ndonmRseas

nsenRdamso

esdnRsaonm

nsnasemdRo

emnosandsR

Randomness

dasnnmseoR

anmdRonsse

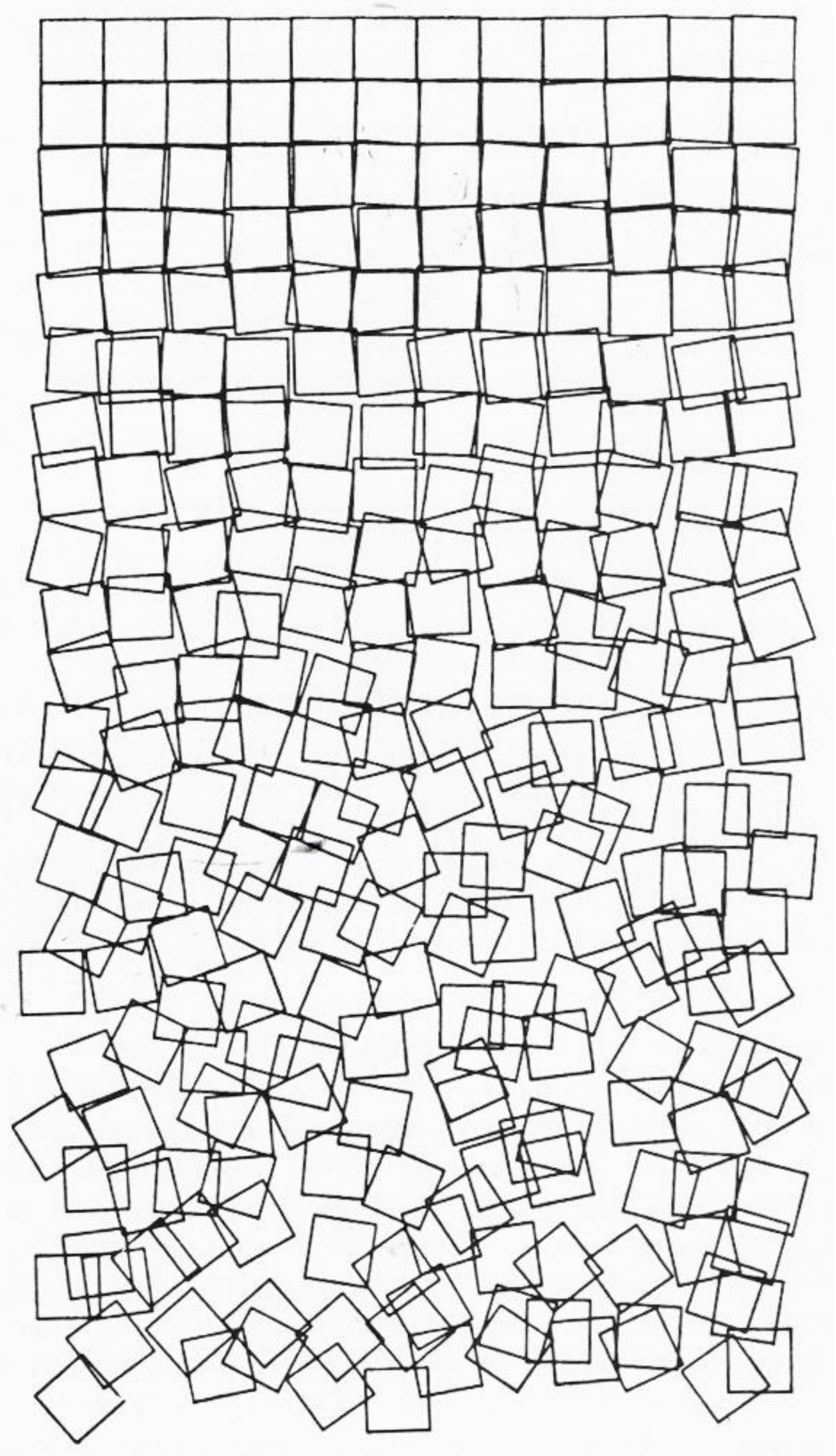
sRedmnaons

nndesRsamo

Module 08
CS 106 Winter 2020

“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

```
int(random(N));
```

Choose a random integer from the set 0, 1, … **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?

