Using Computational Mathematics, Fractal Geometry, Chaos Theory, Nero Networks, and Quantum Computing to Peer into the World of Artificial Intelligence

BMC Advanced Spring 2024

"We have search engines, still perfecting knowledge engines, but ultimately wisdom engines are what humanity strives for."

— Bernt Wahl (2019)

In this class, we are going to exploit cutting edge technologies based largely on mathematical models, high speed processing, and large data sets to solve high level problems by integrating them together.

Much as we break the rules of traditional Euclidian Geometry with new ways of thinking about mathematics using Fractal Geometry and Chaos Theory, the integration of Nero Networks and Quantum Computing coupled with technological advances - especially in scale and operation velocity -that can utilize methods to increase the complexity of solving problems, breaking the bonds of conventionality.

You are all encouraged, as Steve Jobs said, to "Think Different."

Assignment 1: Watch the "Think Different" video and name the folks you might recognize. Then choose one and explain how they thought differently and what contributions they made in two sentences. You can also choose someone else who thought differently.

Now take solution methods and combine them, they become the collective human knowledge too complex for one individual to process, this is referred to as a collective intelligence. This is where machines become indispensable in putting fragmented knowledge together to create understanding beyond the capacity of the human brain. A collection of thoughts and ideas.

Here we look at various technologies that help us look at ways to solve problems with the aid of computational devices.

Computational Software

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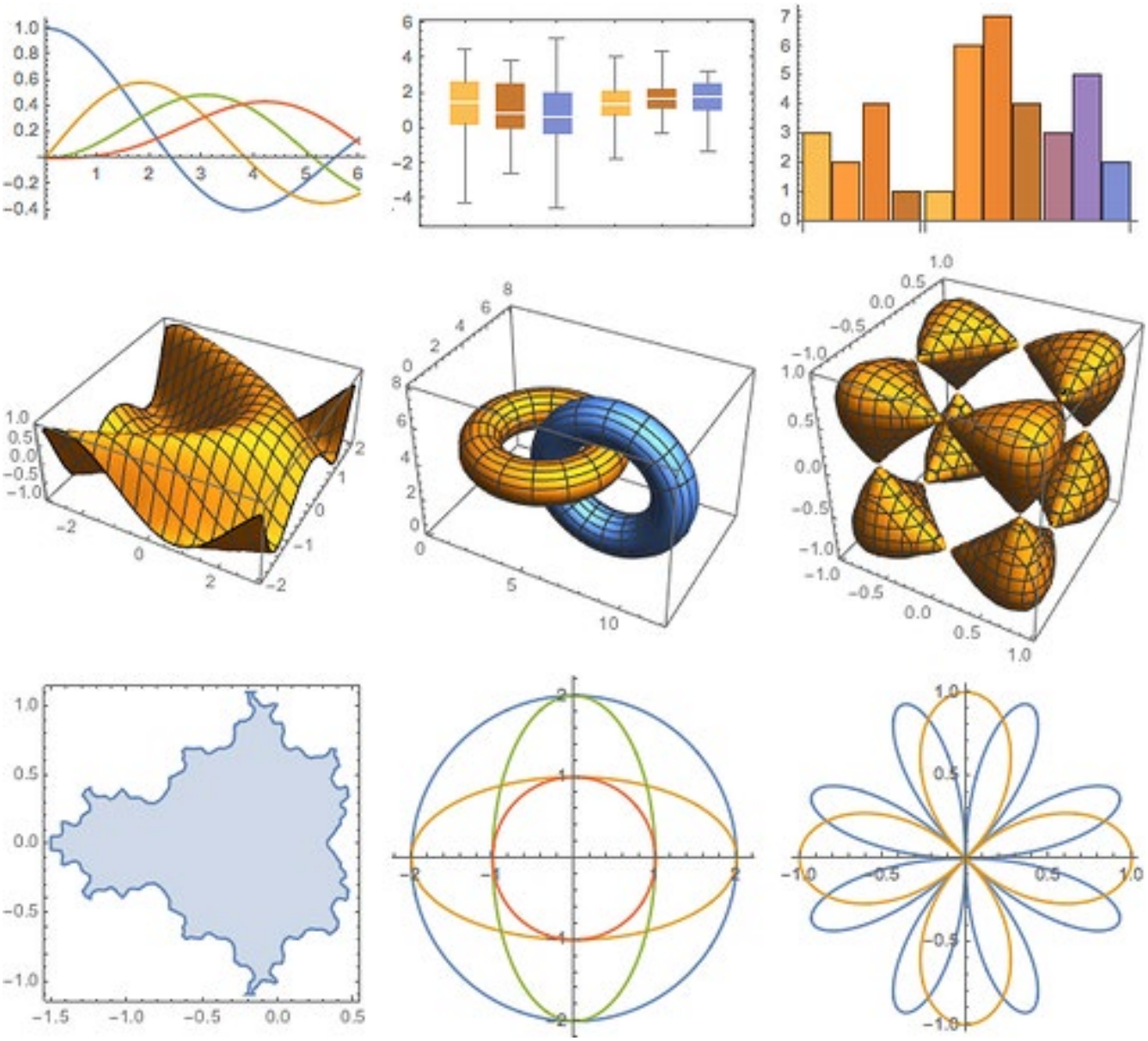
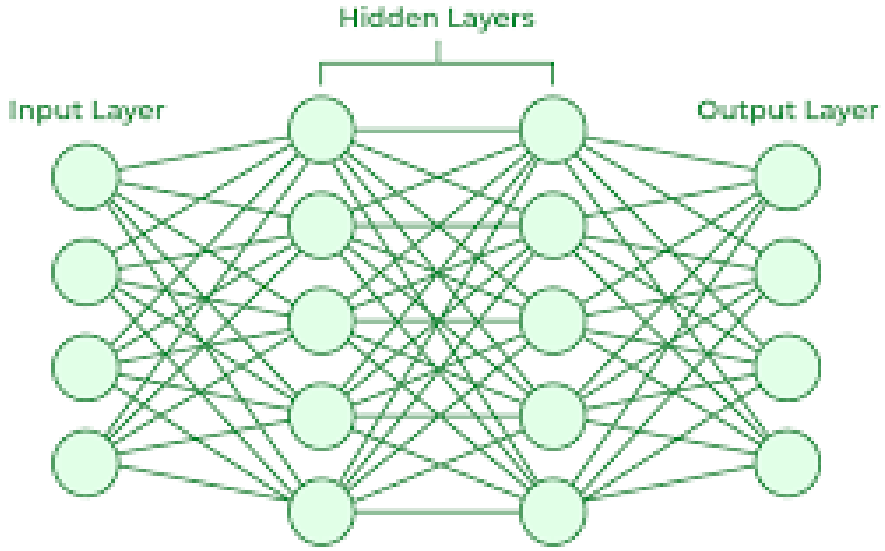
Mathematica rendering:

