

The Making Of Mathematical Art

Christopher R. H. Hanusa

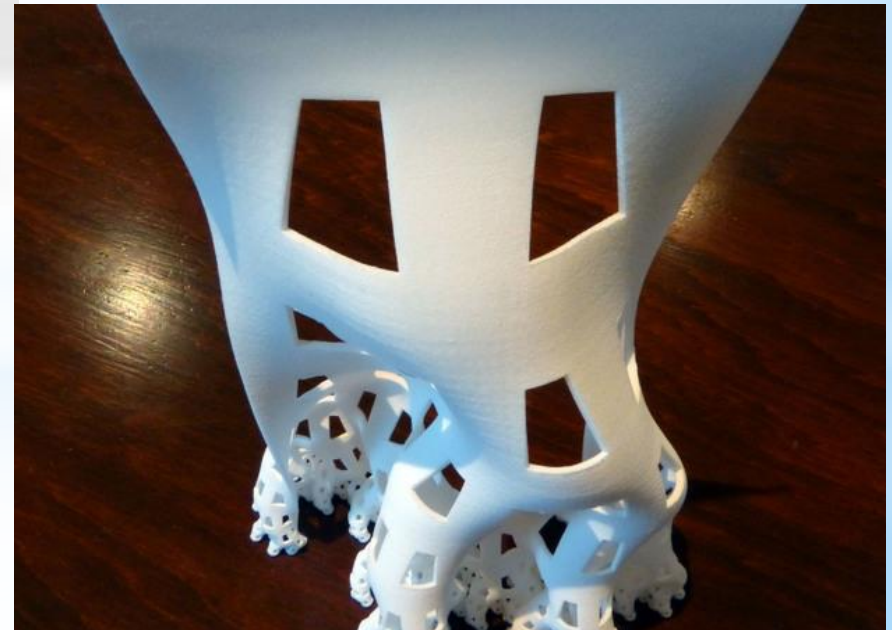
Queens College

Mathematics + Art ?

Bathsheba Sculpture



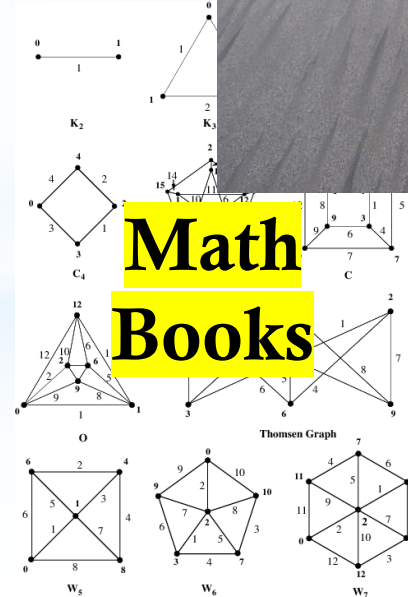
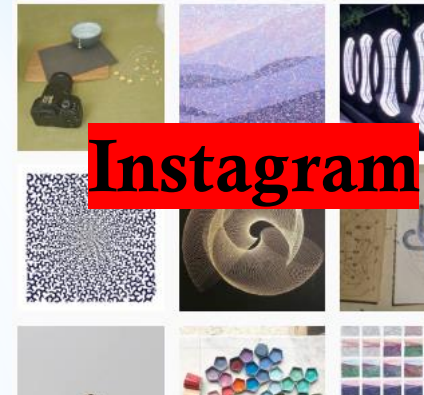
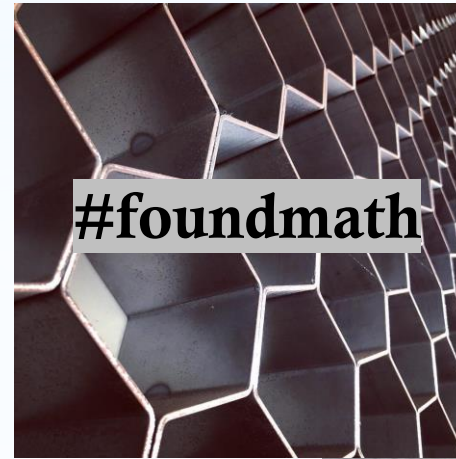
Henry Segerman



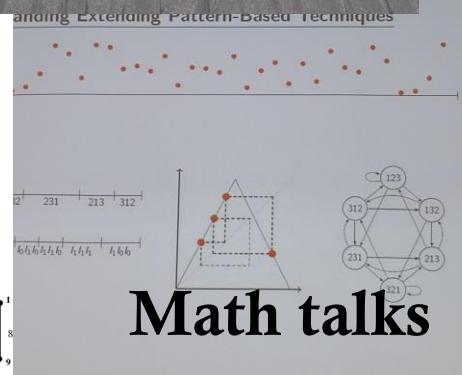
- Repetition
- Symmetry
- Geometry
- Higher Dimensions

The Design Process

Inspiration



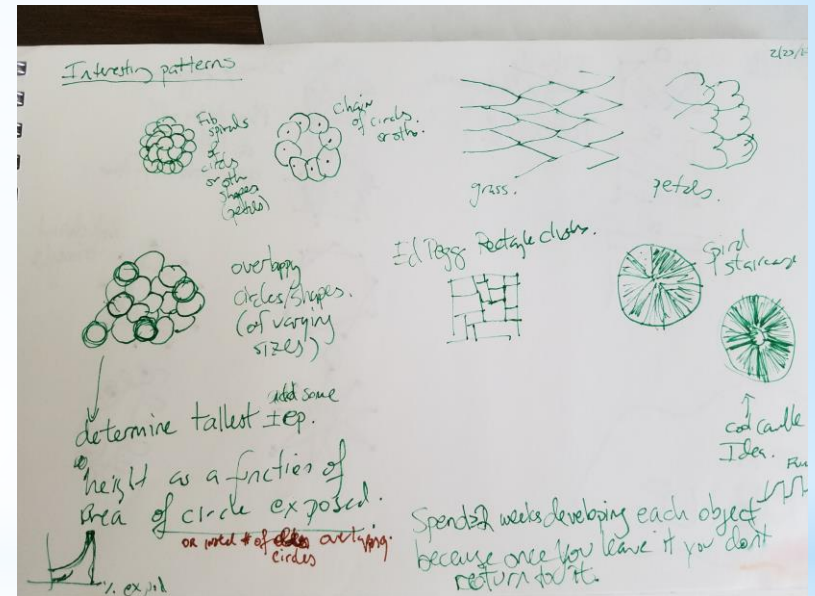
**Math
Books**



The Design Process

Inspiration

Concept



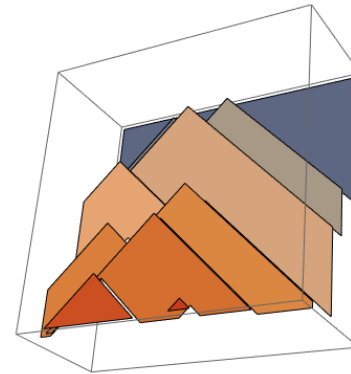
The Design Process

Inspiration

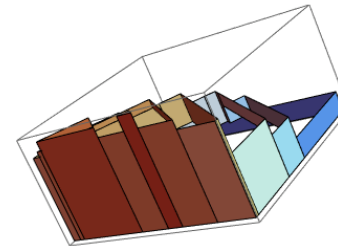
Concept

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[bdry, #], Position[bc  
blankwalls = MapThread[RegionProduct[#, 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

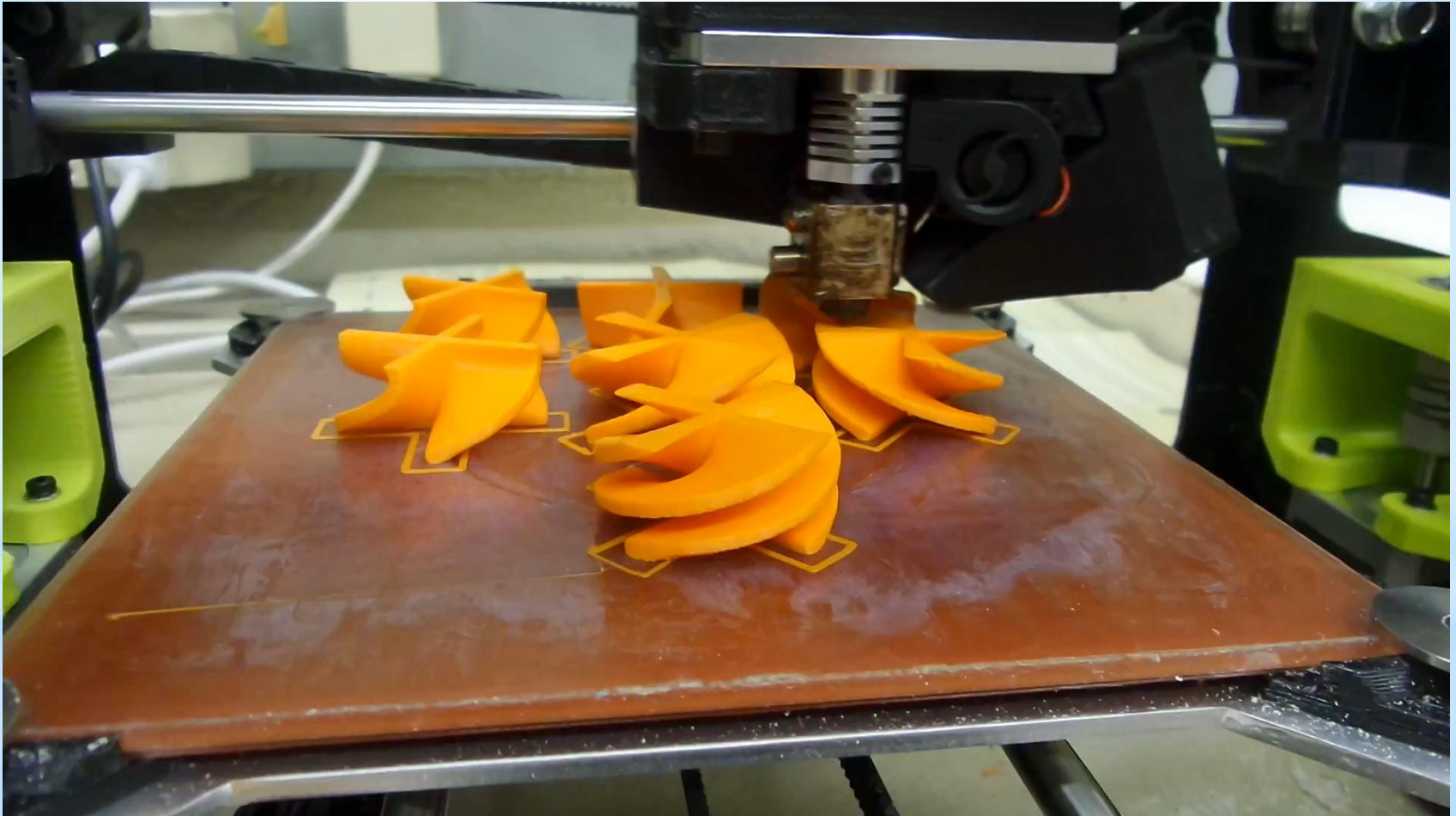
Design

Prototype

Final Artwork

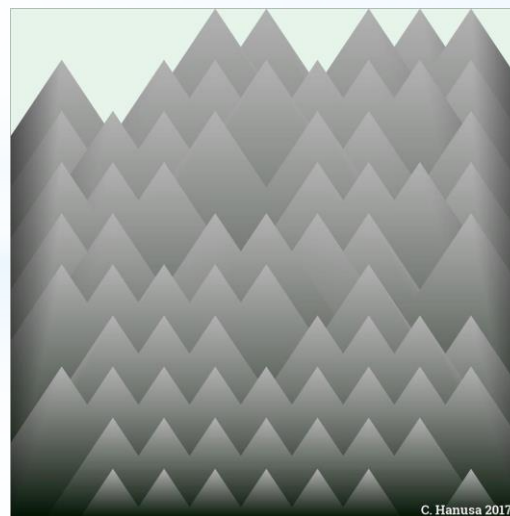
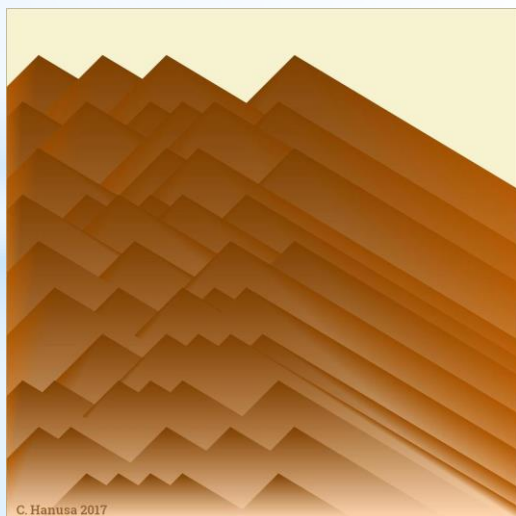
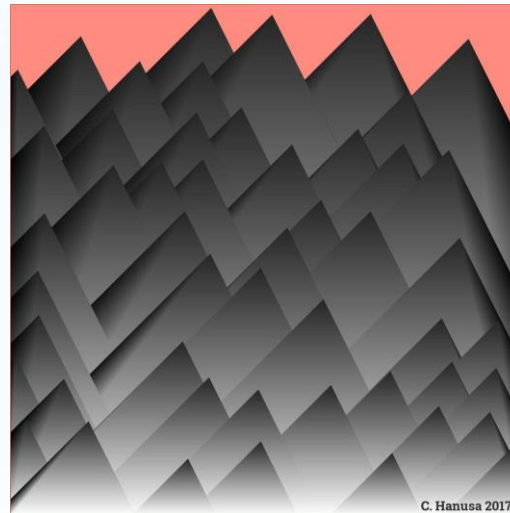
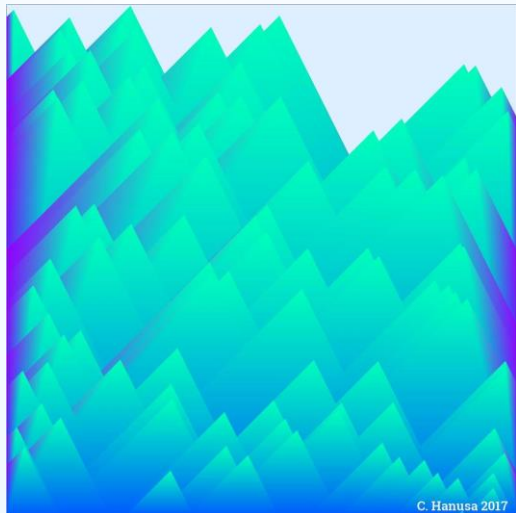


What does 3D Printing look like?



