

Using Random Numbers to Create Art

Christopher R. H. Hanusa

Queens College

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

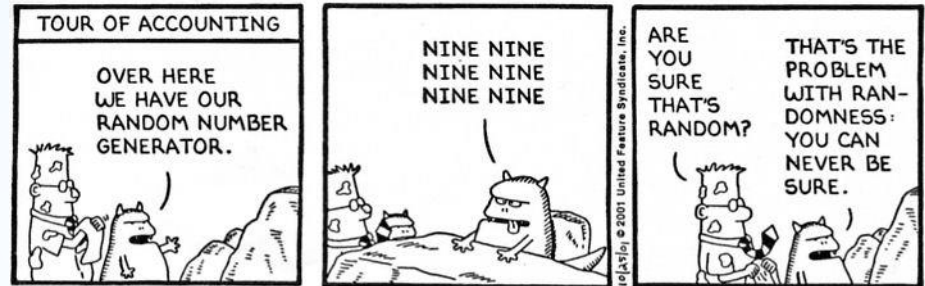
Generating Random Numbers



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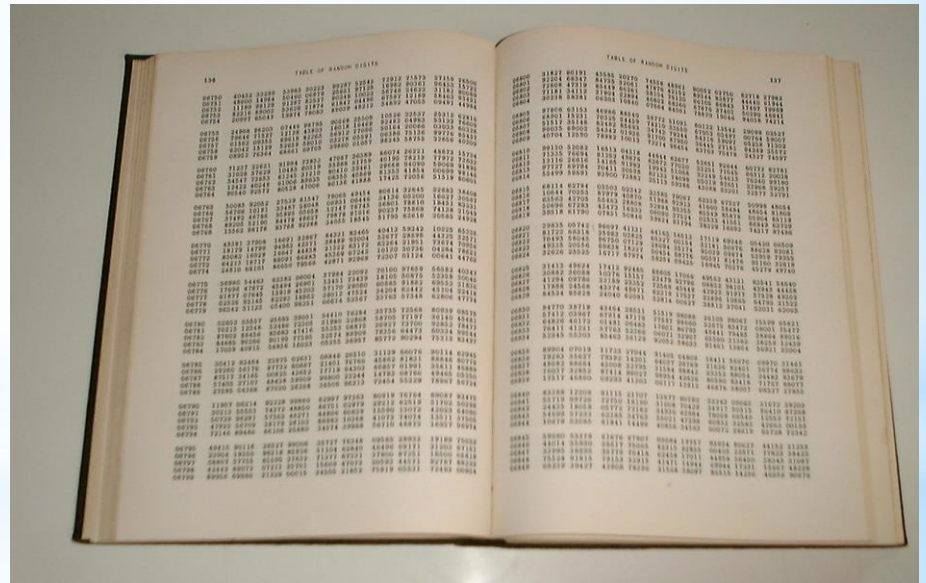
Generating Random Numbers

- Flip a coin
- Roll a die



Generating Random Numbers

- Flip a coin
- Roll a die
- Tables in books



Generating Random Numbers

TABLE OF RANDOM DIGITS

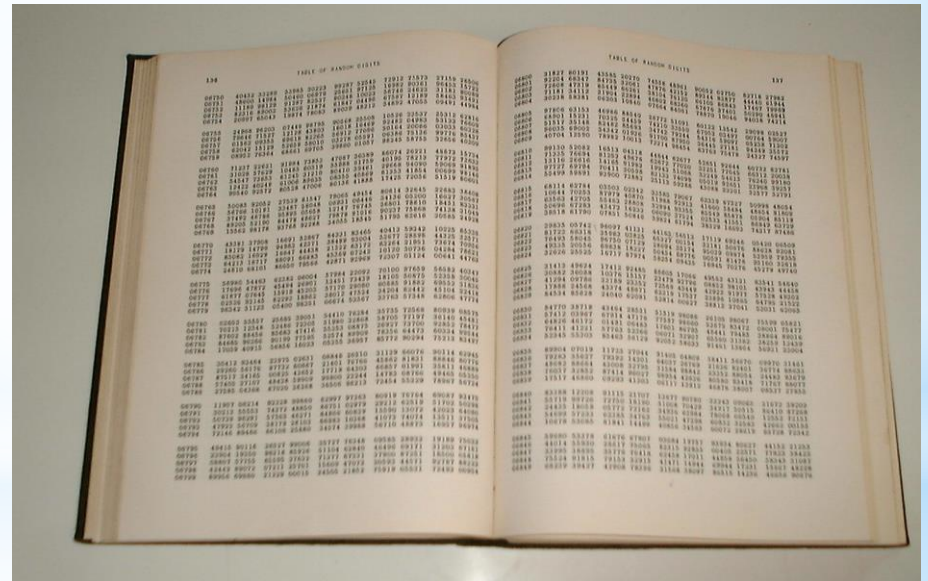
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82216 89002	53626 21874	81847 04496	67587 12189	58463 93491
20997 85043	19874 78083	89039 48217	34892 47055	09491 44984
24968 96203	07446 98795	90568 25508	10526 23537	25912 62816
79646 71527	32128 43803	16018 16469	92482 04983	53133 76609
01862 09355	69618 82265	56912 77096	50164 20086	03033 60328
62042 15129	52659 58010	03278 05591	06389 79136	99776 85457
08952 76364	84661 89705	39860 01057	98245 58755	32656 40299
71237 22621	91984 73833	47087 36389	86074 26221	48873 15734
31028 57629	10485 60319	55985 81759	40193 78213	77972 72632
54547 73653	61245 31210	80410 39461	29668 94090	59069 91893
12422 40249	81006 89635	08355 40869	61353 41854	00699 98146
98540 92577	80528 47006	80136 41888	17425 72056	51319 80601
50085 92052	27539 81547	78065 49454	80614 32645	22683 38408
56766 10191	33487 38048	08231 06446	34136 05200	16627 30587
37492 46786	95895 05658	12147 78745	36501 78810	18451 83331
89205 52190	84478 48637	79879 91016	90337 75868	74138 31045
15362 98178	93768 92288	34055 18545	51793 62010	30585 24928
43382 37808	16691 52867	84331 83465	40413 58342	10225 85338
18179 14799	94983 42371	38489 93004	33677 28898	44325 32571
80042 16929	18647 44438	21222 63172	63264 21951	73674 70934
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71877 07645	15918 45203	57170 29050	60885 01882	68552 31836
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8342 51123	05400 98351	06674 53367	32783 57348	62860 47774
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	44846 16923	05355 36997	85772 90394	75213 83497

TABLE OF RANDOM DIGITS

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04601	92204 68347	84735 32061	47876 42152	89344 83877	44440 61944
04602	72608 47319	85449 56261	38104 76120	66105 86843	17467 79969
04603	71181 34112	21904 22824	46802 68260	67676 37401	50290 46941
04604	30238 58381	06203 10940	07664 84031	78870 19046	94038 74214
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04610	99130 52082	16513 04318	44844 82677	52651 92644	69732 82781
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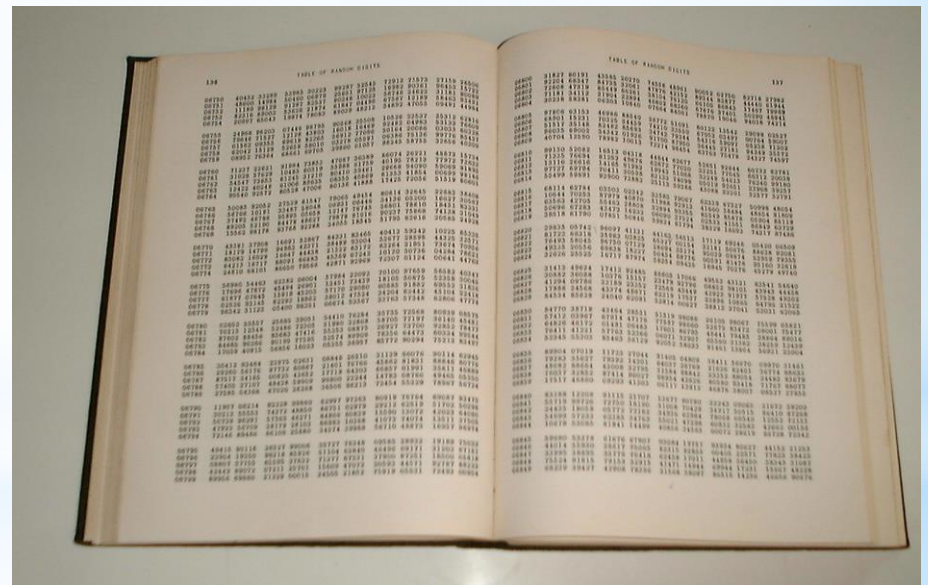
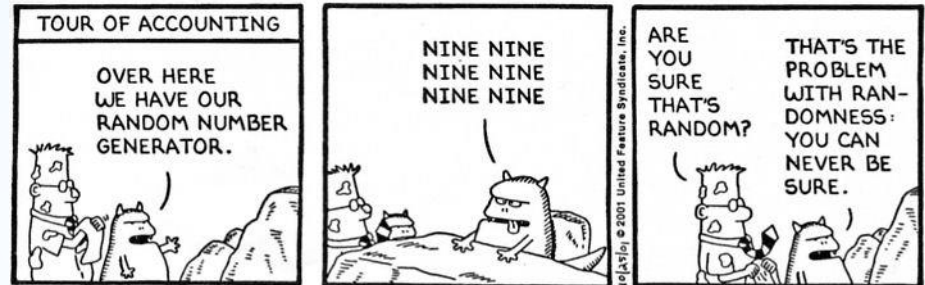
Generating Random Numbers

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



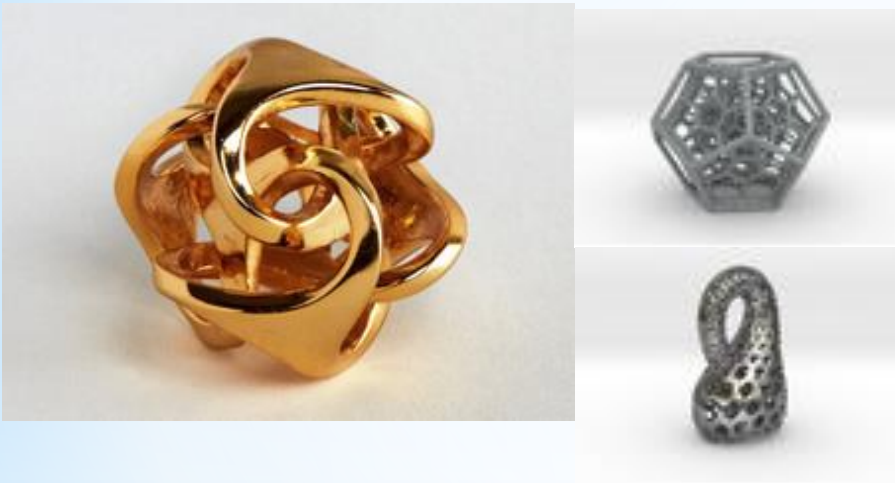
Generating Random Numbers

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



Mathematics + Art ?

