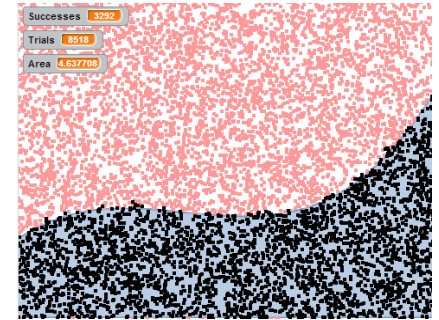
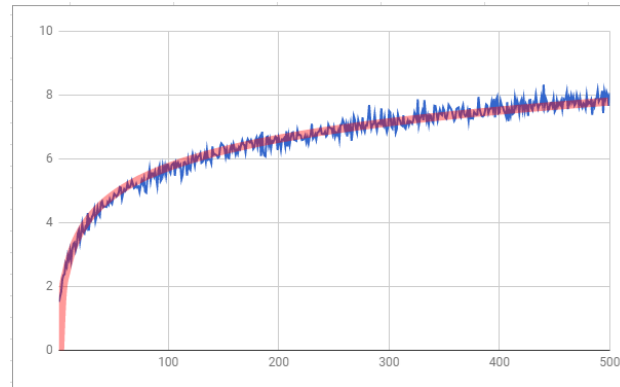
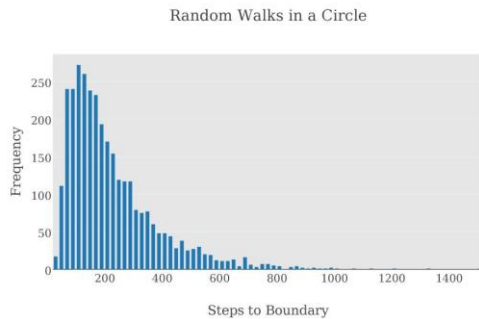


stats and sims in scratch



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WARM UP

The Two Heads Problem

Suppose you flip a fair coin until you see two consecutive Heads.

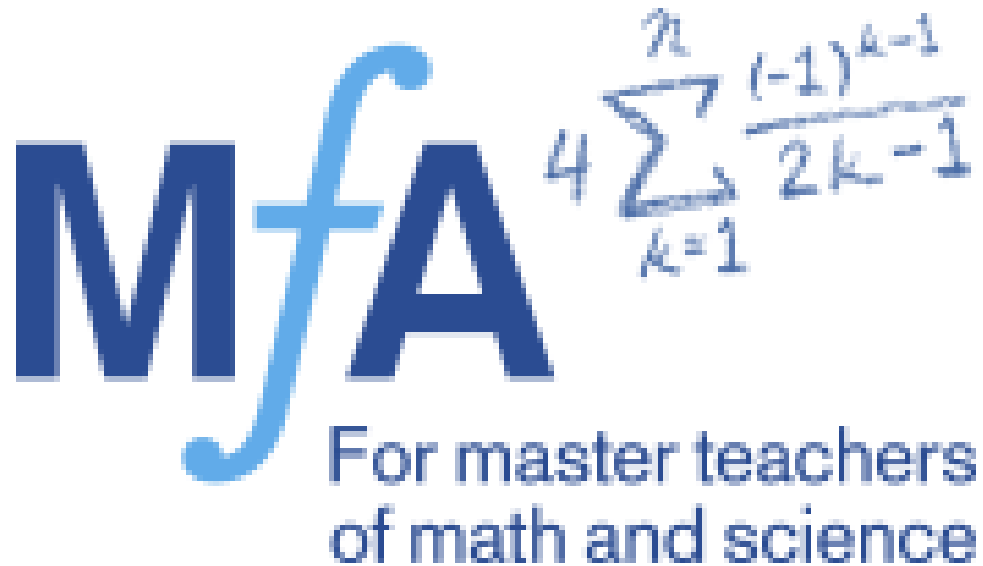
How many times would you expect to flip the coin until this happens?



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Part 1: Why?

1. Why Stats and Sims?

2. Why  ?

What is

SCRATCH?