Mathematical Images

Sand Art (2017)



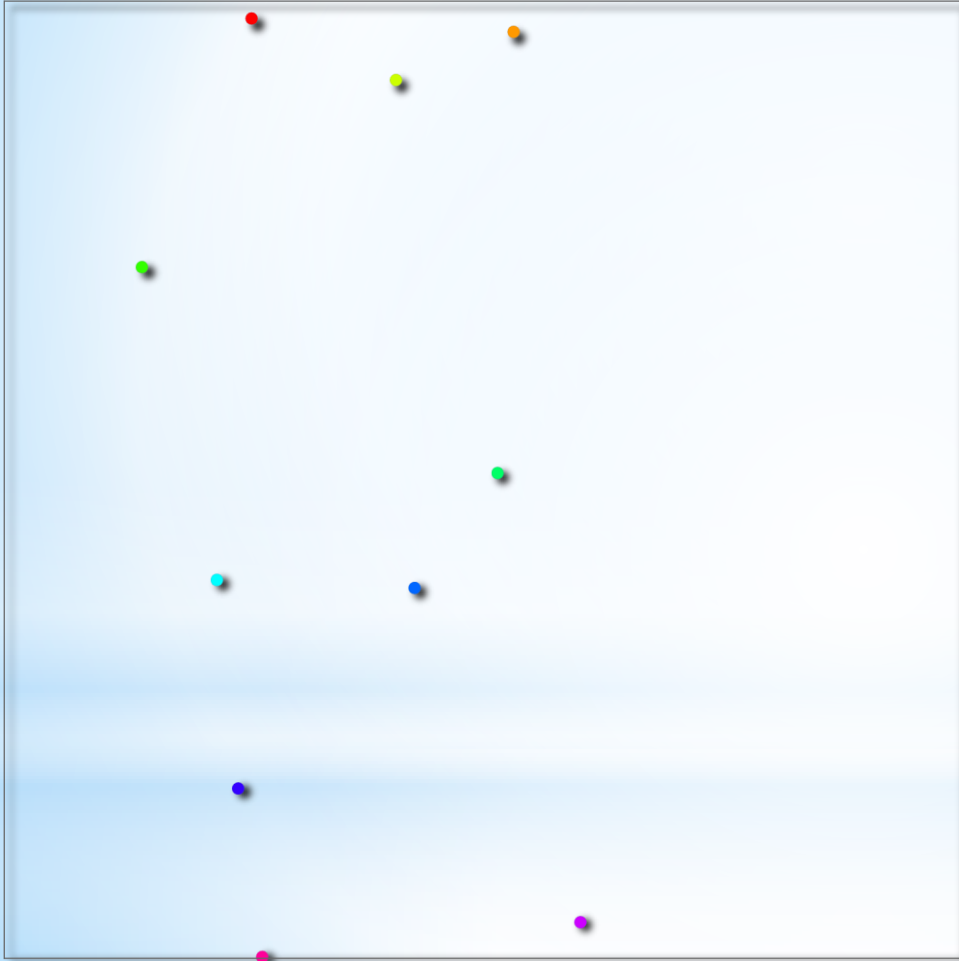
Inspiration: Playa Hermosa



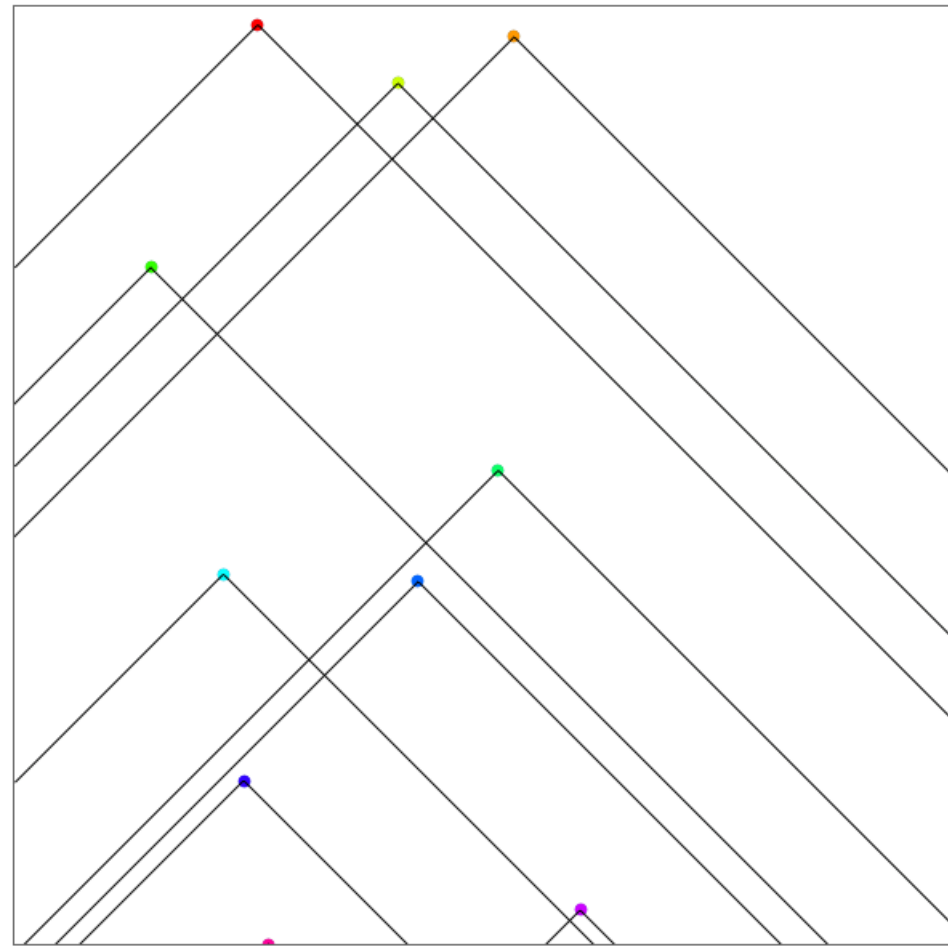
Deconstruction



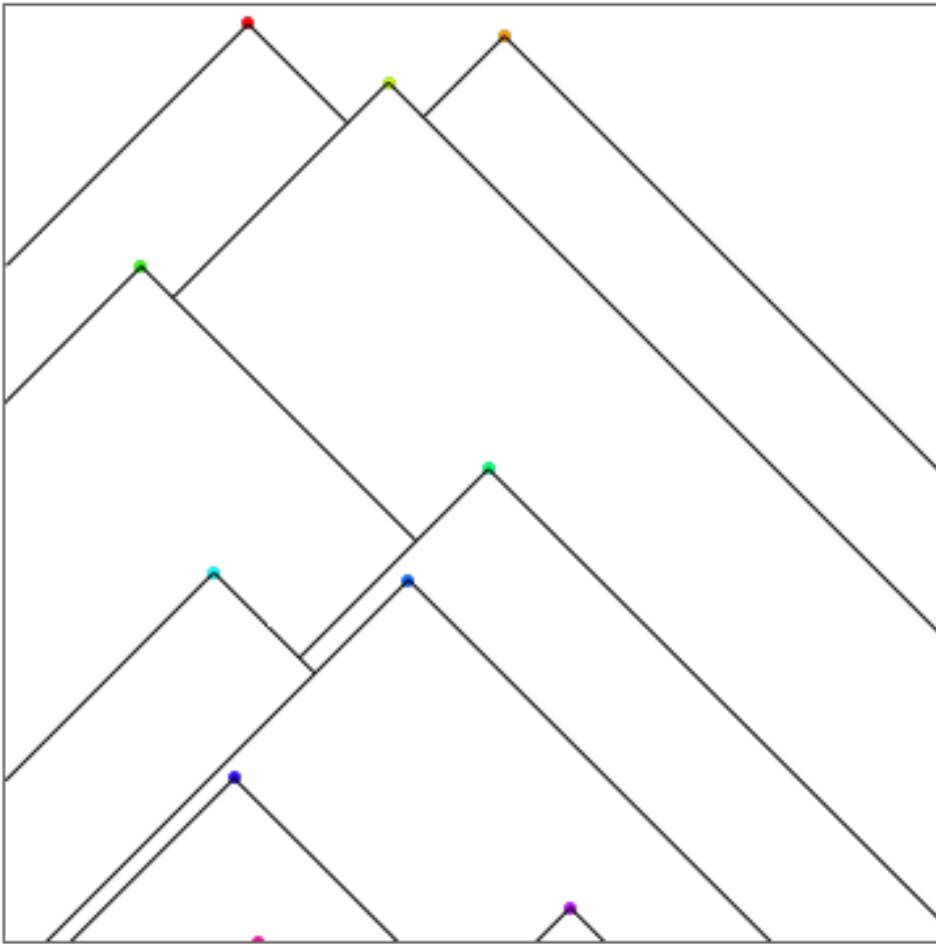
Reconstruction



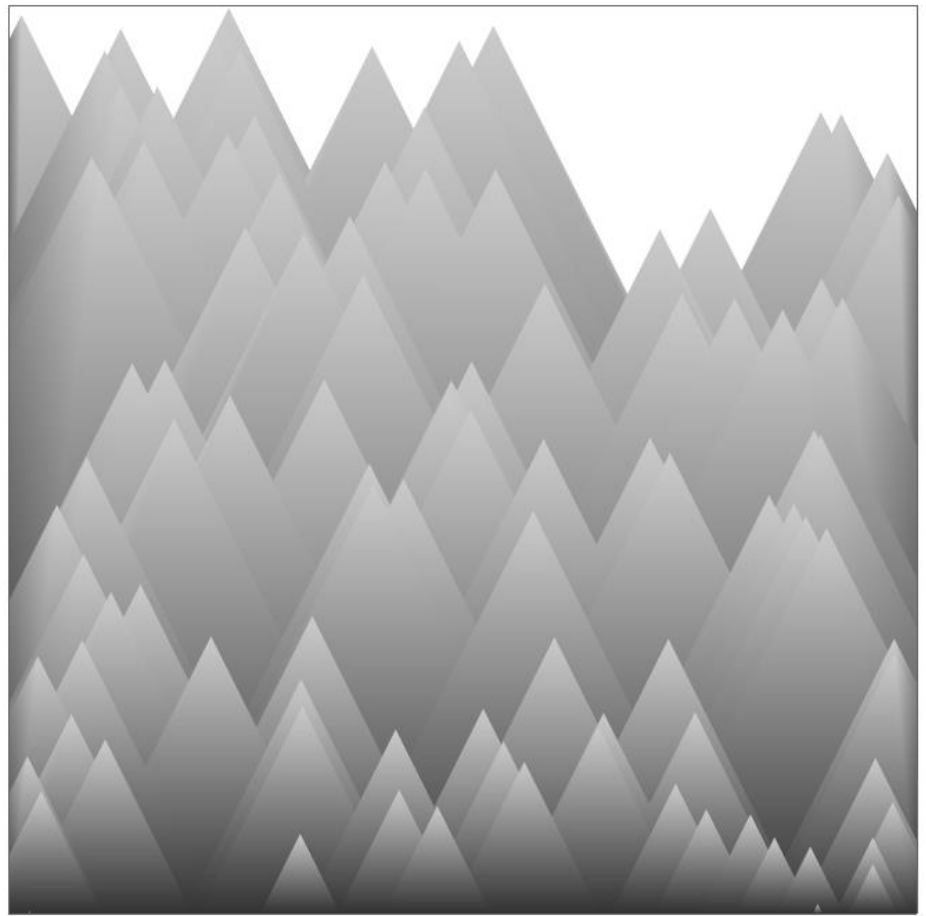
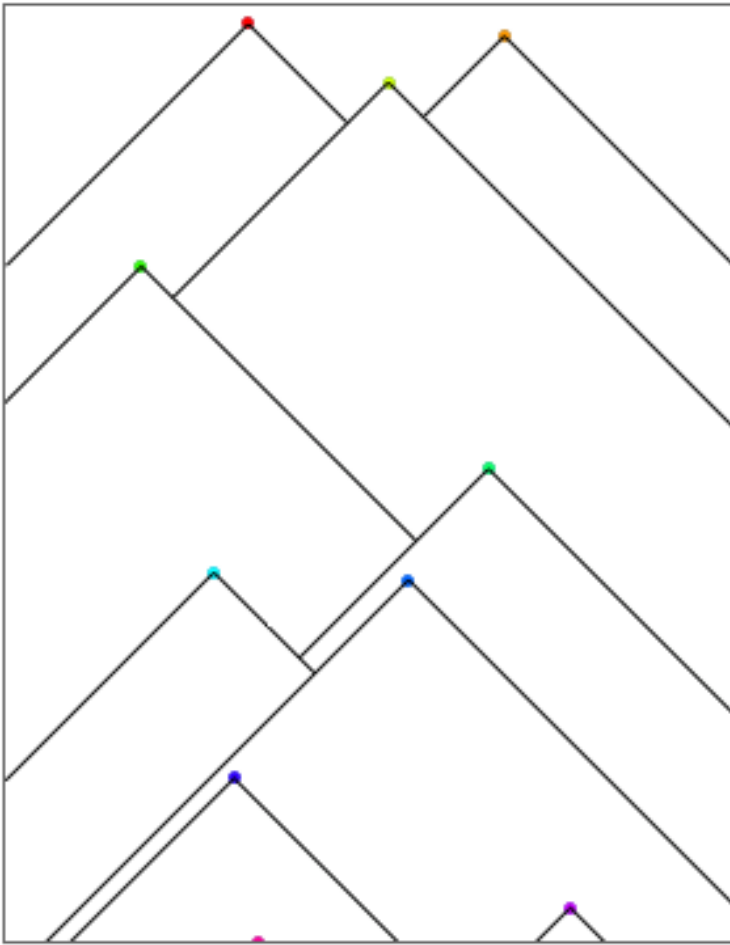
Reconstruction



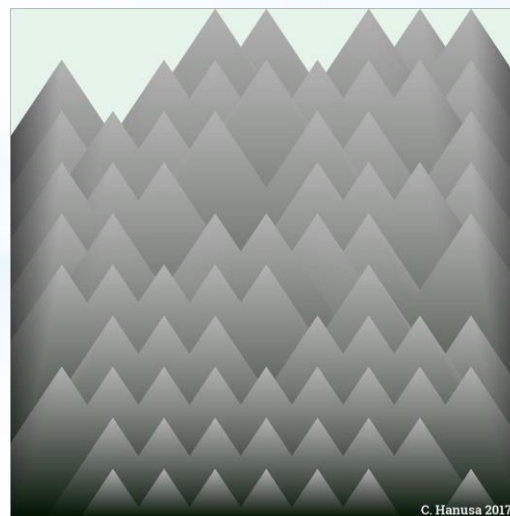
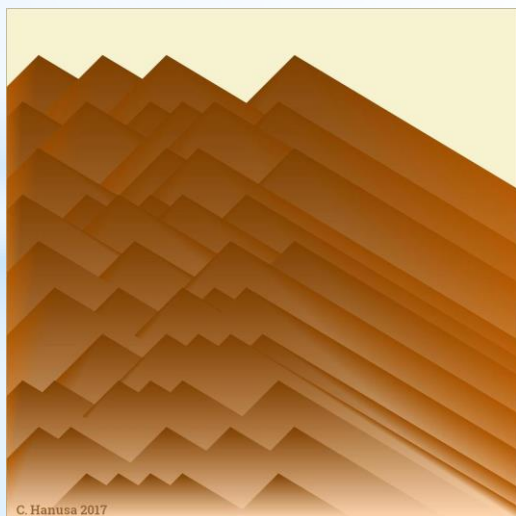
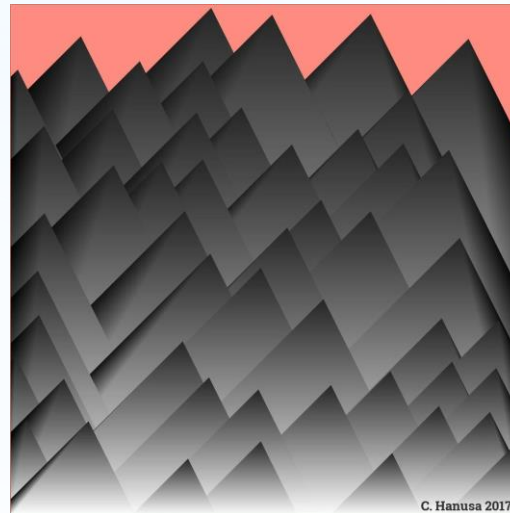
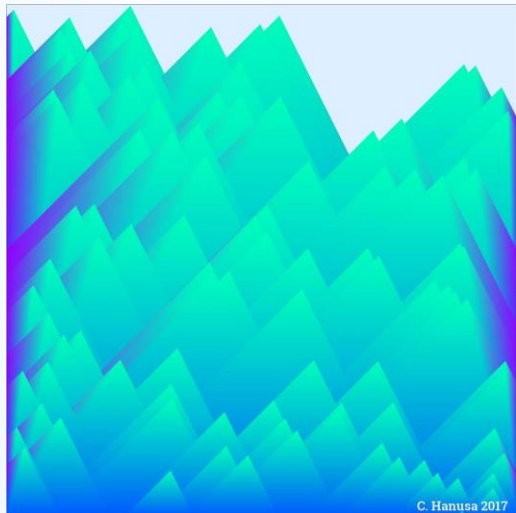
Reconstruction



