CompSci 190: Chance & Iteration

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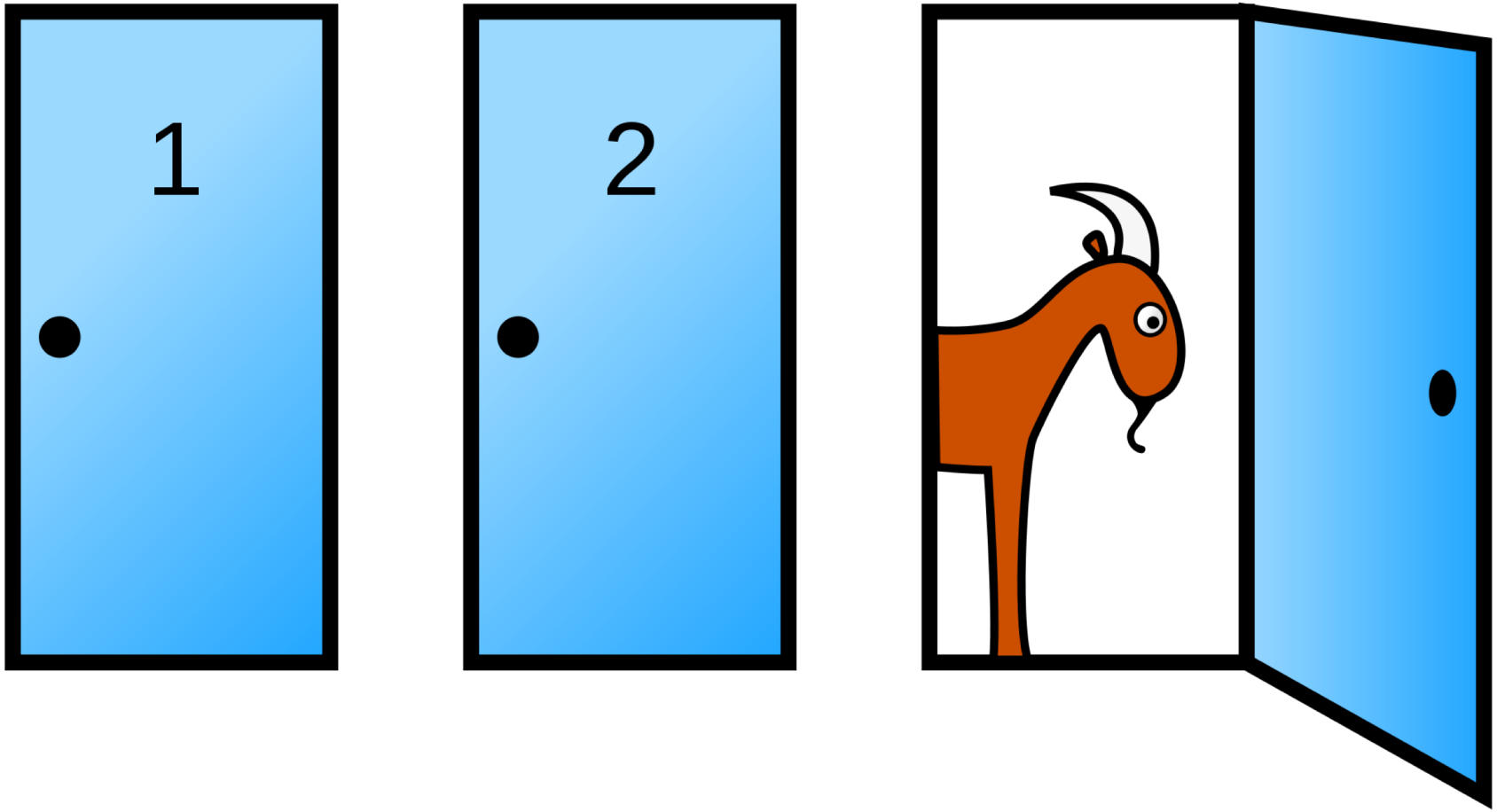
Monty Hall Problem



Random Selection

`np.random.choice`

- Selects at random
- with replacement
- from an array
- a specified number of times

```
np.random.choice(some_array, sample_size)
```

(Demo)

Discussion Question

```
d = np.arange(6) + 1
```

What results from evaluating the following 2 expressions? Are they the same? Do they describe the same process?

```
np.random.choice(d, 1000) + np.random.choice(d, 1000)
```

```
2 * np.random.choice(d, 1000)
```

Comparison Operators

The result of a comparison expression is a **`bool`** value

```
x = 2                    y = 3
```

Assignment statements

```
x > 1                    x > y                    y >= 3

x == y                   x != 2                   2 < x < 5
```

Comparison expressions

(Demo)

Combining Comparisons

Boolean operators can be applied to **`bool`** values

```
a = True        b = False
```

Evaluate to **`True`**

```
not b           a or b              a and not b
```

```
a and b         not (a or b)        b and b
```

Evaluate to **`False`**

(Demo)

