

# Good Heavens, Dogs? Hell No, Gods!

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UNIVERSAL EDITION





# Foreword

Anyone?



# Preface

## Origins

The spark that ignited this project was not a flash of inspiration, but a painful accident. My highly respected dentist recommended the precautionary removal of a wisdom tooth: “Problems might be expected, and they will only get worse over time,” he warned. Trusting his expertise, I followed his advice, and soon I was one tooth—and a few hundred dollars—lighter.

But the problems got worse anyway. The socket refused to heal, leaving the nerves exposed. With the Christmas holidays in full swing, all dentists were off duty, and for days it felt as though the ache had expanded from one tooth to engulf my entire head.

In that haze of pain, my thoughts turned irrational. First, I condemned the sugar industry for ruining people’s precious teeth with such a toxic product. My dentist became the next object of blame, and before long, even the government education system stood accused of failing in its duty to train competent dentists.

Eventually, of course, the holiday ended, the clinic reopened, and the original mistake was repaired. Relief came quickly. Yet what remained was a question I had pondered many times with my colleagues: could pain ever be implemented as software?

My colleague, apparently blessed with better teeth, believed it was possible. With sensors, firmware, and code, a robot might be made to simulate agony. I disagreed. To behave as if in pain is not the same as to feel pain, I argued.

It was this missing “pain function” in the standard library of C/C++ that planted the seed of an obsession. That seed has grown, over years of trial and error, into the pages that follow.

## Method and Approach

The conclusions presented here have been developed using typical software design methods and tools. Code, like theory, must ultimately work. Programs written according to these principles run reliably; they do not succeed by persuasion, but by execution.

No program is without flaws. Bugs are inevitable. In the same way, some arguments here may contain errors. But I trust that, as with good software, the imperfections will not obscure the larger

structure, nor the promise of the approach.

This book attempts to weave together threads from physics and computation while consciously avoiding philosophy. Every conclusion drawn is backed by a simulation whenever possible.

## Formal Theory

This book is based on a set of formal papers written in the language of academic research, with definitions, theorems, proofs, and simulations. Many of the concepts were initially developed and verified through programming, then systematically converted into formal mathematics.

The two strands are designed to support each other. The papers provide rigor; the book provides perspective. Together they form a record of an unusual journey: from a very personal question about the nature of pain, through simulations of information and collapsing dust clouds, to a model that seeks to unify entropy, geometry, and consciousness under a single informational framework.

## Acknowledgments

I extend my gratitude to my loving wife, who patiently endured countless nights beside me as I typed away on my noisy laptop. Despite the many disturbances to her sleep, she remained remarkably understanding and supportive throughout the creation of this book.

I owe a deep debt of gratitude to my brother, whose unwavering patience has been central to my journey with programming and the eventual completion of this work. Without his enduring support (and constructive criticism), I might never have ventured into this field, let alone finished such an ambitious project. I also owe him an apology for the many fishing trips I disrupted by insisting he listen to my theories.

Special thanks (or perhaps blame, offered in good humor) go to Andy Jones. His gift of *The Structure of Space and Time*, based on the 1995 Cambridge lectures by Roger Penrose and Stephen Hawking, proved transformative. Without that “gift,” I might never have developed the necessary obsession to see this work through to the end.

A great deal of thanks must also go to ChatGPT, Gemini, and other AI models. They have patiently fulfilled every request to debug code, verify references, and convert materials to L<sup>A</sup>T<sub>E</sub>X and Python—all without ever refusing a task or letting out a sigh.

I also wish to express my appreciation to those who generously shared insights beyond my own expertise. Though they prefer to remain unnamed, their contributions have enriched both the content and the quality of this work in ways I cannot overstate.

Finally, I want to remember my dog, Raju (R.I.P.), my loyal hunting companion, with whom I shared many memorable hare (R.I.P. as well) hunts.

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# Chapter 1

## Introduction

### 1.1 Advances in Science

During the past centuries, physics has achieved remarkable success in unifying a large number of partial theories into two powerful frameworks: Quantum Mechanics and General Relativity. The equations in both theories match all observations with remarkable precision, limited only by current technological capabilities. Those capabilities themselves have reached a level that would have seemed almost inconceivable only a few decades ago.

Gravitational-wave observatories such as LIGO can detect distortions of spacetime smaller than a proton's diameter, measuring relative changes in length caused by distant black-hole mergers billions of light-years away. Atomic clocks, exploiting the quantum structure of atoms, now keep time so precisely that they would lose or gain less than a second over the age of the universe, and are sensitive enough to register differences in gravitational potential corresponding to changes in height of mere centimeters.

Elsewhere, quantum electrodynamics predicts the magnetic moment of the electron to a precision verified to many decimal places, making it one of the most accurately tested theories in all of science. Interferometers routinely resolve wavelengths far smaller than the structures they probe, while particle accelerators recreate conditions not seen since the earliest moments after the Big Bang. Even the global positioning systems that guide everyday navigation rely on relativistic corrections so precise that neglecting them would lead to kilometer-scale errors within a single day.

The theoretical descriptions of nature have become so accurate that reality itself now serves as the experimental apparatus for testing them. Physical law is no longer merely inferred from observation; it is continuously confirmed, corrected, and operationalized by technologies that depend on its validity to function at all. The theories have escaped the confines of paper and chalk and become embedded in the technological fabric of modern civilization. An obvious example is computation. From the quantum-mechanical behavior of transistors to the relativistic corrections required for satellite navigation, our deepest physical theories now operate continuously and invisibly inside machines that process information at planetary scale. Computation is no longer merely a tool for studying nature; it has become a physical process in its own right, governed by energy constraints, thermodynamics, noise, and quantum limits.

This trajectory has culminated in the rise of artificial intelligence systems of unprecedented complexity. These systems are not programmed in the traditional sense but are shaped through optimization processes that resemble physical evolution more than logical deduction. Trained on vast datasets and executed on hardware operating near fundamental physical limits, they exhibit behaviors—learning, abstraction, creativity—that were once considered exclusively biological. Remarkably, their success does not rely on new physical laws, but on exploiting known ones at scale, transforming raw energy into structured information with extraordinary efficiency.

In addition to significantly enhancing our understanding of how the universe works, science has also bestowed upon humanity a vast array of practical applications. These range from the development of microprocessors to the creation of GPS systems, not to mention nuclear bombs.

Science has much to celebrate.

## 1.2 The Elusive Theory of Everything

Following the success of unifying partial theories into two grand pillars—General Relativity (GR) and Quantum Mechanics (QM)—it appeared certain that the unification process would eventually reach the ultimate goal of physics: a Theory of Everything. This would be a single equation capable of describing the entire universe. To date, however, this has not happened. Despite overwhelming evidence supporting both theories, they remain fundamentally incompatible; they cannot both be correct.

Historically, most attempts at unification assume that the quantum description is more fundamental, so it is General Relativity that should be modified, because everything else has already been quantized. Matter fields—electrons, photons, quarks—all obey quantum field theory. Spacetime might simply be another field awaiting quantization, and several facts appear to support this view.

First, GR breaks down at small scales. Near singularities or at the Planck length, curvature becomes infinite. This signals a failure of the continuum picture, not of quantum mechanics. The intuition is therefore to quantize gravity to remove these divergences, just as quantizing electromagnetism resolved the ultraviolet catastrophe.

However, despite decades of research, no single framework has yet succeeded in combining the principles of quantum mechanics with the geometric description of spacetime provided by General Relativity.

