

CS 103000

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Week 4:

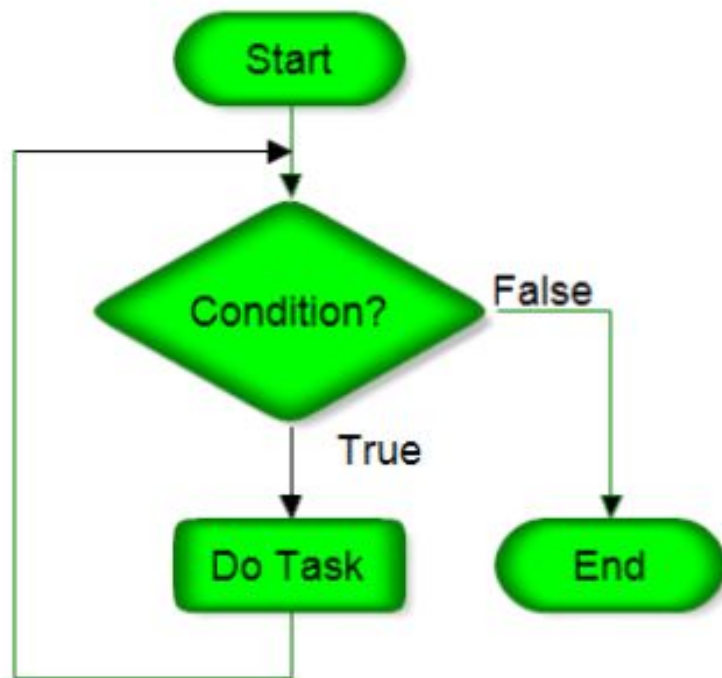
LOOPS (part 1) +

RANDOMNESS



Dall-E 2: cats learning C++ in the forest on '90's technology

While Loop





```
while ( raining )
```

what is RANDOM?

- Elusive - easier to describe what it *isn't*
- No discernable **pattern**
- Not **predictable**
(Reveals itself in **sequence**)
- Not **deterministic** (the more factors we know, the more causality or pattern we can find, then it's not random)

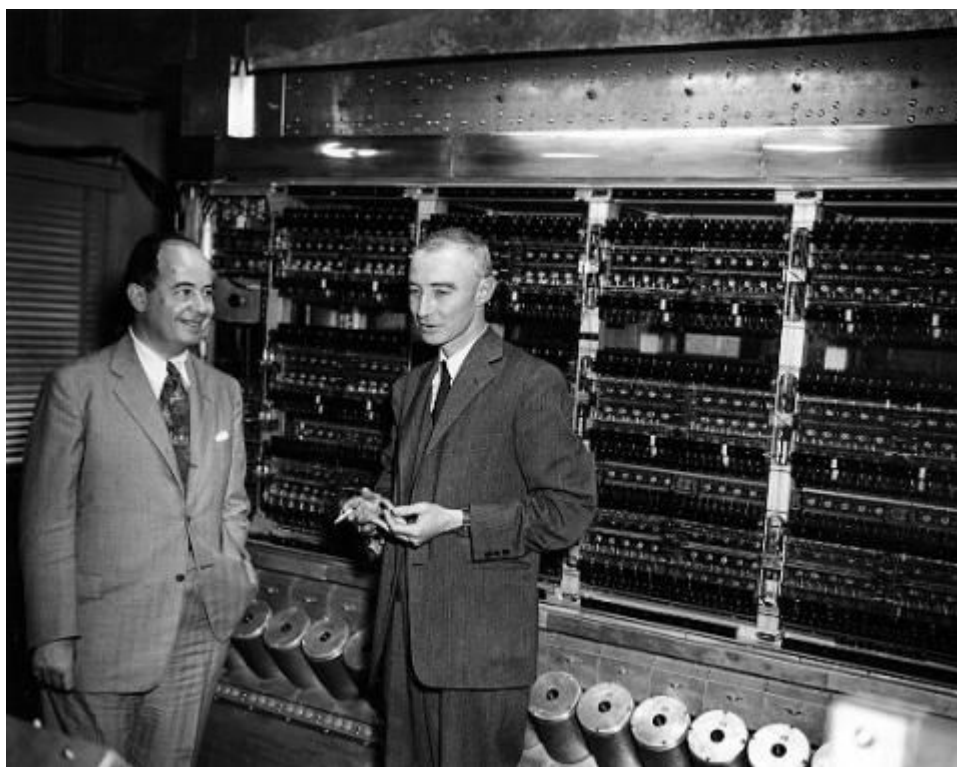
BUT ...