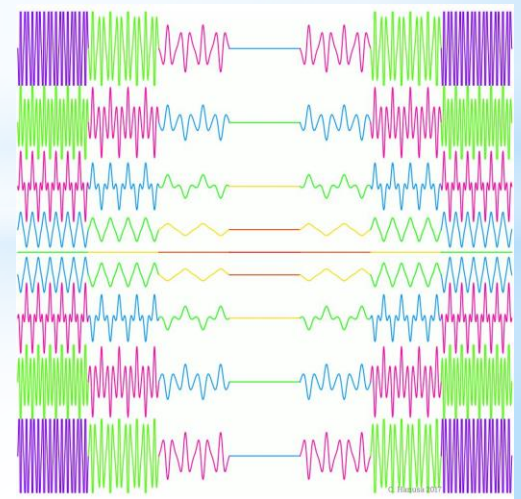
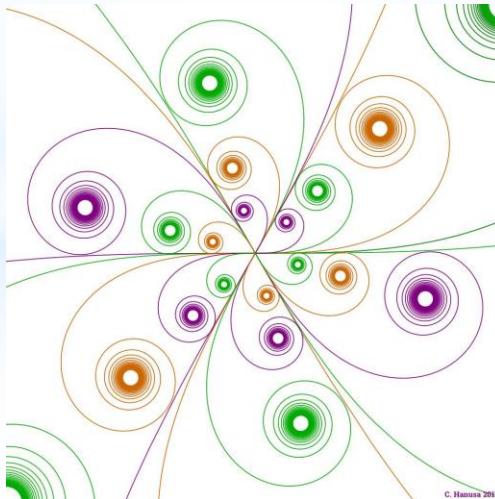
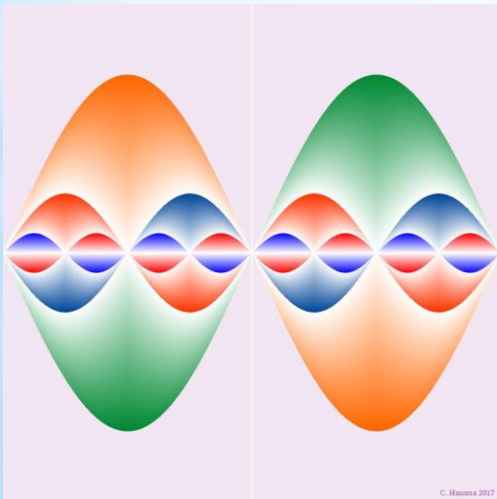
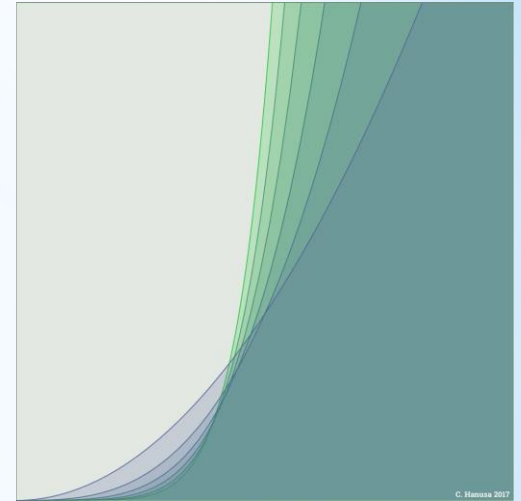
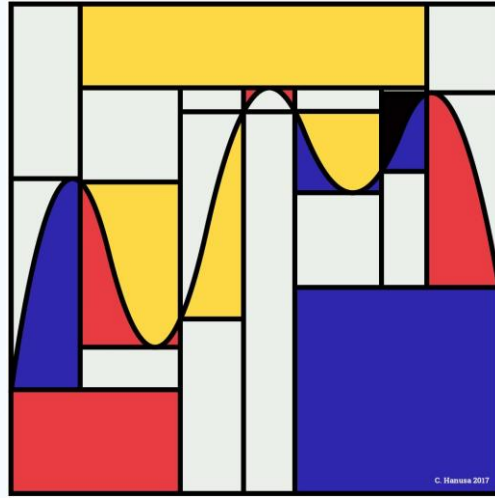
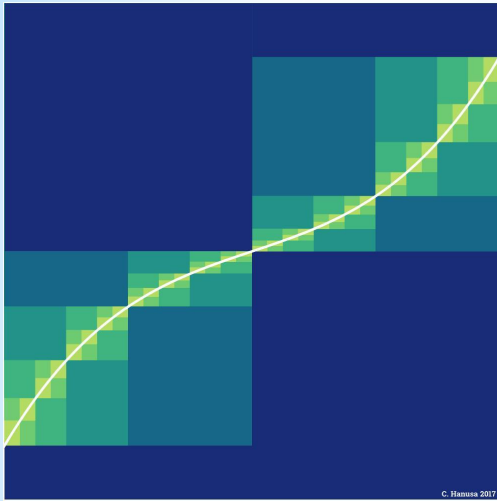
Reconstruction



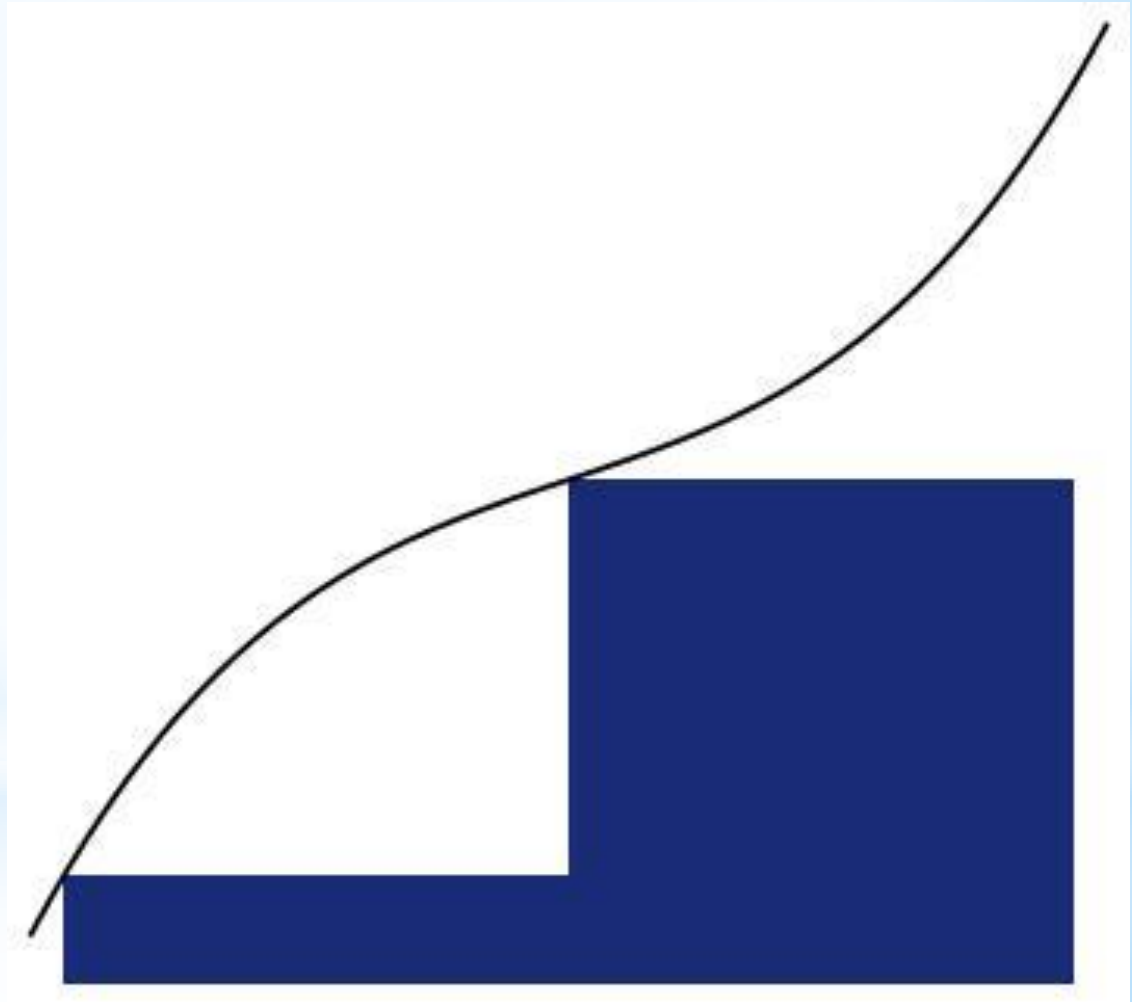
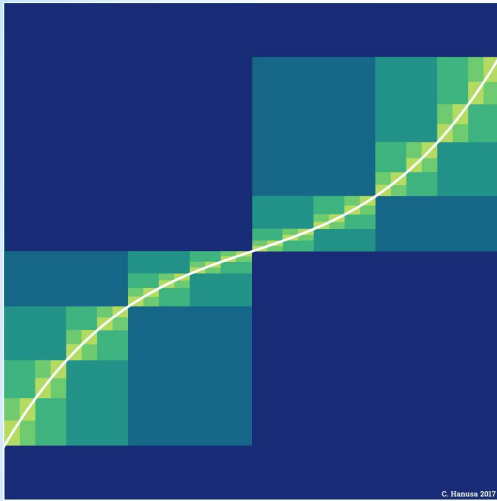
Sand Art (2017)



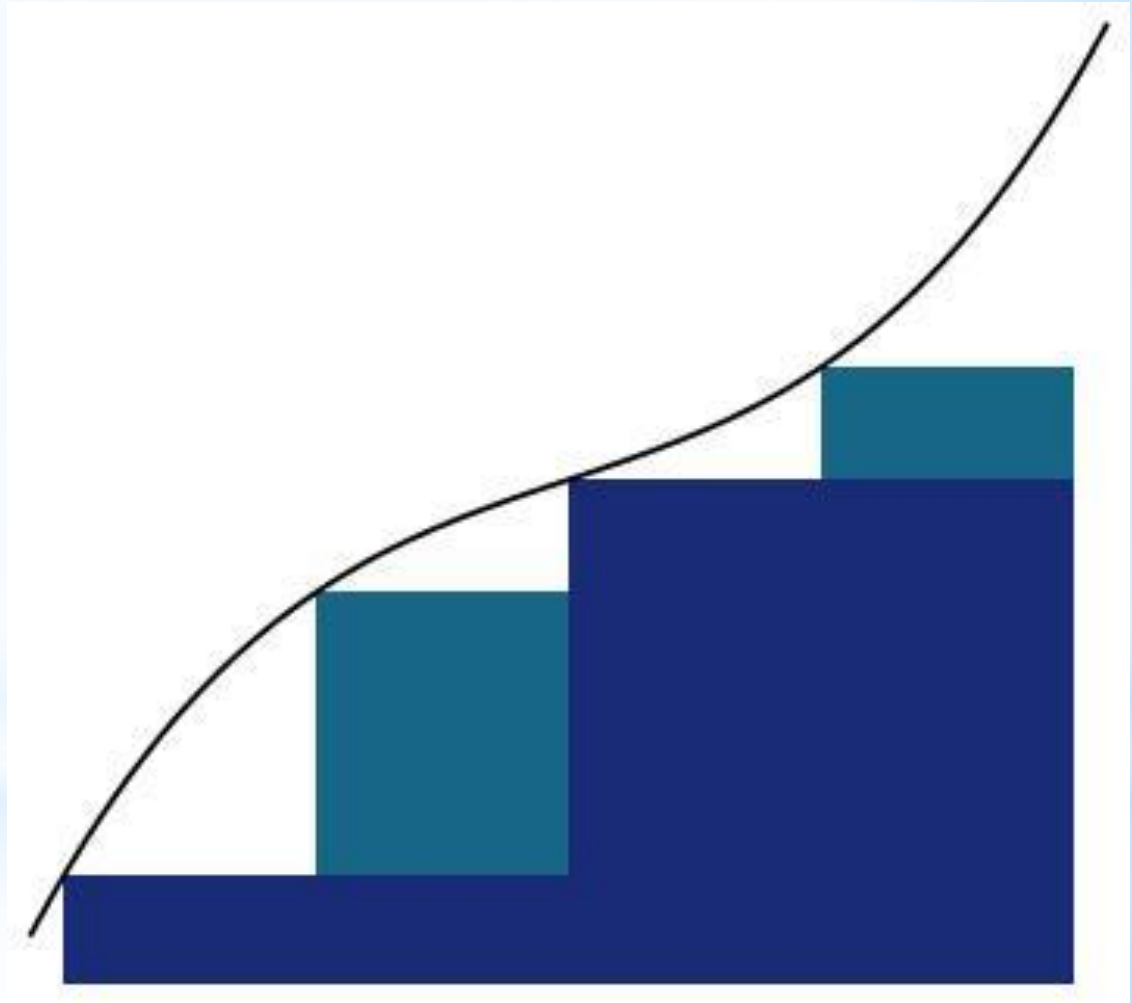
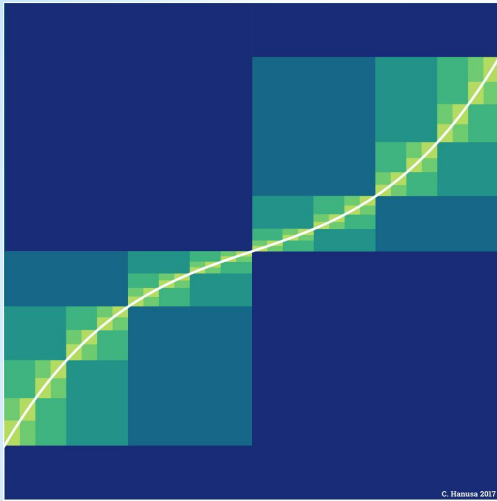
Calculus Art (2017)



