

A wide-angle photograph of a sunset over the ocean. The sun is low on the horizon, casting a bright orange glow across the sky and reflecting off the water. In the foreground, dark, silhouetted vegetation is visible. In the middle ground, two large, dark rock formations stand in the water, part of the Twelve Apostles. The background shows more coastline and a vast expanse of ocean under a dramatic, cloudy sky.

# AI-Driven Development in Go



Dec 9 2021  
@GopherCon

Natalie Pistunovich  
@NataliePis

# Hello

Natalie Pistunovich

On Twitter: **@NataliePis**

Lead Developer Advocate at Aerospike **@aerospikeDB**



# Hello

Natalie Pistunovich

On Twitter: **@NataliePis**

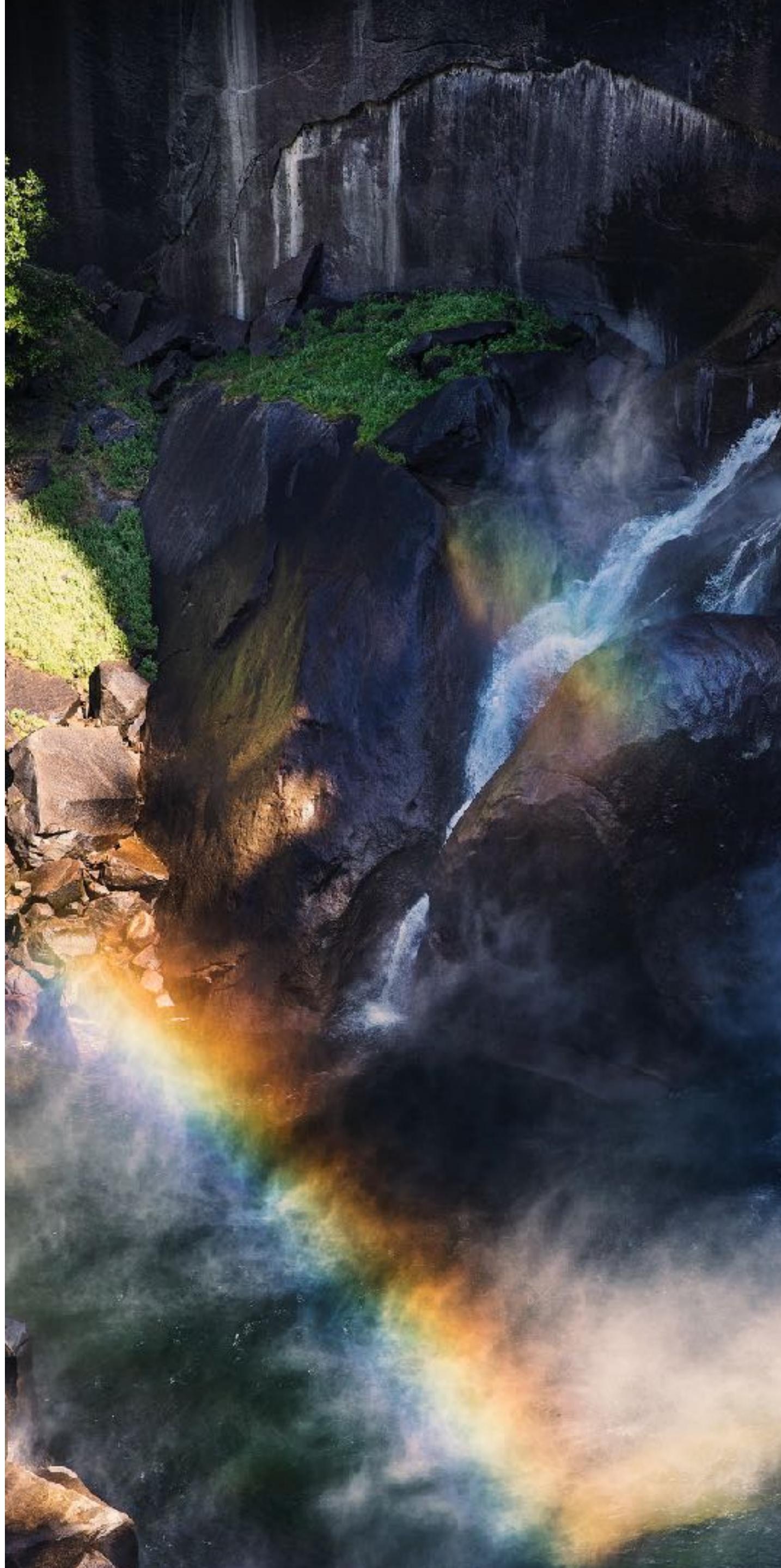
Lead Developer Advocate at Aerospike **@aerospikeDB**



# Hello, AI World

main.go

- A Brief History of AI
- AI-generated Code and Go
- What's next for Gophers?



# Brief History of Artificial Intelligence





# Brief History of AI

- AI seeds were planted by classical philosophers



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI
- 1974–1980: First AI winter



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI
- 1974–1980: First AI winter
- 1980-1987: Boom



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI
- 1974–1980: First AI winter
- 1980-1987: Boom
- 1987-1993: Second AI Winter



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI
- 1974–1980: First AI winter
- 1980-1987: Boom
- 1987-1993: Second AI Winter
- 1993-2011: The AI is back



# Brief History of AI

- AI seeds were planted by classical philosophers
- 1956: AI founded as an academic discipline
- 1956-1974: Symbolic AI
- 1974–1980: First AI winter
- 1980-1987: Boom
- 1987-1993: Second AI Winter
- 1993-2011: The AI is back
- 2011-Today: A(G)I and Big Data

# Brief History of AI Models





# Brief History of AI Models

- 2010: IBM DeepMind founded



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released 117M



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released 117M
- 2019: GPT-2 released 1.5B



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released 117M
- 2019: GPT-2 released 1.5B
- 2020: GPT-3 released 175B

# Where's AI Today?





2050 is closer  
than 1990



Until we meet again.



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released
- 2019: GPT-2 released
- 2020: GPT-3 released **175B**



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released
- 2019: GPT-2 released
- 2020: GPT-3 released **175B**
- 2021: Switch Transformer open sourced **1.6T**