Bathsheba Sculpture

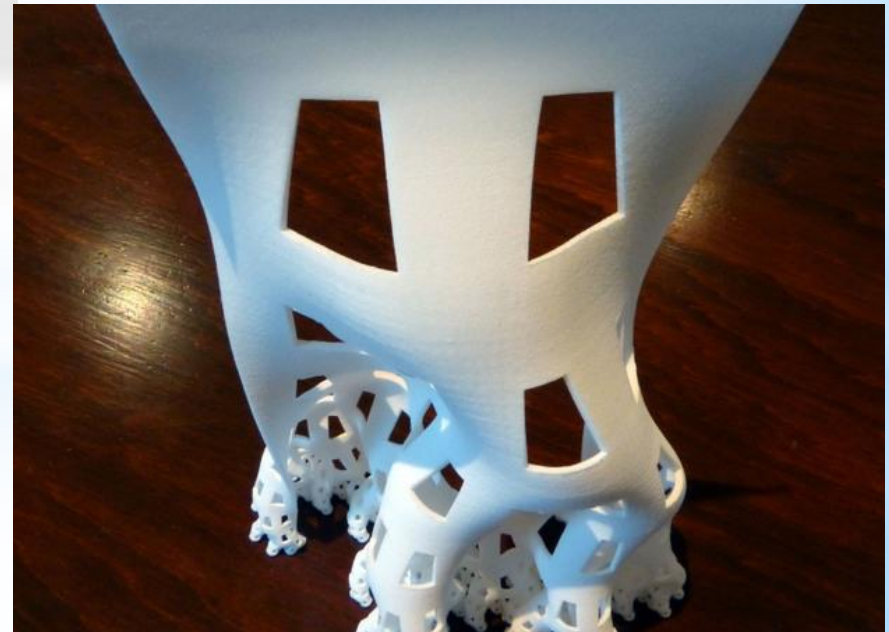
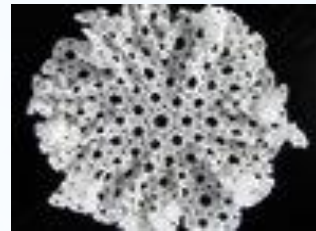


Mathematics + Art ?

Bathsheba Sculpture



Henry Segerman

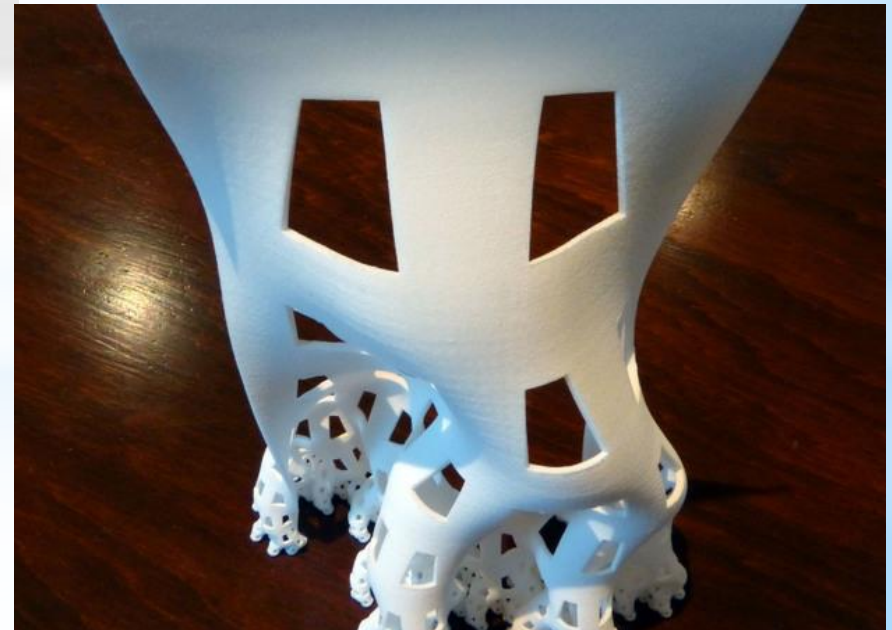
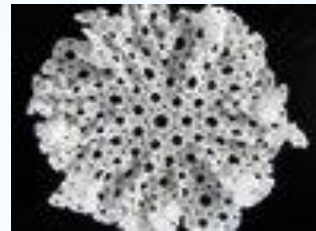


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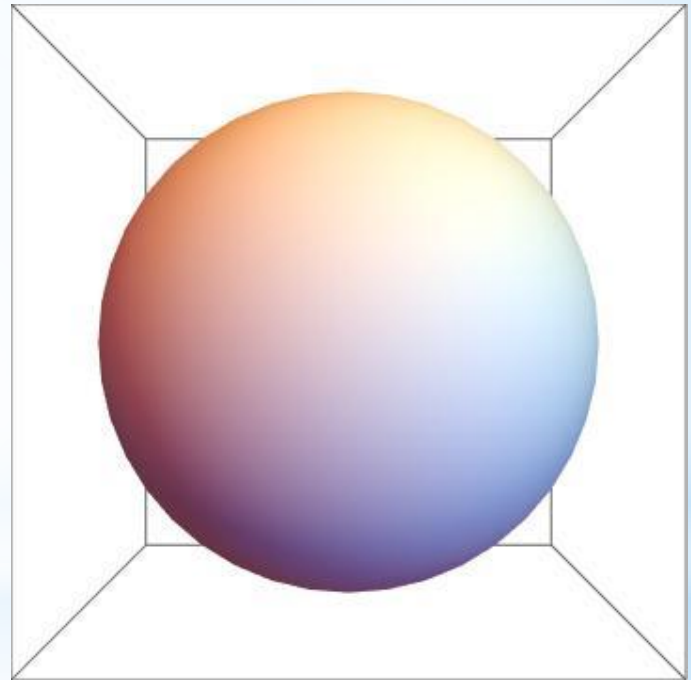


- Repetition
- Symmetry
- Geometry
- Higher Dimensions

Generative Art / Creative Coding

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

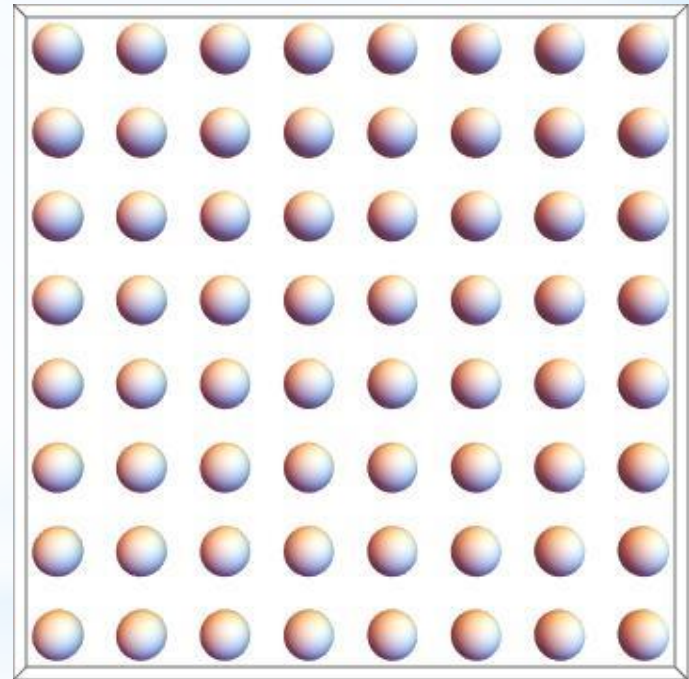
- Specify **objects**



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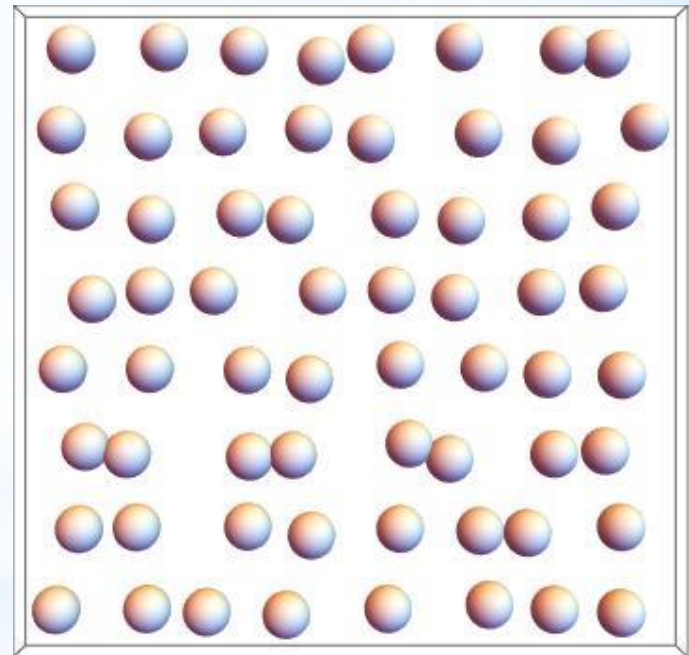
- Specify **objects**
- Give **rules** for placement