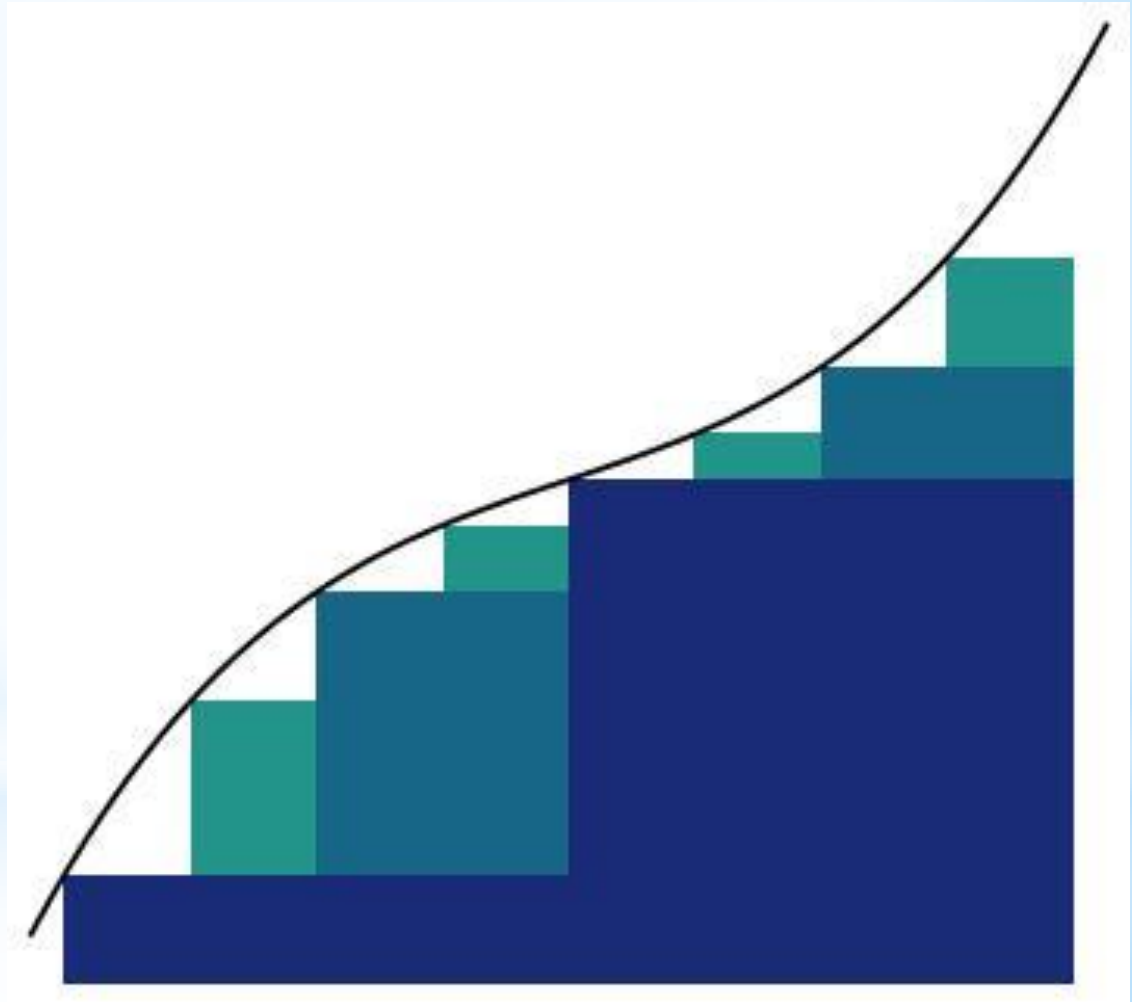
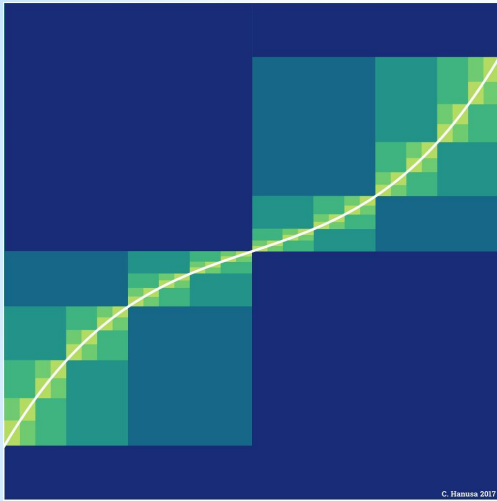
Riemann Valley (2017)



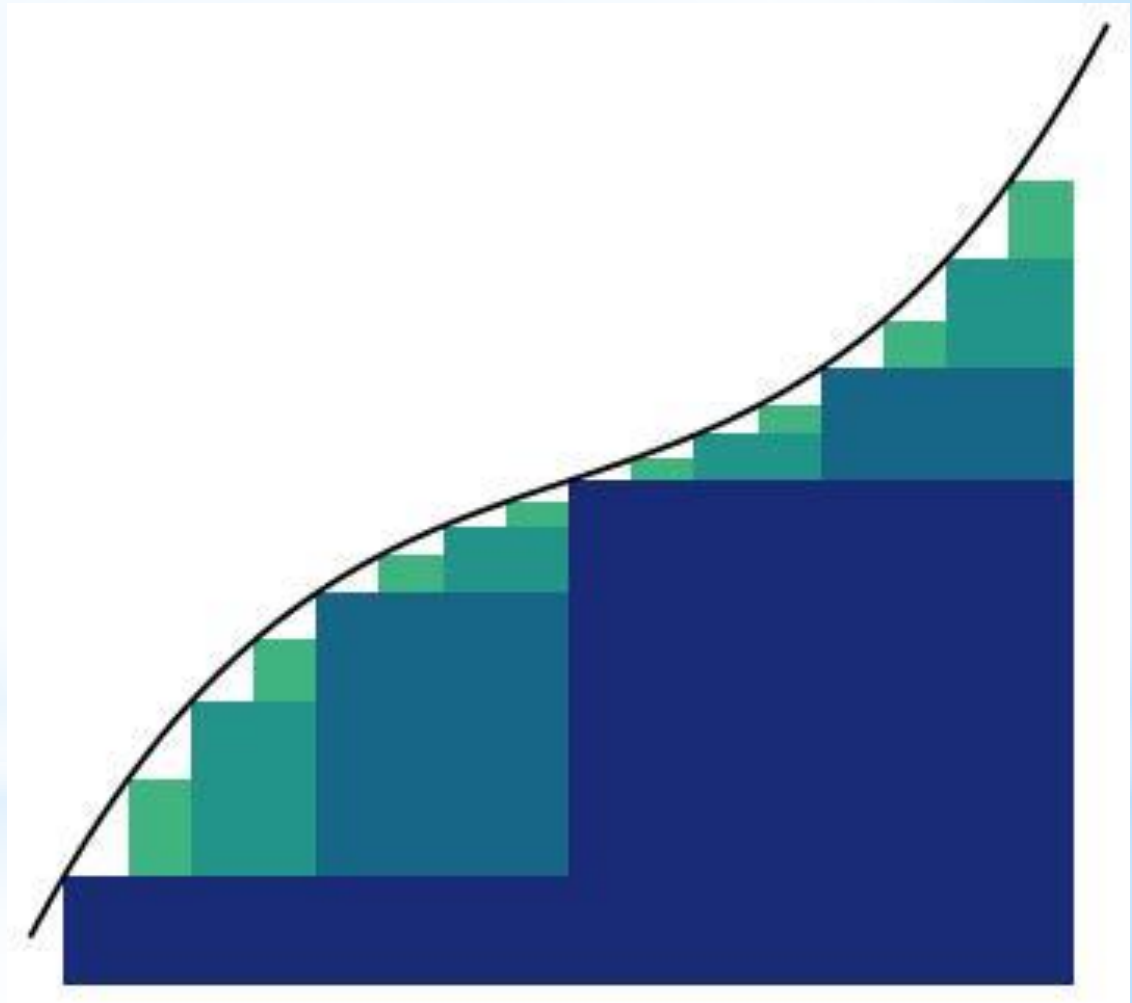
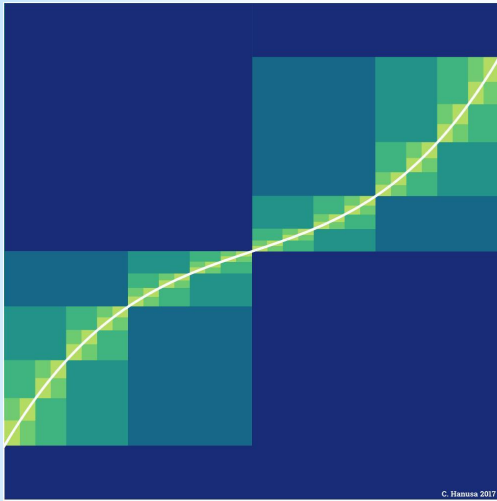
Riemann Valley (2017)



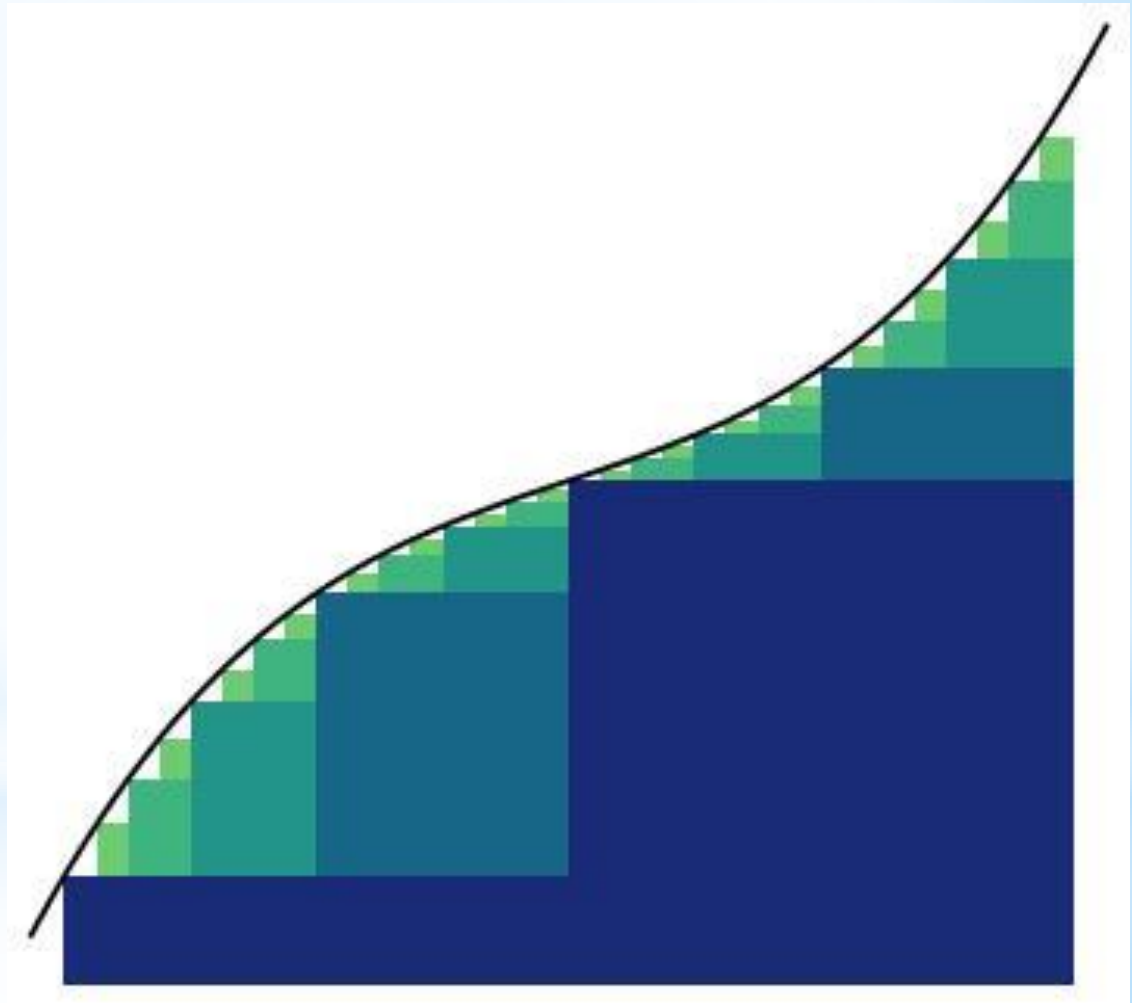
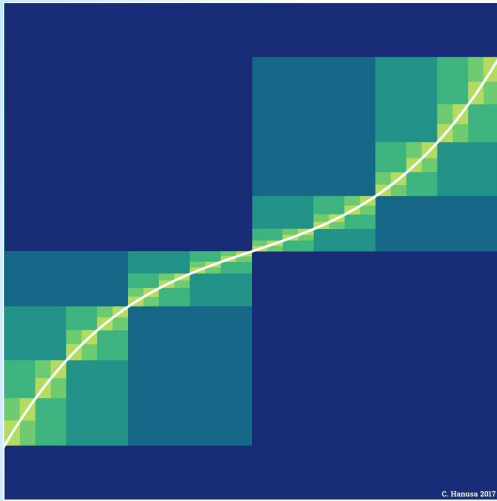
Riemann Valley (2017)



