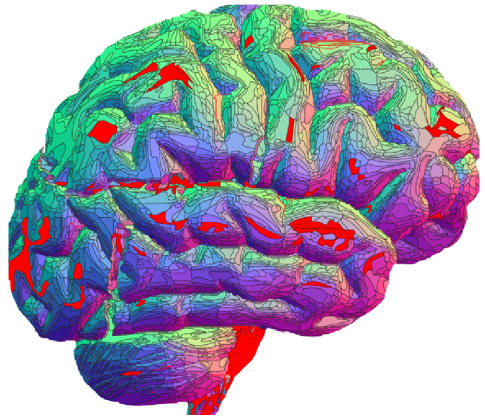


Internet/Cloud/AI





Internet/Cloud/AI

External Brain

**YOU + A.I.**



**ENVIRONMENTAL  
SUPER POWER / HERO  
ATTORNEY**

# As an **environmental attorney** and **problem solver . . .**

A  
B  
C  
D  
E  
F  
G  
H  
I  
J  
K  
L  
M  
N  
O  
P  
Q  
R  
S  
T  
U  
V  
W  
X  
Y  
Z

**using this code**

**to protect this code**

A  
C  
T  
G



# 26 letters

Your quiver . . .

## BINARY CODE ALPHABET REFERENCE

1	A	00001	14	N	01110
2	B	00010	15	O	01111
3	C	00011	16	P	10000
4	D	00100	17	Q	10001
5	E	00101	18	R	10010
6	F	00110	19	S	10011
7	G	00111	20	T	10100
8	H	01000	21	U	10101
9	I	01001	22	V	10110
10	J	01010	23	W	10111
11	K	01011	24	X	11000
12	L	01100	25	Y	11001
13	M	01101	26	Z	11010



# 600,000 words

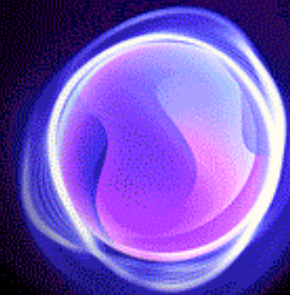
[English]

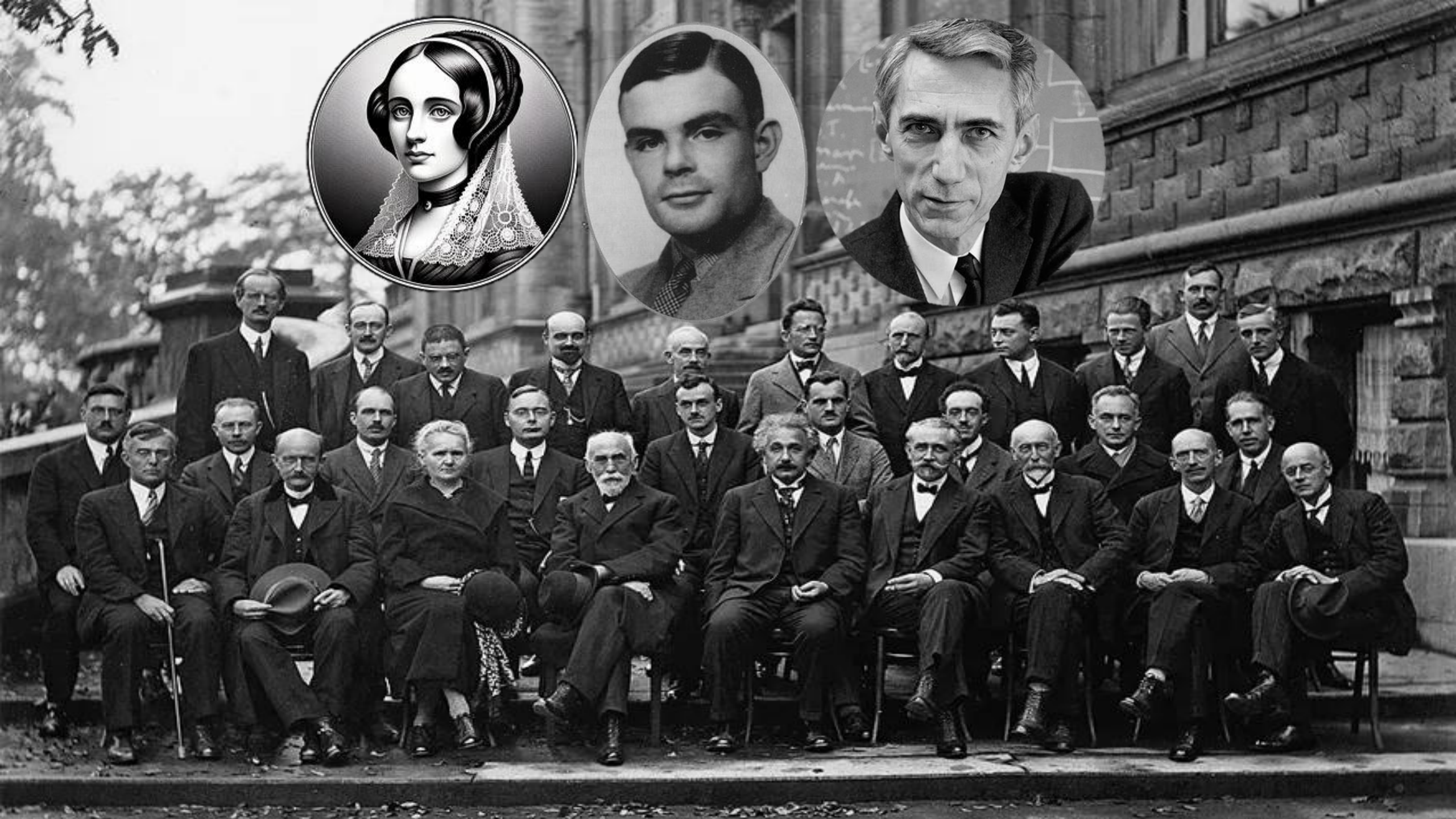
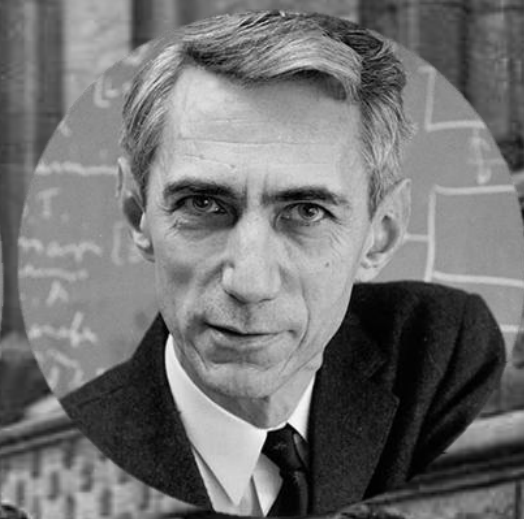
# **Presentation will cover . . .**

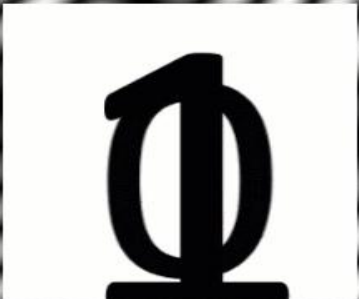
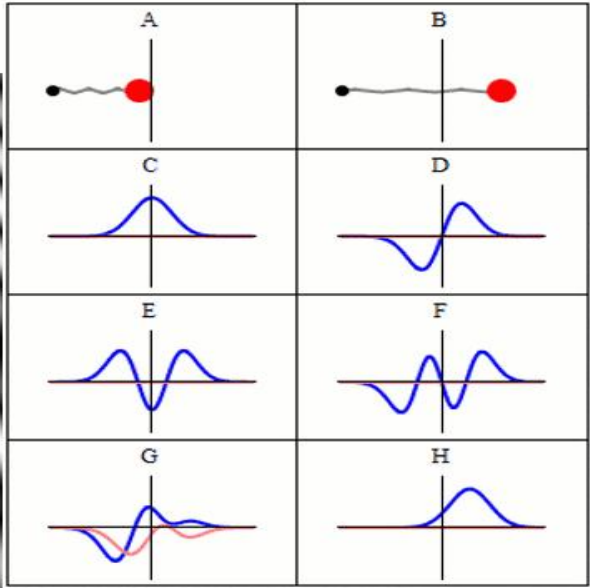
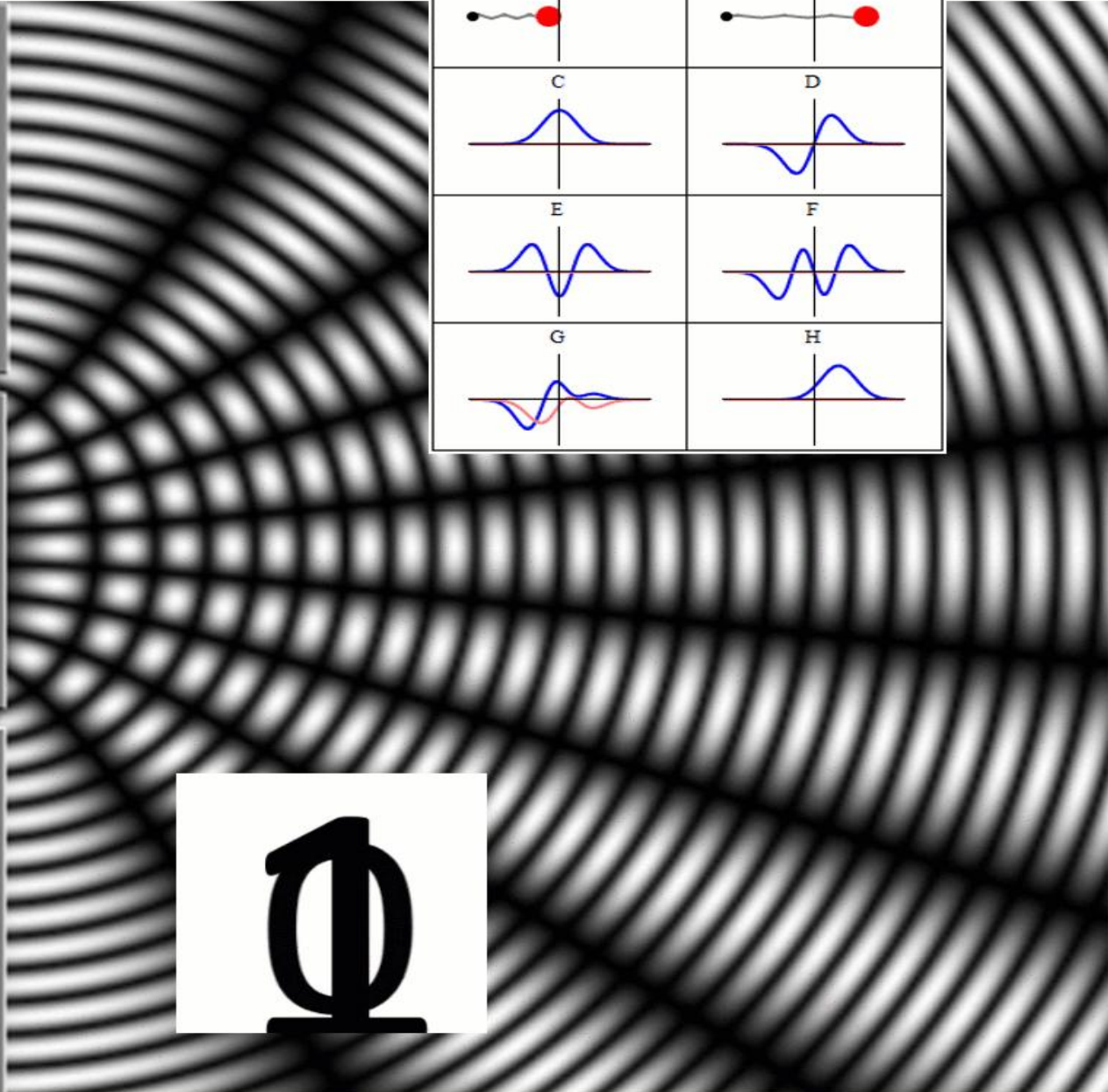
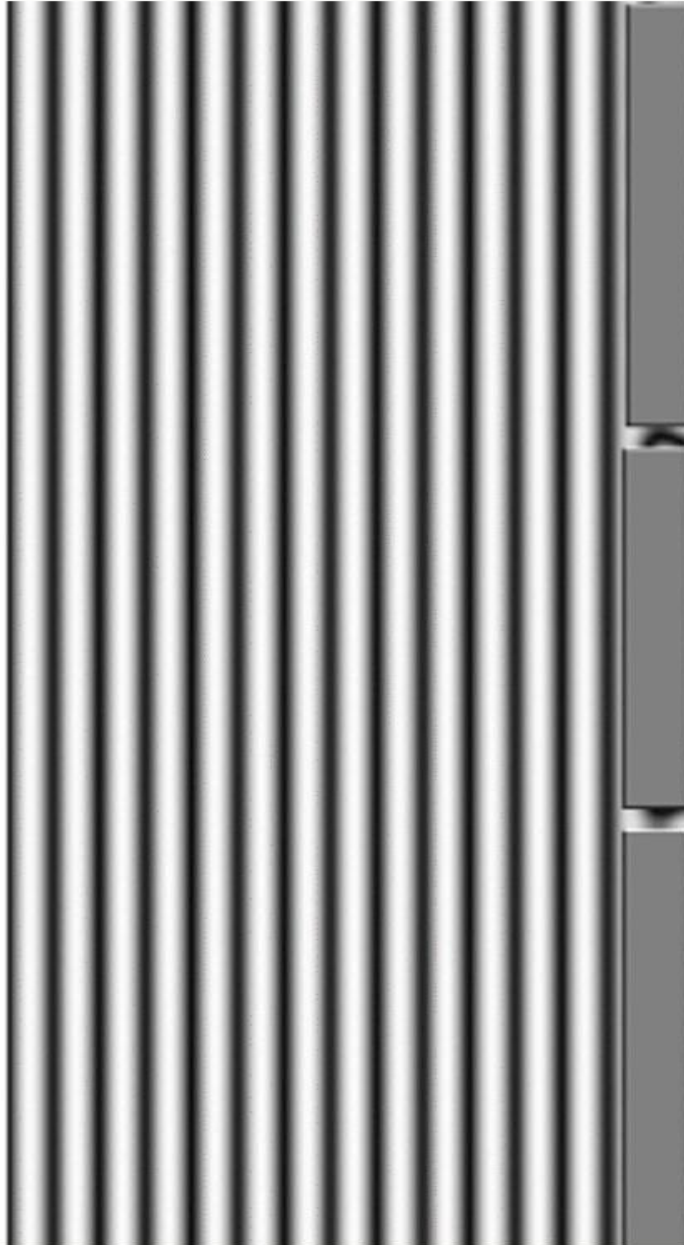
- ✓ **How does AI work?**
- ✓ **Where's it headed?**
- ✓ **Current uses in environmental law?**
- ✓ **Future uses in environmental law?**
- ✓ **Final Tips & Thoughts**

**How does AI  
work?**

Ai

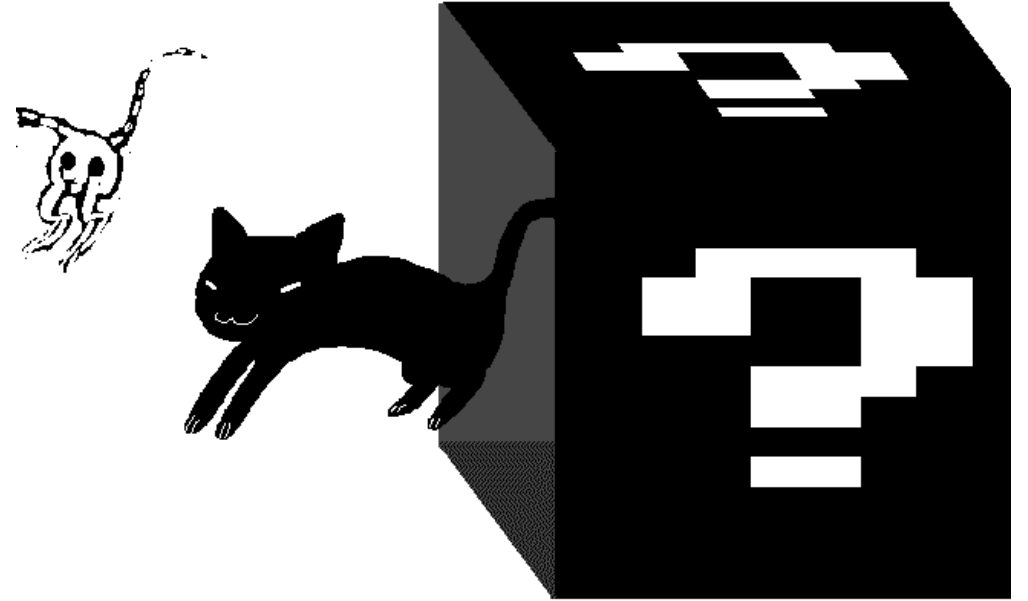






“Everything we call real is made of things that cannot be regarded as real. If quantum mechanics hasn't profoundly shocked you, you haven't understood it yet.”

— Niels Bohr



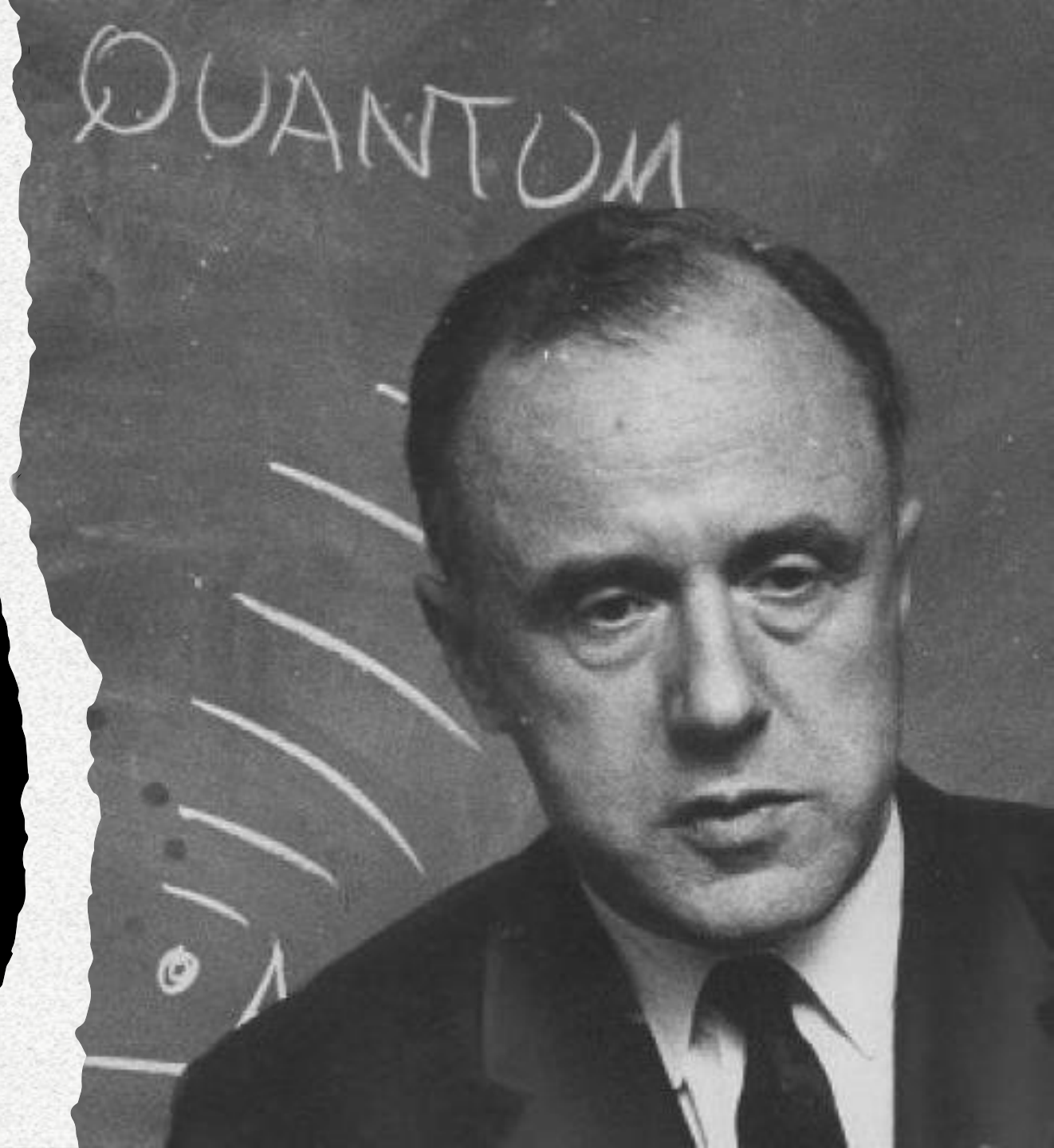
**Schrodinger took his cat to the vet.**

The vet said, “I have good news and bad news.”

“All things  
physical are  
information.”