### 1.2.1 Semiclassical Gravity

One of the earliest attempts to bridge the quantum–classical divide is *semiclassical gravity*. In this approach, matter is treated as fully quantum, while spacetime remains classical. To make the Einstein field equations workable, the operator-valued stress–energy tensor of quantum matter is replaced by its expectation value—the renormalized average of the energy and momentum calculated over the quantum state of the matter fields. This resulting set of ordinary numbers can then be inserted into the equations governing curvature.

Semiclassical gravity is remarkably successful. It accurately describes a wide range of phenomena, from laboratory experiments to astrophysical observations and cosmology. It even predicts striking effects such as Hawking radiation in black holes. Yet its very success also exposes its conceptual limitation: the approach is *ad hoc*. Spacetime geometry is treated as classical while matter is quantum. The theory works well for everything we can observe, but it does not answer any of the deeper question, like what is the physics at the singularity of a black hole.

### 1.2.2 Perturbative Quantum Gravity

A natural next step is *perturbative quantum gravity*, where spacetime is expanded around a simple background—typically flat or slightly curved—and the perturbations are treated as quantum fields. This approach is conceptually straightforward and extends the familiar machinery of quantum field theory to gravity.

However, it quickly runs into a fundamental problem: gravity is *nonrenormalizable*. Unlike the Standard Model, where infinities in quantum corrections can be controlled through renormalization, attempts to remove infinities in perturbative quantum gravity fail. The equations produce uncontrolled divergences, and no systematic procedure yields finite, predictive results. The techniques that work spectacularly well for matter fields simply break down for spacetime itself.

### 1.2.3 Nonperturbative and Geometric Approaches

In response to the failure of perturbative quantization, researchers have developed nonperturbative frameworks that do not assume a fixed background geometry. A leading example is Loop Quantum Gravity (LQG), which models spacetime as a discrete combinatorial structure of spin networks. LQG is mathematically rigorous and fully background-independent, offering a conceptually clean quantization of geometry.

However, it seems major obstacles still remain. Deriving a smooth classical spacetime limit is nontrivial, and embedding standard particle physics into the LQG framework remains unresolved.

### 1.2.4 String Theory: A Unified but Unverified Framework

Another major avenue is string theory, in which point particles are replaced by one-dimensional strings. Gravity emerges as one of the vibrational modes of the string, and the framework unifies all fundamental forces in principle. String theory deals with deep mathematical and abstract structures, dualities, extra dimensions, black-hole entropy counting, just to name a few.

However, significant challenges remain also with the string theory. It relies on supersymmetry, which has not been observed experimentally. The theory admits an enormous landscape of possible vacuum states—often estimated at around  $10^{500}$ —raising concerns about predictivity and falsifiability. Extra spatial dimensions are required, typically assumed to be compactified at extremely small scales, yet they remain empirically undetected. Direct experimental tests of string-scale physics are effectively out of reach.

Also, one might ask what a theory as flexible as string theory is good for. Ask any question and one of those  $10^{500}$  worlds include the answer. A theory sufficiently flexible to accommodate all observations risks explaining none.

### 1.2.5 Emergent and Holographic Approaches

A more radical class of ideas treats gravity and spacetime as emergent rather than fundamental. This perspective arose from puzzles at the intersection of gravity, thermodynamics, and quantum theory. Black holes behave as thermodynamic objects, possessing entropy proportional to horizon area and emitting thermal radiation. These results suggest a deep link between geometry, information, and statistical mechanics.

The observation that gravitational entropy scales with area rather than volume led to the holographic principle: the idea that the degrees of freedom of a region of spacetime may be encoded on its boundary. Holographic dualities further support this view, showing that spacetime geometry and gravitational dynamics can emerge from nongravitational quantum theories.

#### From Geometry to Bitstring

The holographic principle argues that a three-dimensional universe can be described by a two-dimensional theory ( $N \rightarrow N - 1$ ). This is actually quite surprising result. Everything that happens in the universe (whether it had four dimensions or eleven, can be described by its  $N - 1$  dimensional surface. However, If  $3D$  can map to  $2D$ , why stop there?

In software architecture, any  $N$ -dimensional space is ultimately stored as a one-dimensional bitstring ( $N \rightarrow 1$ ). A sequence of bits has no intrinsic geometry; width and height are formatting conventions imposed by interpretation. Following this logic to its conclusion, the universe may be fundamentally dimensionless. Space, curvature, and connectivity are rendering modes of a one-dimensional sequence of axiomatic instructions.

### 1.2.6 The Simulation Hypothesis: Reality as Software

During recent years so called simulation hypothesis has become increasingly popular. If the universe is fundamentally informational, it is tempting to conclude that we are merely a program running on some higher-order "hardware." In this view, the strange "quantization" of our world is simply the resolution of the grid, and the speed of light is the clock-speed of the processor.

However, the simulation hypothesis feels like a philosophical "shell game." It merely translates the mystery of existence by one level: if we are a simulation, who simulated the simulators? Furthermore, it ignores the staggering Information Cost of reality.

Consider the entropy of a single human being. To simulate even a single strand of DNA with perfect fidelity requires tracking billions of quantum interactions. To harvest enough information from a "parent universe" to simulate an entire "child universe" would require a thermodynamic overhead that seems unsustainable.



Perhaps the most human explanation for the friction between General Relativity and Quantum Mechanics is one familiar to any software engineer: The universe is running on legacy code. In this view, the fundamental incompatibility between the smooth, geometric curves of GR and the discrete, probabilistic jumps of QM is not a profound mystery of nature, but a design bug. We often assume a "Theory of Everything" must be an elegant, unified masterpiece, but real-world software is rarely that clean. It is often a patchwork of modules written by different people, at different times, with different goals.

### 1.3 The Deeper Problem: Unexplained Assumptions

In addition to problems finding unified theory of everything there is even more serious problem-all candidate theories rely on unexplained assumptions. This incompleteness can be expressed as

$$\text{ToE}_{\text{incomplete}} = \text{ToE}_{\text{complete}} \setminus \mathcal{A},$$

where  $\mathcal{A}$  denotes the set of unexplained axioms.

General Relativity does not tell what the spacetime is made of, it takes it granted. Quantum field theory assumes fields and large number of constants that have been experimentally defined to get the theory to match the measurements. String theory assumes extra dimensions and vast landscapes.

One might expect a genuine Theory of Everything to explain - everything, including us intelligent (well, more or less) observers.



## Chapter 2

# Typical Software

It is easy to imagine a powerful computer with a huge database and advanced logic. Such a system could be highly efficient in its operations, capable of making accurate and intelligent decisions in nearly any imaginable situation. However, it is difficult to see how such a mechanically operating machine could truly feel pain.

Imagine a typical software program consisting of thousands of lines of code. How many additional source lines would need to be added to transform the software into a conscious entity? Would it be the  $10^{14}$ th line that suddenly imbues the system with the ability to feel pain? Could it be the introduction of a deeply nested loop that finally grants consciousness? Or is it the number of `if-else` clauses that holds the secret?

Regardless of the number of loops and source lines added, it appears that nothing significant would occur. The software program would remain just that—a software program, albeit larger in size.

### 2.1 The Hard Problem of Consciousness

A computer is a mechanical device whose operation can always be reduced to the manipulation of its bits and pieces. The elementary building blocks of the computer are typically electronic components equivalent to mechanical relays. The notion that a collection of relays connected in a network of copper wires could genuinely experience consciousness and perceive pain is somewhat difficult to believe. Should I type gently on my keyboard, fearing that striking the keys too hard might trigger a migraine for my laptop? Do partially broken memory chips introduce suffering, much like a broken tooth does for its owner? Could defects transform my happy computer into a suffering one, making it wish it were dead, or at least turned off?