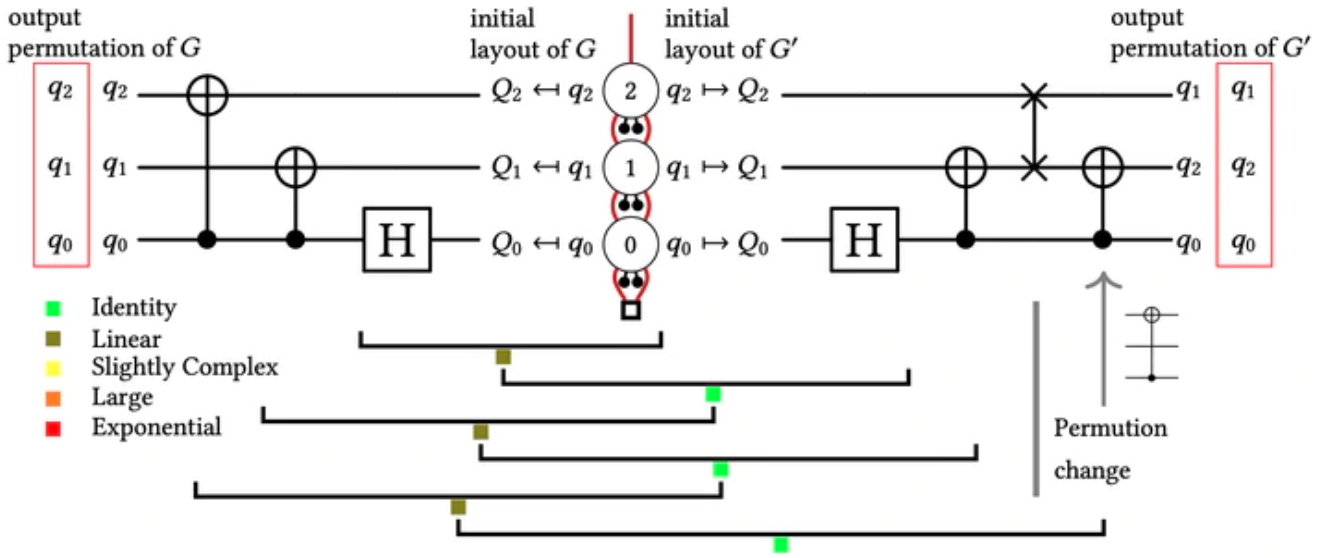


Neural Networks



Artificial neural networks are a branch of machine learning models that are built using principles of neuronal organization discovered by connectionism in the neural networks constituting how human brains process information.

Quantum Computing: is a multidisciplinary field comprising aspects of computer science, that utilizes quantum mechanics to solve complex problems faster than on classical computers.



Combining various methods of soliton render mimics thinking process, in artificial thinking referred to as Artificial Intelligence

Artificial Intelligence:

Using abstract understanding to seek potential solutions. Information compression, companies like Nvidia are using image/data compression to mimic real objects characteristics, much as Adobe used Postscript developed to render text and picture files many decades prior.

Find 5 art pieces or objects that exhibit fractal structures. Be willing to share them with the class on Wednesday. Here are some examples.

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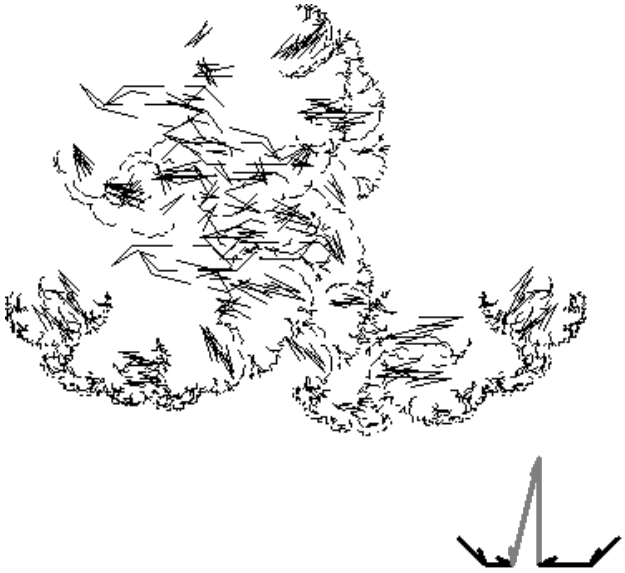
Clouds



1, Peter van Roy, "Tempete", digital media, (1989),
white with black paint screen print 24" x 24" (2021)

Cloud structured in art below:

Figure 1

Philip James De Loutherbourg, *An Avalanche in the Alps,* 1803

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Branch

2, Peter van Roy, " Branch 1 (Minimalist tree)", digital media with proportional line width, (1989), white with black paint screen print 24” x 24” (2021)

Branch structured in art below:

Figure 2

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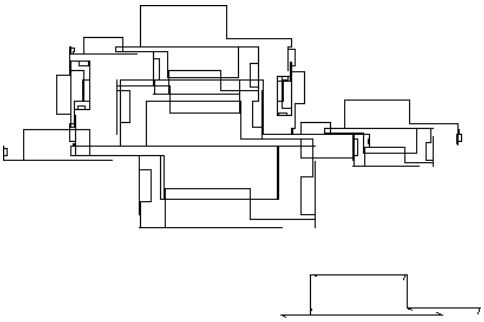
Branch and city #j8 is a piece of digital artwork by Leif Sohlman, 2020.