computers ARE deterministic

SAME INPUTS -> SAME OUTPUTS



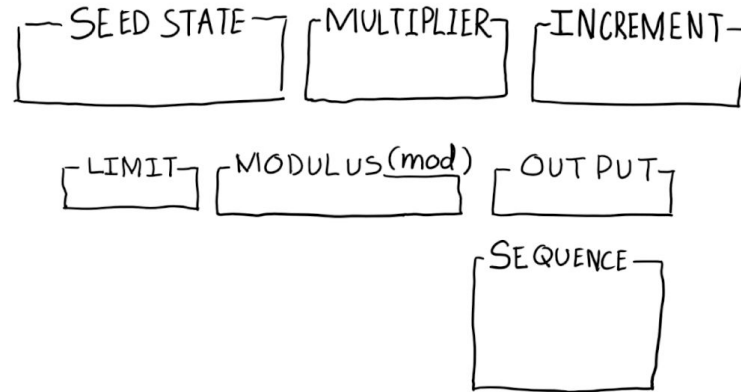
SNL



John von Neumann (here w/Robert Oppenheimer):
"Anyone who considers arithmetical methods of
producing random digits is, of course, in a
state of sin."

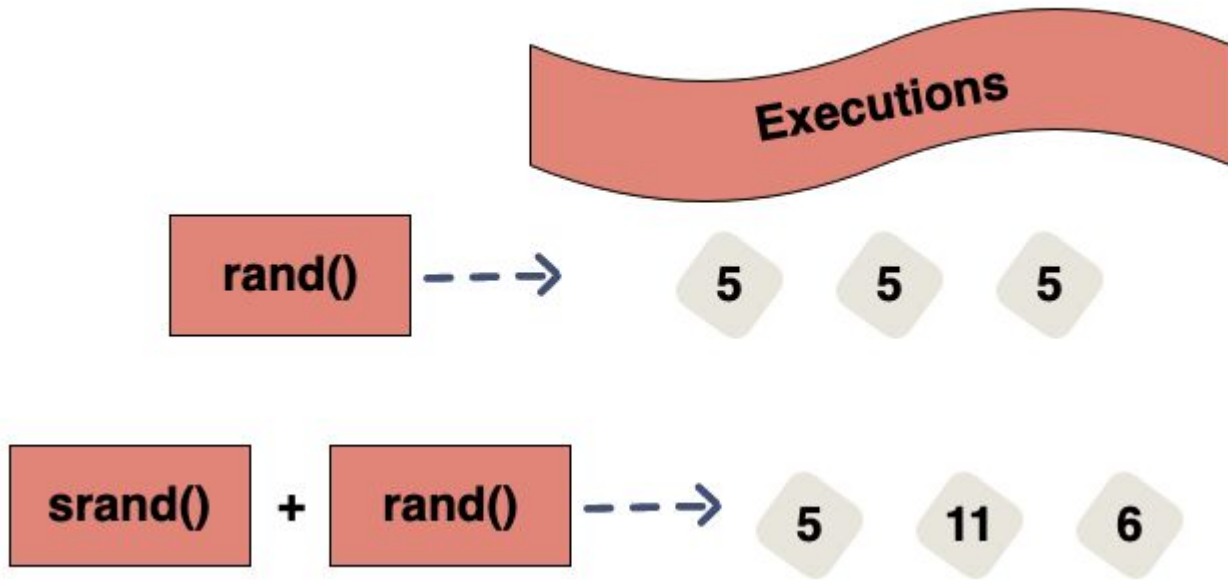
Pseudorandom! a **simulation**, random enough

- `rand()` = Linear Congruential Generator (LCG)
- $x = ((a * x) + c) \% m$
- Next number based on the previous (**state**)





`srand()` = SEED



RANDOMNESS FROM SEED ONLY; SAME SEED = SAME SEQUENCE!

Random integer between 0 and 1:

```
rand() % 2;
```

Random integer between 0 and 9:

```
rand() % 10;
```

Random integer between 0 and 10:

```
rand() % 11;
```

Random integer between 10 and 20:

```
rand() % 11 + 10;
```

- $x = ((a * x) + c) \% m$
- if: a (multiplier) = 3
- if: c (incrementor) = 4
- if: m (modulo %) = 15
- if: $x_0 = 1$
- Write out the first 6 numbers of this sequence.

1708965155 ... 1708965156 ... 1708965156 ...



PROJECT EULER

<https://projecteuler.net/>

800+ problems ...



Multiples of 3 or 5

Problem 1



If we list all the natural numbers below 10 that are multiples of 3 or 5, we get 3, 5, 6 and 9. The sum of these multiples is 23.

Find the sum of all the multiples of 3 or 5 below 1000.

Problem 1: answer 233168