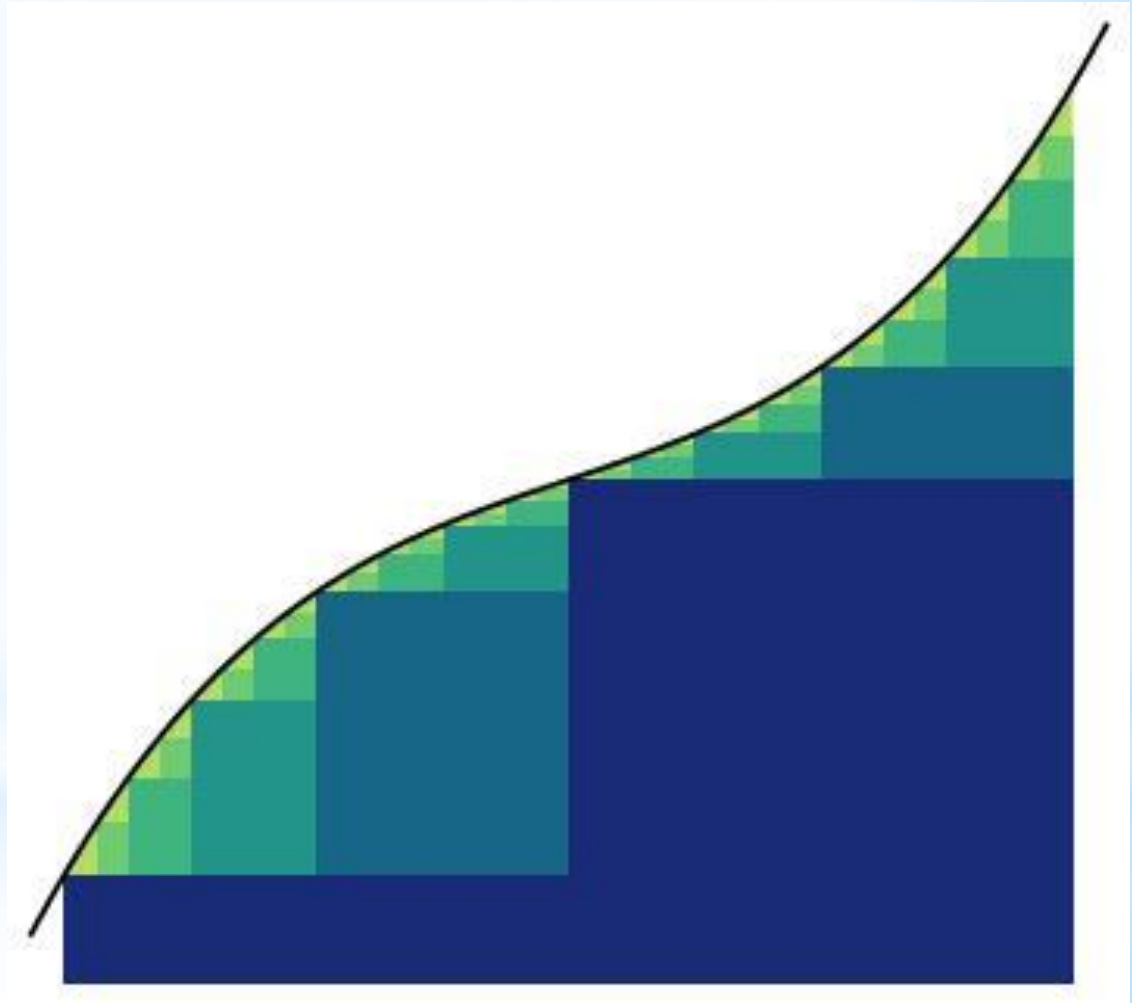
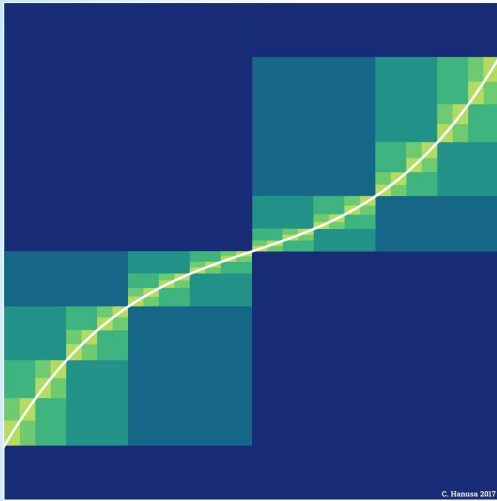
Riemann Valley (2017)



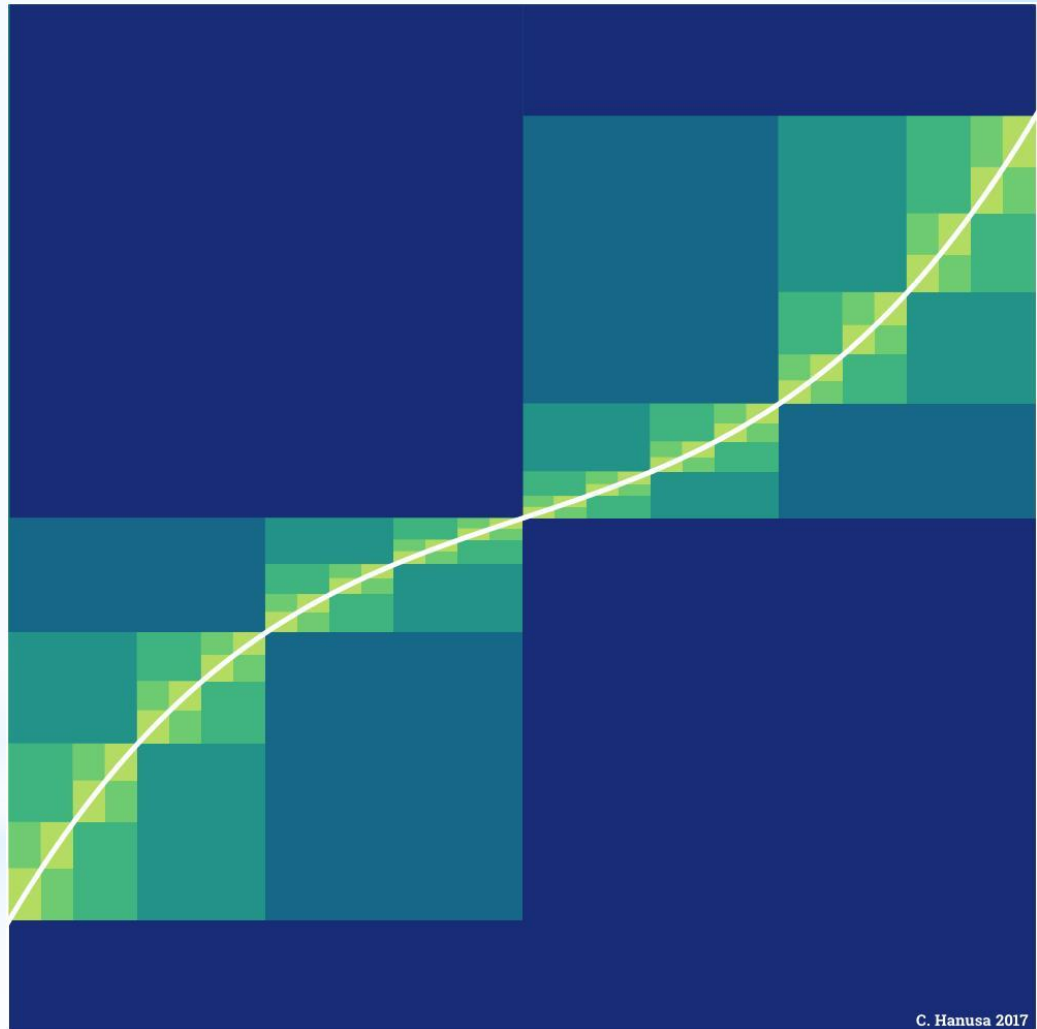
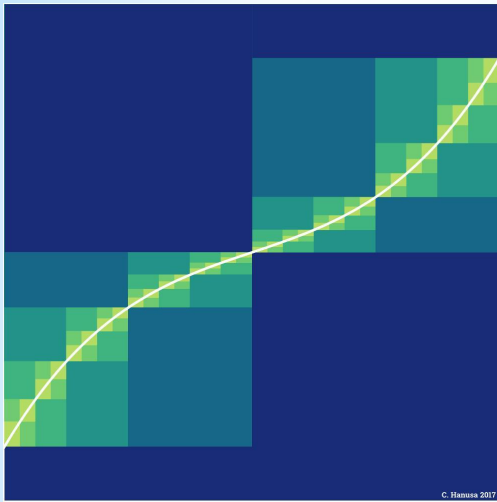
Riemann Valley (2017)



Riemann Valley (2017)



Riemann Valley (2017)



Generative Art

That's Random

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

Key property: Each choice is independent of previous choices.

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Which feels more random?

List A:

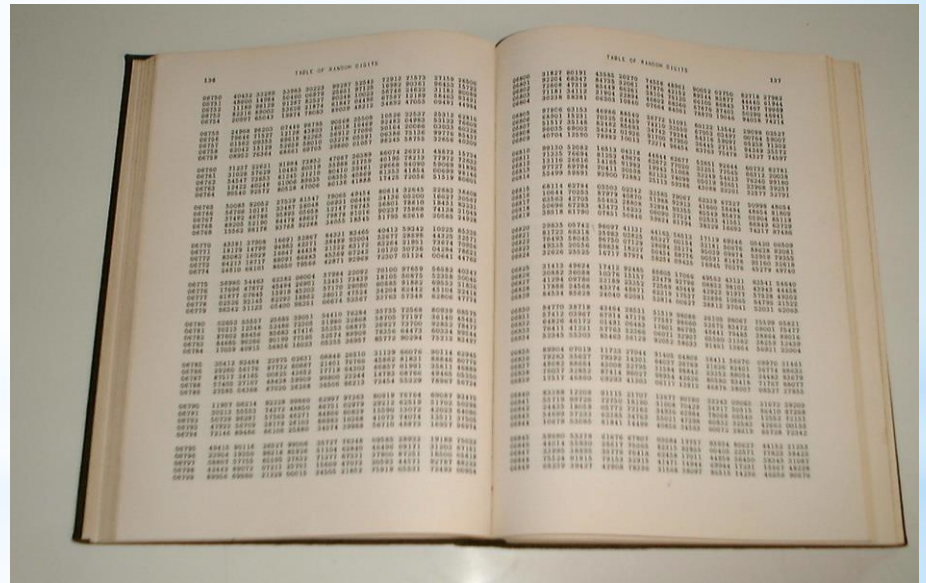
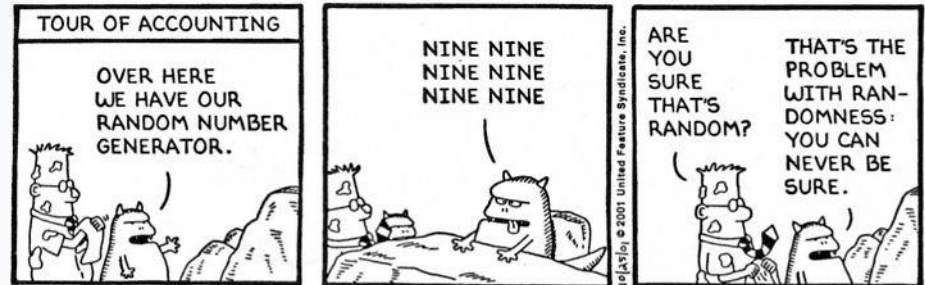
4, 3, 2, 2, 3, 3, 3, 3, 2, 4, 3, 4, 4, 4, 1, 3, 3, 4, 3, 3, 1, 3,
1, 4, 1, 1, 1, 1, 3, 3, 1, 1, 4, 3, 3, 2, 3, 1, 1, 1, 3, 4, 3, 1

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

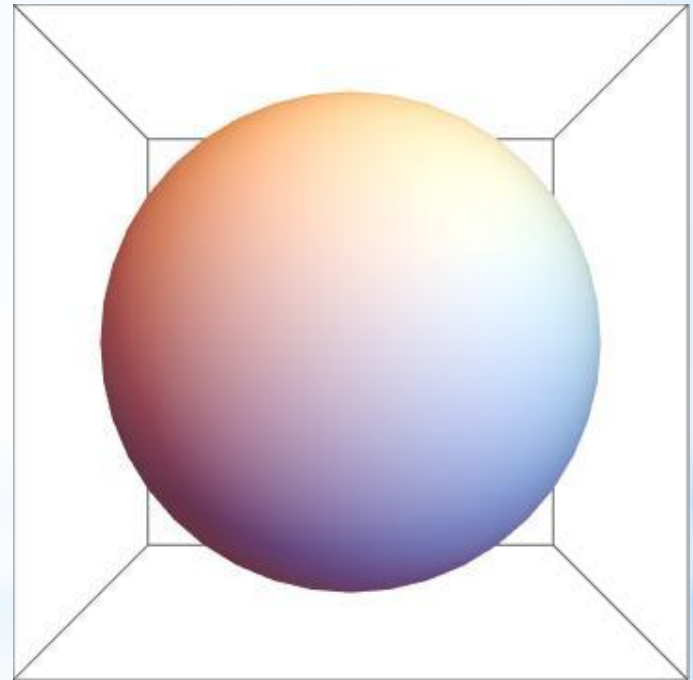
- Flip a coin
- Roll a die
- Tables in books
- Noise from outer space (random.org)
- Use a computer?



Generative Art / Creative Coding

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

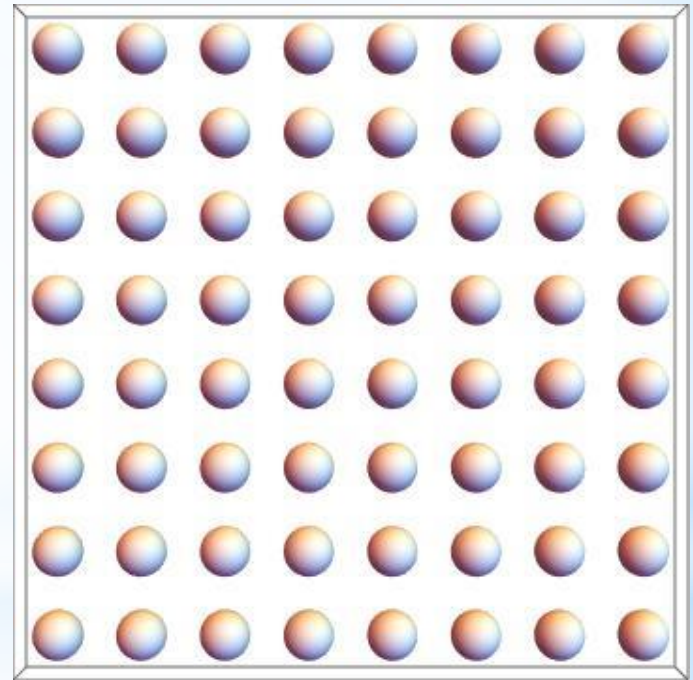
- Specify **objects**



Generative Art / Creative Coding

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

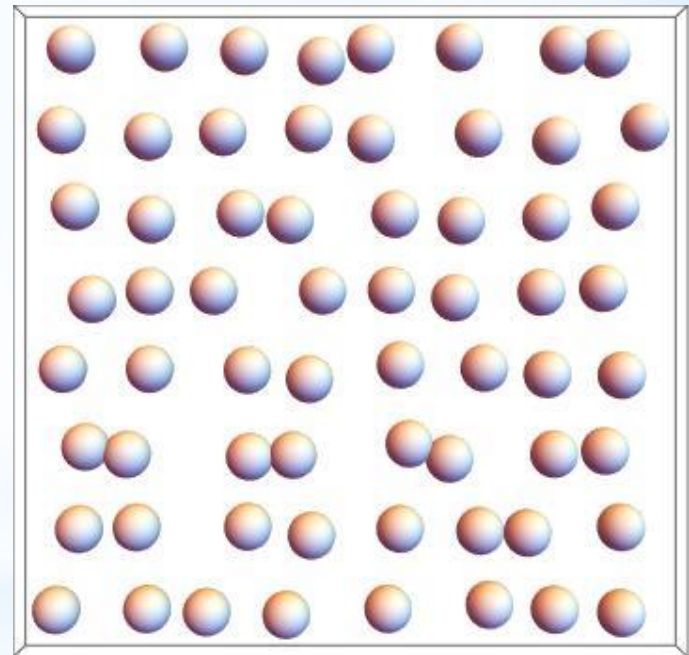
- Specify **objects**
- Give **rules** for placement