Figure 3

Branches at Sunrise Wall Sculpture Copper (Anonymous)
| Metal tree wall art, Tree wall art, Metal wall sculpture (2020)

"Architecture"



4, Peter van Roy, " Drunken Architecture ", digital media, (1991),
white with black paint screen print 24” x 24” (2021)

Habitat 67, Montreal, Canada Habitat 67 in Canada is a complex which resembles a very interesting arrangement of cubes that kids play with. It is pretty interesting how it was designed – it looks so original, and the same time is a building completely stable and comfortable for living! The architect Moshe Safdie created it as a main attraction for Expo 67, when it was officially exposed!

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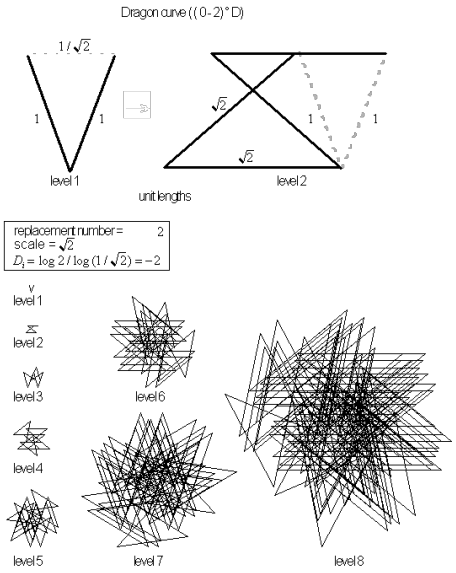
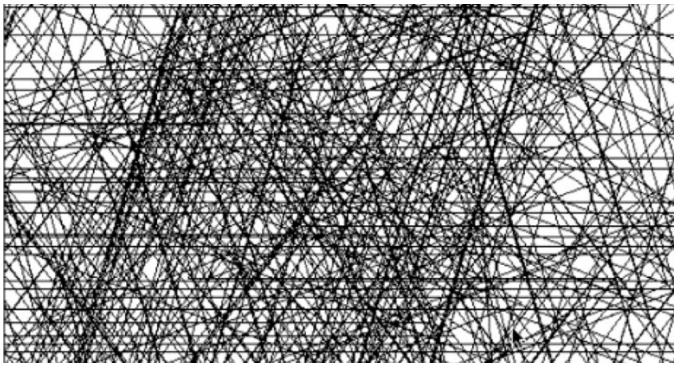
The JAIST Gallery Design is Inspired by Cryptic Puzzles

Created by Tatsu Matsuda Architects, the layout features a combination of cubic displays and interlocking boxes that can be arranged and rearranged in numerous different ways. The architects had to use a computer algorithm to figure out how to incorporate 144 Penta Cubes into the room, creating a construction that can be separated into 12 segments. The gallery visitors, there to see the impressive puzzles on display, will be surprised to find themselves within one, meshing their environment with the artwork.
https://www.trendhunter.com/trends/gallery-design





4, Peter van Roy, " Drunken Architecture ", digital media, (1991), white with black paint screen print 24" x 24" (2021)

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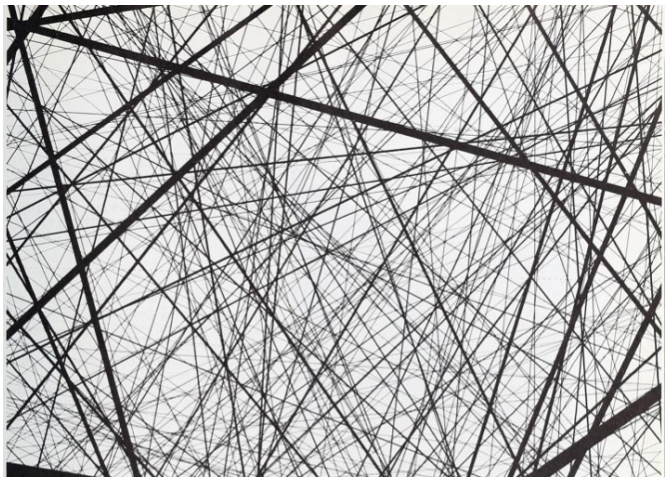
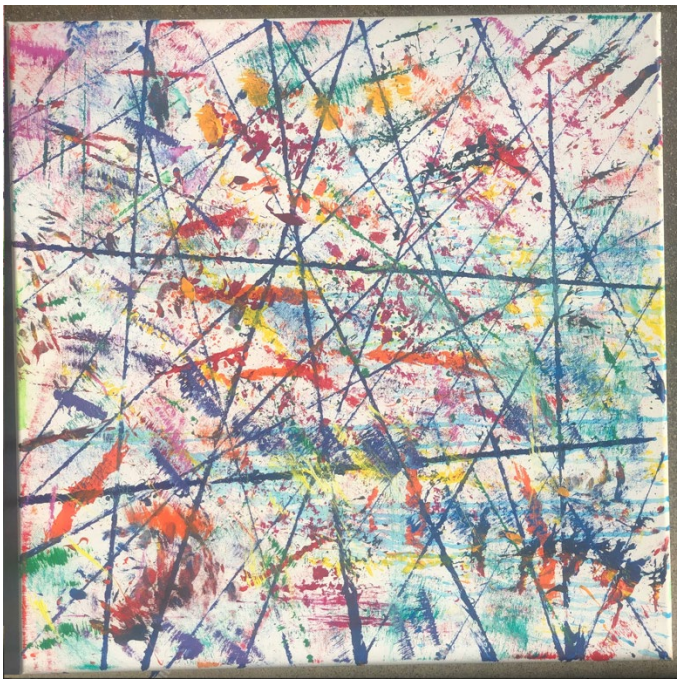