SCRATCH

Scratch v442 | File | Edit | Tips | About | phonner

Untitled-6 by phonner (unshared) | Share | See project page

Motion | Events | Control | Sensing | Operators | More Blocks

- Looks
- Sound
- Pen
- Data

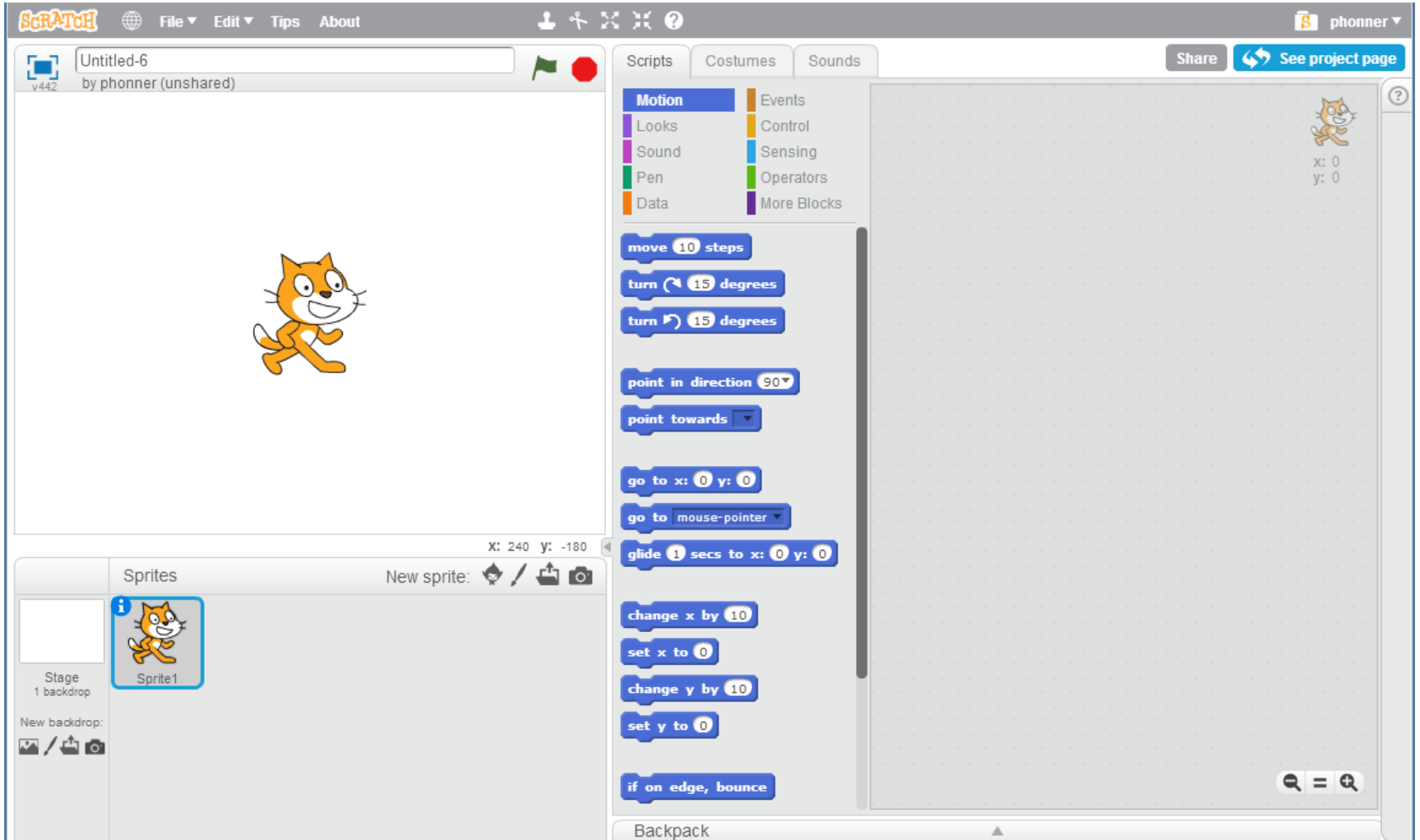
move 10 steps
turn 15 degrees
turn 15 degrees
point in direction 90
point towards
go to x: 0 y: 0
go to mouse-pointer
glide 1 secs to x: 0 y: 0
change x by 10
set x to 0
change y by 10
set y to 0
if on edge, bounce