Aggregating Comparisons

Summing an array or list of bool values will count the True values only.

```
1     + 0      + 1                 == 2
True + False + True               == 2
sum([1    , 0      , 1    ))     == 2
sum([True, False, True))         == 2
np.count_nonzero(([True, False, True)) == ?
```

(Demo)

More Python Commands

- Printing
  - Use **`print`** to display the value of a variable
- Control Statements
  - The purpose of **`if`** is to define functions that choose different behavior based on their arguments
  - The purpose of **`for`** is to perform a computation for every element in a list or array

(Demo)

Probability

- Lowest value: 0
  - Chance of event that is impossible
- Highest value: 1 (or 100%)
  - Chance of event that is certain

- If an event has chance 70%, then the chance that it doesn't happen is
  - 100% - 70% = 30%
  - 1 - 0.7 = 0.3

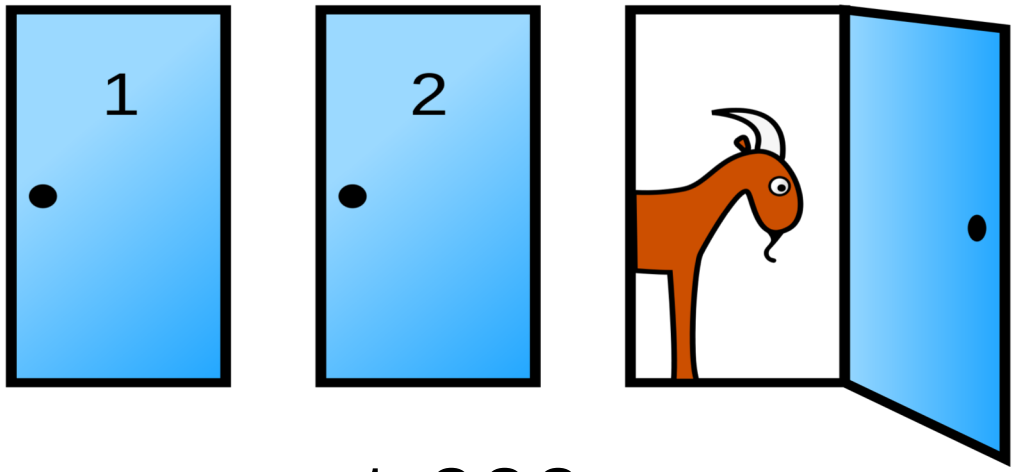
(Demo)

Equally Likely Outcomes

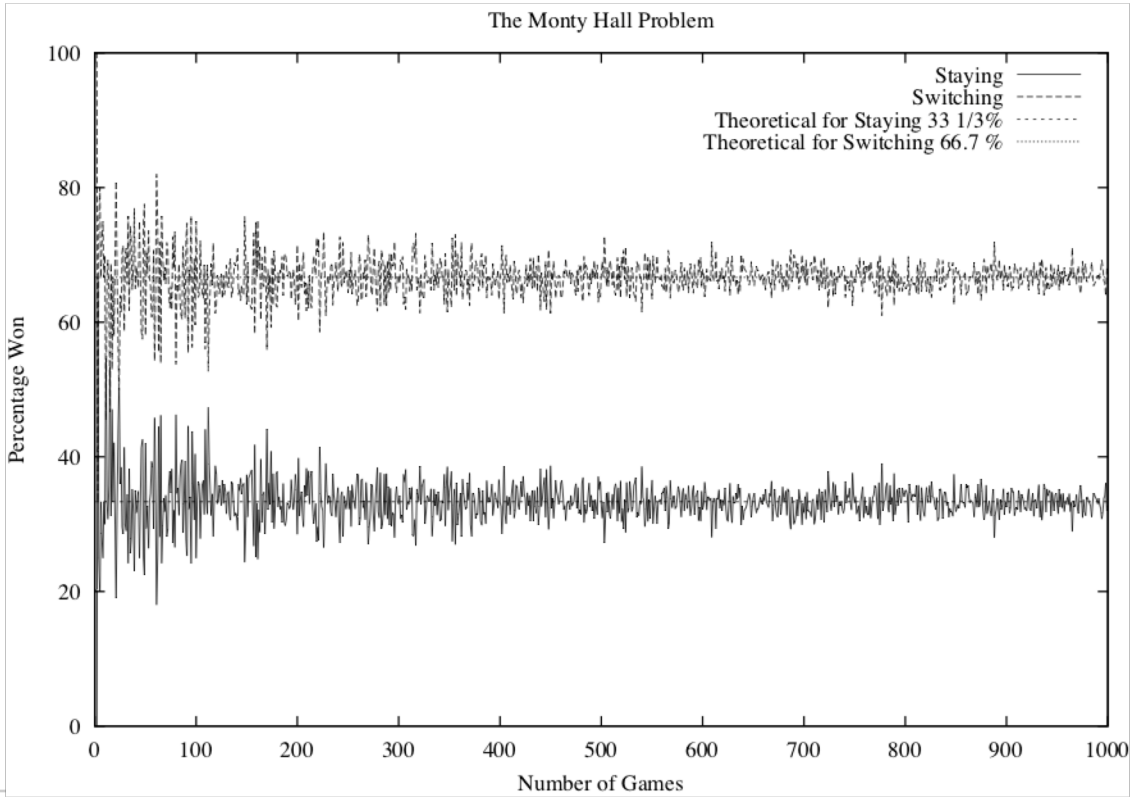
Assuming all outcomes are equally likely, the chance of an event A is:

$$P(A) = \frac{\text{number of outcomes that make A happen}}{\text{total number of outcomes}}$$