If software were truly capable of sensing pain, what would be the worst thing that could happen to it? Is it division by zero, or a reference to an uninitialized variable?

```
int uninitialized;  
int initialized = 3;
```

```
int good = 2 * PI * initialized;    // feel good :)
int bad  = 2 * PI * uninitialized; // feel pain :(
int maximal_pain = 1/0;    // division by zero, maximal pain!
```

If consciousness is not solely a software issue, could it be related to hardware instead? For example, the graphics board controls what the computer renders on its screen. By writing appropriate values to memory addresses constituting the so-called video memory, one can turn pixels on and off to create images. What would be the memory addresses one has to poke in order to create pain?

```
// try to poke pain
*((bool *)0x000000) = true; // argh
```

As ridiculous as these examples may be, they demonstrate the problem well. There is not even a hint of understanding of how pain and other human experiences could be implemented with software and traditional computers.

There is, however, an even more serious hurdle. Neuroscience has made significant advances in studying the operation of the human brain. The introduction of brain imaging techniques, such as magnetic resonance imaging (MRI), allows researchers to examine the neurobiological correlates of human behaviors. What is remarkable is that human behaviors do not seem reducible to the mere operation of the elementary building blocks of the brain. It seems conscious behaviors cannot be explained solely through the physical processes of the brain. This is known as the “hard problem of consciousness” [1].

## 2.2 Organic Tissue Issue

Could consciousness lurk in the fact that humans are composed of organic biological tissue, [*my wife*: “such as celluloid”]?, which is considered “alive” as opposed to non-organic matter like silicon? Hardly; both fat and silicon are ultimately made up of the very same type of subcomponents.

Is all matter conscious to some degree, as panpsychism suggests? Could plants, trees, or even rocks have some level of consciousness [3, 5, 2, 6]?

The best imaginable way to study whether an object is conscious is by torturing it with an appropriate torturing device. So let us torture rocks with the best possible rock-torturing device one can imagine—a sledgehammer. Rocks do not seem to care! This observation cannot, of course, prove rocks unconscious. Rocks could well be conscious, they just do not have the sense to feel pain. Or perhaps they do sense pain intensely, but they just cannot show it. They might be in everlasting pain, but have no mouth to scream, no legs to kick. What a terrible destiny!

## 2.3 Proposed Sources of Consciousness

Despite centuries of inquiry, no consensus exists regarding the physical or metaphysical source of consciousness. On the contrary, the scientific and philosophical literature presents an unusually broad and fragmented landscape of proposals.

### 2.3.1 Macroscopic and Biological Sources

The most conservative position locates consciousness at the level of the biological organism, specifically within the human brain. In this view, consciousness emerges from the coordinated activity of large populations of neurons, often associated with particular brain regions or global neural dynamics.

Some theories emphasize specific neural correlates, such as the thalamocortical system, recurrent feedback loops, or global workspace architectures. Others focus on large-scale synchronization phenomena, such as gamma-band oscillations or integrated information across distributed neural networks. While these approaches differ in detail, they share a commitment to consciousness as a high-level emergent property of biological complexity.

### 2.3.2 Cellular and Subcellular Mechanisms

Moving to smaller scales, several proposals identify consciousness with specific cellular or subcellular structures. Among the most well-known is the Orch-OR theory, which attributes conscious processes to quantum coherence within neuronal microtubules. Variants of this idea propose that cytoskeletal structures, synaptic vesicles, or other intracellular components play a decisive role.

Related hypotheses suggest that consciousness may arise from biochemical signaling pathways, molecular conformational changes, or information-processing mechanisms operating below the level of neurons themselves. While such models attempt to explain qualitative experience by appealing to finer physical detail, they often struggle to connect microscopic processes to the unified, macroscopic character of conscious awareness.

### 2.3.3 Fundamental Physical Substrates

At the most reductionist end of the spectrum are theories that locate consciousness in fundamental physics. Some approaches propose that consciousness is tied to quantum states, wave-function collapse, or entanglement. Others invoke spacetime structure, suggesting that consciousness is associated with curvature, causal structure, or even singularities, such as those found in black holes.

In extreme forms, these ideas border on panpsychism, the view that consciousness—or proto-consciousness—is a basic property of matter itself. In such frameworks, elementary particles may possess rudimentary experiential aspects, with complex consciousness arising from their aggregation. While philosophically attractive to some, these theories face the challenge of explaining how simple experiential units combine into the rich, unified experiences familiar to humans.

### 2.3.4 Computational and Informational Accounts

Another major class of theories treats consciousness as an informational or computational phenomenon. According to this view, consciousness is not tied to any specific physical substrate, but to patterns of information processing. Functionalist approaches argue that any system implementing the appropriate computational structure—biological or artificial—could, in principle, be conscious.

Examples include theories based on integrated information, predictive processing, recurrent computation, or self-modeling systems. These accounts extend naturally to artificial intelligence, raising the possibility that sufficiently advanced machines could possess genuine subjective experience. However, they leave open the question of why certain computations should be accompanied by experience at all, rather than remaining purely formal processes.

### 2.3.5 Cosmological and Exotic Proposals

Beyond mainstream science lie a variety of more speculative ideas. Some authors have suggested that consciousness is a property of the universe as a whole, associated with cosmological initial conditions, dark matter, or unknown forms of exotic physics. Others have proposed that consciousness is linked to vacuum fluctuations, zero-point energy, or as-yet-undiscovered fields.

While these ideas often lack empirical support, their sheer diversity underscores the absence of a clear theoretical anchor. The fact that consciousness has been attributed to black holes, fundamental particles, neural networks, microtubules, algorithms, and the universe itself illustrates not explanatory abundance, but explanatory uncertainty.

### 2.3.6 A Pattern of Dispersion

Taken together, these proposals reveal there is no privileged scale, structure, or object that has not been nominated as the source of consciousness by someone. The diversity of these proposals is itself a noteworthy empirical fact.

# Chapter 3

## Belief-Systems

### 3.1 Souls

Modern science avoids the word “soul” because it cannot be tested, but philosophers, neuroscientists, and even some physicists continue to explore whether consciousness requires something beyond ordinary physical processes. In effect, some modern theories echo older soul-like concepts, even if they do not use the word.

- **Eccles & Popper (Interactionist Dualism):** John Eccles argued that consciousness cannot be explained by material processes alone; he proposed a non-physical “self” (similar to a soul) interacting with the brain.
- **Penrose & Hameroff (Orch-OR theory):** They suggested that consciousness may arise from quantum processes in neurons and speculated that this might connect with the idea of a soul, though their theory remains widely disputed.
- **David Chalmers:** His formulation of the “hard problem of consciousness” does not invoke a soul explicitly, but it reopens the possibility by arguing that subjective experience appears irreducible to brain activity.
- **Near-death experience researchers (e.g., Pim van Lommel):** Some argue that NDEs indicate consciousness can exist independently of the brain, again resonating with traditional soul concepts.

Thus, while the term “soul” has largely dropped out of scientific vocabulary, the debate surrounding consciousness often returns to closely related conceptual territory.

#### 3.1.1 Christianity and the New Testament

If the New Testament is to be taken seriously we humans have a soul. The soul is described as the immaterial and eternal part of a human being—the part that survives death. Conscious choices are

said to determine its ultimate destiny. But how strong is the evidence behind these claims? Do we have grounds for confidence in the reliability of the New Testament? Did Jesus of Nazareth, the central figure of Christianity, even exist as a historical person?

The historical record is mixed. There is no direct archaeological evidence that can be tied unambiguously to Jesus himself: no tomb, inscription, or artifact that can be reliably identified as his.