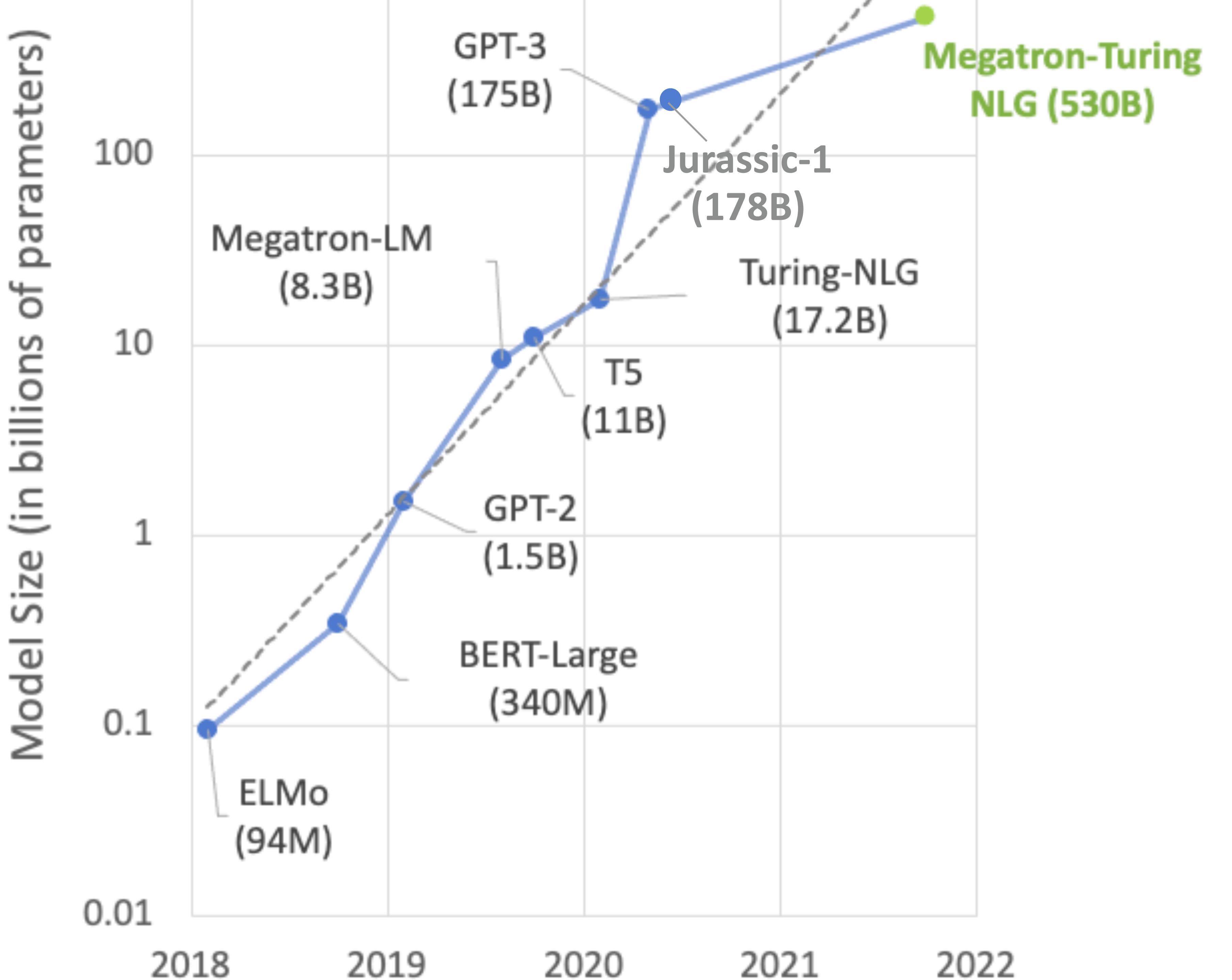
# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released
- 2019: GPT-2 released
- 2020: GPT-3 released **175B**
- 2021: Switch Transformer open sourced **1.6T**  
Wu Dao 2.0 released **1.75T**



# Brief History of AI Models

- 2010: IBM DeepMind founded
- 2014: DeepMind starts collaborating with Google
- 2015: OpenAI founded
- 2017: GoogleAI founded
- 2018: GPT-1 released
- 2019: GPT-2 released
- 2020: GPT-3 released **175B**
- 2021: Switch Transformer open sourced **1.6T**  
Wu Dao 2.0 released **1.75T**  
Megatron-Turing released **530B**





Dr\_Singularity · 14d · *edited 14d*

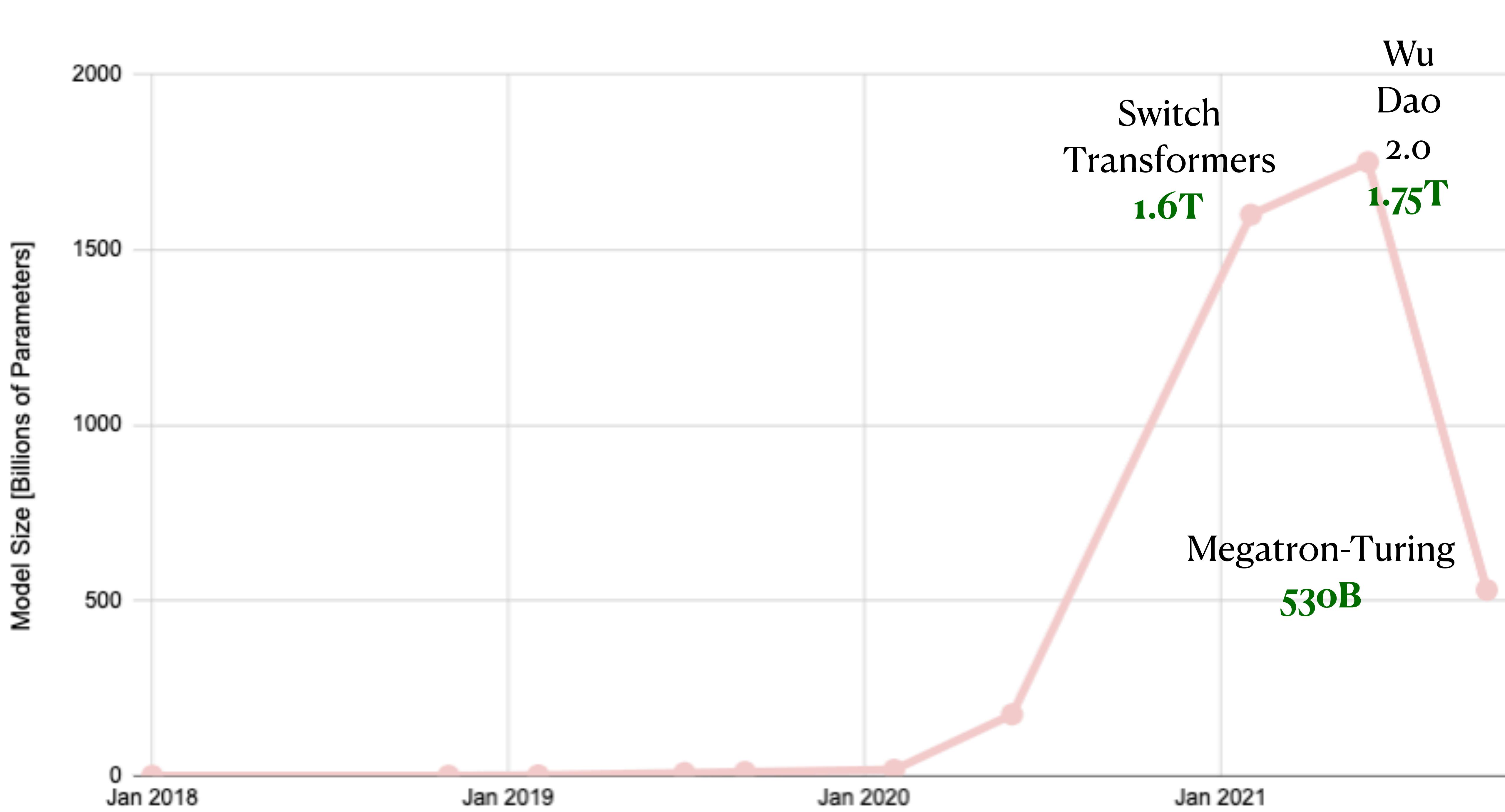
ASI/Singularity 2022-2025

Very nice. Jump from 175B to 530B parameters, comparing with animals brain net sizes

We've just made leap from Mole rat size net(GPT-3) to Octopus size net (~500B)

1/91 size of human cerebral cortex(16T) in 2020 with GPT-3 to

1/30 size of human cerebral cortex - 2021



GPT-4

**100T**

*Not an Official Number*

Switch  
Transformers  
**1.6T**

Wu  
Dao  
2.0  
**1.75T**

Model Size [Billions of Parameters]

