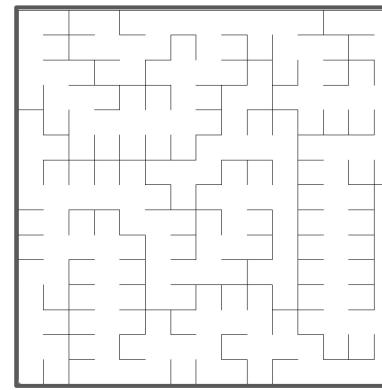
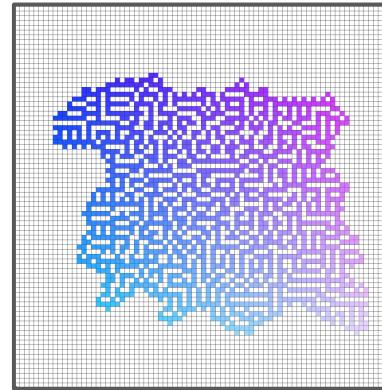
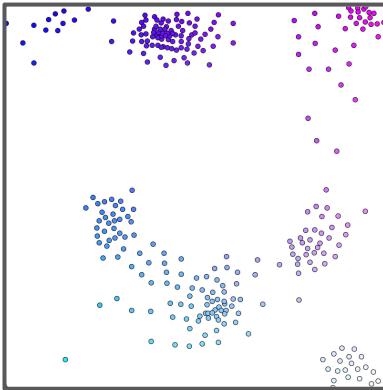
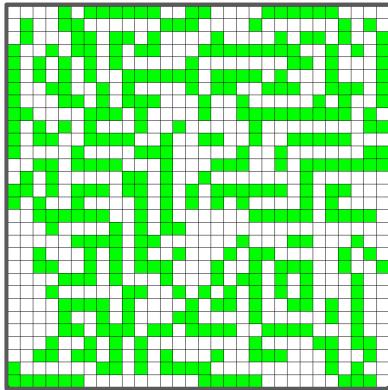
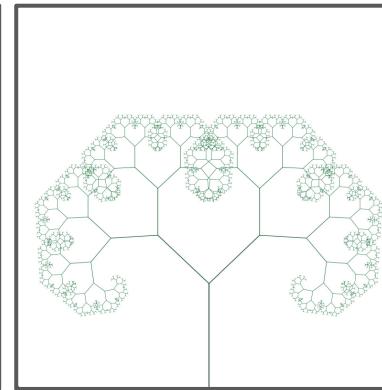
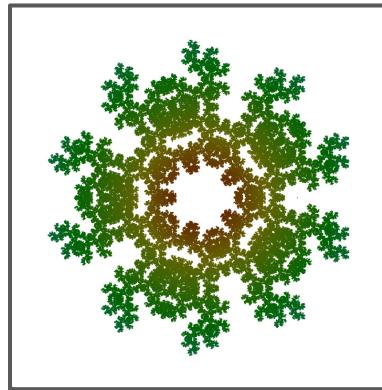
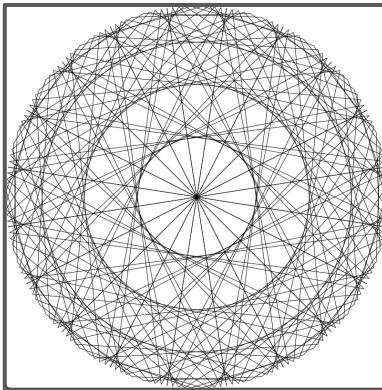
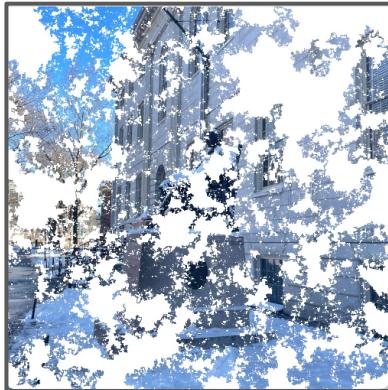


