

# AI & Quantum

Information Technologies and the Future of  
Environmental Protection

Why are these  
technologies so  
powerful?

by Jed Anderson, EnviroAI



Red or blue?

The bottom of the rabbit hole . . . what underlies the power in these technologies?

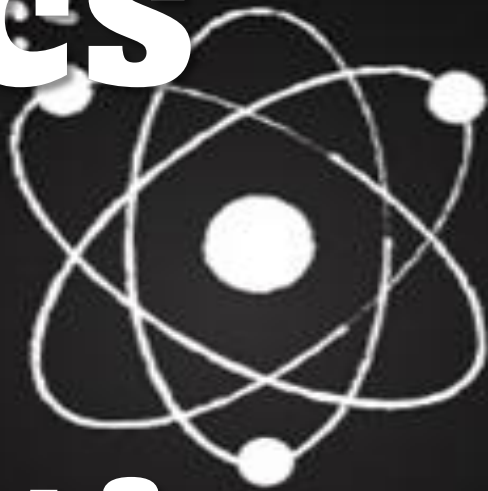
# Physics

# &

# Information

# Theory

Bits/Qubits  
and  
Entropy



$$R = \sigma T^4$$
$$x = A \cos(\omega t + \alpha)$$
$$\sigma = 5.67 \cdot 10^{-8}$$
$$R = \alpha \sigma T^4$$
$$\lambda_m = \frac{b}{T}$$
$$b = 2.9 \cdot 10^{-3}$$

$$\Psi_n = \sqrt{\frac{2}{L}} \sin \frac{n\pi x}{L}$$
$$\omega = \sqrt{\omega_0^2 - \beta^2}$$
$$W = |\Psi|^2$$
$$h\nu = A + \frac{mV_{max}^2}{2}$$
$$\Delta m > 0 \quad \Delta m < 0$$
$$c = c_0 \cdot n$$
$$p = \frac{h\nu}{c}$$
$$R = \frac{1}{\tau}$$
$$p = \frac{1}{c} \sqrt{W_x^2 + W_y^2 + 2E_0}$$
$$E_{rel} = \Delta m c^2$$
$$c_0 = \sqrt{c^2 - 2\beta^2}$$
$$\lambda = \frac{h}{p}$$
$$\varphi = \frac{W}{q_0}$$
$$f(\nu) = 4\pi \left[ \frac{2\pi h \nu}{m} \right]^{1/2} \nu e^{-\frac{2\pi h \nu}{kT}}$$
$$\Delta u = \frac{\Delta v}{v_0}$$
$$\lambda_K = \frac{hc}{A}$$
$$W = mgh$$
$$F_{rel} = \gamma m v$$
$$\langle v \rangle = \sqrt{\frac{8KT}{\pi m_0}} = \sqrt{\frac{8RT}{\pi \mu}}$$
$$A = F \Delta s \cos \alpha$$

$$x = A_1 \cos(\omega t + \alpha_1) + A_2 \cos(\omega t + \alpha_2)$$
$$\lambda = vT$$
$$k = \frac{2\pi}{\lambda}$$
$$\xi = A \cos(\omega t - kx)$$
$$n = \frac{c}{v}$$
$$\eta = \frac{v_2}{v_1}$$
$$u = \frac{1}{2} \rho v^2$$
$$E_2 = \frac{5}{2} \cdot \hbar \omega (n=2)$$
$$\sigma = en(u_n + u_p)$$
$$R_s = \frac{35}{8}$$
$$\frac{r}{ne} = \frac{h}{\lambda}$$
$$p = p_0 e$$
$$\psi = N \rho$$
$$E_3 = -L \frac{d\theta}{dt}$$

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$$A = 10D$$
$$q = \frac{\Delta \Phi}{R}$$
$$D = \frac{1}{3} \langle v \rangle \langle \lambda \rangle$$
$$\Delta = L_2 - L_1$$
$$E = \frac{q}{4\pi \epsilon_0 r^2}$$
$$\chi = \eta \frac{R}{\mu}$$

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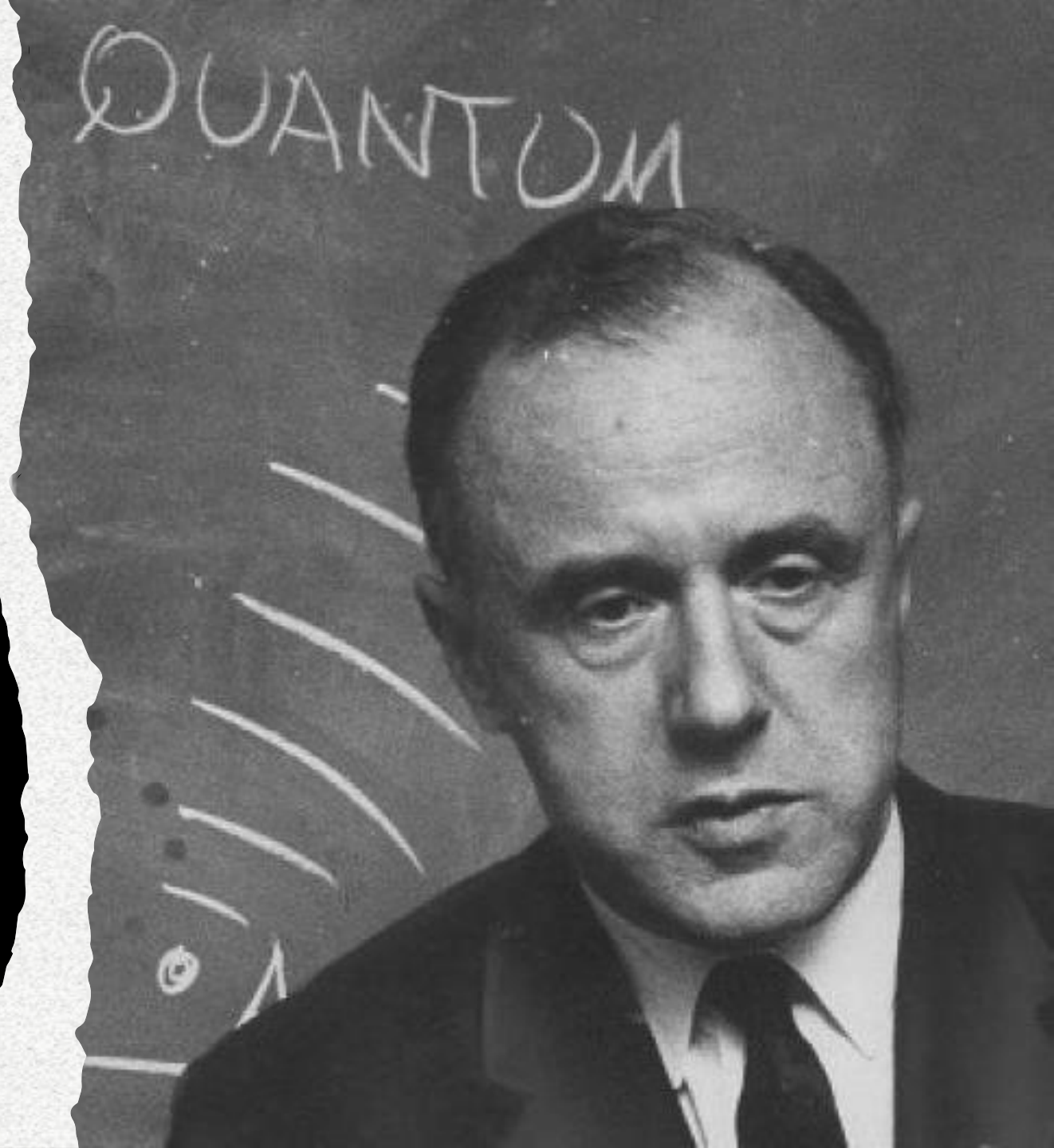
“Everything we  
call real is made of  
things that cannot  
be regarded as  
real.”