100000

75000

50000

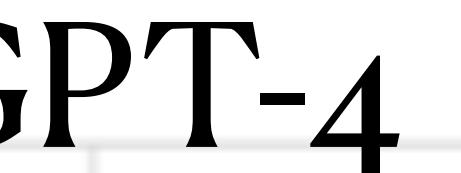
25000

Jan 2018

Jan 2019

Jan 2020

Jan 2021

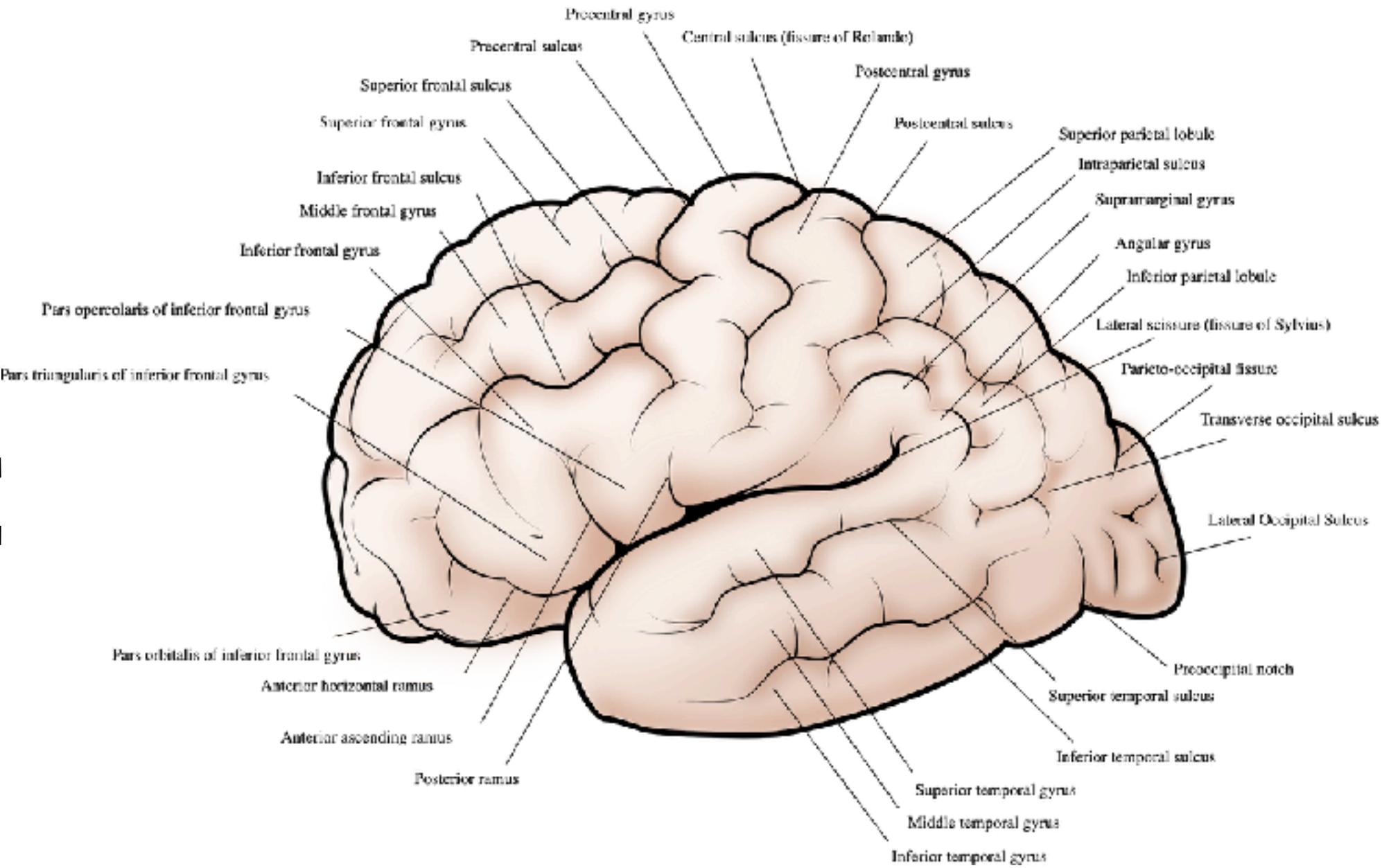


“In a human, there are  
more than 125 trillion  
synapses just in the  
cerebral cortex alone”

- Stephen Smith, Stanford Professor

# GPT4

=



?

# Codex



# Prompt Engineering



# AI-generated Code and Go

A wide-angle photograph of a city skyline at sunset. The sky is filled with dramatic, wispy clouds colored in shades of orange, yellow, and blue. In the foreground, a dark river or body of water reflects the warm colors of the sky. On the right side, the silhouette of a modern city skyline is visible, featuring several prominent buildings, including one with a Mercedes-Benz logo on top. A construction crane is visible on one of the buildings. The overall atmosphere is serene and captures the beauty of urban architecture against a natural sunset backdrop.

# AI-Generated Code and Go

- Codex supports multiple programming languages



# AI-Generated Code and Go

- Codex supports multiple programming languages
  - Go
  - JavaScript
  - Perl
  - PHP
  - Ruby
  - Shell
  - Swift
  - TypeScript
  - Python

# AI-Generated Code and Go

- Codex supports multiple programming languages
- Small code snippet: human generated  $\approx$  machine generated

# Playground

Use a Client Library in Go

X ▾

Save

View code

Share

...

```
1 /* Using the Aerospike client for Go
2 Implement these steps in Go:
3 Open a new connection
4 Create key in namespace "test", in set "set", with name "foo"
5 Store the key
6 Sleep for 5 sec
7 Read the key
8 Iterate over the bins and only the first two
9 Close the connection. */
```

Engine

davinci-codex

▼

Temperature

0.05



Response length

500



Stop sequences

Enter sequence and press Tab

### X # X

X

Top P

1

Frequency penalty

0

Presence penalty

0

Rest of

1

Generate



72

Go ▾

1

```
9 Close the connection. */
10
11 package main
12
13 import (
14     "fmt"
15     "log"
16     "time"
17
18     as "github.com/aerospike/aerospike-client-go"
19 )
20
21 func main() {
22     // define a client to connect to
23     client, err := as.NewClient("127.0.0.1", 3000)
24     if err != nil {
25         log.Fatalln(err.Error())
26     }
27
28     // define the key to be used
29     key, err := as.NewKey("test", "set", "foo")
30     if err != nil {
31         log.Fatalln(err.Error())
32     }
33
34     // define the bins to be used
35     bins := as.BinMap{
36         "bin1": "value1",
37         "bin2": 2,
38         "bin3": 3.3,
39         "bin4": true,
40         "bin5": []byte{0x01, 0x02, 0x03},
41     }
42
43     // write the key
```