Plate 285 RANDOM PATTERS OF STREETS

4, Benoit Mandelbrot " RANDOM PATTERS OF STREETS ", Printed media, (1982),



4, Bernt Wahl, "Stained glass “Paints 24” x 24” (2021)

- **Ruth Asawa**
  at Rena Bransten Gallery, San Francisco, California
  Recommendation by Dewitt Cheng
- *Ruth Asawa, 'Untitled (S.514),' c. 1950s, copper wire, 13-1/2 x 16x16'*

- Artists currently investigating the gap between nature and culture with a certain ironic shrug might take a careful look at the long career of San Francisco artist **Ruth Asawa**, which synthesizes her feeling for nature with Modernist ideas about abstraction and truth to materials. A small selection of her work since the 1950s provides a good introduction to the drawings, paintings, and the crocheted- or tied-wire sculptures for which she is best known. The crocheted-wire pieces, hanging in strands from the ceiling, suggest onions, plant bulbs, droplets, bubbles and fruits (the visible seeds and swelling shells suggesting botanical mother and child), while their open-weave construction invokes basketry and mathematical models. The tied-wire sculptures are flat, symmetrical dendritic wall-hanging pieces suggesting hexagonal sprays of foliage, root balls, fireworks, electrical discharges (as in Van de Graaf generators), stars and mandalas. The drawings "Pine Tree," "Redwood Trees," "Owl," "Waves," "Watermelon," "Chrysanthemum" and "Imogen Cunningham" depict California's natural landscape (including one of its eminent photographers) through a synthesis of traditional Eastern stylization and revolutionary Western abstraction.

Fractalism: mathematical and nature's art forms in a tangible medium

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Abstract

Fractal Geometry is an integral part of creating images in art that manifested natural forms. Fractalism -- derived from fractal methods –is found throughout art, it is often used to capture the realism of nature: mountains, trees, clouds, etc. However, it was not until the late Nineteenth-Century with the advent of revolutionary new painting techniques, that Fractalism evolved as a major art influence.

Currently, there are three major fractals inspired artforms: linear fractals that are precise self-similar replications at different scales, diffusion-limited aggregation (toxiclibs) fractals generated with consistent Harsdorf dimensions through a set of processes, and nonlinear fractals generally derived from polynomial equations.

With the advent of rendering software and massive computation power, a vast array of stunning images can now be created by algorithms in spectacular detail that in the past were too computationally intensive to render. This has propelled a new class of artists/creators that can now not only manually render physical fractal art forms on canvases and in sculpture form but are now able them to be rendered computationally with ever-increasing high-resolution monitors, printers, in virtual reality. Work is currently being conducted to visualize these patterns abstractly with conceptional thoughts and brain activity.

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Exploring Fractals

Read Chapter

Chapter 1 Fractals in our World

Computer simulations: Random Forest, Monti Caro Simulations:

Fuzzy Logic: Probability of Outcomes.

Learning methods French monk fruit yields.