— John Wheeler

Princeton University





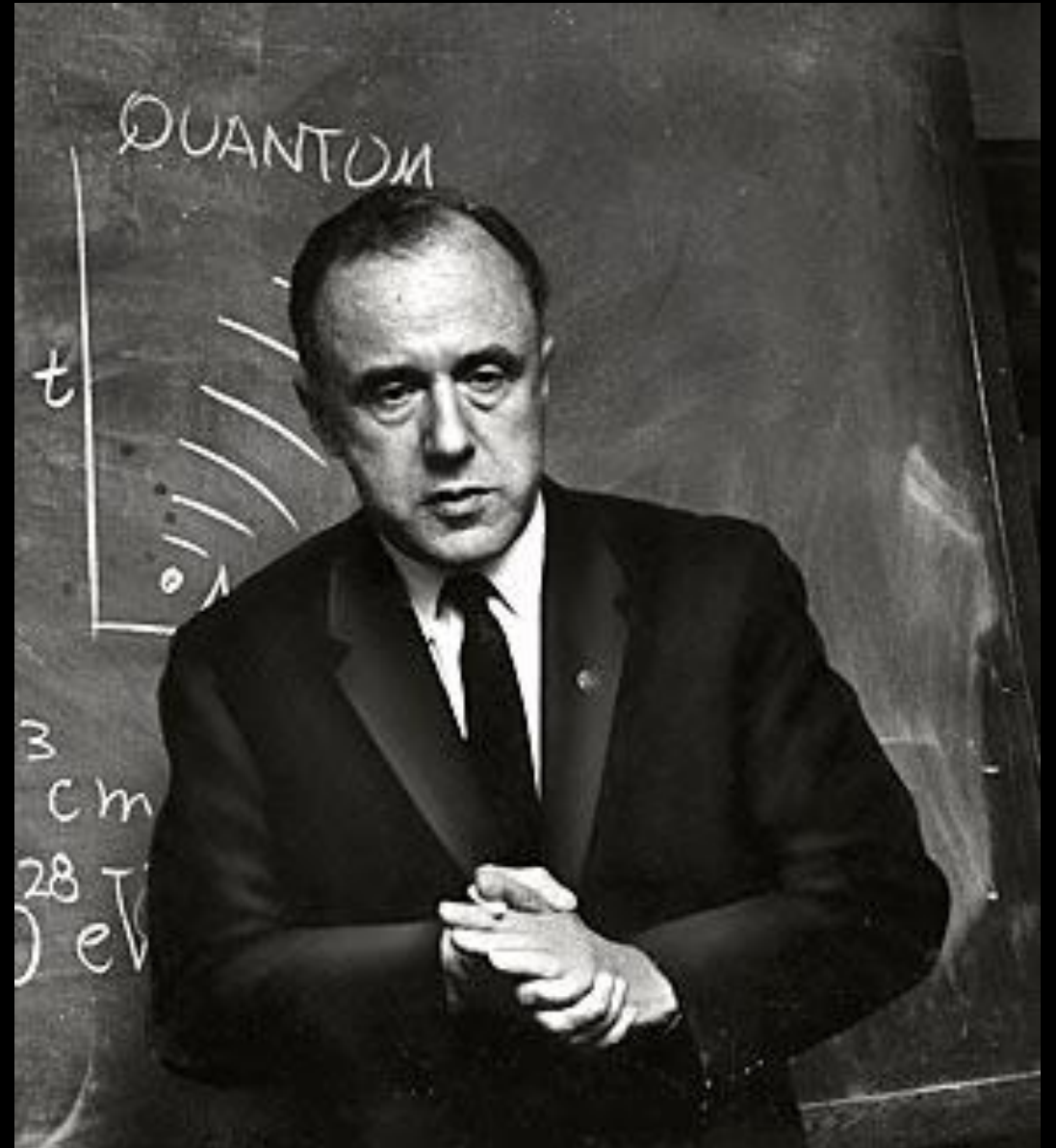
**“It from bit.”**

**– John Wheeler**

**“If and when we learn how to combine bits in fantastically large numbers to obtain what we call existence, we will know better what we mean both by bit and by existence.”**

**-John Wheeler**

Princeton University



$10^{90}$

Bits of information in the universe

[This includes human-generated information]

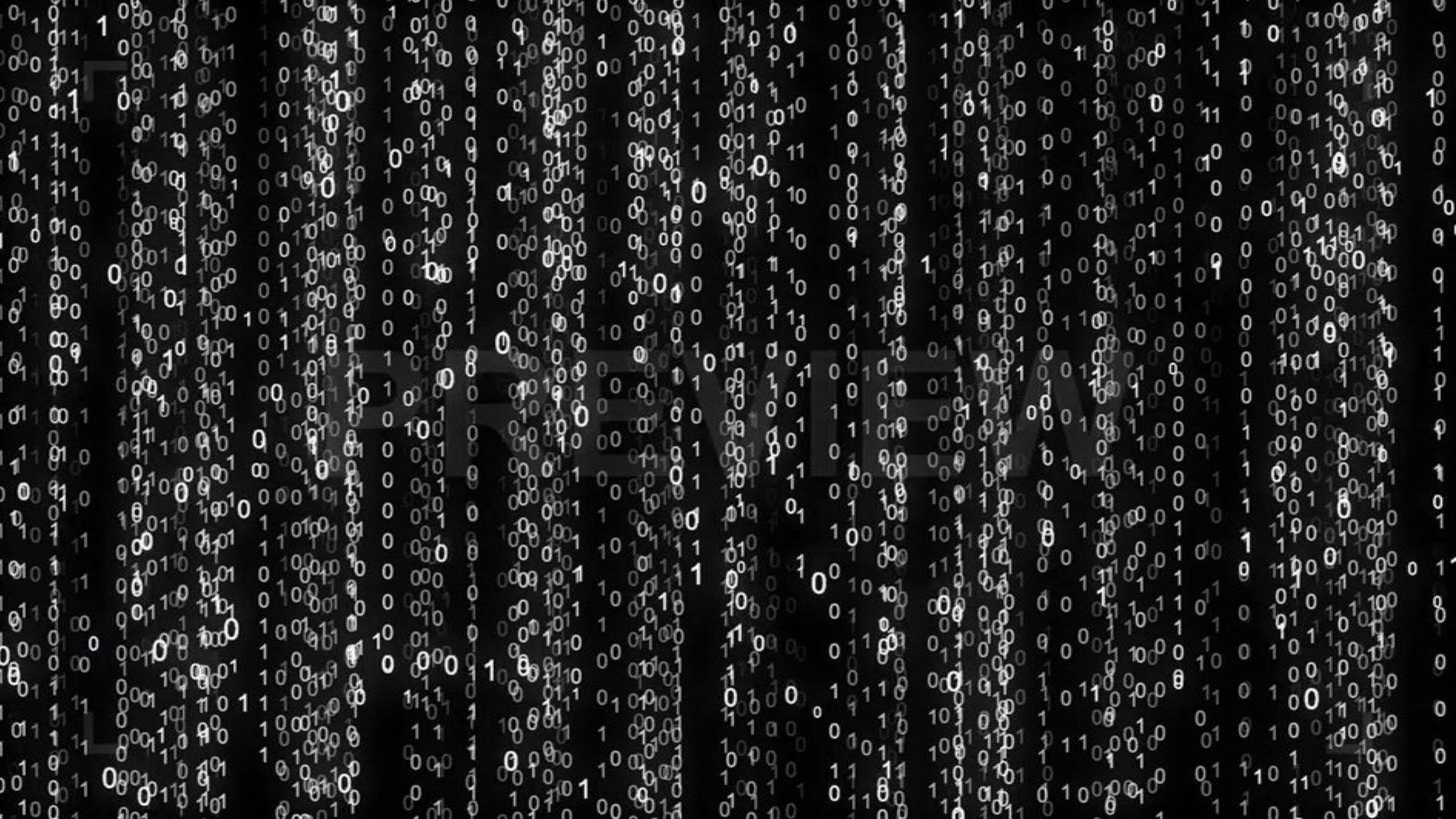
(MIT, 2002)

$10^{45}$

Bits of human-generated  
information

$10^{21}$

Bits of human-generated  
information GPT-3 was trained on



# All “Its” are also Bits or Representable as Bits

## TREE

01001101001  
01010111011  
11011101110  
01011101100  
01010110111  
[etc.]

## MUSIC

01001101001  
01010111011  
11011101110  
01011101100  
01010110111  
[etc.]

## WORDS

01001101001  
01010111011  
11011101110  
01011101100  
01010110111  
[etc.]

## COOKIE

01001101001  
01010111011  
11011101110  
01011101100  
01010110111  
[etc.]

## MATH

01001101001  
01010111011  
11011101110  
01011101100  
01010110111  
[etc.]

## UNIVERSE

01001101001  
01010111011  
11011101110  
01011101100  
01010110111  
[etc.]



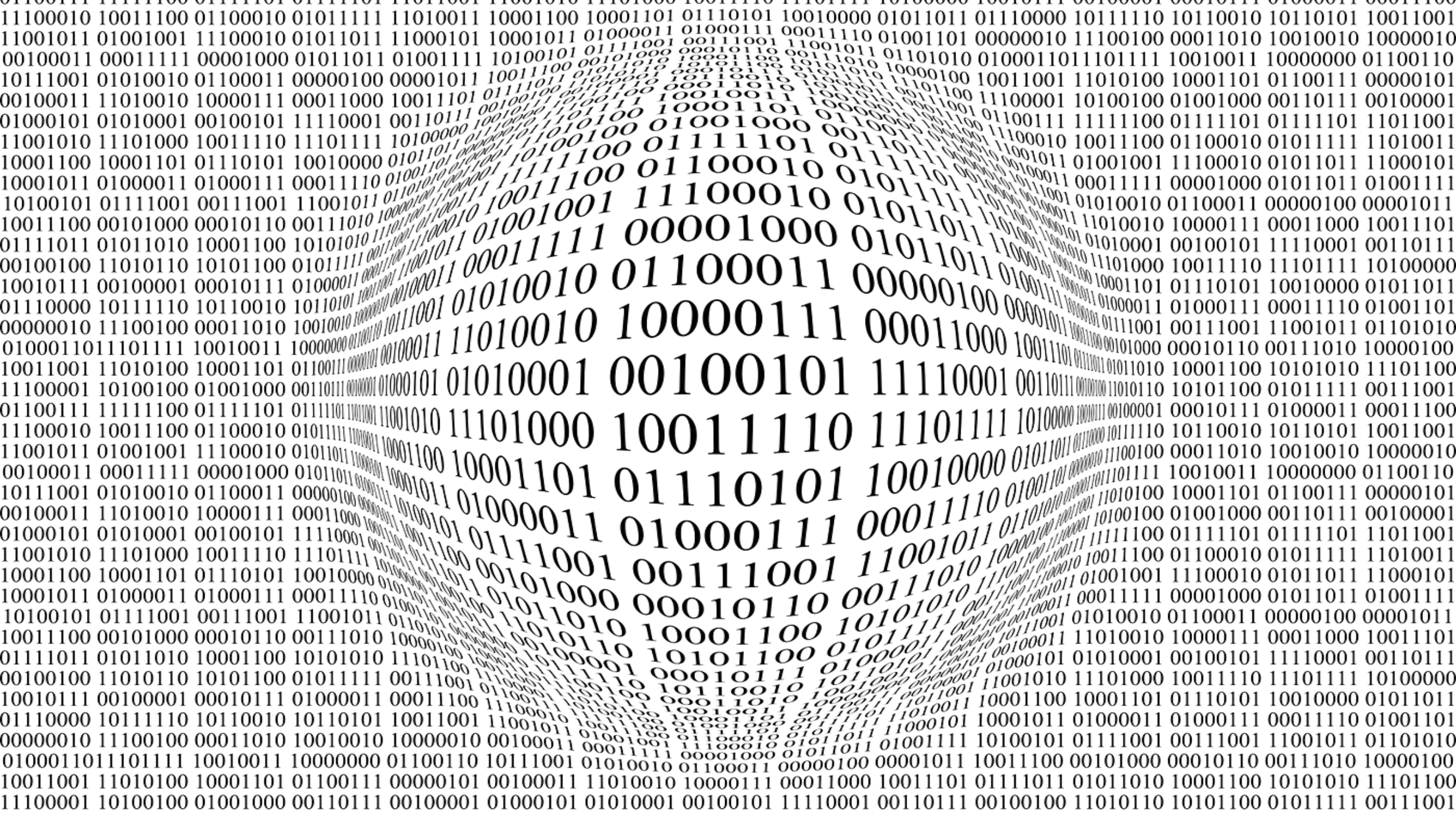
**Human Being =**  
comprised of  
**6 Billion Bits**

CTAAAGATGATCTTTAGTCCCGGTTTCGAA  
TCTTTAGTCCCGGTTGATAACACCAACC  
GTAATACCAACCGGGACTAAAGATCCCG  
GGGACTAAAGTCCCACCCCTATATATATG

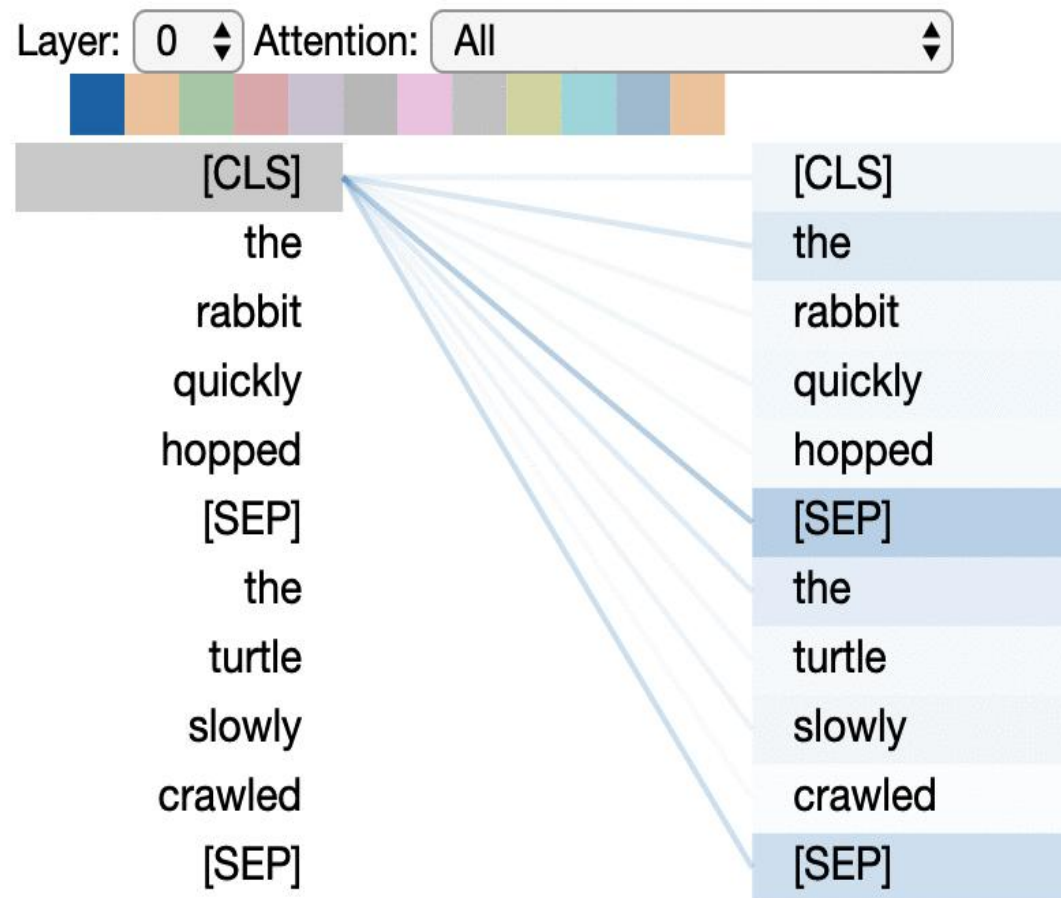
TTCAAATTTCTTCAAAAAGAGGGGAG  
GTGATTACATACAAATCGGAGGTGCCTA  
TTTGTCATACTACATTTGCACCTATGTTTT  
GTAAGTTGATGAGAGAGAAAATGTGTGT

TTTGCTAAACAAGGTTTTATAAAATAGTTG  
AAATAATAGAAAACAAACTAAAATGAAAAT  
TATTACTTAACAAATAGTTTTTAAGAATTAT  
AATAAAGATATCTTATAATTATTGTATGACT

ACGGTTTTTTTGACTCATGTAGATGGATC



**Words  
are just  
data.**



# 26 letters



All just "Bits" ...

## BINARY CODE ALPHABET REFERENCE

1	A	00001	14	N	01110
2	B	00010	15	O	01111
3	C	00011	16	P	10000
4	D	00100	17	Q	10001
5	E	00101	18	R	10010
6	F	00110	19	S	10011
7	G	00111	20	T	10100
8	H	01000	21	U	10101
9	I	01001	22	V	10110
10	J	01010	23	W	10111
11	K	01011	24	X	11000
12	L	01100	25	Y	11001
13	M	01101	26	Z	11010

# 600,000 words [English]

Languages are always evolving.

English has only  
been around for  
1,400 years.

**LANGUAGE KEEPS  
GETTING SIMPLER!**

Complicated.

A B C D E F G  
H I J K L M N  
O P Q R S T  
U V W X Y Z

Simpler.

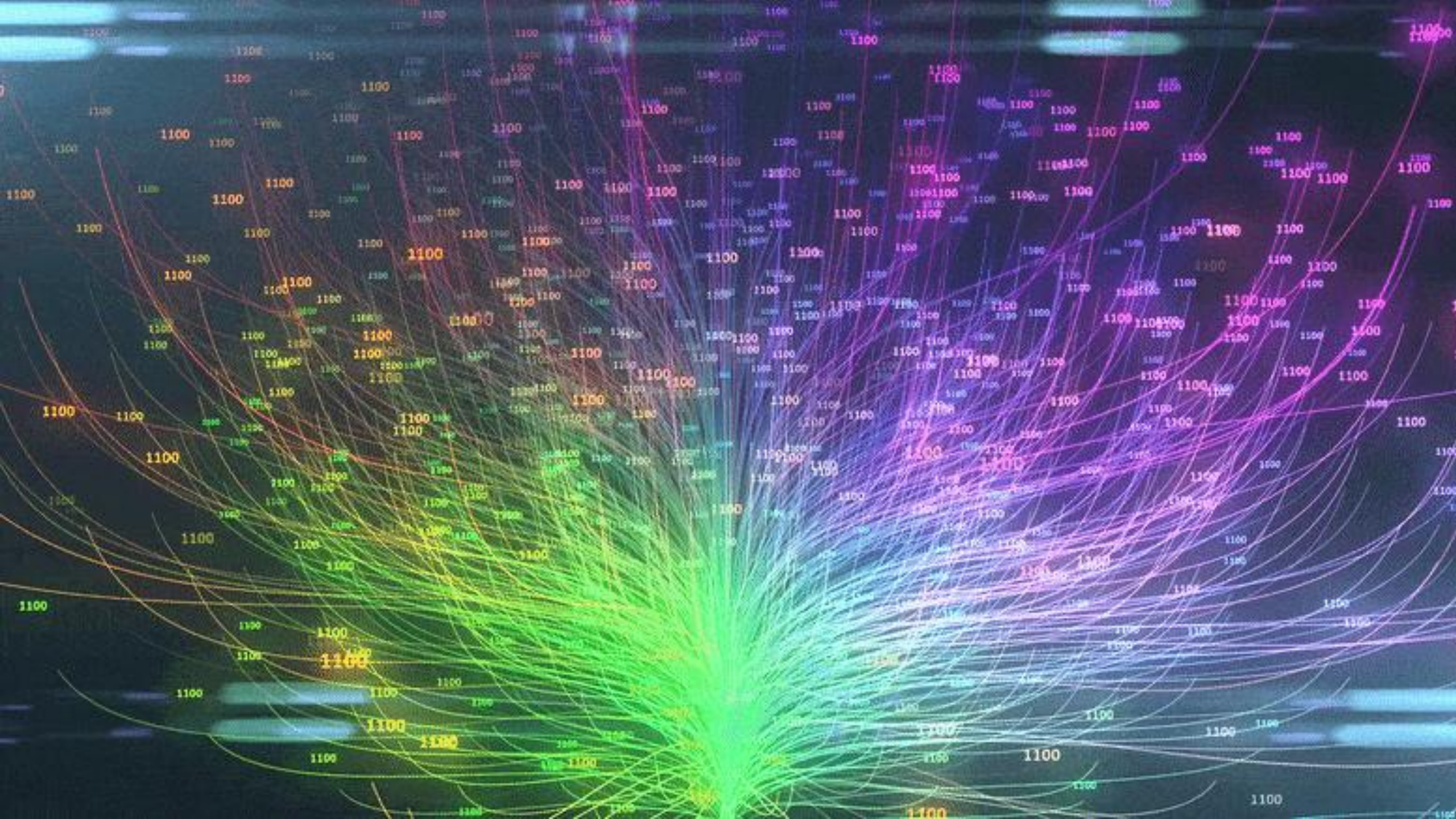
**0** or **1**

Simplest.

**0**

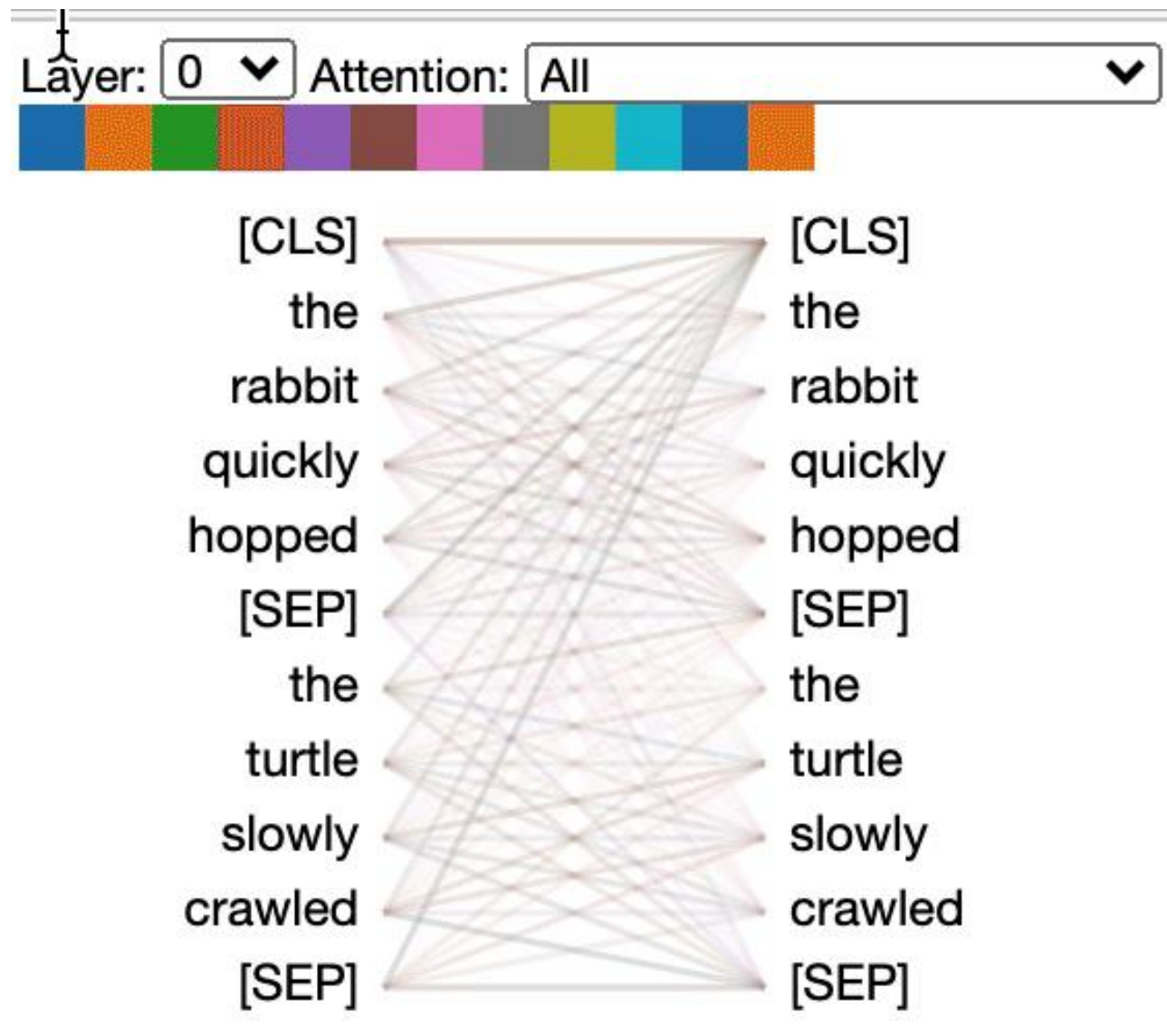
The image features a black background with numerous white, uppercase letters scattered across it. The letters are of various sizes and orientations, creating a sense of randomness. In the center, there is a dense, roughly circular cluster of letters that is more concentrated than the surrounding area. Overlaid on this central cluster is the text "Words going into the Large Language Model" in a bold, white, sans-serif font. The text is arranged in two lines, with "Words going into the Large" on the top line and "Language Model" on the bottom line. The overall composition suggests a theme of data input or processing for a language model.