— Niels Bohr



“All things  
physical are  
information.”

— John Wheeler

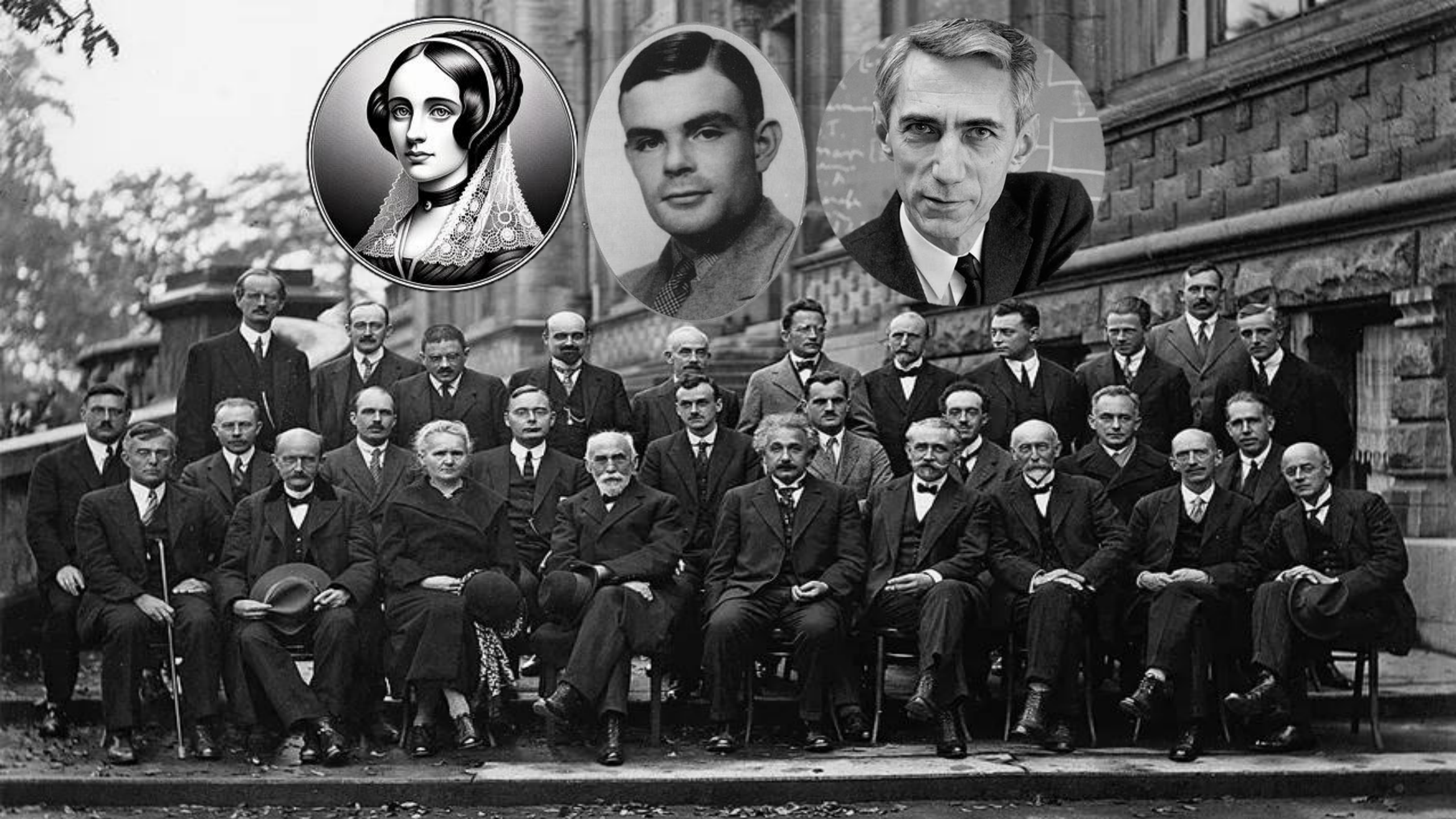
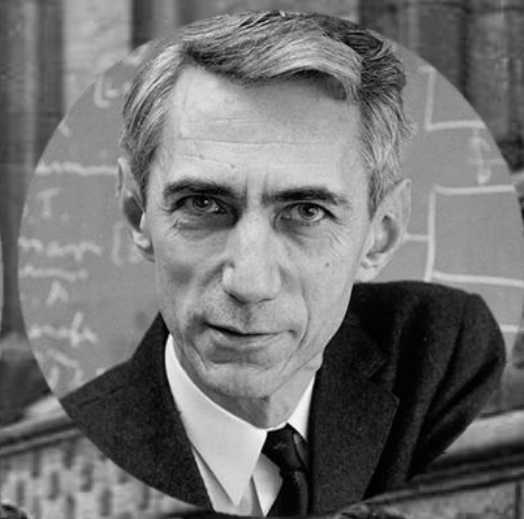


