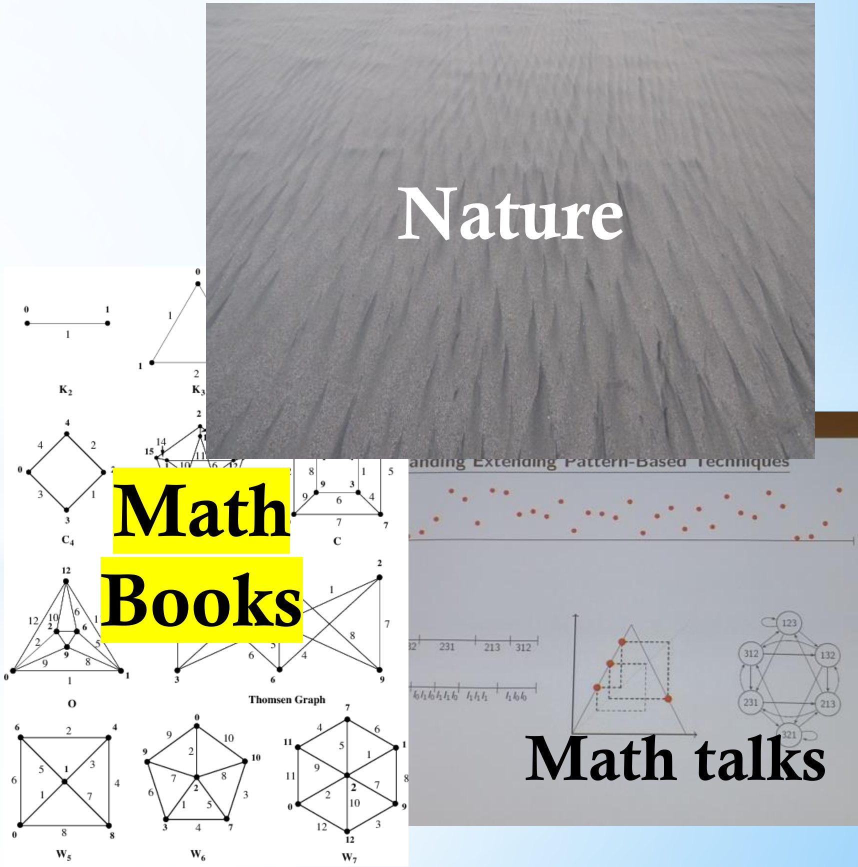
- Repetition
- Symmetry
- Geometry
- Higher Dimensions

The Design Process

Inspiration

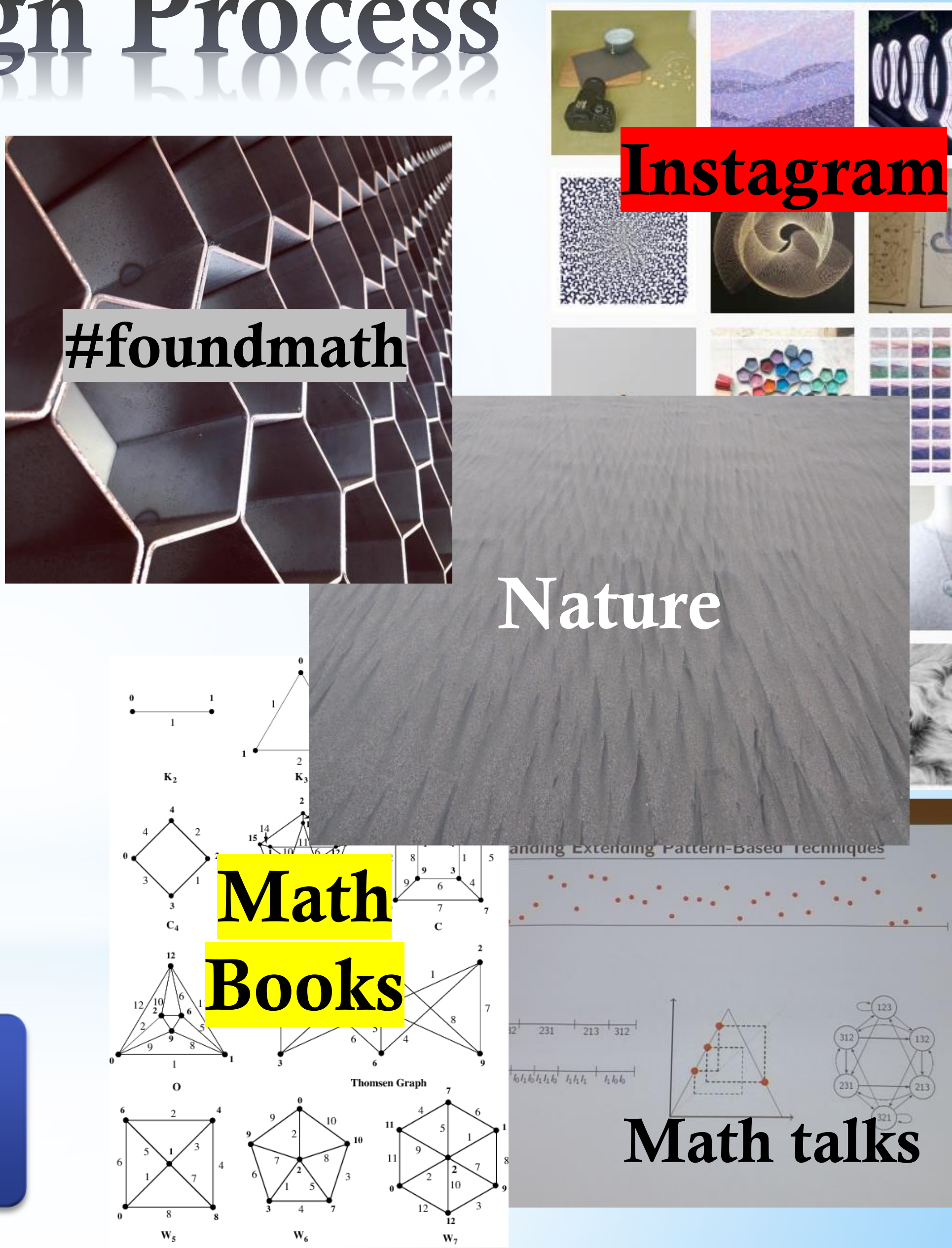
The Design Process

Inspiration


Nature
Math Books
Math talks
Thomsen Graph

The Design Process

Inspiration


#foundmath
Instagram
Nature
Math Books
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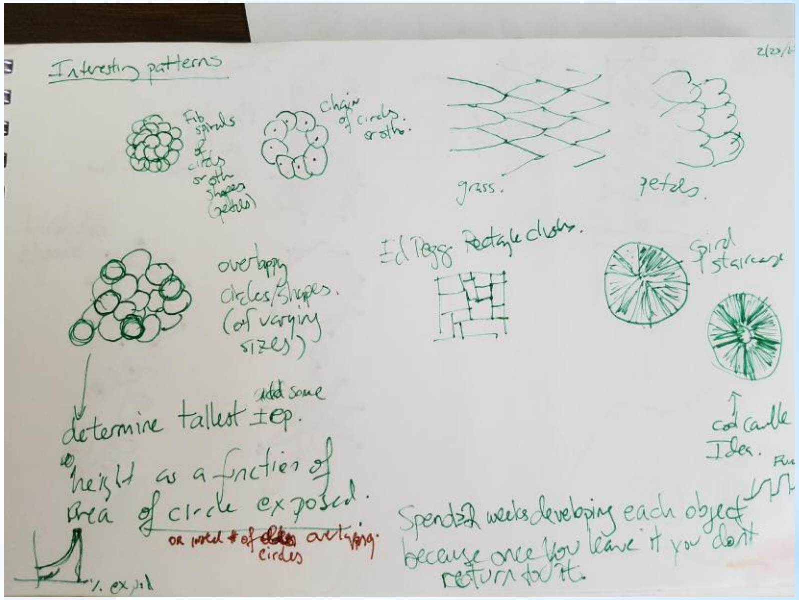
The Design Process

Inspiration

Concept


Interesting patterns
2/20/1
Fib spirals of circles or other shapes (petals)
chain of circles or other.
grass.
petals.
Ed Pegg Rectangle dissections.
Spiral staircase
overlapping circles/shapes. (of varying sizes)
cool candle Idea.
% exposed

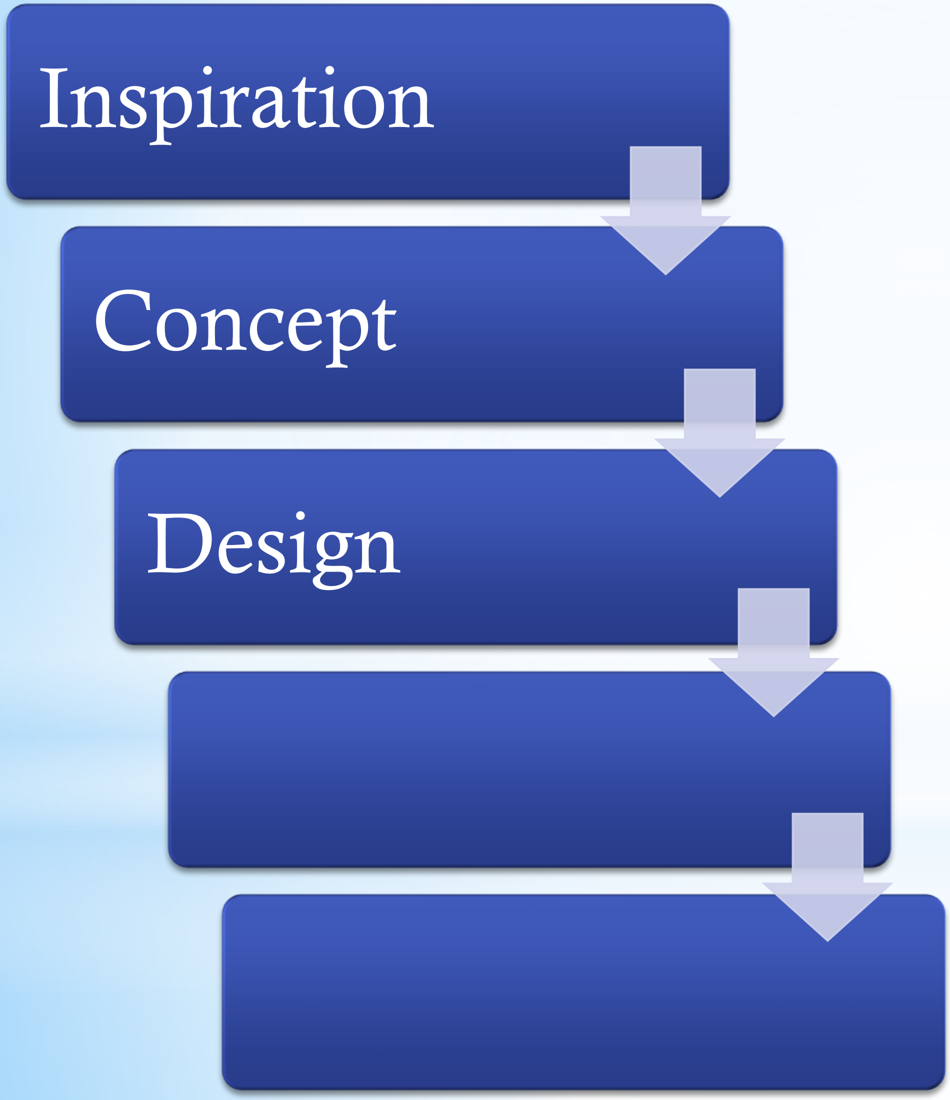
determine tallest step. add some

height as a function of area of circle exposed.

OR total # of ~~circles~~ circles overlapping.

Spend 2 weeks developing each object because once you leave it you don't return to it.

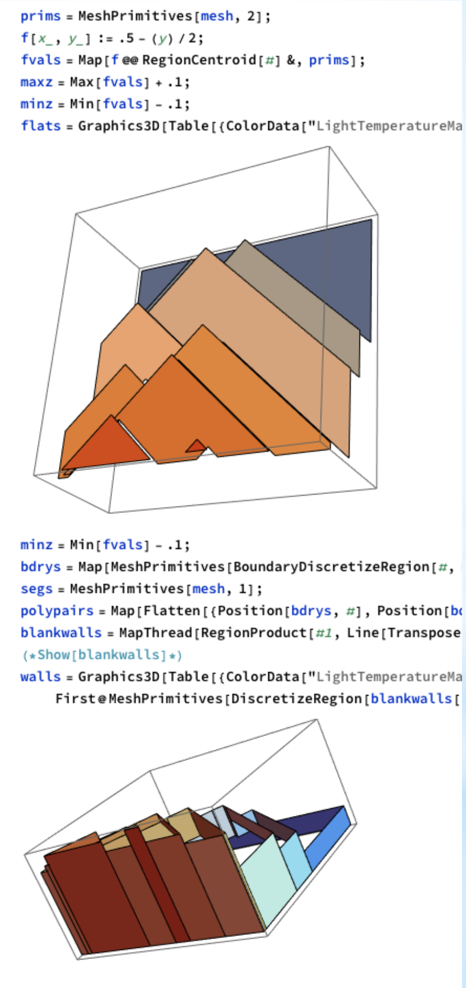
The Design Process



Inspiration

Concept

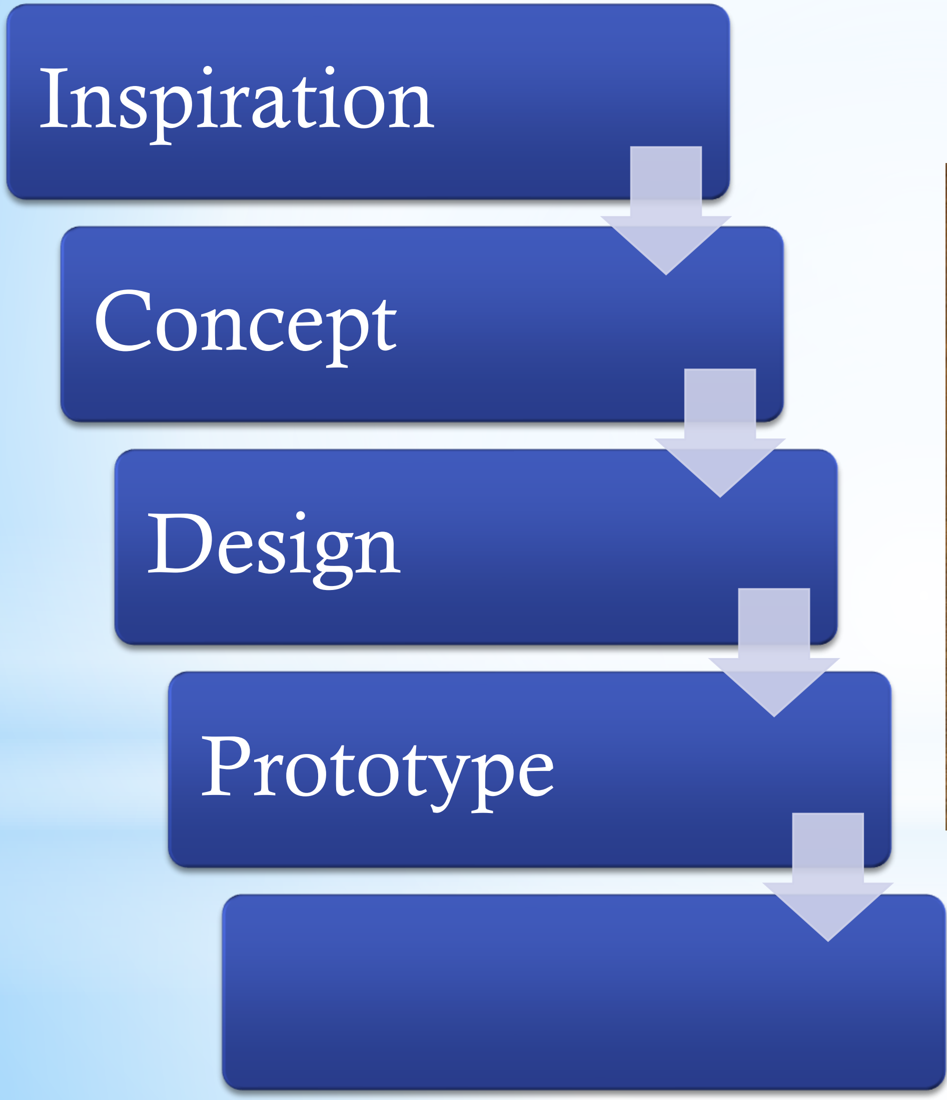
Design



```
prims = MeshPrimitives[mesh, 2];
f[x_, y_] := .5 - (y) / 2;
fvals = Map[f @@ RegionCentroid[#] &, prims];
maxz = Max[fvals] + .1;
minz = Min[fvals] - .1;
flats = Graphics3D[Table[{ColorData["LightTemperatureMa
```

```
minz = Min[fvals] - .1;
bdrys = Map[MeshPrimitives[BoundaryDiscretizeRegion[#,
segs = MeshPrimitives[mesh, 1];
polypairs = Map[Flatten[{Position[bdrys, #], Position[bc
blankwalls = MapThread[RegionProduct[#1, Line[Transpose
(*Show[blankwalls]*)
walls = Graphics3D[Table[{ColorData["LightTemperatureMa
    First@MeshPrimitives[DiscretizeRegion[blankwalls[
```

The Design Process



Inspiration

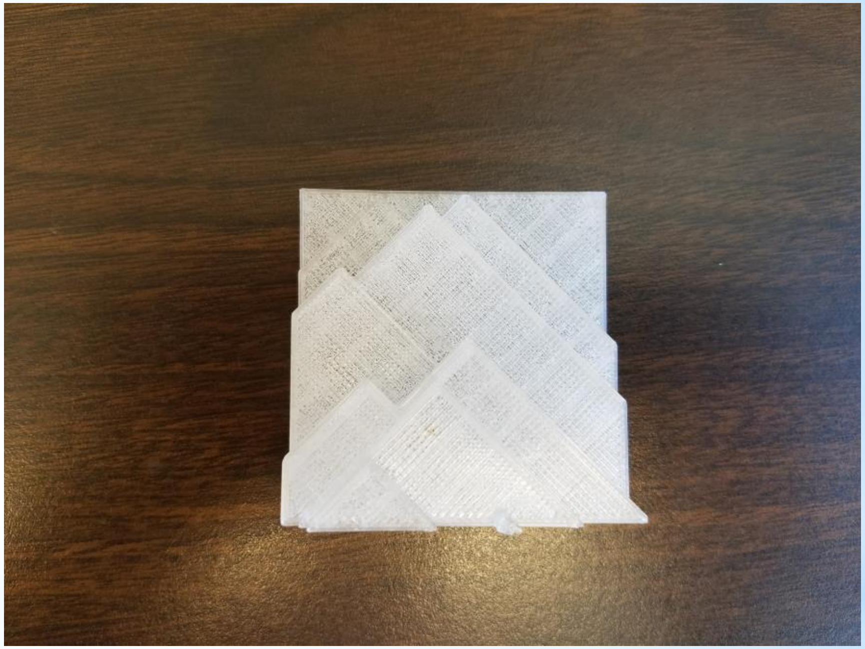
Concept

Design

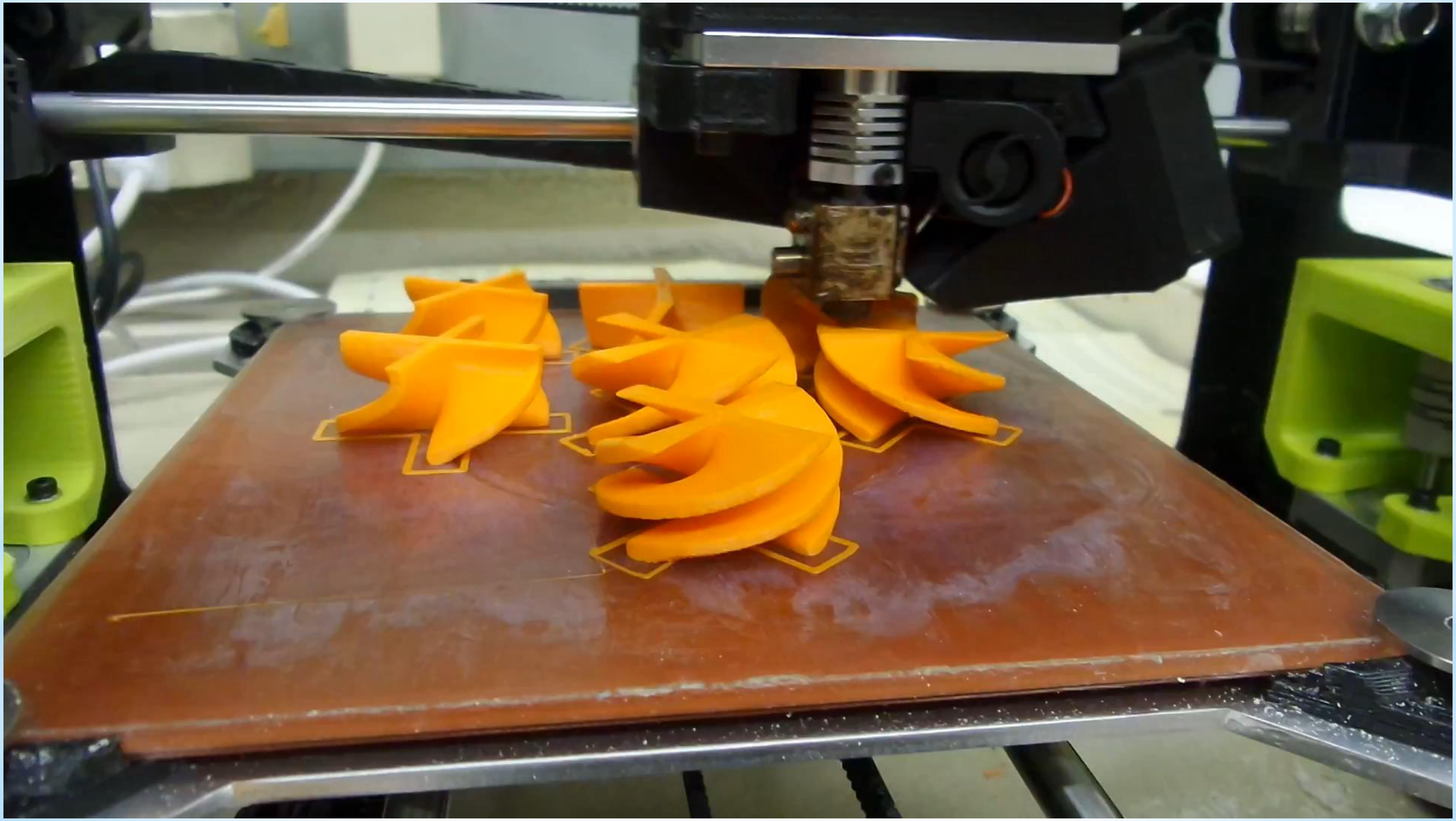
Prototype

The Design Process

- Inspiration
- Concept
- Design
- Prototype
- Final Artwork

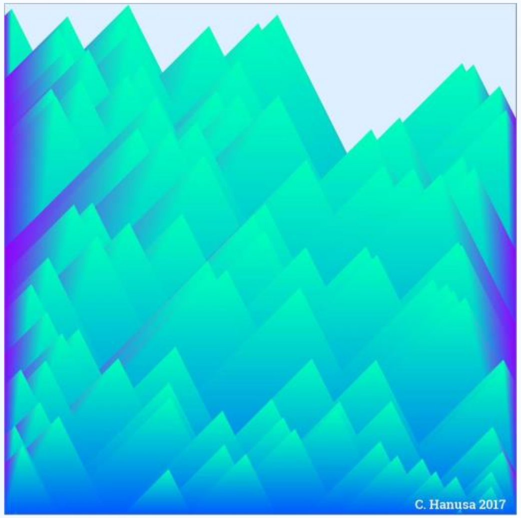


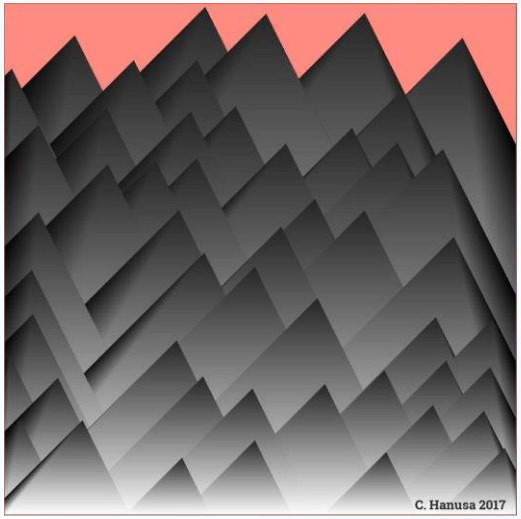
What does 3D Printing look like?



