A random walk

Ben Griffiths
@beng

What is Randomness?

- Lack of direct predictability

- Lack of bias

- Having no definite aim or purpose

Why is it interesting?

- Stumbling across stuff that's good enough.

- Hard for us to reason about

  - sometimes that's bad

  - sometimes that's good

Randomise the slides

```ruby
1 30.times do |i|
2    puts "HUMAN, swap slide #{i} with slide #{rand(30)}"
3 end
4
5 10.times do |i|
6   puts "HUMAN, delete slide #{rand(30-i)}"
7 end
8
```

Entropy

- The entropy of an unbiased coin toss is 1 bit

- Entropy rate of English text is somewhere between 0.6 and 1.5 bits per letter.

- Entropy of a measure is how much information it contains.

The illusion of infinity

ALA SERITOROBBRAWN ELULI A NVI CA
AARL MIS MELLT POL K SE TEROIANER
VYKINIA YPTHAMMAN T NDALI ZZH DAHE
KOR FUUBASAMEGELLQUNN

	A	B	C	D	E
A	21	9	7	13	4
B	26	2	0	0	8
C	11	0	0	0	3
D	23	0	0	2	20
E	2	1	3	3	1

Citizenship test

```ruby
 1 def citizenship(takes)
 2   no_of_questions = 20
 3   options_per_question = 4
 4   passmark = 10
 5
 6   qualifiers = takes.times.count do
 7     score = no_of_questions.times.count do
 8       rand() < (1.0/options_per_question)
 9     end
10     score >= passmark
11   end
12
13   qualifiers/takes.to_f
14 end
```
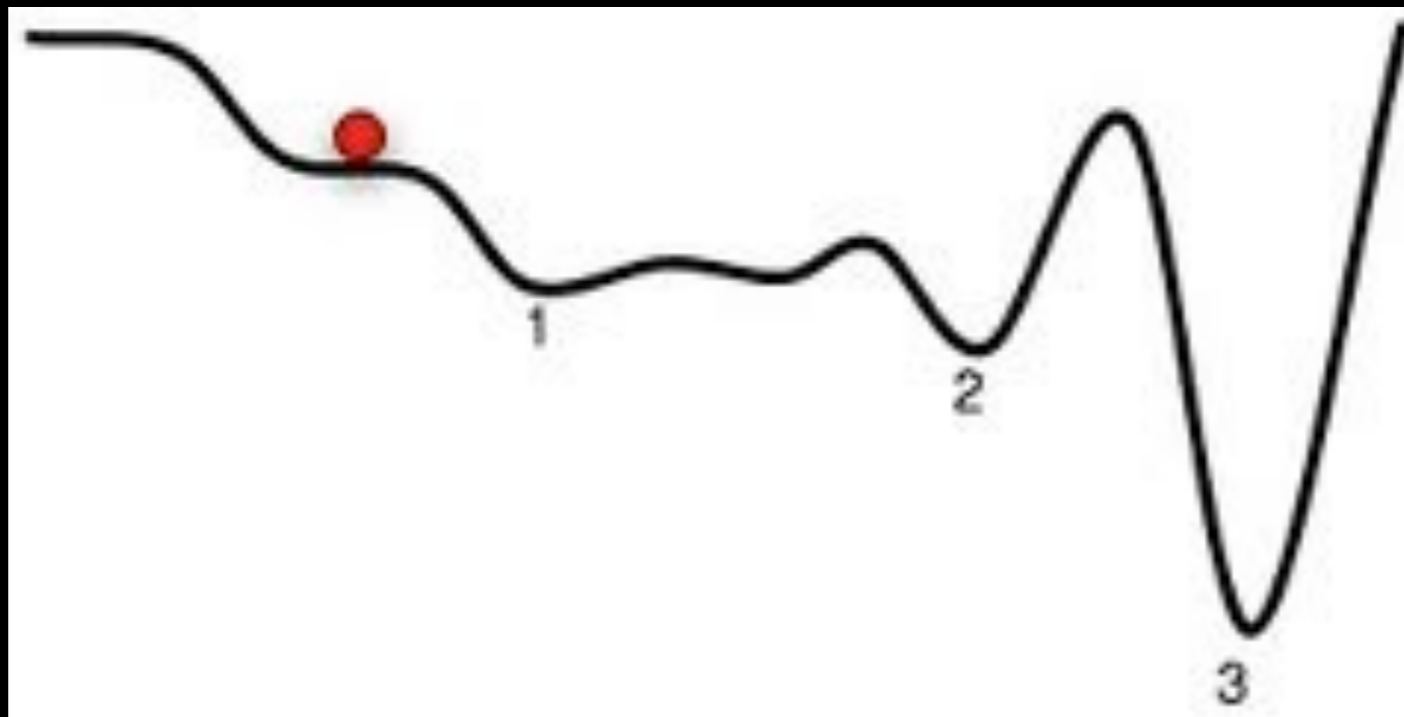
1000 samples: 1 in 52.63 pass
10000 samples: 1 in 64.93 pass
100000 samples: 1 in 69.97 pass
1000000 samples: 1 in 71.64 pass

