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PROBABILITY

You've almost surely encountered this idea before

WHAT IS PROBABILITY?

Pragmatic answer

- *A measure of the likelihood of an event*

Theoretical answer

- *A formal system to quantify uncertainty*

APPLICATIONS

Everyday real-world problems deal with uncertain information and/or outcomes

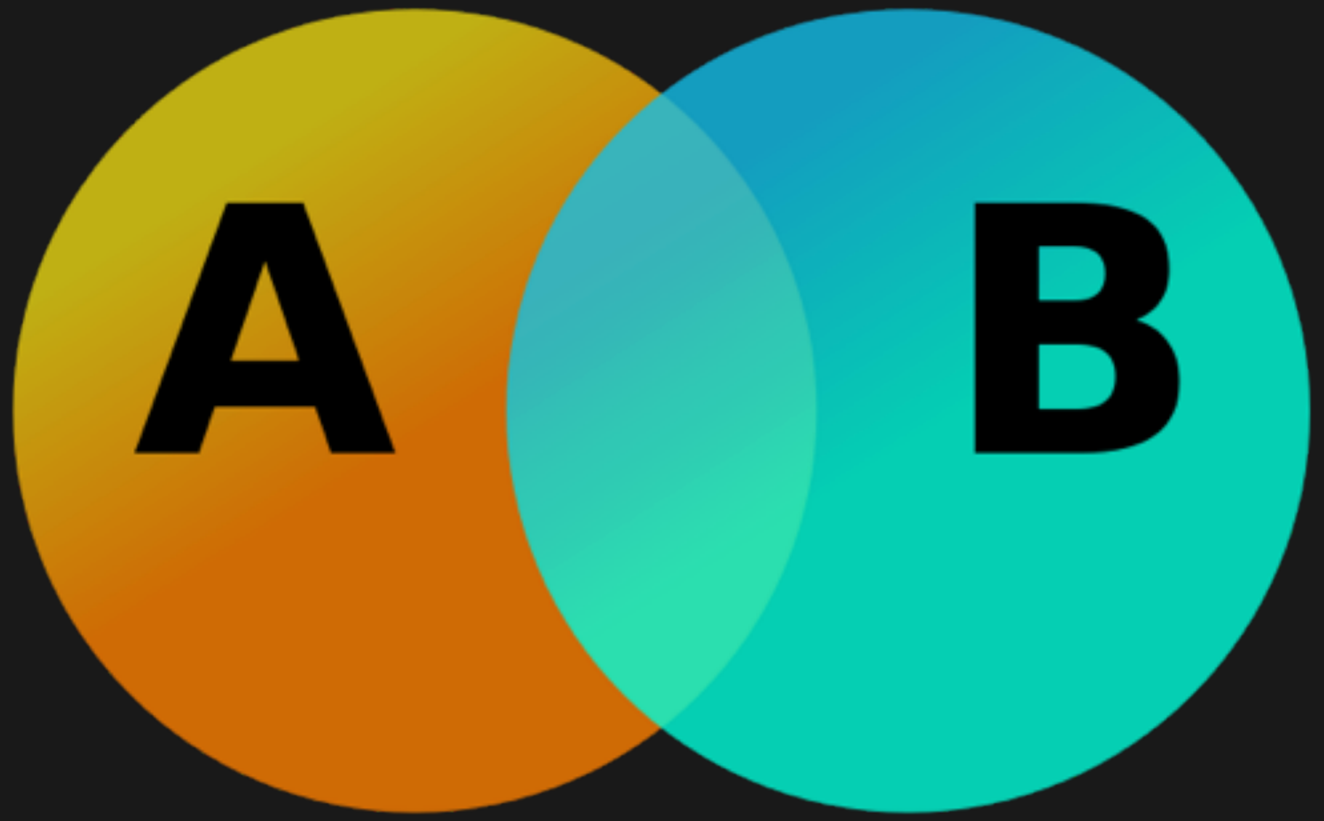
- Diagnosis – predict cause given symptoms (e.g., medical treatment, mechanical repairs)
- Risk assessment (e.g., financial, environmental)
- Product reliability (e.g., electronics, vehicles)

RULES OF PROBABILITY

A and B are events of uncertain occurrence

Probability theory assumes these *axioms*:

- $0 \leq P(A) \leq 1$
- $P(True) = 1$, $P(False) = 0$
- $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$