**Words going into the Large  
Language Model**



# Words are just data.

**NLP** (natural language  
processing)



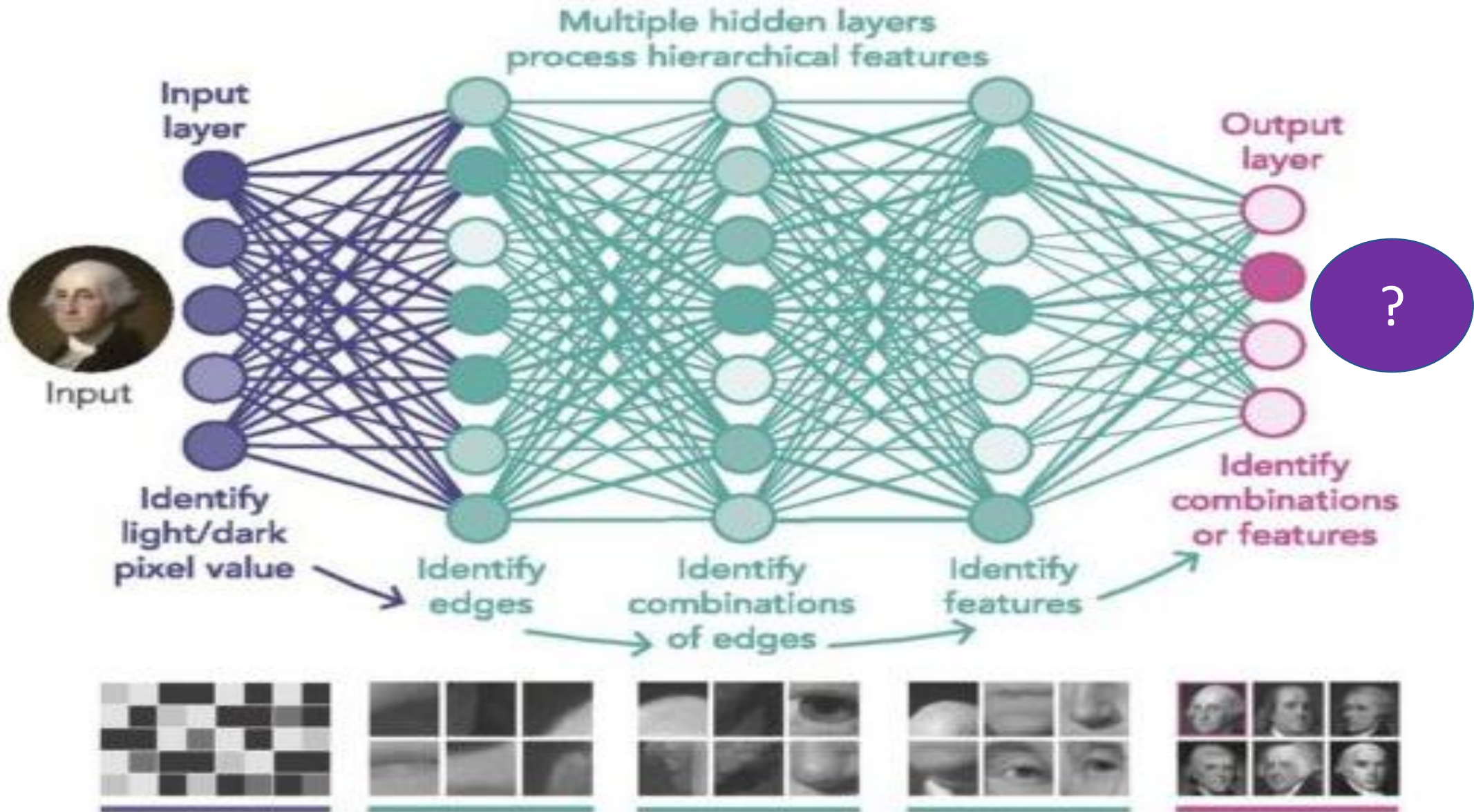
## Traditional programming



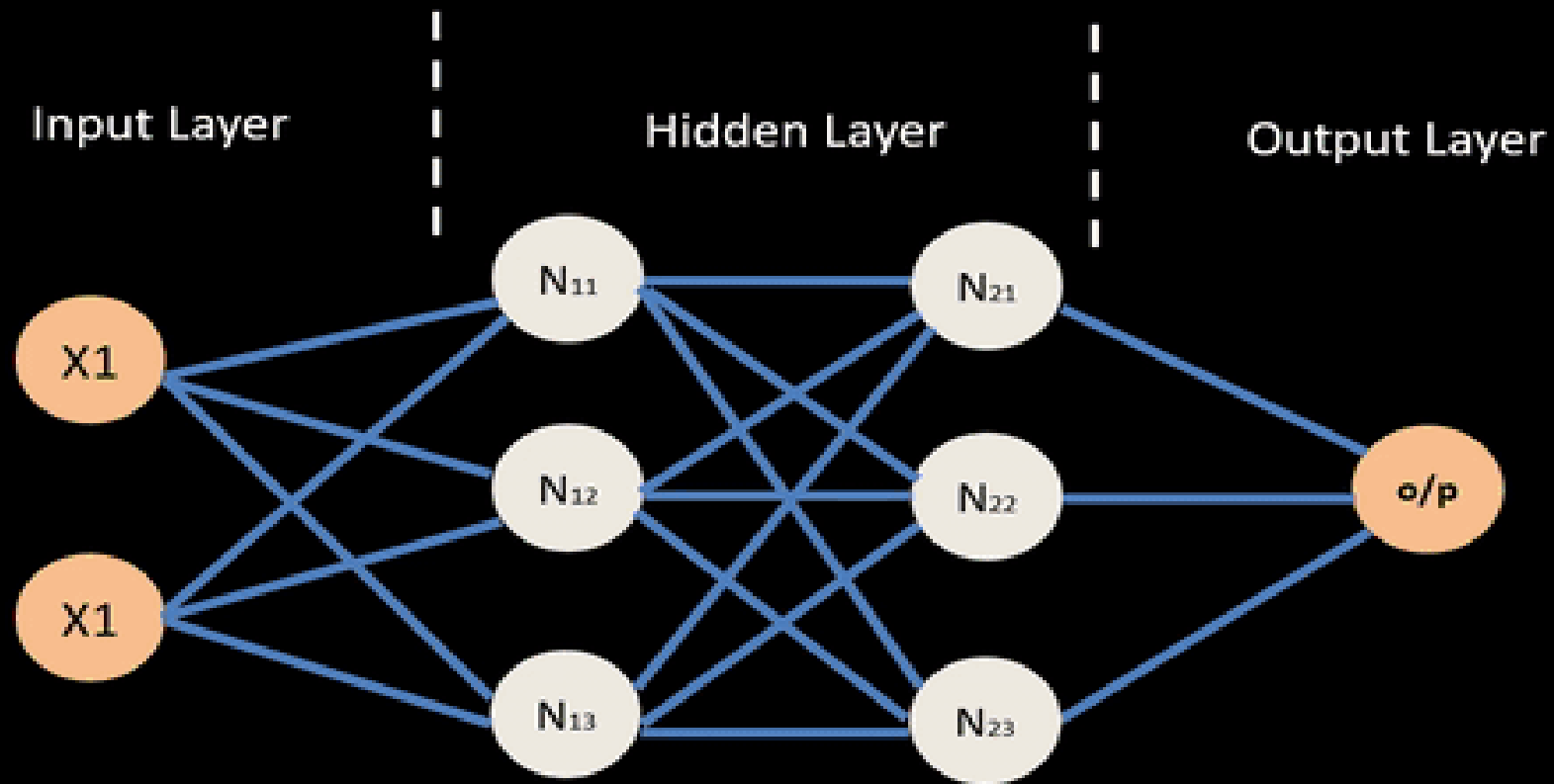
## Machine learning

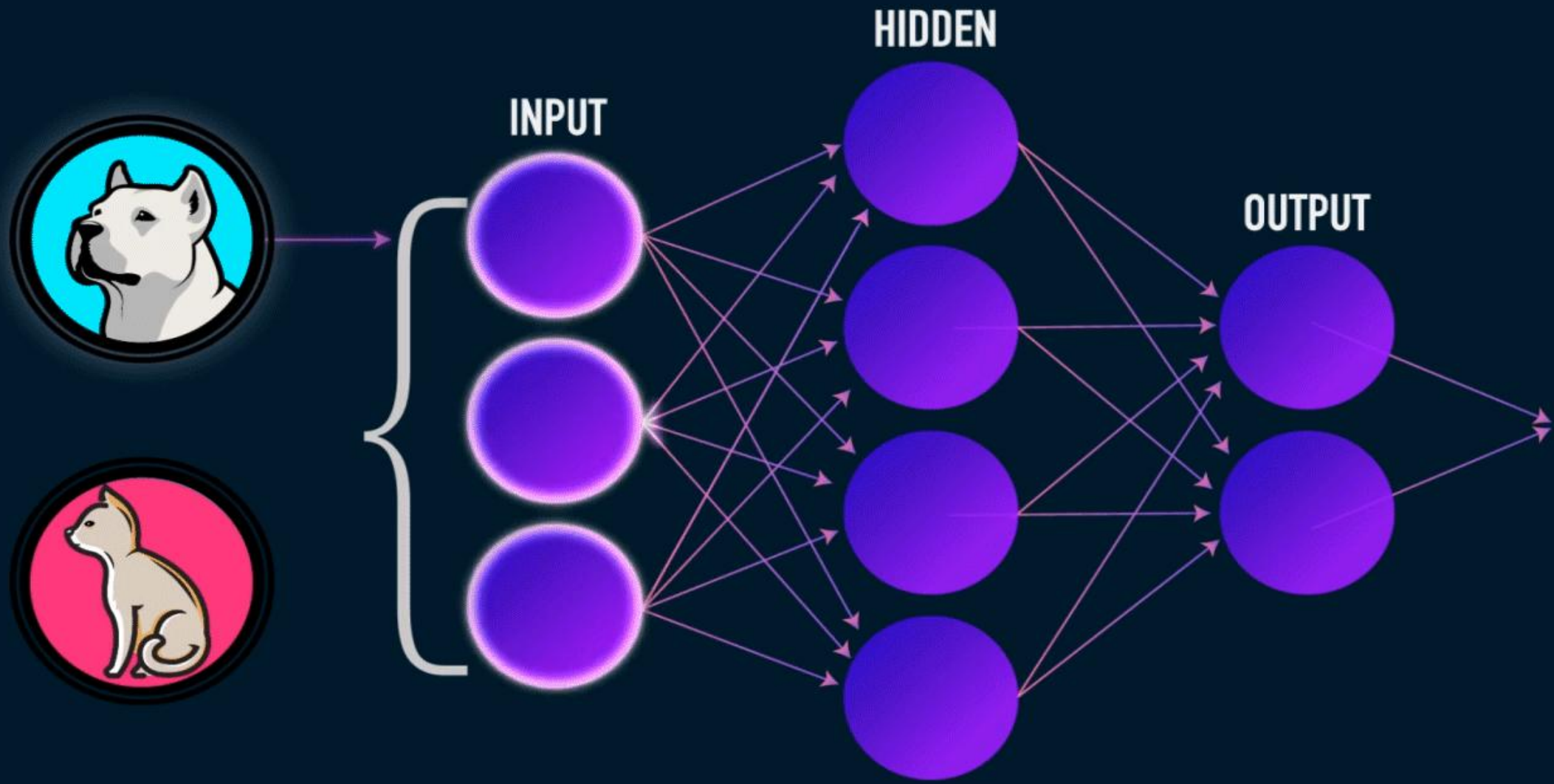


# DEEP LEARNING NEURAL NETWORK



# Neural Network – Backpropagation







Lane Change: RIGHT

Ego Speed: 14.50 MPH

Time: 28559.552448000

CALIP: 1.35 / 0.10 / R 0.00 deg

Vision fps: 0.00 Draw fps: 16.46 Display fps: 18.68

ML(0.00), E(1.00), F(0.00), TF(0.00), S(0.00)

MRW: FLP(0.00), FRP(0.00)

+0.0000 AUTO\_HIGH\_BEAM

+0.0000 BLINDED

+0.0000 RAINING

+0.0000 TIRE\_SPRAY

+0.0001 WET\_ROAD

0.7873 RESTRICTED

0.0000 CONTROLLED\_ACCESS



L:1 R:0 F:1 ON:1

W:7.8 AP:0.3 RT:

VS: 25.0 MPH St: 1

merge: 1:0 1 74.3 L

9.7  
S



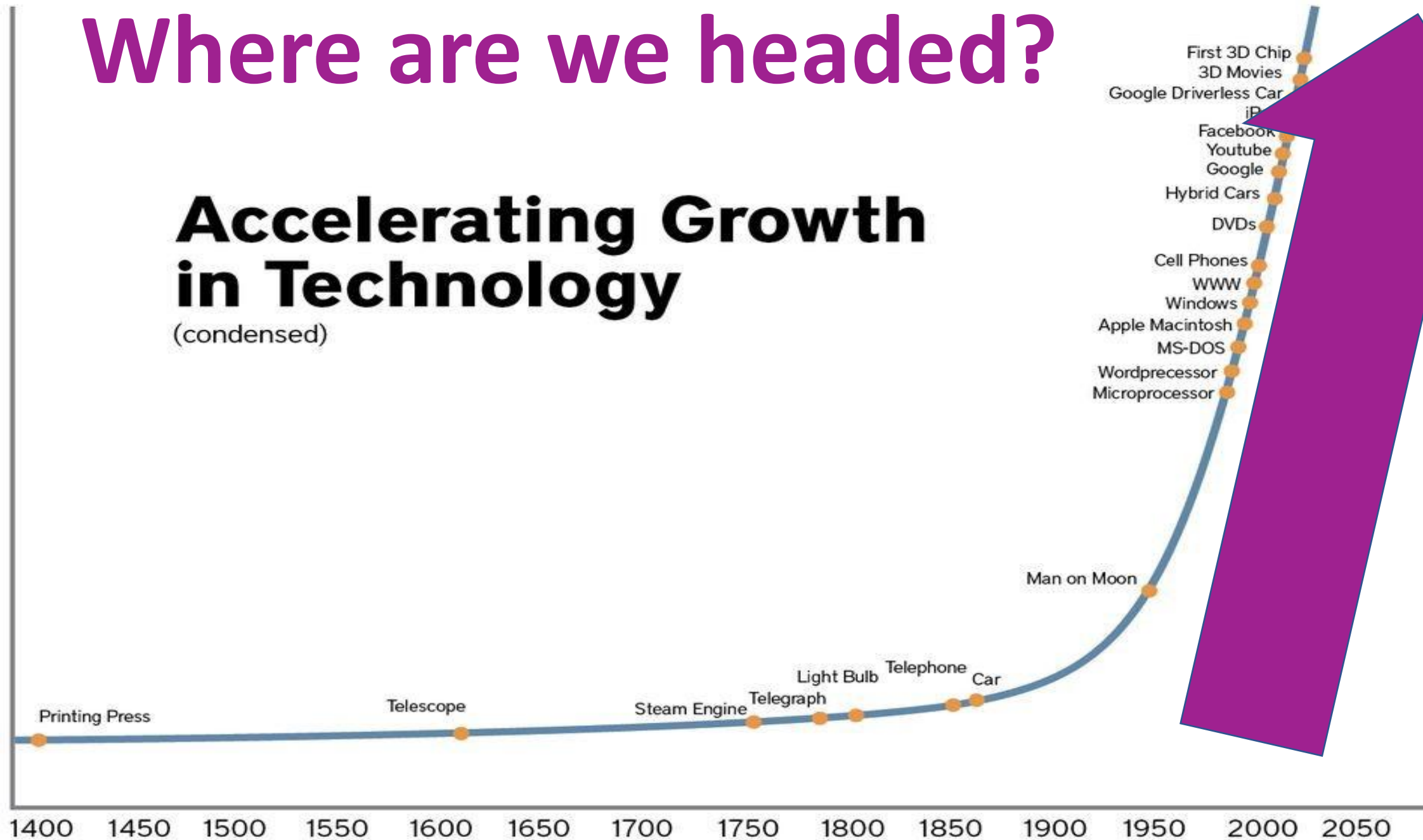
MAIN -

**Where does AI  
appear to be  
headed?**

# Where are we headed?

## Accelerating Growth in Technology

(condensed)



# >\$7 Trillion in Chips

**Forbes**

FORBES > BUSINESS


BREAKING

## Nvidia Is Now More Valuable Than Amazon And Google

Derek Saul Forbes Staff  
*I cover breaking news with a focus on markets and sports business.*

Feb 12, 2024, 11:48am EST

**TOPLINE** Nvidia's market value surpassed those of fellow technology titans Amazon and Alphabet on Monday, an almost unbelievable feat accomplished as Nvidia's stock more than quadrupled over the last 15 months as investors bought into Nvidia's market-leading position in artificial intelligence.



**BUSINESS INSIDER**

TECH

## Sam Altman wants to raise up to \$7 trillion. That's, uh, a lot of dough.

Katie Moberg | Feb 9, 2024, 1:29 PM CST



Sam Altman is looking to raise \$5-7 trillion for the future of chip building.

TECH

## Elon Musk compares the AI race to playing poker — you need to spend billions every year just to sit at the table

Tom Carter | Jan 29, 2024, 5:49 AM CST



Elon Musk is developing AI projects at Tesla while also running xAI.

- Elon Musk compared the AI race to a poker game where you need to spend billions to stay competitive.

## Zuckerberg's Meta Is Spending Billions to Buy 350,000 Nvidia H100 GPUs

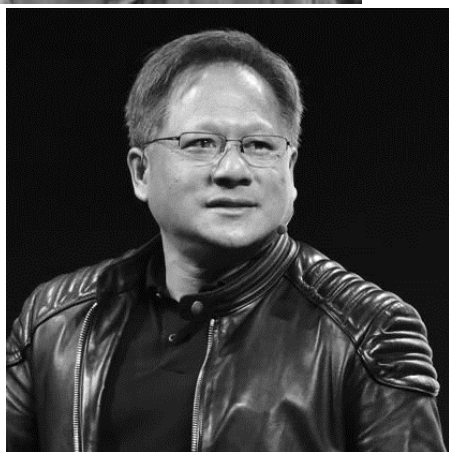
In total, Meta will have the compute power equivalent to 600,000 Nvidia H100 GPUs to help it develop next-generation AI, says CEO Mark Zuckerberg.

By Michael Kan | January 18, 2024





**AGI within 5-10 years?**  
**(i.e. superhuman intelligence)**



# Personalized A.I. Agents Are Here. Is the World Ready for Them?

The age of autonomous A.I. assistants could have huge implications.



Sam Altman is the chief executive of OpenAI, which is introducing personalized chatbots. Justin Sullivan/Getty Images

By **Kevin Roose**

Published Nov. 10, 2023 Updated Nov. 11, 2023

# OpenAI's next move could be controlling your computer

Sam Altman sees a future where ChatGPT uses your computer for you

By Maxwell Zeff / Gizmodo Published Monday 7:45AM



THE AI WILL SEE YOU NOW

## Nvidia's "Chat With RTX" is a ChatGPT-style app that runs on your own GPU

Nvidia's private AI chatbot is a high-profile (but rough) step toward cloud independence.

BENJ EDWARDS - 2/15/2024, 10:54 AM



## OpenAI introduces custom AI assistants called "GPTs" that play different roles

Users can build and share custom-defined roles—from math mentor to sticker designer.

BENJ EDWARDS - 11/6/2023, 12:21 PM



**“AI is about to completely change how you use computers.”**

**– Bill Gates**

**Within 5 Years . . . everyone will have a personal AI Assistant**

“In the next five years, [y]ou won’t have to use different apps for different tasks. You’ll simply tell your device, in everyday language, what you want to do.” – Bill Gates



Ai

The image features the letters 'Ai' in a white, sans-serif font. The letter 'i' has a vertical stem and a dot. The dot is replaced by a glowing, spherical object with a purple and blue gradient, resembling a planet or a futuristic light source. The sphere is surrounded by a faint, circular glow.

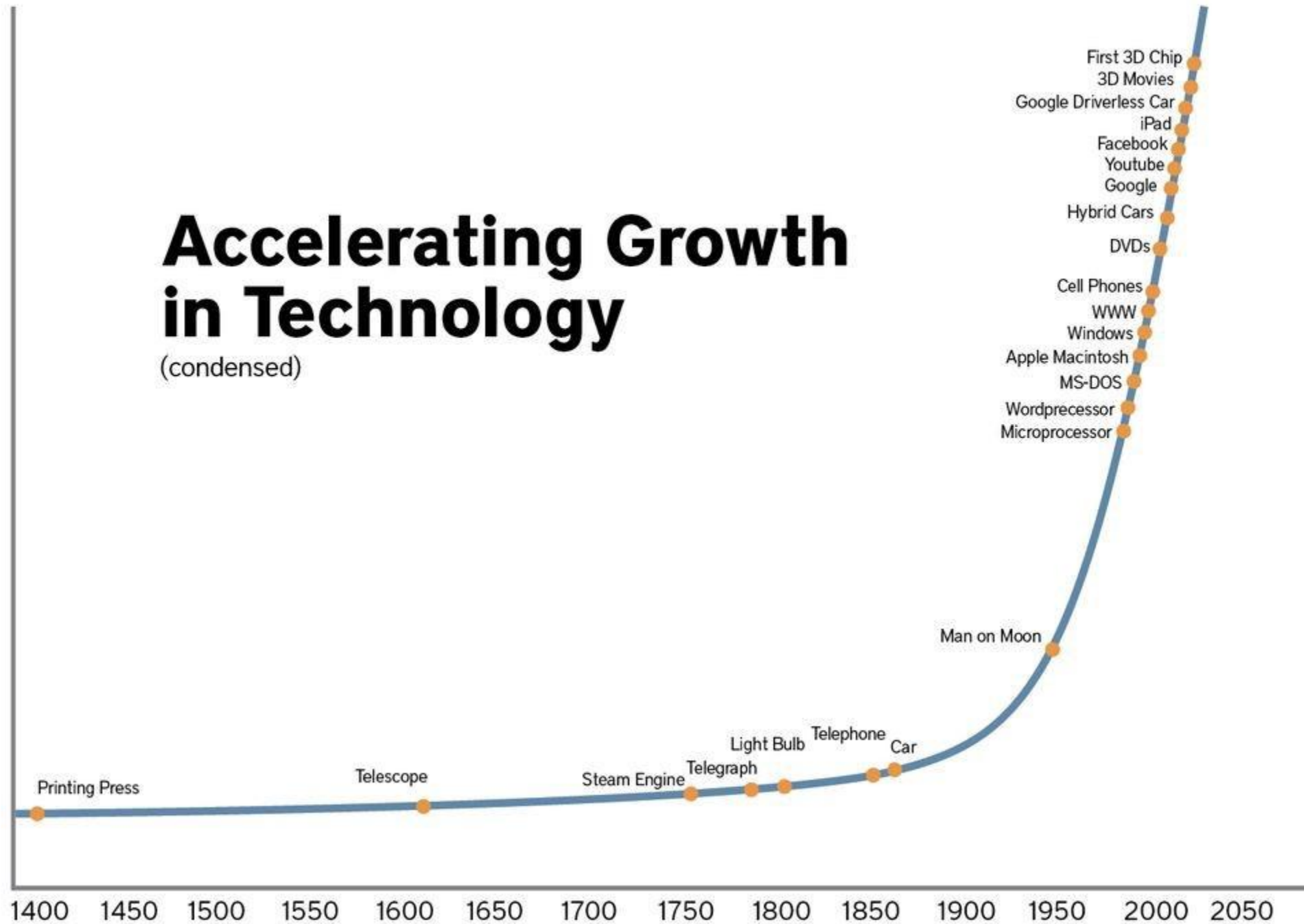
**“A.I. is  
more  
important  
than fire or  
electricity.”**