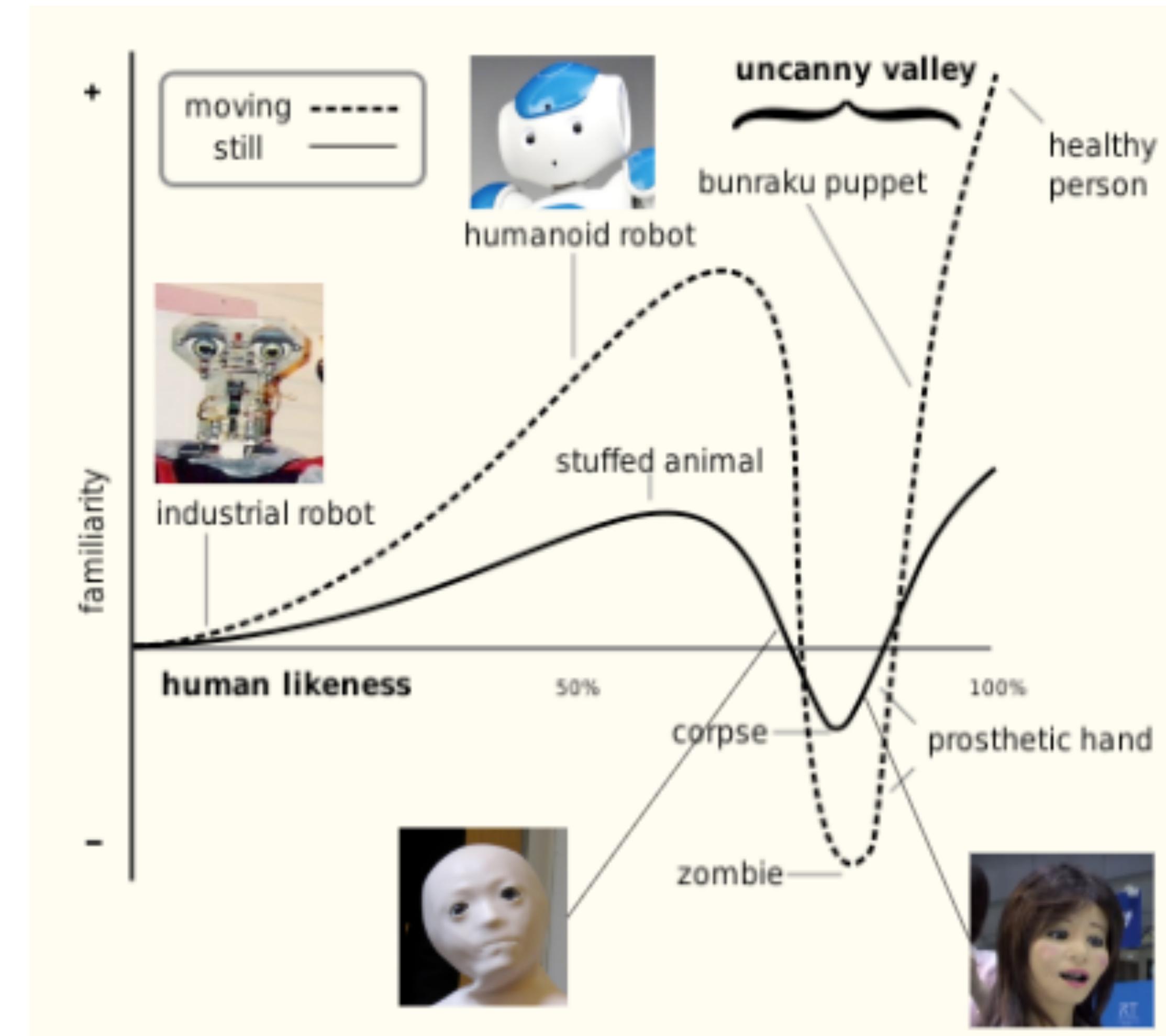
```
42
43     // write the key
44     writePolicy := as.NewWritePolicy(0, 0)
45     err = client.Put(writePolicy, key, bins)
46     if err != nil {
47         log.Fatalln(err.Error())
48     }
49
50     // sleep for 5 seconds
51     time.Sleep(5 * time.Second)
52
53     // read the key
54     readPolicy := as.NewPolicy()
55     rec, err := client.Get(readPolicy, key)
56     if err != nil {
57         log.Fatalln(err.Error())
58     }
59
60     ...
61
62
63
64
65
66
67
68
69
70
71
72
73 }
```

```
56     if err != nil {
57         log.Fatalln(err.Error())
58     }
59
60     // print the record
61     fmt.Println(rec.Bins)
62
63     // iterate over the bins and only print the first two
64     for k, v := range rec.Bins {
65         fmt.Println(k, v)
66         if k == "bin1" || k == "bin2" {
67             fmt.Println(k, v)
68         }
69     }
70
71     // close the connection
72     client.Close()
```

# AI-Generated Code and Go

- Codex supports multiple programming languages
- Small code snippet: human generated  $\approx$  machine generated
- But in a large codebase?

# The Uncanny Valley of Code



# AI-Generated Code and Go

- Codex supports multiple programming languages
- Small code snippet: human generated  $\approx$  machine generated
- But in a large codebase? The Uncanny Valley of code!
- Good thing that Go its already autogenerated with gofmt

# AI-Generated Code and Go

- Codex supports multiple programming languages
- Small code snippet: human generated ≈ machine generated
- But in a large codebase? The Uncanny Valley of code!
- Good thing that Go is already autogenerated with gofmt

**Go is also...**

# AI-Generated Code and Go

- Codex supports multiple programming languages
- Small code snippet: human generated ≈ machine generated
- But in a large codebase? The Uncanny Valley of code!
- Good thing that Go is already autogenerated with gofmt

**Go is also...**

- Standardized and simple: everyone's code looks similar

# AI-Generated Code and Go

- Codex supports multiple programming languages
- Small code snippet: human generated ≈ machine generated
- But in a large codebase? The Uncanny Valley of code!
- Good thing that Go is already autogenerated with gofmt

## Go is also...

- Standardized and simple: everyone's code looks similar
- Easy to read, even if the AI wrote it

# AI-Generated Code and Go

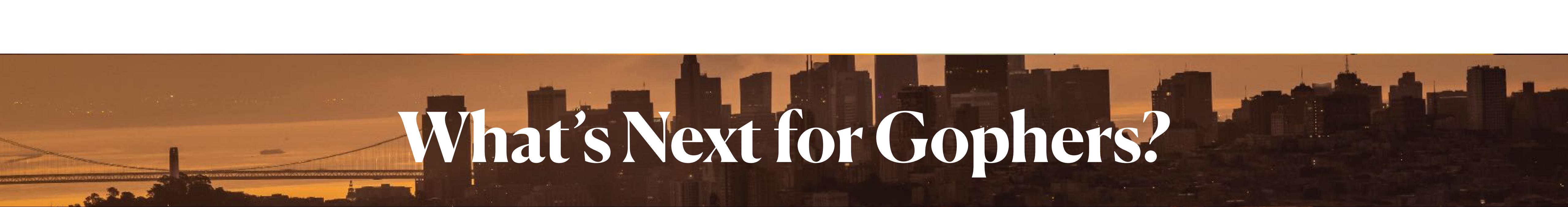
- Codex supports multiple programming languages
- Small code snippet: human generated ≈ machine generated
- But in a large codebase? The Uncanny Valley of code!
- Good thing that Go is already autogenerated with gofmt

## Go is also...

- Standardized and simple: everyone's code looks similar
- Easy to read, even if the AI wrote it
- Parsing the code to a syntax tree, then writes it out according to the language rules

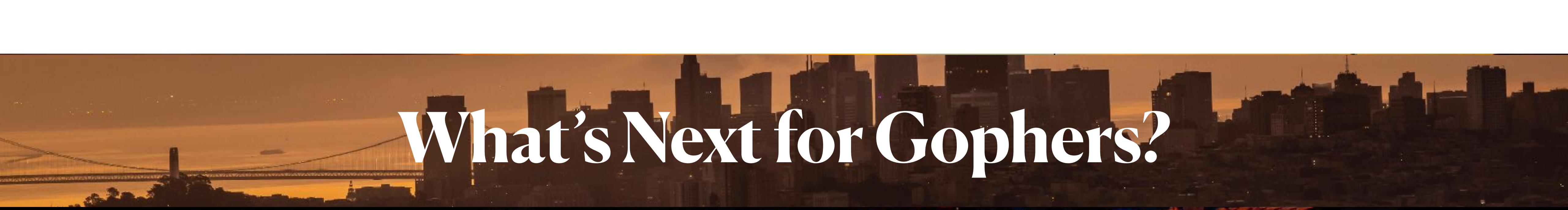
# What's Next for Gophers?