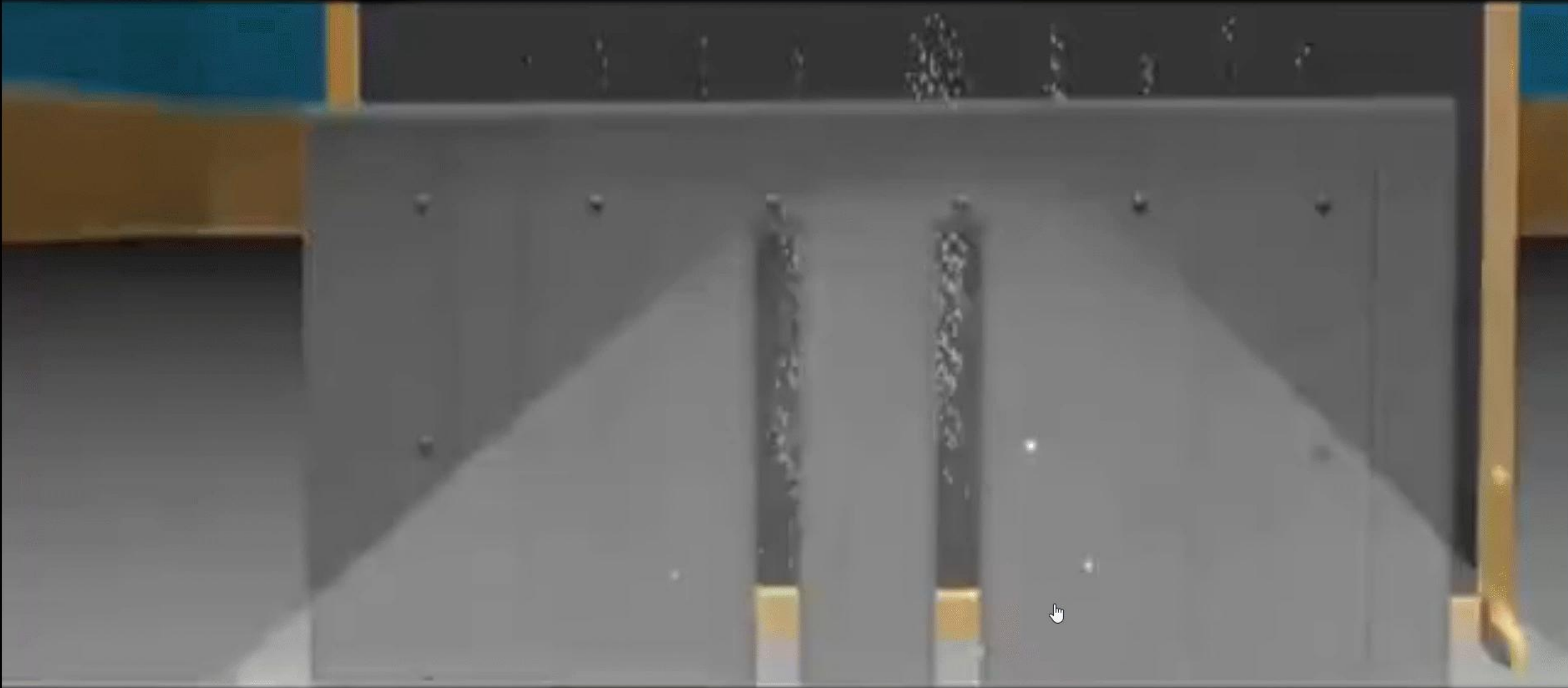


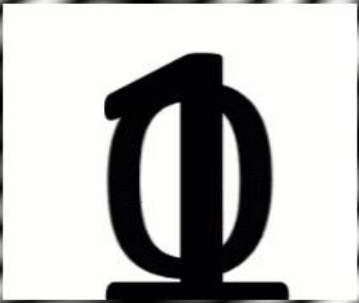
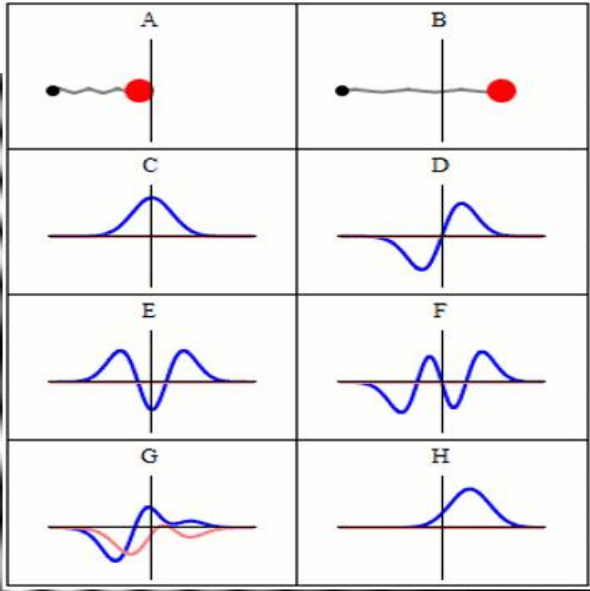
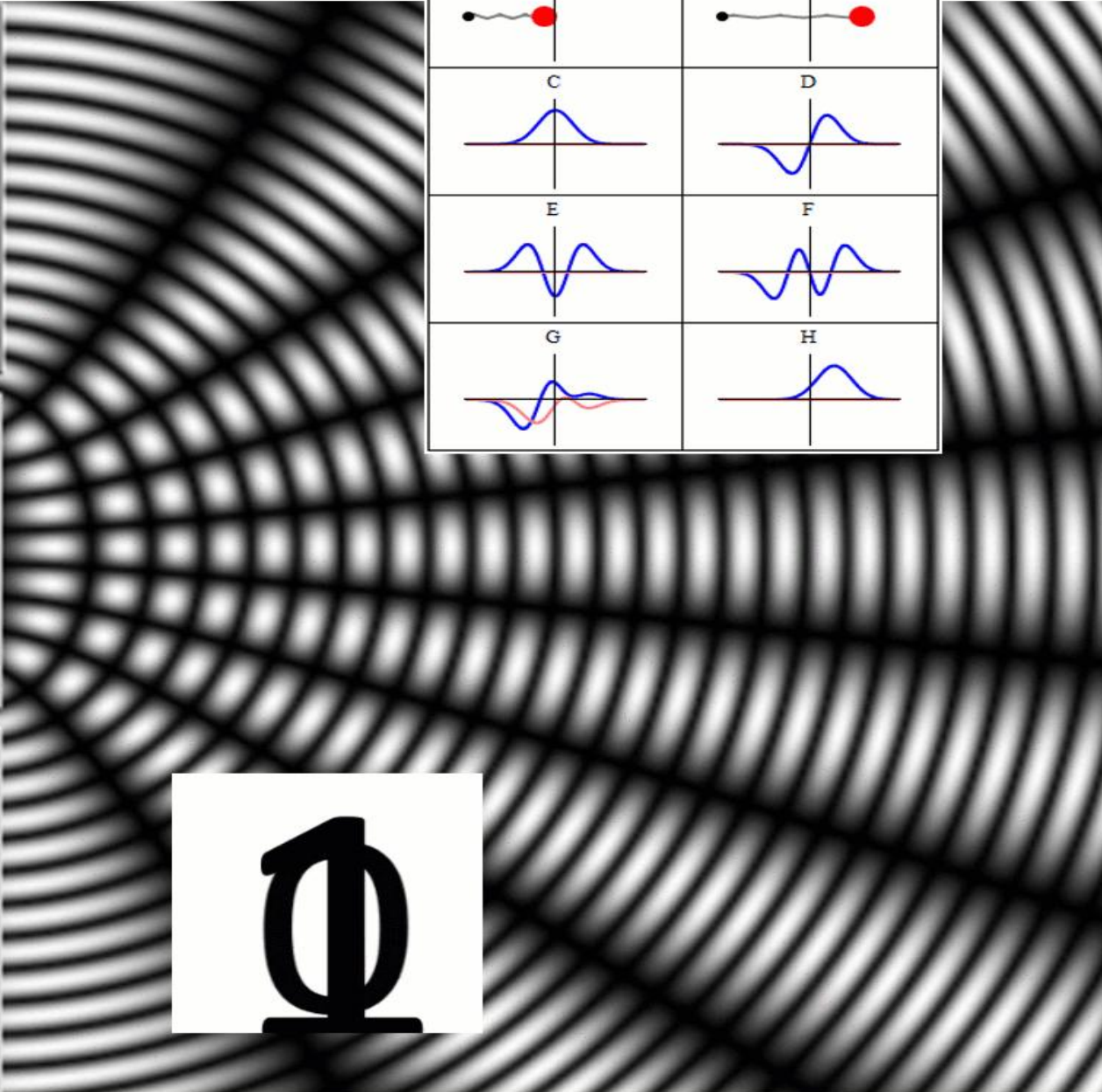
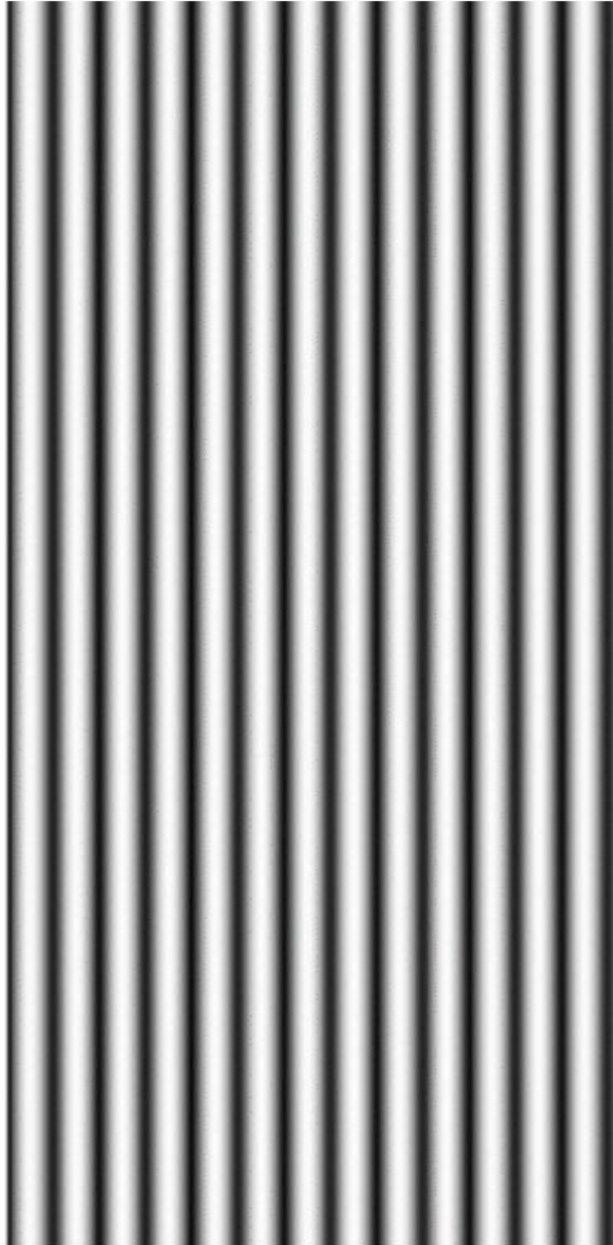
# Information.