However, there are a few references outside the Bible. The Jewish historian Josephus and the Roman historian Tacitus, among others, mention Jesus briefly. Nearly all historians—Christian, Jewish, and secular—accept that Jesus existed, even if they disagree about his nature or significance.

The New Testament itself survives in thousands of Greek manuscripts, far more than almost any other ancient text. None are originals, but by comparing them, scholars have reconstructed a highly reliable text, though not with complete certainty. Most textual variations are minor copyist errors introduced through manual transcription methods—laser printers being a much later invention.

Thus, while the Gospels cannot be proven archaeologically in a strict sense, the manuscript tradition is unusually strong by the standards of ancient history.

### 3.1.2 The Gospels as Evidence

Among the four canonical Gospels, three—Matthew, Mark, and Luke—tell broadly the same story. These are known as the *Synoptic Gospels*. Their similarities and differences have been studied extensively:

- Mark contains approximately 661 verses. Roughly 600 appear in Matthew, and about 350 in Luke.
- Matthew and Luke also share around 230 verses not found in Mark.
- This overlap led scholars to propose a second, now-lost common source known as the “Q document” (from the German *Quelle*, meaning “source”).
- The standard *Two-Source Hypothesis* holds that Matthew and Luke drew from both Mark and Q.

Estimated dates of composition are as follows:

- Mark: approximately 65–70 CE
- Matthew and Luke: approximately 70–90 CE
- John: approximately 90–100 CE

These dates are inferred through handwriting analysis, linguistic style, and historical references. They represent educated ranges rather than precise timestamps. The sheer number of manuscripts



and their relatively early composition—within one or two generations of Jesus’ life—give the Gospels greater historical credibility than many other ancient texts, such as Homer’s *Iliad* or Plato’s dialogues. Nevertheless, they remain religious testimonies rather than neutral historical reports.

### 3.1.3 Contradictions

Here a difficulty arises: if the New Testament conveys truth, why do others who worship the same God reject it?

Judaism, for example, does not accept Jesus as the Messiah. From the Jewish perspective:

- Jesus did not fulfill the messianic prophecies, such as rebuilding the Temple, regathering the exiles, establishing universal peace, and inaugurating God’s kingdom on Earth.
- Jesus did not meet the traditional personal qualifications of the Messiah.
- The doctrines of the Trinity and the divinity of Jesus contradict Judaism’s emphasis on the absolute oneness of God.

This raises uncomfortable questions. Jews worship the same God described in the Hebrew Bible. Jesus himself was Jewish. If those who preserved and transmitted the Hebrew Scriptures do not recognize him as Messiah, why should others?

And what of Islam, Hinduism, Buddhism, and countless other traditions? These belief systems appear mutually incompatible with Christianity. Are they to be dismissed as false religions, with believers whose fate is simply unfortunate?



# Chapter 4

## Magic

If one allows even a single paranormal creature to exist, what prevents there being a whole flock of them?

### 4.1 Paranormal Experience

There is only one somewhat “paranormal” incident I can be certain of—one I experienced myself. It was a dark night when, as a young student, I suddenly sensed that someone had entered my room. I tried to get up and turn on the light, but a strange low-frequency sound (about 50 Hz) emerged right behind my head. The harder I tried to move, the louder it became, until even breathing felt impossible. I gave up resisting—and immediately, I could breathe again. Seconds later, the sound (and the “visitor?”) vanished. I was free to move and found no one in the room. I was certain I wasn’t dreaming.

Initially, I might have dismissed the incident as a hallucination, but later I heard an older lady describe the exact same phenomenon on a radio program. The only difference was that she also saw a tunnel with a light at the end. I never saw a tunnel, let alone a light (should I be worried?). Still, the buzzing sound incident stuck with me for years.

Soon after, I found a leaflet from a religious group claiming modern science was a scam. It offered “proofs,” such as a case where Carbon-14 dating supposedly showed an animal to be ancient even though it had died yesterday. Naturally, I believed it.

As a boy, I thought my father was a smart man. Despite lacking a formal education due to the war, he understood complex topics—percentage calculus, for example. So when he told me that some people can feel underground water flows, I believed him too. He even suspected those flows could have harmful effects on people sleeping nearby. Indeed, my grandmother was living proof! One day, we ran our own experiment with divining rods. We failed to find a single water flow.

Then there was my best friend, who swore by a certain paranormal phenomenon: two people place their hands over the head of a third, concentrate, and after a few minutes, they can lift them using only their fingertips, “defying gravity.” Finally, I thought, here was a chance to prove the

paranormal! We gathered a group and tried. We concentrated with all our might, slipped our fingers under the seated person, and... nothing. He stayed firmly in the chair. We even switched roles, suspecting that one of us was subconsciously not concentrating hard enough, but gravity remained annoyingly consistent.

Not even the classic method of altering concentration—drinking lots of beer—made a difference. Gravity was unimpressed. Alcohol, however, had other noticeable effects the next morning.

One of my teachers was also convinced of spiritual creatures, insisting we simply lacked the senses to see them. “With our tiny human eyes, we can’t even see infrared!” he said. So, during my army service, I finally tried infrared night-vision goggles. To my disappointment: no glowing demons, no invisible spirits, nothing! And what could possibly be more infrared than Satan?

Later, I discovered a university study where 32 dowzers attempted to locate underground water veins in a double-blind test. Not a single success. When I brought this up to a colleague who swore he could dowse, he scoffed. So I blindfolded him and asked him to repeat the trick. Without being able to see, he couldn’t even remember the spots he’d pointed out minutes earlier. Apparently, water flows are highly mobile—especially when your eyes are covered.

I was also told that special supplements—up to and including LSD—could “expand the mind” to perceive truths beyond reality. After so many failed experiments, I wondered: how would this one be different?

If the brain is an informational processor, then drugs do not “open a door” to a hidden dimension; they simply disrupt the local hardware. Think of the brain as a high-resolution camera lens meant to capture a clear image of reality. If you crack the lens or smear it with oil, the resulting image might look “otherworldly” or “trippy,” but you aren’t seeing a hidden world—you are seeing the failure of the equipment. A malfunctioning camera doesn’t reveal ghosts; it just produces artifacts, noise, and chromatic aberration. In the same way, a chemically scrambled brain produces “information noise” that we mistake for “spiritual insight.” It is a failure of the processing logic, not a breakthrough into new data.

In the end, the only mysterious phenomenon I still cannot explain is that strange 50 Hz buzzing. According to my parents, I was born with bluish skin, likely due to a lack of oxygen during labor. Perhaps the other lady with the tunnel-and-light story was also born blue. That seems more likely than a paranormal visitor buzzing in my bedroom at midnight. Perhaps there is no such thing as magic—just a temporary lack of oxygen.

And then there is James Randi’s famous *One Million Dollar Paranormal Challenge*. Surely a million dollars is motivation enough to demonstrate real magic. But no one has ever collected the prize.

## 4.2 Definition of Magic

How, then, should we define “magic”?

By categorizing the natural and the supernatural, one notices that magical creatures all share the same trait: non-physicality. Magic appears to defy the laws of physics—laws based on observation

and mathematics. Thus, in the spirit of rigorous definition:

$$\text{Magic} \neq \text{Physics}$$

By definition, magic must contradict physics, or else it would simply *be* physics. And since physics rests on observation and axioms, magic must rest on either non-axioms or non-observation. That is, it cannot be observed, and it cannot be explained in terms of axiomatic systems.