Simulated Annealing

- Good for Samurai swords

- Also good for finding the global minimum in a large search space.

Select a random row

- NAIVE : SELECT * FROM USERS ORDER BY RAND LIMIT 1

- BETTER: WHERE id = FLOOR((max ID in table)*RAND())

- BUT when there are separate conditions...

Mutation testing

"Heckle is unit test sadism™ at it's core."
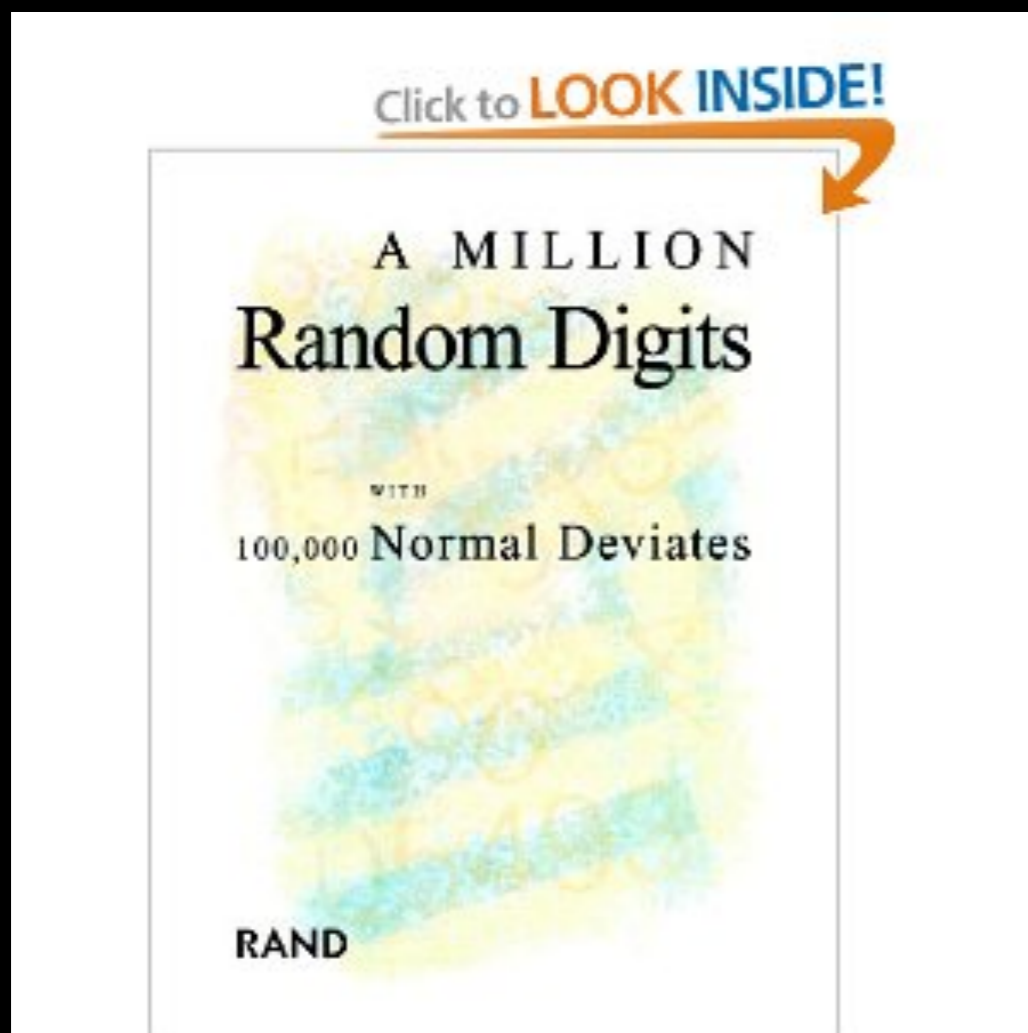