Everything in and around us at  
some level is information.

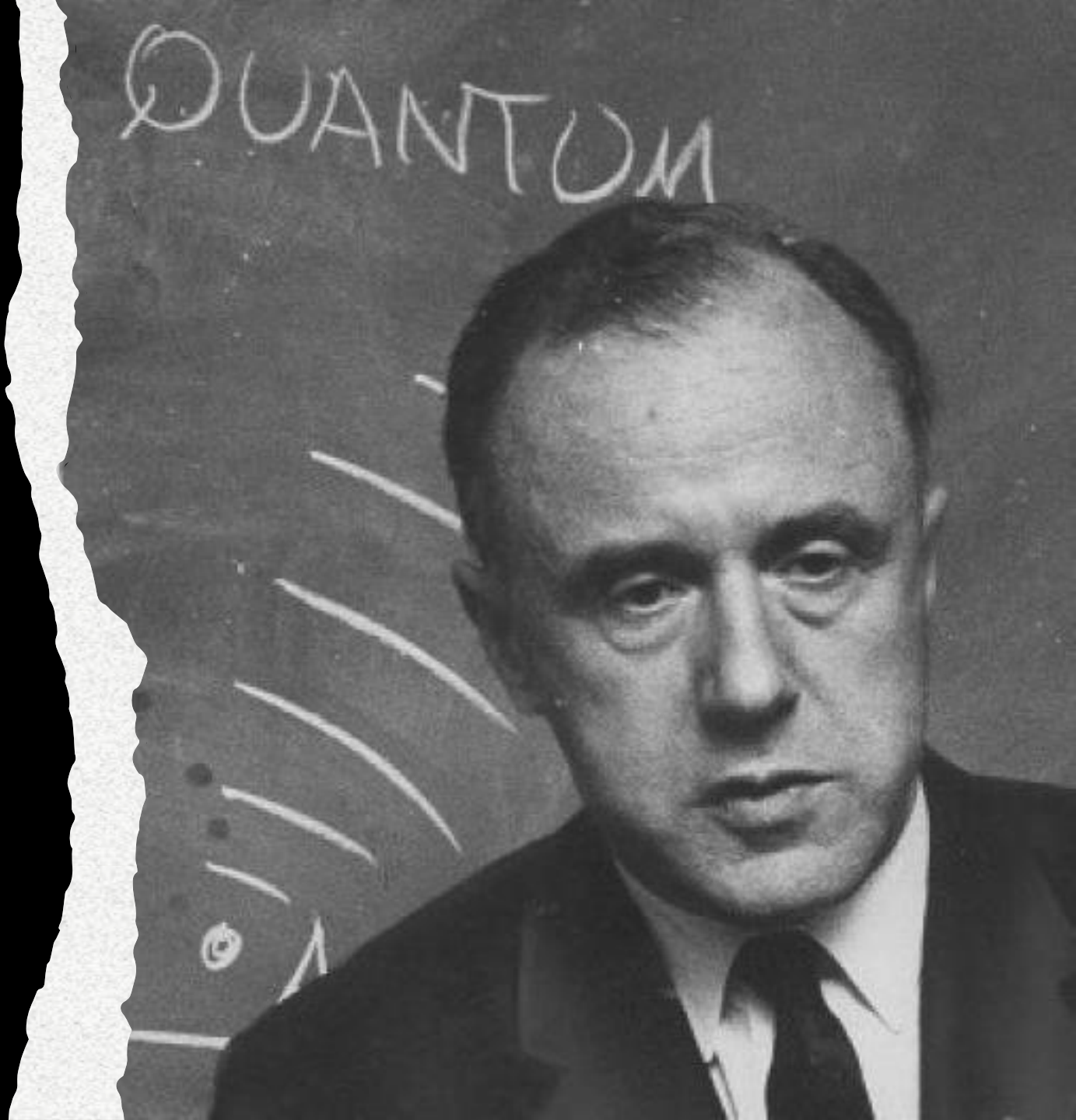
[perhaps except consciousness]







“All things physical  
are information.”  
— John Wheeler



# Classical Digital Computer

**0**

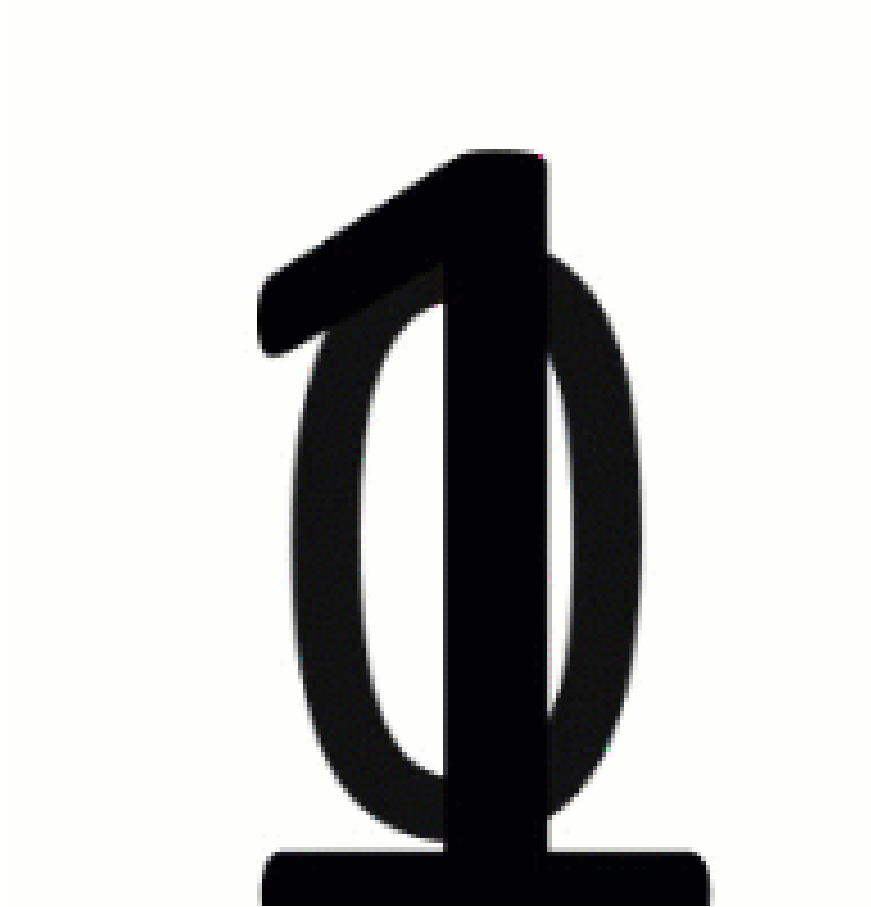
(no)