Mathematics, an axiomatic system, is the study of logical reasoning. A non-axiomatic system, therefore, is the study of non-logical reasoning.

$$\text{Magic} = \text{Non-sense}$$

The best synonym for non-logical reasoning is perhaps *nonsense*.



# Chapter 5

## DNA

### 5.1 DNA as the Blueprint of Life

Based on the recent scientific discoveries DNA is the blueprint of life, carrying the information needed to build every living organism on Earth. The journey to understanding it has been long and fascinating.

In 1869, Dr. Friedrich Miescher isolated a new chemical substance from human white blood cells, which he called *nuclein*. This discovery marked the first step toward understanding the molecular basis of heredity. (Friedrich Miescher, nuclein)

In 1888, Theodor Boveri studied cell division and observed that tiny rods split alongside the cell. These rods were later named chromosomes. (Theodor Boveri, chromosome)

Thomas Hunt Morgan, studying fruit flies, created the first chromosome maps, linking traits to specific chromosomal regions. These regions were called *genes*. (Thomas Hunt Morgan, gene mapping)

In 1928, Frederick Griffith performed his famous experiment with *Streptococcus pneumoniae*. By mixing heat-killed lethal bacteria with harmless living bacteria and injecting the mixture into mice, he demonstrated that some “transforming principle” from the dead bacteria could make the living ones lethal. This hinted at DNA as the carrier of hereditary information. (Griffith experiment)

The double-helix structure of DNA was revealed in 1953 by James Watson and Francis Crick, based on X-ray diffraction images captured by Rosalind Franklin. The mechanism of replication was confirmed in 1958 by the Meselson–Stahl experiment, demonstrating semi-conservative replication—each new DNA molecule consists of one old and one new strand. This showed how information is faithfully transmitted from cell to cell. (Watson and Crick, Rosalind Franklin, Meselson–Stahl experiment)

## 5.2 Homeobox Genes

DNA explains the blueprint, but why do cells differentiate into muscles, teeth, or neurons when they all share the same genome? The answer lies in regulatory genes.

In the 1980s, Walter Gehring and colleagues discovered the *homeobox* genes while studying fruit flies. One mutant fly had a leg growing in its head, revealing eight genes that control where and when other genes are activated. These genes are remarkably conserved across species. (Homeobox, Walter Gehring)

A striking experiment involved transplanting a gene responsible for eye development from a mouse into a fruit fly embryo. The fruit fly developed extra, fully functioning fly eyes—not mouse eyes—demonstrating that the underlying genetic instructions were functionally conserved. This highlighted **the common ancestry of all life**, just as Charles Darwin predicted in *On the Origin of Species* (1859). (On the Origin of Species). We software developers, it appears, still have some catching up to do when it comes to code reusability.

## 5.3 Applications

Since DNA's discovery, research has advanced tremendously, leading to numerous applications:

- **Medicine:** Genetic testing and DNA sequencing enable early detection of disorders and improved treatments. Gene therapy can correct faulty genes. (Genetic testing, DNA sequencing, Gene therapy)
- **Forensics:** DNA analysis is invaluable in solving crimes. (Forensic DNA analysis)
- **Agriculture:** Genetic modification improves crop yields, pest resistance, and nutritional content. DNA barcoding aids species identification, conservation, and combating wildlife trafficking. (Genetic engineering, DNA barcoding)
- **Evolutionary Biology:** DNA sequences allow reconstruction of evolutionary histories with unprecedented accuracy. (Molecular phylogenetics)

## 5.4 Digitized DNA

Despite its complexity, DNA operates on surprisingly simple principles. Its four nucleotides—Adenine (A), Guanine (G), Cytosine (C), and Thymine (T)—pair specifically (A with T, C with G) in the double helix. This complementarity allows DNA to be replicated accurately, with each strand serving as a template for a new one. (Base pairing, DNA replication)

Remarkably, DNA sequences can be translated into binary code for computers without loss of information. Entire genomes, including the human genome, are now digitized. Synthetic biology has even made it possible to build bacterial genomes from scratch, controlling living cells with artificial DNA. (Synthetic biology, Human Genome Project)



One can imagine an inkjet-like printer that propels nucleotides instead of ink, “printing” life directly from digital DNA. While not commercially available yet, experiments such as those conducted by a UC Berkeley team in 2019 demonstrate that this is no longer pure science fiction. (Genome synthesis)

## 5.5 Developer’s Angle

It seems there is no “soul” or “fire” one would have to ignite in order to create life, at least for bacteria to behave as living organisms. Simply compose the desired structure from DNA molecules, place them into an appropriate environment, and one obtains “life.”

Engineers might recognize parallels between cells and modern software development. A biological cell resembles a factory running sophisticated Computer-Aided Manufacturing (CAM): the genome is the software, and cellular machinery is the hardware executing it. Nature invented CAM long before humans did, and understanding DNA as both software and hardware provides a powerful perspective on evolution, development, and biotechnology.



## Chapter 6

# Why Quantum Mechanics?

### 6.1 The Non-computable Mind

Sir Roger Penrose suggests a radical, and perhaps more "human," alternative that consciousness is non-computable—that the human mind can grasp truths and perceive meanings that no formal axiomatic system (like a computer) ever could. Penrose, alongside anesthesiologist Stuart Hameroff, points toward the infinitesimal. They suggest that consciousness might not emerge from the "wiring" of neurons, but from deeper, quantum gravitational effects occurring within the tiny structures of the brain called microtubules. In this view, the "flash" of a thought is a moment of quantum collapse—a bridge between the wavelike potential of Hilbert space and the concrete, 3D geometric reality.

The source of consciousness or not, Quantum Mechanics is extraordinarily successful at describing small-scale phenomena.

### 6.2 The Mystery of Superposition

One of the key features of QM is the superposition principle: systems can exist in multiple states simultaneously. Particles can be here and there, wave-like and particle-like, in ways classical intuition cannot capture.

The double-slit experiment demonstrates this vividly. Sending photons through two slits produces an interference pattern, even when photons are sent one by one. Naively, one might conclude that each particle must pass through both slits simultaneously—but this is a misleading classical image. What actually propagates through both slits is the *wavefunction*. The particle itself is only localized upon detection.

Superposition allows interference: the probability amplitudes of different paths combine, giving rise to the patterns we observe. It is the mathematical structure of the wavefunction that encodes all the information about possible outcomes.

### 6.3 Identity, Exclusion, and the Quantum Address System

Early intuitions suggested that particles “come and go like clouds,” without classical identity. In a sense, this is correct: we cannot tag an electron in one detector and later ask if it is the same electron in another detector. Classical individuality fails.

Quantum mechanics imposes structure through the *wavefunction*. Particles of the same type are described by states in Hilbert space. Their “identity” resides in the **\*\*state they occupy\*\***, not in a classical label. This is where the Pauli exclusion principle comes in: it enforces a unique occupation for fermions.

Formally, consider two identical fermions with wavefunction  $\psi(x_1, x_2)$ :

$$\psi(x_1, x_2) = -\psi(x_2, x_1) \tag{6.1}$$

If  $x_1 = x_2 = x$ , then:

$$\psi(x, x) = -\psi(x, x) \quad \Rightarrow \quad \psi(x, x) = 0 \tag{6.2}$$

The probability of finding two identical fermions in the same state vanishes. Exclusion is thus an *idempotency condition*: once a state is occupied, it cannot be occupied again.

By contrast, bosons obey symmetric wavefunctions:

$$\psi(x_1, x_2) = +\psi(x_2, x_1) \tag{6.3}$$

They may share the same state freely, enabling phenomena such as Bose-Einstein condensation.