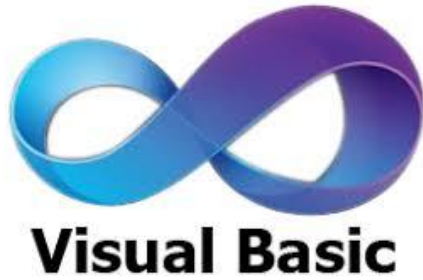
X: 240 Y: -180

Sprites | New sprite: | Stage | 1 backdrop | Sprite1

Stage 1 backdrop
New backdrop:

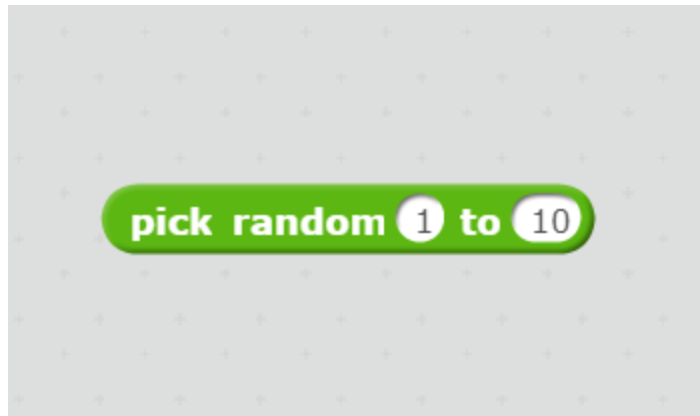
Backpack



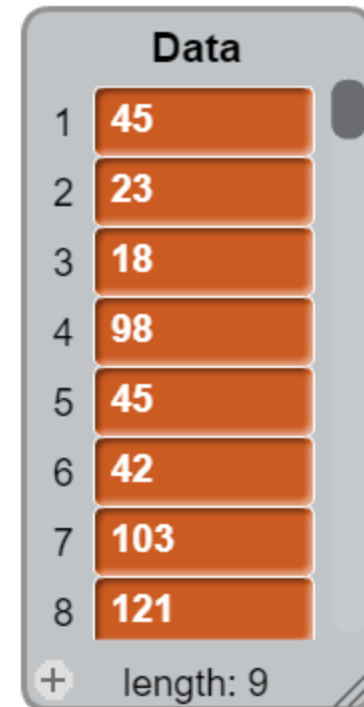


Part 2: The Basics

Random number generation



List management



List management

Make a List

Data

add thing to Data ▾

delete 1 ▾ of Data ▾

insert thing at 1 ▾ of Data ▾

Data

(empty)