Generative Art / Creative Coding

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

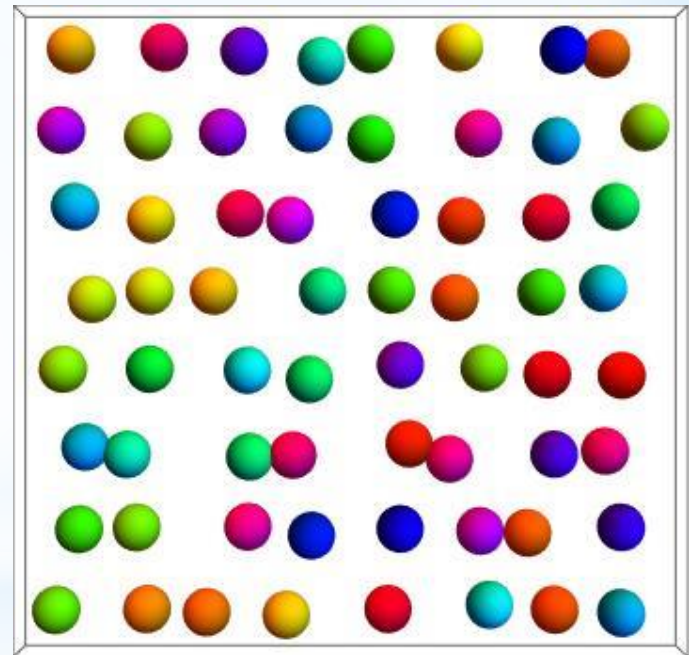
- Specify **objects**
- Give **rules** for placement
- Add **randomness**



Generative Art / Creative Coding

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

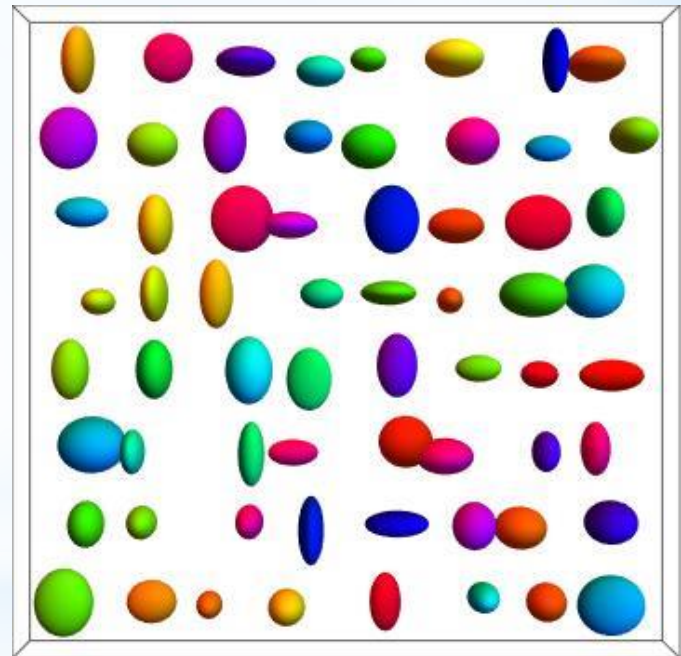
- Specify **objects**
- Give **rules** for placement
- Add **randomness**



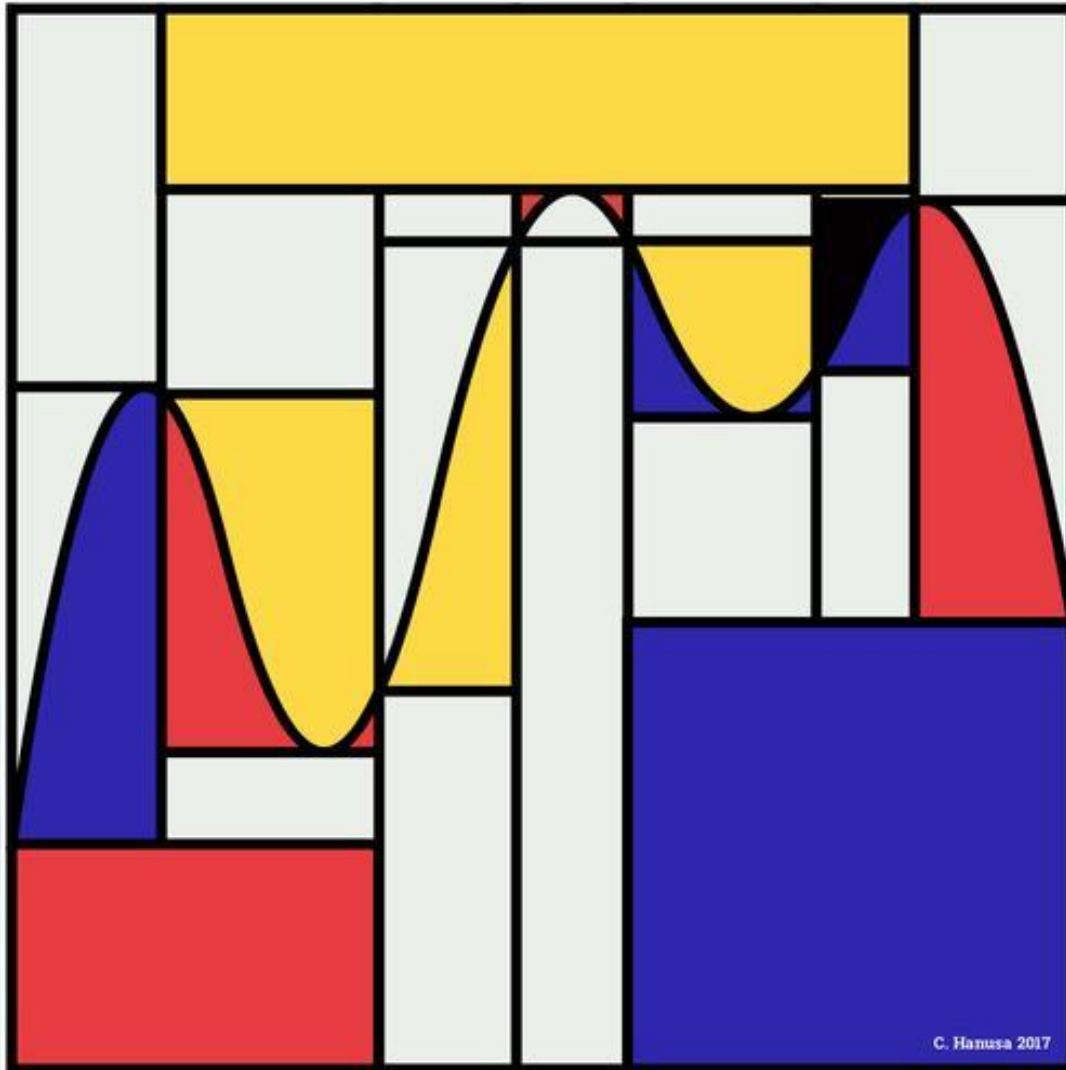
Generative Art / Creative Coding

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

- Specify **objects**
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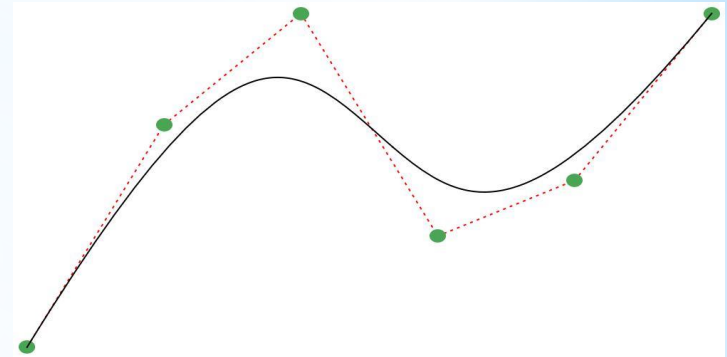


Riemondrian (2017)



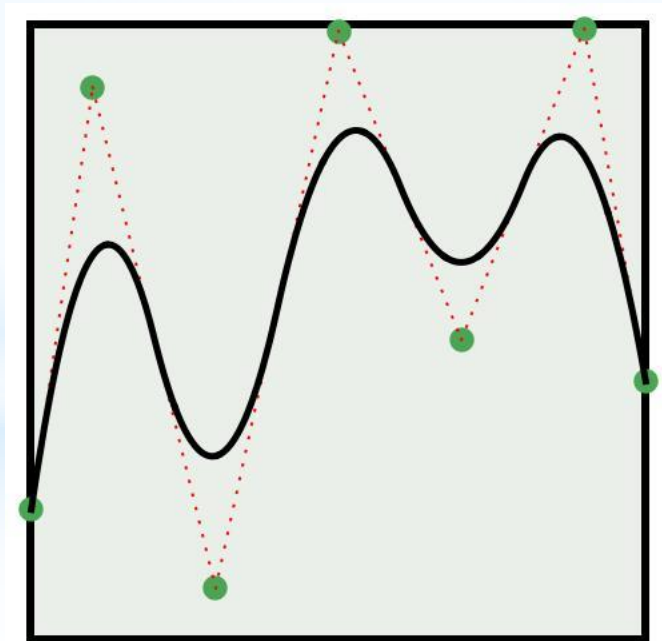
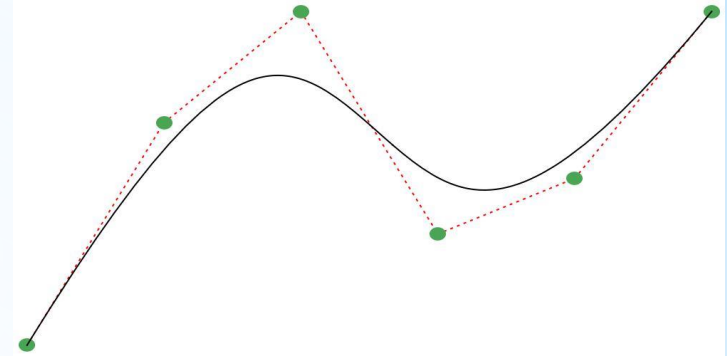
Random Splines

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



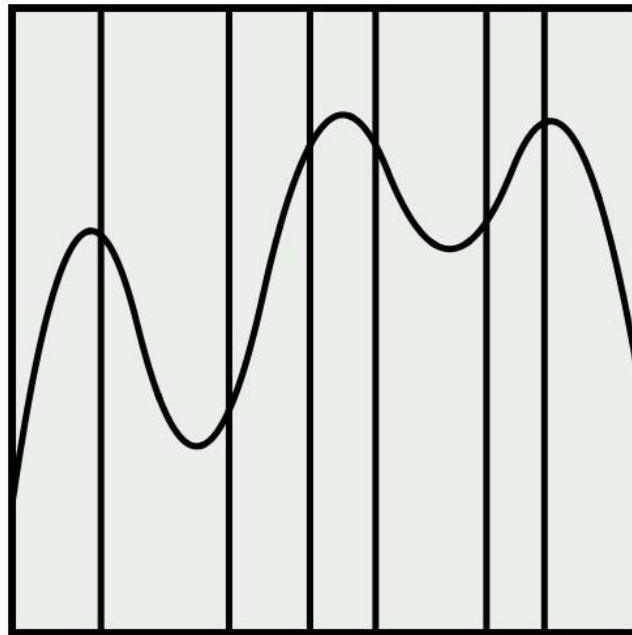
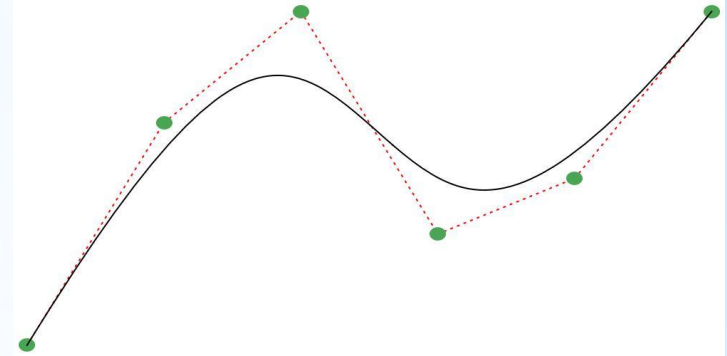
Riemondrian (2017)

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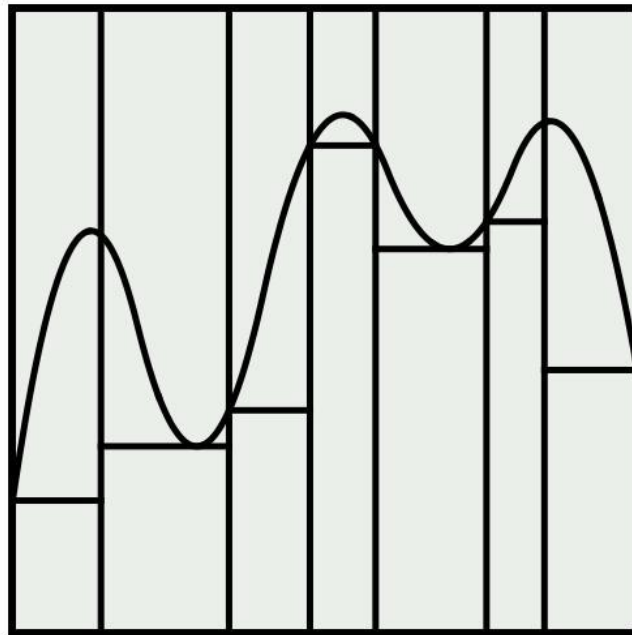
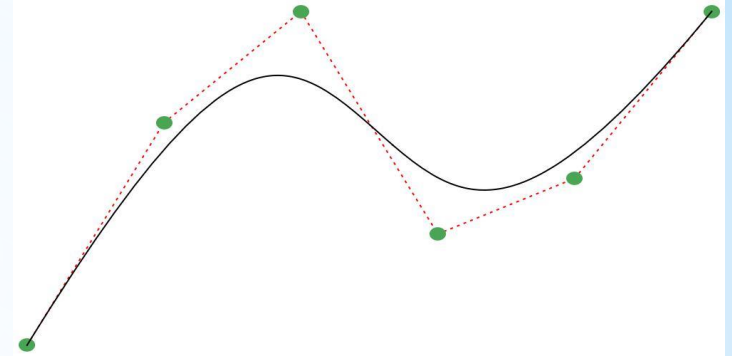
Riemondrian (2017)

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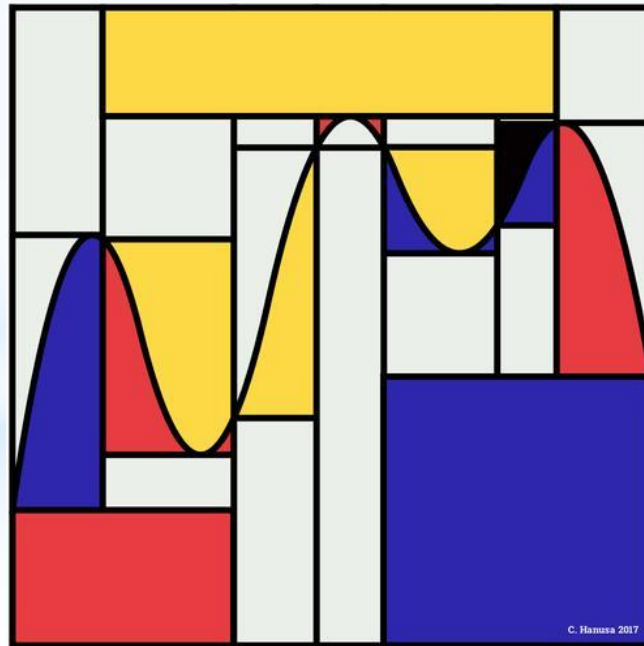
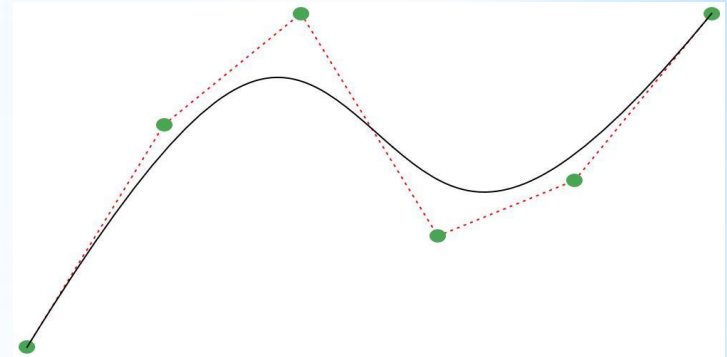
Riemondrian (2017)