### 6.4 The Rasterization Analogy

Think of a computer rendering an image on a screen. Each pixel is an addressable state. Drawing the same pixel twice does not create a new dot—it is redundant. Fermions behave similarly: Pauli exclusion prevents redundant occupation of a quantum “pixel.”

Bosons, on the other hand, are like pixels that can accumulate brightness: multiple bosons increase amplitude, analogous to layering ink to make a color more intense.

From this perspective, quantum mechanics resembles a **\*\*cosmic rasterization system\*\***:

- **Geometry** provides the address space: inside/outside, here/there.
- **Fermions** enforce idempotent occupancy: each state gets used only once.

- **Bosons** allow accumulation and coherence: multiple particles can enhance certain features.

Randomness in quantum outcomes is analogous to **dithering** in graphics: the finite information in the system is smoothed out to produce continuous-looking macroscopic behavior, even though the underlying “hardware” is discrete.

## 6.5 Why Quantum Mechanics Exists

What is the purpose of all this? Why does the universe implement such a system at all?

Consider the problem of preserving observers. For a complex informational structure (like a conscious being) to persist:

- States must be localized and distinguishable.
- Degenerate occupation must be avoided.
- Information must not leak away uncontrolled.

Geometry ensures well-defined “inside” and “outside,” while fermionic exclusion enforces unique occupation. Together, they preserve the **identity of information**, making observers statistically possible.

In this view, maybe Quantum Mechanics is not merely a set of strange rules. It is a **necessary layer of encoding**, ensuring that the universe can maintain persistent structures capable of observation. The laws of physics act as filters: only configurations that respect locality, identity, and distinguishability survive.

## 6.6 Quantum Tunneling: The "Thin Wall" Leak

In classical physics, a boundary is an impenetrable conditional statement: if (position > wall) return;. However, in the quantum “rendering engine,” objects are not point-sources; they are probability distributions.

This leads to a phenomenon strikingly familiar to anyone who has written rendering software based on a photon mapping principle. In ray tracing, if a geometry’s surface is too thin or the step-size of the calculation is too large, a photon may inadvertently “leak” to the other side of a boundary.

Quantum tunneling is the universe’s version of this leak. Because a particle’s position is defined by a wavefunction ( $\psi$ ) with “tails” that extend infinitely, there is a non-zero probability that the state will be “written” on the other side of a potential barrier. What we perceive as a strange subatomic trick is actually a fundamental byproduct of a system that calculates existence based on probabilities rather than absolute coordinates.

## 6.7 Entanglement: The Shared Pointer Bug

Entanglement is very cool feature. Two particles described by the same wavefunction are connected; when one is touched, the other one get spookingly affected, faster than light.

In software engineering, one of the most common (and frustrating) bugs occurs with pointers. You create two variables that you think are independent, but they both point to the same memory address. You modify Variable A, and Variable B "spookily" changes at the same time. You haven't sent a signal from A to B; you've simply modified the shared data they both reference.

Entanglement is the universe's shared pointer. When two particles are entangled, they cease to be two independent "data objects" in Hilbert space. Instead, they become two different "readouts" of a single underlying memory address.

When we measure the spin of one particle, we are accessing that shared address. The "spooky action at a distance" is simply the realization that what we thought were two separate objects are actually two views of the same information.

## 6.8 The Two's Complement Interpretation

This shared information can be interpreted through the lens of Two's Complement logic. In a computer, the bit-string 11111111 is just a state. Its value depends entirely on the "observer's" cast:

- Interpreted as Unsigned, it is 255.
- Interpreted as Signed, it is -1.

The "state" is singular, but the "measurement" yields different results based on the context. Entangled particles exist in such a singular state. The universe doesn't need to "tell" Particle B to flip its spin; it simply ensures that the total sum of the shared information remains consistent, just as a signed byte must remain a valid bit-string regardless of how we read it.

## 6.9 Pauli Exclusion: The Bridge Between Quantum Mechanics and Curved Spacetime

Quantum Mechanics and General Relativity are traditionally seen as fundamentally incompatible. Quantum Mechanics is formulated in Hilbert space, with well-defined states and operators evolving on a *fixed background*. Probabilities, superpositions, and interference patterns are all defined relative to this static spacetime scaffold.

By contrast, General Relativity describes spacetime itself as dynamic: geometry is curved, influenced by energy and momentum, and there is no fixed backdrop on which dynamics occur. Attempting

to naively quantize gravity leads to divergences and inconsistencies; the mathematical frameworks of the two theories appear, at first glance, to be mutually exclusive.

Yet Pauli's exclusion principle emerges as a remarkable bridge between these otherwise incompatible systems. By enforcing that no two identical fermions may occupy the same quantum state, exclusion generates macroscopic effects that directly influence spacetime geometry. Consider the following examples:

- **White dwarfs:** Electron degeneracy pressure resists gravitational collapse, stabilizing stars against the compressive force predicted by General Relativity.
- **Neutron stars:** Neutron degeneracy pressure prevents matter from collapsing into a singularity, again enforcing stability in highly curved regions of spacetime.

In information-theoretic terms, exclusion ensures that each quantum state—each “logical pixel” in Hilbert space—is uniquely occupied. Geometry alone cannot enforce this; quantum mechanics alone cannot constrain macroscopic density. Together, they preserve persistent structures and localized information.

Formally, the antisymmetry of the fermionic wavefunction:

$$\psi(x_1, x_2) = -\psi(x_2, x_1) \quad (6.4)$$

ensures that for  $x_1 = x_2$ :

$$\psi(x, x) = 0 \quad \Rightarrow \quad P(x, x) = 0 \quad (6.5)$$

where  $P(x, x)$  is the probability of two fermions occupying the same state. This mathematical idempotency manifests physically as degeneracy pressure, which in turn affects the curvature of spacetime predicted by General Relativity.

Pauli exclusion appears to act as a bridge: it maps the *microscopic rules of quantum Hilbert space* onto *macroscopic geometric constraints*, enabling matter and observers to persist in a curved universe. In this sense, what might appear as a purely quantum rule is intimately linked to the structure of spacetime itself—a first hint that the universe's laws are designed, or at least organized, to preserve information.

## 6.10 Nature's Dithering: Solving the Banding Problem

To keep users happy, computer software utilizes a technique called dithering to blur out the artifacts caused by limited precision. This same necessity might explain the inherent "randomness" of the subatomic world.

Imagine a rendering engine calculating the color for a specific pixel. The internal calculation—performed with high precision—results in a value of 1.8. However, the output device (the screen or the "classical" world we see) is limited; it only supports discrete integer values of 1.0 and 2.0.

If the software simply rounded to the nearest value (2.0), the resulting image would suffer from harsh "banding"—visible steps where there should be smooth gradients. Nobody is happy with that.

Instead, the software smears the quantization error through probability. It flips a weighted coin:

- There is an 80% probability the pixel will be rendered as 2.0.
- There is a 20% probability it will be rendered as 1.0.

Over many pixels (or many observations), the human eye averages these discrete dots back into a smooth 1.8. This unpredictability, built into our software to hide hardware limitations, mirrors the unpredictability of the microcosm.

Nature, it seems, does not have infinite resources to describe every coordinate of the universe with infinite bits. It needs dithering to get rid of the "Moiré patterns" and "banding effects" that would otherwise occur due to the limited precision of its "output device"—the physical reality we inhabit.

## 6.11 Cosmic Reality Show?

Are we just actors in a cosmic reality show, with particles as pixels in a universal television apparatus?

From the perspective of information, Quantum Mechanics exists to make the show watchable at all.