+ length: 0

Part 2: The Basics

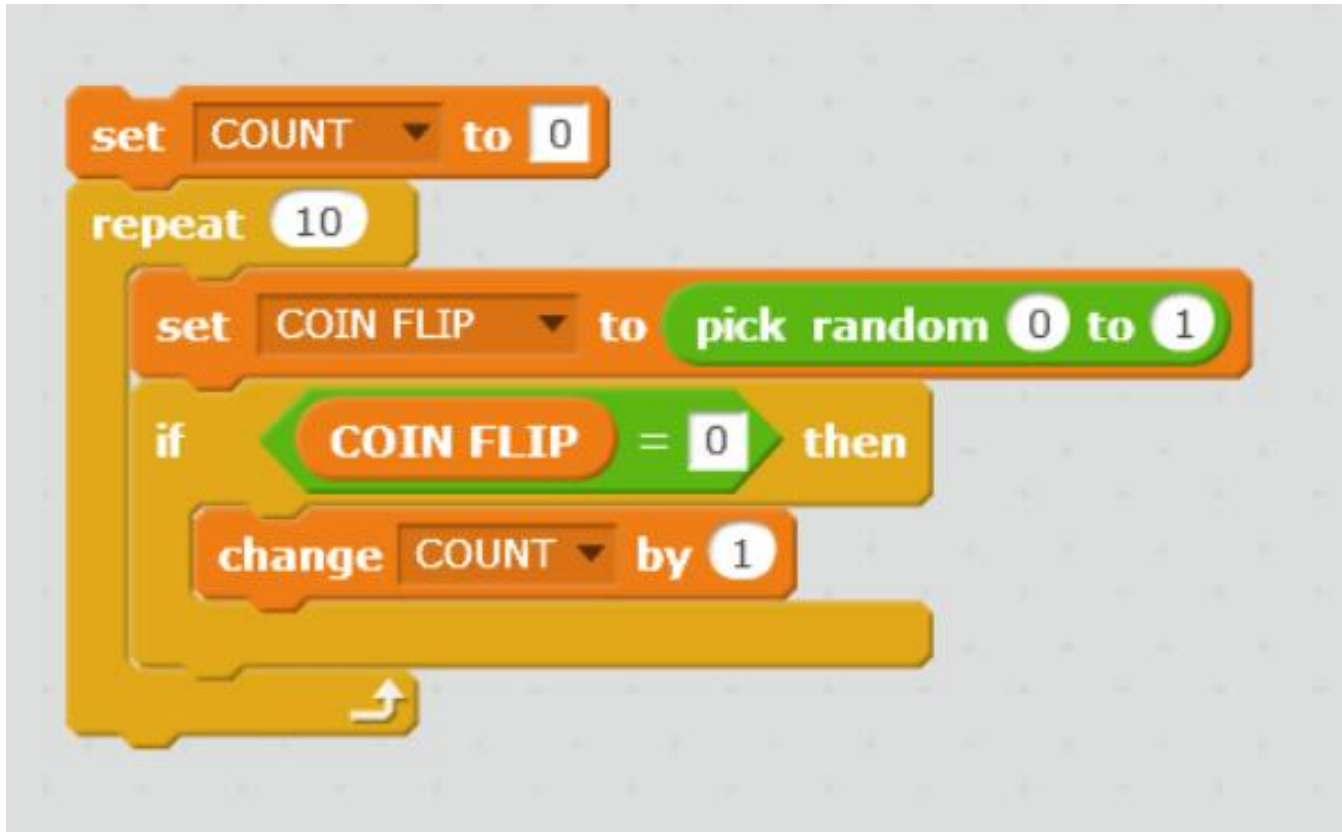
With random numbers and lists,
we can do a lot of probability
and statistics!

What Can We Do?



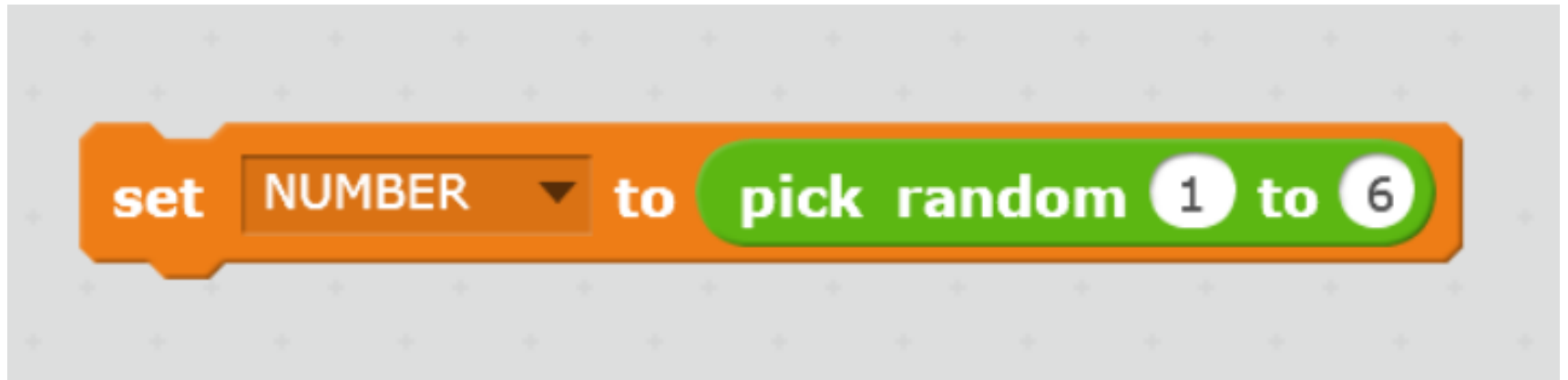
Flip a coin

What Can We Do?