# Code the Universe

## Lecture #6

Sudhan Chitgopkar  
January @ Harvard GSAS

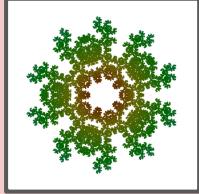
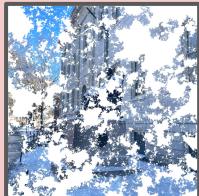
# Look How Far We've Come



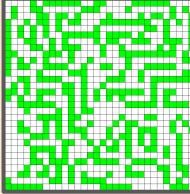
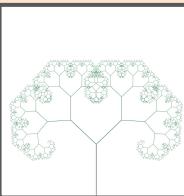
The Coffee Cup Pattern is a Fractal which can be generated with the Chaos Game or Recursively or using Cellular Automata which is a form of Artificial Life but can also be used to make Maze-like structures.

# Concept Consistency

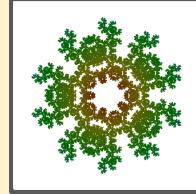
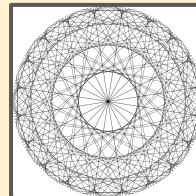
Randomness



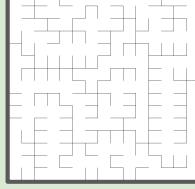
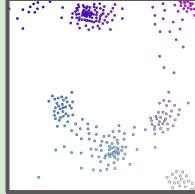
Coordinate Systems



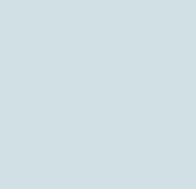
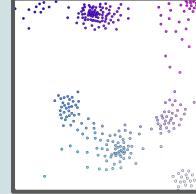
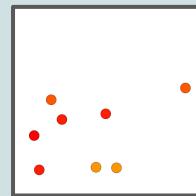
Algebra & Trig



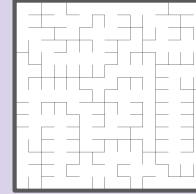
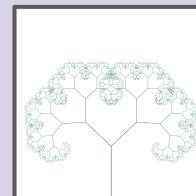
Objects



Vectors & Forces



Recursion



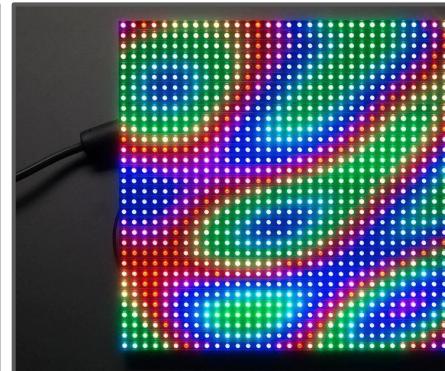
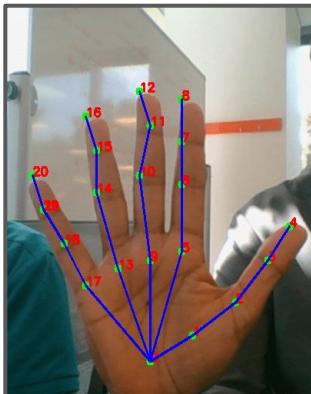
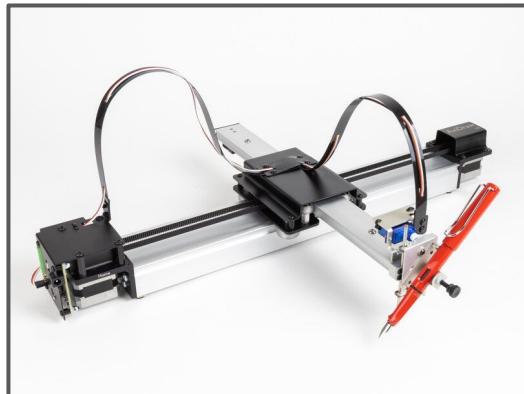
This stuff is everywhere.