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Riemondrian (2017)

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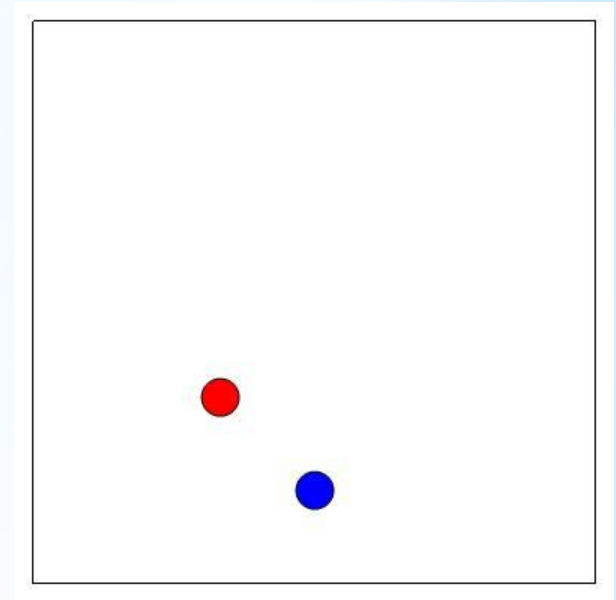
Mathematical Sculptures

The New Normal (2017)



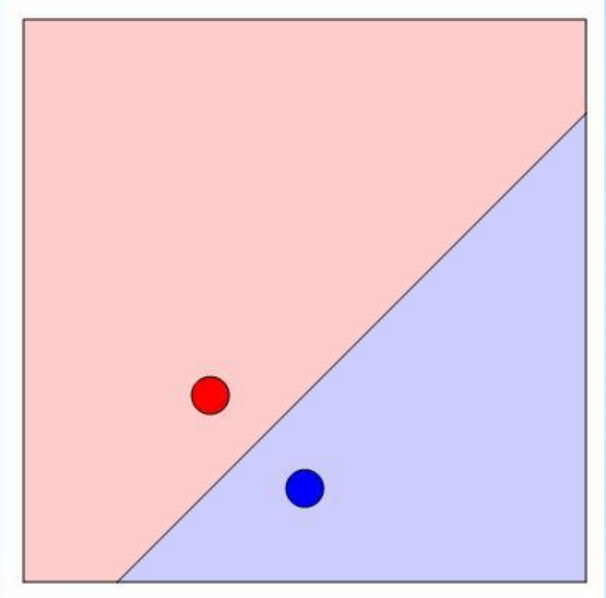
Voronoi Diagrams

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



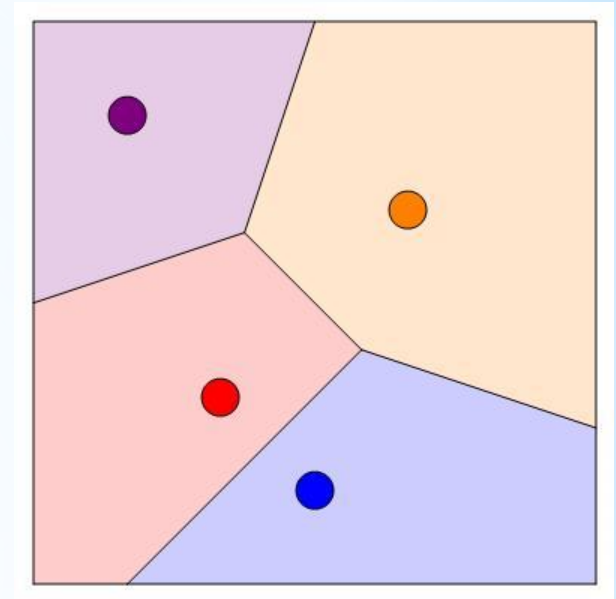
Voronoi Diagrams

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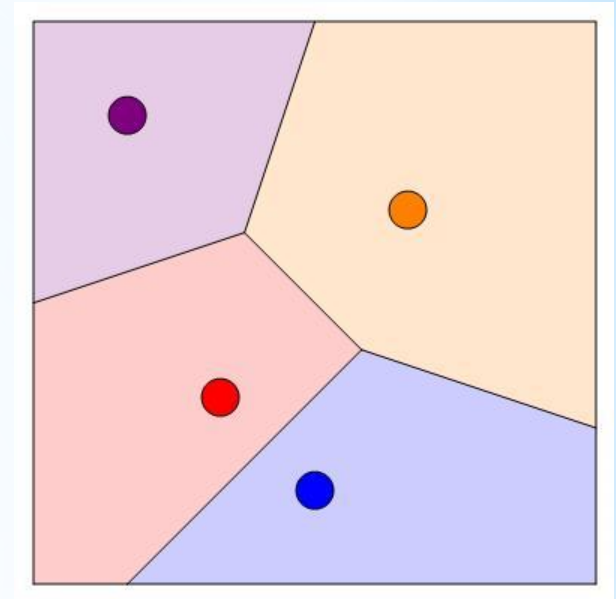
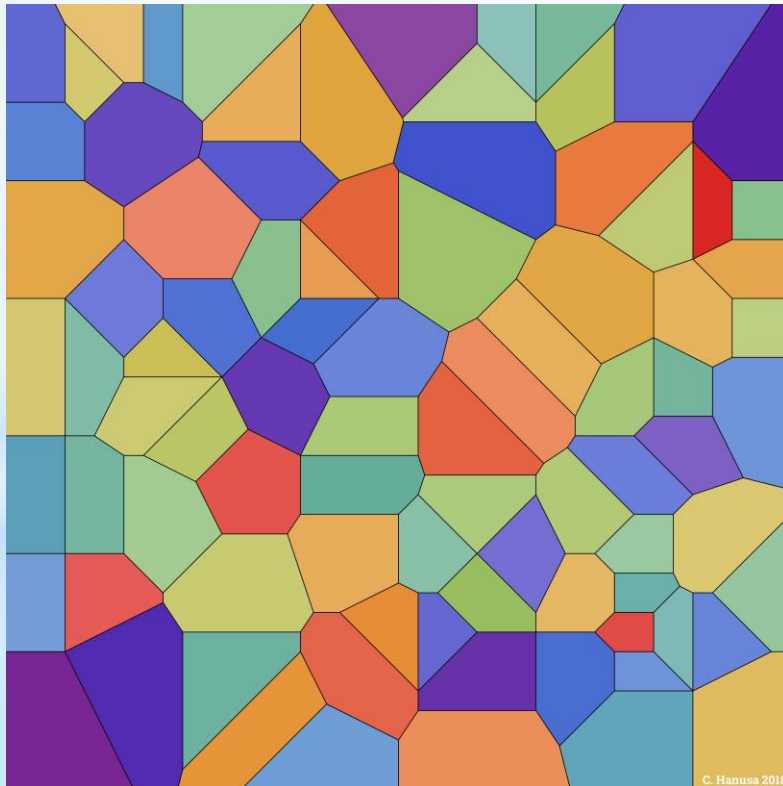
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Voronoi Diagrams

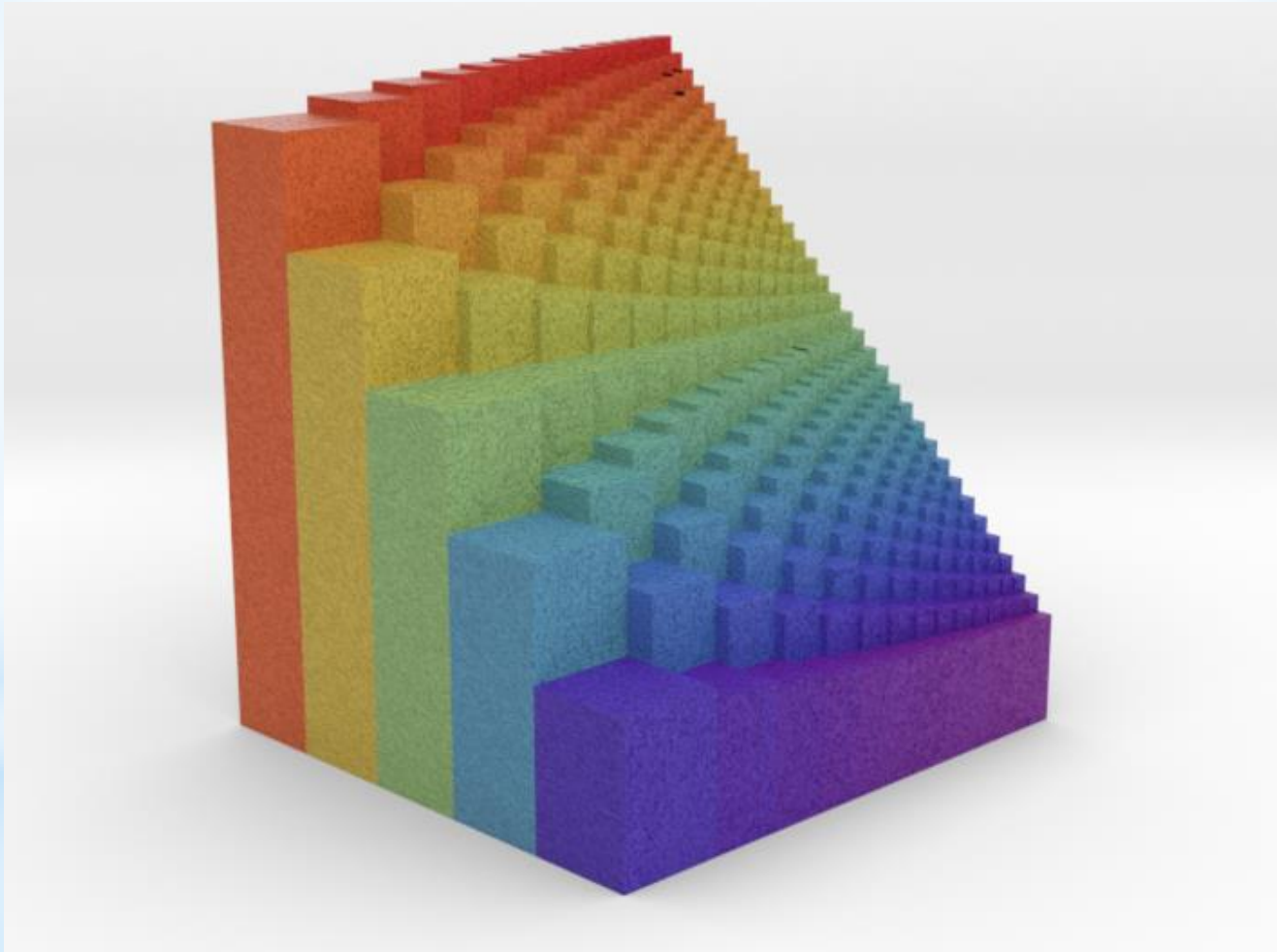
The **Voronoi Diagram** for a **set of points** is the **division of the region** into pieces based on **closeness**.



The New Normal (2017)



Rainbow Staircase (2017)

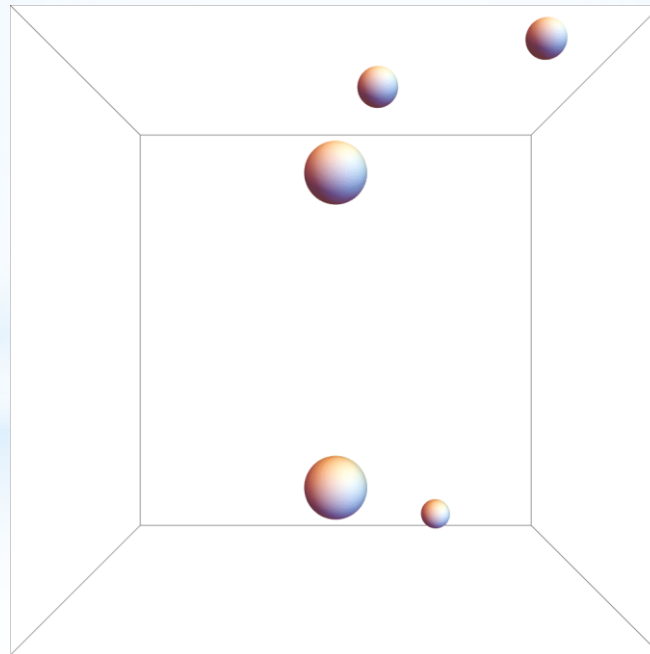
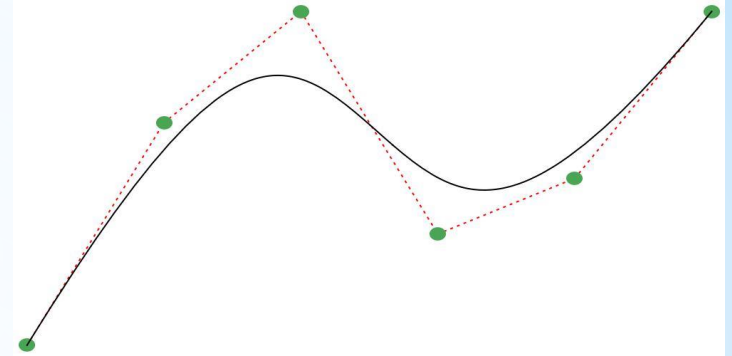


Tortoise Torus (2017)



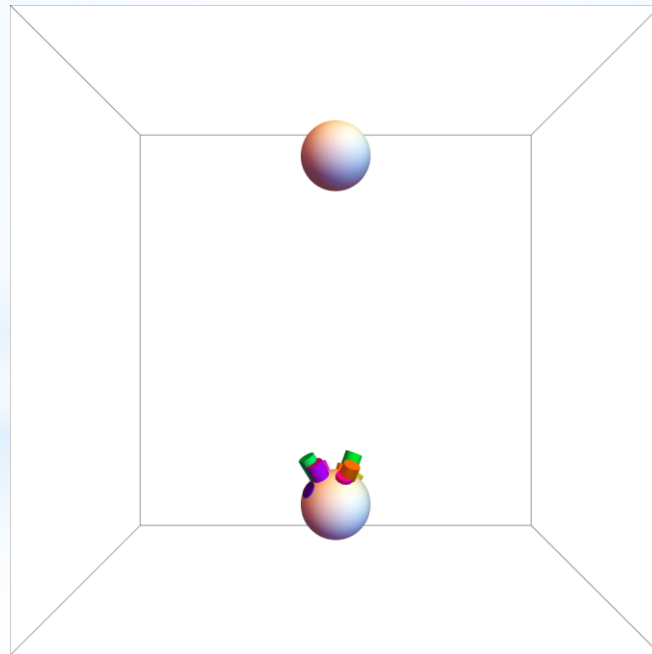
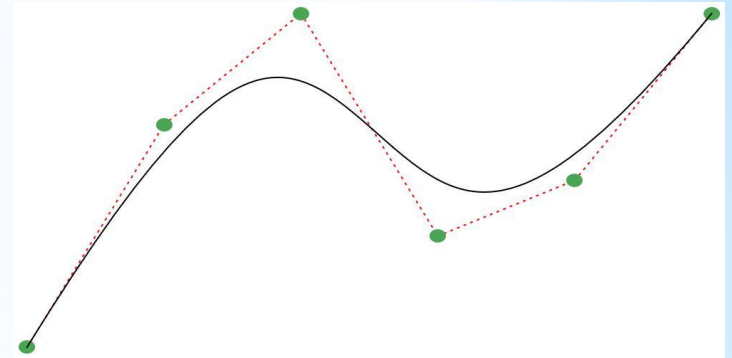
Spaghetti