or

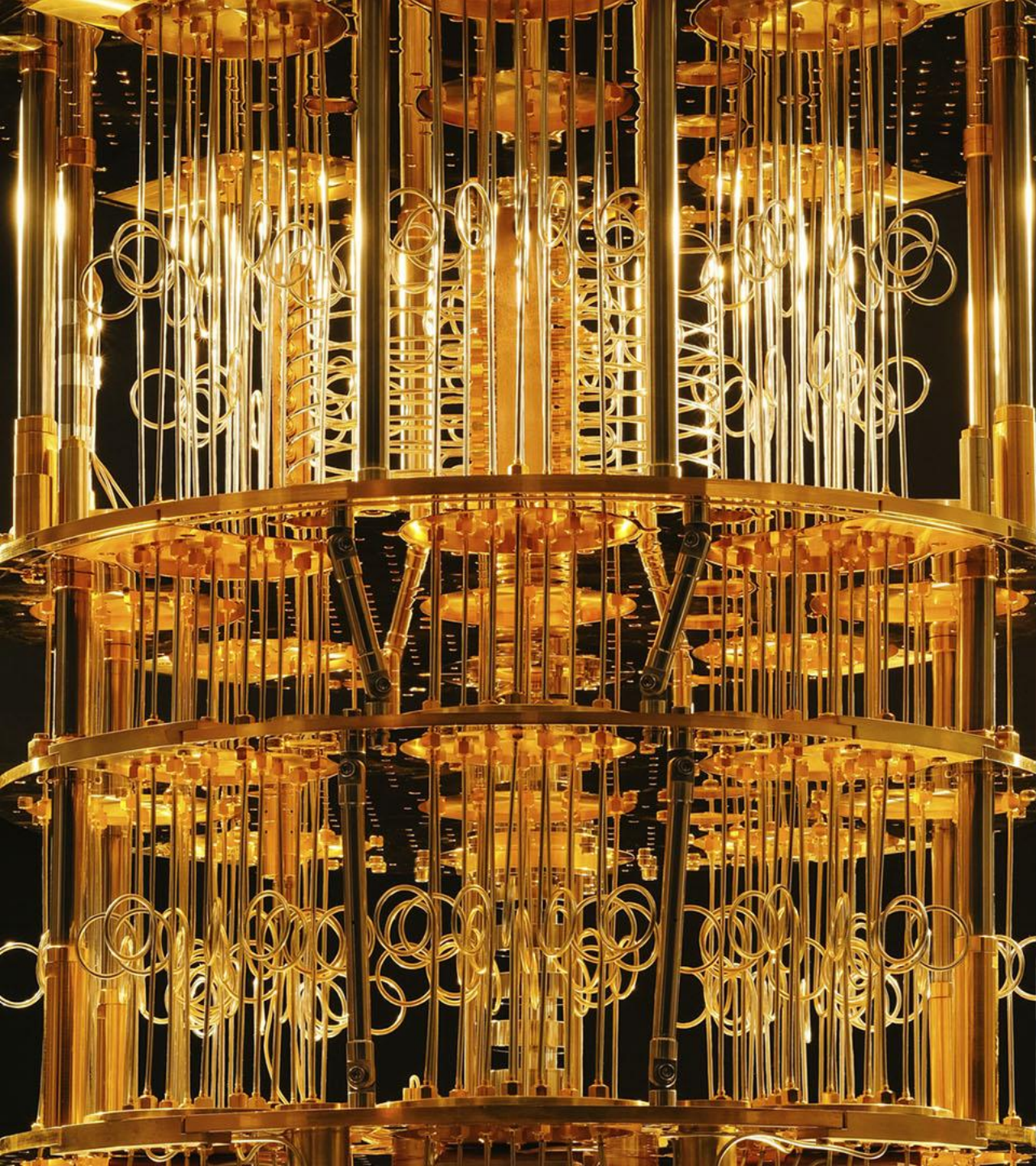
**1**

(yes)

# Quantum Computer



(yes/no)



## Quantum Data

1

## Classical Data

(binary computer)

01001010010101  
10101101110000  
10011110000111  
10101011111000  
01010111100011  
01010101010101  
11010110101011

## Biological Data

ACTGACTGACTTAGG  
ATTCGAGATCCATTC  
CTTGAGACCTTTTTT  
ACCCCTATAGCATCA  
TTCCAGGATCTATTAT  
CCTATATATAGGGGC  
CCATATAAATGGGCT

## Human Data

Language data  
(letters), sensory  
data (visual  
images), numeric  
data (numbers)

**All at some level is data.**

**Bits**

# TREE

01001101001  
01010111011  
11011101110  
01011101100  
01010110111

[etc.]

# MUSIC

01001101001  
01010111011  
11011101110  
01011101100  
01010110111

[etc.]

# HUMAN

01001101001  
01010111011  
11011101110  
01011101100  
01010110111

[etc.]

# COOKIE

01001101001  
01010111011  
11011101110  
01011101100  
01010110111

[etc.]