Mathematical Images

Sand Art (2017)


C. Hanusa 2017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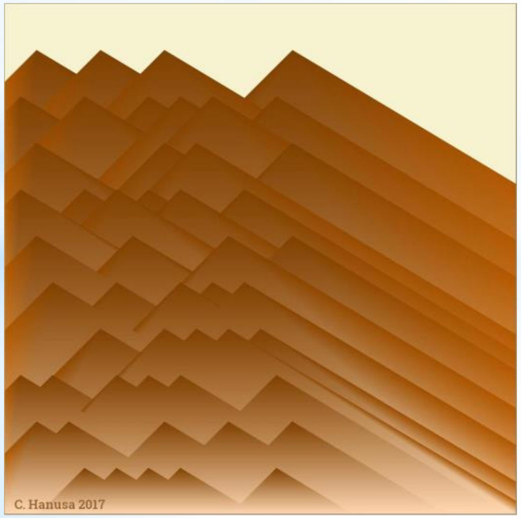
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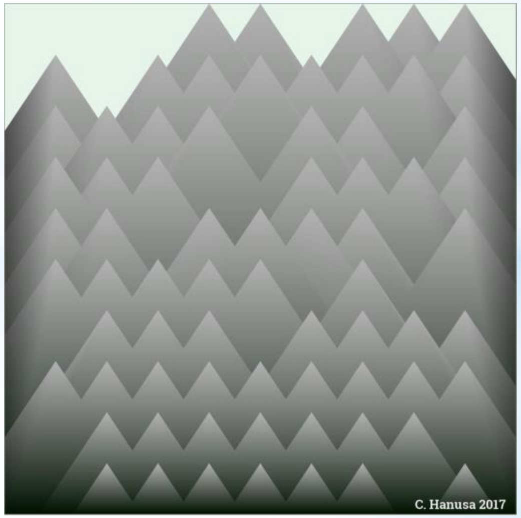
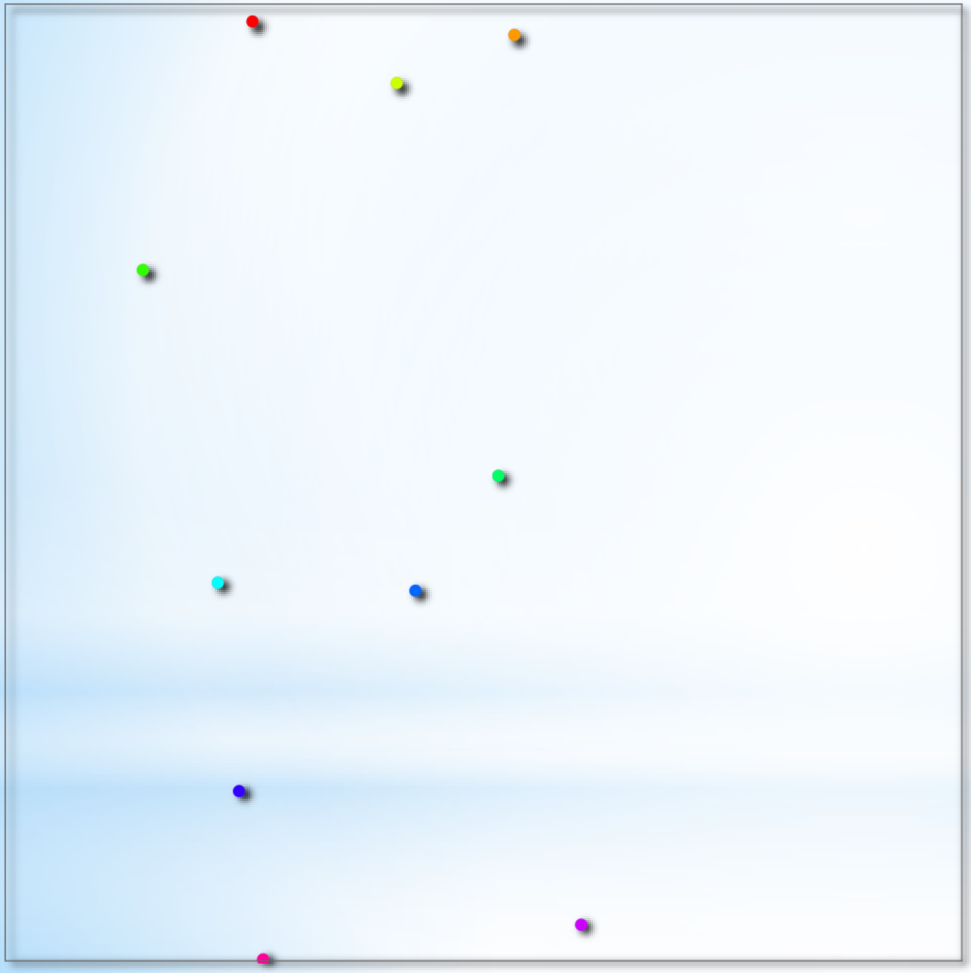

C. Hanusa 2017

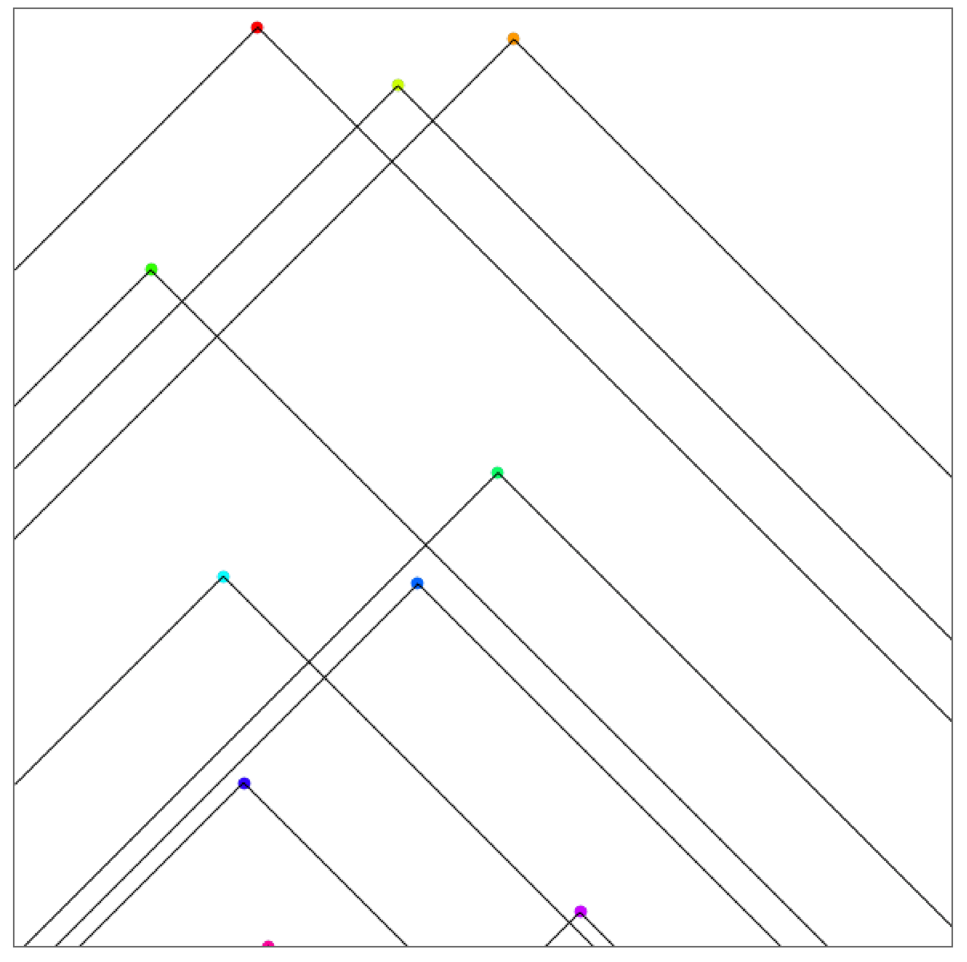
Inspiration: Playa Hermosa

Deconstruction

Reconstruction



Reconstruction



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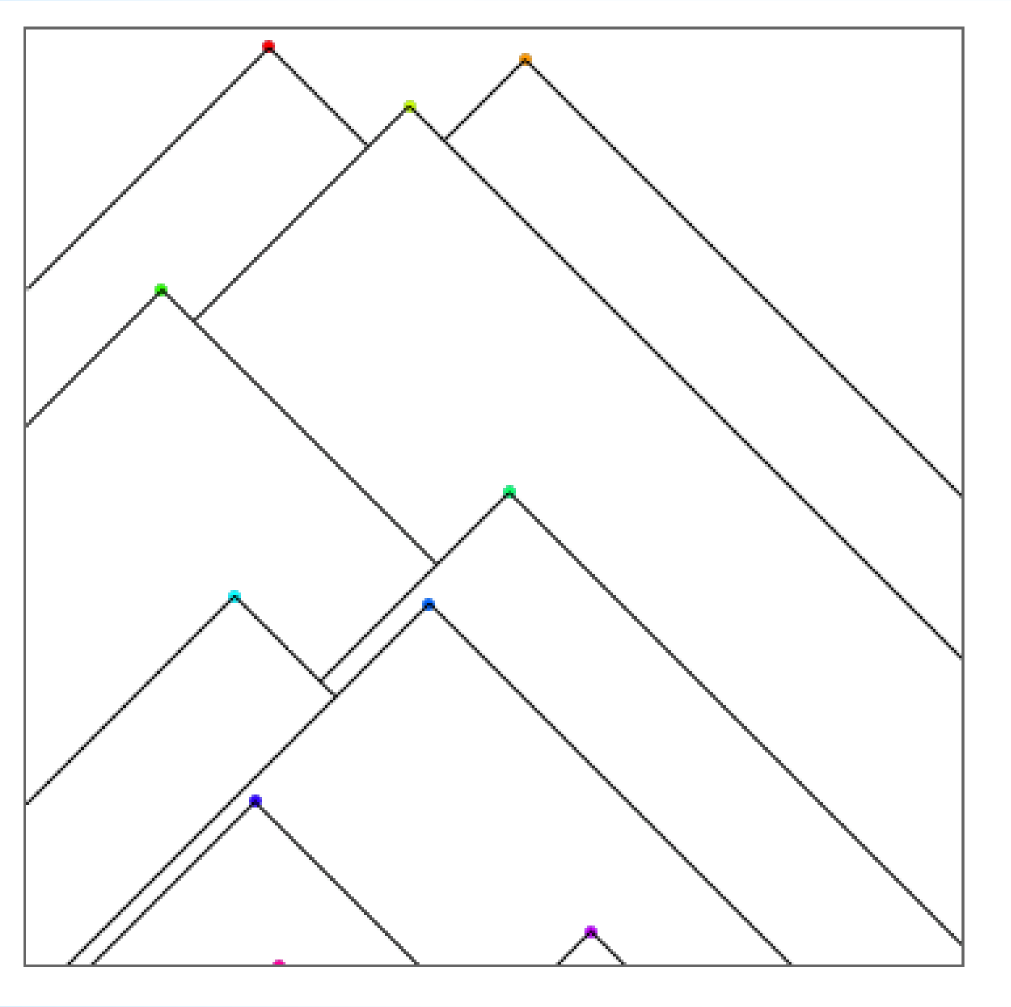

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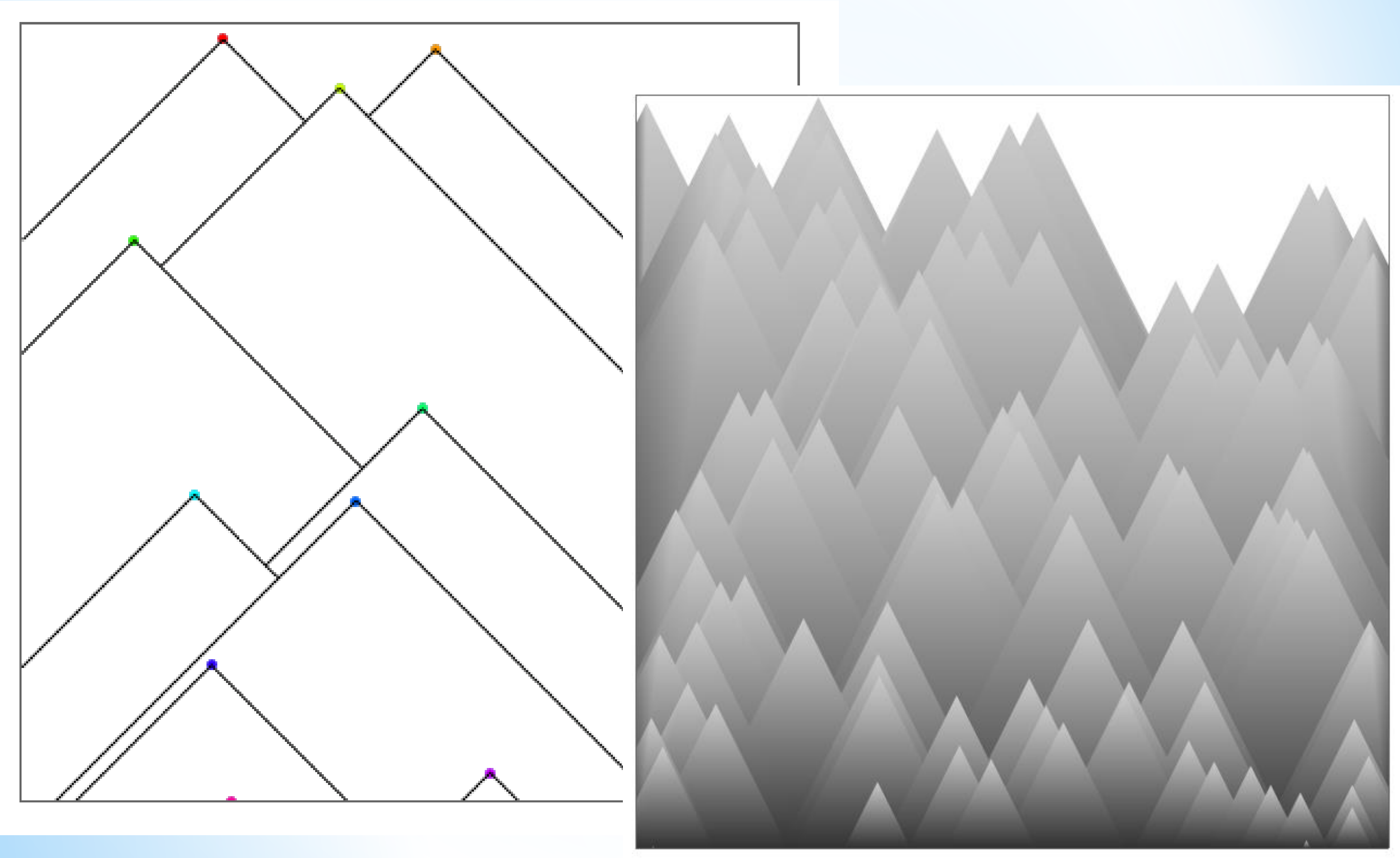

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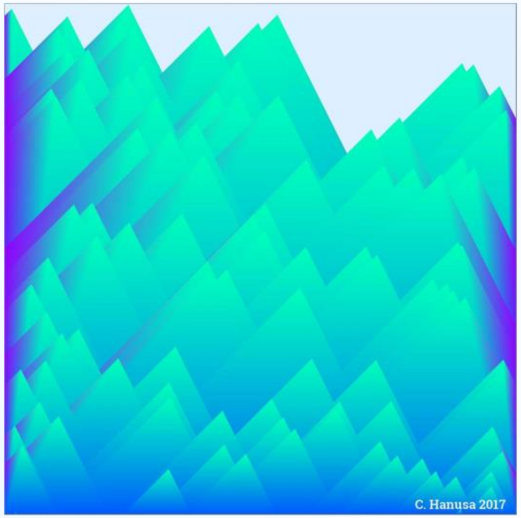
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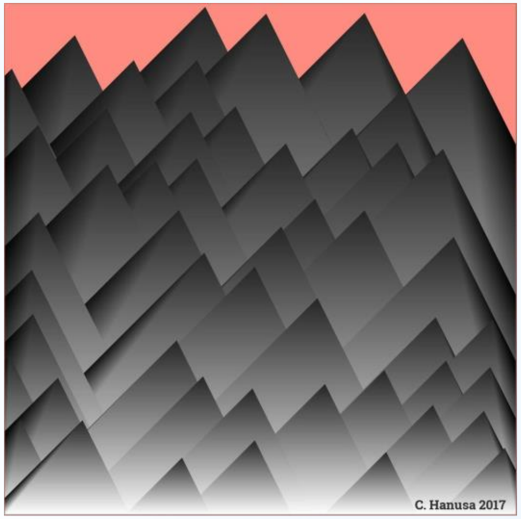
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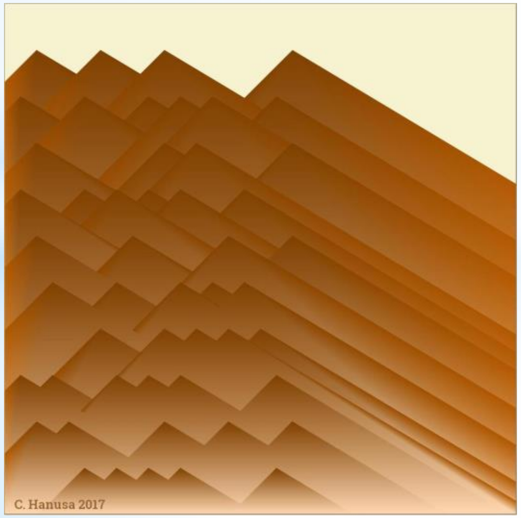
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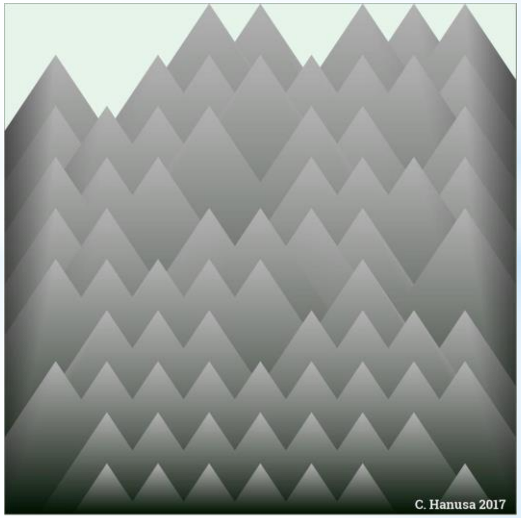
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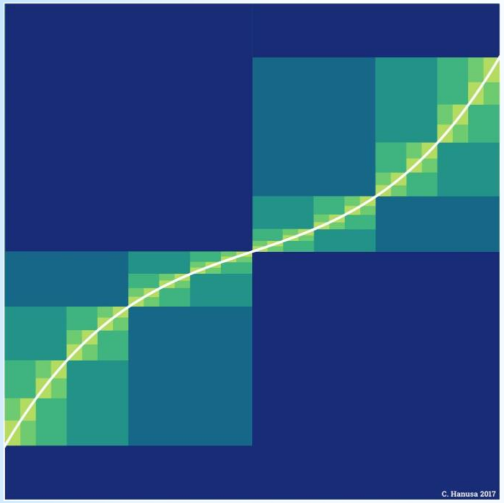
Calculus Art (2017)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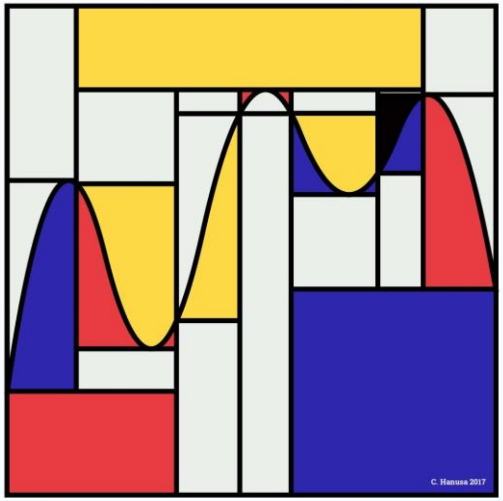
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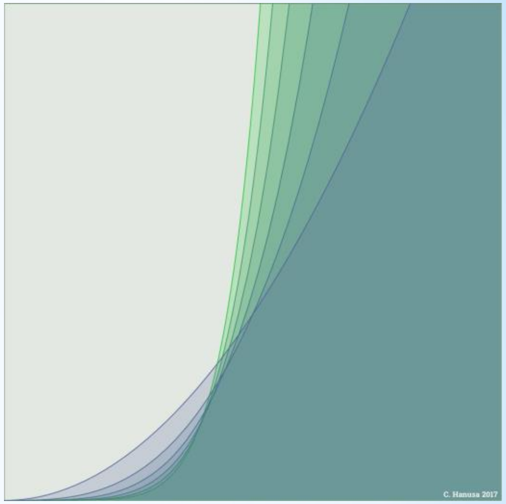
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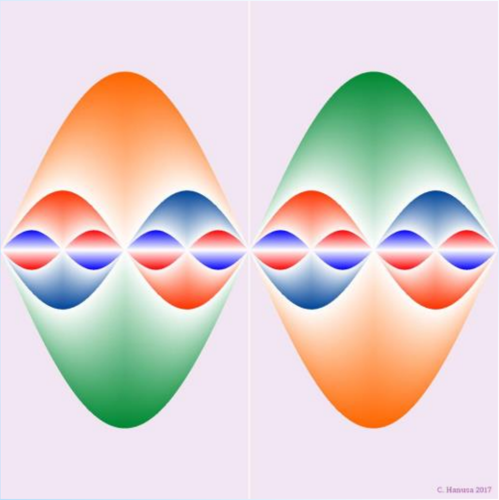
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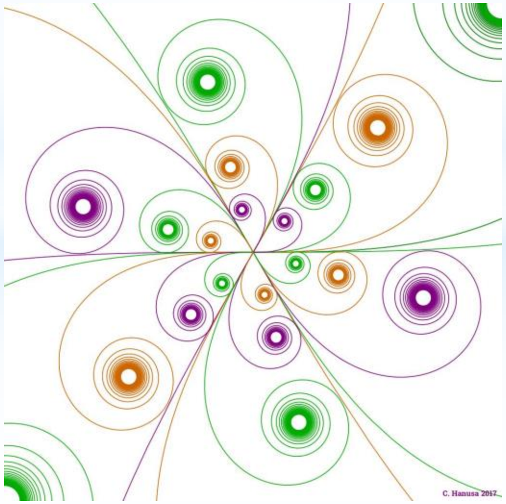
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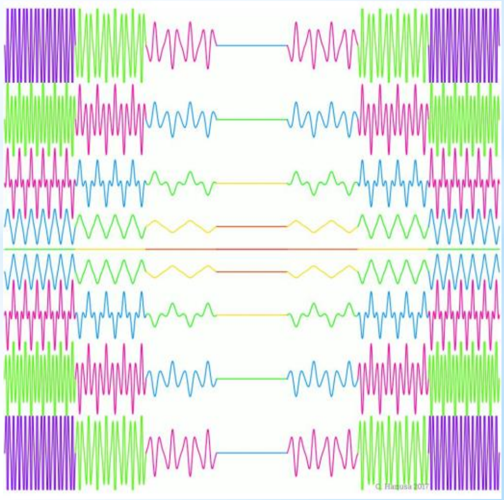
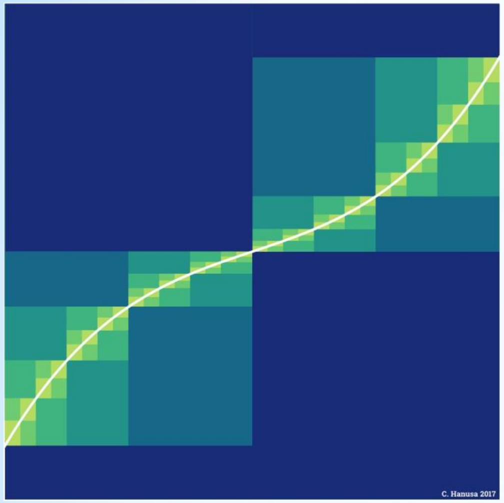