"Declare War on Everything with Chaser"

Random deployment

"On check-in, if the tests pass, there's a 25% chance that the code will deploy."
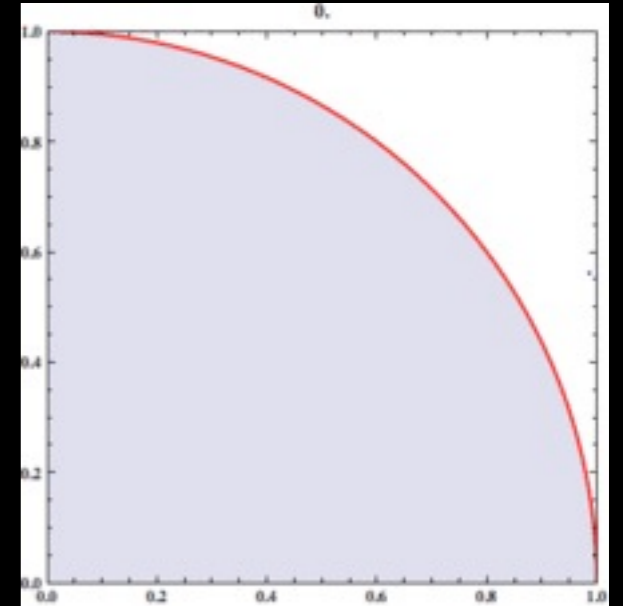
A million Random Digits with 100,000 Normal Deviates

"It was necessary for me to give this book only two stars. This was a nice enough story. However, the author really needed a twist at the end. I could tell halfway through the book where the story was headed."

Monte Carlo

- Repeated random sampling

```
20 def approx_pi(throws)
21    inside = throws.times.count {Math.hypot(rand, rand) <= 1.0}
22    4.0 * inside / throws
23 end
24
25 [1000, 10_000, 100_000, 1_000_000, 10_000_000].each do |n|
26       puts "%8d samples: PI = %s" % [n, approx_pi(n)]
27 end
```

Avoiding queue contention

- A queue of work to process

- Multiple distributed workers

- Failure tolerant

- No message must be processed more than once.