# MATH

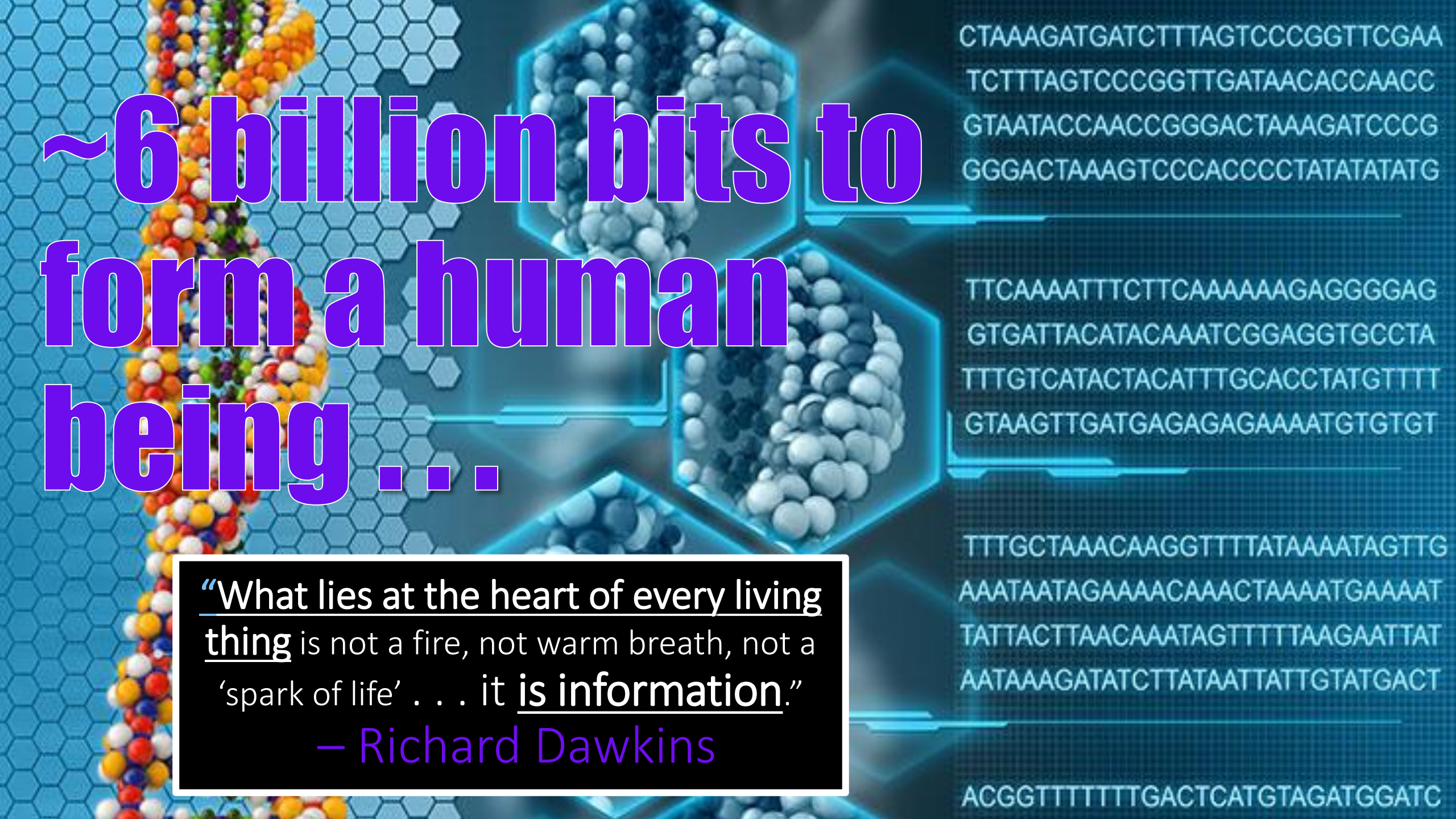
01001101001  
01010111011  
11011101110  
01011101100  
01010110111

[etc.]

# UNIVERSE

01001101001  
01010111011  
11011101110  
01011101100  
01010110111

[etc.]



~6 billion bits to  
form a human  
being . . .

“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

CTAAAGATGATCTTTAGTCCCGGTTTCGAA  
TCTTTAGTCCCGGTTGATAACACCAACC  
GTAATACCAACCGGGACTAAAGATCCCG  
GGGACTAAAGTCCCACCCCTATATATATG

TTCAAATTTCTTCAAAAAGAGGGGAG  
GTGATTACATACAAATCGGAGGTGCCTA  
TTTGTCATACTACATTTGCACCTATGTTTT  
GTAAGTTGATGAGAGAGAAAATGTGTGT

TTTGCTAAACAAGGTTTTATAAAATAGTTG  
AAATAATAGAAAACAAACTAAAATGAAAAT  
TATTACTTAACAAATAGTTTTTAAGAATTAT  
AATAAAGATATCTTATAATTATTGTATGACT

ACGGTTTTTTTGGACTCATGTAGATGGATC



**“It from bit.”**

**– John Wheeler**



“The computational universe is not an alternative to the physical universe. The universe that evolves by processing information and the universe that evolves by the laws of physics are one and the same.”

– Seth Lloyd, MIT



# Is this thing we are living in a simulation ... or a computer?



---"If it looks like a duck,  
swims like a duck, and  
quacks like a duck . . .  
then its not necessarily a duck .  
. . but the odds have gone up  
considerably now that it also  
likes crackers."

- Jed Anderson

# The Universe



# of “computations” increasing over time  
... running the code(s) more and more times

**Bang!**

...  
“computations” begin  
13.8 billion years ago

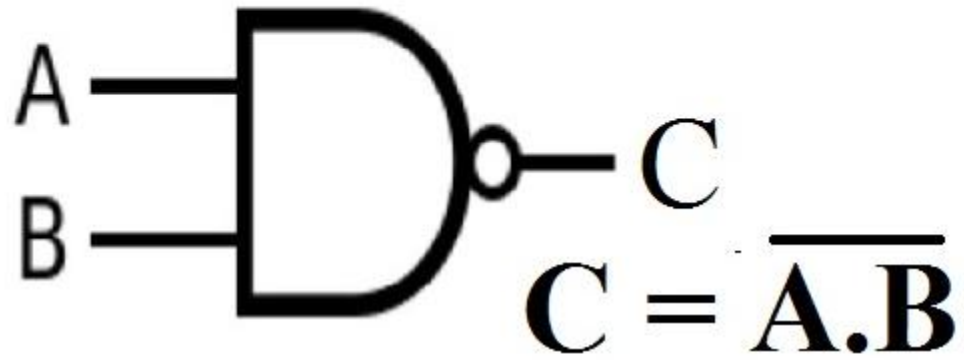
**Nature = Simple Equations/Algorithms/Code**

$$E = MC^2$$

**Yes/No**



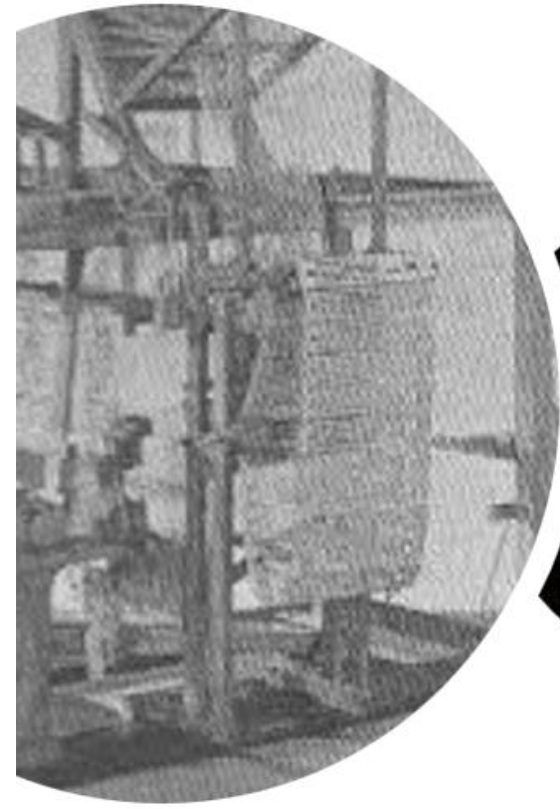
**Universe in some respects is just a bunch of NAND gates . . .**



Alan Turing

Truth Table

INPUT		OUTPUT
A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0



A great story . . .