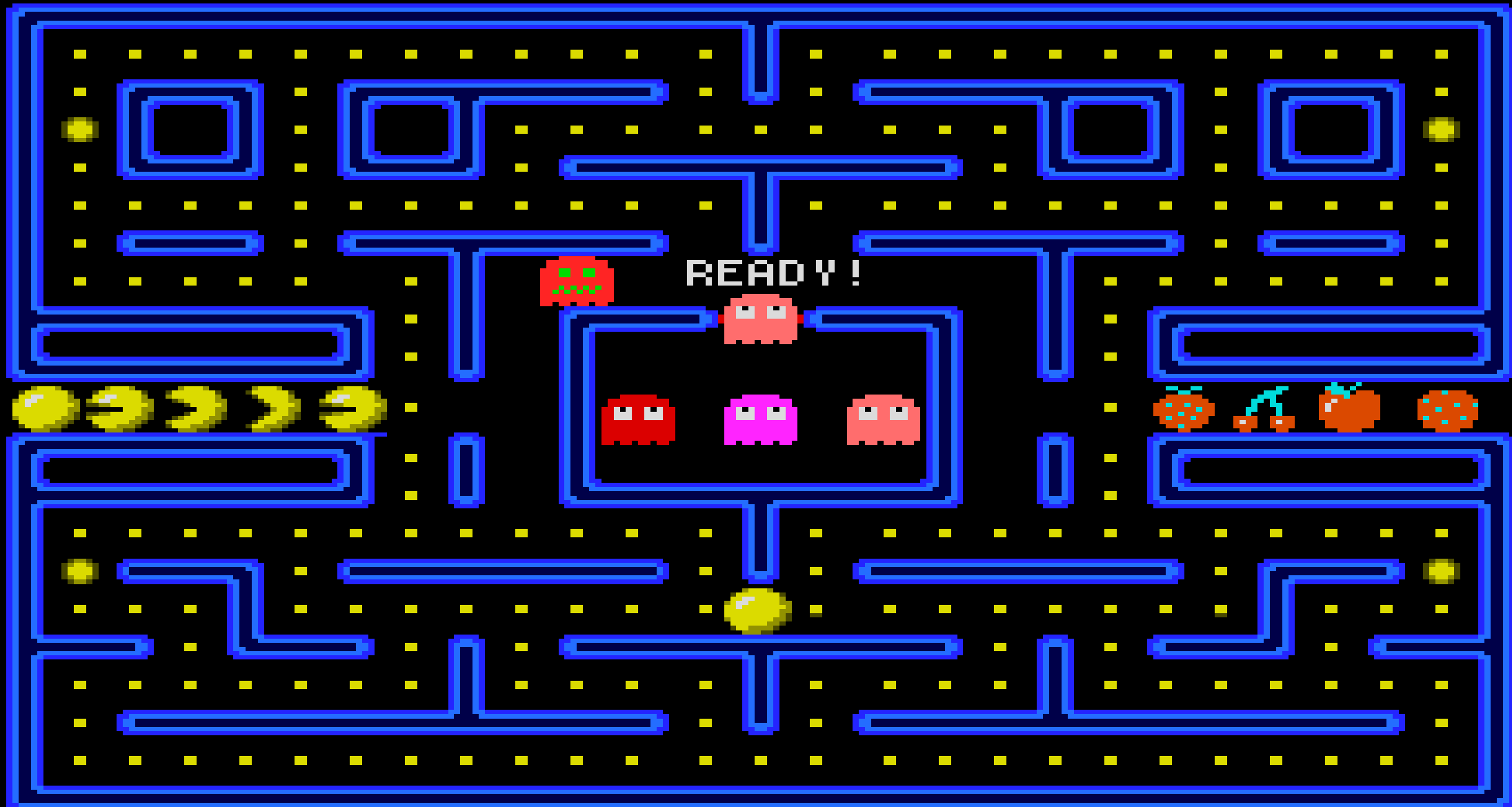
**–Google CEO, Sundar Pichai**



# Accelerating Growth in Technology

(condensed)





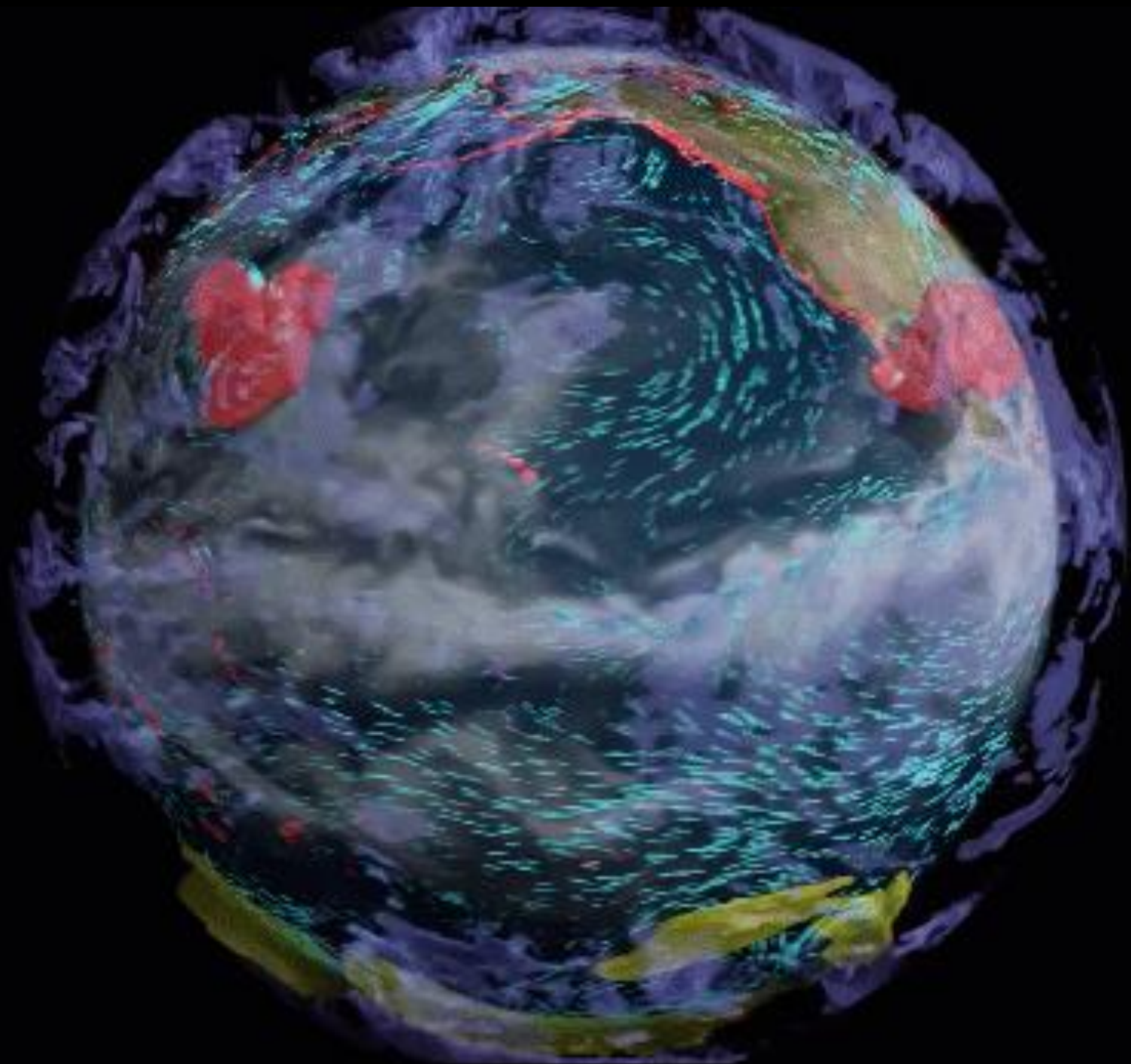


Perfect Brew. Perfect Cup.  
KORNER CUP  
San Clara Road  
B NORTH  
Downtown Fremont

THEATER

SHOUBATE





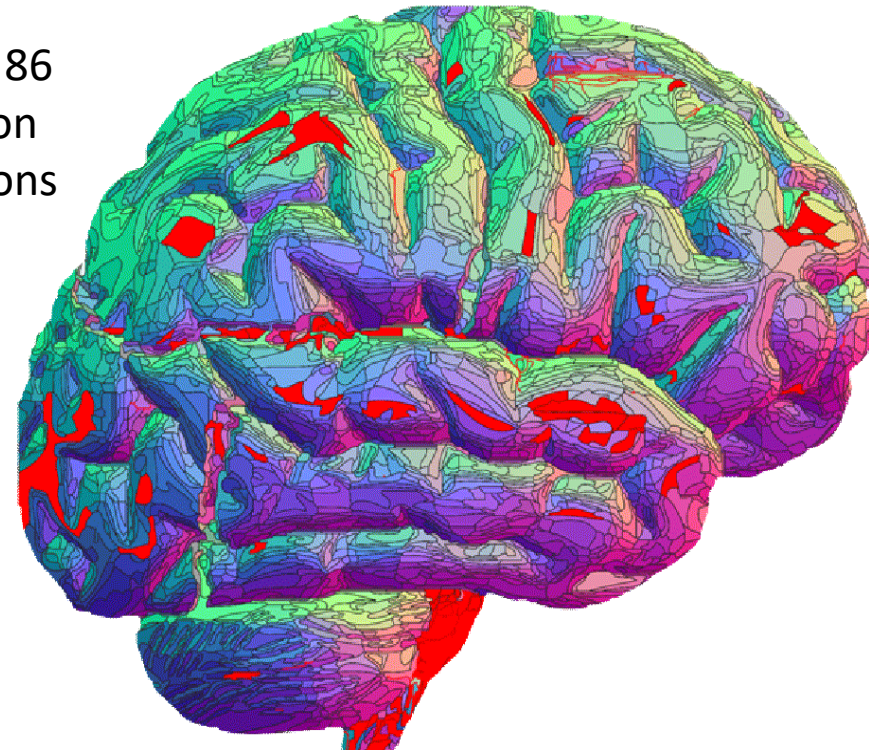
# YOUR BRAIN IS LIMITED BY YOUR SKULL

Metric	Computer	Human Brain
Processing Speed	3.5 GHz (typical modern processor)	200 Hz (average neuron firing speed)
Processing Power	>100 trillion operations per second (100 petaflops for top supercomputers)	Estimated 38 petaflops
Data Storage	10s-1000s petabytes for largest data centers	Estimated 2.5 petabytes
Communication Speed	10-100 gigabits per second	120 megabits per second (estimate for speed of signals along neurons)

Key points in the comparison:

- Computers have far faster processing speeds and greater raw computing power compared to the average firing rate of neurons. Top supercomputers approach or exceed the estimated processing power of the human brain.
- The largest data centers can store much more data than the estimated capacity of the human brain. However, the brain uses its limited capacity in a very dense and efficient way.
- Communication speed reflects how fast signals can be sent across networks. Computers far exceed the brain in terms of pure data transmission rate across its system.

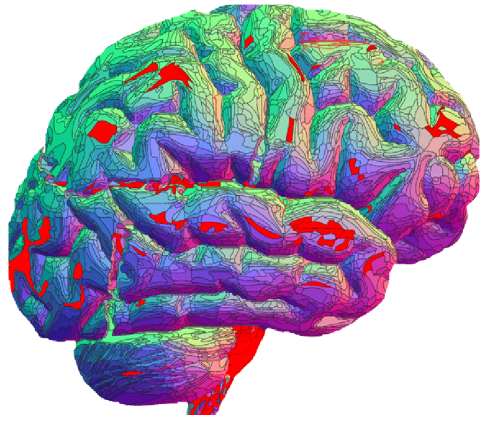
Only 86 billion neurons



Only 125 trillion neural connections



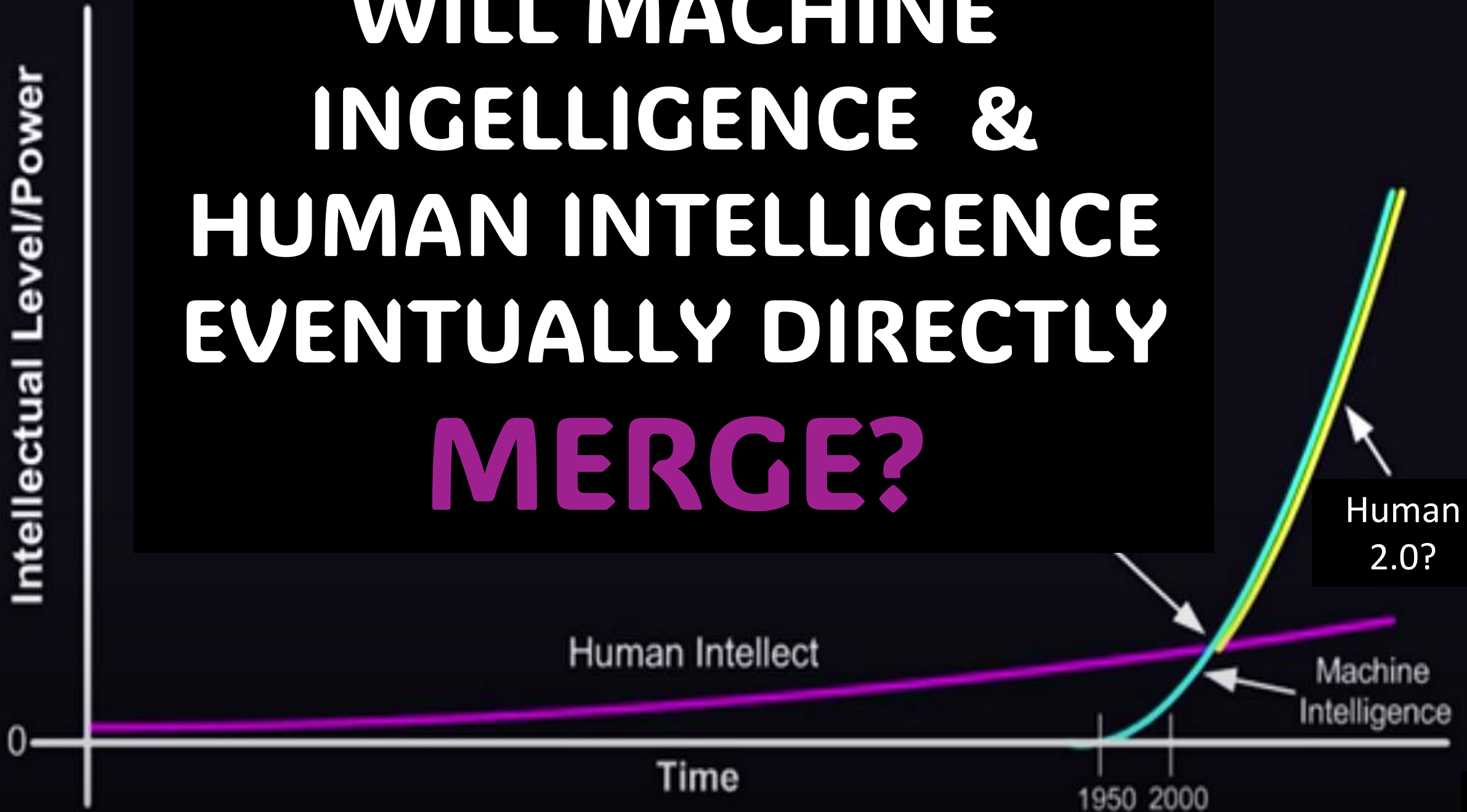
**A  
COMPUTER  
COULD  
OSTENSIBLY  
BECOME  
THE SIZE OF  
THE  
UNIVERSE**



Internet/Cloud/AI



# WILL MACHINE INTELLIGENCE & HUMAN INTELLIGENCE EVENTUALLY DIRECTLY MERGE?

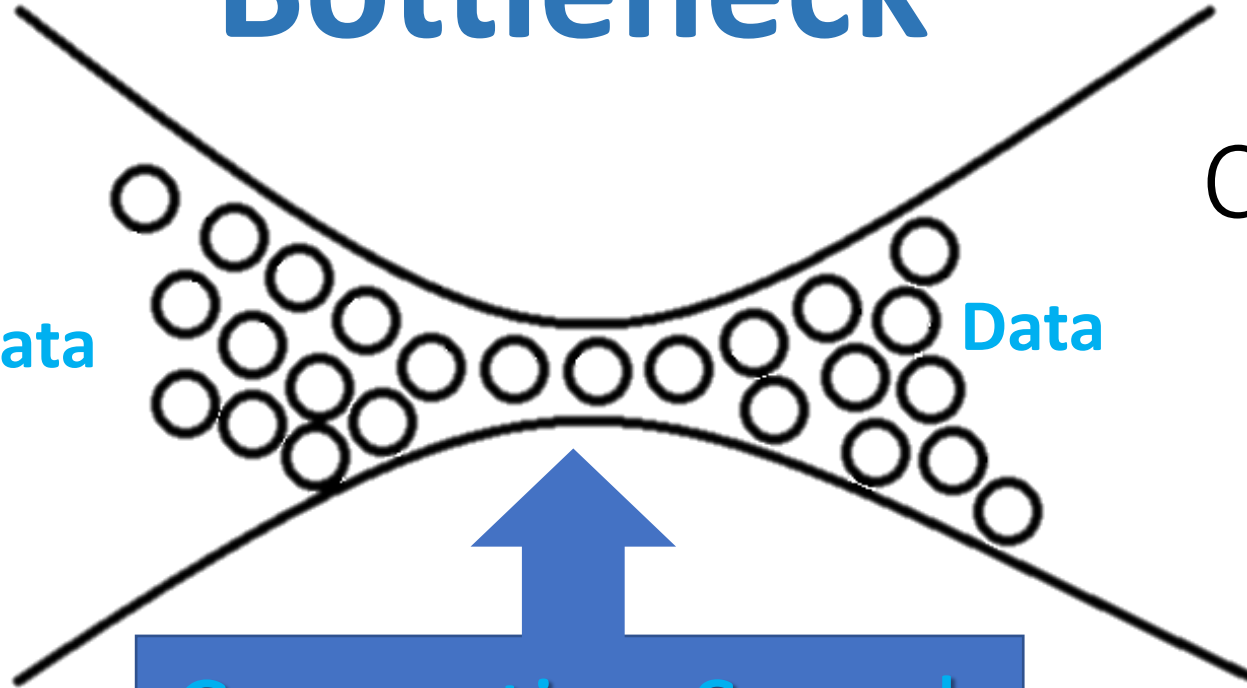


# Bottleneck

HumanMind =

- 100 trillion neural connections
- massively parallel

Data



Data

Computer/AI =

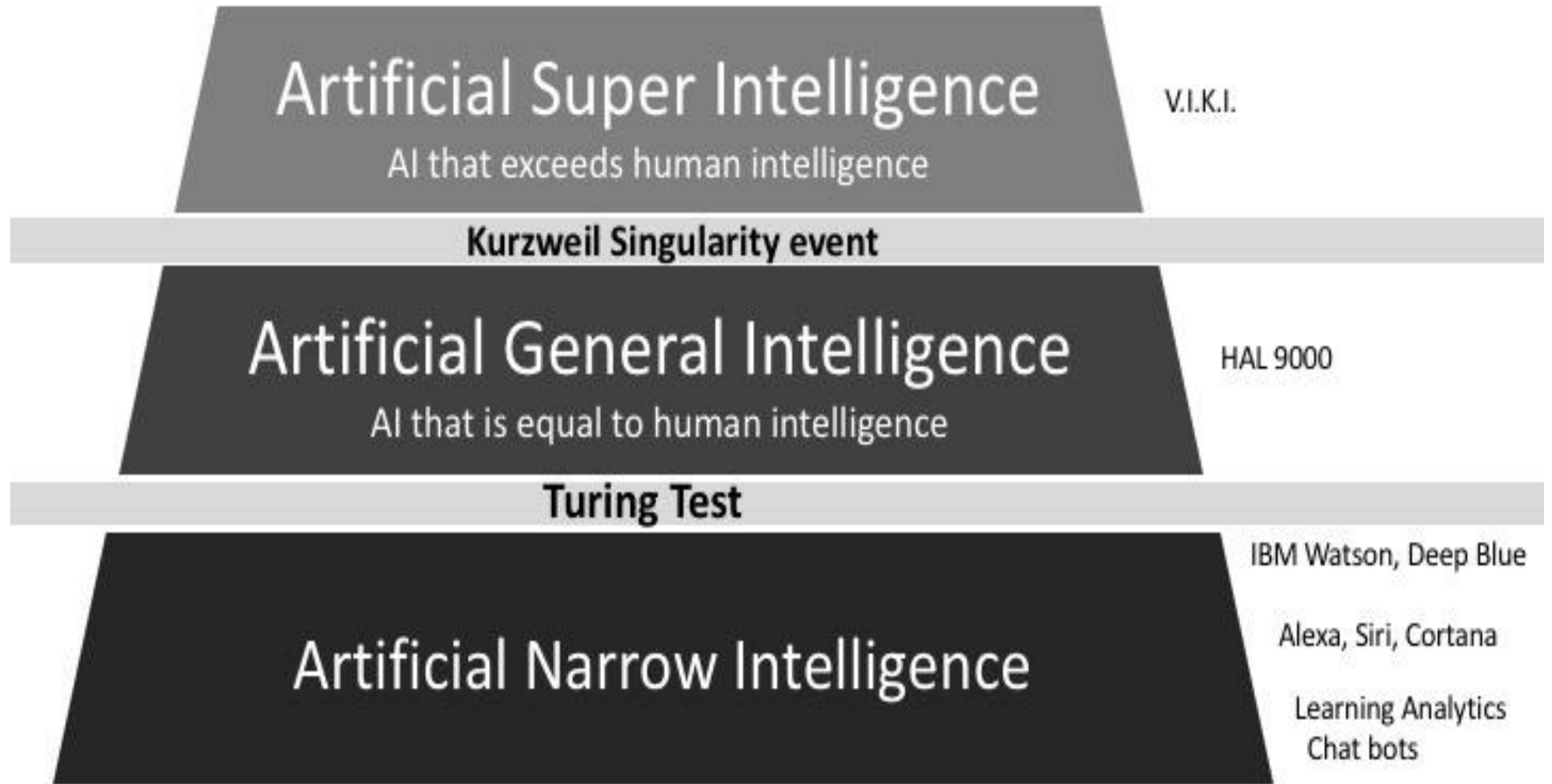
- Speed of light connection
- Not physically limited (does not need to fit inside a head)

Connection Speed:

Typing, reading, and talking to a computer

**(only 39 bits per second)**

# Levels of Artificial Intelligence







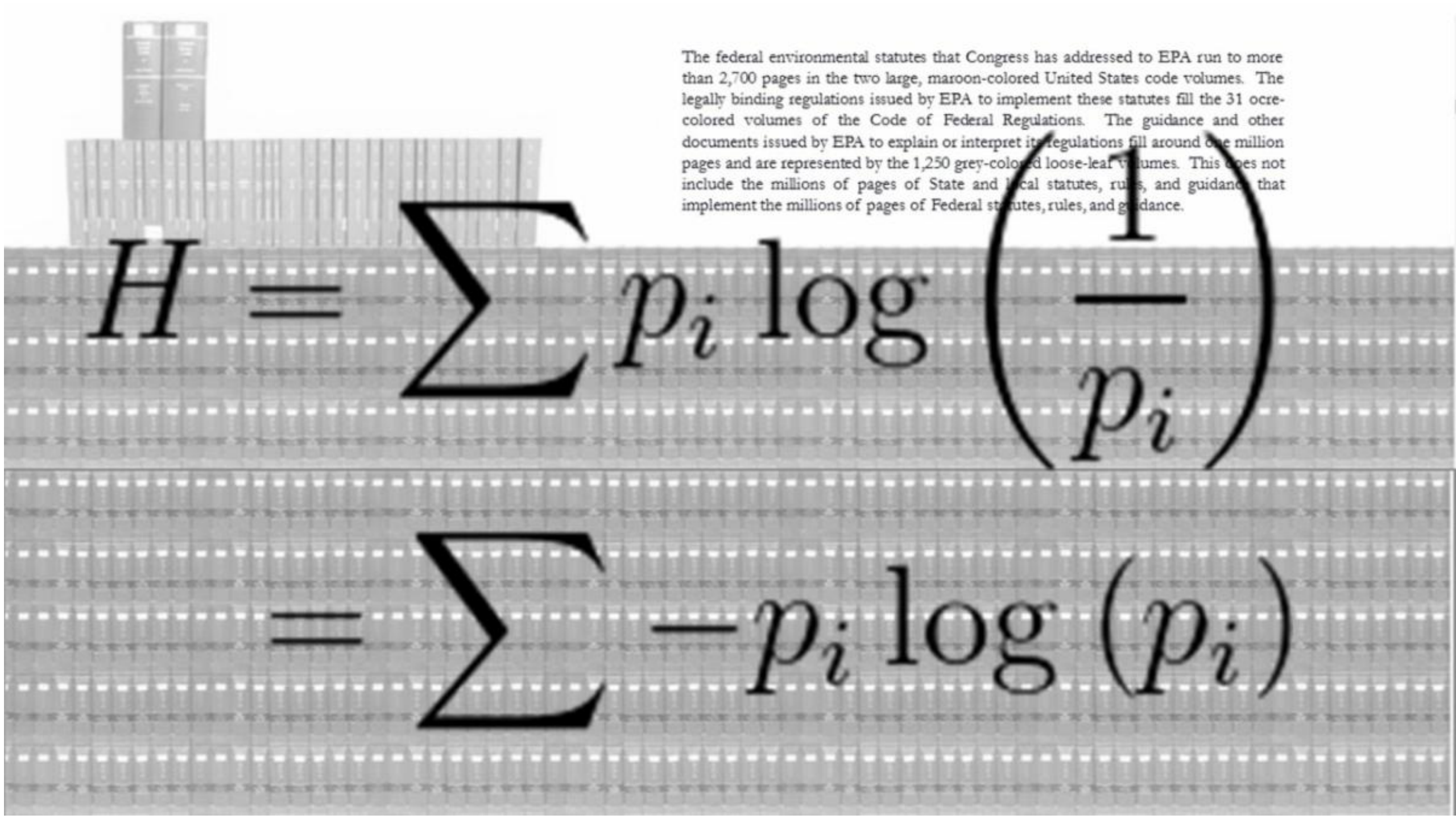
“Looking to the future, the next big step will be for the very concept of the ‘device’ to fade away”

~Sundar

Pichai, **Google CEO**

**A.I.**

“The relationship between human intelligence and artificial intelligence **will necessarily be one of symbiosis**. The challenge and potential of exploring this co-evolutionary future is the biggest story of the next century.” – Bryan Johnson



The federal environmental statutes that Congress has addressed to EPA run to more than 2,700 pages in the two large, maroon-colored United States code volumes. The legally binding regulations issued by EPA to implement these statutes fill the 31 ocre-colored volumes of the Code of Federal Regulations. The guidance and other documents issued by EPA to explain or interpret its regulations fill around one million pages and are represented by the 1,250 grey-colored loose-leaf volumes. This does not include the millions of pages of State and local statutes, rules, and guidance that implement the millions of pages of Federal statutes, rules, and guidance.

$$H = \sum p_i \log \left( \frac{1}{p_i} \right)$$
$$= \sum -p_i \log (p_i)$$

**Current uses in  
environmental  
law?**

What refinery in Texas has the least stringent TCEQ "special conditions" in its air permit and the most regulatory flexibility? Explain.

# EnviroChat

Environmentally-Trained  
Chatbot

## AI #1 Response

What refinery in Texas has the least stringent TCEQ "special conditions" in its air permit and the most regulatory flexibility? Explain.":

The refinery with the least stringent TCEQ "special conditions" in its air permit and the most regulatory flexibility is the Big Spring Refinery in Texas. This refinery has a permit that allows for the use of sweet natural gas containing no more than 5 grains total sulfur per 100 standard cubic feet process tail gas or refinery fuel gas that complies with the applicable requirements of the U.S. Environmental Protection Agency EPA regulations in Title 40 Code of Federal Regulations 40 CFR Part 60 Subpart J on Standards of Performance for New Stationary Sources Petroleum Refinery Related Fuel Gas Combustion Units. The permit also allows for the use of alternate sampling facility designs that must be submitted for approval to the TCEQ Regional Director. Additionally, the permit holder is not required to comply with any additional local, state, and federal requirements to which these facilities are subject.

## AI #2 Response

The El Paso Refinery has the least stringent TCEQ "special conditions" in its air permit and the most regulatory flexibility. This is because the El Paso Refinery has a flexible permit TCEQ Permit No. 18897 that covers the majority of the emission units at the refinery. This permit was evaluated to ensure consistency with the Federal Clean Air Act requirements and does not include any special conditions.

WESTERN REFINING  
EL PASO ALL SITES :  
AIR / New Source  
Review Permit

## AI #3 Response

The Valero Houston Refinery has the least stringent TCEQ "special conditions" in its air permit and the most regulatory flexibility.

The TCEQ has issued a number of special conditions for the Valero Houston Refinery, including:

- The refinery must use low-sulfur crude oil.
- The refinery must use a flare to control emissions of volatile organic compounds (VOCs).
- The refinery must use a vapor recovery system to control emissions of benzene.
- The refinery must use a continuous emissions monitoring system (CEMS) to monitor emissions of sulfur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), and VOCs.

However, the TCEQ has also granted the refinery a number of regulatory flexibilities, including:

- The refinery is allowed to use a different method to control emissions of SO<sub>2</sub> than what is required by the TCEQ.
- The refinery is allowed to use a different method to control emissions of NO<sub>x</sub> than what is required by the TCEQ.
- The refinery is allowed to use a different method to control emissions of VOCs than what is required by the TCEQ.

These flexibilities allow the refinery to choose the most cost-effective and efficient methods to control emissions.

**“We are training large language models on millions and millions of environmental documents . . . and prompting and fine-tuning the models to perform as environmental assistants. This is the first AI effort of its kind in the world that we are aware of.”**

-Jed Anderson, CEO, EnviroAI



**“What’s the best permit condition for a . . .**



**Environmental**

# “Prompt Engineer”

1	What is the lowest scrubber circulation rate allowed by TCEQ in any permit?
2	What is the most recent TCEQ requirement in any permit condition pertaining to combustion zone net heating value?
3	What are the potential "alternative means of compliance" for a polypropylene facility?
4	Provide examples of "chemical flexibility" provisions granted by TCEQ in permit conditions?
5	What is the highest throughput limit from any polypropylene loading line in Texas?
6	What is the least frequent cooling water monitoring for conductivity in Texas?
7	Does TCEQ allow for feedstock flexibility in permit provisions?
8	What is the highest percentage of allowed scrubber downtime due to data loss?
9	What is the longest allowed extension for delay of repair for a cooling tower allowed by TCEQ?
10	Is there any alternative to performing daily AVO inspections?



**TundraPro**

# Enviro.AI

Financial value? Operational value? Environmental value?

# One Refiner Saved Over \$500k in just one AI Prompt.

[Found a better permit condition that another refiner had recently been issued]

**TUNDRA PRO**

by EnviroAI



# Environmental “Prompt Engineering” - Tips - Lesson #1

1. **Consider assigning a role.**
2. **Give a clear, descriptive, and accurate task with accurate language.**
3. **Provide context. This will help the chatbot to generate a more relevant response.**
4. **Use examples. This can help the chatbot to better understand the type of response you are looking for.**
5. **Ask it to explain, provide examples, provide support.**
6. **Be specific. The more specific you are in your prompt, the more likely the chatbot is to generate a satisfactory response.**
7. **Provide details. Include details about the topic, the audience, the tone, the format, the main points, the length, or the style of the output.**
8. **Consider using both open-ended and close-ended questions**
9. **Create constraints: “I want you to do this . . . I don’t want you to do that”**
10. **Experiment.** Try different ways of asking the same question to see which way produces the best response.

**Enter prompt:** Please draft an air permit and create a sys

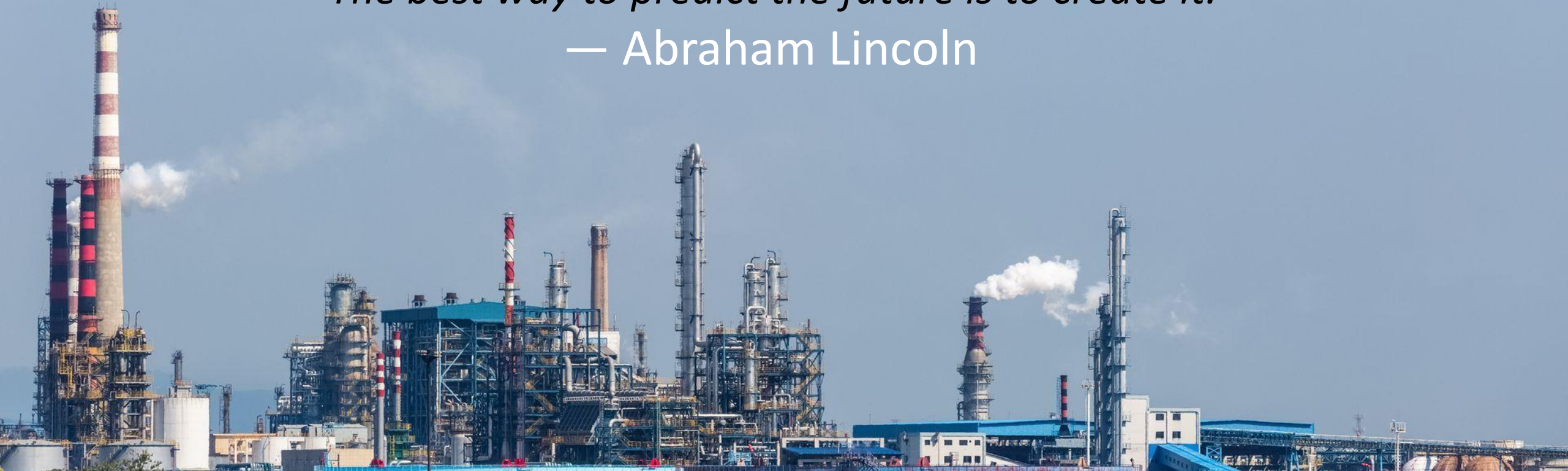
## **Environmental Law in Virtual/Digital-Twin Environments**

Spatial Computing . . . VR/MR/AR . . . Metaverse

# Enviro.AI

*“The best way to predict the future is to create it.”*

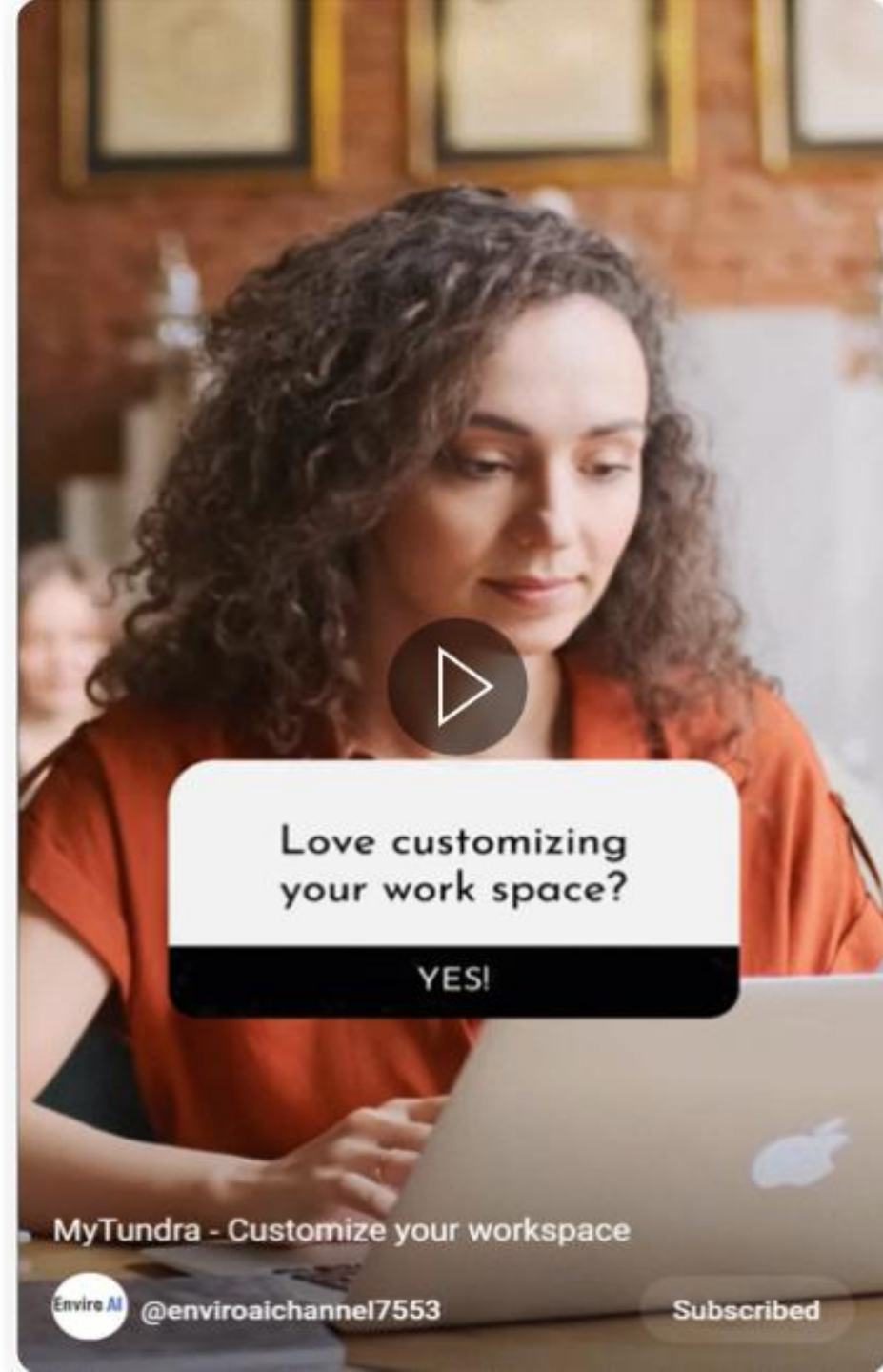
— Abraham Lincoln



Other AI enhanced  
environmental tools?

# My Tundra™

Personalize Your Facility Experience



Love customizing  
your work space?

YES!

MyTundra - Customize your workspace

Enviro AI

@enviroaichannel7553

Subscribed

### My Sites

Shell Chemical Company - Norco Manufacturing Complex

ExxonMobil Refining & Supply Co - Baton Rouge Refinery

CHEVRON PHILLIPS CHEMICAL SWEENEY OLD OCEAN FACILITIES

DOW CHEMICAL LA PORTE SITE

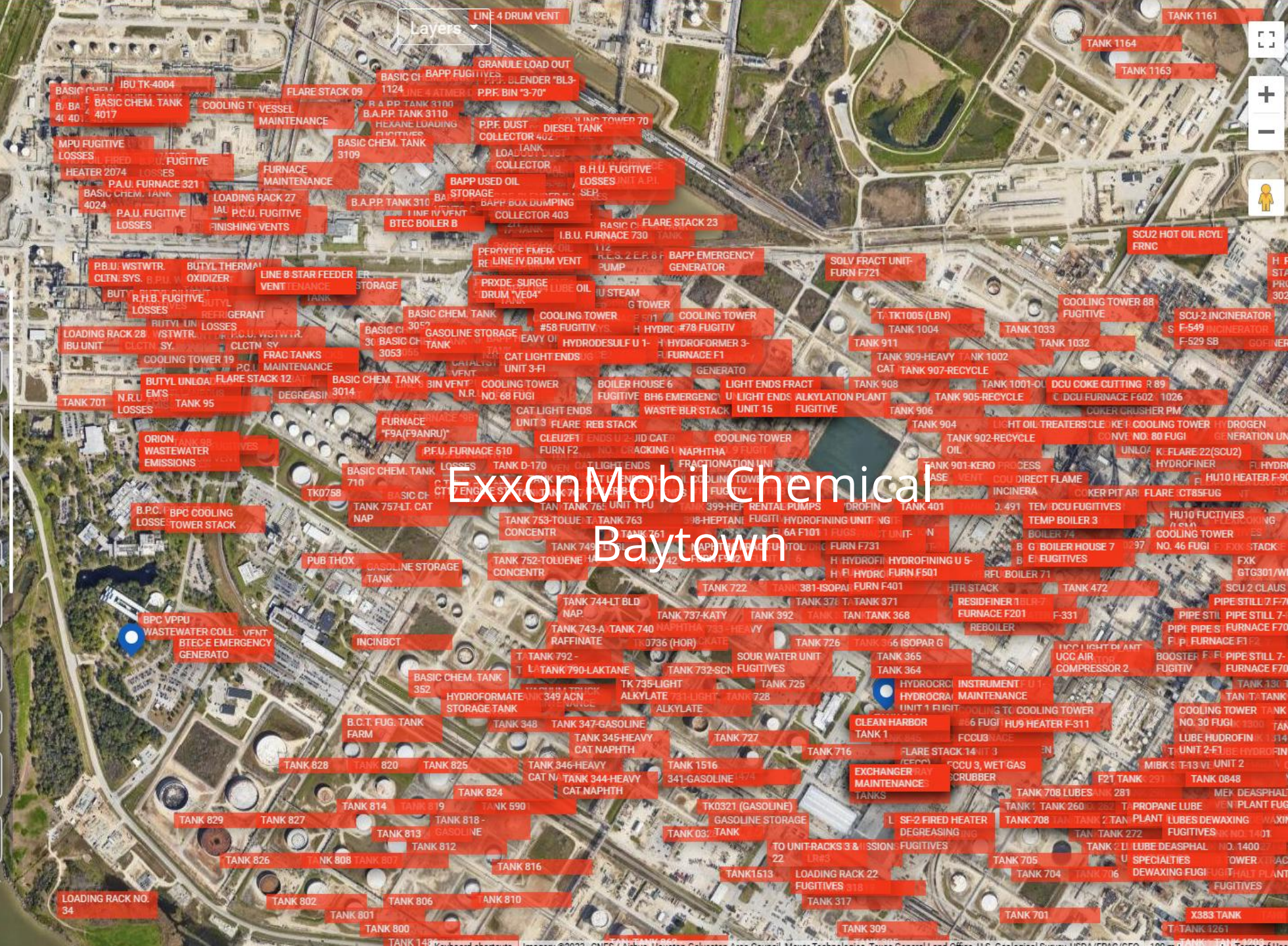
INEOS POLYETHYLENE NORTH AMERICA LA PORTE PLANT

SHELL OIL CO/NORCO MANUF COMPLEX/EAST SITE

HOUSTON REFINING

ExxonMobil Refining & Supply Co - Baton Rouge Refinery

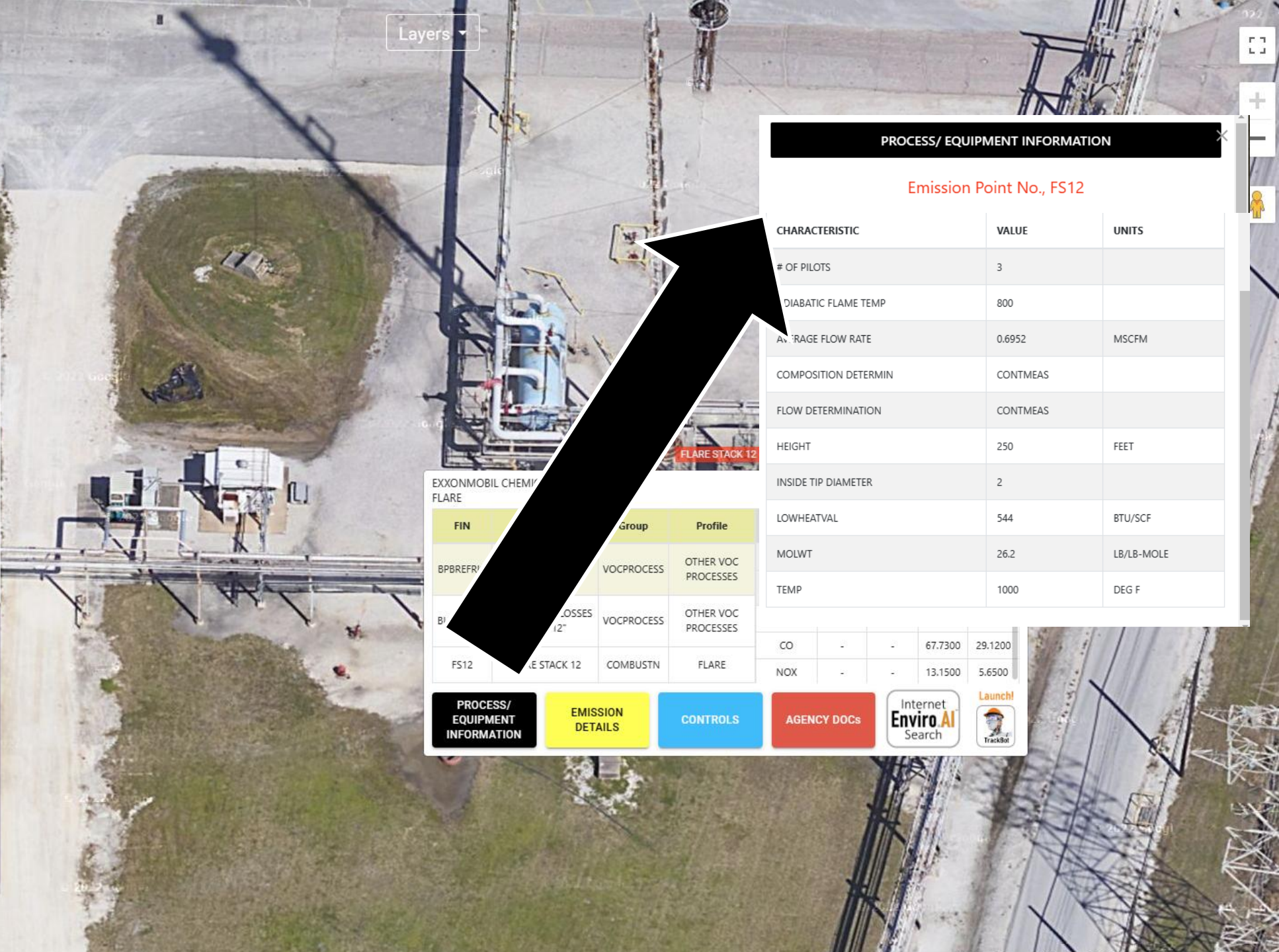
EXXONMOBIL CHEMICAL BAYTOWN CHEMICAL PLANT



# ExxonMobil Chemical Baytown

### My Sites

- Shell Chemical Company - Norco Manufacturing Complex
- ExxonMobil Refining & Supply Co - Baton Rouge Refinery
- CHEVRON PHILLIPS CHEMICAL SWEENEY OLD OCEAN FACILITIES
- DOW CHEMICAL LA PORTE SITE
- INEOS POLYETHYLENE NORTH AMERICA LA PORTE PLANT
- SHELL OIL CO/NORCO MANUF COMPLEX/EAST SITE
- HOUSTON REFINING
- ExxonMobil Refining & Supply Co - Baton Rouge Refinery
- EXXONMOBIL CHEMICAL BAYTOWN CHEMICAL PLANT



**PROCESS/ EQUIPMENT INFORMATION**

Emission Point No., FS12

CHARACTERISTIC	VALUE	UNITS
# OF PILOTS	3	
DIABATIC FLAME TEMP	800	
AVERAGE FLOW RATE	0.6952	MSCFM
COMPOSITION DETERMIN	CONTMEAS	
FLOW DETERMINATION	CONTMEAS	
HEIGHT	250	FEET
INSIDE TIP DIAMETER	2	
LOWHEATVAL	544	BTU/SCF
MOLWT	26.2	LB/LB-MOLE
TEMP	1000	DEG F

EXXONMOBIL CHEMICAL FLARE

FIN	Group	Profile
BPBREFR/	VOCPROCESS	OTHER VOC PROCESSES
B/	LOSSES 12"	VOCPROCESS
FS12	FLARE STACK 12	COMBUSTN

CO	-	-	67.7300	29.1200
NOX	-	-	13.1500	5.6500

PROCESS/ EQUIPMENT INFORMATION
EMISSION DETAILS
CONTROLS
AGENCY DOCs
Internet Enviro AI Search
Launch! TrackBot



**Future uses in  
environmental  
law?**

Traditional programming

*environmental laws*



Machine learning

*new way of protect nature*



Real-Time AI Digital-Twin  
Environmental Protection  
System with Dynamic  
Simulation/Compliance  
Feedback Loops  
(Ex. Houston Air Quality)

## System Requirements

- ✓ **1 GB per second of incoming sensor data**
- ✓ **1-10 PFLOPs simulation computing capability**
- ✓ **100-1000 cloud servers for stream processing and control**

- Anthropic – Claude, 2/27/24





- Algorithmic
- Real-time
- Dynamic
- Remove the need for most written regulations

How many bits in the universe?