## 6.12 Conclusions

- Superposition allows interference and encodes all possible outcomes in a wavefunction. - Pauli exclusion enforces identity, preventing degeneracy in fermionic states. - Bosons enable accumulation and coherence, enriching structure without enforcing identity. - Quantum randomness is a dithering (smoothing) mechanism at the level of observed macrostates. - Geometry and exclusion together provide the minimal infrastructure for preservation of information in observers.



## Chapter 7

# Why General Relativity?

### 7.1 Curved Spacetime and Gravity

According to General Relativity gravity is not a force in the traditional sense. Instead, matter and energy curve spacetime, and objects follow the paths dictated by that curvature. In Einstein's equation:

$$G_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}, \tag{7.1}$$

the distribution of mass-energy  $T_{\mu\nu}$  determines the curvature  $G_{\mu\nu}$ , which in turn governs the motion of all objects. Highly concentrated mass-energy can curve spacetime so intensely that the curvature formally becomes infinite—a singularity.

Time and space are no longer absolute. Each observer measures intervals according to their local trajectory through curved spacetime. The future is already embedded in the four-dimensional geometry, though not all events are accessible to a given observer.

### 7.2 Time Dilation and the Observer's Perspective

A thought experiment makes this concrete. Imagine a programmer in orbit around a black hole, and consider a hypothetical object falling toward the event horizon. From the distant programmer's perspective, the object slows as it approaches the horizon, never seeming to cross it. To the falling object, however, the rest of the universe appears to speed by: billions of years can pass outside while only seconds elapse locally.

This difference is not a quirk but a fundamental property of spacetime itself. Time is a **\*\*personal, observer-dependent dimension\*\***, and gravitational fields stretch or compress the rate at which events are experienced.

### 7.3 Why Does Spacetime Have This Structure?

But why does the universe operate in this way? Why is spacetime curved, time relative, and gravity geometric rather than a simple force?

There is some analogy from computer graphics. In a ray-tracing renderer:

- Regions with complex geometry take longer to render, requiring multiple intersections and “is-inside” tests.
- Empty regions render quickly, as no details need evaluation.

Could curvature and time dilation in the universe emerge from similar mechanism? Regions of high mass-energy, where many states are concentrated, experience slower local “processing” (time dilation), empty regions can evolve more freely.

From this viewpoint, GR is not only a description of motion and gravity—it is a **computational infrastructure for the universe**, ensuring that observers and informational structures survive in a consistent, persistent environment. However, where is the computer running the ray tracer?

### 7.4 Sense of Geometric Space

A conscious intelligent observer (without naming anyone in particular!) has a natural sense of 3D space. But why is it that we perceive ourselves living in a world of solid geometric objects? Why do we lack a "wavelike self" defined in the vastness of Hilbert space?

Both are equally real—it just takes a good microscope and a double-slit experiment to prove it. So, why do we require these two vastly different descriptions just to define who we are?

# Chapter 8

## Science vs. Religion

It is not difficult to find people who do not believe in science. Physics would be nothing more than a religion—a belief system itself. Instead of believing in sacred texts, one believes in scientific papers.

### 8.1 Practicing Physics

Physics is a field of science that is fundamentally about the study of observable phenomena.

All fields of science, including physics, follow the so-called scientific method. The method defines how science is practiced. First, one makes observations about the phenomenon to be studied. Then one develops hypotheses to explain the phenomenon. In the case of physics, these are typically described in the language of mathematics. The new theory is then tested against available data. Each new observation that is consistent with the predictions of the theory increases the credibility of the theory.

However, no amount of experimentation can ever prove a theory right. Regardless of the amount of successful experimentation so far, nothing guarantees that the next experiment will support the theory. A physical theory is always subject to falsification. Even a single contradictory experiment can prove the theory wrong.

### 8.2 Practicing Religion

While different religions have different practices, there are some key elements that many of them share. These include prophecy, prayer, rituals and ceremonies, and moral and ethical guidelines.

At the heart of all religions, however, are sacred texts and faith. People read these texts, memorize them, and believe them.

It is important to note that rational thinking should not be applied to compare sacred texts to observations. Experiments should not be carried out to test them. This is because applying rational

reasoning to religious texts leads to logical contradictions, and hence, doubt. Doubt is something between believing and not believing. All doubts are often related to Satan and his attempts to trick us away from the truth.

For example, according to some interpretations of holy texts, the Earth is only some thousands of years old. However, we can observe annoying dinosaur fossils. Based on science, with overwhelming observational evidence, they have to be much older. What one observes would seem to be in total contradiction with what one believes.

These apparent contradictions can be solved by assuming God is great and so far beyond everything that no human being will ever come close to comprehending. With our pitifully thin layer of grey brain matter, it is actually foolish to even try to question the holy texts. God naturally put those dinosaur fossils there just to test one's faith!

One can also explain many of the apparent contradictions in sacred texts by assuming that the sacred texts are not to be taken literally. One allows a suitable level of flexibility in their interpretation.

### 8.3 Conclusions

Religions require total unconditional belief, and all doubt is bad. In science, the situation is exactly the opposite. A theory is accepted as a scientific theory only when there is a significant amount of experimental data supporting it. Theories of physics are always subject to experimental verification. In fact, the most complex system humans have ever built—the Large Hadron Collider—was constructed specifically to challenge existing theories.

In science, one believes only what one sees, whereas in religions the situation is exactly the opposite.

The only conclusion one can draw by comparing science and religion is that the two concepts are fundamentally different. Science is not a belief system.

In fact, the most central concept in physics—consistency with observations—would be lethal to religions. If the claims of religions could be experimentally verified, there would be no room for believing anymore. If we saw God, we would start studying the properties of the system and develop mathematical laws to model them. Observation would turn religion into science.

## Chapter 9

# Anthropic Principle

The “Anthropic Principle” states that the universe must be compatible with the existence of intelligent observers. We should not therefore wonder why everything appears to be so delicately adjusted to make our existence possible. If this wasn’t the case, then there wouldn’t be us either.

According to Stephen Hawking, the universe contains vastly more galaxies than strictly needed for life to develop on one planet, suggesting that a strong anthropic principle (requiring life everywhere) is unnecessary. Only one would be enough to produce the raw materials and get us important humans developed.

One might question this reasoning. If the probability for development of intelligent life happened to be extremely small, then isn’t this huge universe precisely what one needs to get intelligent life developed at least on one planet? So it actually boils down to probabilities.

Even if the probability of life turned out to be high, maybe God, or whoever wanted to get us created, is a perfectionist and only good (e.g., sin-free) humans will do—which we apparently are not.

Or maybe God is impatient! God doesn’t want to wait 1 400 000 000 000 billion years. Why not create 14 billion galaxies and wait only one year?

If there is God, then who created God? If God was never created but simply *is*, then why couldn’t the universe simply *be* as well? Both constructions would be rather magnificent to exist. However, if God created the universe, then God is apparently more intelligent and complex. Correspondingly, the probability of God is smaller than the probability of the universe.

Can we resist the temptation to play with our genome? Researchers are currently trying hard to create artificial self-aware systems on all possible fronts. Also, it does not really matter whether God *just is*, or whether he was created (possibly by another God), because in both cases there would be God. So we might as well strip all these obvious and false blocks out of the code, which simplifies the diagram to the following form:

```
if (God exists) {  
    // God creates a man,
```

```
    // for his own image creates he him
} else {
    // man creates virtual man
    // for his own image creates he him
}
```

There might soon be God, sorts of, many of them. This happens as soon as we get the first DNA simulations executed, or self-aware conscious AI systems developed. We humans will then play the role of God, and those simulated fellows play the role of sinful humans—trying to turn to science and prove God wrong.