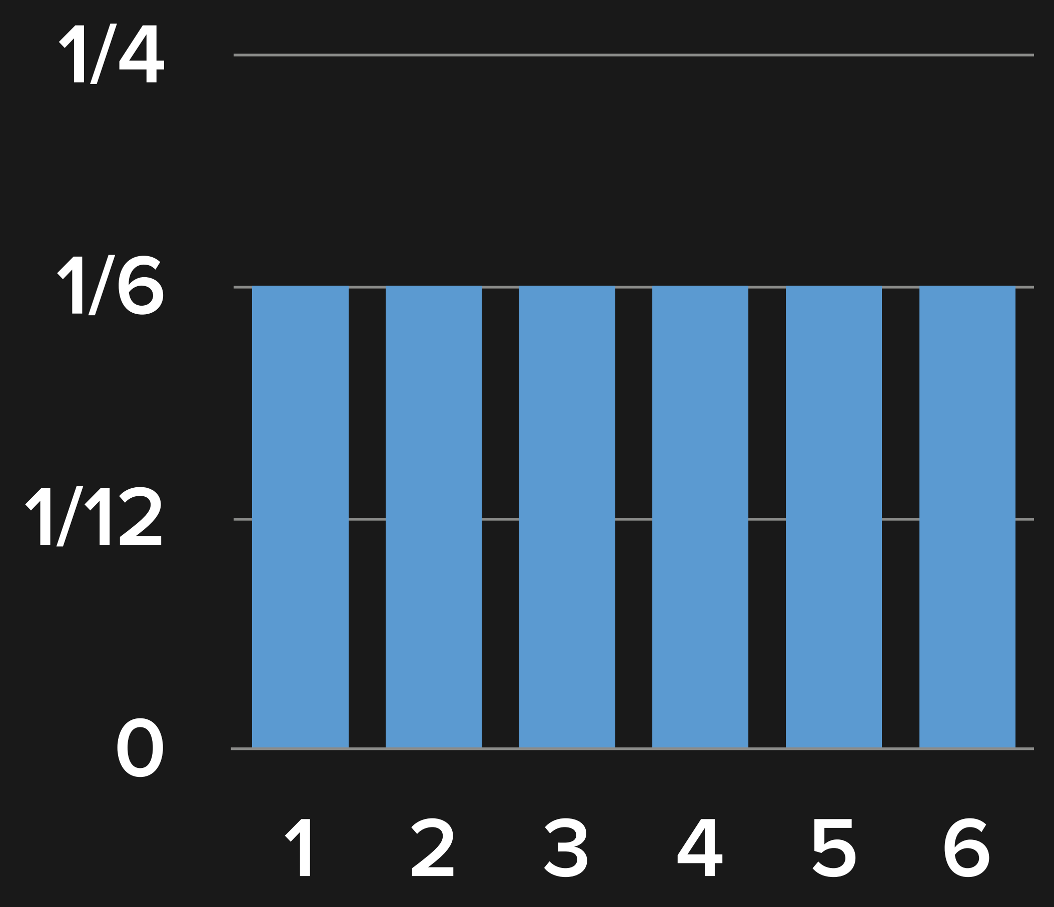
DISCRETE PROBABILITY

Deals with events that occur in countable sample spaces

Examples: coins, dice, cards, random walks

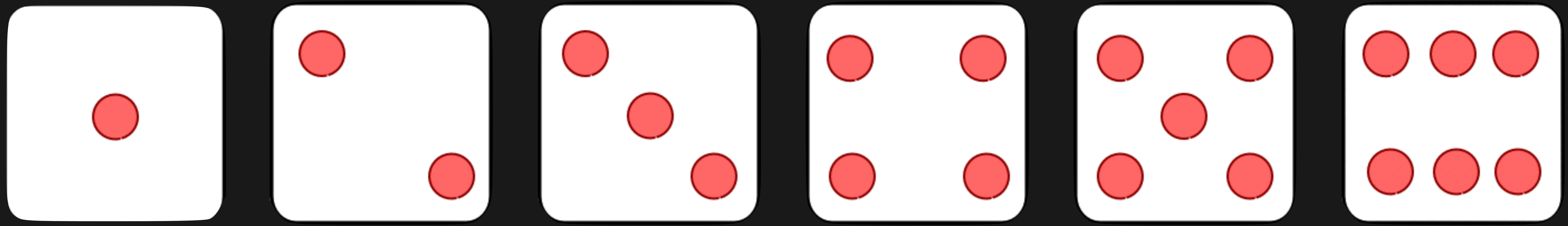
UNIFORM DISTRIBUTION

A known finite number of outcomes are equally likely to occur



Each of *n* values has probability 1/*n*

Example: Rolling a fair die



WORD FREQUENCIES

How many distinct words are in a text sample?