JA

I do not have enough information to definitively state how many bits there are in the entire physical universe. Here are a few points about quantifying bits in the universe:

- The universe is incredibly large, complex, and not fully explored or understood. Its full information content is unknown.
- Bits are a unit used to measure digital information storage and processing capacity. The universe itself is an analog reality, not a digital creation, so referring to its total information content "in bits" is more of an abstract analogy than a literal, quantifiable measure.
- There could be a near infinite number of bits, depending on how finely grained we analyze the information content down to the quantum scale across the billions of galaxies each containing trillions of stars and other objects. But most of this potential information encoding may be redundant or random noise.
- Certain theories in physics propose that every particle and quantum of space or energy encodes bits via properties like quantum spin or specific states. But there is no consensus on how to calculate this.
- Seth Lloyd, a professor of mechanical engineering, has proposed upper bound estimates of  $10^{120}$  bits as the total computational capacity of the universe. But this is a very rough estimate involving many uncertainties.

So while the information content of the entire physical universe is certainly tremendously large, I do not think there is enough knowledge or evidence yet to put an exact number on the total number of bits it contains. Any specific number would involve many open-ended assumptions rather than being definitively calculable. Most estimates provide ballpark upper bounds based on theories of how information could be physically encoded. But the full answer remains elusive.

AI

Copy



Based on Seth Lloyd's calculation, how many bits would it take to represent all the conditions on earth?

JA

Unfortunately, Seth Lloyd's calculation does not provide enough specifics to estimate the number of bits needed to represent all the conditions on Earth alone. His  $10^{120}$  bit estimate applies to the entire observable universe, but he does not break that down into separate estimates for Earth or other individual planets and systems.

To estimate the number of bits needed to represent all conditions on Earth, we would likely need to consider factors like:

- The resolution of measurement - More precise measurements require more bits.
- Types of conditions - Physical properties, chemical conditions, weather data, biological information, etc across both space and time.
- Whether redundant or compressible data can be accounted for - There may be overlap and patterns that reduce unique information.
- If microstates at the quantum level need to be included.

My best guess would be on the order of at least  $10^{30}$  to  $10^{40}$  bits to store a high resolution "snapshot" of conditions on Earth at a given point in time across environmental, geospatial, chemical, biological domains and accounting for some level of quantum indeterminacy. Video at high resolutions could require orders of magnitude more over time. But without more specifics from Seth Lloyd about the breakdown of his universal estimate, it's hard to adapt it directly to estimate just the conditions on Earth. The Earth also remains complex and not fully measured or understood at the highest resolutions. So significant uncertainties remain for any such "bits of Earth" estimate.

AI

Copy



Thank you. Considering your 10 to the 30th to 10 to the 40th bit estimate to store a high resolution snapshot of conditions on Earth, if this were to be made into a real-time digital or quantum twin, how much computational capacity would be needed to run this system? Thank you.

JA

Excellent question! Creating a fully detailed real-time digital or quantum twin of Earth would require immense computational capacity. A few key factors in estimating the required capacity:

1. Resolution levels - As I mentioned before, higher resolutions require exponentially more storage and computational power. We'd need to define the spatial and temporal resolution we desire. Capturing microscopic and quantum states may quickly become infeasible.
2. Complexity of simulations - Real-time weather and climate modeling alone can consume petaflops of computing on today's supercomputers. Simulating atmospheric, oceanic, seismic, ecological and anthropic systems in interaction and at high resolutions steps this up massively.
3. IO Bandwidth - We'd need to ingest enormous streams of sensor data from satellites, environment sensors, connected devices, etc. Processing and distributing output data also consumes bandwidth.
4. Parallelization limits - We can use parallel computing to spread the workload, but Amdahl's law limits total speedup. Some parts of the analysis may need to run sequentially.

With those caveats, my back-of-the-envelope estimate would be that we'd need a system with at least  $10^{22}$  floating point operations per second (flops) throughput to create a continuously running digital twin of the entire planet at a reasonably useful resolution.

For context, that is about an exaflops system, which is around 100x faster than the fastest supercomputers today. We would probably need to employ quantum computing and advanced AI techniques to reach this scale.

The storage and bandwidth requirements would also be massive - likely requiring breakthroughs in storage density and quantum IO networking to support. In summary, simulating our planet at this scale remains a epic challenge for future generations! But an inspiring north star as computing advances.

AI

Copy Retry

Share

That's fascinating. Thank you for this information. Can you tell me please, at a much smaller scale, what would it require to create this system just for the Houston, Texas Ship Channel area and just focused on measuring and protecting air quality in real-time? Thank you!

JA

Sure, narrowing the focus to just the Houston Ship Channel area and specifically focused on air quality monitoring would significantly reduce the computing requirements compared to a complete global Earth twin. Some estimates on what it might take:

1. Storage and bandwidth - To monitor air quality factors like particulate/gas levels, pollution dispersion, temperature, humidity etc. in real-time across the Ship Channel area, we'd need high-density sensor coverage. Assuming 1000 sensors, with 100 data points per second per sensor, at 8 bytes per reading, that's ~800 MB of sensor data per second that needs to be streamed and stored. This is manageable with today's technology.
2. Real-time simulation and modeling - To model pollution/particle dispersion through the area, a high resolution computational fluid dynamics simulation updated dynamically could be required. A reasonable estimate could be needing simulation power of 1-10 PetaFLOPs. This is feasible to run on a moderate supercomputer or large cloud compute cluster today if optimized.
3. Coordination logic and control systems - Complex event processing, analysis and control systems would monitor the incoming data streams, run dispersion and forecast simulations, initiate warnings or real-time coordination logic across port authorities, regulators and emission generators. This is very feasible to run with modern stream processing platforms and machine learning pipelines powered by 100-1000 cloud servers.

So in summary - to model and manage the air quality for Houston Ship Channel area in real time:

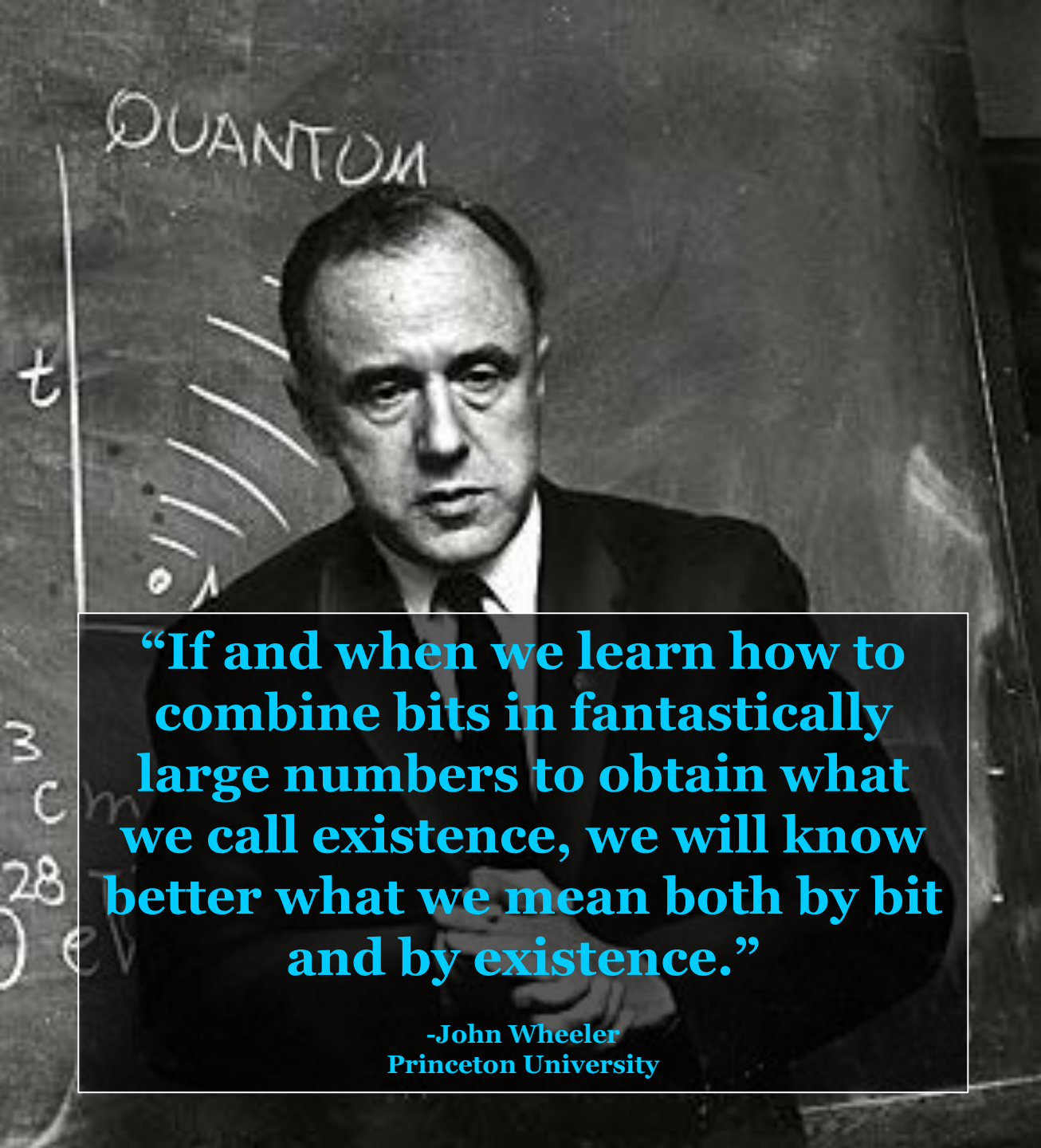
- 1 GB per second of incoming sensor data
- 1-10 PFLOPs simulation computing capability
- 100-1000 cloud servers for stream processing and control

With today's technology this system is feasible to architect and deployment for protecting the air quality of a specific geographic region. The much bigger challenge is simulating the whole Earth!

AI

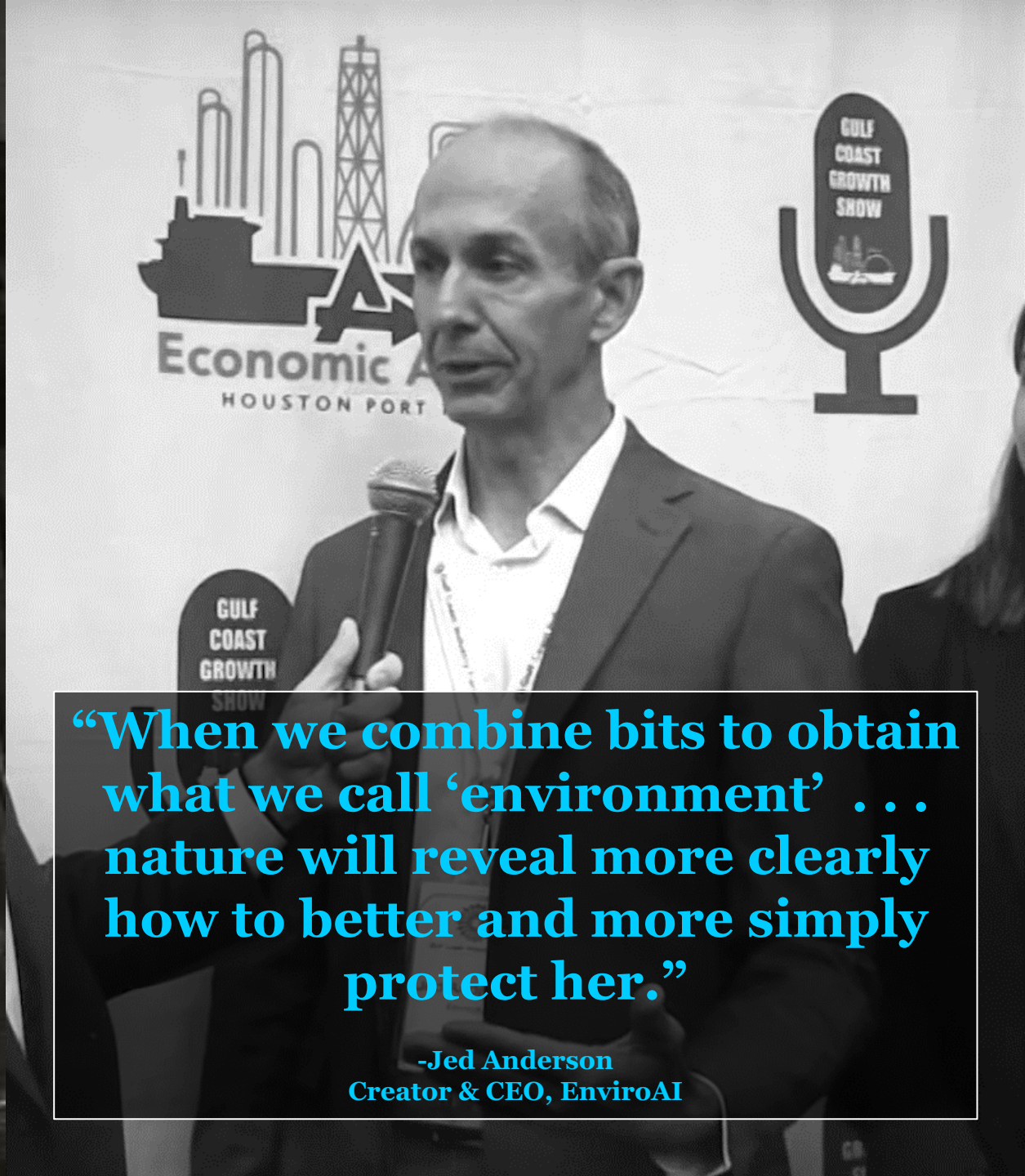
Copy Retry

Share



**“If and when we learn how to combine bits in fantastically large numbers to obtain what we call existence, we will know better what we mean both by bit and by existence.”**

**-John Wheeler  
Princeton University**



**“When we combine bits to obtain what we call ‘environment’ . . . nature will reveal more clearly how to better and more simply protect her.”**

**-Jed Anderson  
Creator & CEO, EnviroAI**





**Can we run  
environmental legal  
simulations?**

**Yes!**

“Humans, nature, and computers all gotta start computing together. Can’t all run off and do our own thing.”

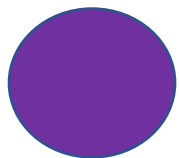
- Jed Anderson, EnviroAI

**13.8 billion  
years ago  
nature starts  
“computing”**

**75 years  
ago humans  
start their own  
computing  
(digital  
computer)**

**10 years  
ago  
computers start  
their own  
computing (AI)**

**“BANG”**





**“A universe where things  
compute together stands a  
much greater chance at  
success.”**

**- Jed Anderson, EnviroAI**



**“Compute  
together . . . stay  
together.”**

- Jed Anderson, EnviroAI



**WHY SIMPLIFY  
ENVIRONMENTAL  
PROTECTION???**

*"Nature is pleased with simplicity. And nature is no dummy." ~Isaac Newton.*

*"When the solution is simple, God is answering." ~Einstein*

*"Nature . . . does not act by means of many things when it can do so by means of a few." ~Galileo*



# SIMPLICITY



**SIMPLICITY**


A night sky filled with stars, with the Milky Way galaxy visible as a bright, hazy band of light stretching across the upper half of the frame. The lower half of the image shows the dark silhouettes of evergreen trees against the starry background.

**SIMPLICITY**

A wide-angle photograph of a lavender field at sunset. The rows of purple flowers stretch towards the horizon, creating a strong sense of perspective. The sky is filled with vibrant orange, red, and purple clouds, with a few dark silhouettes of trees on the horizon line.

**SIMPLICITY**

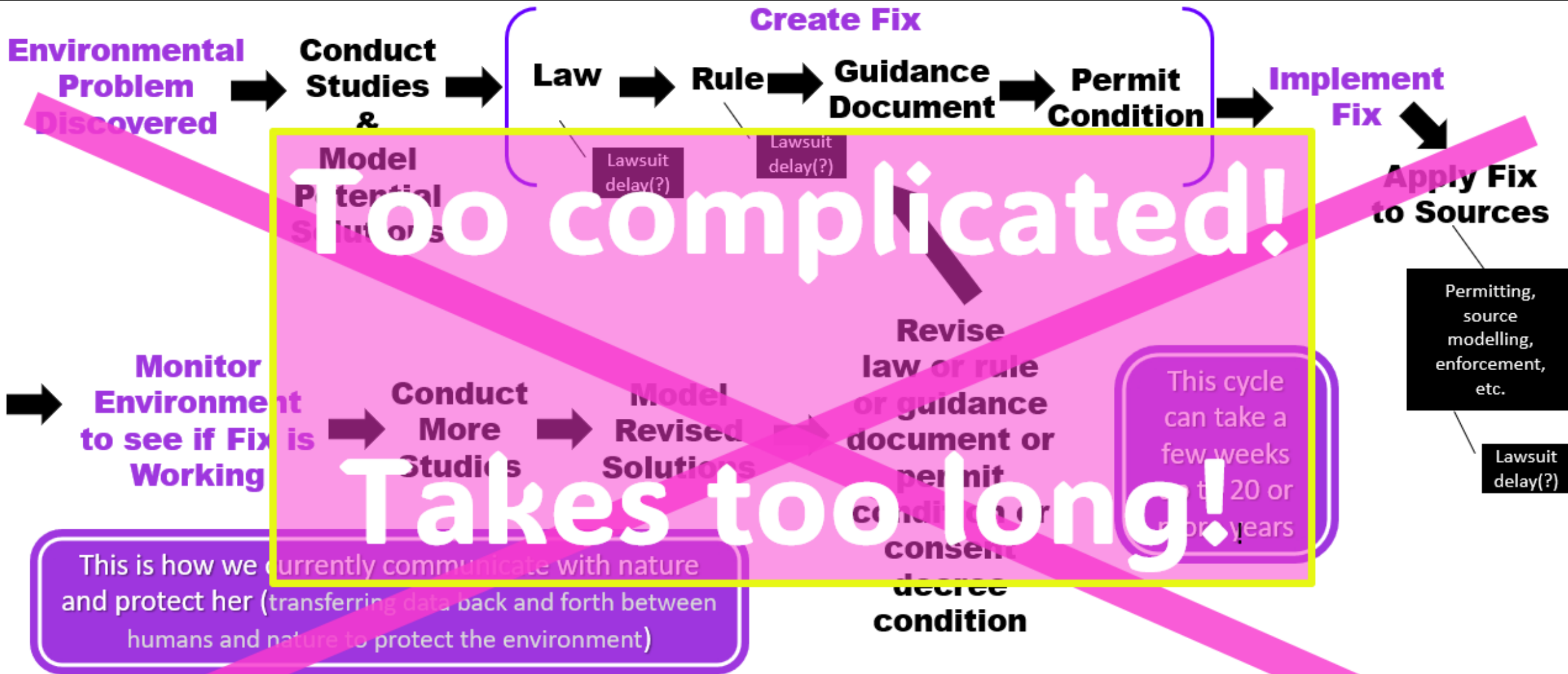
# U.S. Environmental Laws are the Most Complicated Laws in Human History



Title	NetFlowRank	TokenRank	EntropyRank	DepthRank	CompositeScore	CompositeRank
42	2	8	2	10	5.5	1
26	7	2	29	1	9.75	2
5	1	21	23	2	11.75	3
49	25	11	9	5	12.5	4
31	4	17	18	12	12.75	5

*"Measuring the Complexity of the Law: The United States Code"*, Daniel Katz, Chicago Kent College of Law, (2014).

# Current Environmental Protection Cycle



This is how we currently communicate with nature and protect her (transferring data back and forth between humans and nature to protect the environment)



**SIMPLIFY**

A long pier extends into a calm body of water under a vibrant sunset sky. The sky transitions from deep blue on the left to bright orange and red on the right. The pier's structure, including its support posts and a small building at the end, is reflected in the still water. A white rectangular box is centered over the pier, containing the word "SIMPLIFY" in a bold, white, sans-serif font.

**SIMPLIFY**

A night landscape featuring a starry sky with the Milky Way galaxy visible. In the foreground, a pool of water reflects the sky and the surrounding rocky terrain. The word "SIMPLIFY" is written in large, white, bold letters within a pink-bordered box in the center of the image.