C. Hanusa 2017

Riemann Valley (2017)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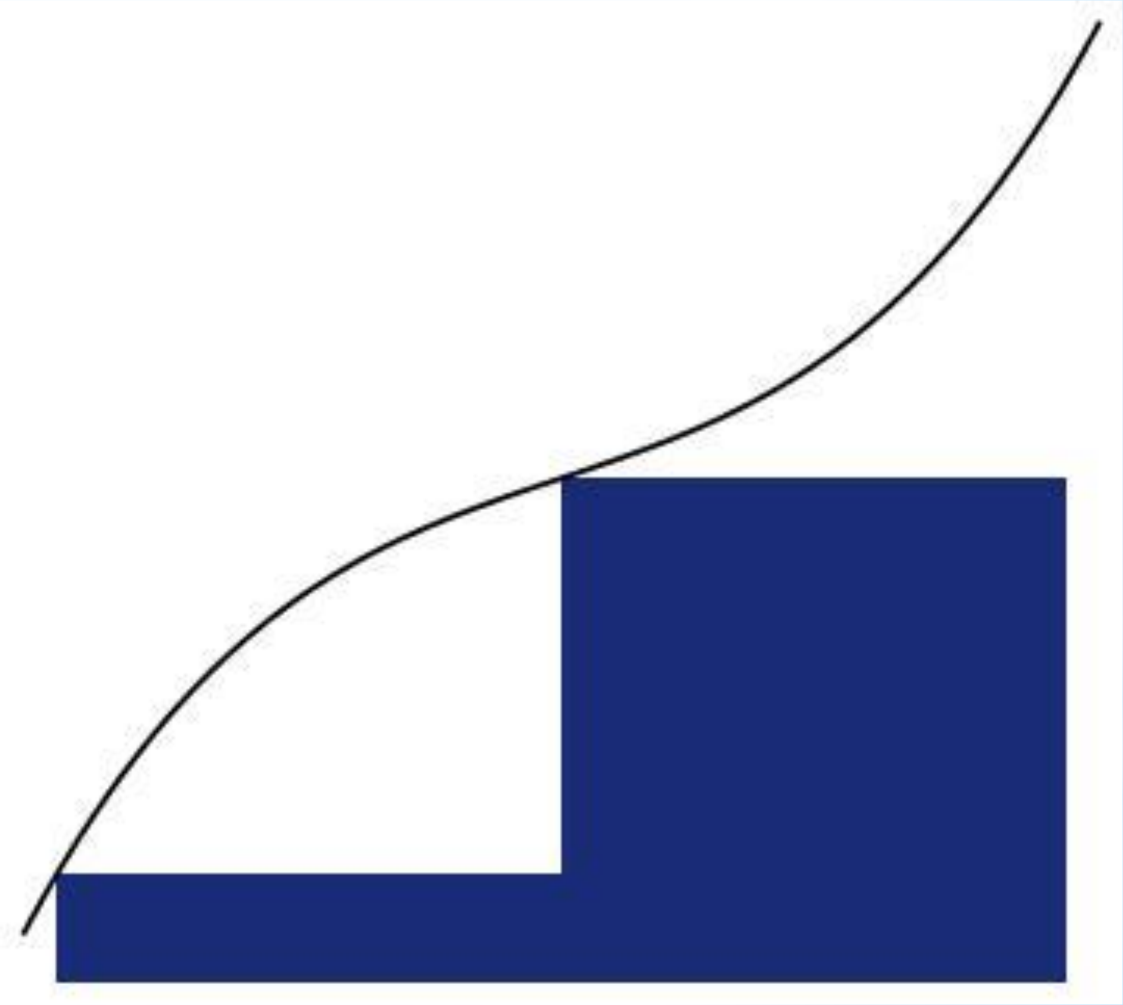

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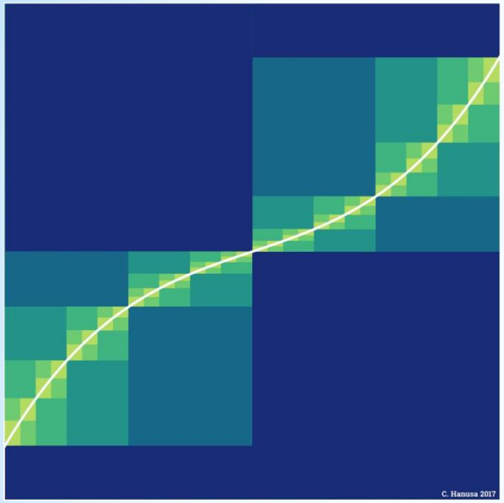
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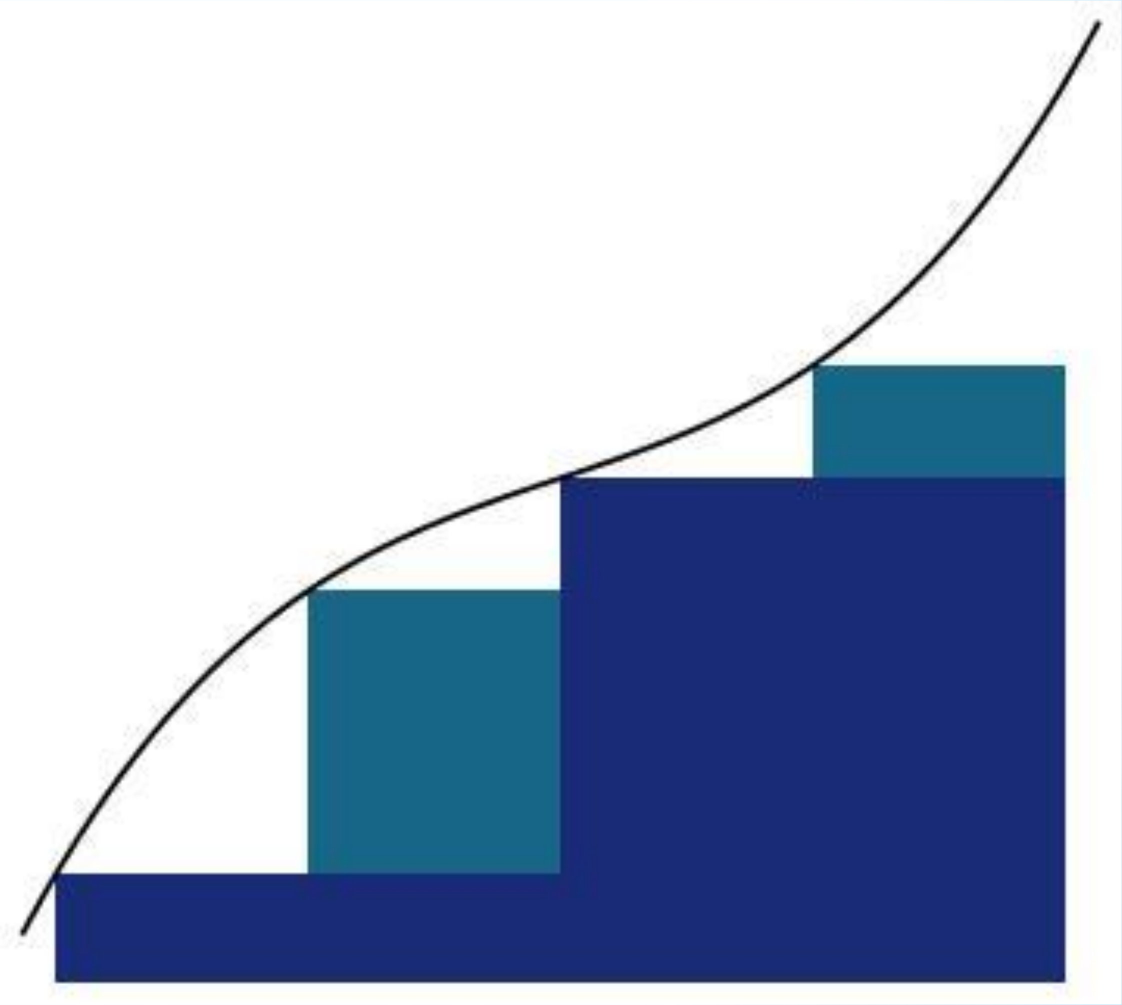

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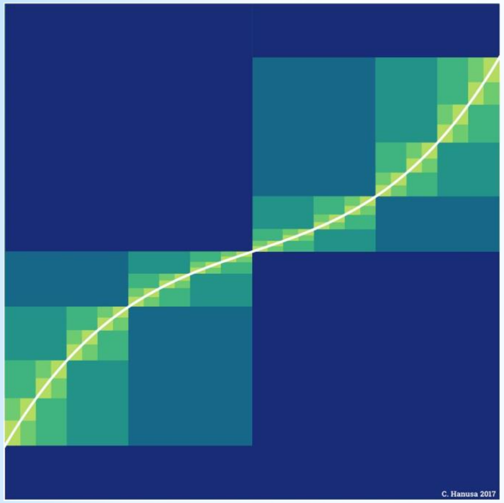
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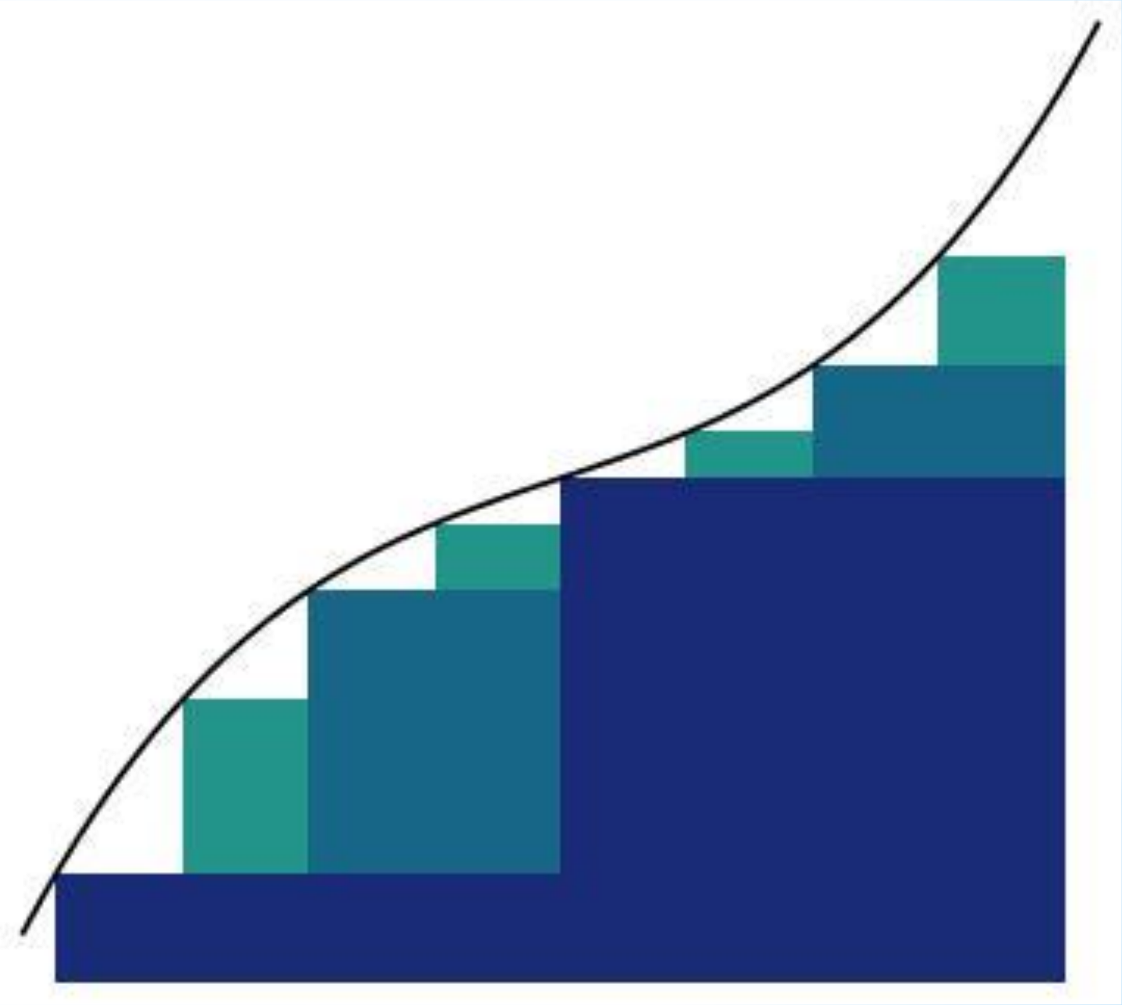

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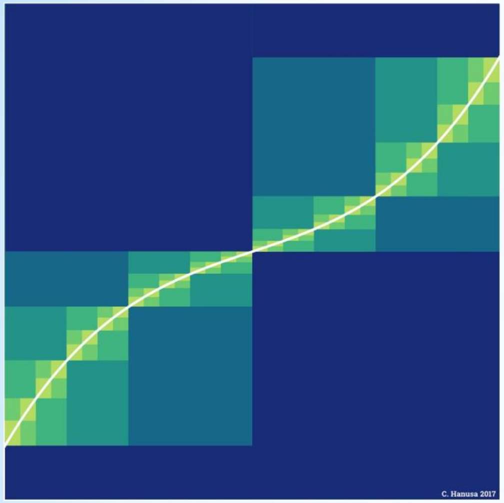
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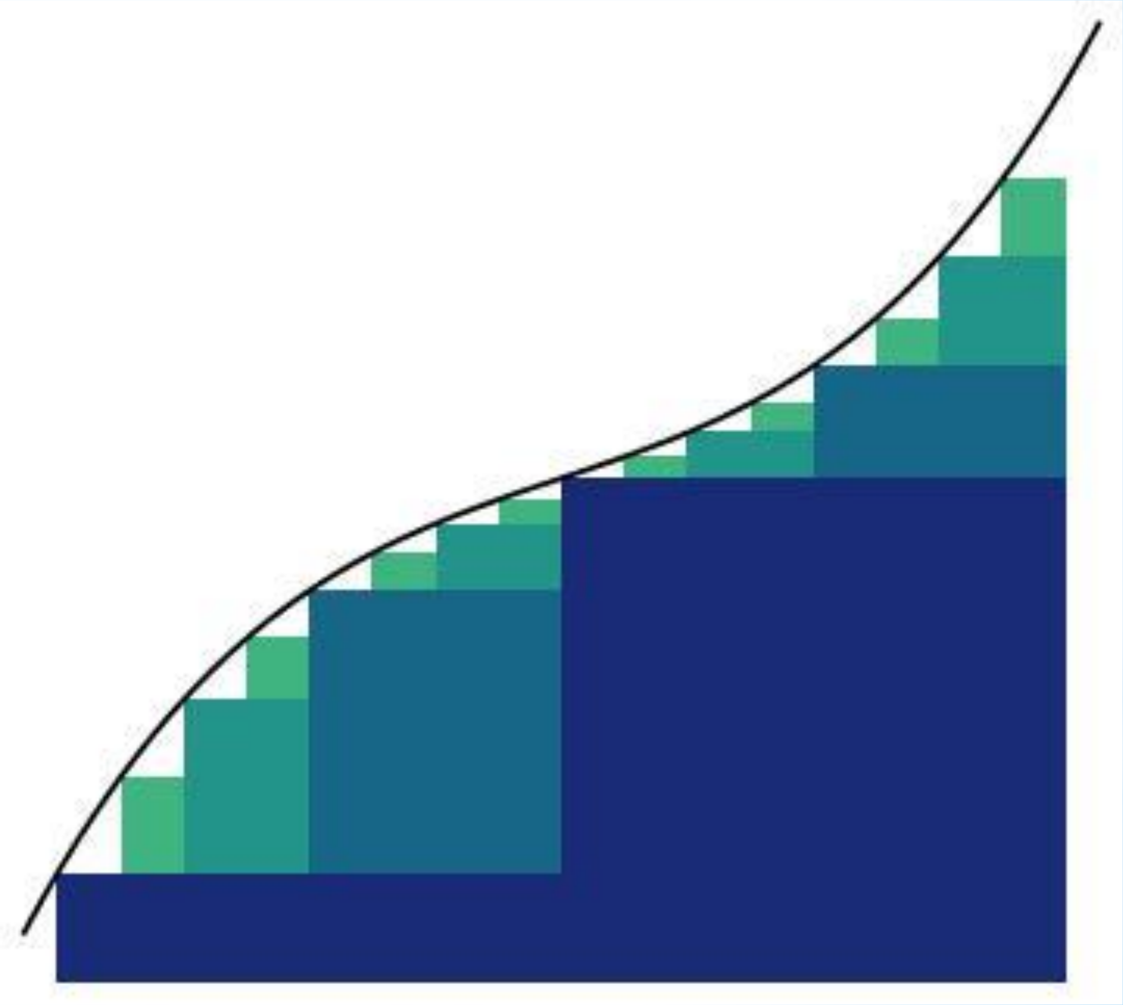

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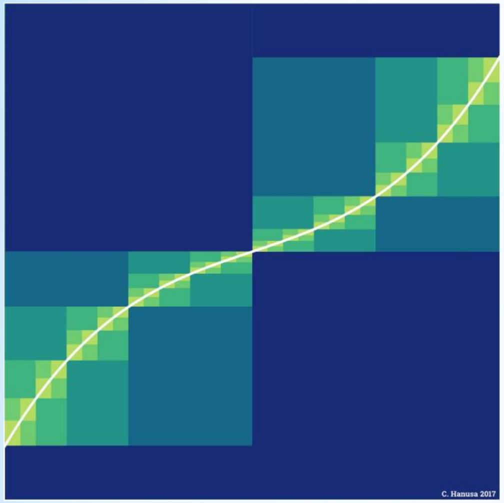
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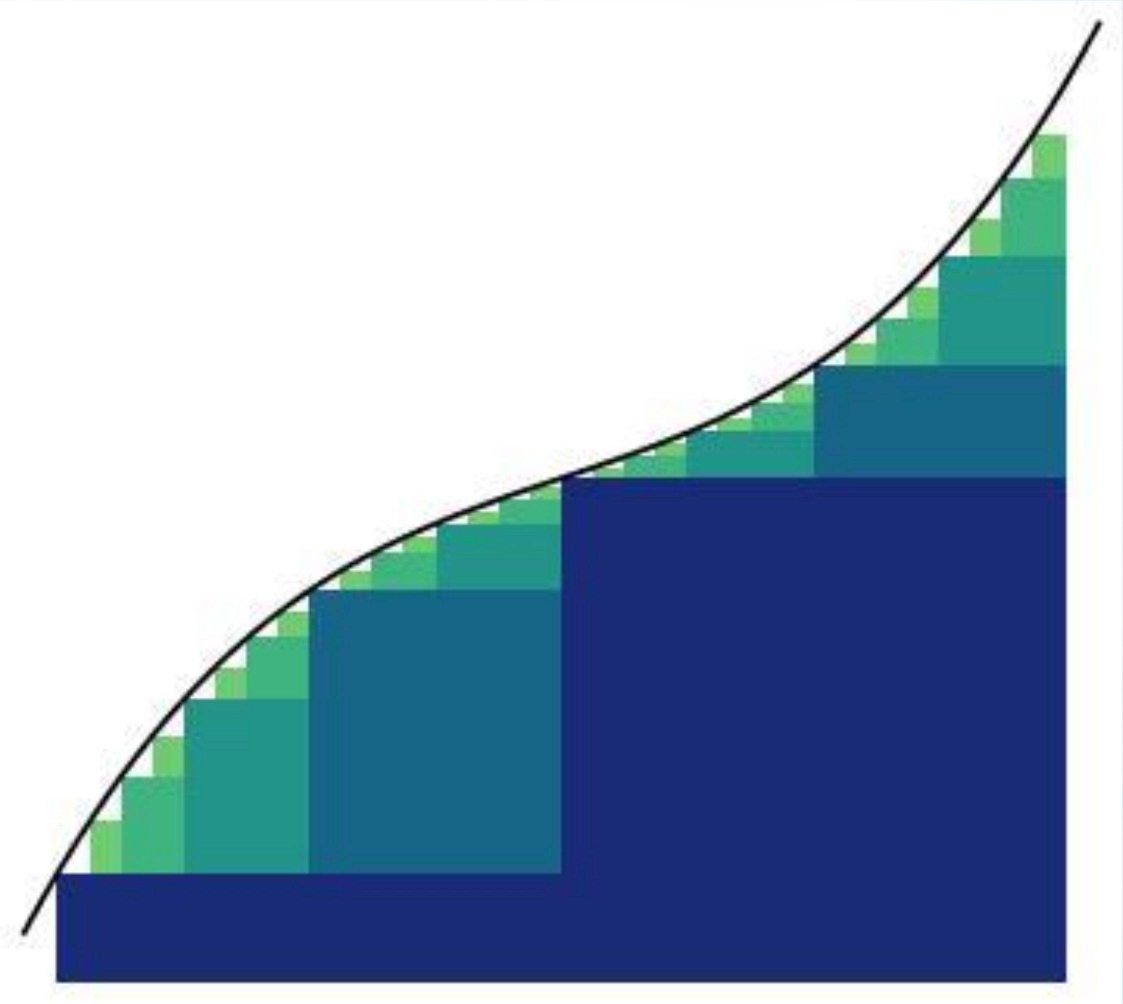