$10^{90}$

Bits of information in the universe

[This includes human-generated information]

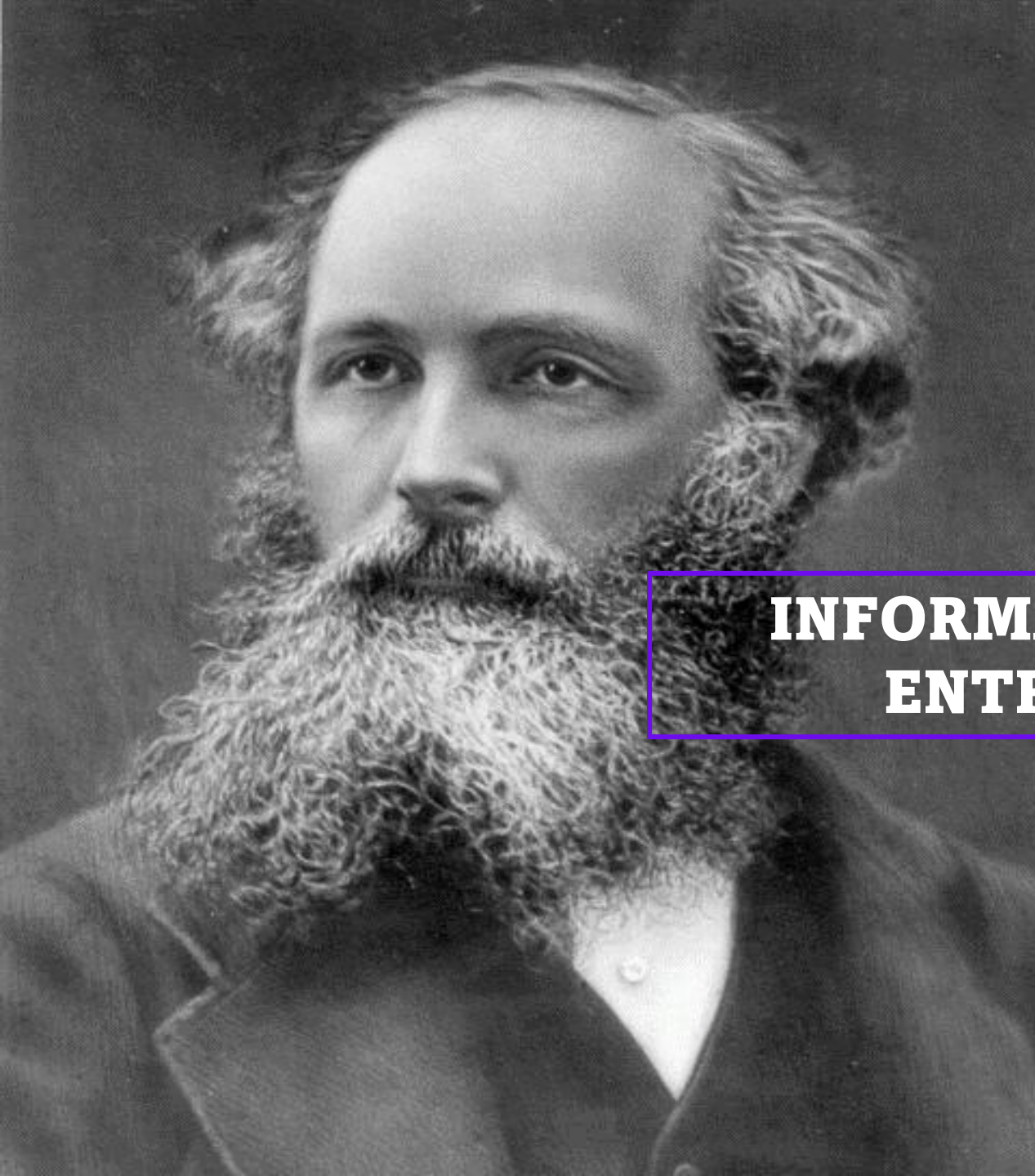
$10^{45}$

Bits of human-generated  
information

$10^{21}$

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

**Entropy**



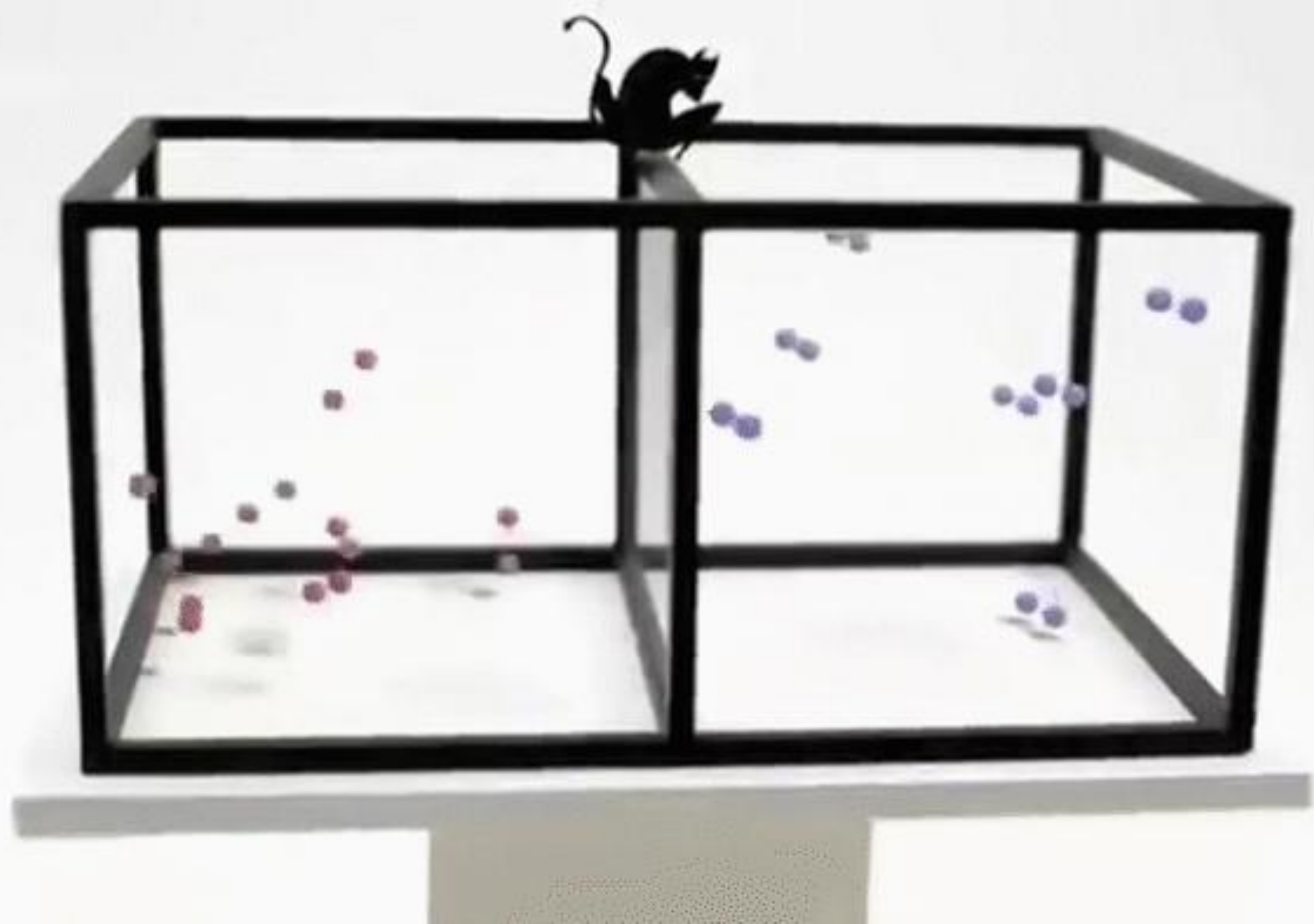
**INFORMATION &  
ENTROPY**

2<sup>nd</sup> law of  
thermodynamics . . .  
entropy always  
increases.