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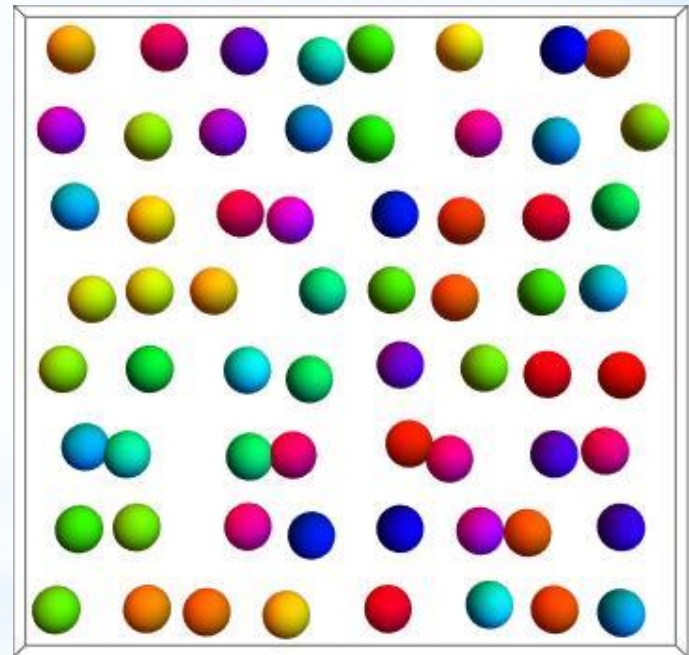
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- Give **rules** for placement
- Add **randomness**



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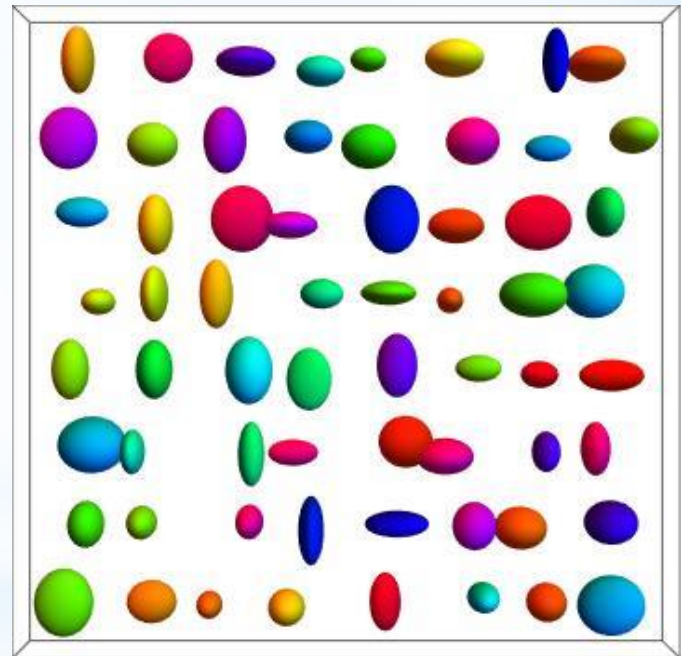
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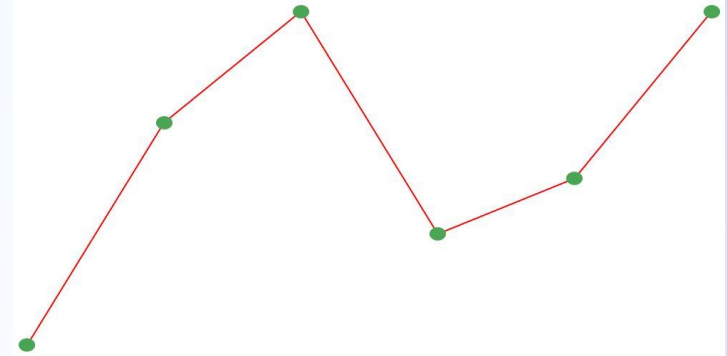
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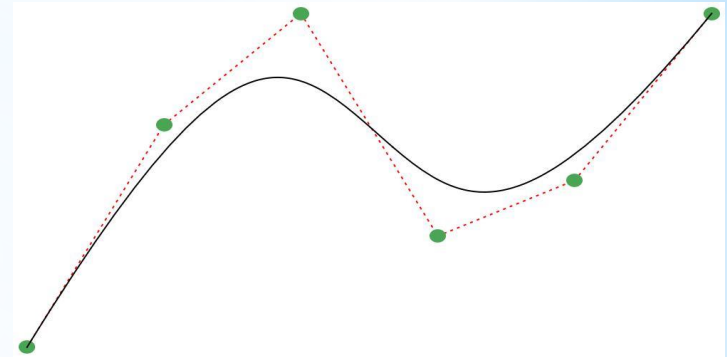
Random Splines