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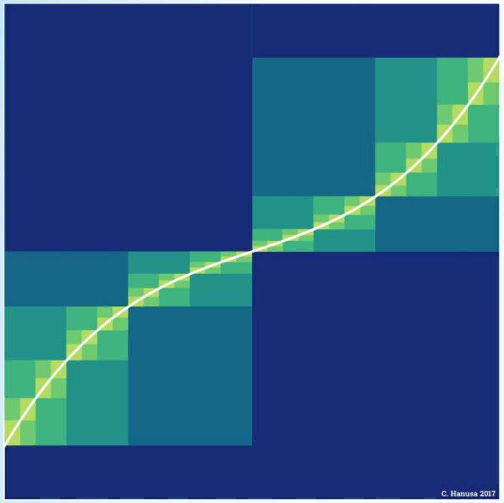
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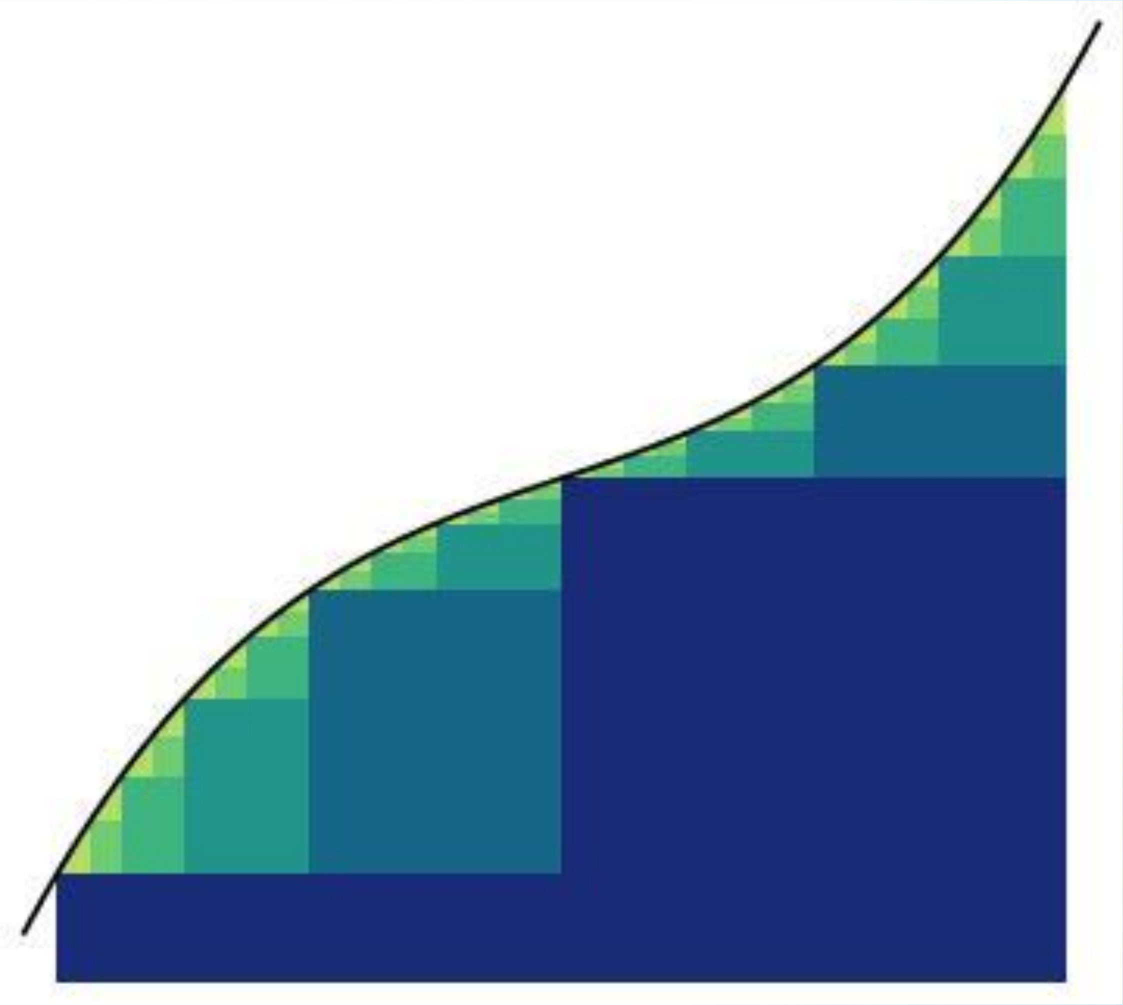

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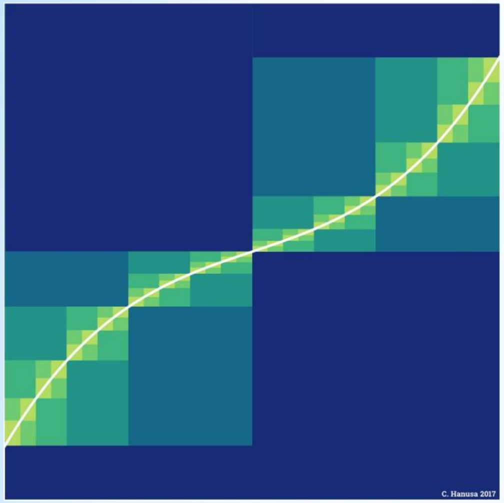
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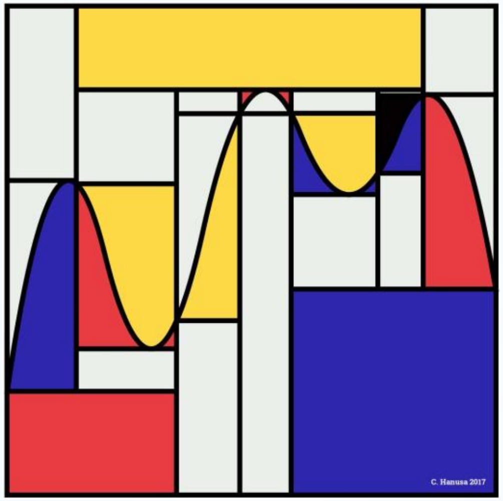
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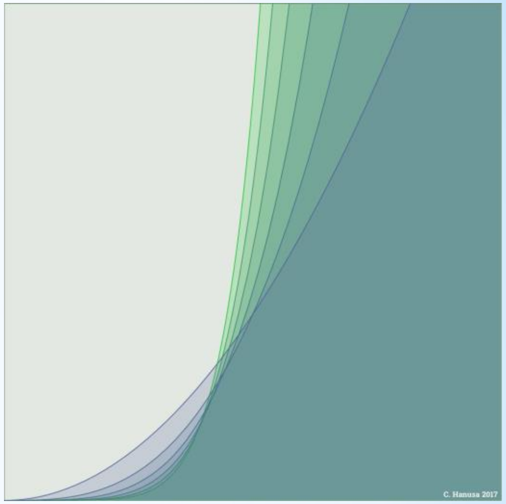
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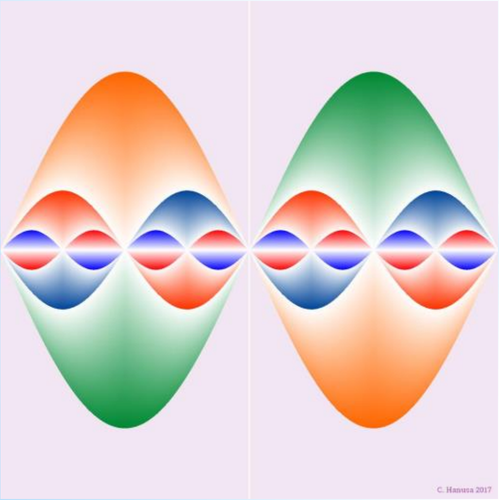
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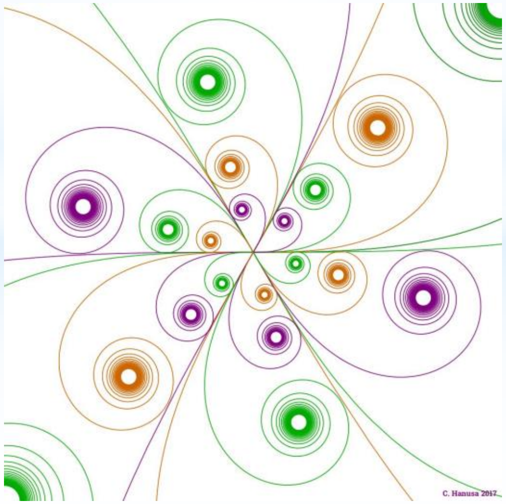
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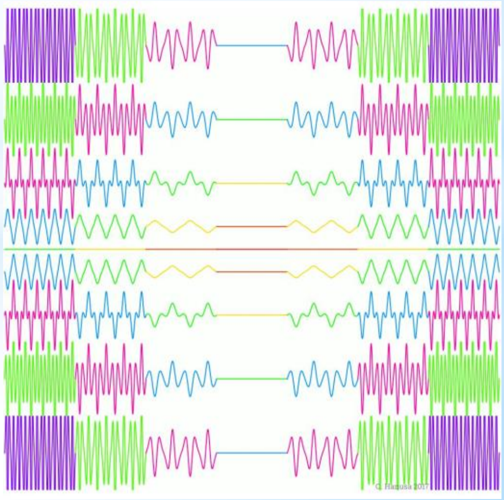

C. Hanusa 2017

Generative Art

That’s Random

A **random number** is a number chosen by chance.

Key property: Each choice is independent of previous choices.

That’s Random

A **random number** is a number chosen by chance.

Key property: Each choice is independent of previous choices.

Which feels more random?

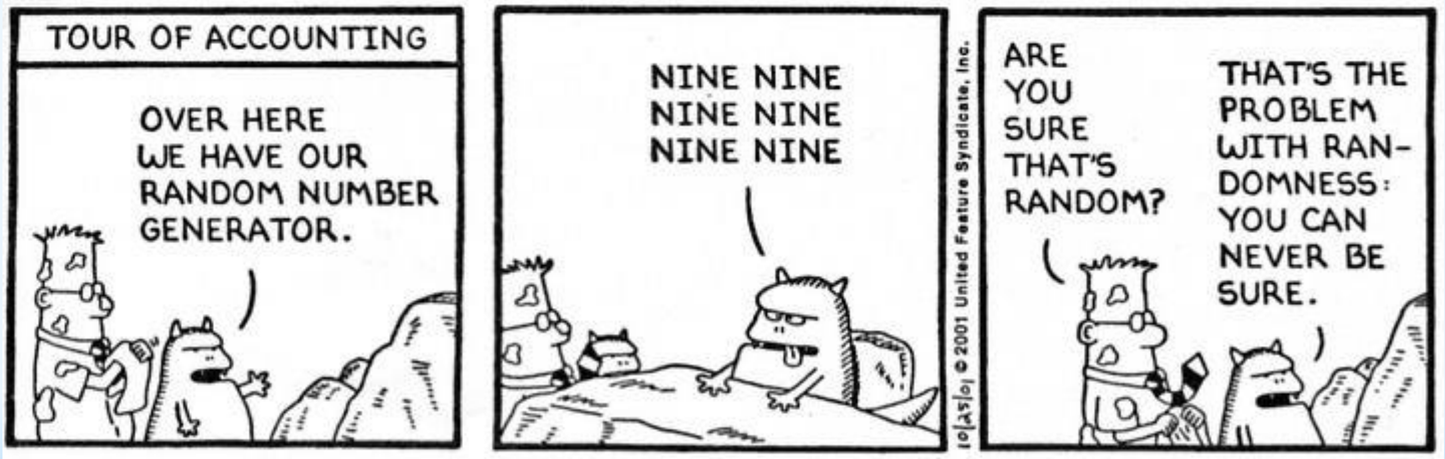
List A:

4, 3, 2, 2, 3, 3, 3, 3, 2, 4, 3, 4, 4, 4, 1, 3, 3, 4, 3, 3, 1, 3, 1, 4, 1, 1, 1, 1, 3, 3, 1, 1, 4, 3, 3, 2, 3, 1, 1, 1, 3, 4, 3, 1

List B:

1, 3, 4, 2, 1, 1, 3, 3, 2, 4, 1, 2, 3, 1, 3, 4, 4, 2, 1, 4, 2, 3, 4, 1, 3, 1, 2, 3, 4, 1, 3, 4, 2, 2, 3, 1, 3, 1, 4, 2, 3, 1, 4, 2

Generating Random Numbers



TOUR OF ACCOUNTING
OVER HERE WE HAVE OUR RANDOM NUMBER GENERATOR.
NINE NINE NINE NINE NINE NINE
ARE YOU SURE THAT'S RANDOM?
THAT'S THE PROBLEM WITH RANDOMNESS: YOU CAN NEVER BE SURE.
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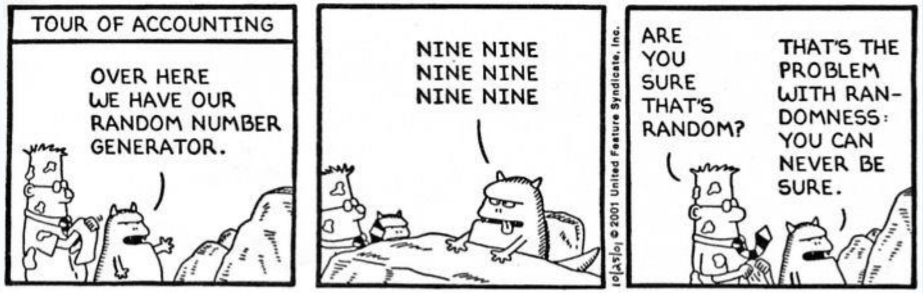
Generating Random Numbers

- Flip a coin
- Roll a die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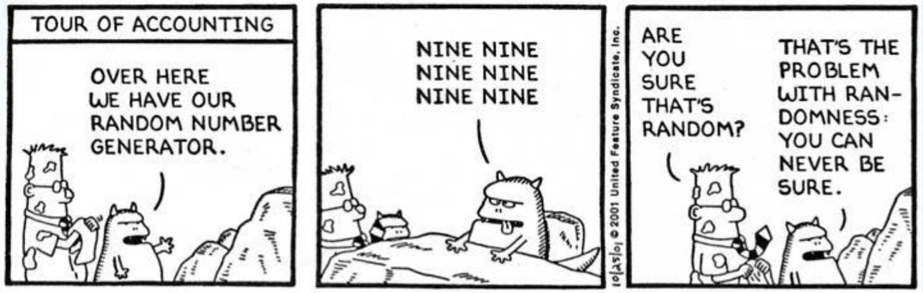
Generating Random Numbers

- Flip a coin
- Roll a die
- Tables in books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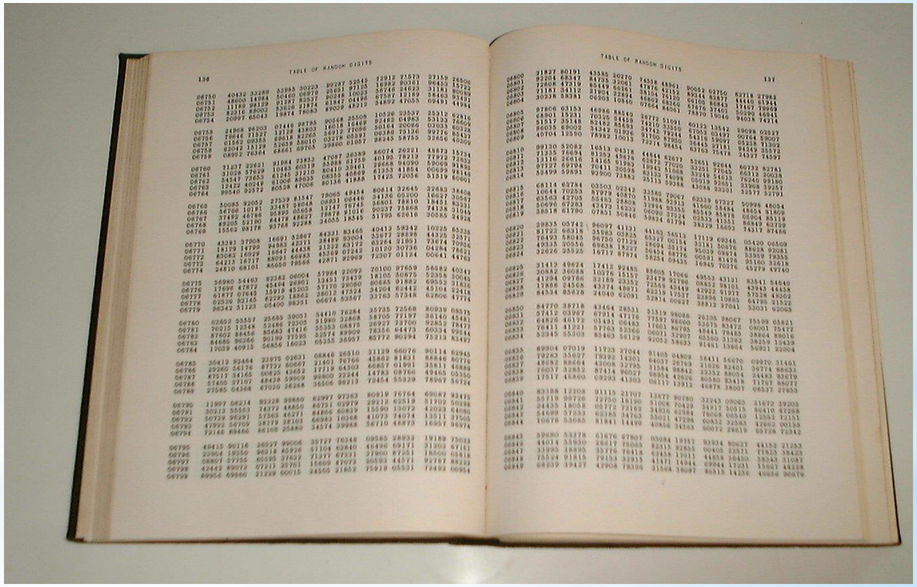
TABLE OF RANDOM DIGITS
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Generating Random Numbers

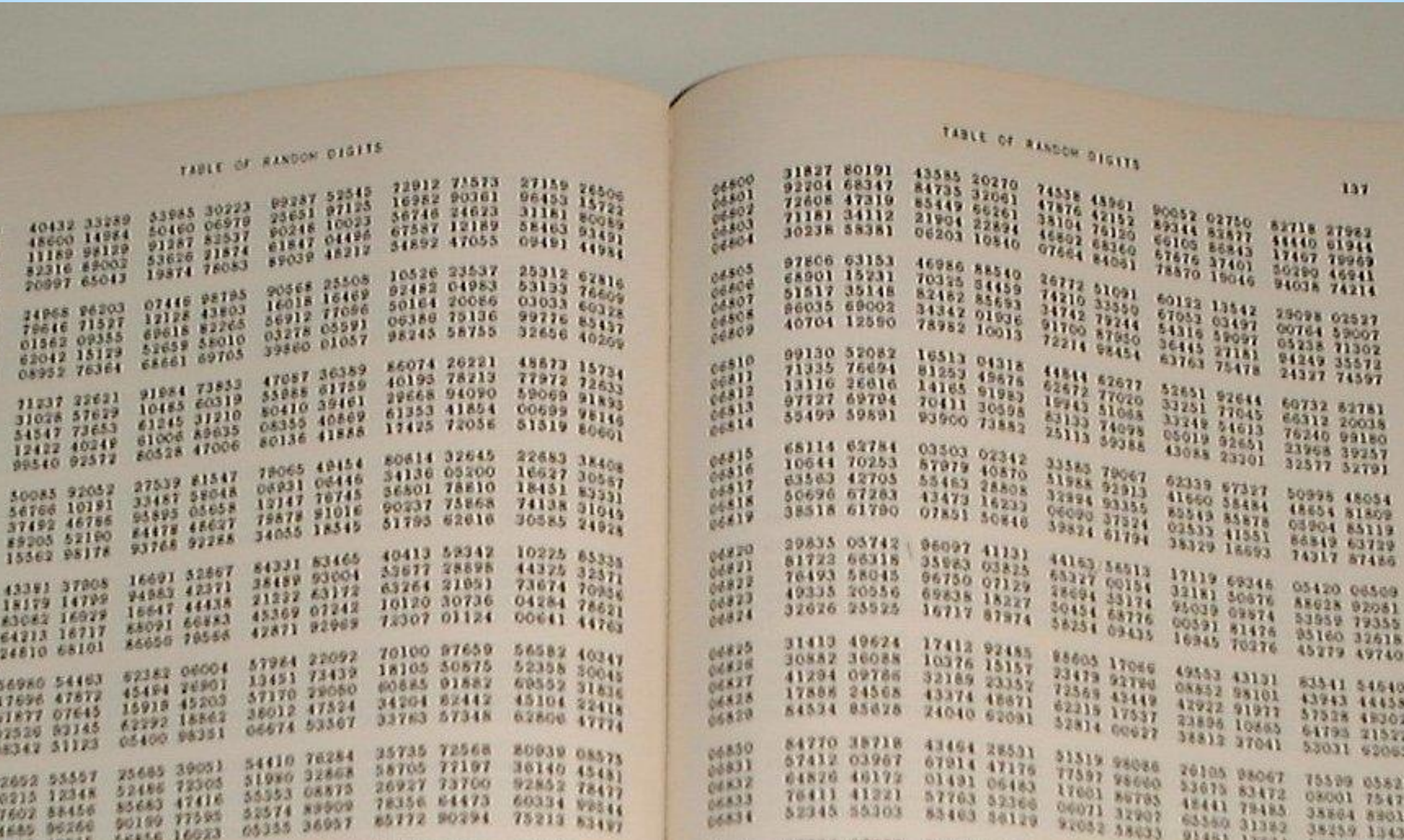

TABLE OF RANDOM DIGITS

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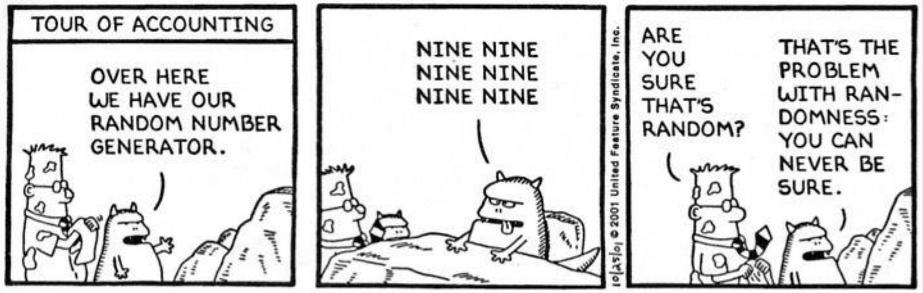
137