# What's Next for Gophers?

Don't put down your keyboard and leave just yet.



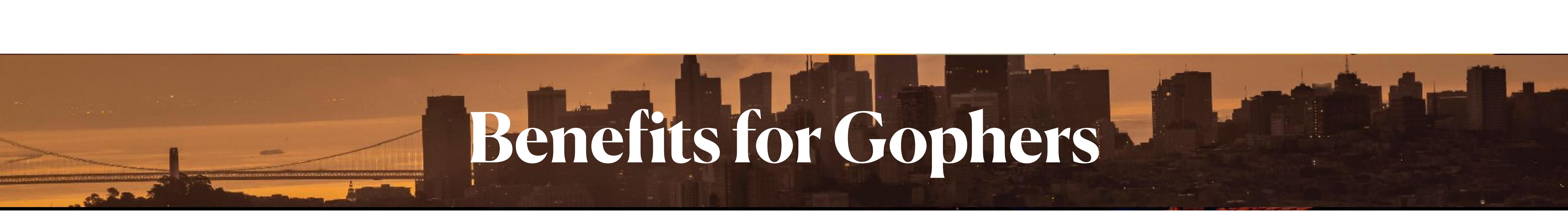
# What's Next for Gophers?

Don't put down your keyboard and leave just yet.

**Hop on the early train and embrace the automation!**

# Benefits for Gophers

A photograph of the San Francisco skyline at sunset. The sky is a warm orange and yellow. In the foreground, the Golden Gate Bridge is visible on the left, and a large body of water with some fog or mist is in the middle ground. The city buildings are silhouetted against the bright sky, with the Transamerica Pyramid being a prominent feature. The overall atmosphere is hazy and scenic.



# Benefits for Gophers

- Automate the repetitive part



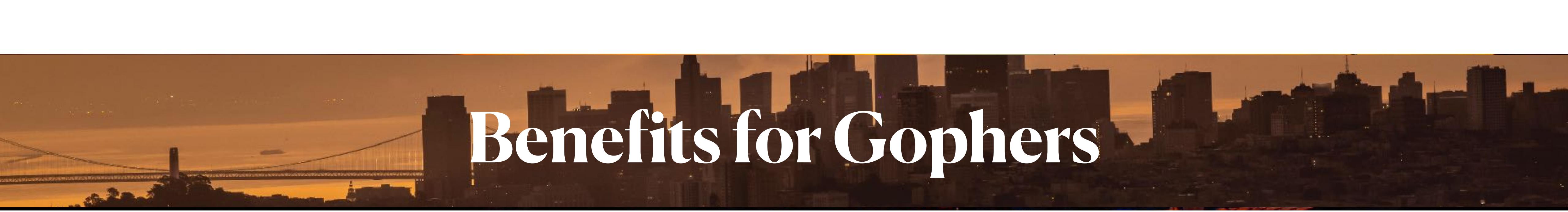
# Benefits for Gophers

- Automate the repetitive part
  - Tests



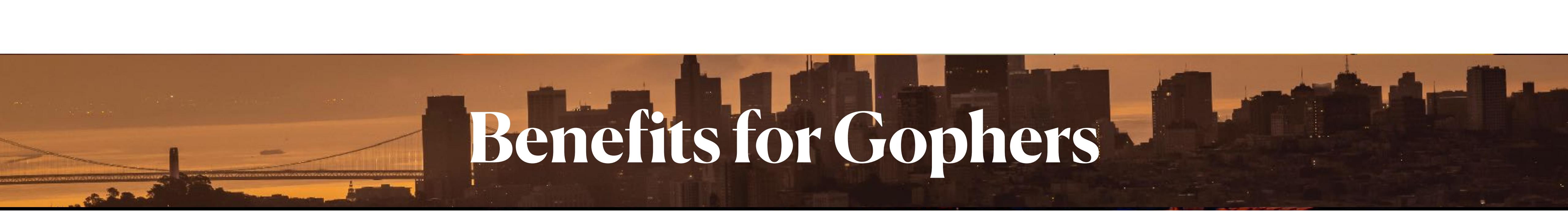
# Benefits for Gophers

- Automate the repetitive part
  - Tests
  - Types



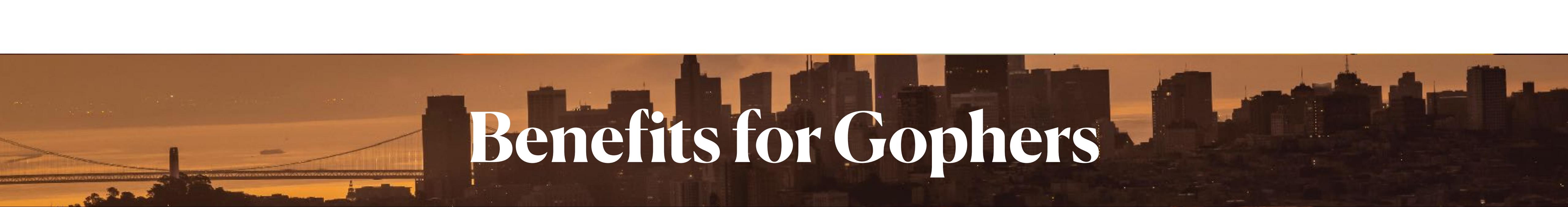
# Benefits for Gophers

- Automate the repetitive part
  - Tests
  - Types
- Get inspired by autocomplete suggestions



# Benefits for Gophers

- Automate the repetitive part
  - Tests
  - Types
- Get inspired by autocomplete suggestions
- Consider alternatives



# Benefits for Gophers

- Automate the repetitive part
  - Tests
  - Types
- Get inspired by autocomplete suggestions
- Consider alternatives
- Automate comments



Natalie  
@NataliePis

What's the ratio of time you spending on writing code/documenting it?

90/10

52.5%

75/25

29.5%

60/40

11.5%

50/50

6.6%

61 votes · Final results

11:41 AM · Aug 27, 2021 · Twitter for iPhone

...



Natalie  
@NataliePis

Follow up survey:

How much faster would you be at your development work if everyone\* would write better documentation?

\* - colleagues, your past self, people who share their OSS projects on GitHub, etc.

10%

16.1%

25%

25.8%

50%

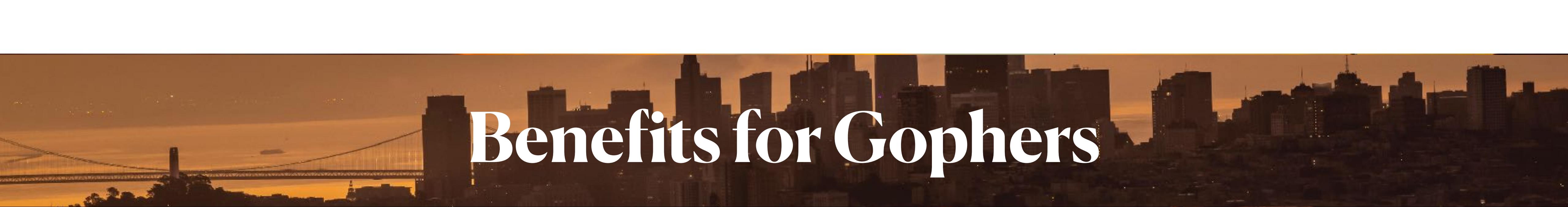
38.7%

100%

19.4%

31 votes · Final results

6:02 PM · Aug 30, 2021 · Twitter for iPhone



# Benefits for Gophers

- Automate the repetitive part
  - Tests
  - Types
- Get inspired by autocomplete suggestions
- Consider alternatives
- Automate comments
- Understand any codebase

# My Prediction





# My Prediction

- AI-generated code will change Software Development
  - Backend
  - Frontend
  - Mobile
  - Game Design
  - QA



# My Prediction

- AI-generated code will change Software Development
  - Backend
  - Frontend
  - Mobile
  - Game Design
  - QA
  - Data Engineering



# My Prediction

- AI-generated code will change Software Development



# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow



# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow
- Everything will be more AI-driven (AKA data-driven AKA ML-driven)



# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow
- Everything will be more AI-driven (AKA data-driven AKA ML-driven)
- Infrastructure and monitoring?



# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow
- Everything will be more AI-driven (AKA data-driven AKA ML-driven)
- Infrastructure and monitoring?



# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow
- Everything will be more AI-driven (AKA data-driven AKA ML-driven)
- Infrastructure and monitoring? Introducing: MLOPS (or AIOPS)

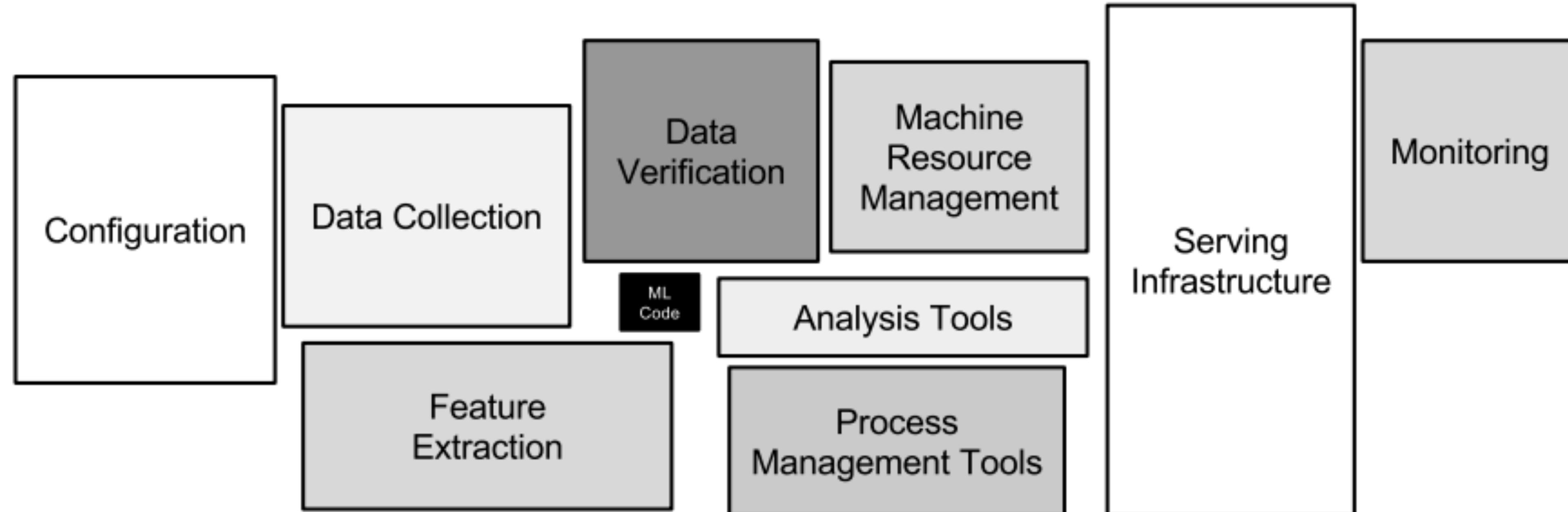


Figure 1: Only a small fraction of real-world ML systems is composed of the ML code, as shown by the small black box in the middle. The required surrounding infrastructure is vast and complex.