TRNG

- Shot noise

- Nuclear decay

- Photons travelling through semi transparent mirror

- RF Noise

- Thermal noise

- Clock drift

ERNIE

- ERNIE 1 - Signal noise from neon tubes

- ERNIE 4 - thermal transistor noise

"ERNIE's output is independently tested each month by an independent actuary appointed by the government, and the draw is only valid if the output passes tests that indicate it is statistically random."
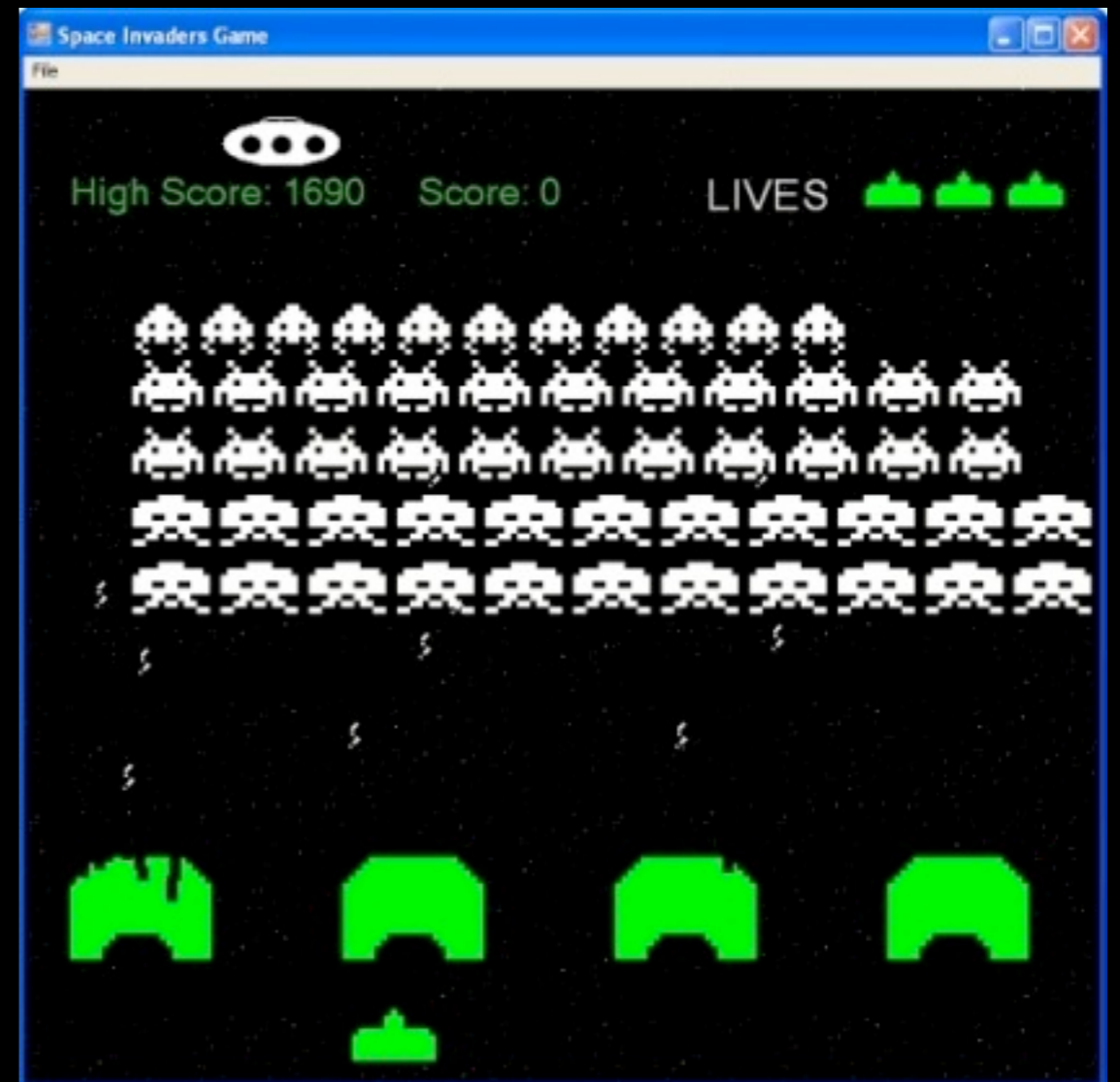
BEAN Machine

Damn you autocorrect.

Random.org

Genetic algorithms

- A genetic representation - an array of bits?