Simulating Monty Hall



x 1,000



Multiplication Rule

Chance that two events *A* and *B* both happen

= P(*A* happens) x P(*B* happens given that *A* has happened)

- The answer is *less than or equal to* each of the two chances being multiplied
- The more conditions you have to satisfy, the less likely you are to satisfy them all

(Demo)

Addition Rule

If event *A* can happen in *exactly one* of two ways, then

$$P(A) = P(\text{first way}) + P(\text{second way})$$

- The answer is *greater than or equal to* the chance of each individual way

Example: At Least One Head

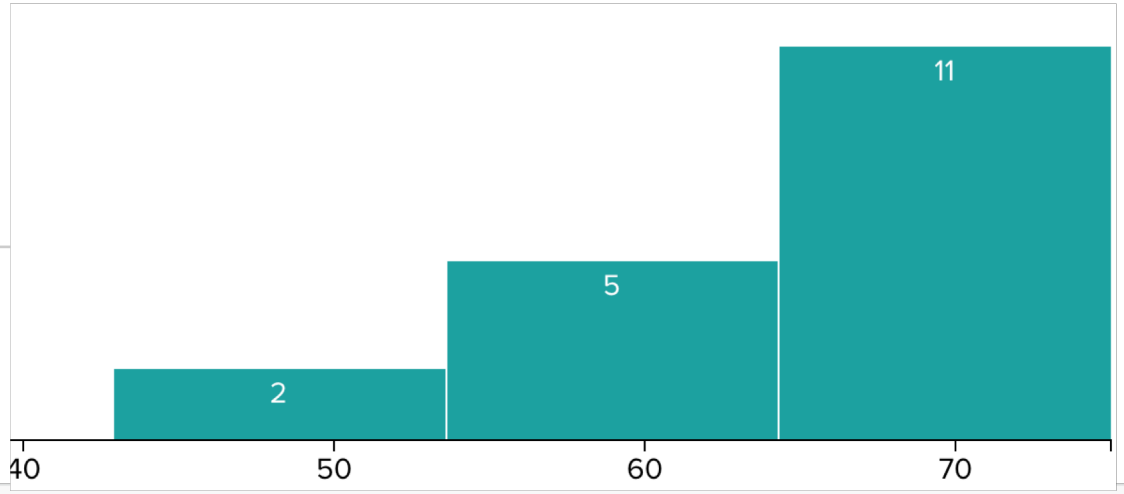
- In 3 tosses:
  - Any outcome *except* TTT
  - P(TTT) = (½) x (½) x (½) = ⅛
  - P(at least one head) = 1 - P(TTT) = ⅞ = 87.5%

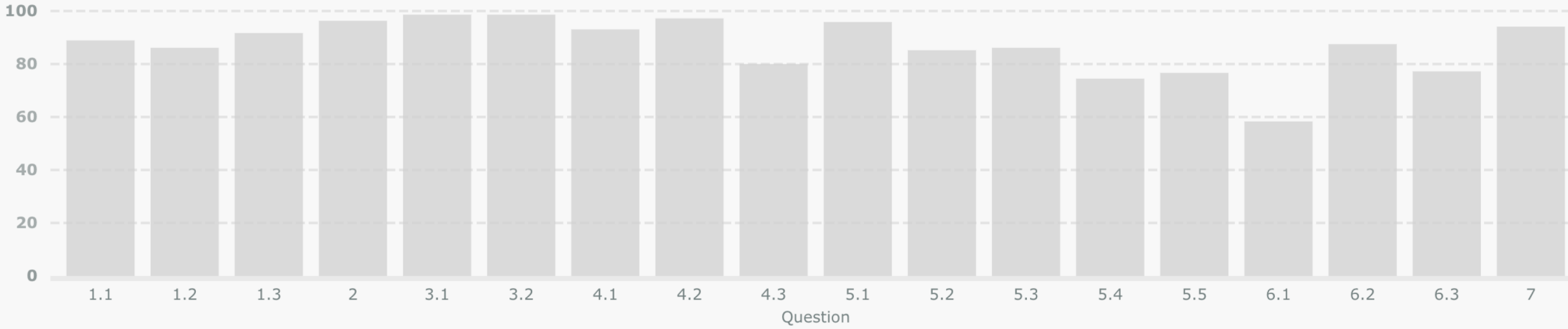
- In 10 tosses:
  - 1 - (½)**10
  - 99.9%

(Demo)

Test 1 Results

- Median: 68





Test 1 75.0 points

MINIMUM	MEDIAN	MAXIMUM	MEAN	STD DEV
62.67%	91.0%	98.67%	87.0%	9.99%