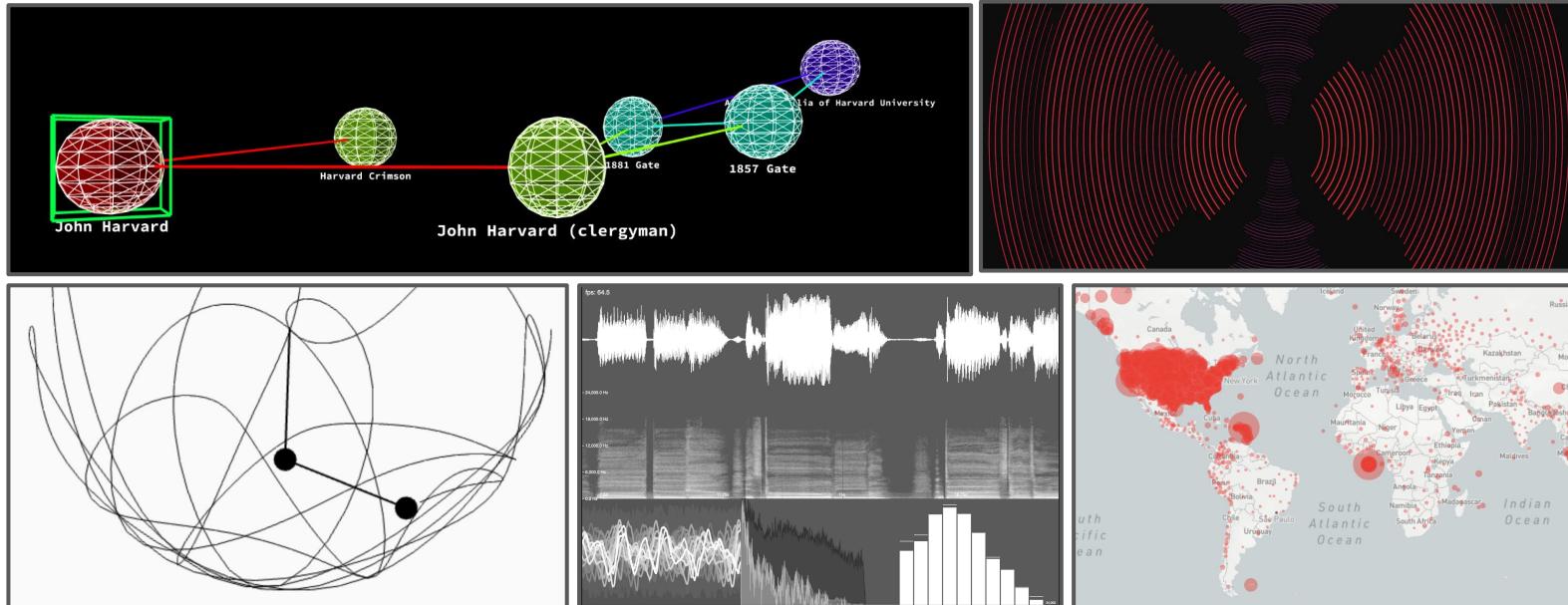
# Into the Analog



# I/O



# Data & Music Visualization



Source: [Sudhan Chitgopkar](#), [Mike Brondbjerg](#), [Daniel Shiffman](#), [Jon Froehlich](#), [Shitz](#)

# Lessons From My Experience

- Be purposeful with your code
  - But don't be afraid to explore
- Learn visual debugging
- Don't get bogged down with minutiae
  - Including language!
- Learn the concepts, not the code
- Wikipedia is your best friend
  - Check the related topics!
- Go outside
- Ask what-if?

# Questions to Consider on Your Next Walk

- What are the differences between fish schooling and bird flocking?
  - What about sheep? Goats?
- Do you see more fractals in the trees or in the flowers?
  - And which ones are the most fractal-like?
- In NY, DC, SF, or Chicago? They're grid-like! What rules might govern which cells (city blocks) are alive (full of people) or dead (empty)?
  - Boston might be closer to a maze than a grid 😬 Which algorithm might produce mazes closest to how it looks?
- Is Math Discovered or Invented?
  - And what does it mean that we were able to use such simple methods to visualize such complex behavior?

# Thank You!



sudhan.dev



github.com/sudhanchitgopkar