Count Heads

What Can We Do?



Roll a die

What Can We Do?



Roll a die 10 times, sum the rolls

What Can We Do?



Flip an unfair coin

What Can We Do?



Roll a die, flip a coin that many times, count heads

What Can We Do?

```
repeat 100
  set NUMBER to pick random 1 to 6
  add NUMBER to MY LIST
set SUM to 0
set K to 1
repeat length of MY LIST
  change SUM by item K of MY LIST
  change K by 1
say SUM / length of MY LIST
```



What Can We Do?

We can write programs that

- Implement fair / unfair coins, dice
- Conduct repeated trials
- Collect, process, analyze data
- Compute average, deviation, range

What Can We Do?

Access everything in the standard probability and statistics curriculum via computing!

Part 3: Project Ideas

Explore distributions!

Fair / biased coins

Sums of fair / biased dice

Normal, skewed, uniform, bimodal

Part 3: Project Ideas

Explore famous, hard problems in probability!

Problem of the Points

Probability of Runs

Gambler's Ruin

Birthday Paradox

Monty Hall

Part 3: Project Ideas

Programmatic data analysis

Here is a set of data; where did it come from?

COIN_FLIP_DATA_1	
1	H
2	T
3	H
4	T
5	H

+ length: 500

COIN_FLIP_DATA_2	
1	H
2	H
3	H
4	T
5	T

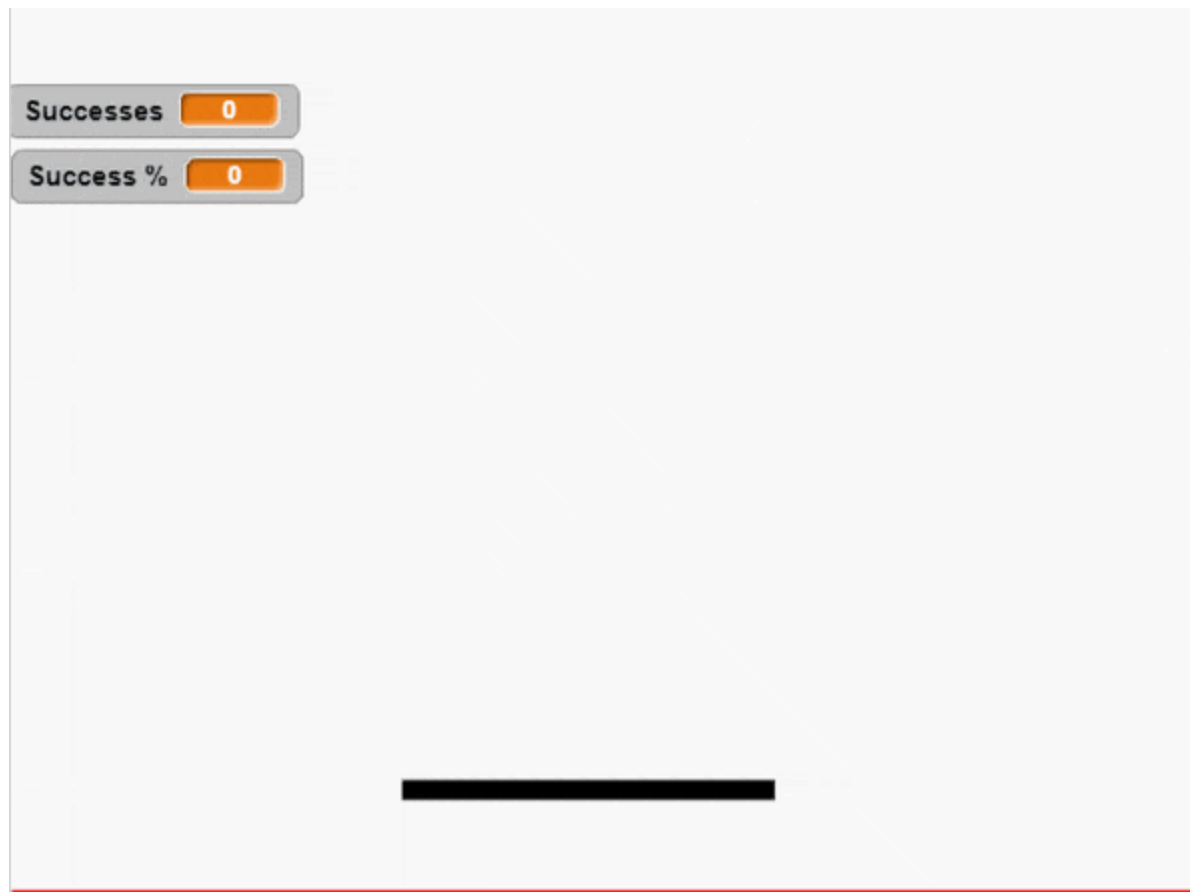
+ length: 500

COIN_FLIP_DATA_3	
1	T
2	H
3	T
4	T
5	T

+ length: 500

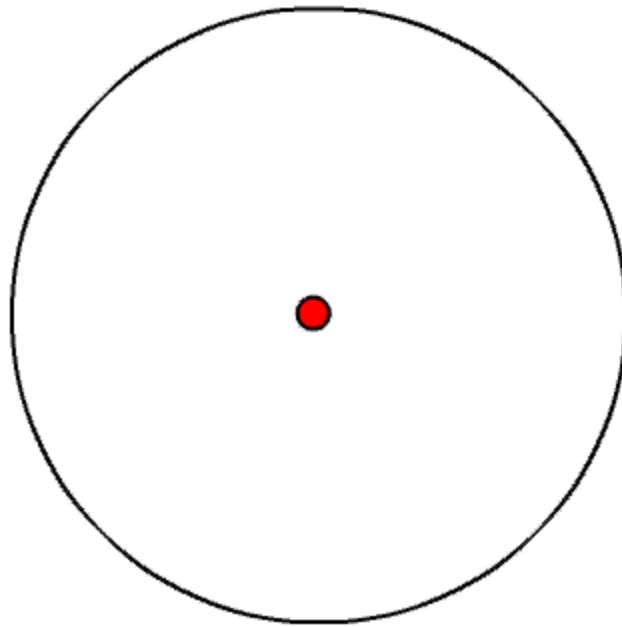
Part 4: Extensions

Agent-based simulation



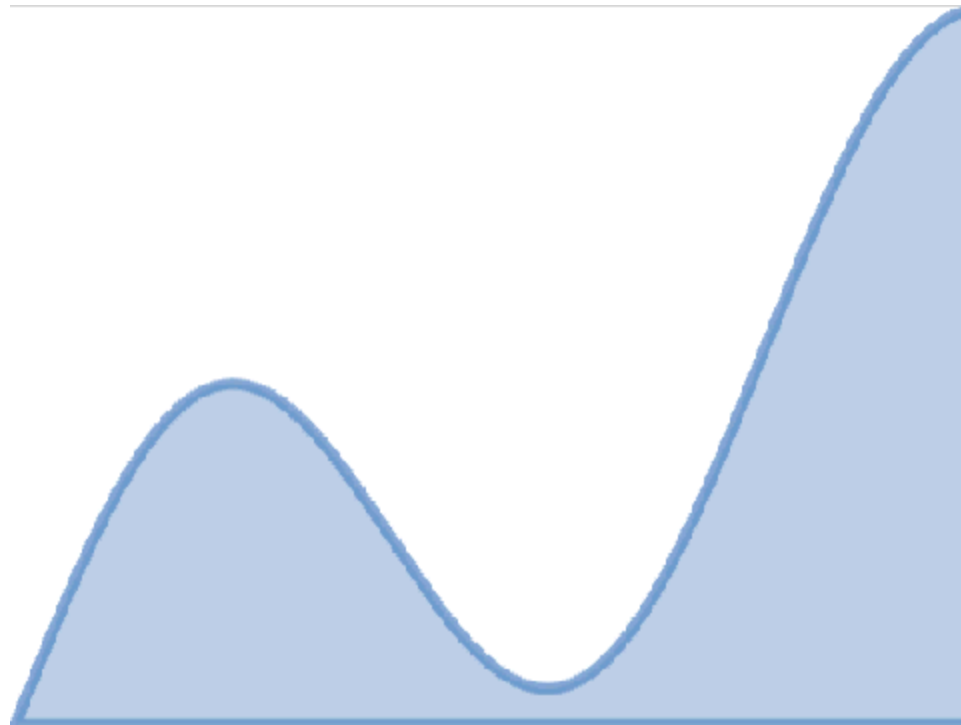
Part 4: Extensions

Agent-based simulation



Part 4: Extensions

Agent-based simulation



Part 4: Extensions

Representations of Data

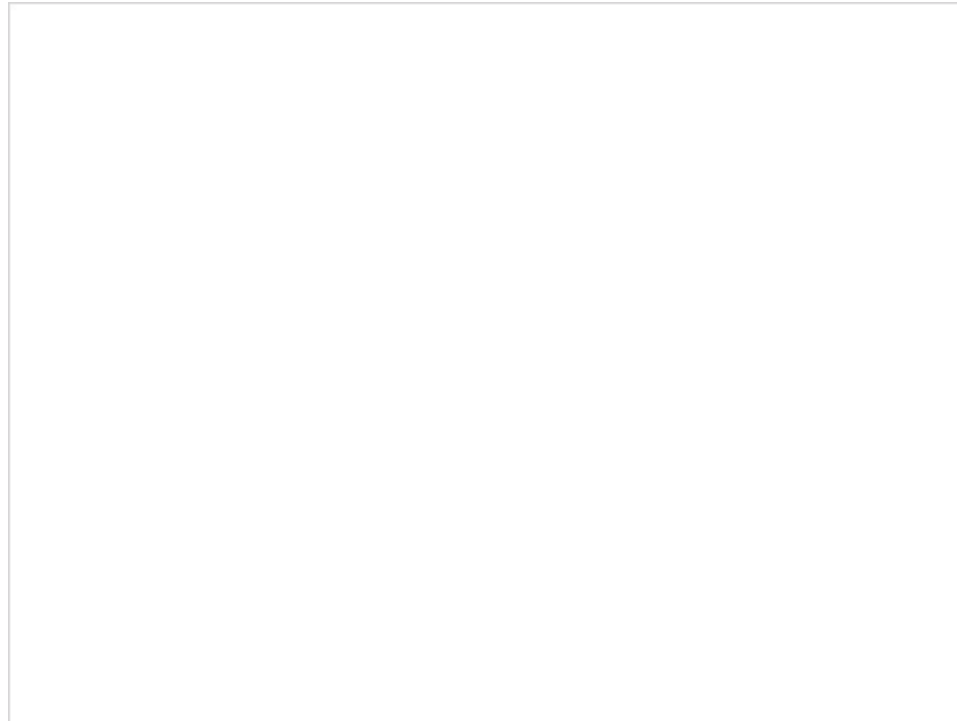
Part 4: Extensions