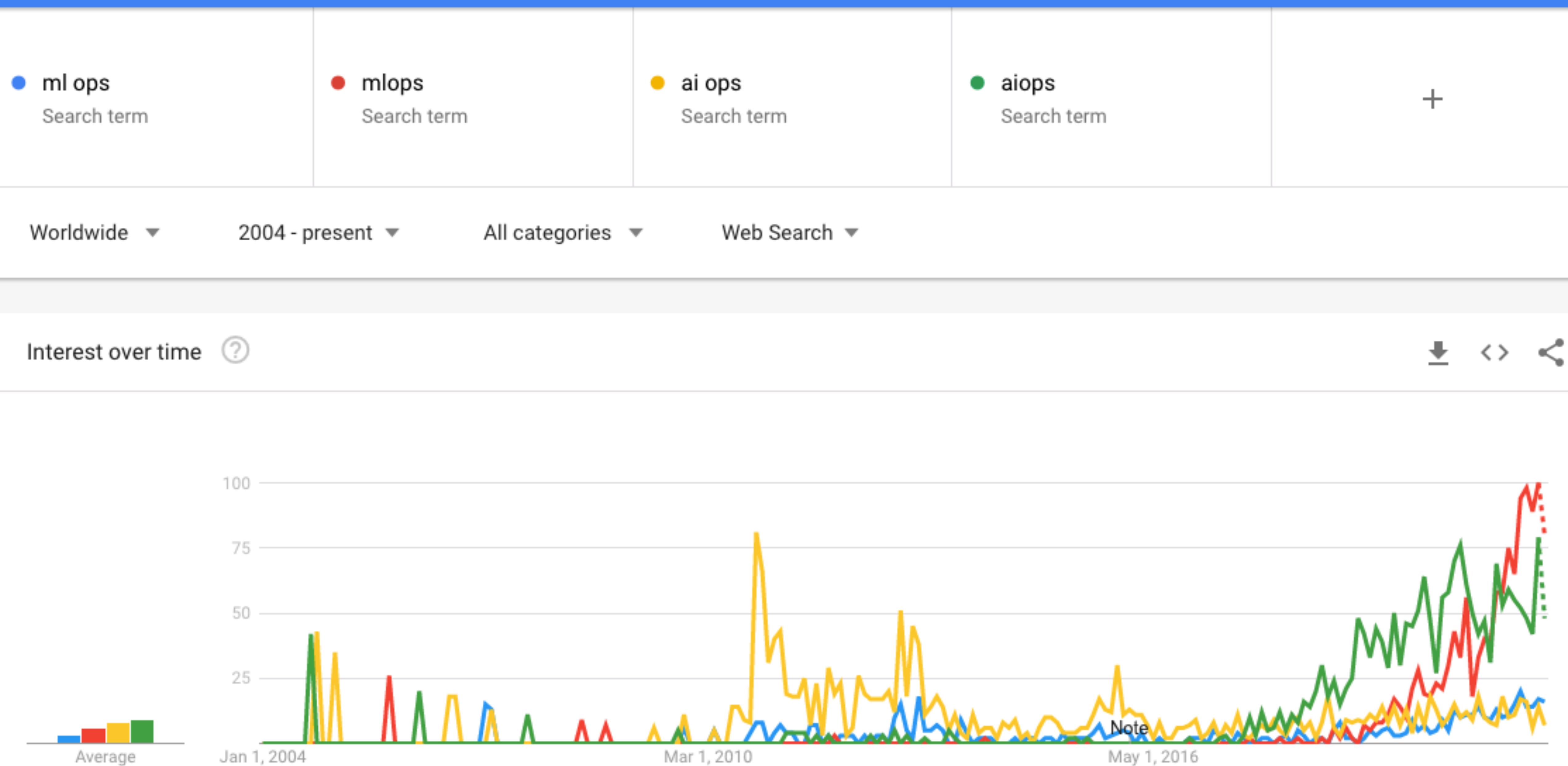
---

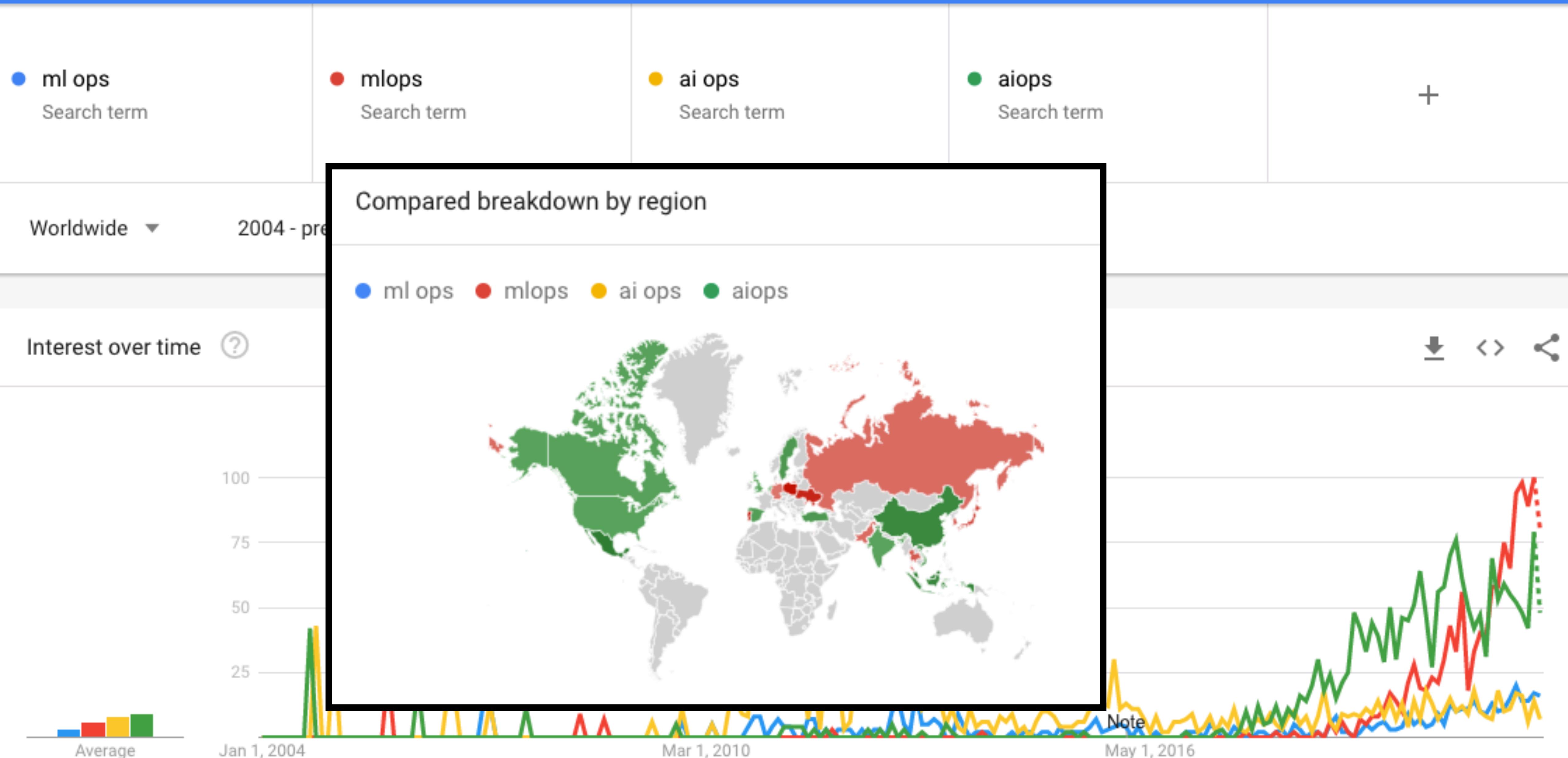
## Hidden Technical Debt in Machine Learning Systems

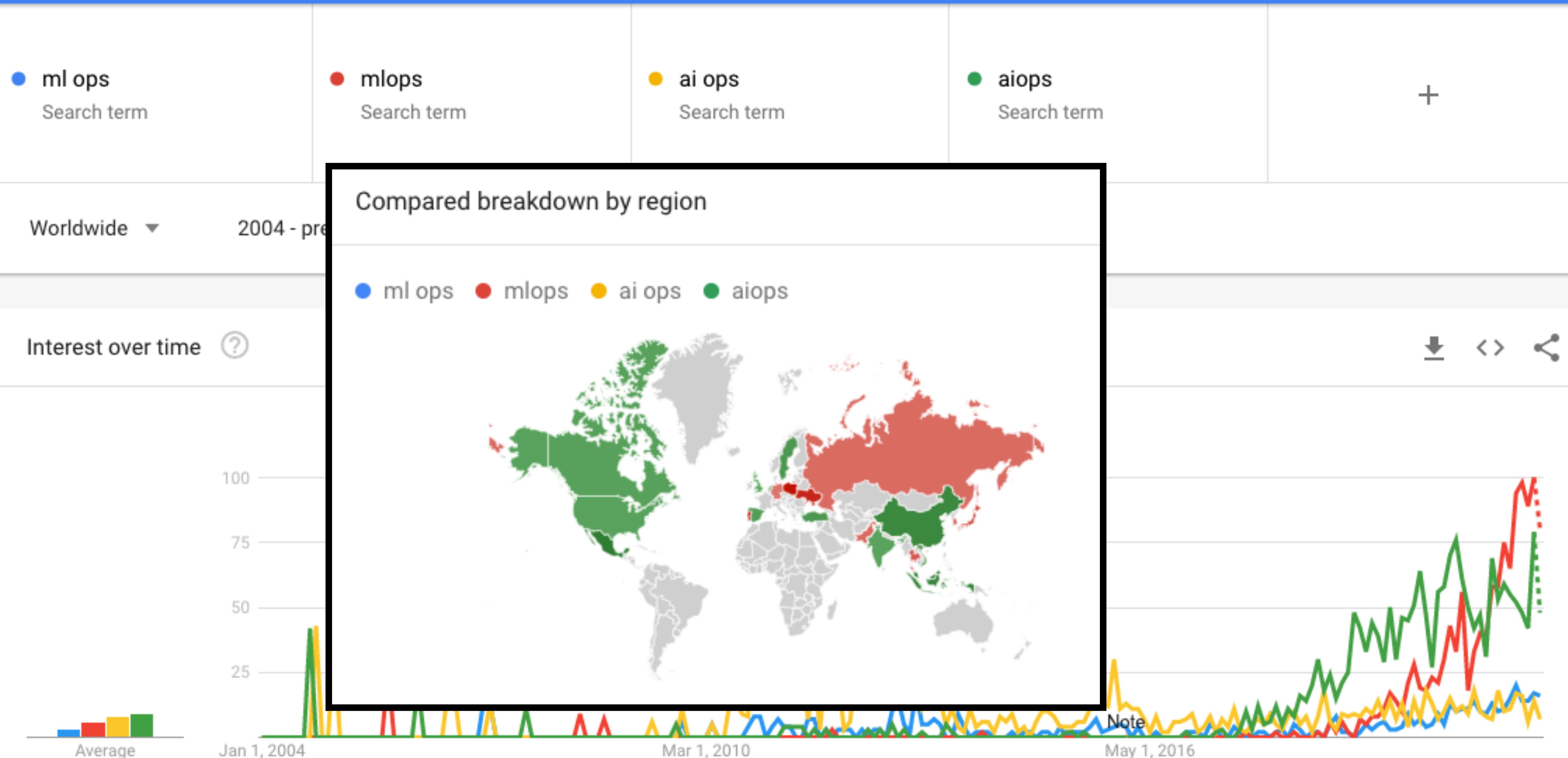
---

**D. Sculley, Gary Holt, Daniel Golovin, Eugene Davydov, Todd Phillips**  
{dsculley, gholt, dg, edavydov, toddphillips}@google.com  
Google, Inc.