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



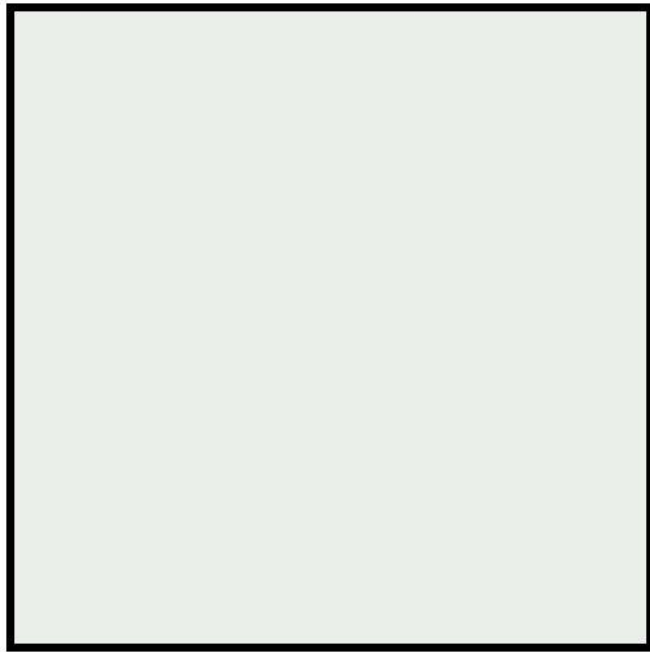
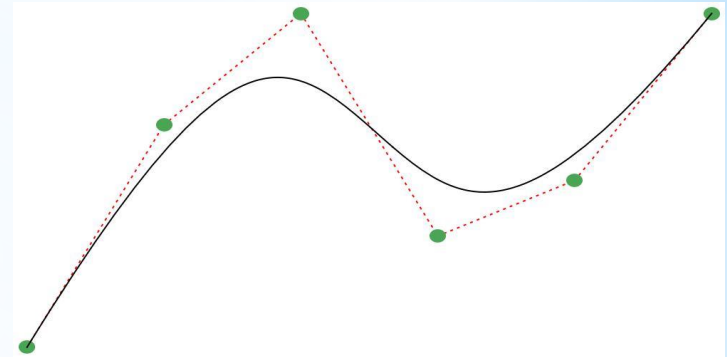
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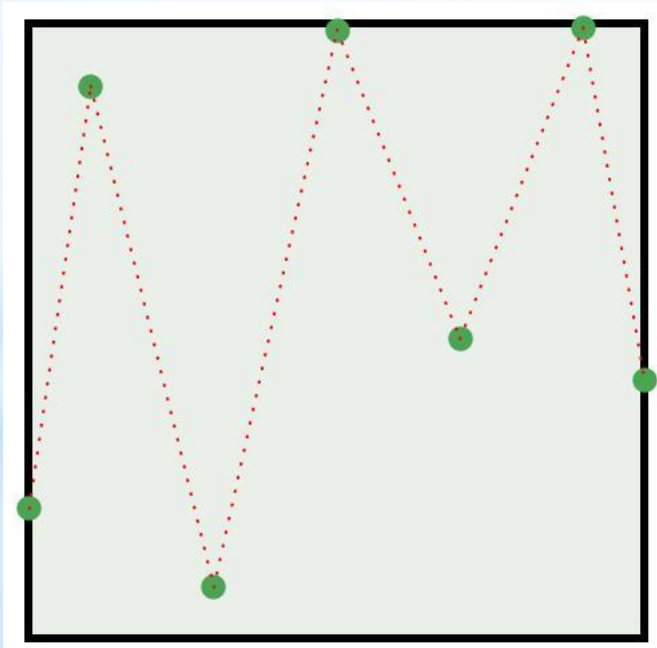
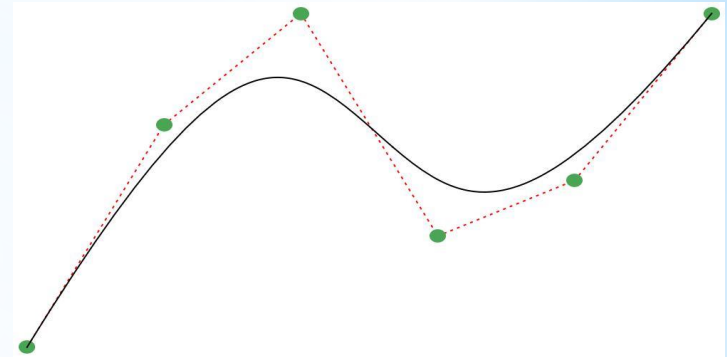
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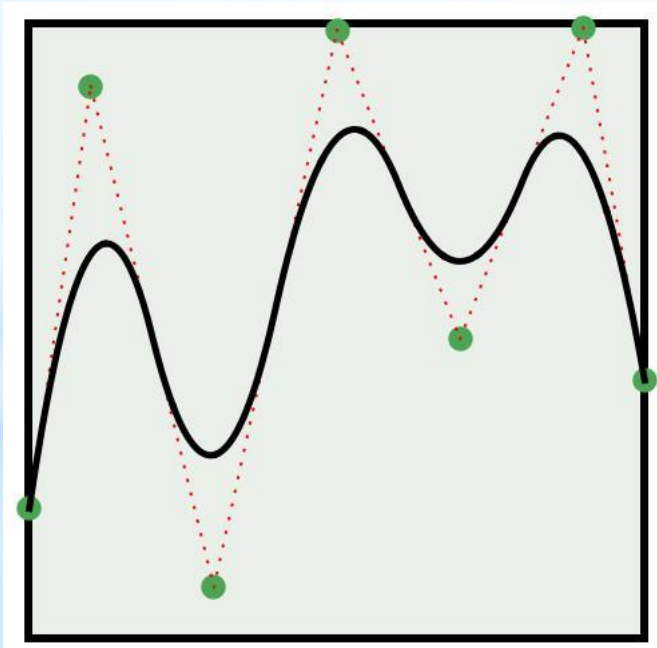
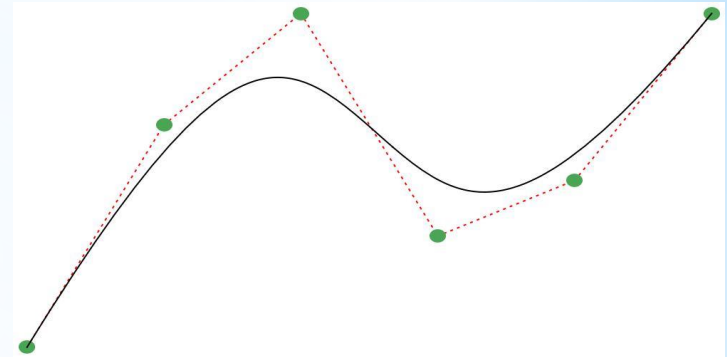
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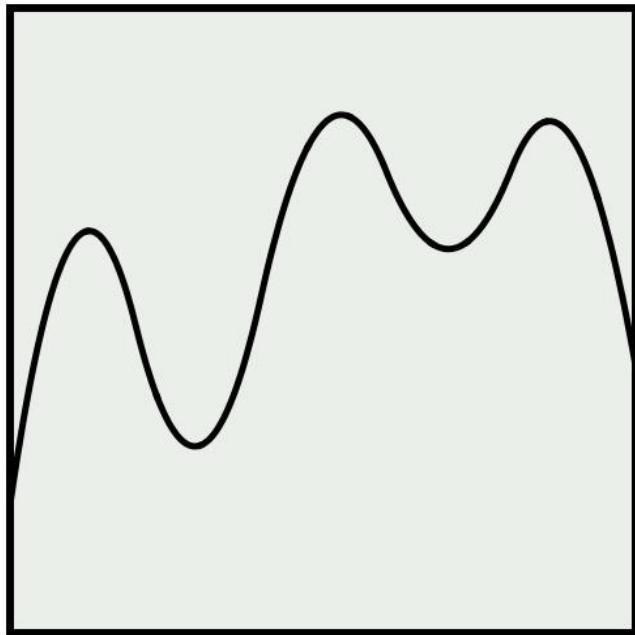
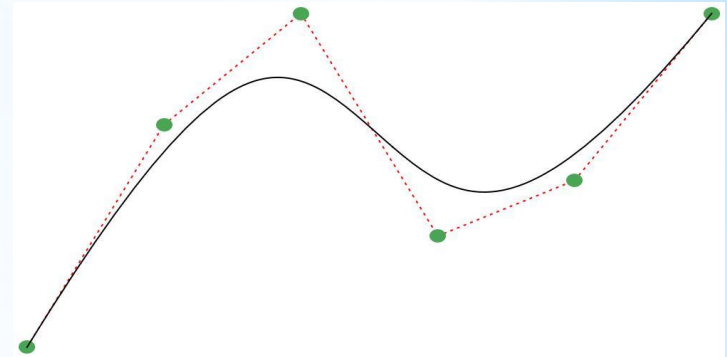
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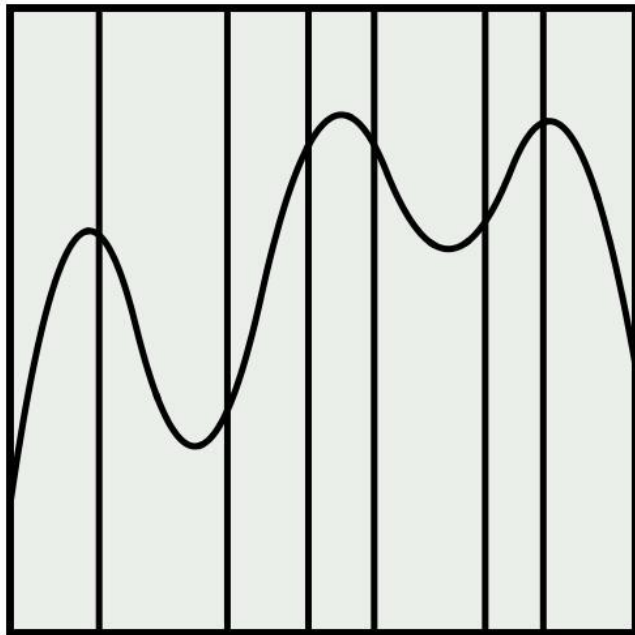
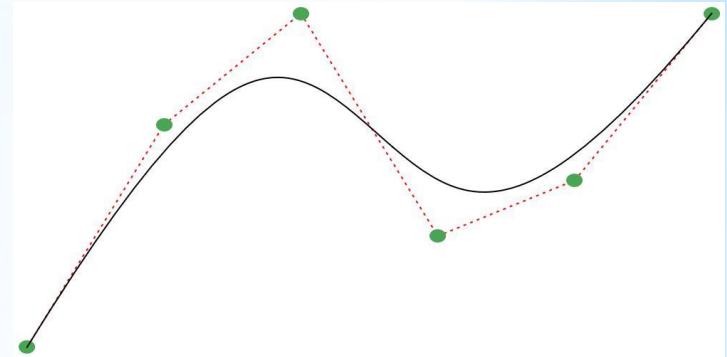
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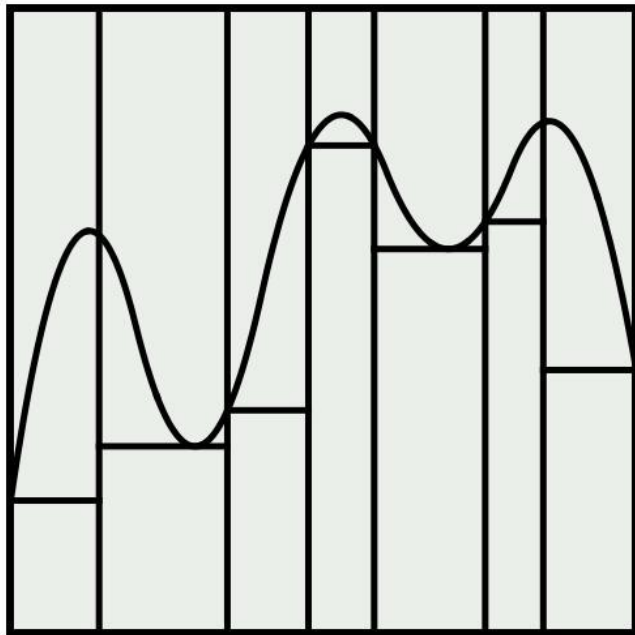
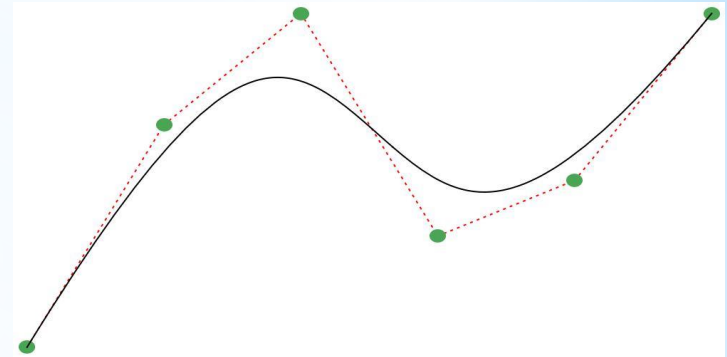
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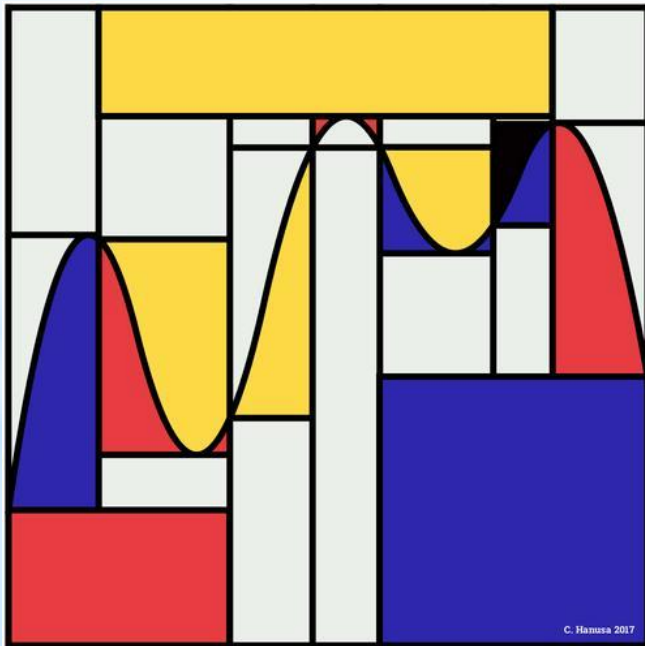
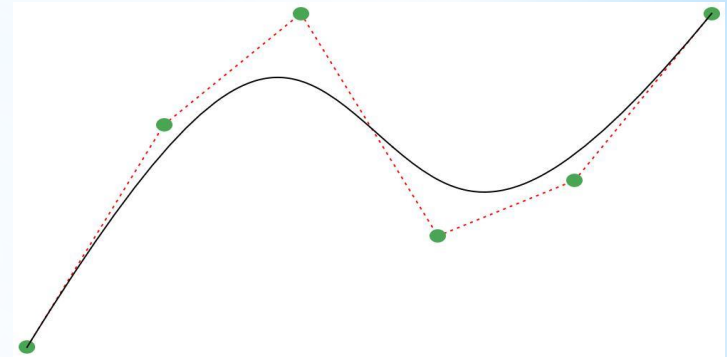
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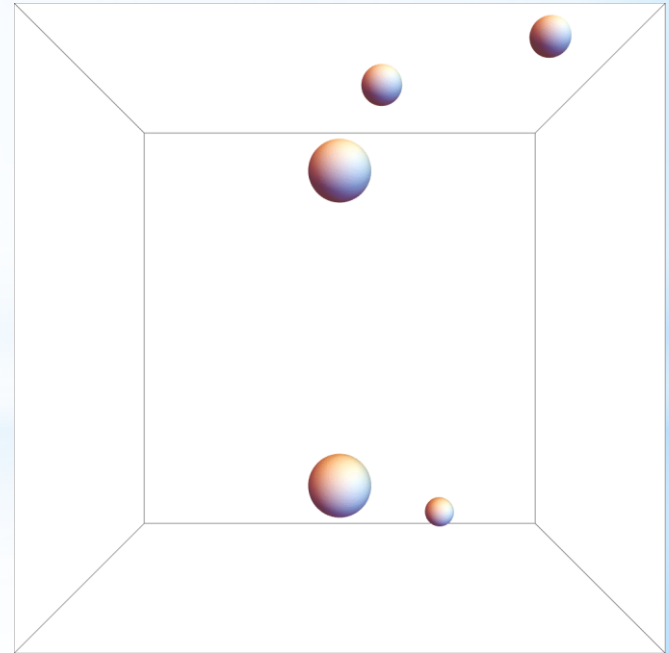
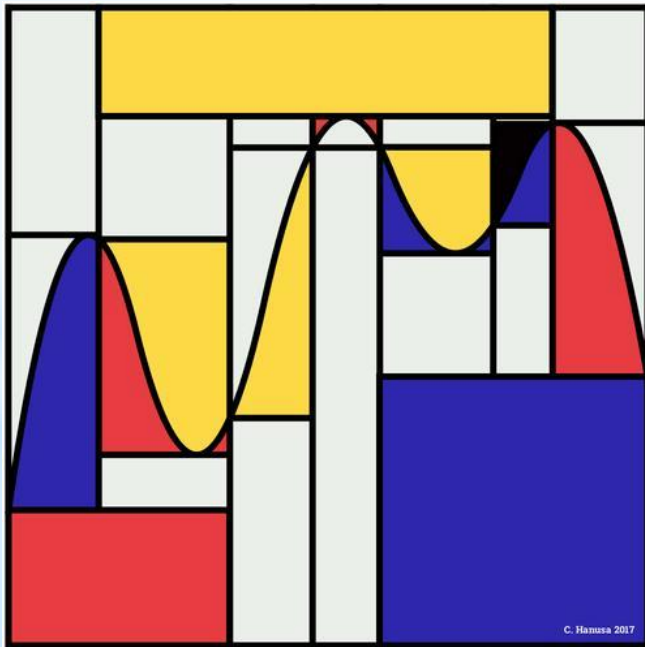
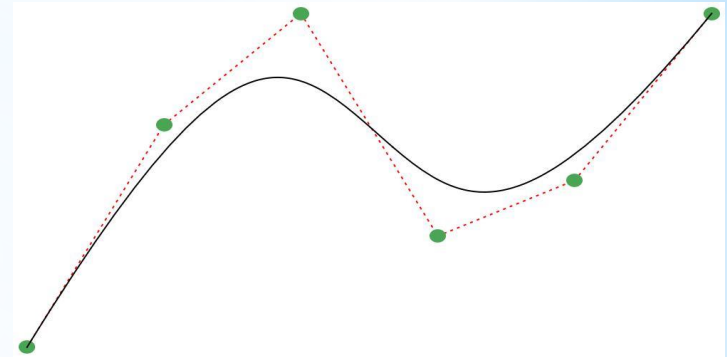
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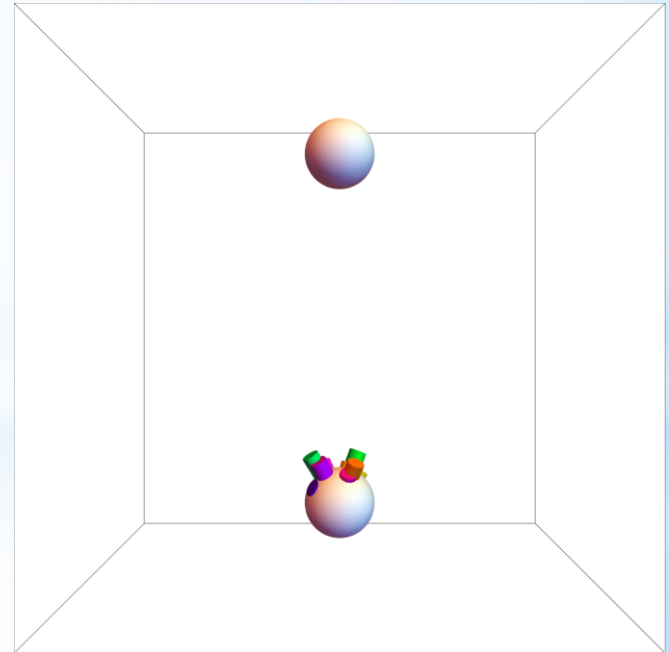
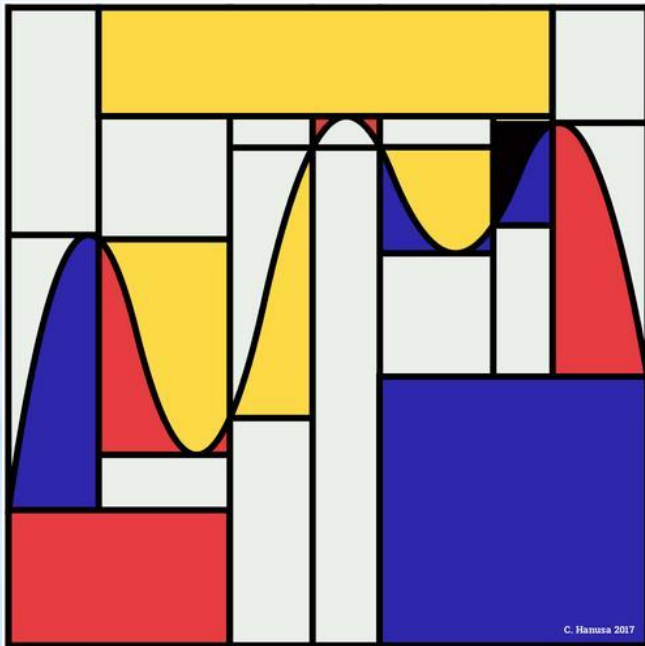
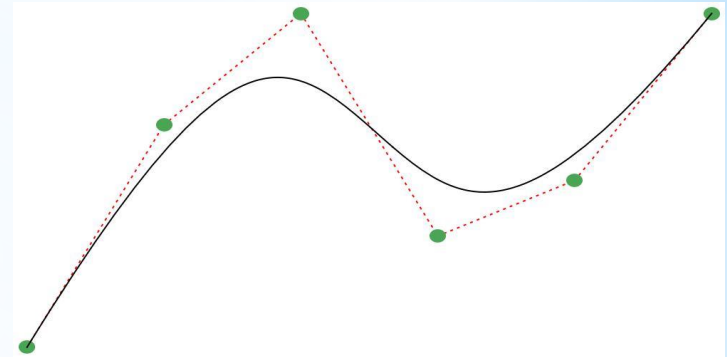
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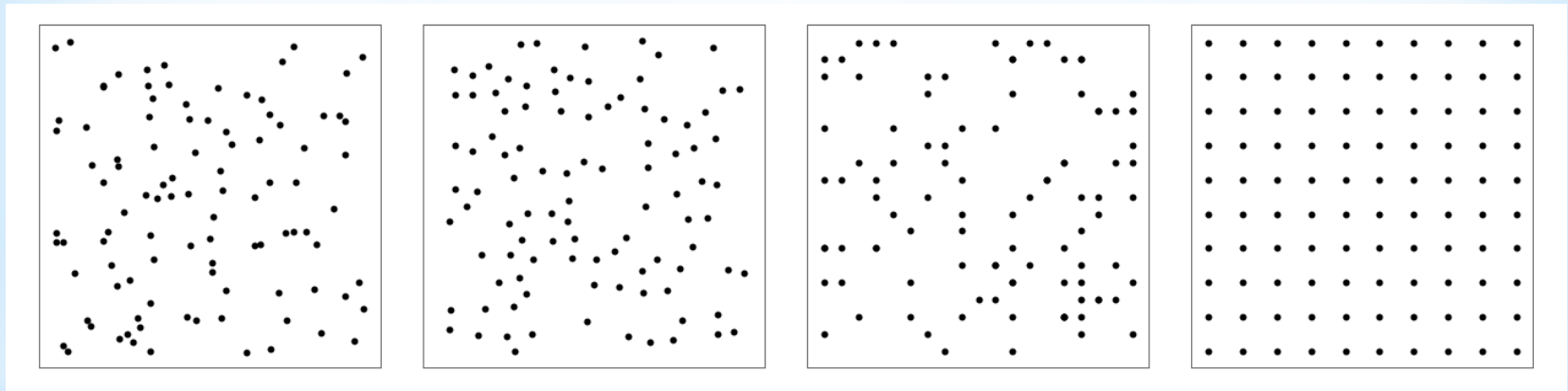
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Random Points