Generating Random Numbers

- Flip a coin
- Roll a die
- Tables in books
- Noise from outer space (random.org)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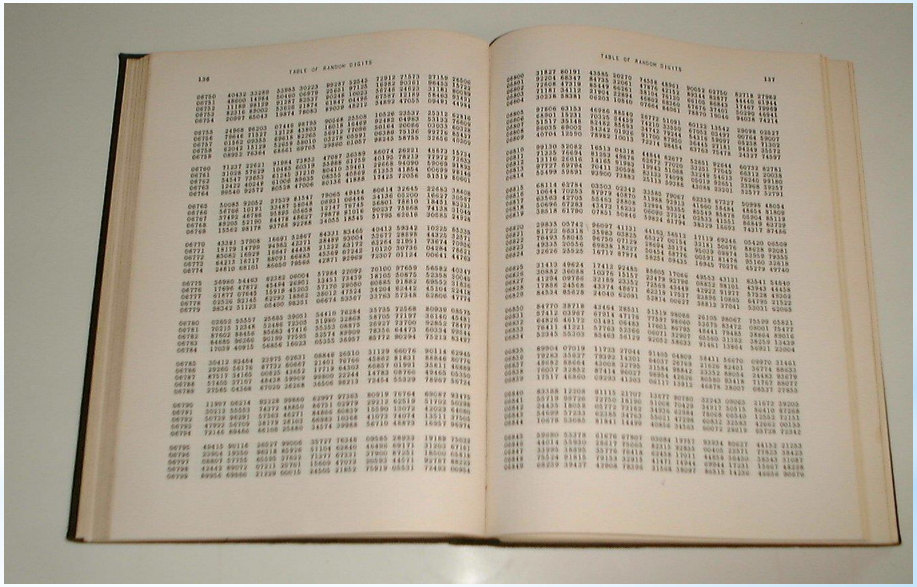
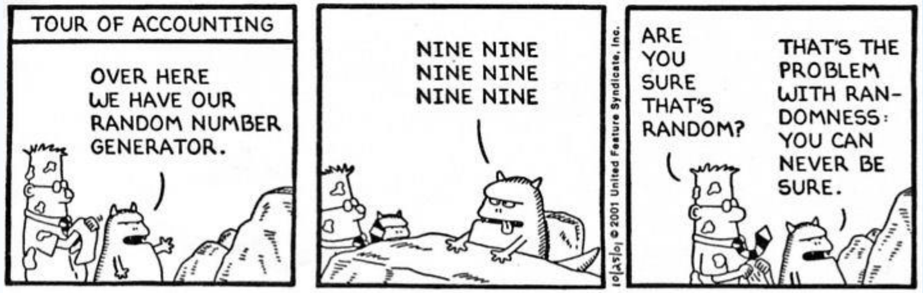


Generating Random Numbers

- Flip a coin
- Roll a die
- Tables in books
- Noise from outer space (random.org)
- Use a computer?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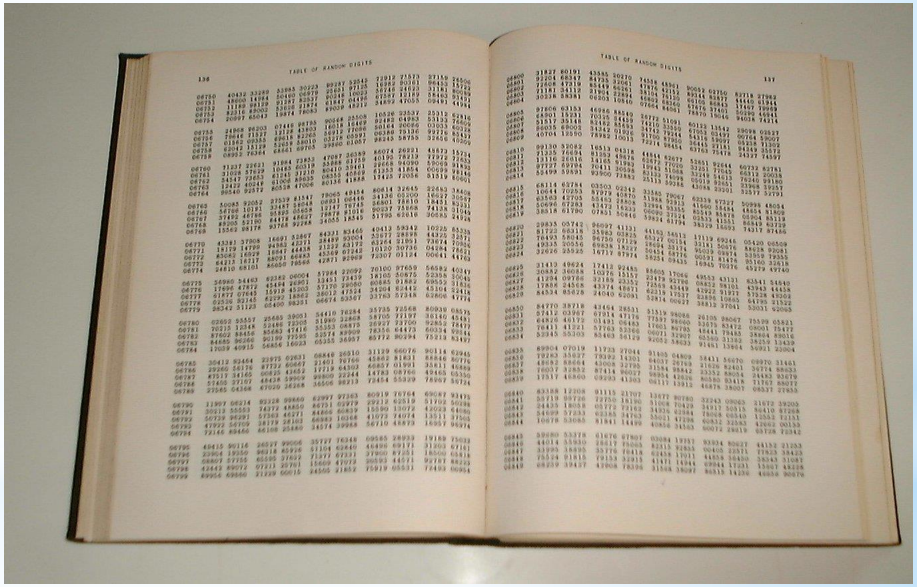
TABLE OF RANDOM DIGITS
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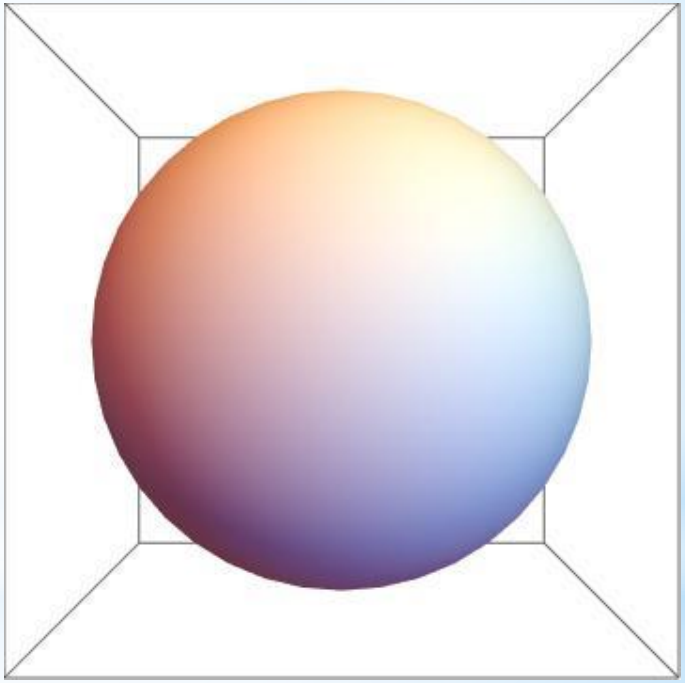
Generative Art / Creative Coding

Use a computer to program an **algorithm**:

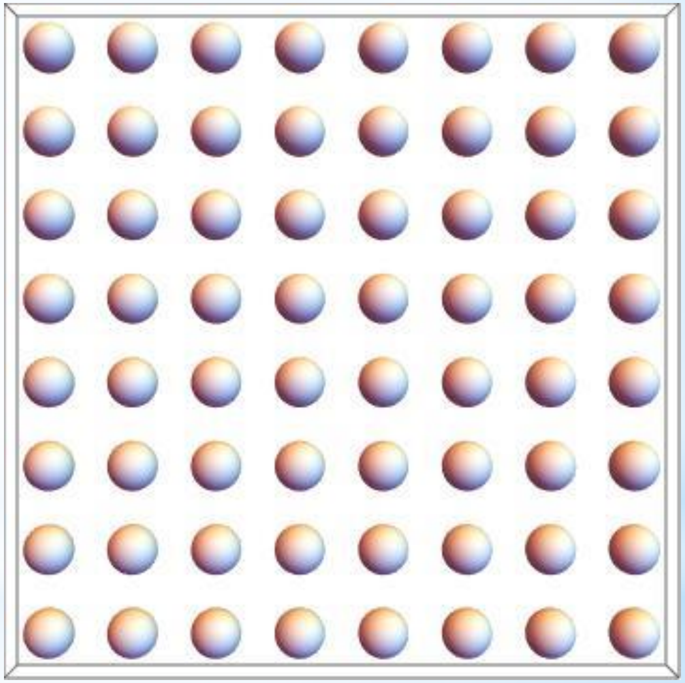
- Specify **objects**



Generative Art / Creative Coding

Use a computer to program an **algorithm**:

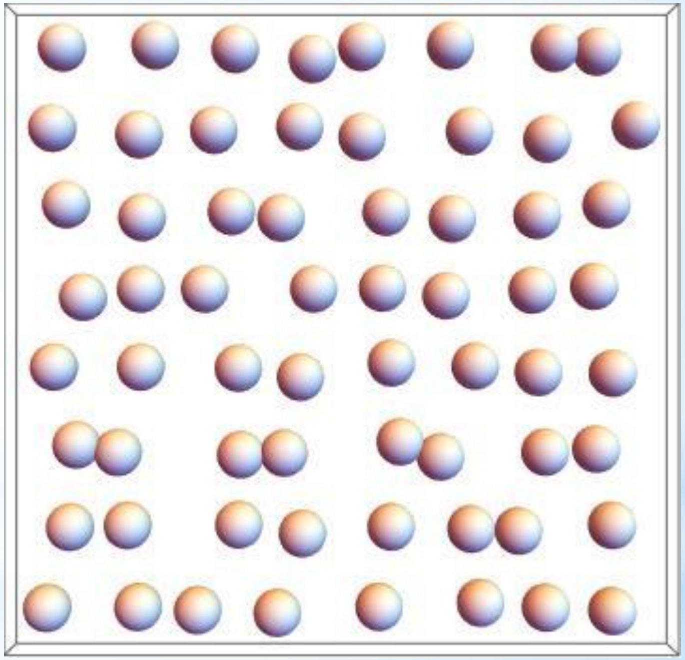
- Specify **objects**
- Give **rules** for placement



Generative Art / Creative Coding

Use a computer to program an **algorithm**:

- Specify **objects**
- Give **rules** for placement
- Add **randomness**



Generative Art / Creative Coding

Use a computer to program an **algorithm**:

- Specify **objects**
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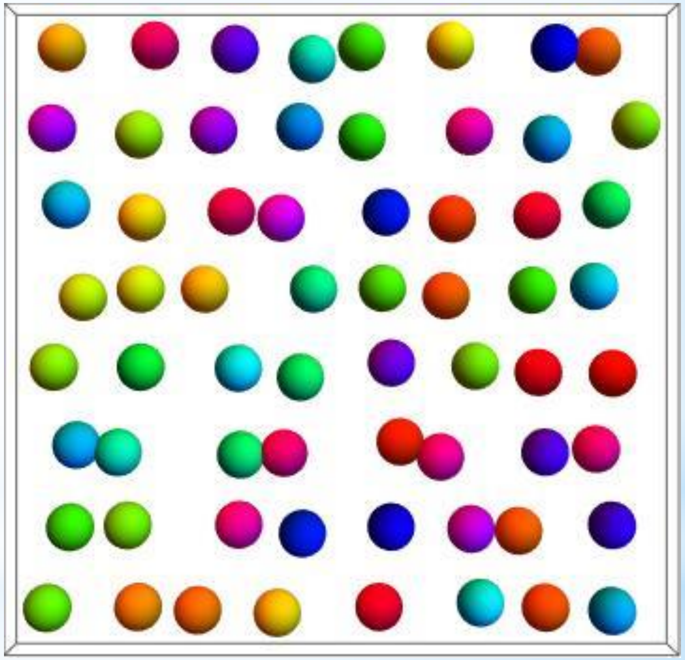
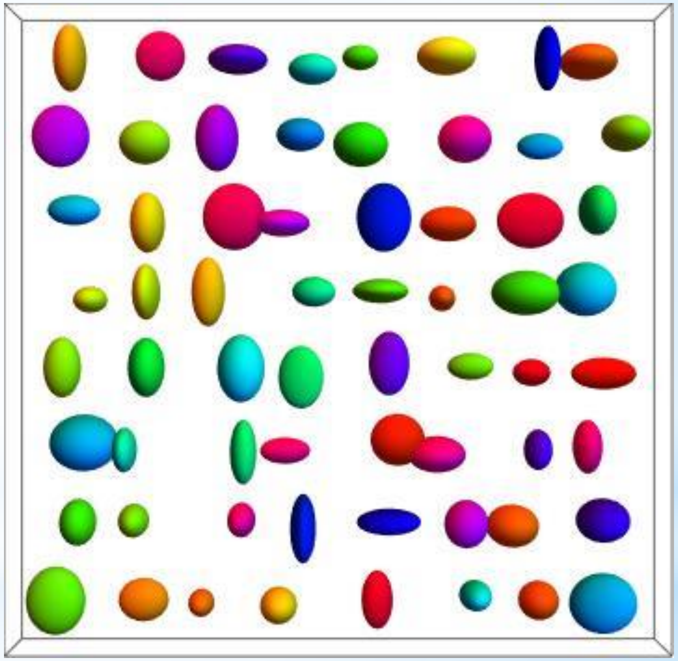


Generative Art / Creative Coding

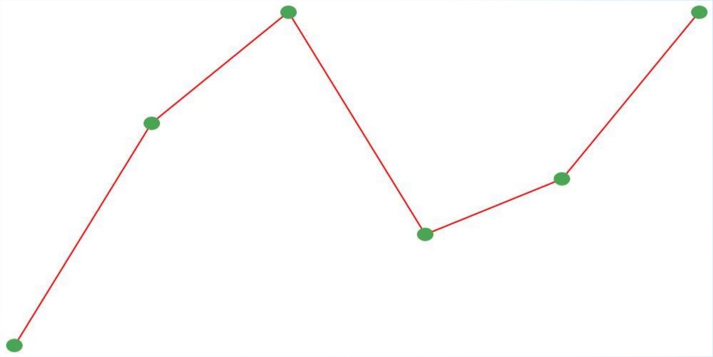
Use a computer to program an **algorithm**:



- Specify **objects**
- Give **rules** for placement
- Add **randomness**

Random Splines

A **spline** is a piecewise function that is a smooth curve and approximates given data points.



Random Splines

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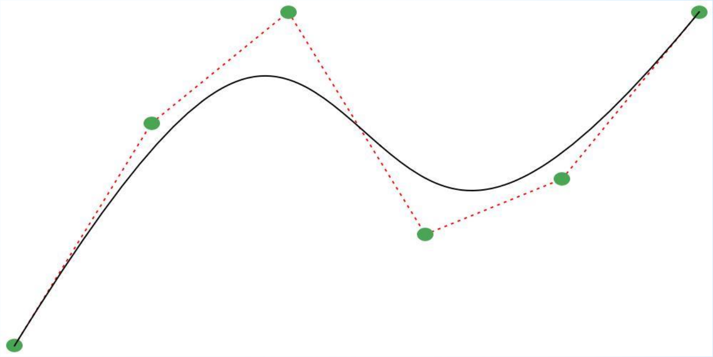

Riemondrian (2017)

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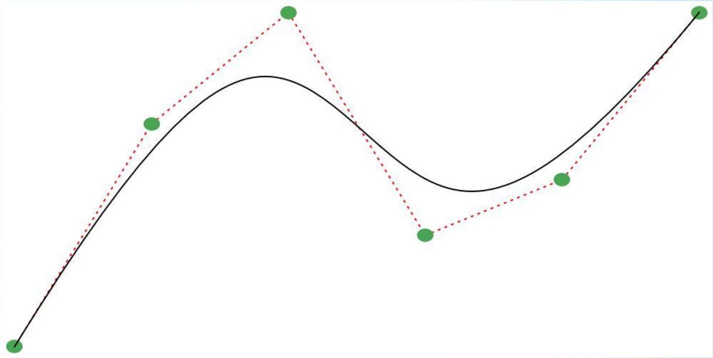

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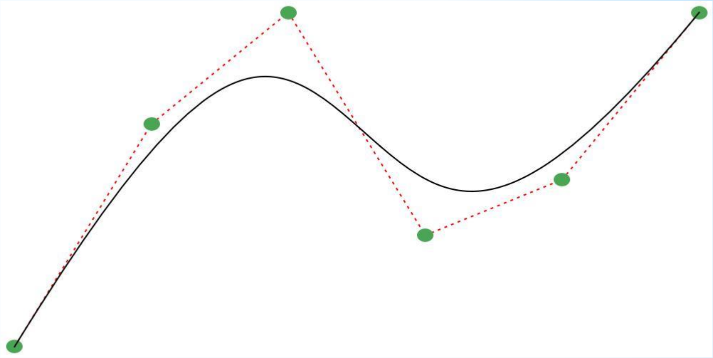

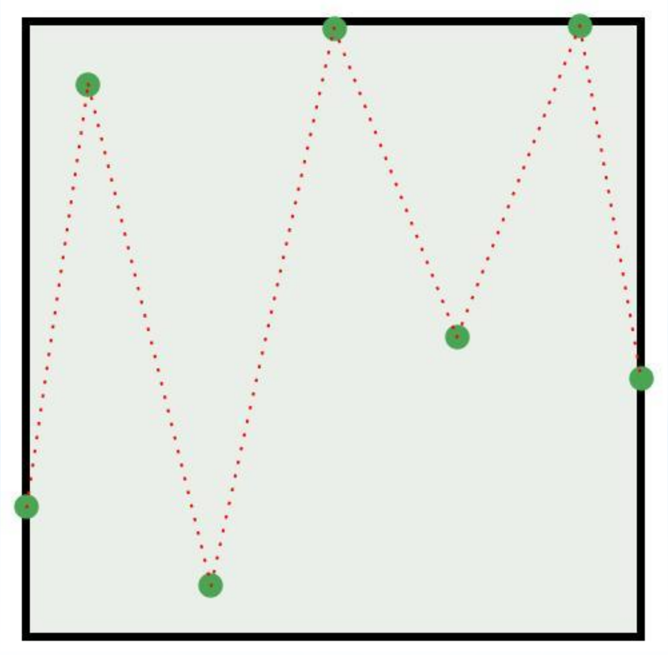

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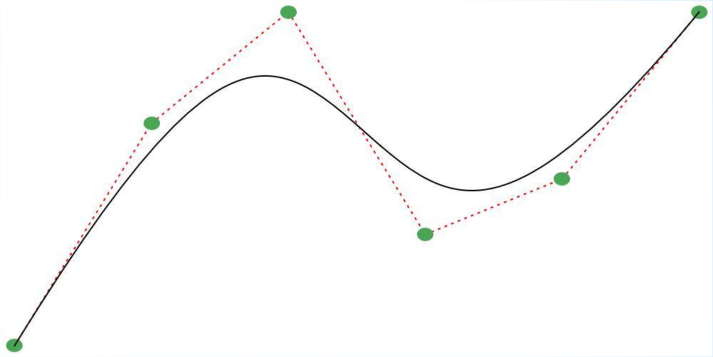

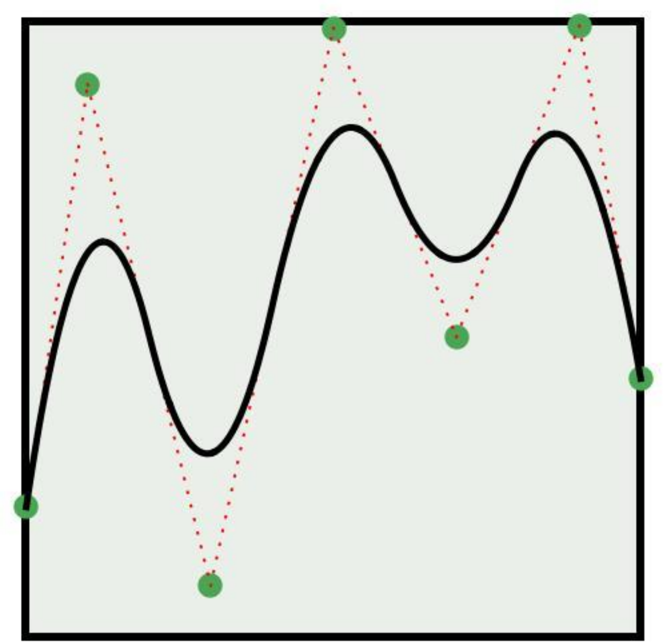

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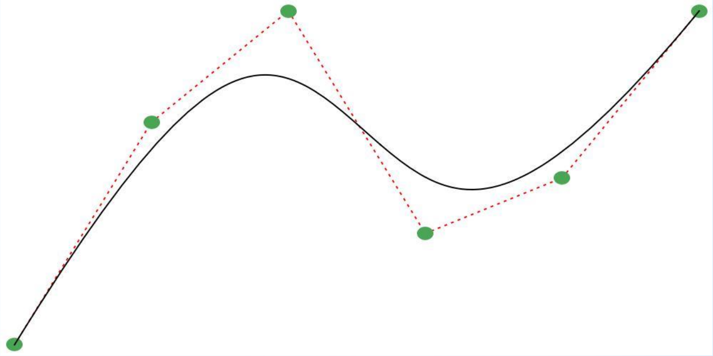

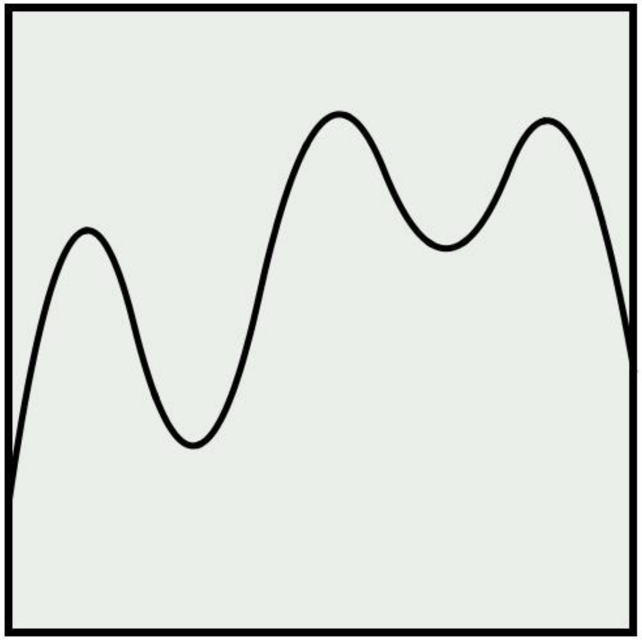

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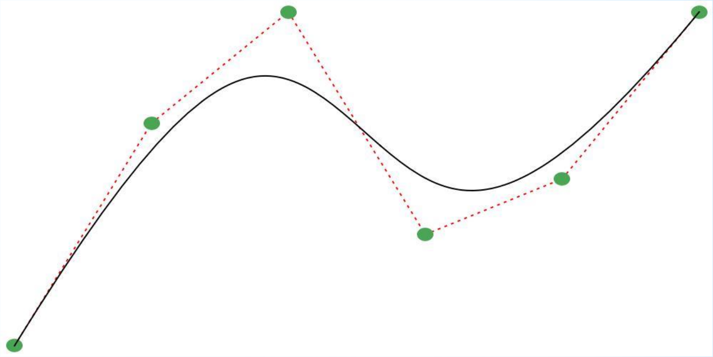