Representations of Data



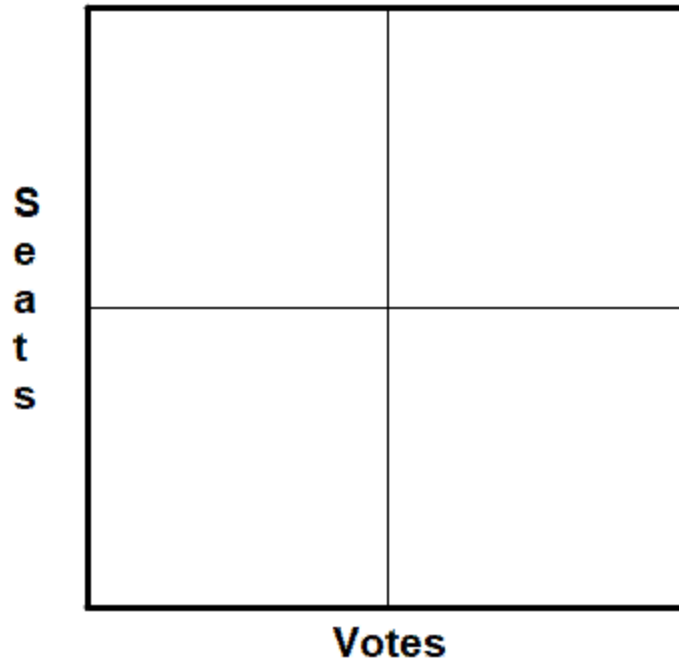
Part 4: Extensions

Representations of Data



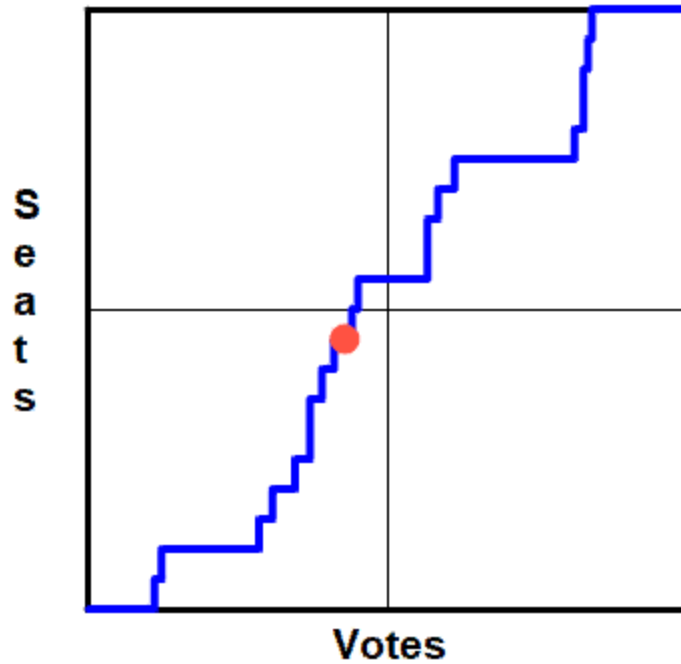
Part 4: Extensions

Representations of Data



Part 4: Extensions

Representations of Data



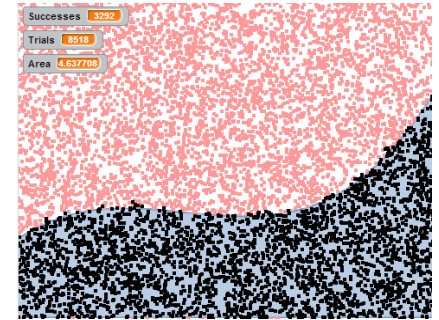
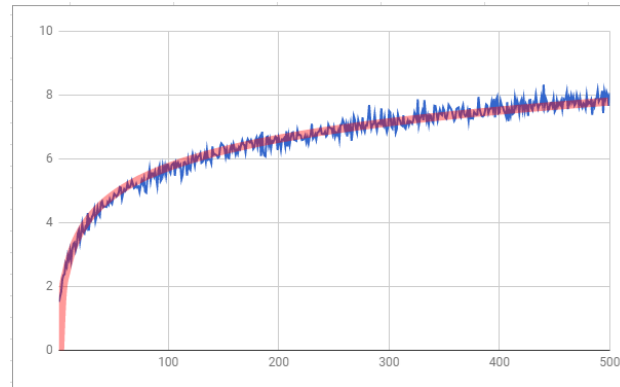
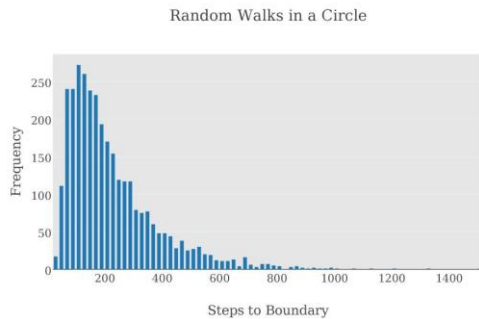
Takeaways

Integrating math and CS

Probability and statistics through the lens of data and programming

Scratch is a powerful toy!

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