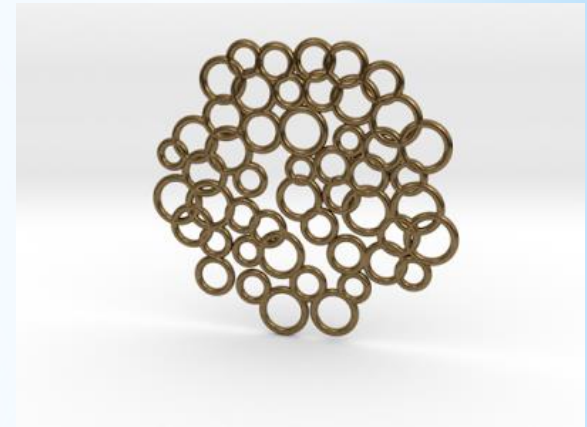
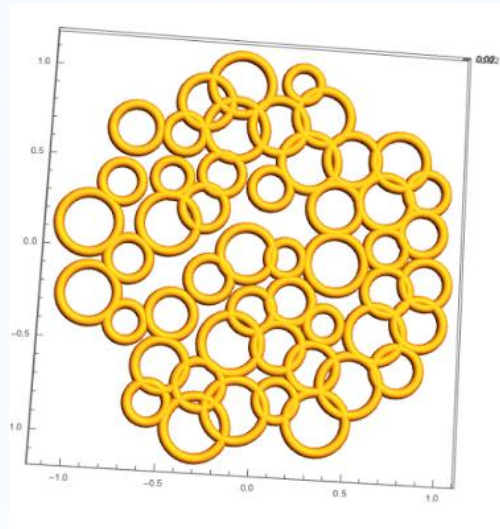
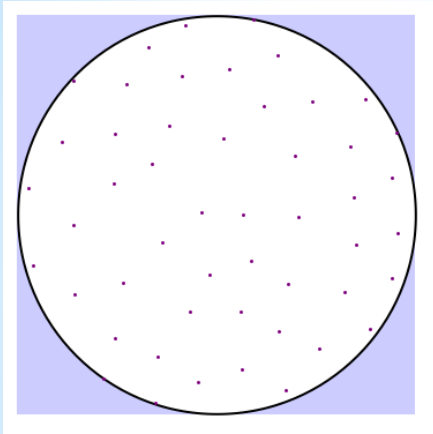
These points were generated using different randomization techniques.