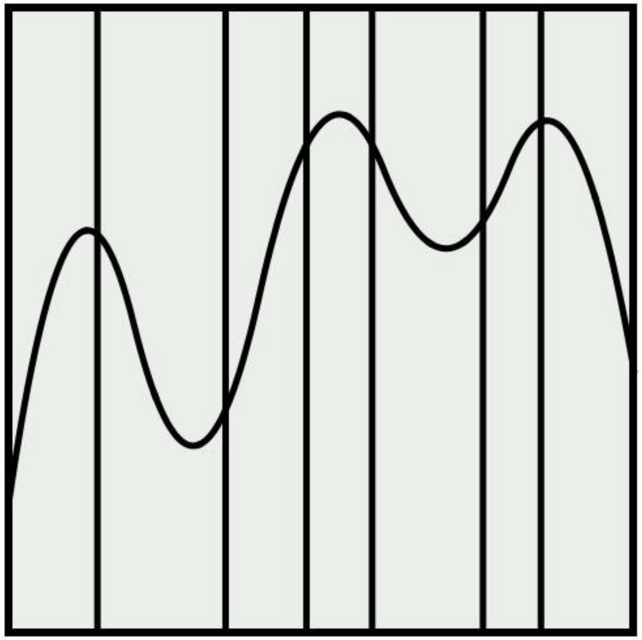

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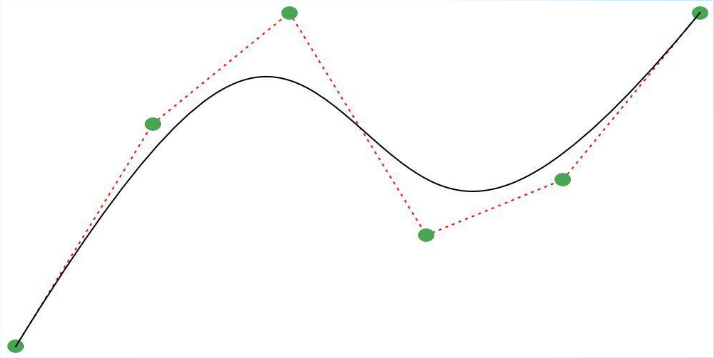

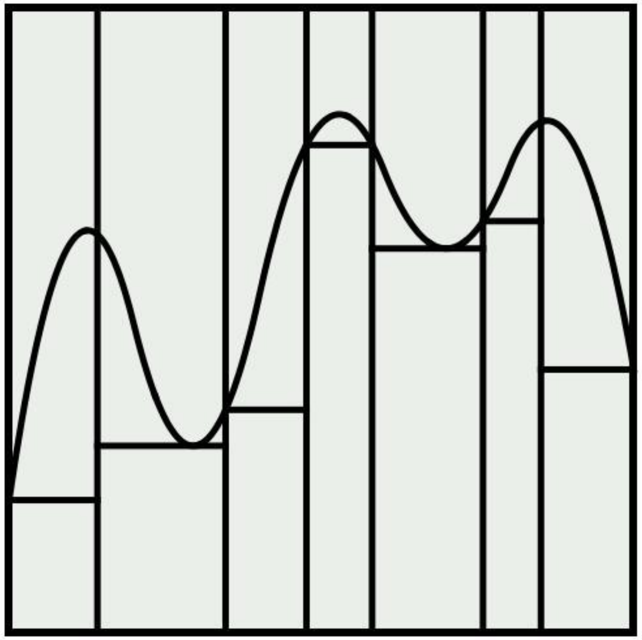

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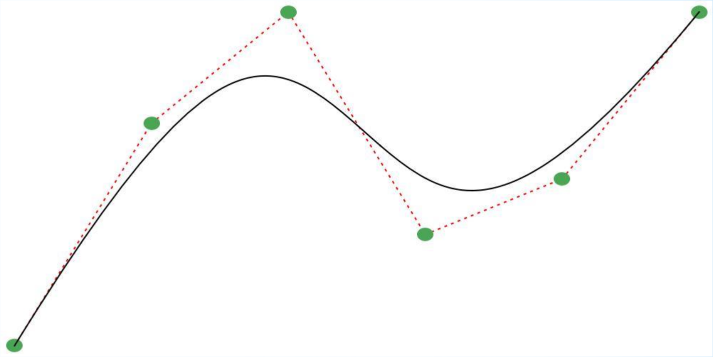
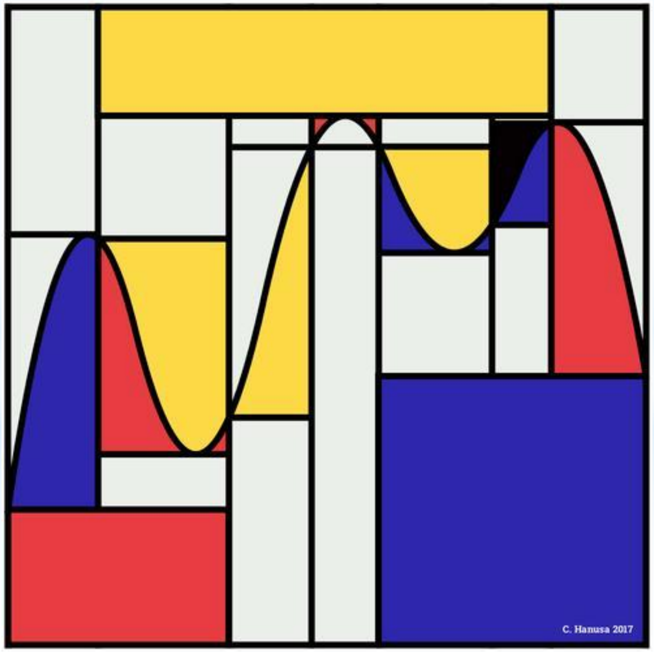
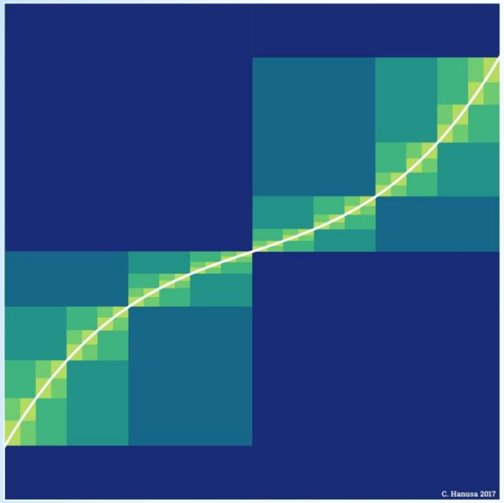
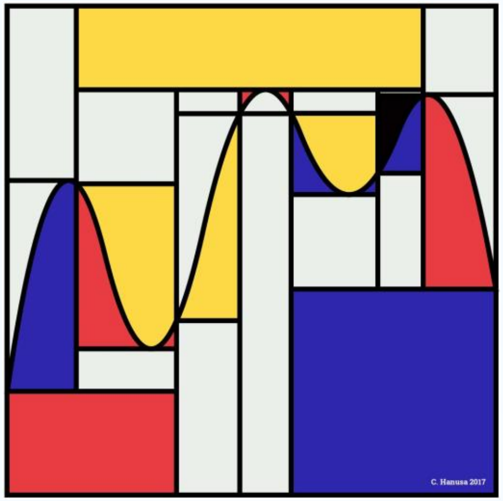
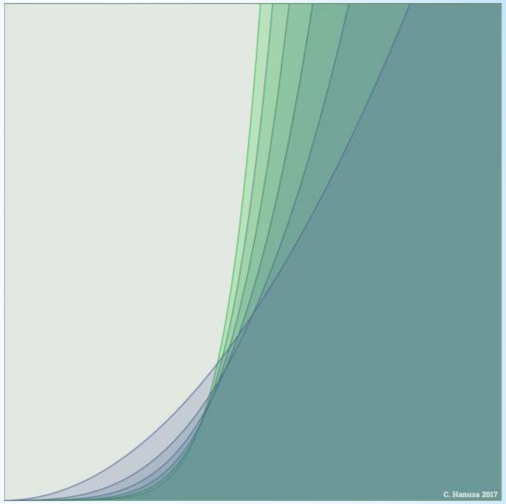


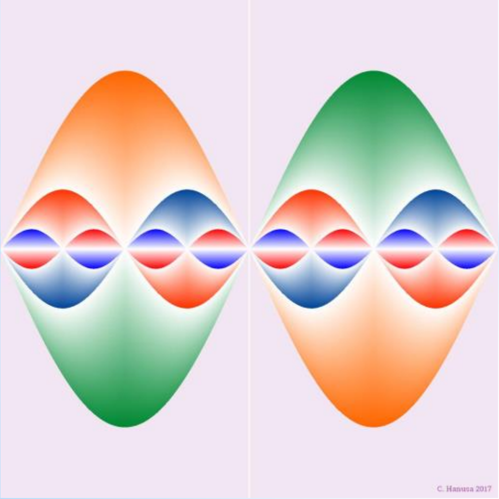

C. Hanusa 2017

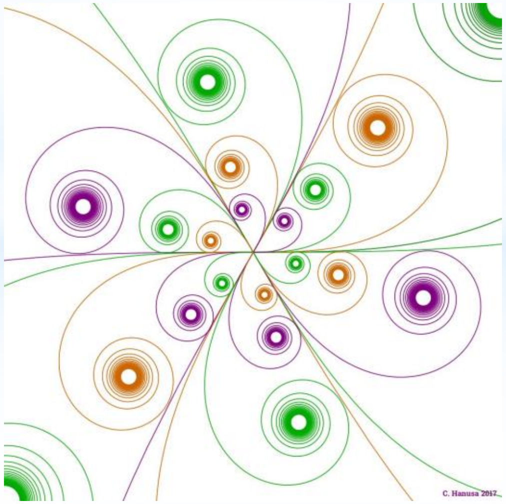
Calculus Art (2017)

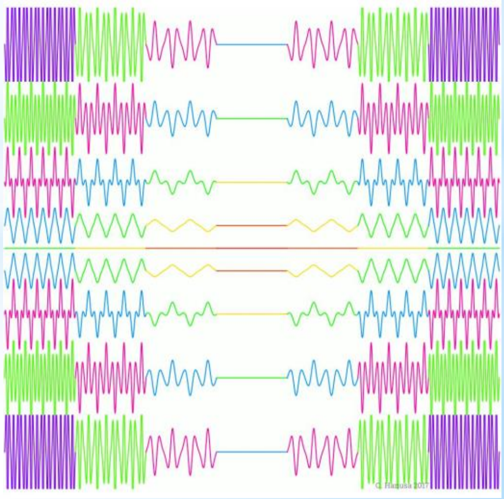

C. Hanusa 2017


C. Hanusa 2017


C. Hanusa 2017

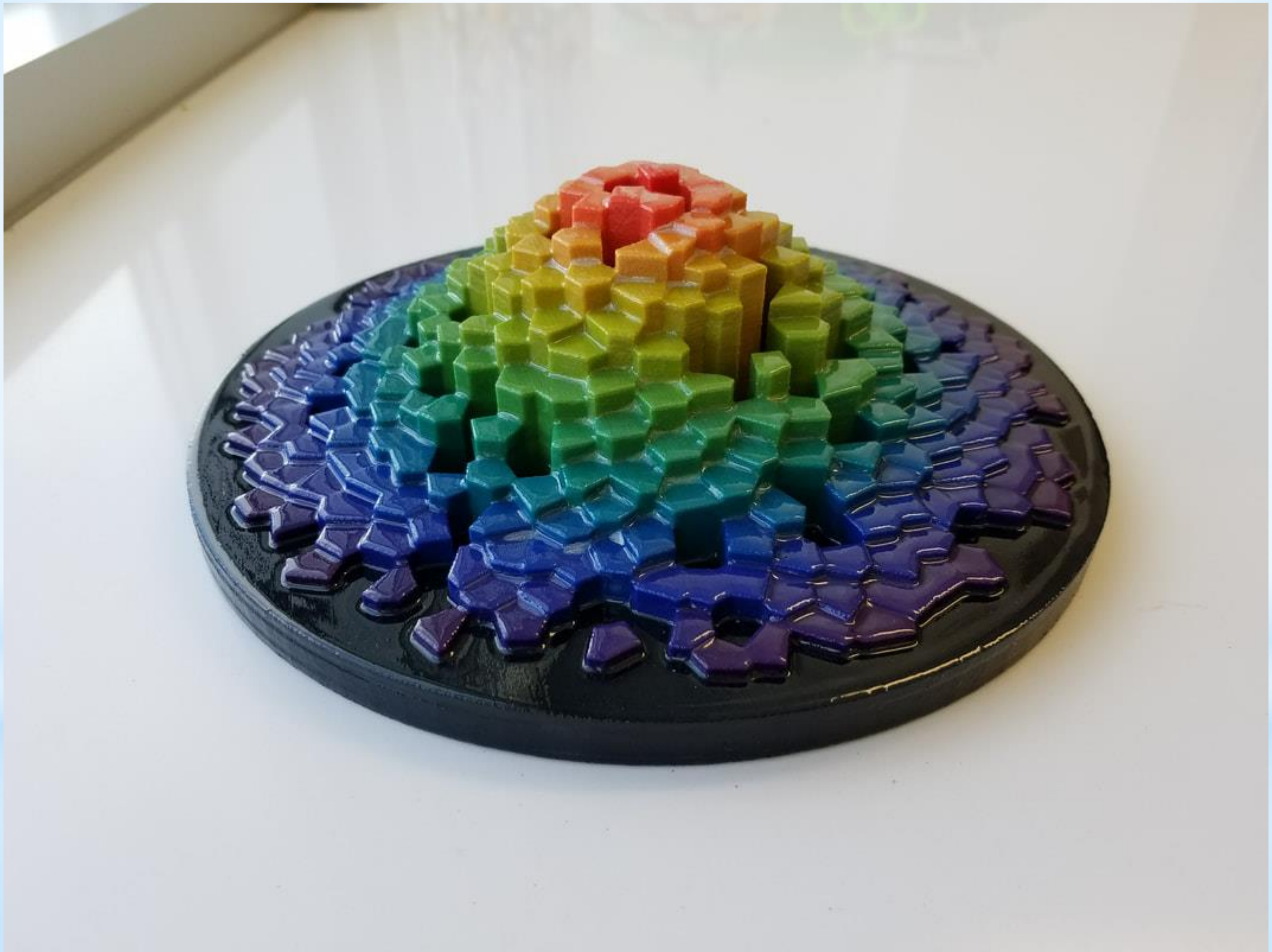

C. Hanusa 2017


C. Hanusa 2017


C. Hanusa 2017

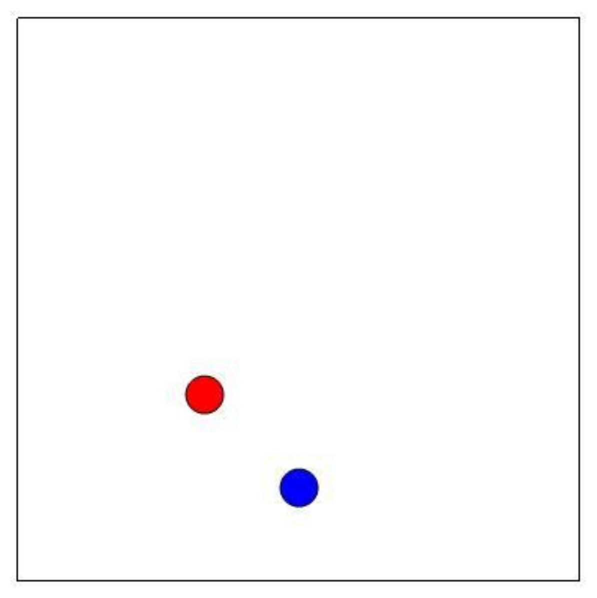
Mathematical Sculptures

The New Normal (2017)



Voronoi Diagrams

The **Voronoi Diagram** for a set of points is the division of the region into pieces based on closeness.



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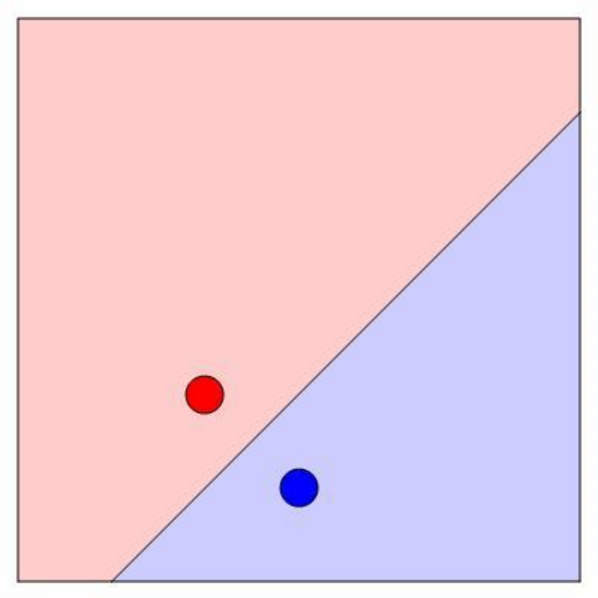

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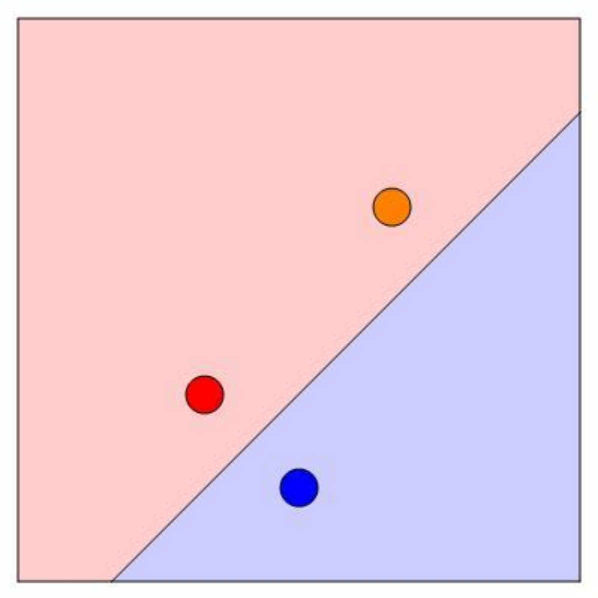

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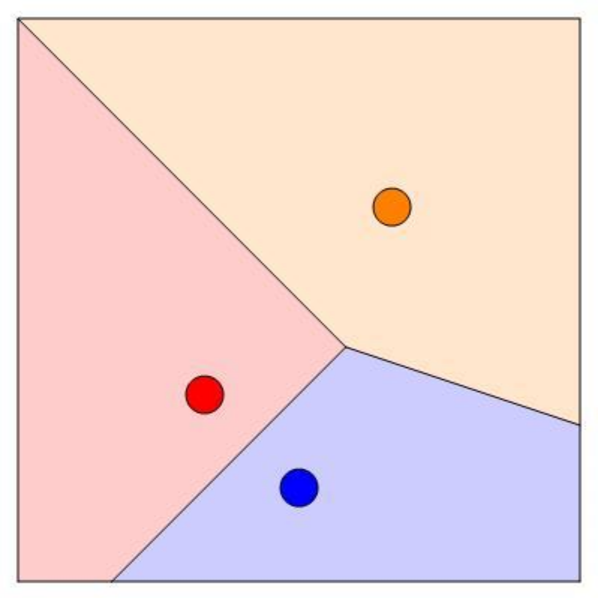

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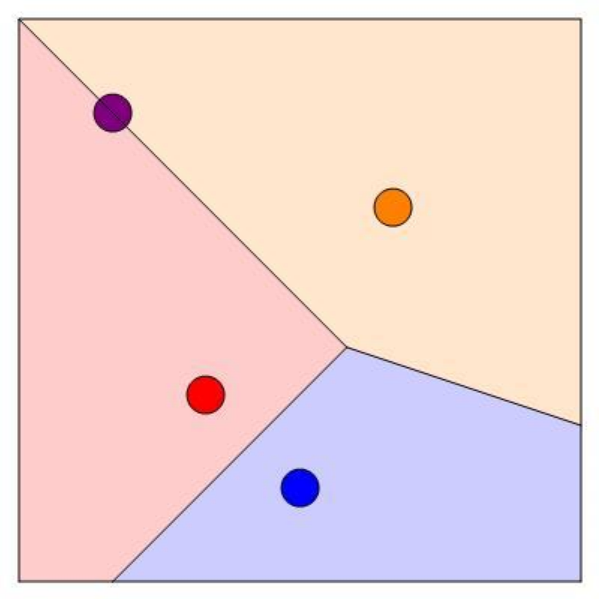

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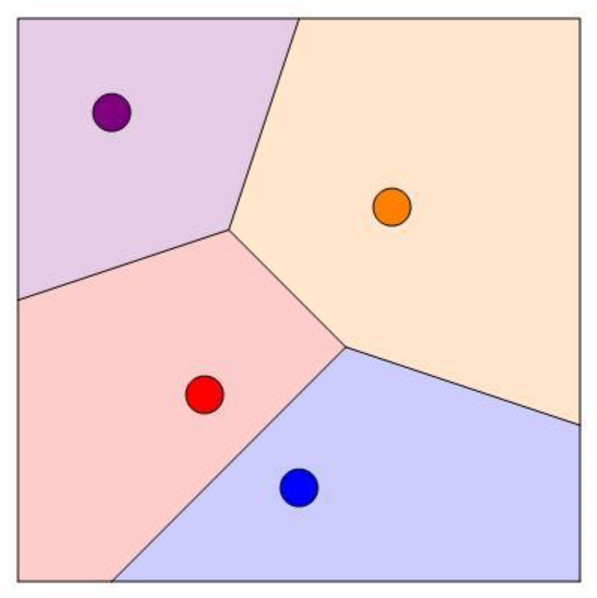