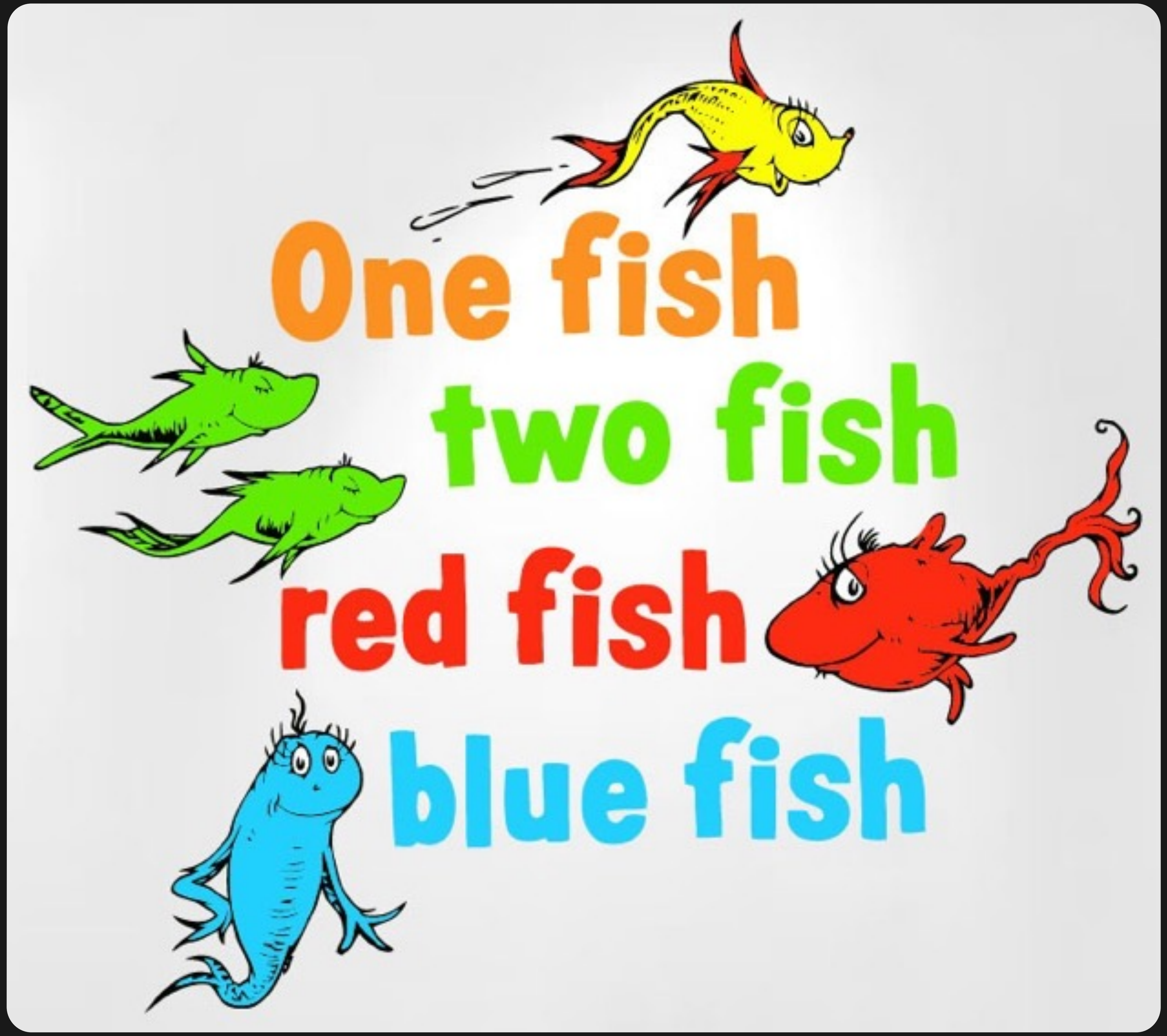
What are the frequencies of individual words?