The degree of  
disorder in a system



entropy



**Bit** = “a unit for  
measuring information.”

- Claude Shannon

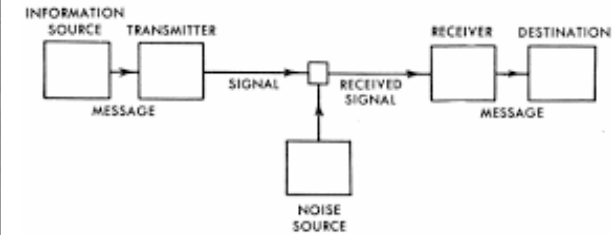


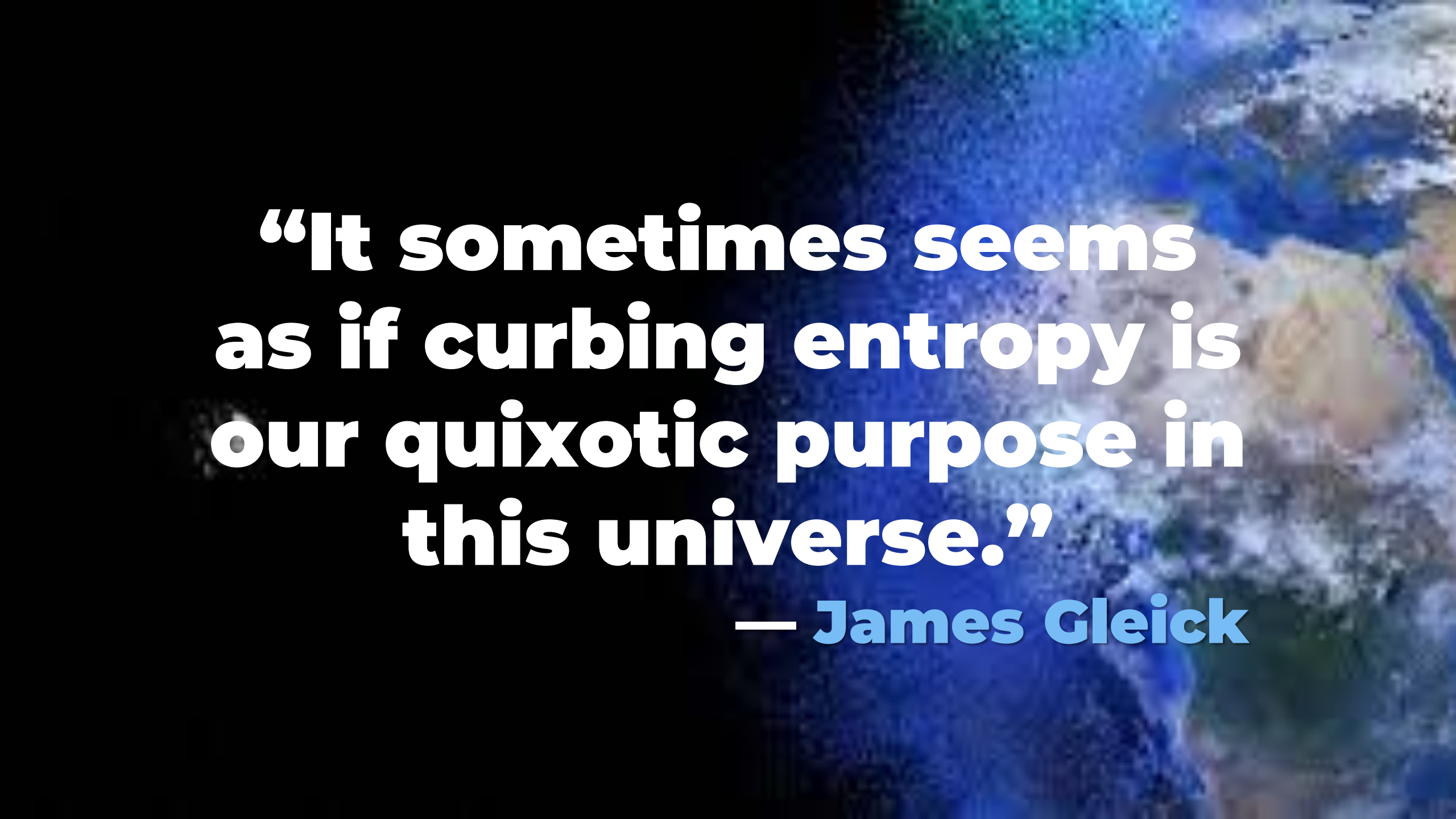


Fig. 1. — Schematic diagram of a general communication system.

# SHANNON ENTROPY

  $H(X) = - \sum_{i=1}^n p_i \log_2 p_i$  



**“It sometimes seems  
as if curbing entropy is  
our quixotic purpose in  
this universe.”**

**— James Gleick**

A diagram illustrating the evolution of the universe from a single point on the left to a complex, multi-galaxy structure on the right. The background is a dark space filled with various galaxies, including spiral, elliptical, and irregular ones, in shades of blue, purple, and orange. Three large white arrows point from left to right, each containing text. The top arrow contains the word 'Entropy', the middle one 'Order to Disorder', and the bottom one 'Complexity'.

**Entropy**

**Order to Disorder**

**Complexity**

A diagram illustrating the evolution of the universe from a simple, glowing point on the left to a complex, multi-colored web of galaxies on the right. The background is a deep space filled with various galaxies, including spiral, elliptical, and irregular forms, in shades of blue, yellow, and red. Three large white arrows point from right to left, indicating a progression or transition. The top arrow is the largest and contains the word 'Intelligence'. The middle arrow is smaller and contains the phrase 'Disorder to Order'. The bottom arrow is the largest and contains the word 'Simplicity'.

**Intelligence**

**Disorder to Order**

**Simplicity**

**AI**

The letters 'AI' are rendered in a bold, white, sans-serif font. The letter 'A' is significantly larger than the letter 'I'. To the right of the 'I' is a glowing, spherical object with a blue and purple gradient, resembling a planet or a data sphere, set against a dark, circular, textured background.

✓ **This thing can really understand, manipulate, and move around bits**

✓ **Entropy fighter . . . building intelligence and organizing information**





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 -

The Future?

# Building a Machine to Help Us Watch Over and Protect the Environment

## 5 Primary Technologies

#1 Artificial Intelligence/Machine-Learning

#2 Digital-Twin/Quantum-Twin Tech

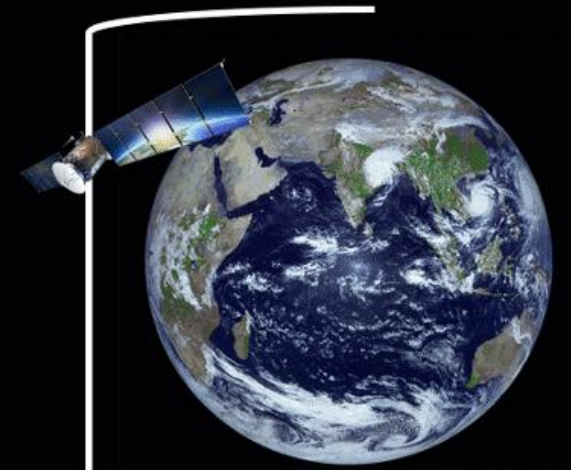
➤ Real-time simulation and modeling

#3 Digital/Quantum Computing

#4 Digital/Quantum Sensing

#5 Digital/Quantum Connectivity and Communication

# AI



AI and Quantum Computing





**“It from bit . . .  
from qubit . . .  
from God.”**

**– Jed Anderson**