Creating Patterns with Distance Functions & Voronoi Diagrams

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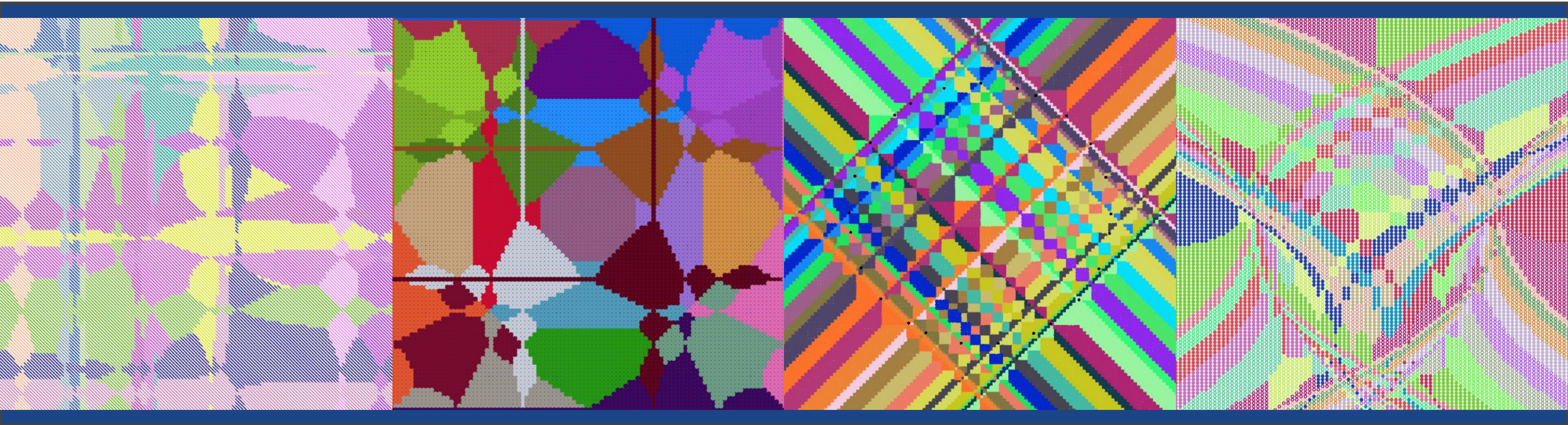
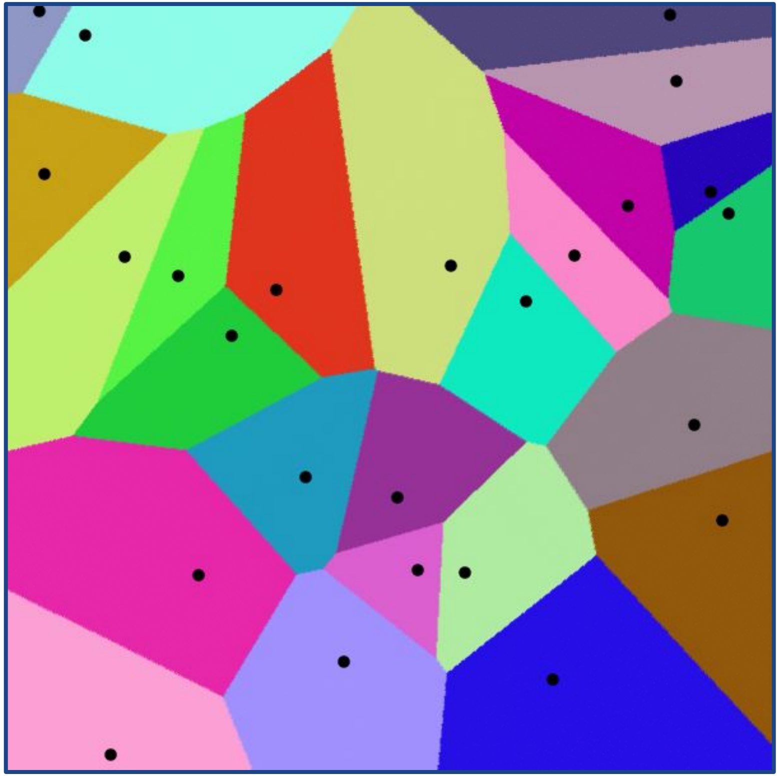