Which is the most random?

Which is the most beautiful?

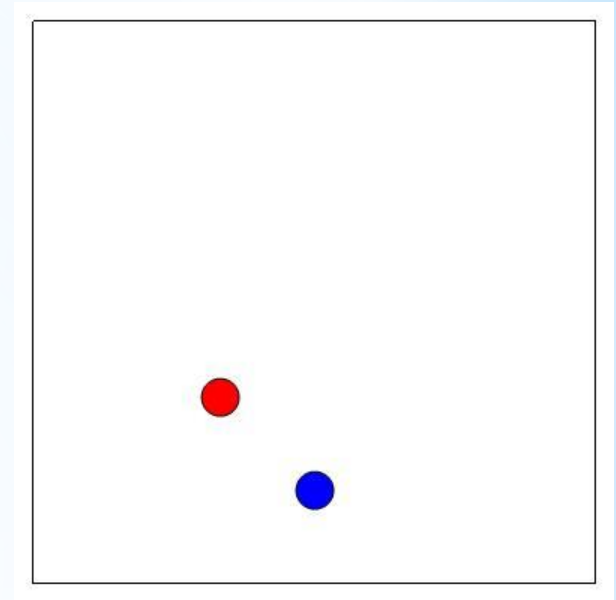
Random Jewelry



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

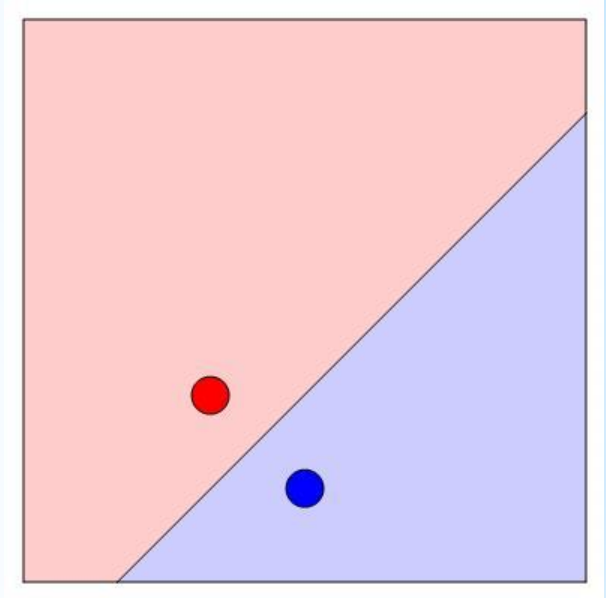
Voronoi Diagrams

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



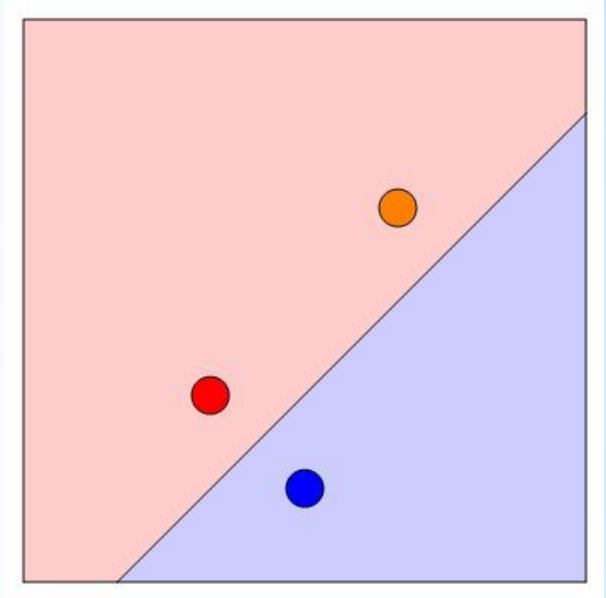
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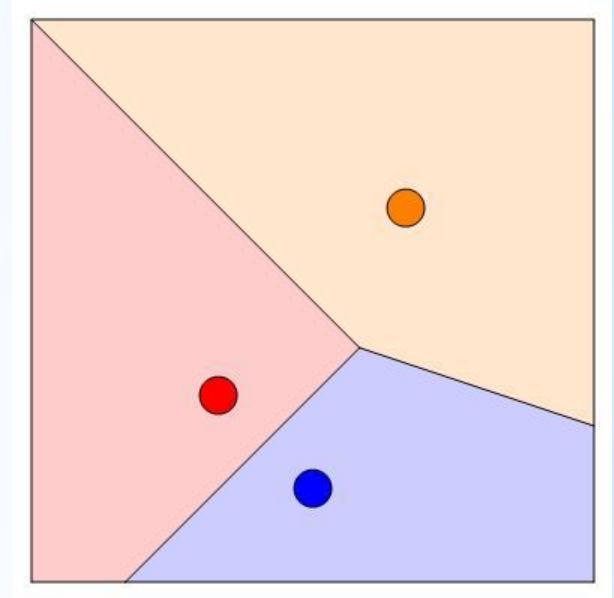
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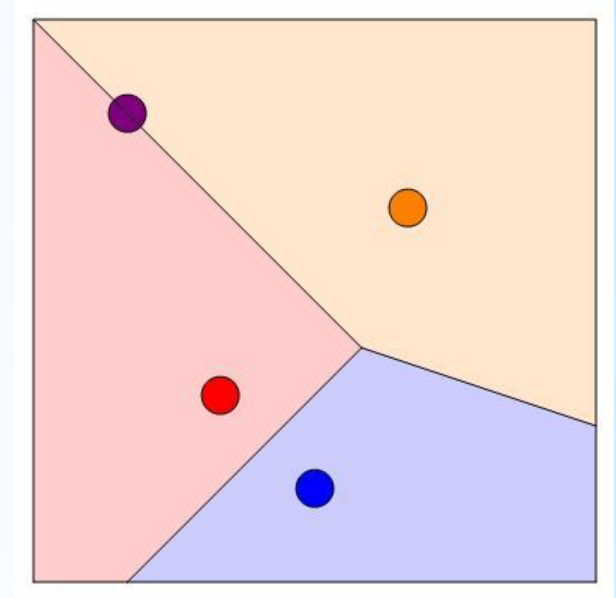
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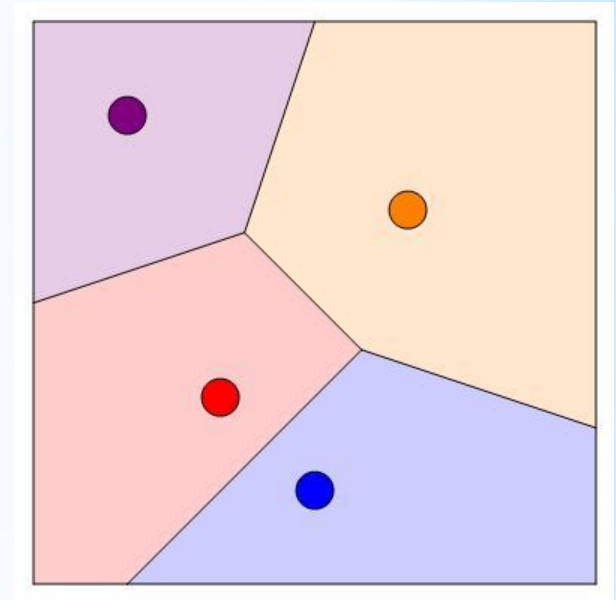
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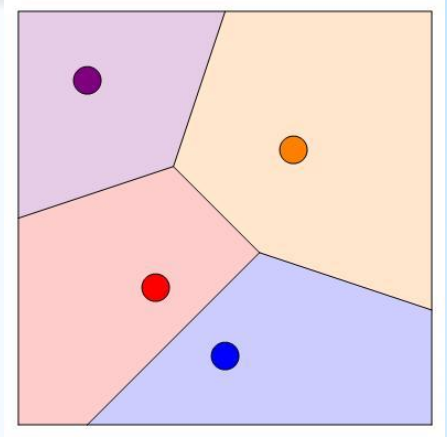
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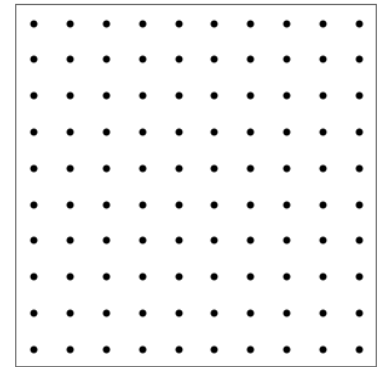
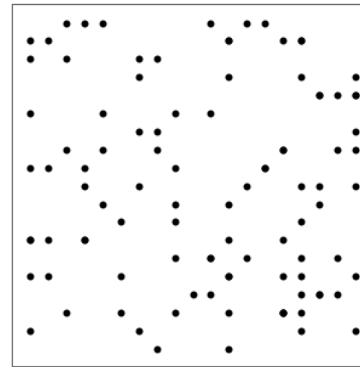
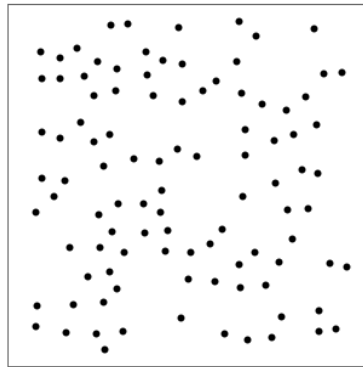
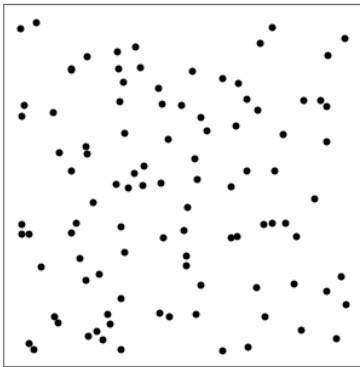