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



Spaghetti

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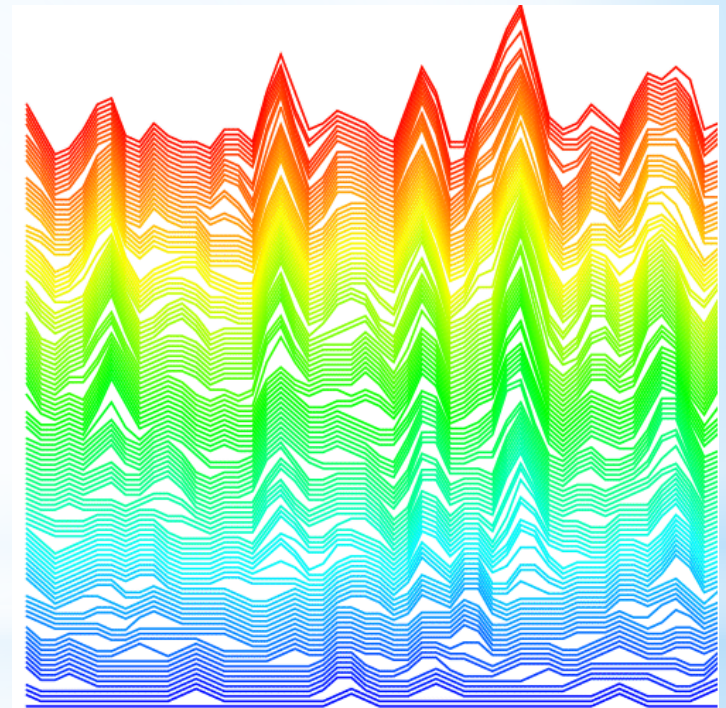
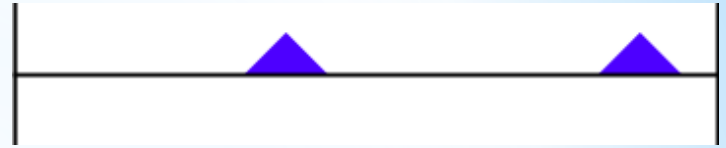


Random Growth

Create bumps at random places

Add bumps together

Wrap around a cylinder

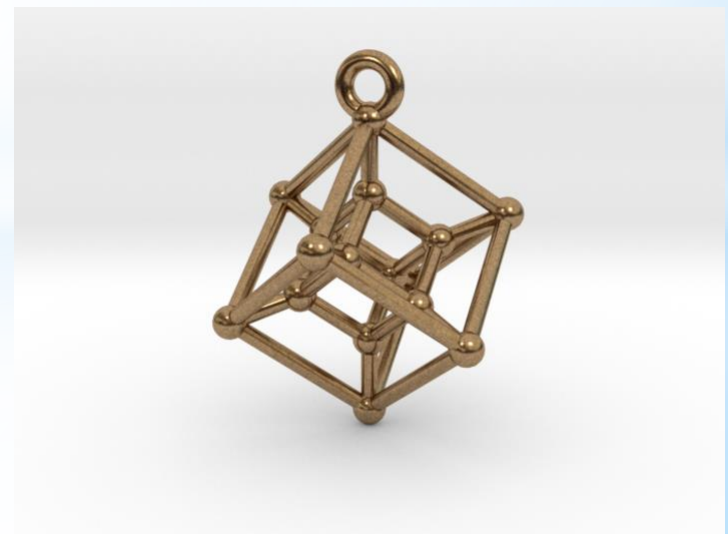
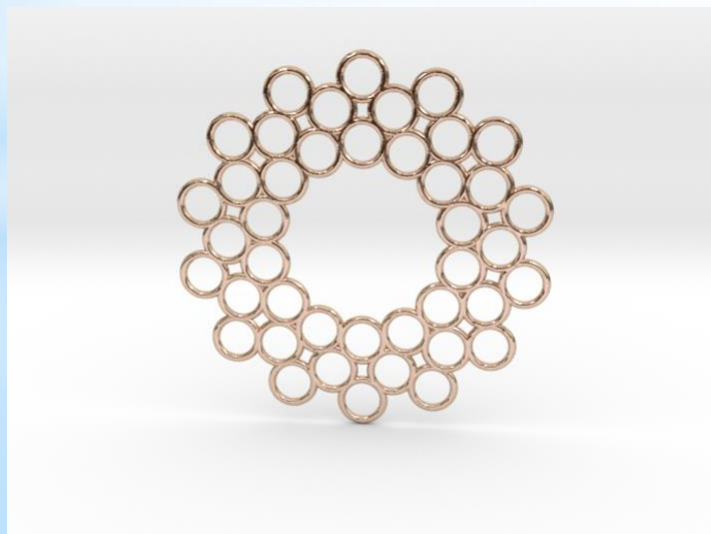


Mathematical Jewelry

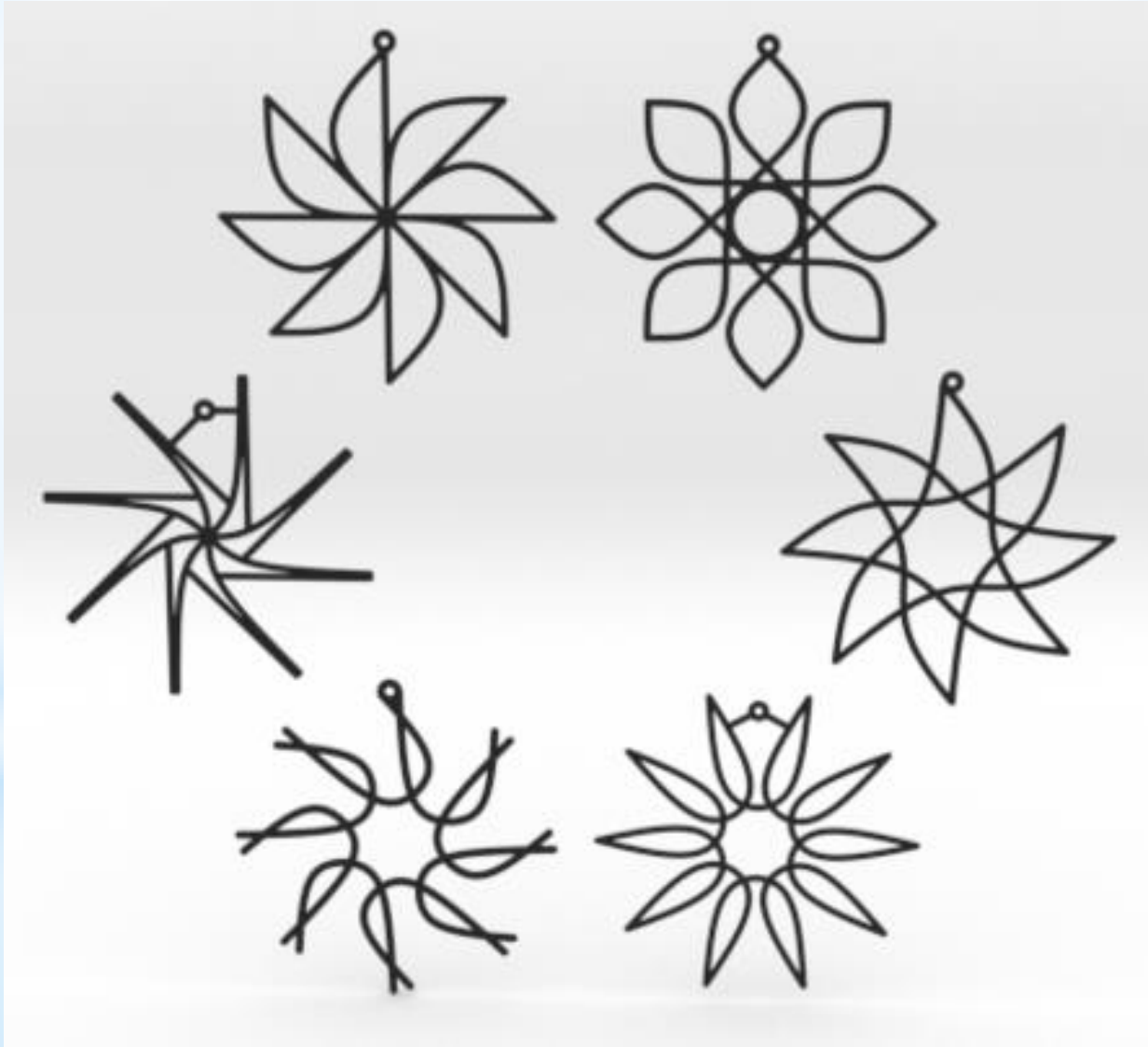
Voronoi Jewelry



Geometric Jewelry



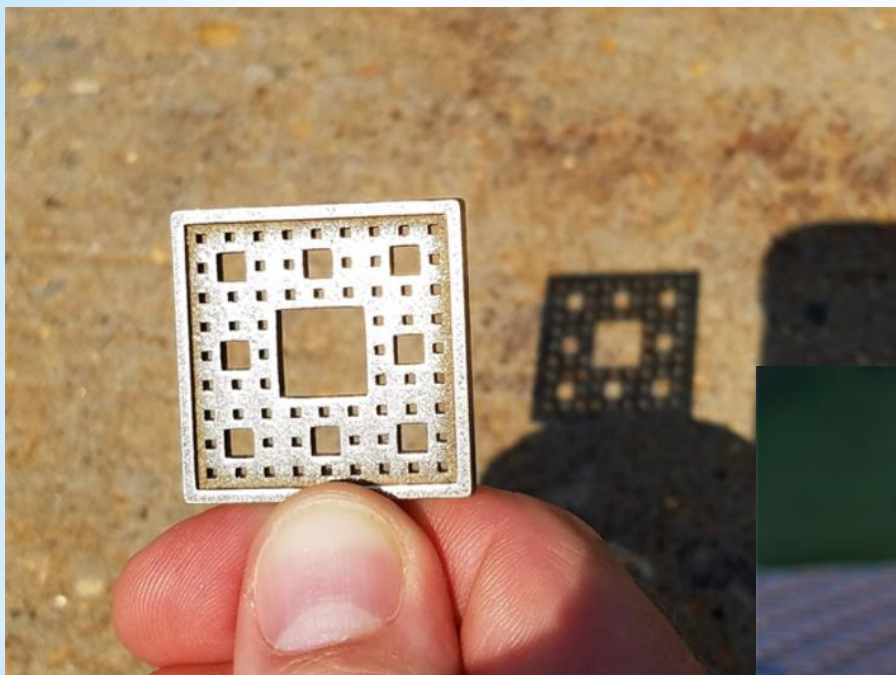
Trigonometry Jewelry



Rotini Earrings



Fractal-inspired



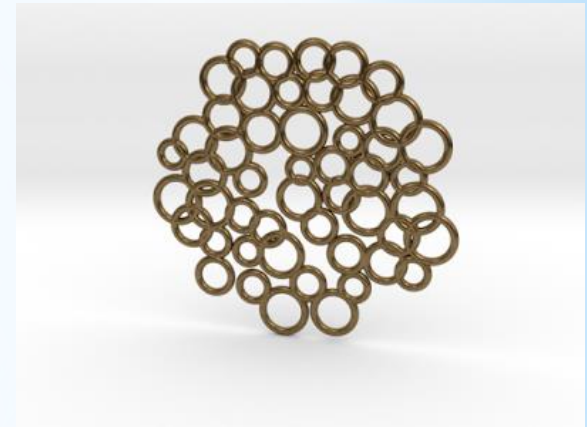
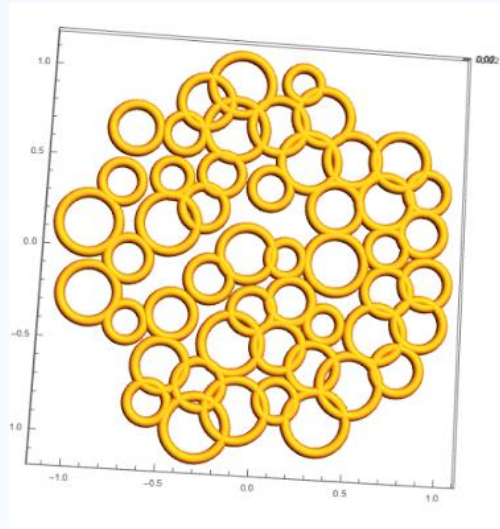
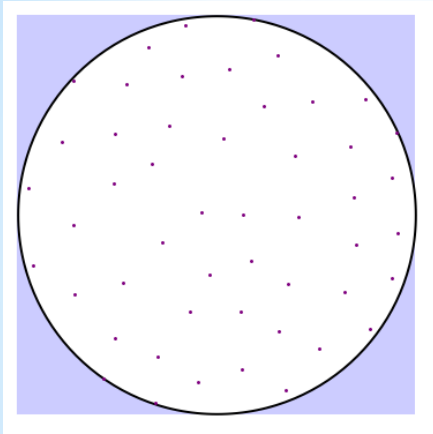
Graph Theory inspired



Golden Ratio inspired



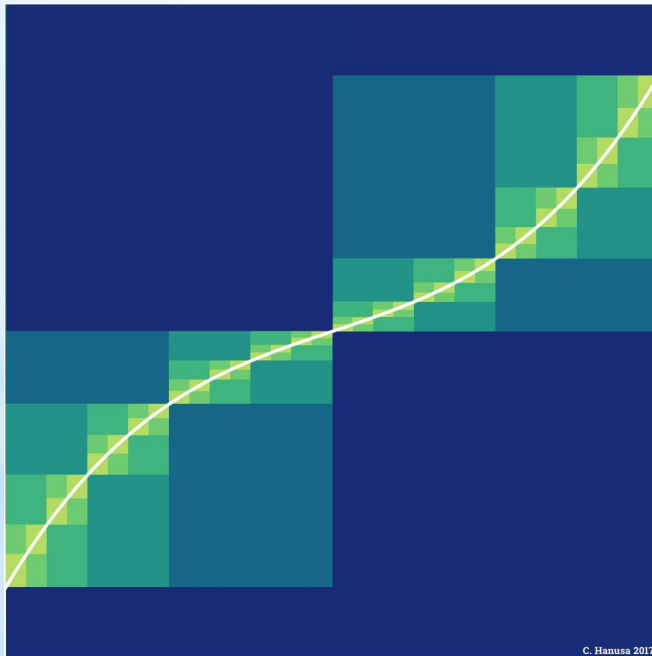
Generative Jewelry



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

Thanks! Questions? Real-time Art!?

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Real-time Art

Art that's never
been seen before