Assignment 2: Forest Fire Game

See how percolated fractal structures help to control forest fires. With the forest fire game, you explore the spread of fires through two forests, each with different densities. The densities represent different fractal dimensions. By starting identical fires randomly in each forest graph, you compare the rate at which the fires spread.

A.

See how percolated fractal structures help to control forest fires. With the forest fire game, you explore the spread of fires through two forests, each with different densities. The densities represent different fractal dimensions. By starting identical fires randomly in each forest graph, you compare the rate at which the fires spread.

1. Get a 4-sheets of graph paper a 6-sided dice.
2. Create 4 "forest" boxes of 6 x 6 squares on each page.
3. Then populate the squares of 6 x 6 boxes with "X" using different patterns and densities. Make sure at least one is random, and one has a geometrical density.

4. Then roll the dice to see which of the 36-grid squares get hit—the first roll for the row (1-6) and the second for coulomb (1-6).
5. The lightning burns down any of the (X) trees in the grid-square and any square that touches the side box side of any (X) box tree. Then if any adjacent (X) tree is touching on the side, it burns down too. Continue the process until all touching (X) trees connected to the original grid-box burns down. Do this for every sheet, recording the process 5-times. Record how many spaces, how many trees and, how many trees burnt down.

Example:

Roll	1	2	3	4	5	6
1	X		X			X
2		X			X	
3	X	X			X	
4			X	X	X	
5	X					
6		X		X		X

B. Can you see any optimal patterns or densities emerging assuming with the ideal is to have as many unburnt trees as you can after a fire? These ratios correspond to Hausdorff dimension (a.k.a. fractal dimension). Show your outcomes and do a brief analysis of your results.

C. Can you a see how else this may relate to other topics (maybe virus transmission)? List a few.

Extra credit:
Describe the parameters you need to set up such a system and model its implementation.

Extra-extra credit: Do the same problem with a finer grid or write a computer program to simulate the process.

1. Get a 4-sheets of graph paper a 6-sided dice.
2. Create 4 "forest" boxes of 30 x 30 squares on each page.
3. Then populate the squares of 30 x 30 boxes with "X" using different patterns and densities. Make sure at least one is random, and one has a geometrical density.

4. Now lay a 6 x 6 grid of 5 x 5 boxes on top of each forest. This will designate the lightning strike area.
5. Then roll the dice to see which of the 36-grid squares get hit- the first roll for the row (1-6) and the second for coulomb (1-6).
6. The lightning burns down any of the (X) trees in the grid-square and any square that touches the side box side of any (X) box tree. Then if any adjacent (X) tree is touching on the side, it burns down too. Continue the process until all touching (X) trees connected to the original grid-box burn down. Do this on every grid, record the process 5-times. Then count how many spaces, how many trees and, how many burnt down.
7. If you want to get more granular, you can roll the dice again to divide the grid square by 5 x 5, using 1-5 values and disregarding 6.

Note: National Parks often let naturally occurring fires burn to help clear out the underbrush and prevent larger fires from occurring.

Chapter 2 Fractals Basic – Taking a Closer Look

Assignment 3: Chaos Game

1. Draw three dots on your page.
2. First chose a starting point.
3. Then randomly go halfway to one of the 3 dots and draw a point.
4. Then from that point, go randomly halfway to one of the three dots again.
5. Continue the same process until an image emerges.
6. What does it look like?

Extra credit: what is the name of the fractal that emerges?

Now create four different images using the Chaos Game .

Resources:

Video

Fractals- The Hidden Dimension

Fractals to Fashion

Software

Fractasketch Manual

Next week

Read Chapter 3 – Creating Classical Fractals

I will try to have a link to Fractasketch so you can download the program. Currently, it only runs on the Macintosh.

Also, I will try to have my TedX talk slides available too.

1. Draw three dots on your page.
2. Chose a starting point.
3. Then randomly go halfway to one of the 3 dots and draw a point.
4. The from that point go randomly halfway to one of the three dots again.
5. Continue the same process until an image emerges.
6. What does it look like?
7. Extra credit: what is the name of the fractal that emerges?

Extra Extra Credit:

1. If you write an excellent definition of the history/origin of one of the following Dragon Curves I will generate a NFT image for you if and when I generate them for your digital art collection. You may have to pay the “gas fee” if I receive too many requests.