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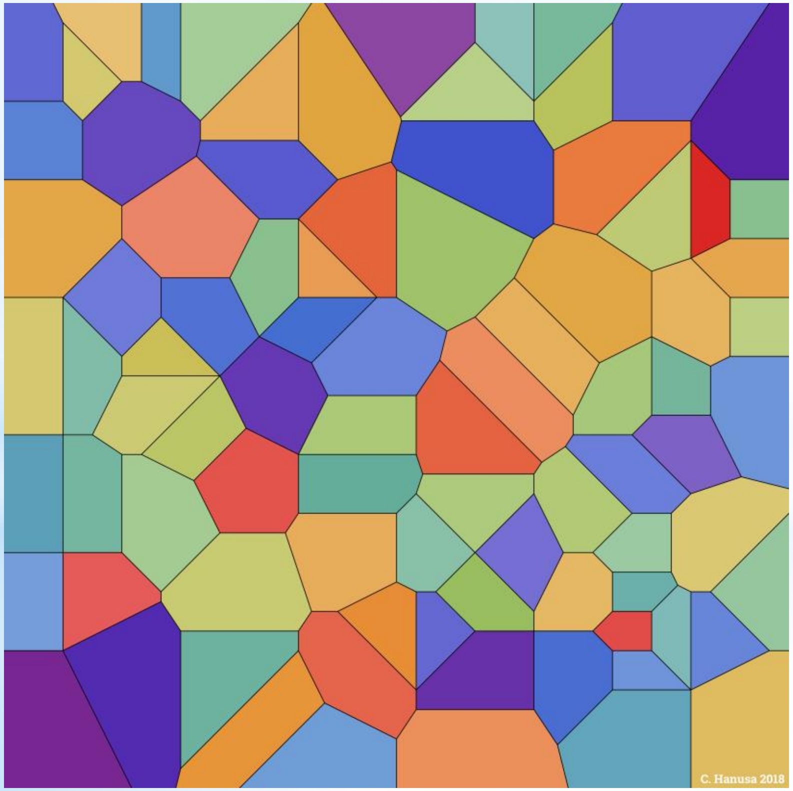
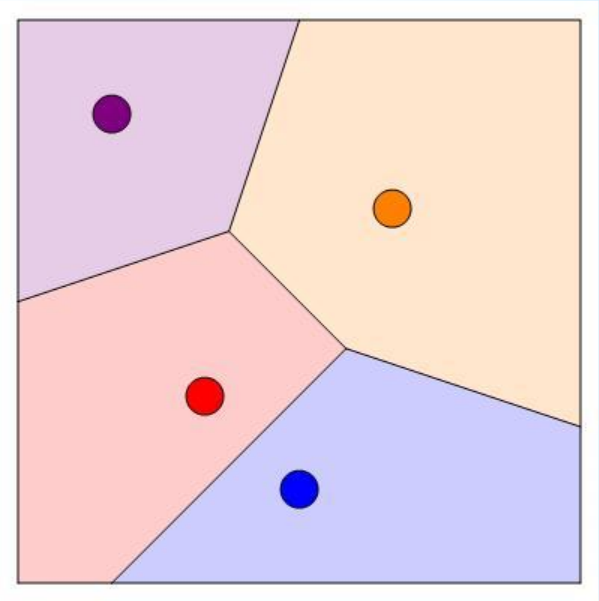
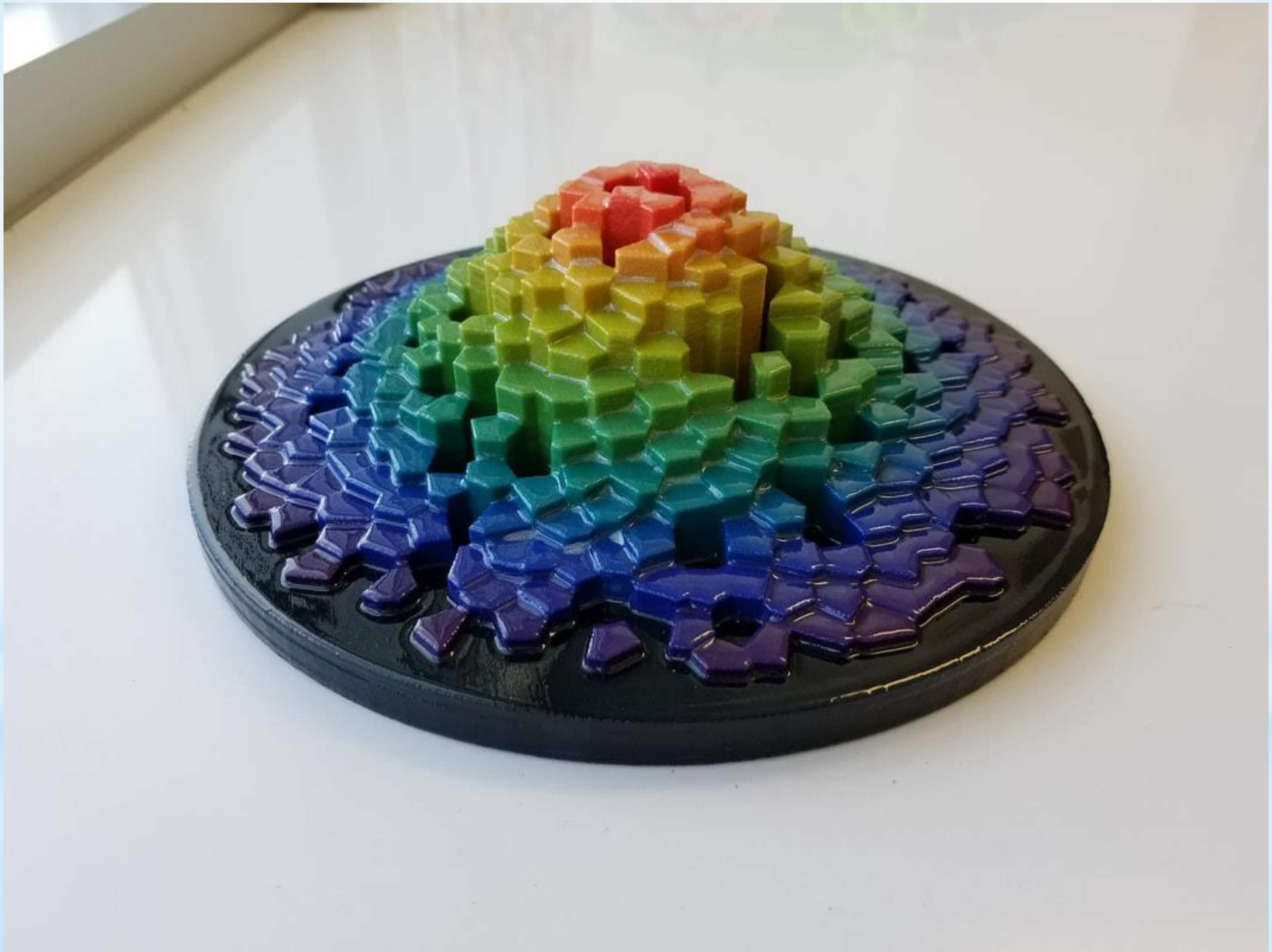
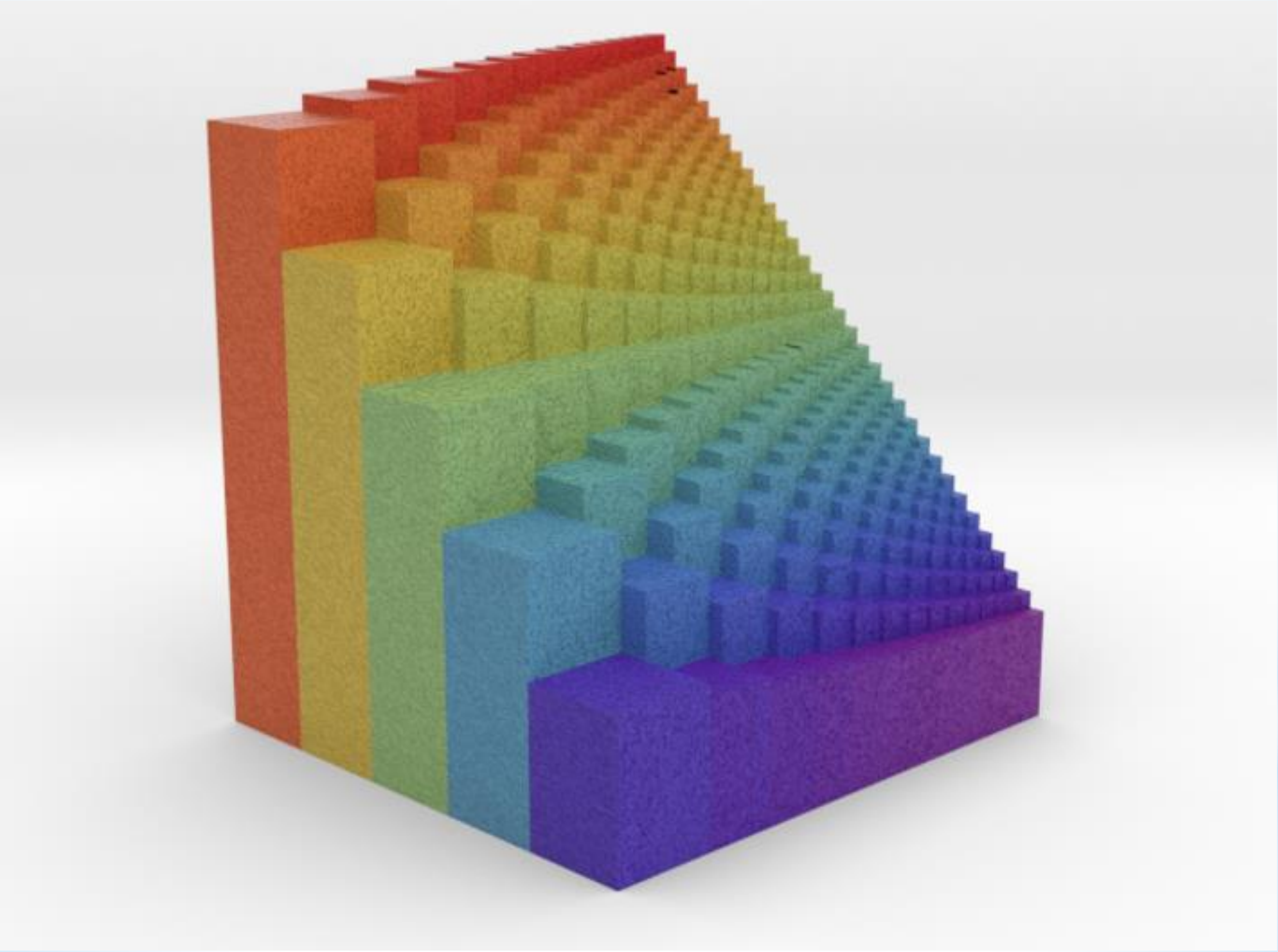

C. Hanusa 2018



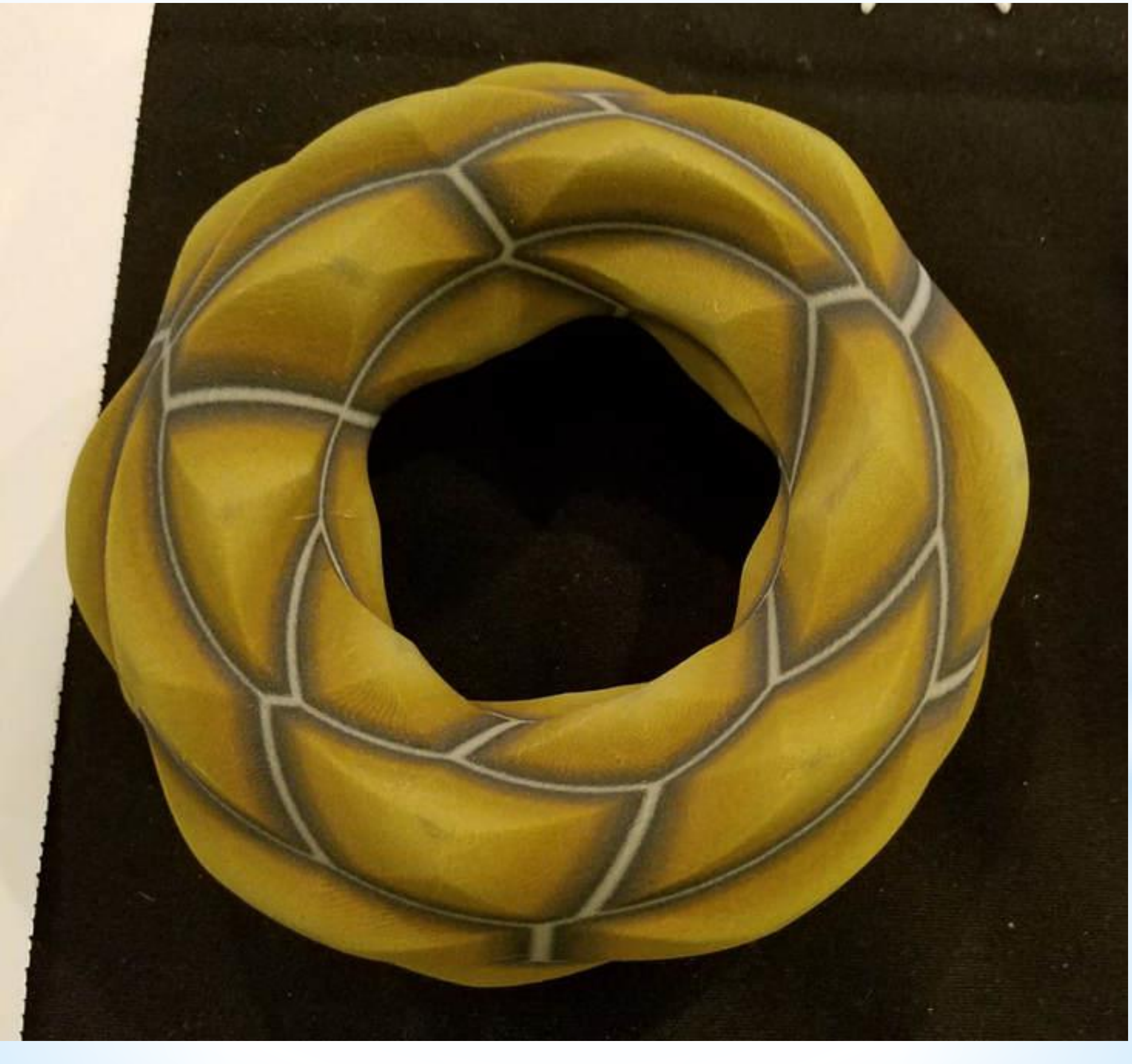
The New Normal (2017)



Rainbow Staircase (2017)

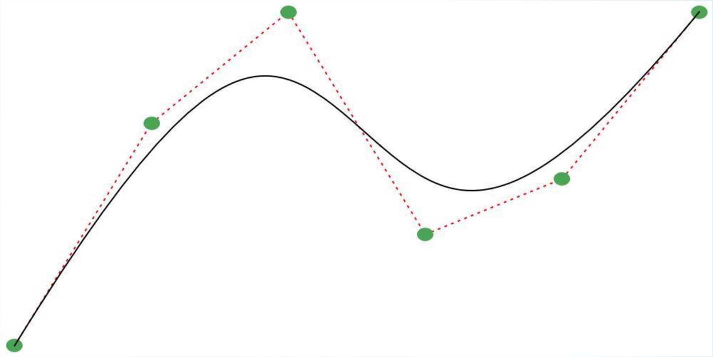


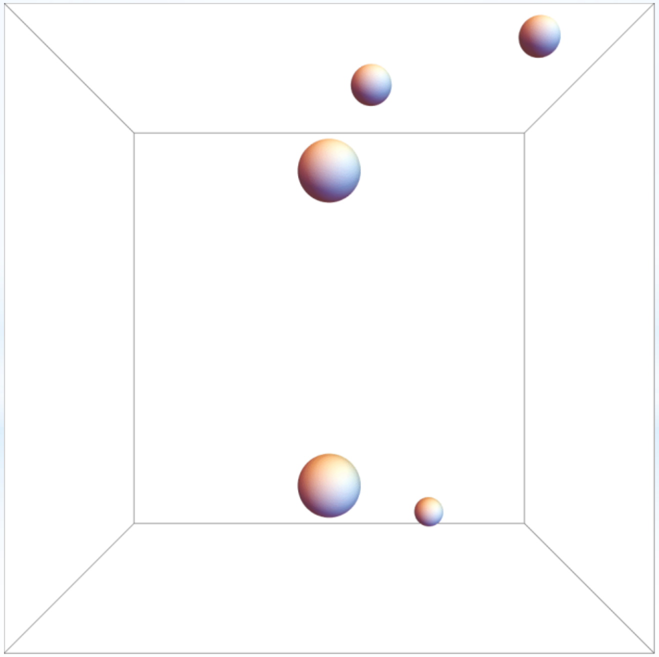
Tortoise Torus (2017)



Spaghetti

A **spline** is a piecewise function that is a smooth curve and approximates given data points.





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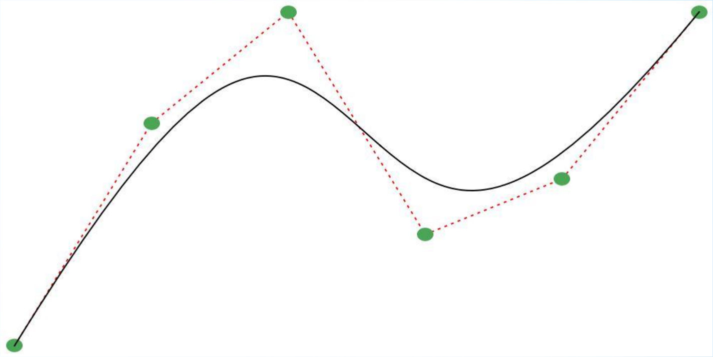
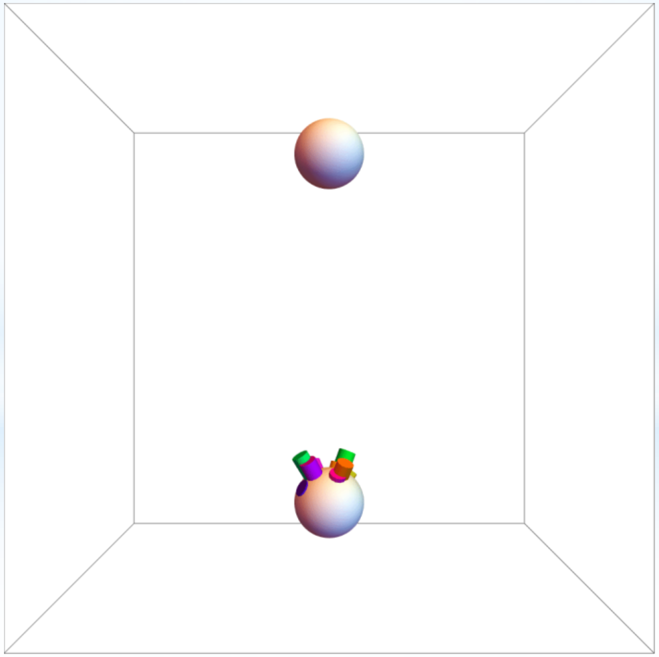
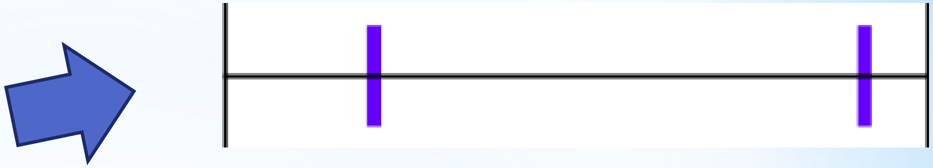




Random Growth

Create blips at random places



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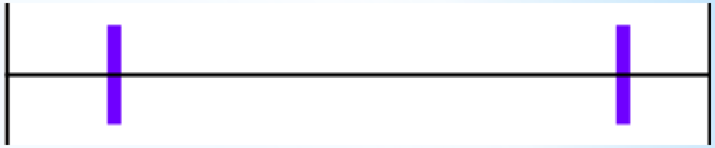

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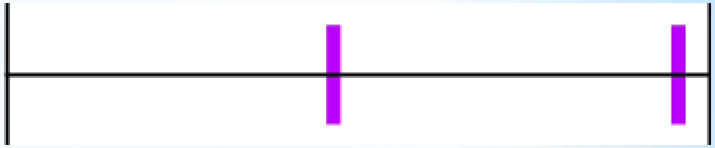

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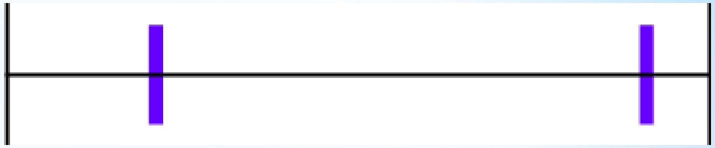

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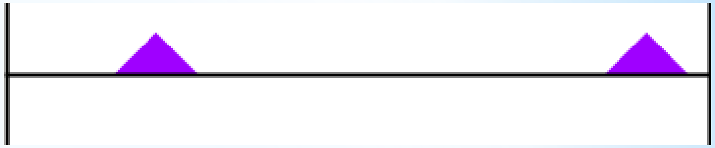

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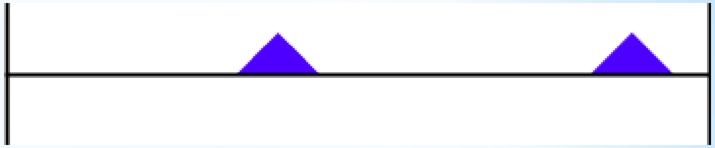
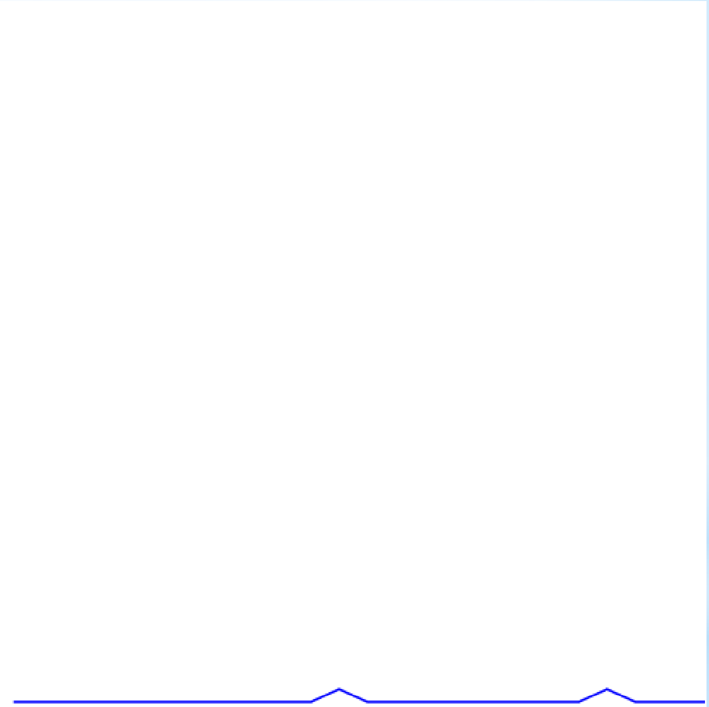


Add bumps together



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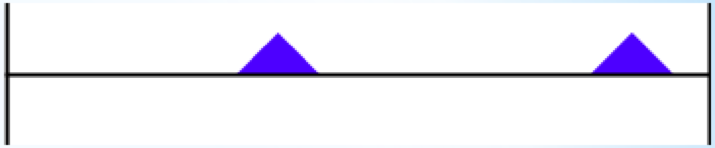