- A fitness function

Chaos Monkey

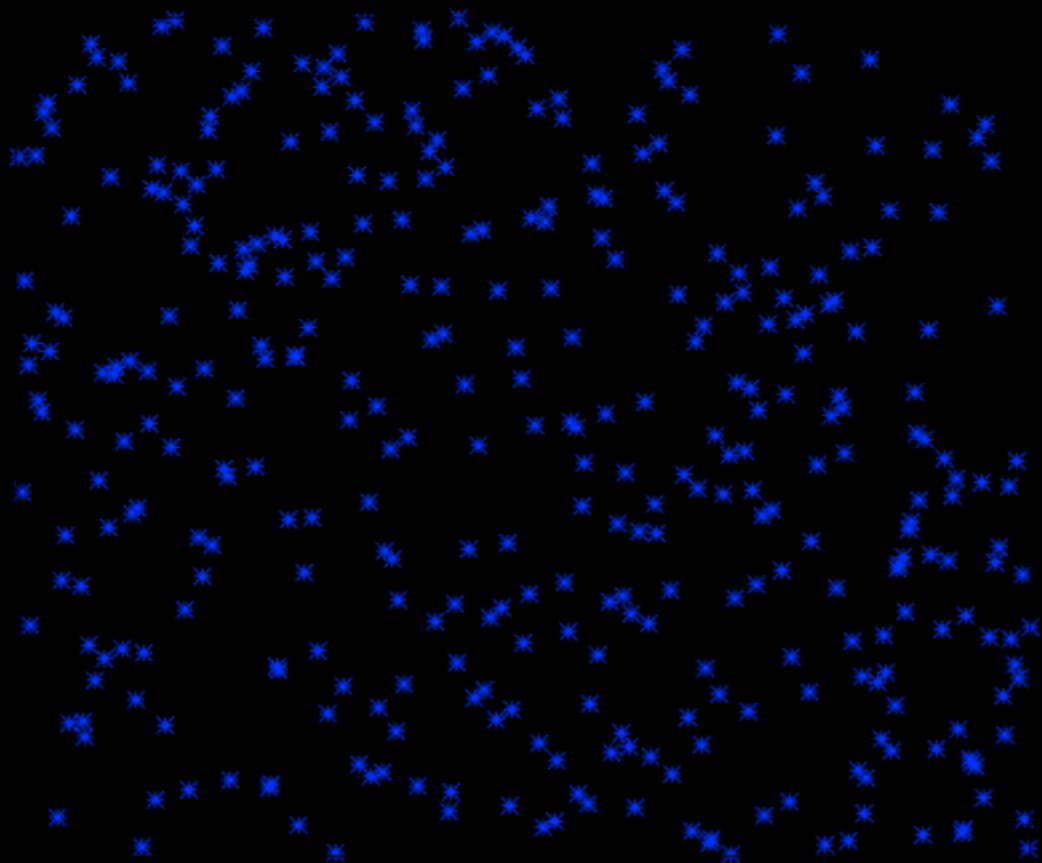"The Chaos Monkey's job is to randomly kill instances and services within our architecture."

PRNG

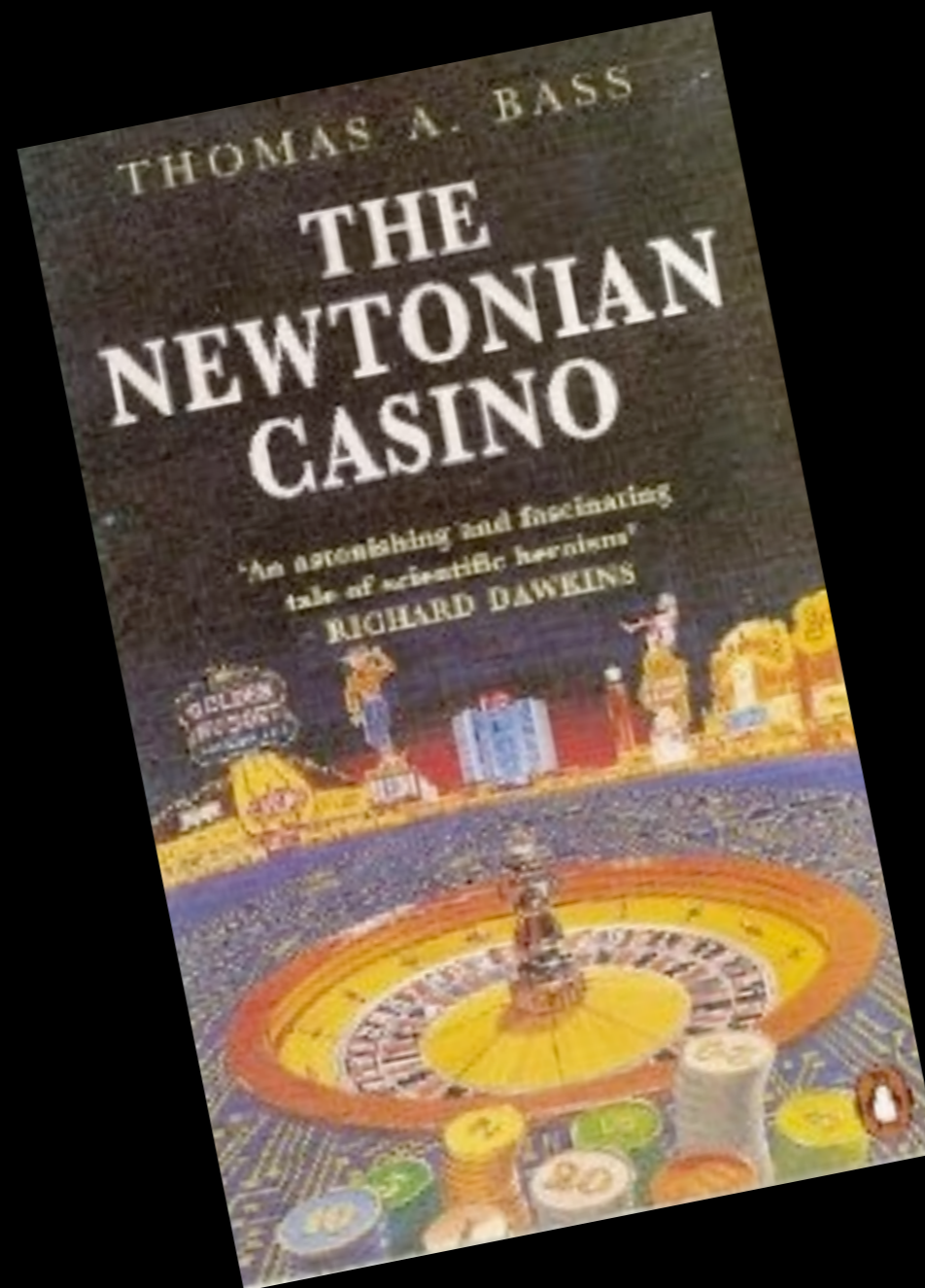"Random numbers should not be generated with a method chosen at random."

