Randomness
“Maybe the greatest novelty here is the ability of the computer not only to follow any complex rule of organization but also to introduce an exactly calculated dose of randomness.”

— E.H. Gombrich

Georg Nees, *Gravel Stones* (1971)
Random functions

random()
randomSeed()
function random(lo = 0, hi) { ... }

**Return** a random number at least as big as lo but smaller than hi.

Get a different answer every time!

If no value for “lo” is given, it is assumed to be 0.
Random integers

\texttt{int(random(N));}

Choose a random integer from the set 0, 1, \ldots\ N-1

(The int() function always rounds down)
Flipping a coin

Write a function that simulates flipping a fair coin.
Demo Code

Demo code: CoinFlips
Demo code: CircleSample
DemoCode: RandomDistribution
Which of the following lines of code might we place in the blank below, giving a function that simulates flipping a coin?

```
function flipCoin() {
    (A) return int(random(6)) % 2 = 0;
    (B) return random(1) < 0.5;
    (C) return int(random(2)) = 0;
    (D) return random(-50, 50) > 0.0;
    (E) All of the above
```
Suppose we wished to simulate rolling a six-sided die. Which expression below would be best way to obtain the number rolled?

(A) `random(6)`
(B) `random(7)`
(C) `int(random(6))`
(D) `int(random(6)) + 1`
(E) `int(random(7))`
Suppose we wished to simulate rolling two six-sided dice. Which expression below would be best way to produce random numbers corresponding to the total shown on the two dice?

(A) \(\text{int} (\text{random}(12)) + 2\)

(B) \(\text{int} (\text{random}(1, 7)) \times 2\)

(C) \(\text{int} (\text{random}(2, 13))\)

(D) \(\text{int} (\text{random}(1, 7)) + \text{int} (\text{random}(1, 7))\);
Flipping a biased coin

What if we wanted to get heads 75% of the time and tails 25% of the time?
10 PRINT CHR$(205.5+RND(1)); : GOTO 10
A fair coin is flipped ten times. Which of the following sequences of flips is the least likely to occur?
https://www.youtube.com/watch?v=1cUUfMeOijg

Cloudflare lobby [photo by @mahtin]
Is this sequence of digits random?

02770539217176293176752384674818467669405132000568127145263560
Most random number generators are like the digits of π: completely deterministic, but hard to predict.

These are called **Pseudorandom Number Generators** (PRNGs).
function randomSeed(seed) { ... }
Demo Code

Demo code: TenPointRandomSeed
Demo code: TenPointRandomVis
Pseudorandom number generators are a double-edged sword.
The good: we can always “replay” a sequence of pseudorandom numbers.
The bad: pseudorandom numbers *are not* actually random.
Demo Code

Demo code: BallOnRandomLine
Goals

- Understand how to use random() to generate unpredictable behaviour.
- Understand how to use randomSeed() to control the generation of pseudorandom numbers.
- Understand the difference between random numbers and pseudorandom numbers.