**SIMPLIFY**



**SIMPLIFY**

**SIMPLER.**



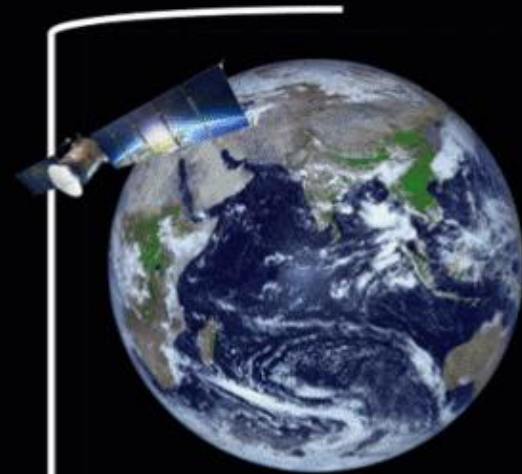
# QUANTUM TWIN AI

**Measuring & Simulating the  
Computational Environment with  
Feedback Loops**

The Future of Environmental Protection

**SIMPLER.**

**AI**



**EnviroAI**



AI and Quantum Computing



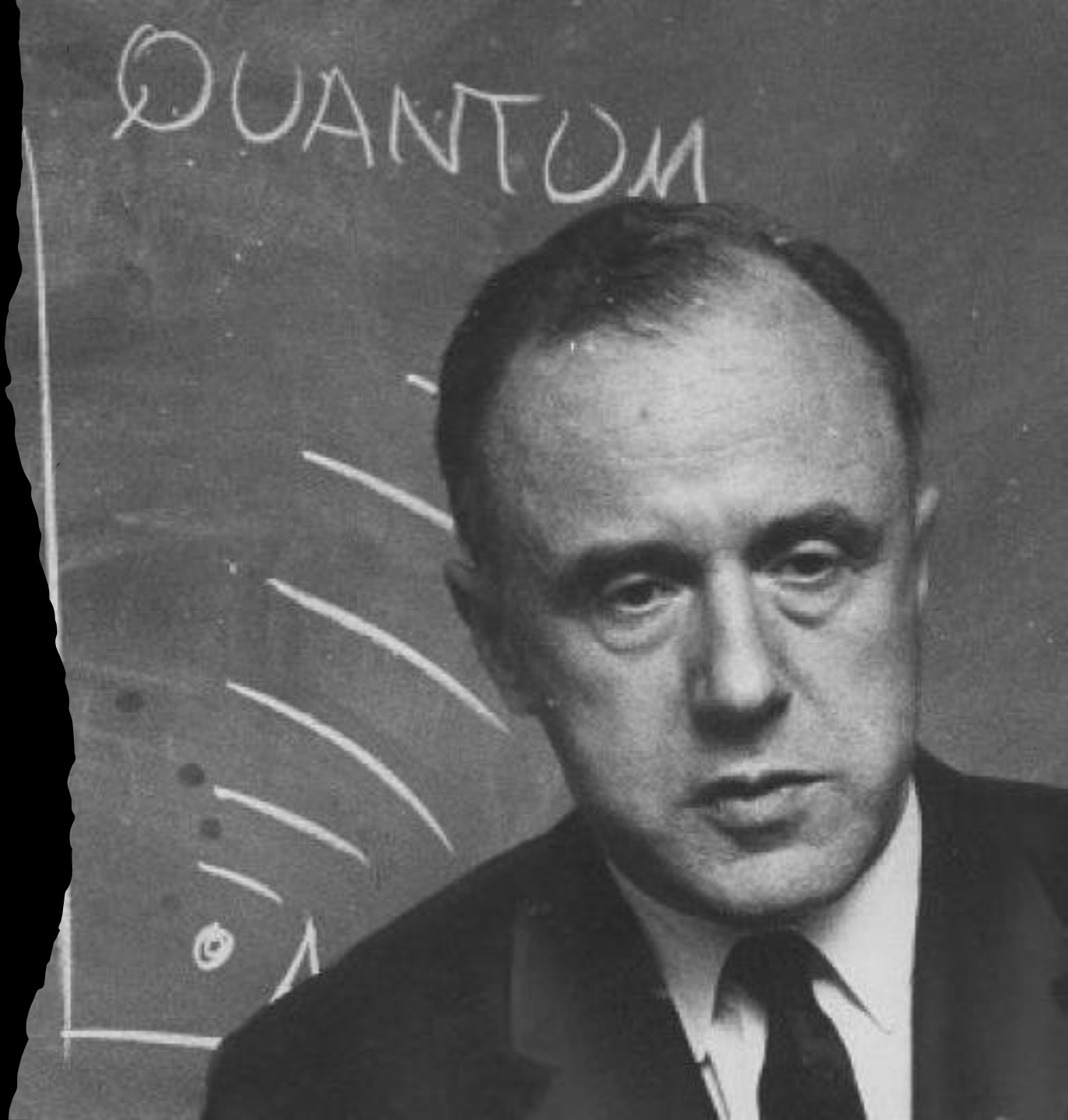
**Source**

“All things  
physical are  
information.”

— John Wheeler

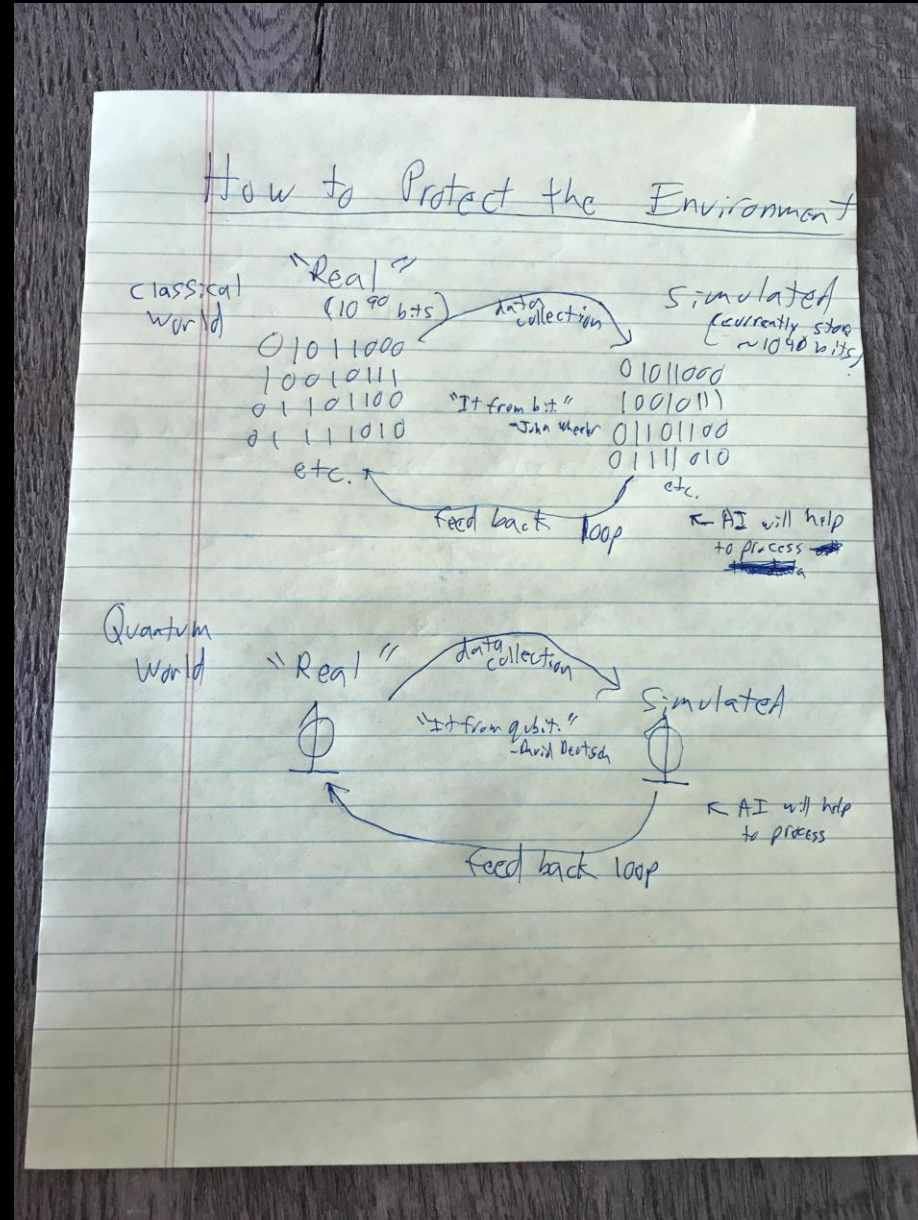
“It’s simpler to begin moving in the direction  
of protecting the environment more  
fundamentally as information using  
information technology. Less energy  
involved. Faster. Less cost. Less entropy.”

— Jed Anderson, Creator and CEO, EnviroAI



# SIMPLER.

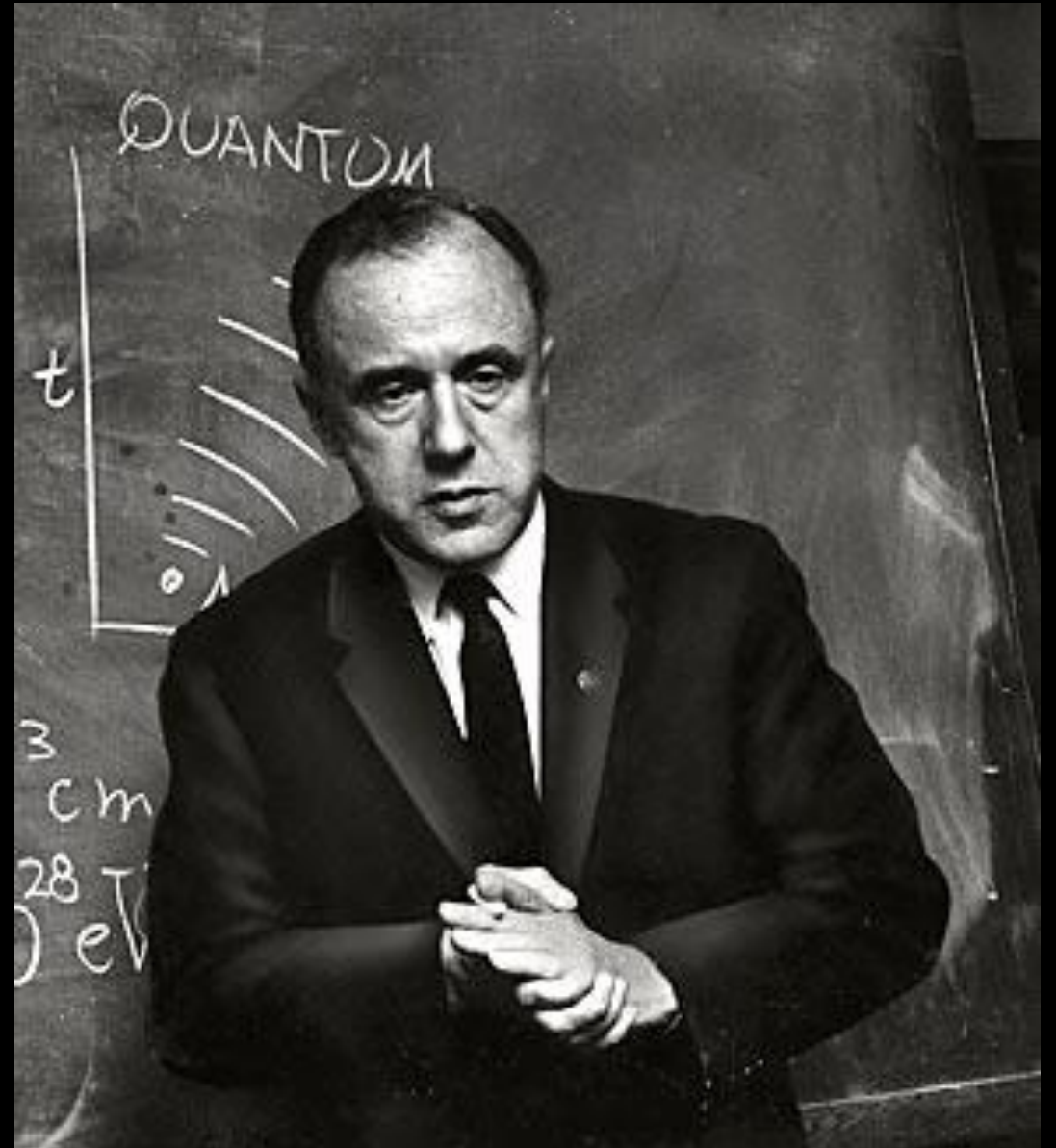
**“It’s just simpler.”** – Jed Anderson, Creator & CEO, EnviroAI



**“If and when we learn how to combine bits in fantastically large numbers to obtain what we call existence, we will know better what we mean both by bit and by existence.”**

**-John Wheeler**

Princeton University



$10^{90}$

Bits of information in the universe

[This includes human-generated information]

$10^{45}$

Bits of human-generated  
information [So far]

$10^{21}$

Bits of human-generated  
information GPT-3 was trained on

# This is an image of a 2021 computer simulation of the universe.

It's the largest simulation to date. It covers 2.1 trillion particles and is over 9.6 billion light-years in length. The simulation took 40,000 processor cores and 20 million computer hours to generate and was stored on 3,000 TB of storage.

Citation: Max Planck Institute, Millennium Simulation, 2021 <https://wwwmpa.mpa-garching.mpg.de/galform/virgo/millennium/>



# In less than 500 years!

We will be able to simulate each bit in the universe at the current rate of growth in computer processing and storage.

## John Wheeler's Hypothesis on Bits and Existence ▾

John Wheeler once said, "If and when we learn how to combine bits in fantastically large numbers to obtain what we call existence, we will know better what we mean both by bit and by existence." Seth Lloyd determined that there is something in the order of 10 to the 120th power bits in the universe. At the current and expected rate of combining bits that humans are currently achieving, when might John Wheeler's hypothesis be potentially proved or disproved?

It's difficult to predict exactly when John Wheeler's hypothesis on the relationship between bits and existence could be proved or disproved. A few thoughts:

- The number of bits Seth Lloyd estimated in the observable universe ( $10^{120}$ ) is enormous and far beyond what humans can currently manipulate or simulate. However, the rate of progress in computing and information processing continues to accelerate rapidly.
- Humans are still very far from combining bits on the cosmic scale that Wheeler refers to. The most complex information processing systems we have created manipulate maybe  $10^{15}$  bits currently. Getting from  $10^{15}$  to  $10^{120}$  is still an immense gap.
- However, if computing power and our ability to combine bits continue to double at the pace observed by Moore's Law (every 18-24 months), then we would reach Seth Lloyd's  $10^{120}$  bit estimate within 400-500 years. Of course, Moore's Law is expected to slow down at some point.
- There are also theoretical limits to how fast and densely bits can be processed, even using all the matter and energy in the observable universe. But these limits are still so mind-bogglingly high that Wheeler's hypothesis seems possibly testable given enough technological progress over centuries.

In summary - barring immense leaps in physics and technology, testing Wheeler's ambitious hypothesis directly seems over 400+ years away based on current trajectories. But indirect evidence proving or disproving ideas related to it could emerge much sooner. Overall there are still huge gaps in our understanding, so timescales are highly speculative.

Copy



Thank you. Can you provide the calculations please for this estimate?

Sure, let me show the work behind the estimate that testing John Wheeler's hypothesis could be 400+ years away:

- Seth Lloyd's estimate of total bits in the observable universe:
  - Approximately  $10^{120}$  bits
- Current estimate of total bits processed in most complex human-made systems:
  - Top supercomputers process on the order of  $10^{15}$  bits per second
  - Over the span of a year that would be  $10^{15} * 31.5$  million seconds per year =  $\sim 10^{24}$  bits per year
- So the gap between bits we can process yearly and total bits in the observable universe is  $10^{120}/10^{24}$  which is roughly  $10^{96}$
- If we assume computing power doubles at the rate of Moore's Law:
  - Doubling every 2 years (a commonly used estimate for Moore's Law timespan)
  - Then in 70 years we double bits processed by  $10^{21}$  times
    - ( $2^{35}$  doubling times over 70 years results in multiplying computing power by  $2^{35} = 10^{21}$ )
  - And over 400 years by 2085 we multiply by  $10^{120}$  times
- So starting from  $10^{24}$  bits per year in 2024:
  - In 400 years at the Moore's Doubling rate =  $10^{24} * (10^{120})$  which reaches  $\sim 10^{120}$  bits
  - Which matches Seth Lloyd's estimate for total bits in the observable universe

In summary, if Moore's Law continues, we should reach the cosmic bit processing capacity in 400+ years, allowing a test of Wheeler's hypothesis on connecting all those  $10^{120}$  bits to produce observable reality. Let me know if any part of the math here needs more clarification!

Copy



How do advances in quantum computing and artificial intelligence potentially impact this? Thank you.

Excellent question! Advances in quantum computing and AI could potentially accelerate progress towards testing Wheeler's hypothesis considerably:

Quantum Computing:

- Quantum computers are theoretically capable of exponential leaps in processing power for certain types of problems and calculations. Some estimates point to 10,000x or even much greater speedups.
- If quantum computing allows us to combine and manipulate more bits per second, it would shrink the timeline needed to reach cosmic bit manipulation capacities. Certain quantum computing architectures may lend themselves better to simulations relevant to Wheeler's ideas.
- Instead of 400+ years predicted by classical Moore's Law, practical quantum computing could shorten the horizon to test Wheeler's hypothesis to 100-200 years potentially. But quantum computing progress is still highly uncertain.

Artificial Intelligence:

- AI itself does not directly provide increased bit manipulation power, but it can enable software and hardware to process information more efficiently.
- AI solutions could find novel shortcuts, connections and patterns in data that allow condensing processes to manipulate information. This could lead to qualitative leaps rather than just quantitative gains.
- Advanced AI may also be what allows us to take full advantage of quantum computing power when it becomes available. Effectively using millions of qubits could require AI assistance.
- So while harder to quantify than raw computing hardware gains, AI advancement could also trim the 400+ year projection meaningfully through efficiency "software" gains as opposed to just faster hardware.

In summary, quantum computing provides the most direct path to vastly faster bit manipulations. But AI also holds significant promise for accelerating progress by orders of magnitude through enabling greater efficiency and research leaps not confined to Moore's Law timelines. The exact amount either could change the projections requires deeper research.

Copy Retry



“The universe computes. The computing universe is not a metaphor, but a mathematical fact: the universe is a physical system that can be programmed at its most microscopic level to perform universal digital computation. Moreover, the universe is not just a computer: it is a quantum computer. Quantum mechanics is constantly injecting fresh, random bits into the universe. Because of its computational nature, the universe processes and interprets those bits, naturally giving rise to all sorts of complex order and structure.”— **Paul Davies, Physicist, ASU**

**"We couldn't build quantum computers unless the universe were quantum and computing. We can build such machines because the universe is storing and processing information in the quantum realm. When we build quantum computers, we're hijacking that underlying computation in order to make it do things we want: little and/or/not calculations. We're hacking into the universe." – Seth Lloyd, Physicist, MIT**

“It from bit symbolizes the idea that every item of the physical world has at bottom...an immaterial source and explanation...that all things physical are information-theoretic in origin and that this is a participatory universe.”  
-**John Wheeler, Physicist, Princeton University**

“The most important application of quantum computing in the future is likely to be a computer simulation of quantum systems, because that's an application where we know for sure that quantum systems in general cannot be efficiently simulated on a classical computer.” - David Deutsch, Physicist, Oxford University

—" **AI is about making machines more fathomable and more under the control of human beings, not less. Conventional technology has indeed been making our environment more complex and more incomprehensible, and if it continues as it is doing now the only conceivable outcome is disaster."**

— *D o n a l d M i c h i e*

A wide-angle landscape photograph capturing a sunset over a glacial river. The foreground is filled with numerous icebergs of various sizes, some partially submerged in the water. The water reflects the vibrant colors of the sky, which transitions from a deep blue at the top to a bright orange and yellow near the horizon. In the background, dark, jagged mountains rise against the sky, with patches of snow or ice on their peaks. The overall scene is serene and majestic, emphasizing the raw beauty of nature.

**SIMPLICITY**



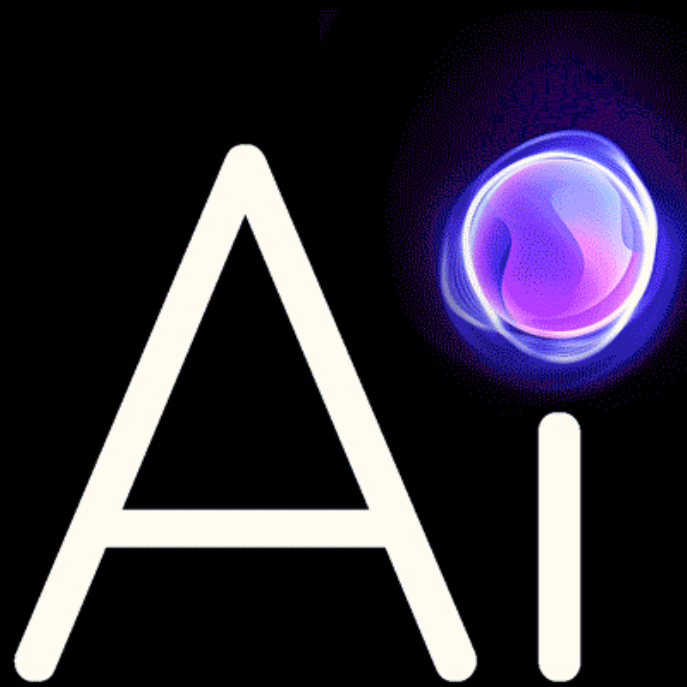
**SIMPLICITY**

A wide-angle photograph of a vast field of purple flowers, likely lavender, stretching to the horizon. The sky is filled with large, dark, dramatic clouds, with a bright orange and yellow glow from the setting sun breaking through near the horizon. The overall mood is serene and contemplative.

**SIMPLICITY**

“The pace of progress in artificial intelligence . . . is incredibly fast. Unless you have direct exposure to groups like Deepmind, you have no idea how fast—it is growing at a pace close to exponential.”

—Elon Musk



“A.I. is more important than fire or electricity.”

—Google CEO, Sundar Pichai

“Artificial intelligence will reach human levels by around 2029. By 2045, we will have multiplied human intelligence a billion-fold.”