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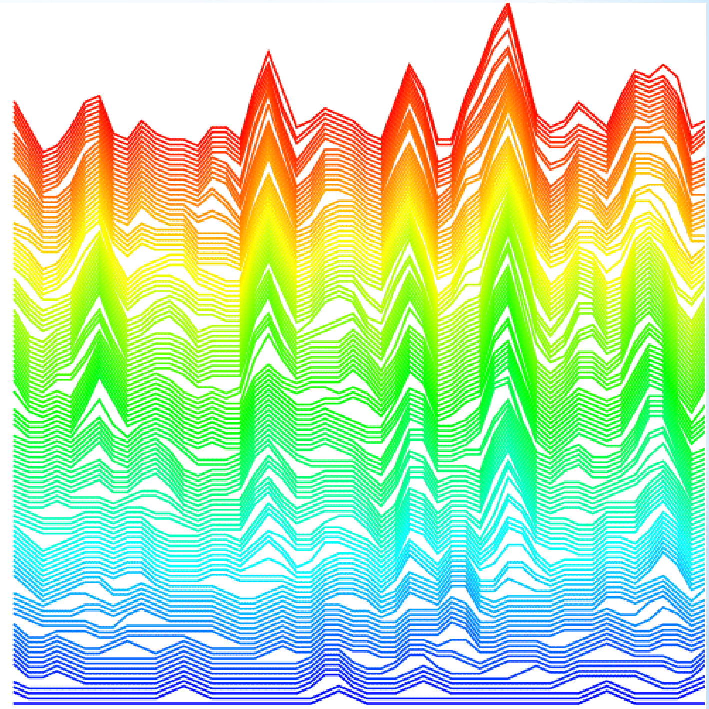
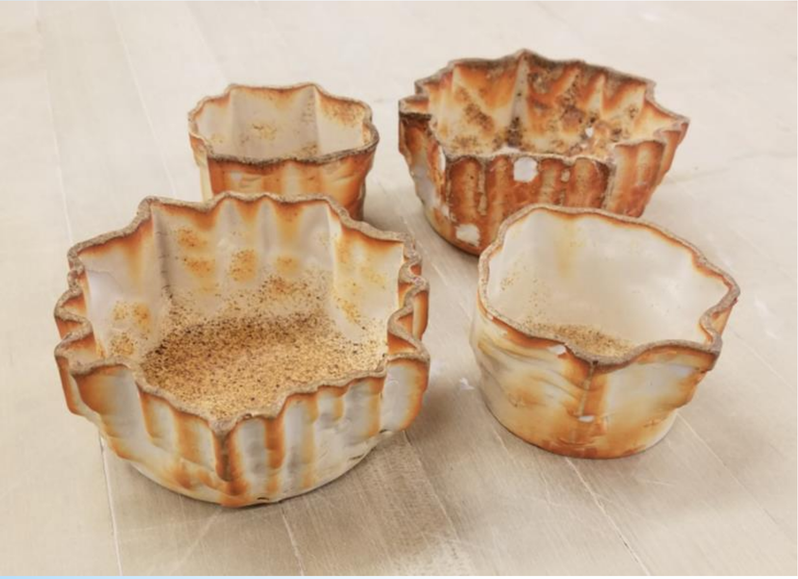
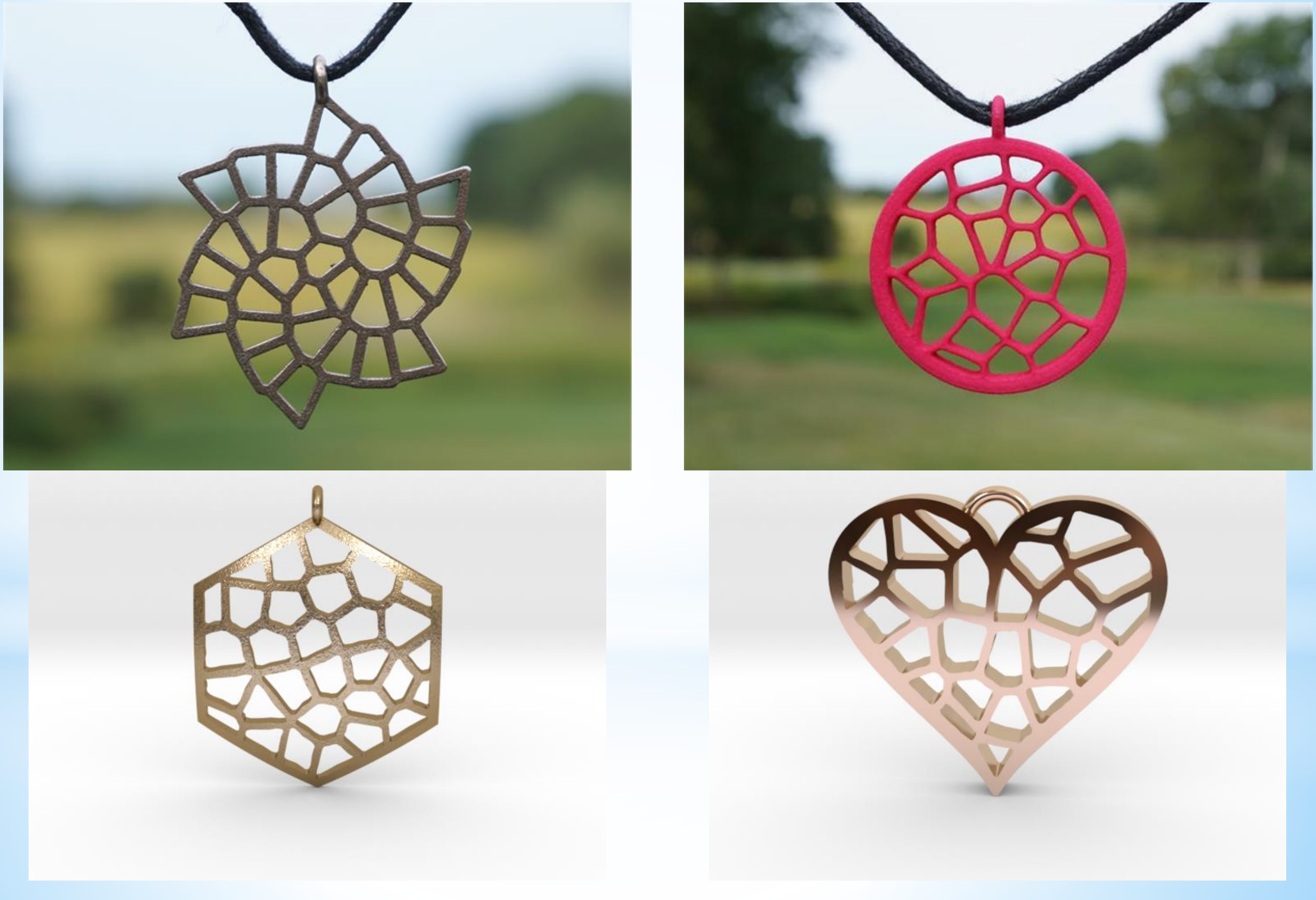


Wrap around a cylinder



Mathematical Jewelry

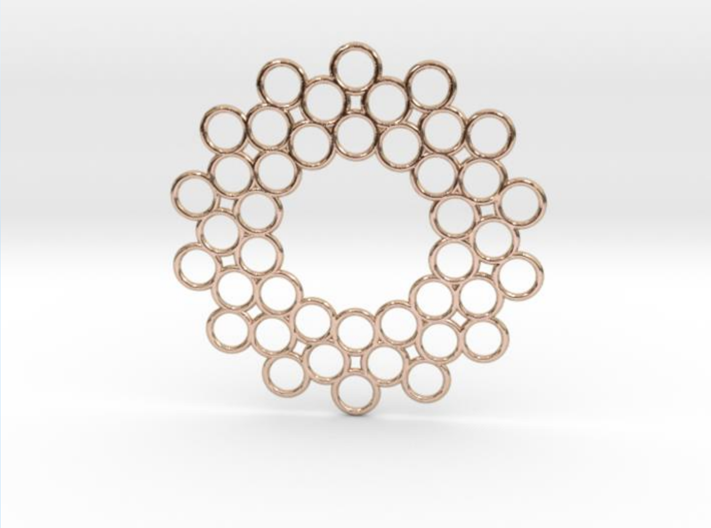
Voronoi Jewelry



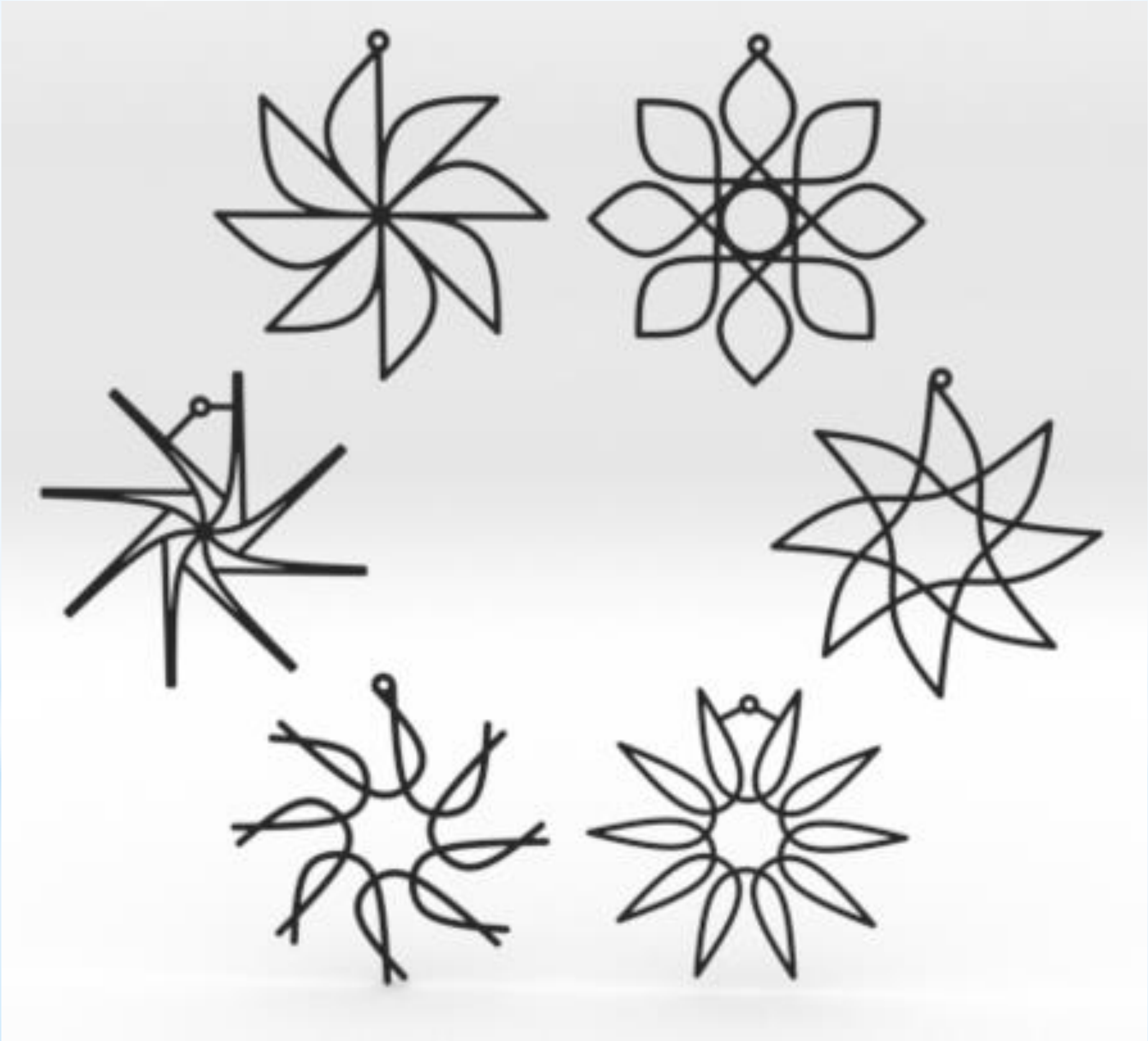
Geometric Jewelry

Hanusa Design
Mathematical Art & Jewelry
hanusadesign.com

Hanusa Design
Mathematical Art &
hanusadesign.c

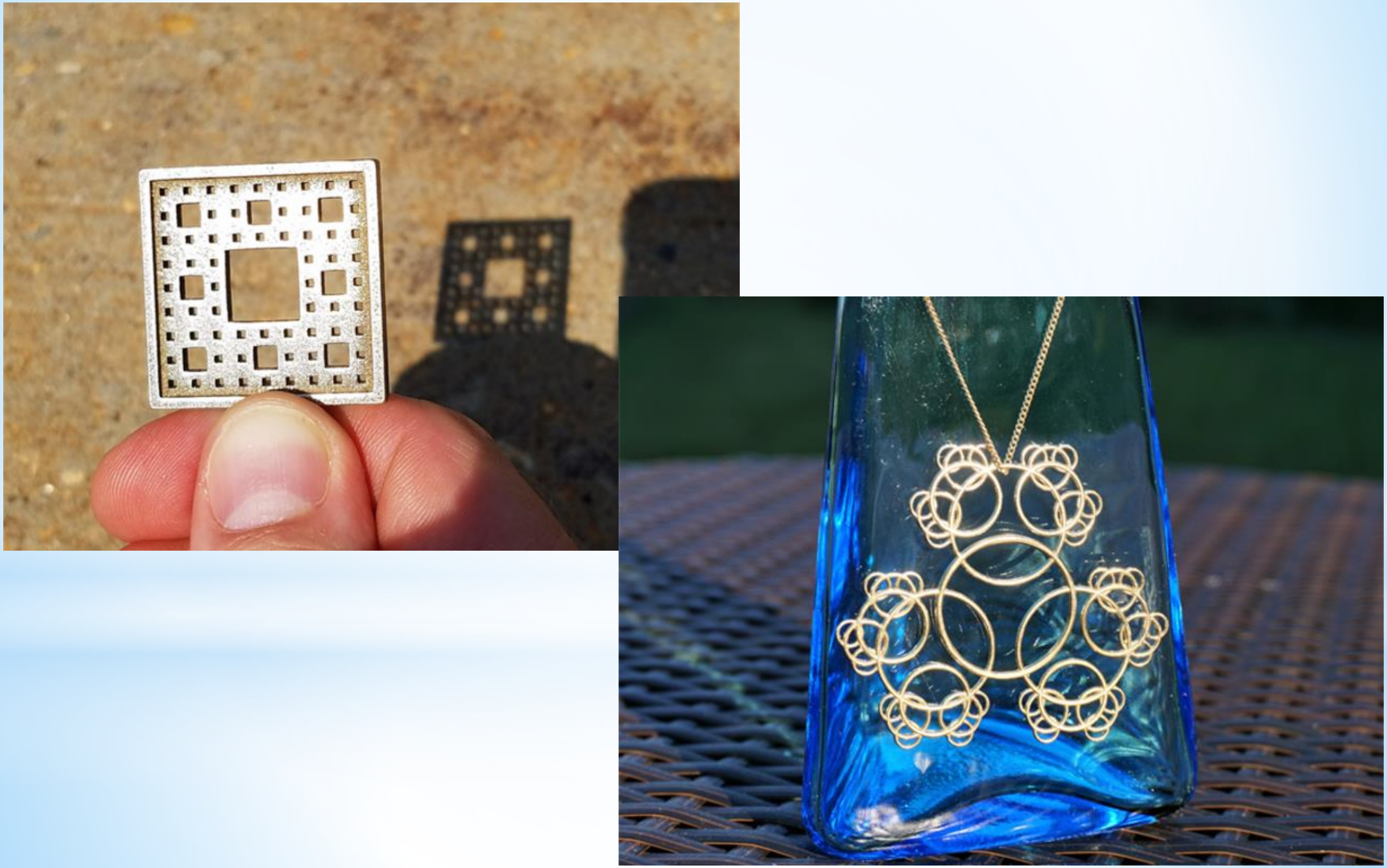


Trigonometry Jewelry

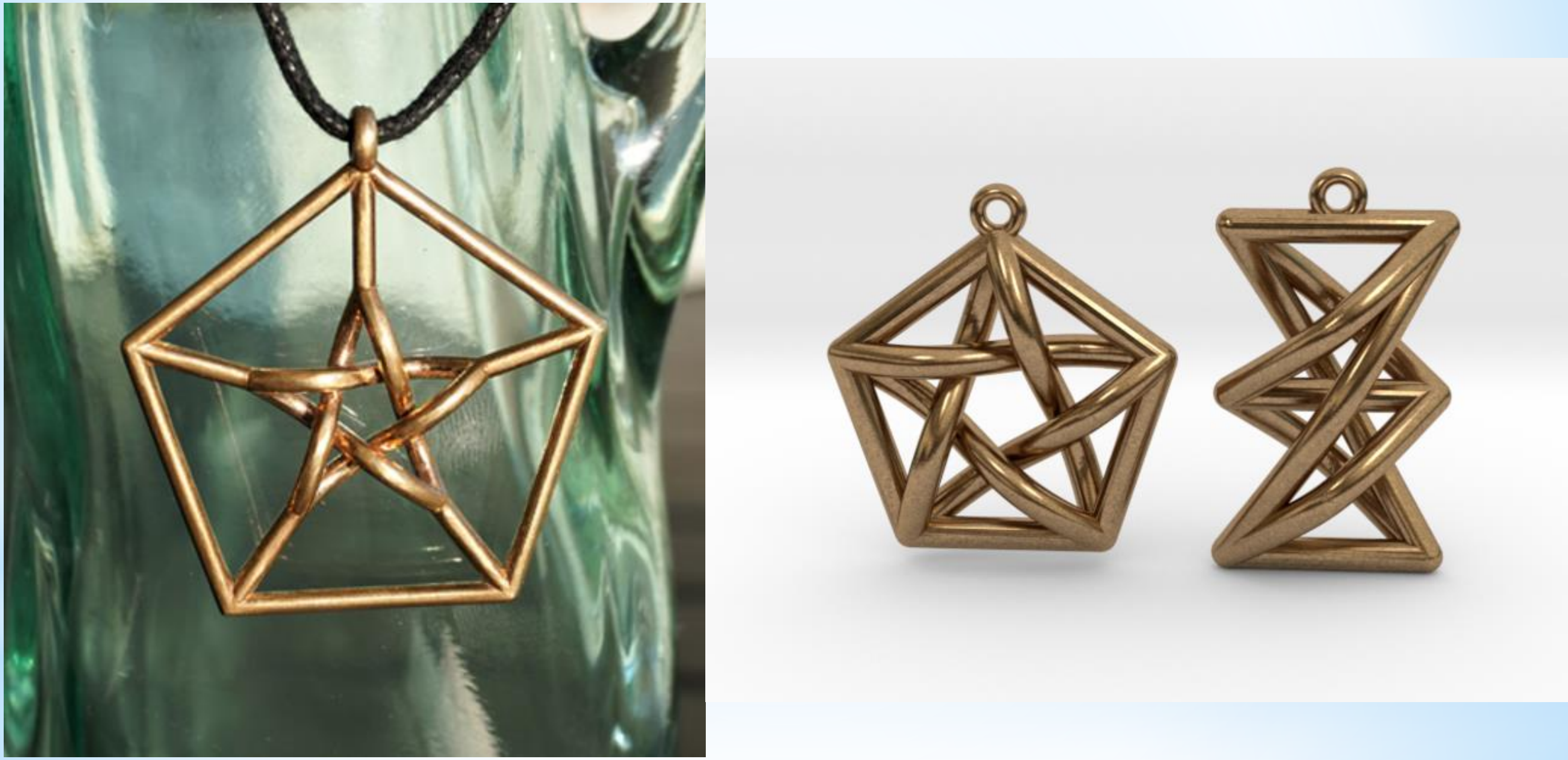


Rotini Earrings

Fractal-inspired

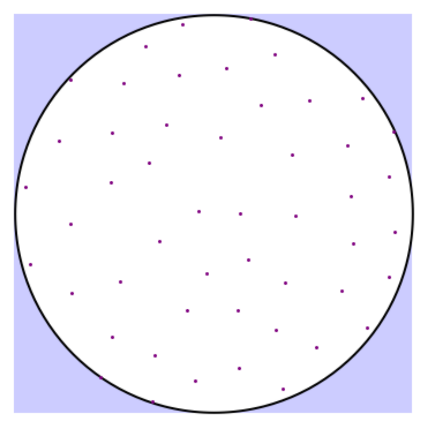


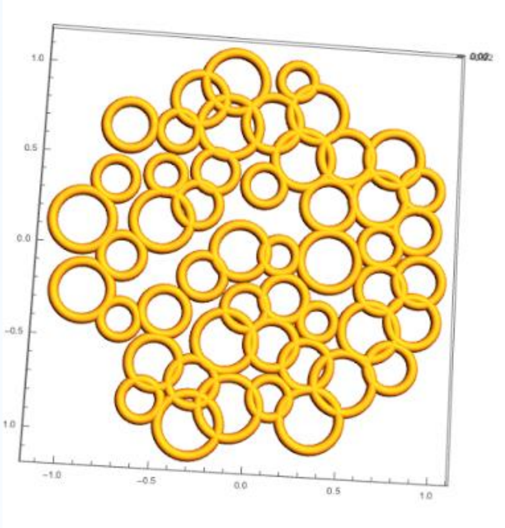
Graph Theory inspired

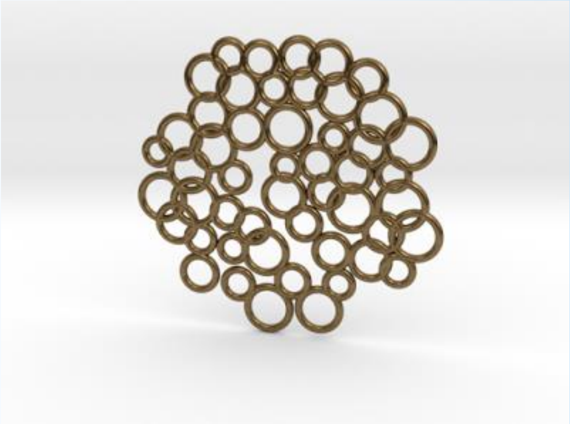


Golden Ratio inspired

Generative Jewelry



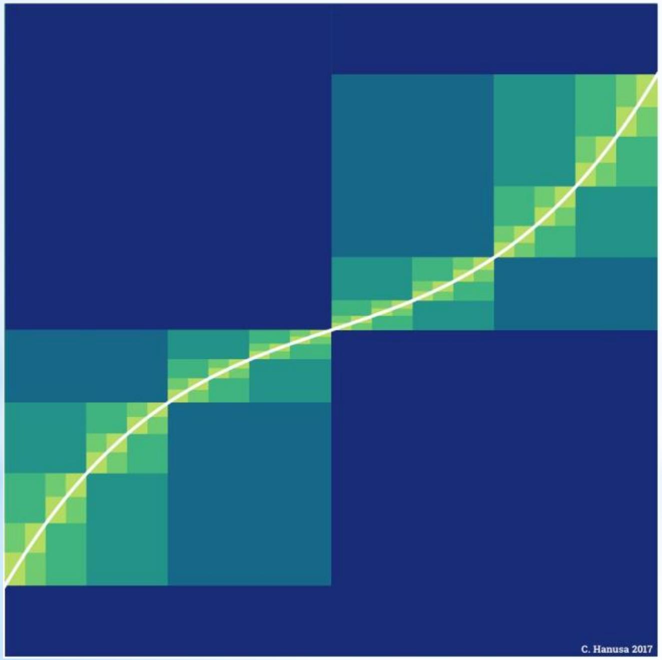




- Choose random points that are not too close
- Choose random size tori
- Export and print on a 3D printer

Thanks! Questions?
Real-time Art!?

qc.edu/~chanusa
> Research > Talks


C. Hanusa 2017

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hanusadesign.com

Real-time Art

Art that's never been seen before