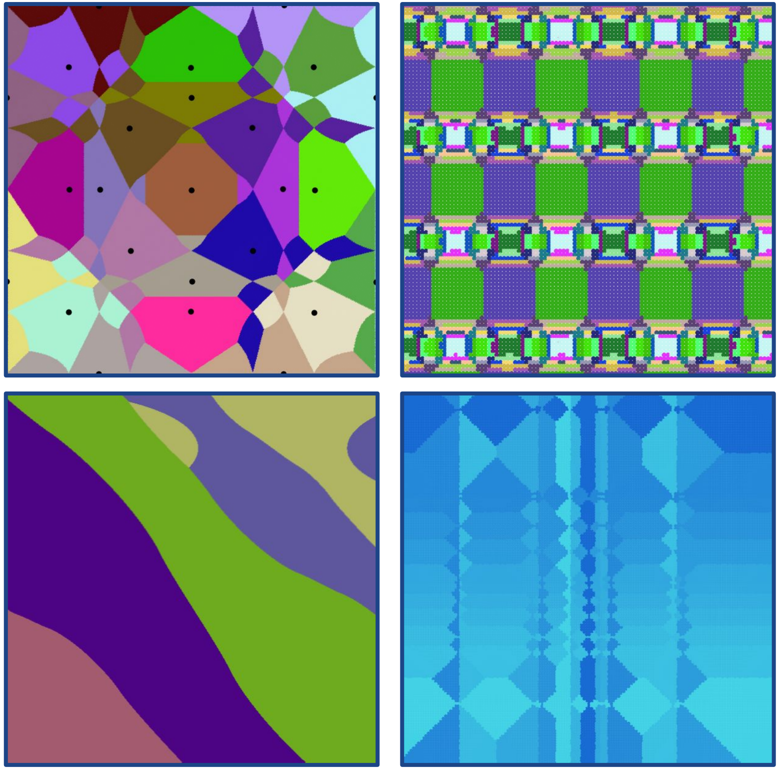


Example of a Voronoi Diagram

Voronoi Diagrams

- Select seed points
- Create regions based on which seed point is closest
- Euclidean distance is commonly used to measure closeness

Question: What if we use a different distance function?



Diagrams Using Novel Distance Functions

Motivations for Non-Classical Diagrams

- Unconventional tilings and artistic designs
- Repeated patterns with cultural analogs (e.g. textile patterns)
- Cell boundaries that emphasize irregular shapes (e.g. curves that resemble fluids)

Our Distance Functions & Results

- We created a drawing algorithm on the AlgoArt Platform for generating Voronoi Diagrams
- Generated over 500+ Voronoi diagrams using 15 unique distance functions

* Note that our distance functions don’t all follow the typical metric rules

Euclihattan

$$\left| |x_2 - x_1| + |y_2 - y_1| + \sqrt{(x_2 - x_1)^2 + (y_2 - y_2)^2} \right|$$

PolarEuclidean

$$\sqrt{\left(cos(x_2) - cos(x_1)\right)^2 + \left(sin(y_2) - sin(y_1)\right)^2}$$

PolarManhattan

$$|cos(x_2) - cos(x_1)| + |sin(y_2) - sin(y_1)|$$

PolarHyperbolic

$$arcosh\left(1 + 2\frac{\left(cos(x_2)-cos(x_1)\right)^2 + \left(sin(y_2)-sin(y_1)\right)^2}{(1-(cos(x_1)^2+sin(y_1)^2))(1-(cos(x_2)^2+sin(y_2)^2))}\right)$$

Wave

$$\left| \sqrt{|x_2 - x_1|} \cdot \frac{x_1 - x_2}{w/2} - \sqrt{|y_2 - y_1|} \cdot \frac{y_1 - y_2}{h/2} \right|$$

PolarWave

$$\left| \sqrt{|cos(x_2) - cos(x_1)|} \cdot \frac{cos(x_1)-cos(x_2)}{w/2} - \sqrt{|sin(y_2) - sin(y_1)|} \cdot \frac{sin(y_1)-sin(y_2)}{h/2} \right|$$

MinDiff

$$min\left(|x_2 - x_1|, |y_2 - y_1|\right)$$

AbsDiff

$$\left| |x_2 - x_1| - |y_2 - y_1| \right|$$

DiffProd

$$|x_2 - x_1| \cdot |y_2 - y_1|$$

Chaos

$$\left| \sqrt{|x_2 - x_1|} \cdot (x_1 + x_2)/2w - \sqrt{|y_2 - y_1|} \cdot (y_1 + y_2)/2h \right|$$

Odd

$$|y_2 - y_1| + 2w/75 * \sqrt{|x_2 - x_1|}$$

Chaos2

$$\left| |y_2 - y_1| - 2w/75 * \sqrt{|x_2 - x_1|} \right|$$