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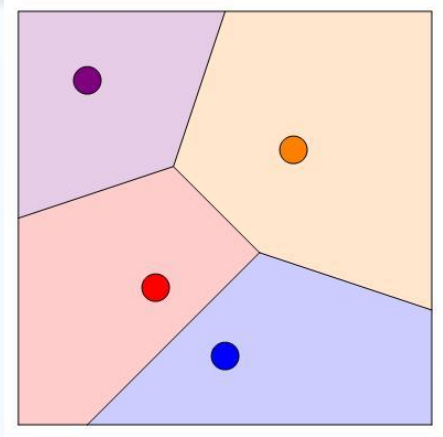


Beautiful things happen when the set of points is random.

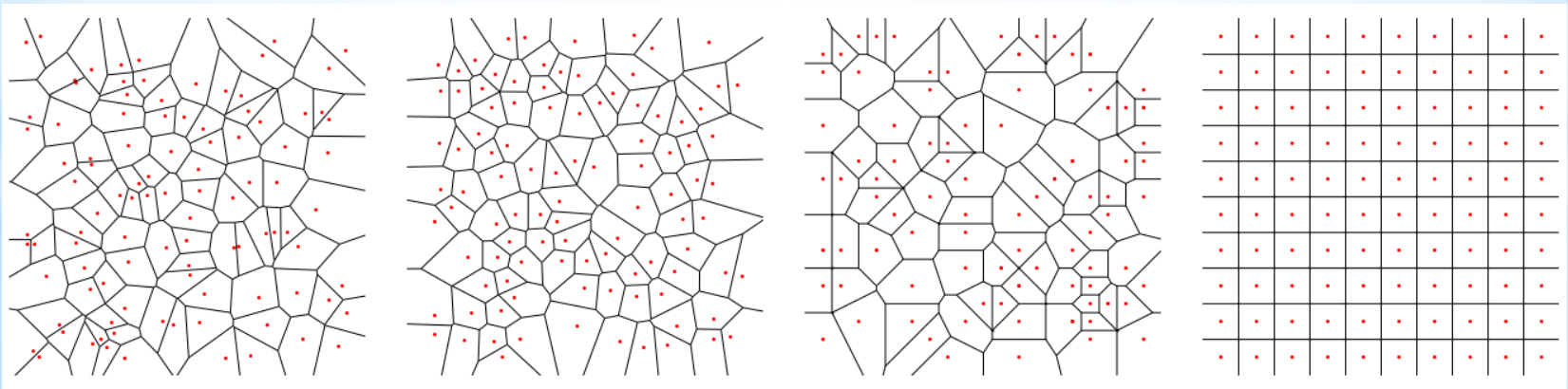


Voronoi Diagrams

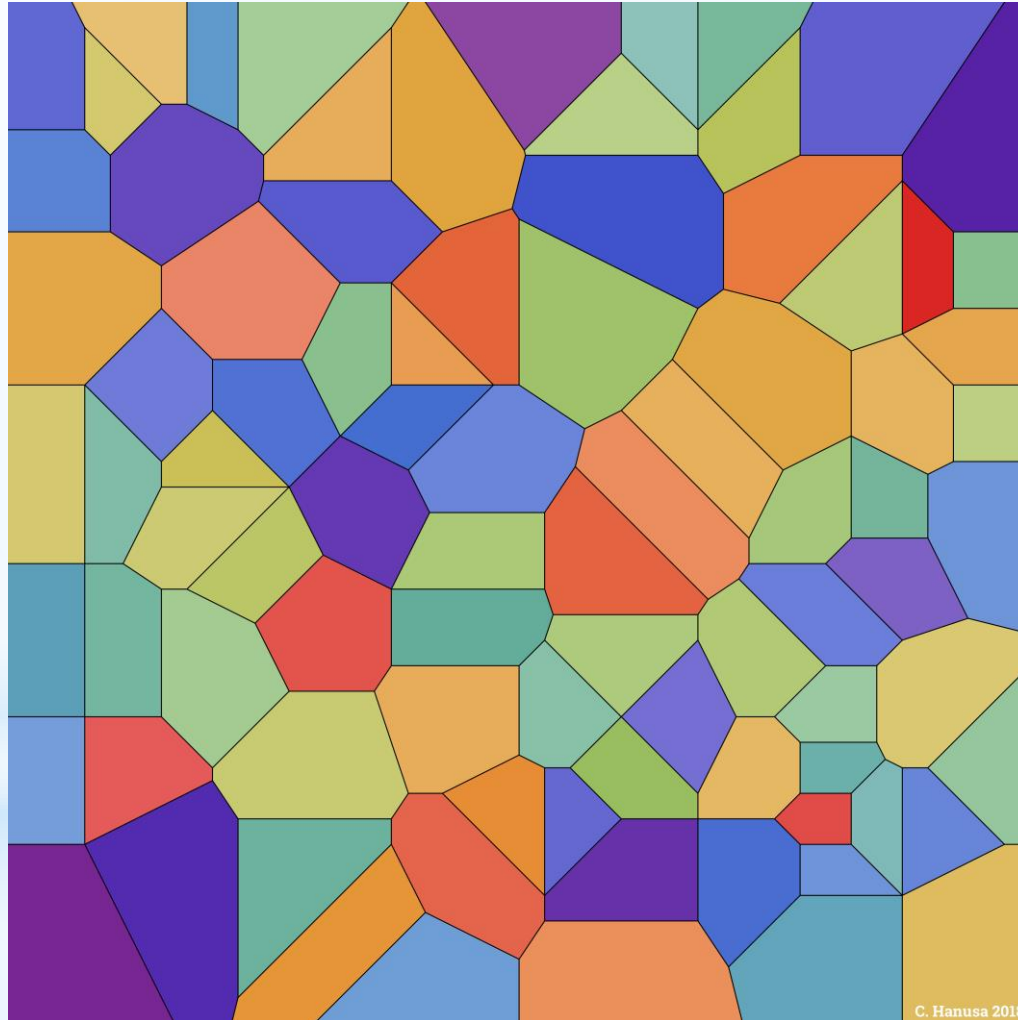
The **Voronoi Diagram** for a **set of points** is the **division of the region** into pieces based on **closeness**.



Beautiful things happen when the set of points is random.