1969 Draft lottery

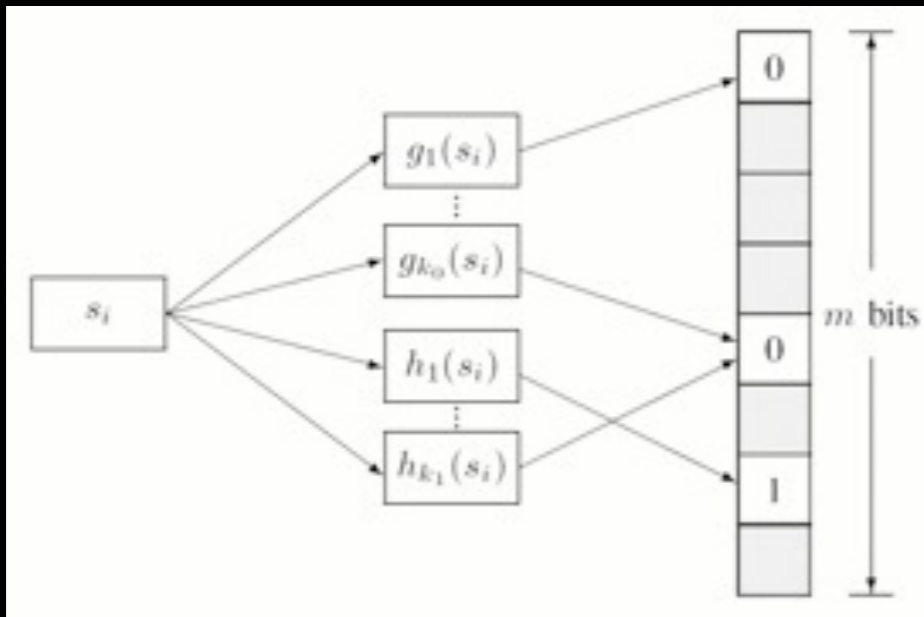"The generation of random numbers is too important to be left to chance."

Robert R Coveyou

Newtonian Casino

Bloom filters


```ruby
class BloomFilter
  def initialize(size)
    @bitarray = BitField.new(size)
    @size = size
  end

  def add(word)
    @bitarray[word.hash % @size] = 1
  end

  def includes?(word)
    return @bitarray[word.hash % @size] == 1
  end
end
```

False positives possible,
false negatives not.

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