**Dietmar Ebner, Vinay Chaudhary, Michael Young, Jean-François Crespo, Dan Dennison**  
{ebner, vchaudhary, mwyoung, jfcrespo, dennison}@google.com  
Google, Inc.









# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow
- Everything will be more AI-driven (AKA data-driven AKA ML-driven)
- Infrastructure and monitoring? Introducing: MLOPS (or AIOPS)



# My Prediction

- AI-generated code will change Software Development
- Code generation will become part of the development flow
- Everything will be more AI-driven (AKA data-driven AKA ML-driven)
- Infrastructure and monitoring? Introducing: MLOPS (or AIOPS)
- Security?

# Get Started





# Get Started

- Apply for access to the AI engines



# Get Started

[beta.openai.com/  
codex-challenge-waitlist](https://beta.openai.com/codex-challenge-waitlist)

[openai.com/join](https://openai.com/join)  
*Now Generally Available*

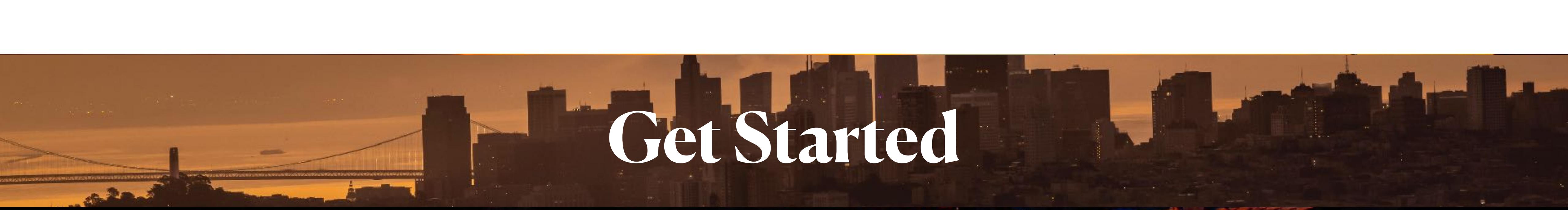
[studio.ai21.com/sign-up](https://studio.ai21.com/sign-up)

[github.com/features/copilot/signup](https://github.com/features/copilot/signup)



# Get Started

- Apply for access to the AI engines
- Practice MLOPS



# Get Started

- Apply for access to the AI engines
- Practice MLOPS



# Get Started

- Apply for access to the AI engines
- Practice MLOPS
- Integrate automation into your flow



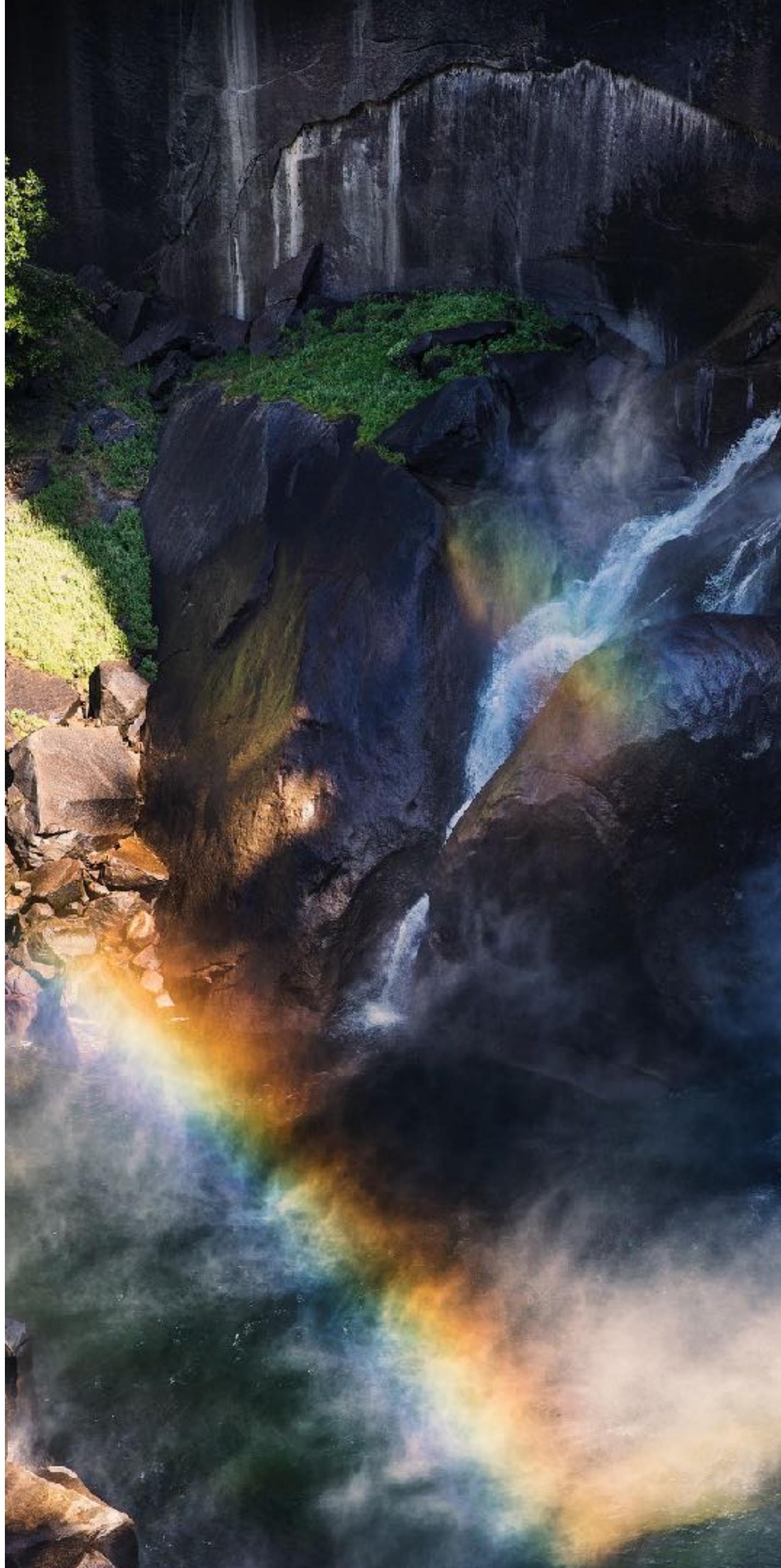
# Get Started

- Apply for access to the AI engines
- Practice MLOPS
- Integrate automation into your flow
- Be excellent to each other

# Recap

## main.go

- A Brief History of AI
  - And the current state of things
- AI-generated Code and Go
  - Go is designed with automation in mind
- What's next for Gophers?
  - Automate even more!



A wide-angle photograph of a sunset over the ocean. The sun is low on the horizon, casting a bright orange glow across the sky and reflecting off the water. In the foreground, dark, silhouetted vegetation is visible. In the middle ground, two large, dark rock formations stand in the water, part of the Twelve Apostles. The background shows more coastline and a vast expanse of ocean under a dramatic, cloudy sky.

# AI-Driven Development in Go



Dec 9 2021  
@GopherCon

Natalie Pistunovich  
@NataliePis