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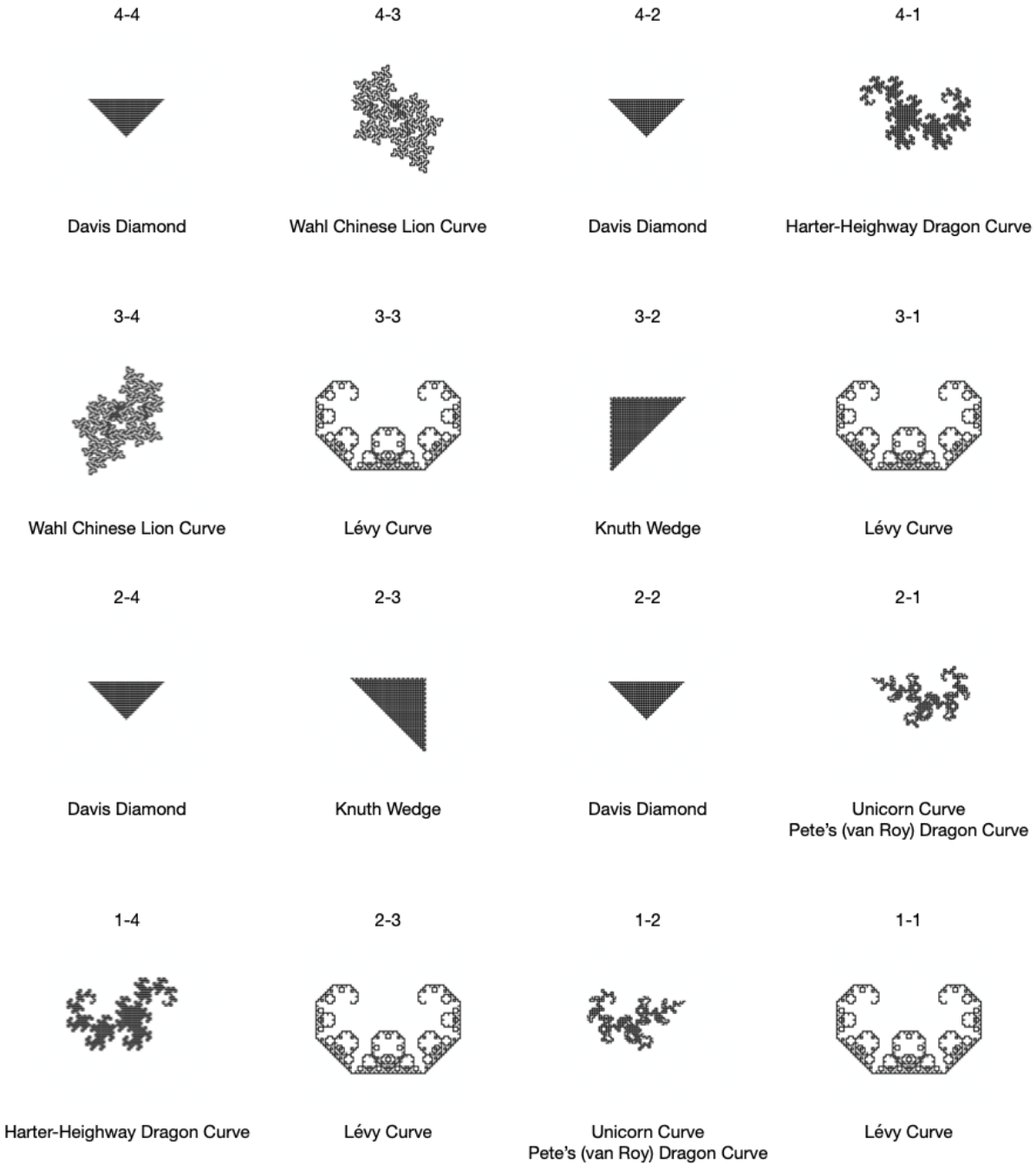
Dragon Curves



2. If you show the seed and iteration # number for “Luxo in Lines” I will generate a NFT image for you if and when I generate them for your digital art collection. You may have to pay the “gas fee” if I receive too many requests.

The first person might also get a limited-edition screen print if I make enough.