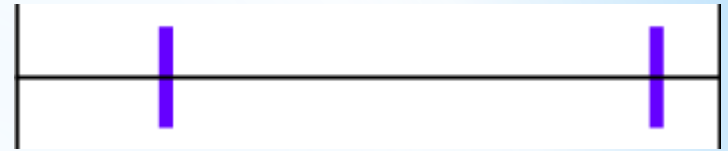


Voronoi Diagrams



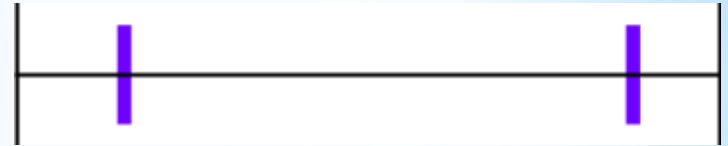
Random Growth

Create blips at random places



Random Growth

Create blips at random places



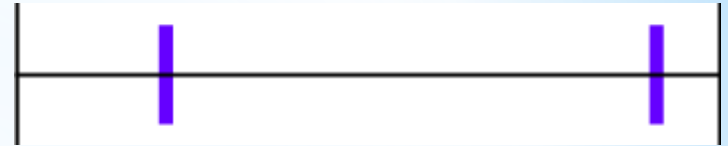
Random Growth

Create blips at random places



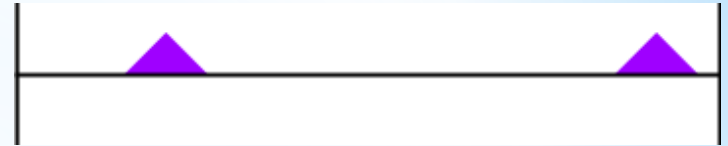
Random Growth

Create blips at random places



Random Growth

Create bumps at random places

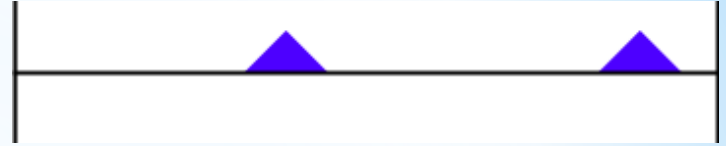


Random Growth

Create bumps at random places



Add bumps together

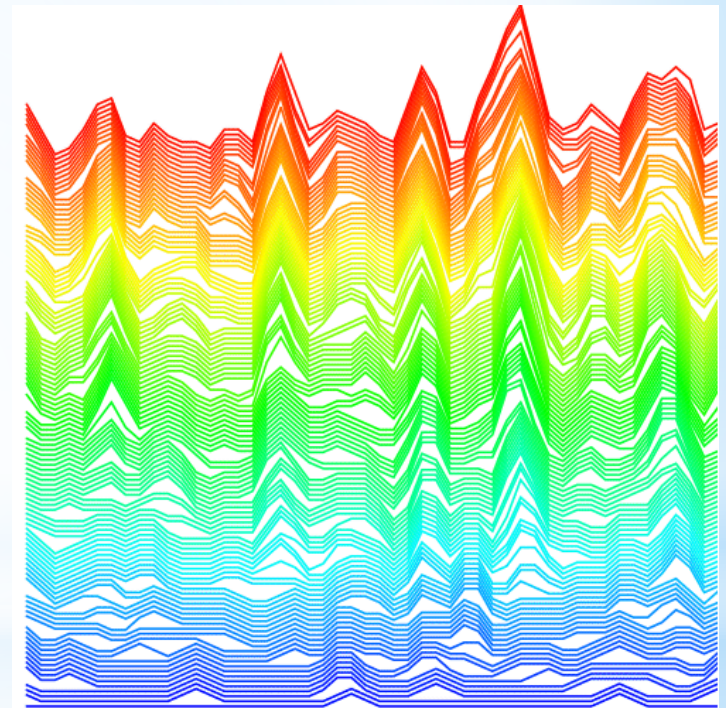
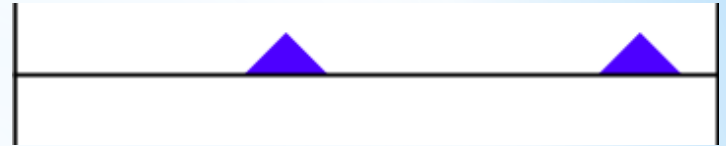


Random Growth

Create bumps at random places

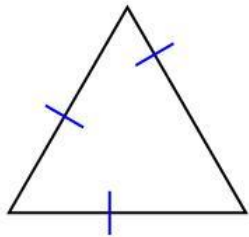
Add bumps together

Wrap around a cylinder



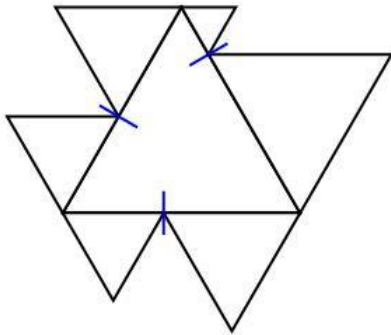
Random Partitioning

Choose random
partitions of a
triangle's boundary:



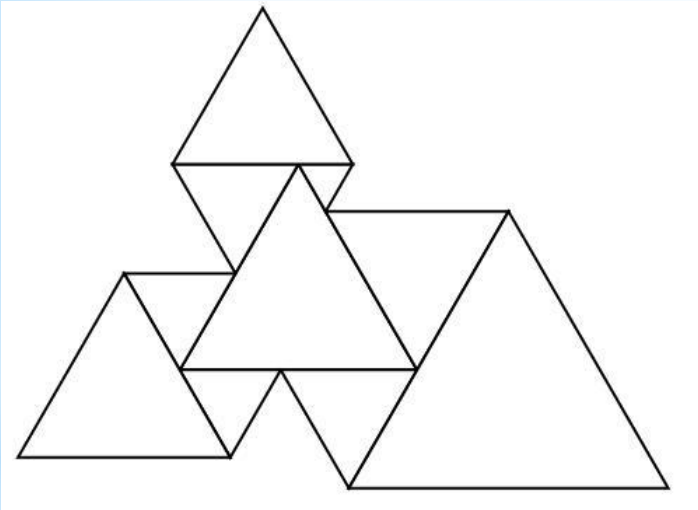
Random Partitioning

Choose random
partitions of a
triangle's boundary:



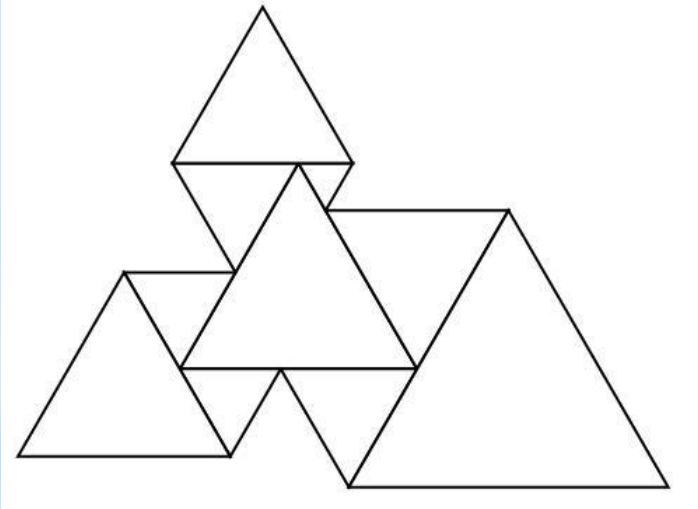
Random Partitioning

Choose random
partitions of a
triangle's boundary:

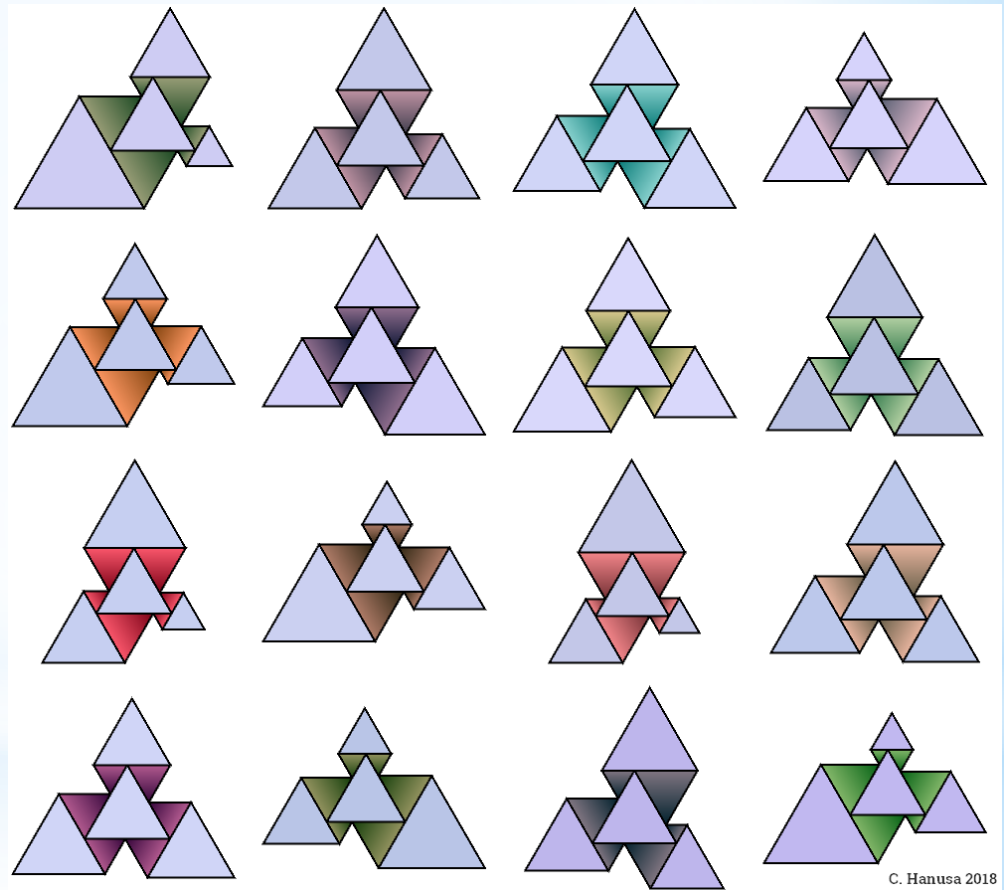


Random Partitioning

Choose random
partitions of a
triangle's boundary:

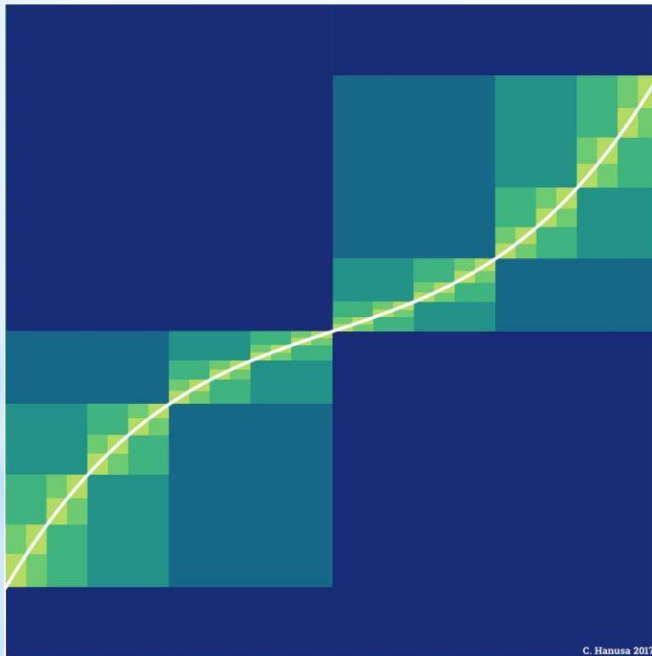


Do it many times:



Thanks! Questions? Real-time Art!?

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Real-time Art

Art that's never
been seen before