We distinguish between *tokens* and *types*:

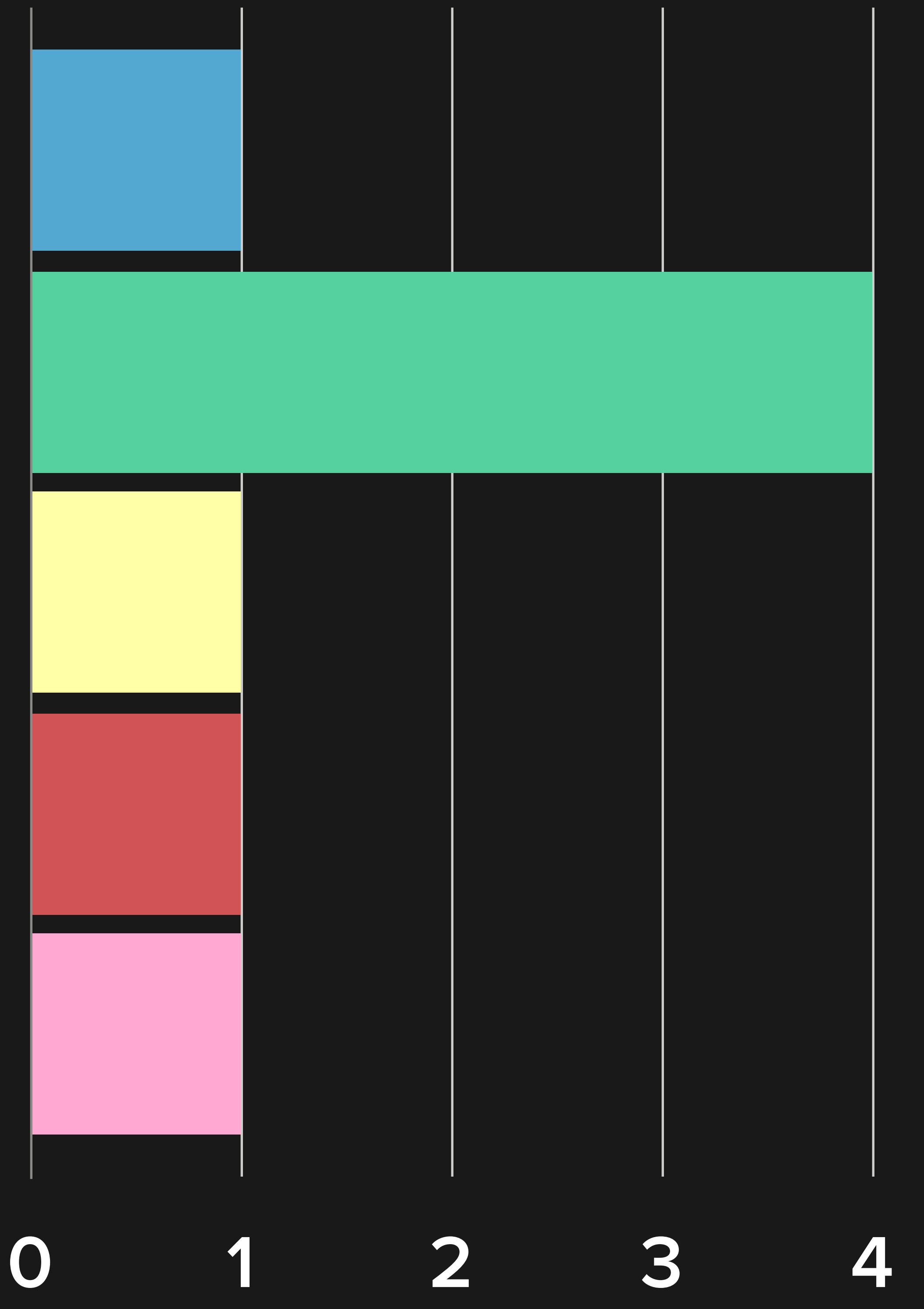
- Tokens – occurrences of words
- Types – distinct words

FREQUENCY DISTRIBUTION

We need to tally tokens in a word histogram



word	count
blue	1
fish	4
one	1
red	1
two	1



SAMPLING DISTRIBUTIONS

What distribution does this Python code use when sampling?

```
words = ('blue', 'fish', 'one', 'red', ‘two')

def sample(seq):
    index = random.randint(0, len(seq) – 1)
    return seq[index]

print(sample(words))
```

How would you change this to sample using word frequencies?

SAMPLING DISTRIBUTIONS

Ideas for how to sample using word frequencies:

- Duplicate words in the list by their multiplicity, then sample that list with uniform distribution
- Accumulate word counts through the list, then find where a uniform random number splits it
- Any other ideas? There are several ways…

FUTURE DIRECTIONS

Collocations and *n*-grams

Conditional probability

Markov models and chains

Text generation and classification

Smoothing and back-off

Today’s milestone – Complete section 4 “Stochastic Sampling” of Twitter Bot tutorial: www.makeschool.com/academy

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