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))`

6 W20 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) `int(random(12)) + 2`

(B) `int(random(1, 7)) * 2`

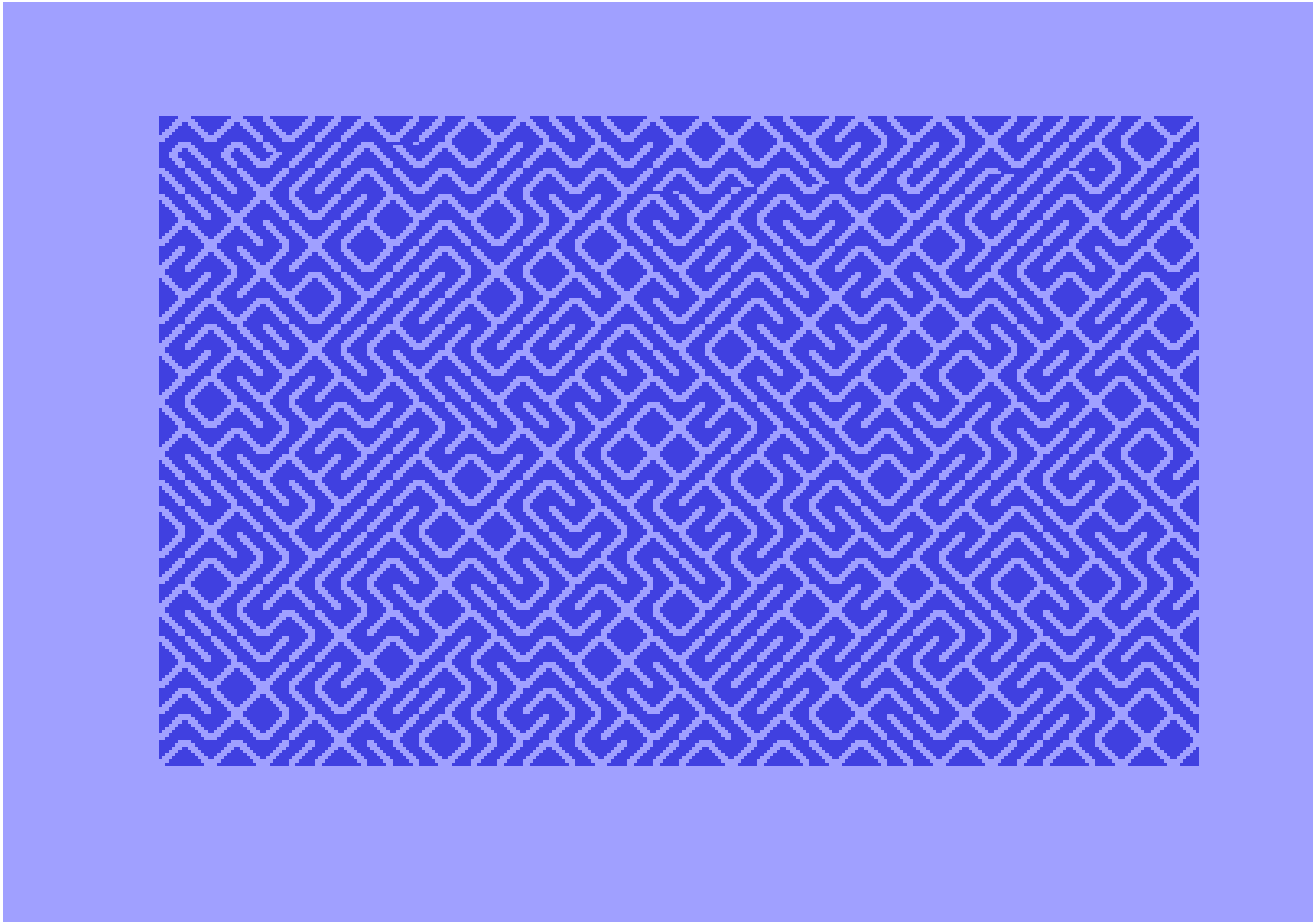
(C) `int(random(2, 13))`

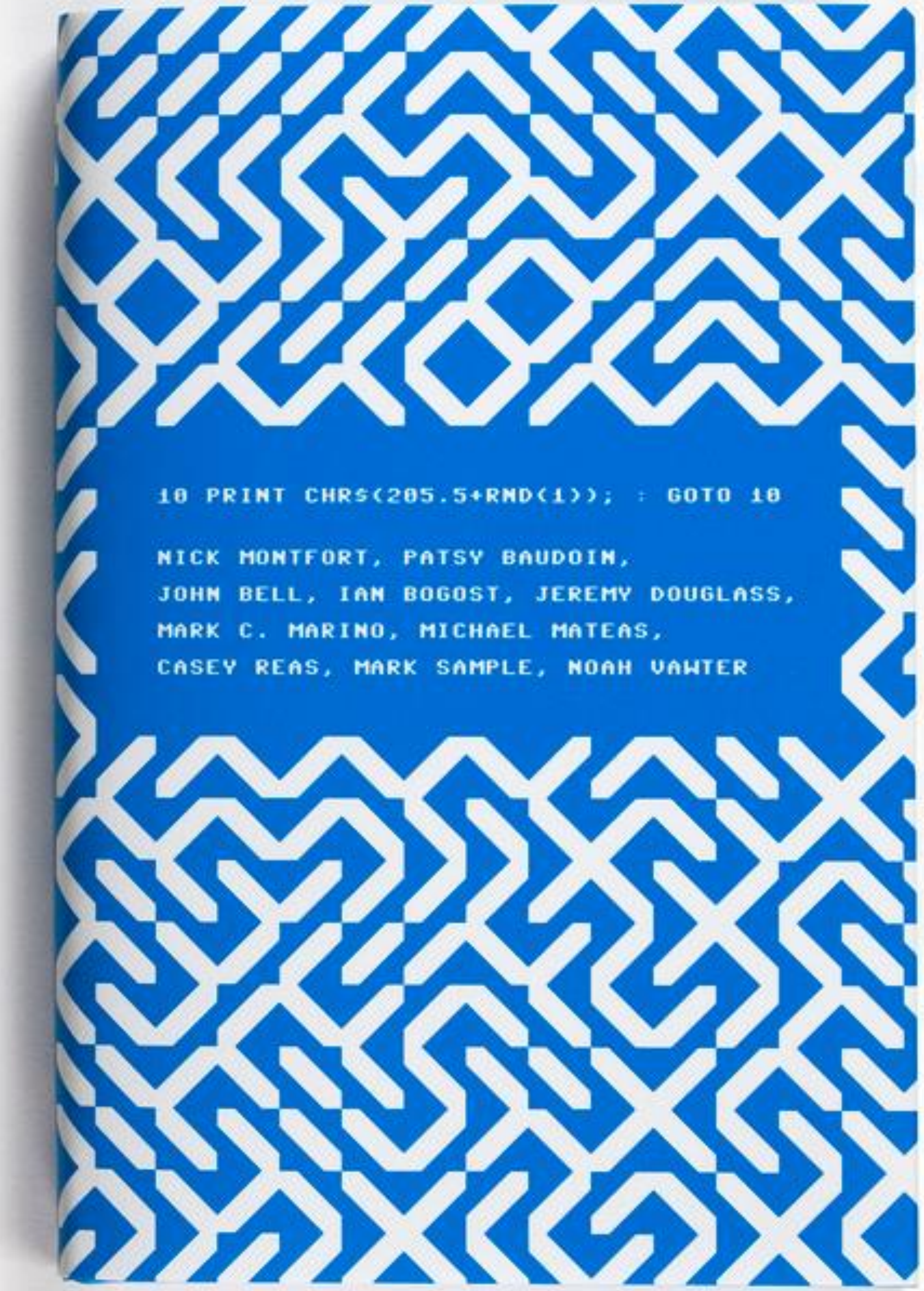
(D) `int(random(1, 7) + int(random(1, 7));`

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
```





10 PRINT CHR$(205.5+RND(1)); : GOTO 10

NICK MONTFORT, PATSY BAUDOIN,
JOHN BELL, IAN BOGOST, JEREMY DOUGLASS,
MARK C. MARINO, MICHAEL MATEAS,
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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

3.14159265358979323846264338327950288419716939937510582097494
5923078164062862089986280348253421170679821480865132823066470
9384460955058223172535940812848111745028410270193852110555964
4622948954930381964428810975665933446128475648233786783165271
2019091456485669234603486104543266482133936072602491412737245
8700660631558817488152092096282925409171536436789259036001133
0530548820466521384146951941511609433057270365759591953092186
1173819326117931051185480744623799627495673518857527248912279
3818301194912983367336244065664308602139494639522473719070217
9860943702770539217176293176752384674818467669405132000568127
1452635608277857713427577896091736371787214684409012249534301
4654958537105079227968925892354201995611212902196086403441815
9813629774771309960518707211349999998372978049951059731732816
0963185950244594553469083026425223082533446850352619311881710
1000313783875288658753320838142061717766914730359825349042875
5468731159562863882353787593751957781857780532171226806613001
9278766111959092164201989380952572010654858632788659361533818
2796823030195203530185296899577362259941389124972177528347913
1515574857242454150695950829533116861727855889075098381754637
464939319

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) { ... }
```

Reset the internal state of p5’s PRNG based on the passed-in seed. A given seed will always produce the same sequence of answers to a given sequence of calls to `random`().

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.