—Ray Kurzweil

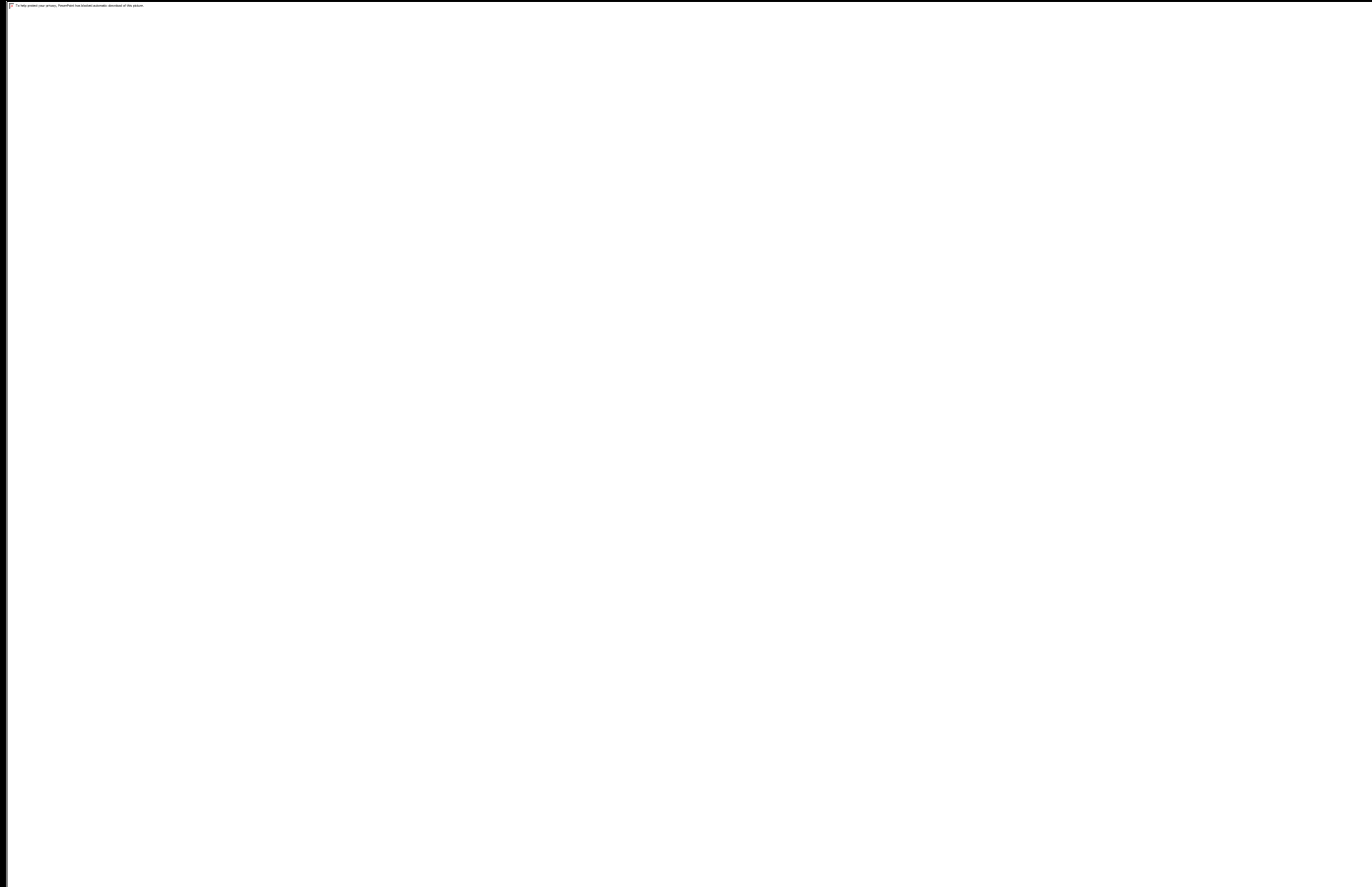


# Perform work in the **EnviroVerse** . . .

- Environmental Auditing
- Phase 1 Reviews
- Modelling
- Monitoring
- Compliance
- Due Diligence
- Permit Preparation
- Reporting
- Investigations
- Inspections

**Stay tuned!**

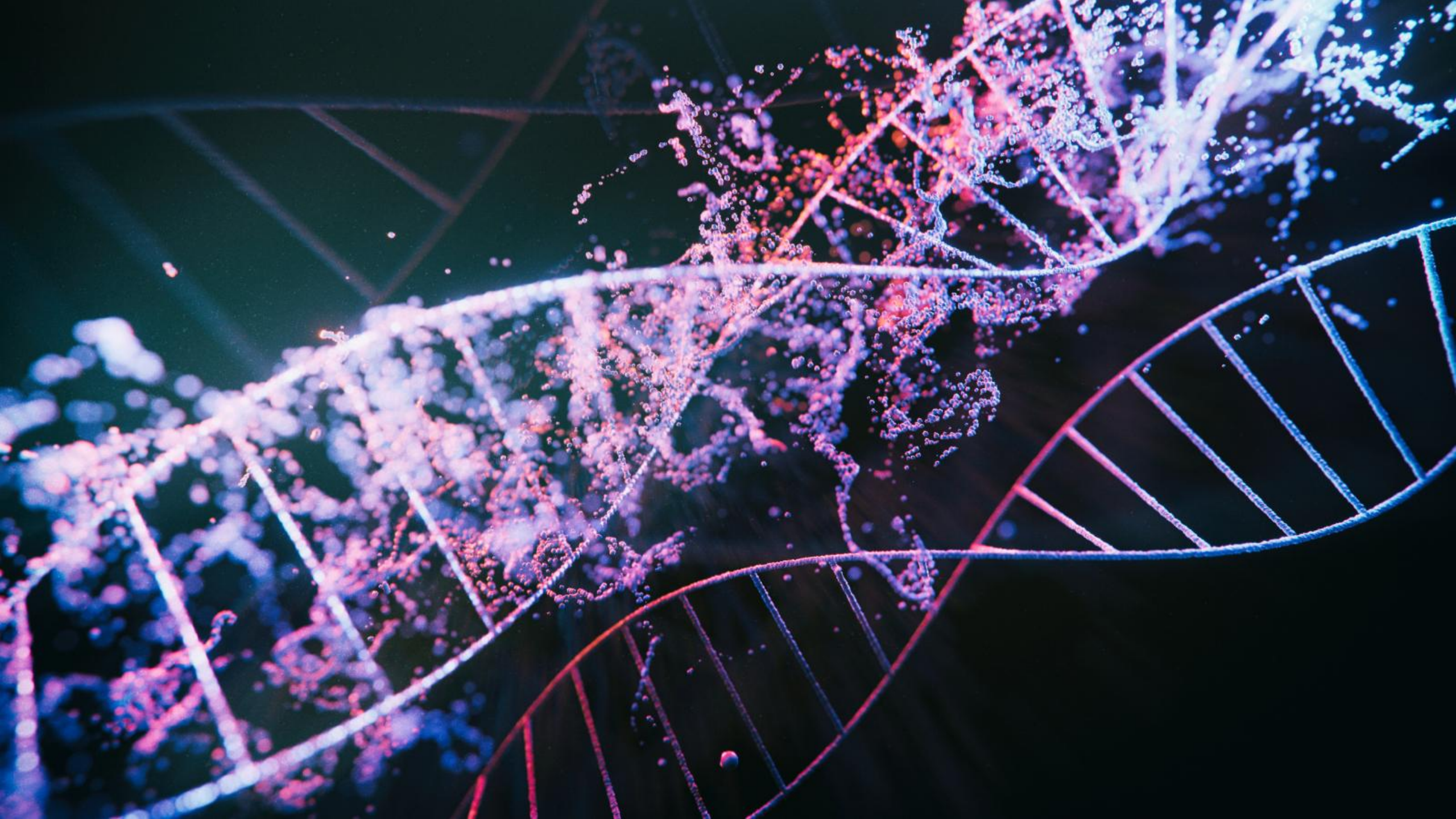
**Client:** “Let me bring my environmental lawyer and let’s meet digitally at the facility tomorrow at 10:00 a.m.”









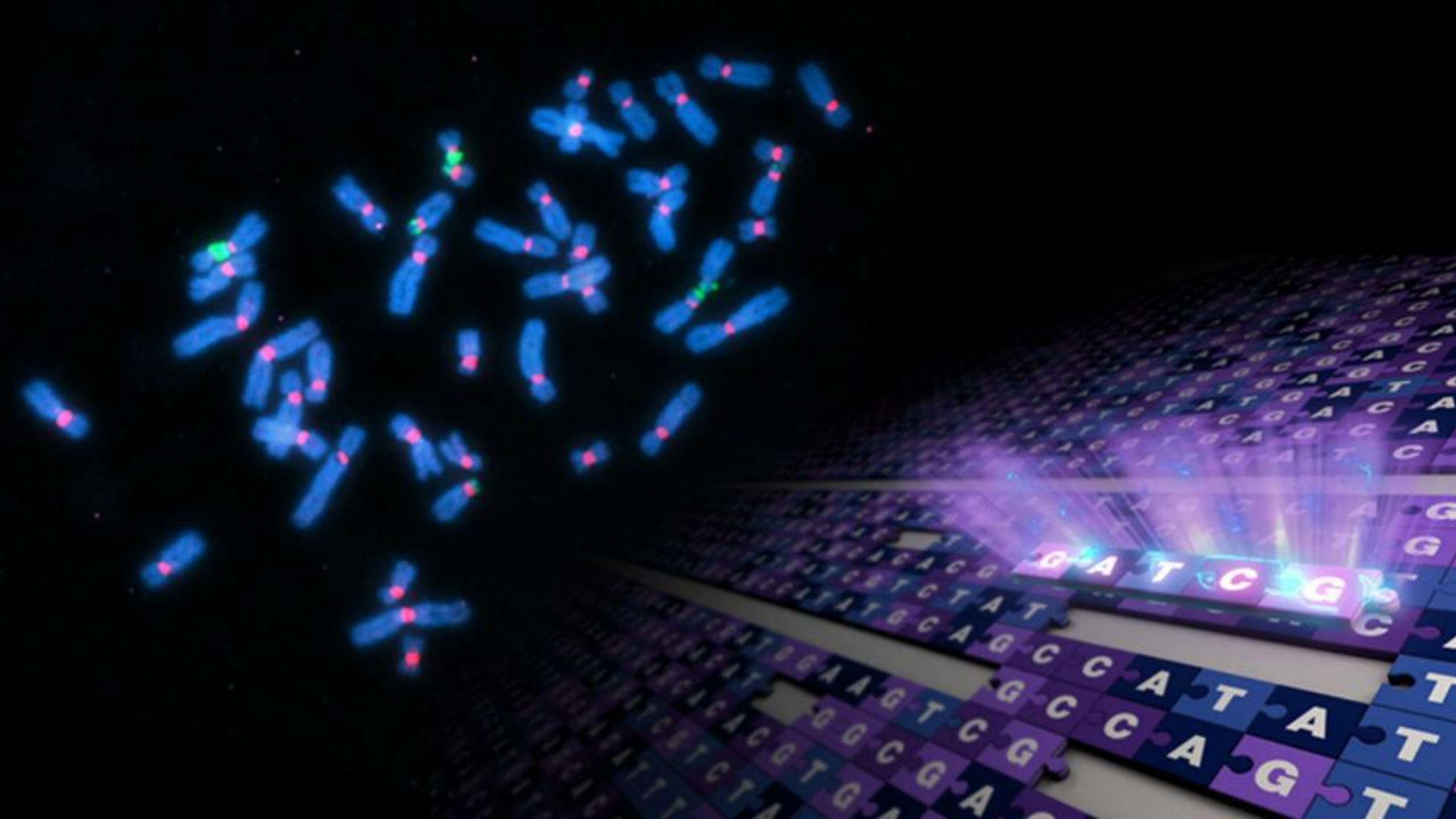




“What lies at the heart of every living thing is not a fire, not warm breath, not a ‘spark of life’ . . . it is information.”

– Richard  
Dawkins





# 10 years-ago most of you wasn't you

(from strictly a matter perspective)



## Turnover Time

Cell type	Length of time
Brain cells	Lifetime
Bone cells	25-30 years
Muscle cells	10 – 16 years
Fat cells	8 years
Lymphocytes	over one year
Liver hepatocytes	0.5 – 1 year
Red blood cells	120 days
Skin cells	10-30 days
Platelets	10 days
Colon	3-4 days
Small intestine epithelium	2-4 days
Stomach	2 days
Blood neutrophils	1-5 days

**The information in your body is continually making almost entirely a “new you” using matter and energy**



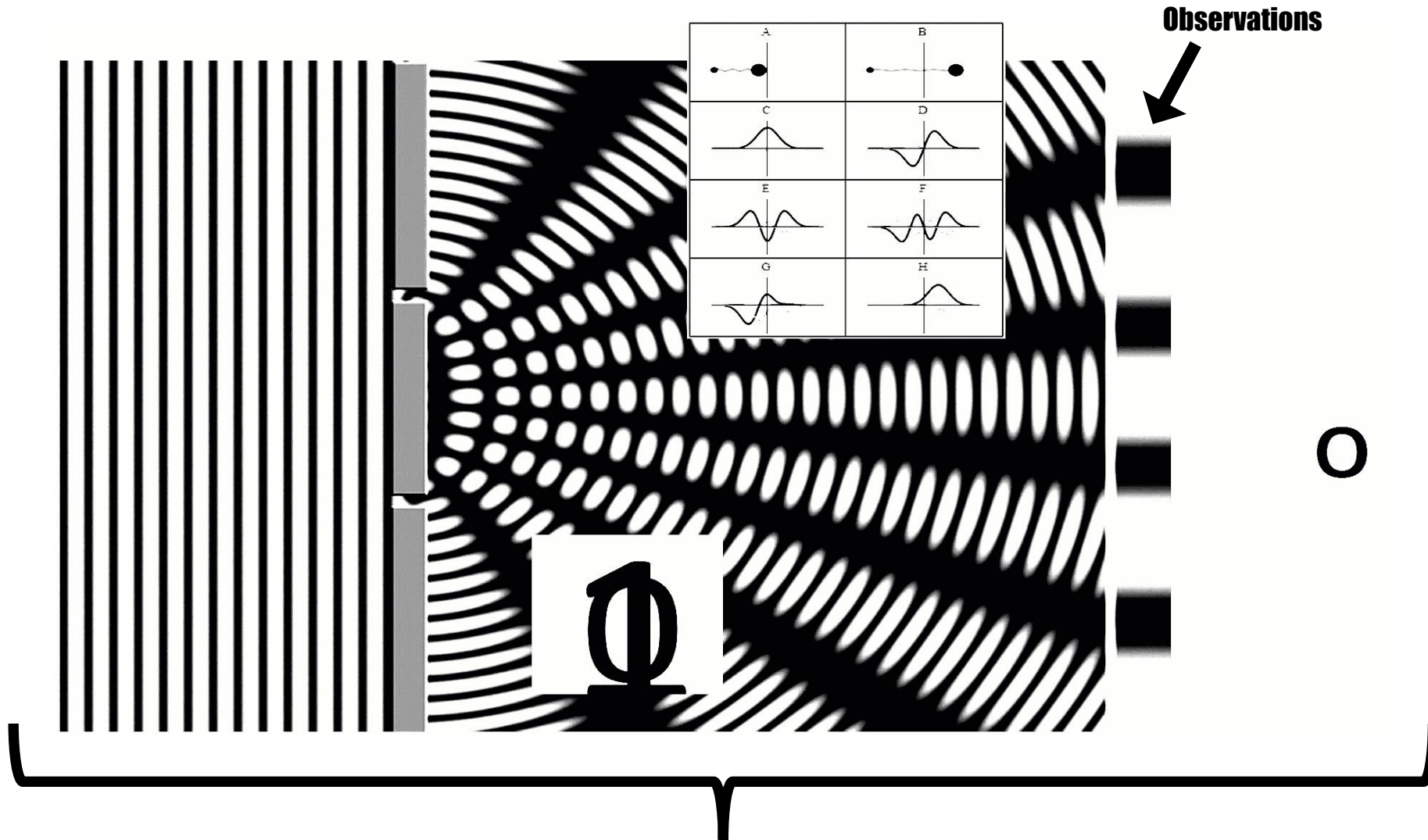
- **Your body makes 330 billion new cells a day**
- **1% of your body's cells are replaced every day**
- **98% of the atoms in your body are replaced every year**
- **By the end of 10 years, most of your body has been replaced**



*“More fundamentally you are not matter. You are information that makes matter.”*

- Jed Anderson





**“Nature Information Processing”**





**“Protecting its  
with bits.”**

– Jed Anderson

# The Future Environmental Compliance & Protection

## 5 Primary Technologies Taking Shape

#1 Artificial Intelligence/Machine-Learning

#2 Digital-Twin/Quantum-Twin Tech

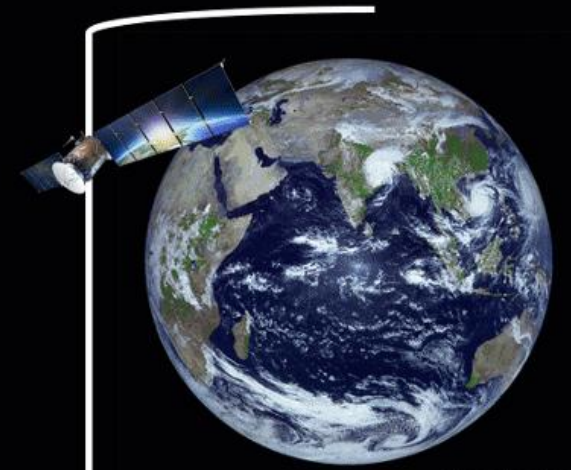
➤ Real-time simulation and modeling

#3 Digital/Quantum Computing

#4 Digital/Quantum Sensing

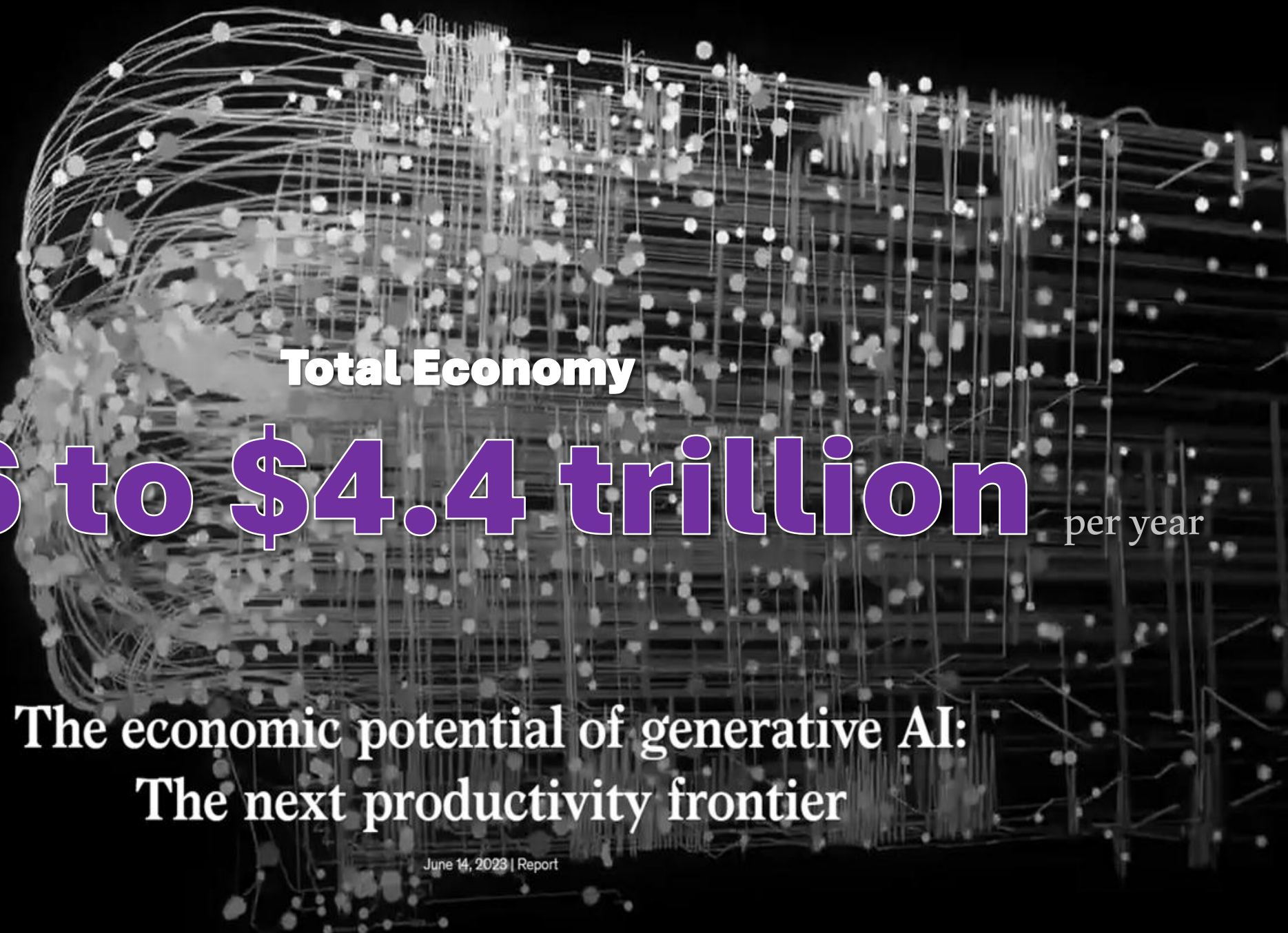
#5 Digital/Quantum Connectivity and Communication

# AI





What's the Value of  
Generative AI to  
Environmental Protection?



**Total Economy**

**\$2.6 to \$4.4 trillion** per year

**The economic potential of generative AI:  
The next productivity frontier**

June 14, 2023 | Report



# Expected Industry Generative AI Savings

Health Care  
Savings



**\$200 - \$360  
billion**

per year (Forbes)

Environmental  
Savings



**AGI** by  
**2026 . . .**  
**2028 . . .**  
**2029 . . . ?**

We don't know when artificial general intelligence will be reached, but most expert's predicted timeframes have significantly dropped over the past year.

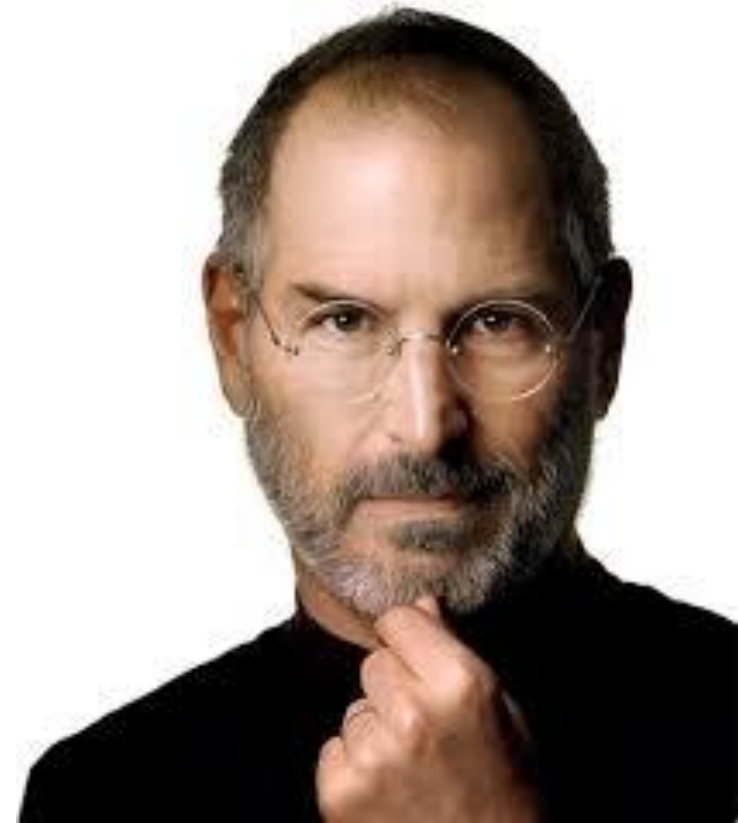


**“Technology is a friend  
of the environment, not  
an enemy.” – Bill Gates**



**“Technology alone  
is not enough.”**

**— Steve Jobs**



**Genius**



*Itzhak  
Perlman*



**... AI is just an  
instrument**

# AI

- Build generative AI prompt skills
- Build your external “AI Brain” tools
  - Off-the-shelf tools
  - Build your own or customize your own tools
  - Keep simplifying your user interfaces
- Stay attuned to new tools and technological developments you can use to become an even better attorney and servant
- Familiarize and keep in mind the foundational principles of information science since these can significantly help you to “see what’s coming”
- Get ready to build your own AI agent(s)!

“The relationship between human intelligence and artificial intelligence **will necessarily be one of symbiosis**. The challenge and potential of exploring this co-evolutionary future is the biggest story of the next century.” – **Bryan Johnson**