Many with a scientific state of mind dislike the strong version of the anthropic principle. However, if the two DNA assumptions hold, then everything in this universe is due to the anthropic principle.

## Chapter 10

# Why Do We Believe?

### 10.1 Introduction

Nearly all nations and societies, even those isolated from the rest of the world, have developed their own spiritual deities that they worship. The widespread and persistent emergence of belief systems across cultures is too significant to dismiss as mere coincidence. This naturally raises the question: *why is belief in God so prevalent?*

### 10.2 Morality and Human Nature

A central component of most religious belief systems is morality. Moral frameworks are commonly grounded in principles such as empathy, compassion, fairness, and recognition of the inherent value and dignity of others. In Christianity, for example, God is regarded as the ultimate source of morality. The Ten Commandments explicitly instruct believers to love God and to love their neighbors as themselves.

Humans with a developed moral sense appear to possess an intuitive understanding of right and wrong. Some actions carry a mild sense of wrongdoing, such as telling a white lie, while others—such as committing a cardinal sin—are perceived as far more severe. Provided an individual is mentally capable (i.e., not suffering from psychosis or deemed *non compos mentis*), people generally have conscious awareness of their actions and can distinguish between moral right and wrong.

Why is it considered wrong to steal food from a friend? Even in hunger, taking food from someone unable to defend it feels inherently wrong. Conscience often guides us toward sharing what we have, even when doing so risks our own well-being. This internal moral compass appears remarkably universal, suggesting that morality is deeply embedded in human cognition.

### 10.2.1 Typical Rights and Wrongs

#### Rights

- Tell the truth
- Show love and empathy
- Share resources
- Act nobly and humbly
- Treat others as you would like to be treated
- Sacrifice for friends or the group

#### Wrongs

- Steal
- Lie
- Behave arrogantly or selfishly
- Kill or cause unnecessary harm

## 10.3 Morality Beyond Humans

Recent advances in DNA research and behavioral science suggest that humans are not fundamentally distinct from other animals. This raises an important question: is morality unique to humans, or do other species exhibit proto-moral behavior?

From personal experience growing up on a farm, some observations are illustrative. We had a dog named Raju who was remarkably perceptive and emotionally responsive. Every weekend, we went hunting for hares. Raju appeared to dream, recognize emotions, follow commands, form strong attachments, and even display apparent jealousy and grief when a new puppy joined the household.

These observations suggest that feelings such as empathy, attachment, and social awareness evolved long before humans appeared. While abstract reasoning and symbolic thought distinguish humans, many foundational social behaviors—including proto-moral instincts—are shared with other group-living animals.

## 10.4 The Evolutionary Basis of Morality

What humans describe as “right” closely aligns with behaviors that promote cohesion and survival in social groups. Cooperative behavior enhances group survival, whereas selfish or disruptive behavior threatens it. This leads to a concise summary:





Figure 10.1: Raju demonstrating early forms of empathy and attachment, illustrating proto-moral behavior in social animals.

**Morality is the native behavior of animals living in groups.**

For example, if a bear attacks, a dog loyal to its human may defend despite personal risk. This mirrors the Christian moral ideal: “There is no greater love than to give one’s life for one’s friends.” Even concepts of ultimate love appear to reflect deeply evolved social instincts.

## 10.5 Humans as Social Animals

Humans naturally form dense, cooperative groups, significantly increasing their chances of survival. Individually, humans are physically weak compared to many predators. Evolution therefore favored traits that prioritize group cohesion over individual advantage. Extreme examples—such as sacrificing one’s life for others—demonstrate how deeply social instincts are embedded in human psychology.

## 10.6 Organizing Groups

Group living is advantageous only when it is effectively organized. A group in which every member attempts to lead independently would fail. Successful groups require leadership that coordinates action, allocates resources, and manages collective risk.

Over evolutionary time, humans developed instincts to identify and follow capable leaders. Those who aligned with effective leadership survived and reproduced; those who did not were less likely to do so. This selective pressure embedded leadership recognition into human cognition.

### 10.6.1 The Theory of God

**God is the model of the best leader we can imagine.**

God embodies the attributes of an ideal leader: wisdom, justice, authority, and protection. Most importantly, God transcends death, the ultimate threat to survival. Human cognition naturally extrapolates principles of effective leadership to their logical extreme, yielding the concept of an eternal, omnipotent leader.

## 10.7 Conclusions

Belief in God emerges naturally from humanity's evolution as a social species. Survival depended on cooperation, social behavior, and effective leadership. Over time those who recognized and followed good leaders survived, with leader recognition ingrained in their genomes and instincts - moral.

It is unsurprising that humans seek meaning and security in such a figure, even when that leader is spiritual in nature and beyond direct observation.

# Chapter 11

## Free Will

If DNA is the blueprint of life and its operations can be described as an axiomatic system, then everything within the human experience must itself be axiomatic by nature. According to the Church–Turing thesis, humans can therefore—at least in principle—be simulated on a computer.

Computers, in general, are deterministic systems. They do not exhibit truly random behavior; even a so-called “random value generator” in a computer is based on deterministic logic, producing values that only appear random to an external observer.

It is evident that such a deterministic system cannot possess *free will* as it is typically understood. A Turing machine running a DNA simulation is bound to follow its logic without any capacity to choose otherwise. This implies that individuals within a simulated universe cannot possess free will either; they are constrained to behave according to the underlying rules of the machine executing the simulation.

However, nothing prevents us from implementing a truly random generator. According to quantum mechanics, there is genuine randomness inherent in nature, which could, in principle, be leveraged to create an indeterministic computer. Could such a “quantum-boosted” machine grant simulated individuals free will?

Consider a person contemplating whether to turn left. Suddenly, a completely unexpected and indeterministic event occurs: a high-energy particle burst emitted by the Sun. A few particles pass through critical brain cells, perturbing the person’s neural activity in a genuinely unpredictable manner. As a result, instead of turning left, the person decides to move forward.

Does this random, unpredictable event introduce free will?

The person had no control over the distant particle burst, nor over the manner in which it affected their internal processing. Consequently, the person has no more free will with this random influence than without it. The only effect of the random event was that the resulting decision became detached from the relevant information and reasoning available to the individual.

In trivial situations, such randomness might appear harmless or even amusing, adding a sense of spontaneity. However, consider a scenario in which a person’s life is at stake. In such circumstances,

the ability to make decisions based on relevant data is crucial. An indeterministic disturbance that disrupts logical reasoning does not enhance free will; it undermines it. We would not want to define free will as something that applies only to inconsequential choices. Survival depends on making decisions guided by meaningful information.

If our decisions are not influenced by indeterministic events, then they are the result of deterministic reasoning. If they *are* influenced by such events, then they are driven by phenomena over which we have no control. Neither case supports the existence of free will.

Allowing randomness to influence decisions does not introduce freedom; it merely replaces reasoning with noise. A coin toss is not an act of will.

**Hypothesis of Free Will:** There is no free will.

We do not possess the freedom to decide when to commit a sin or when to compensate through prayer. Every conscious decision we make follows logical processes in which  $2 + 2$  invariably equals 4. Like computer software, we are bound to follow our internal logic, without the capacity to choose otherwise.

## Chapter 12

# Wooden Computer

The brain of a computer—its central processing unit (CPU)—consists of a set of electric switches called transistors. The CPU does not need to be an electric device. Equally well, one might implement the required logic using a set of wooden parts, for example.

In theory, one could implement a DNA simulation as a mechanically operating computer consisting of wooden components. Instead of using transistors in a silicon chip to control electrons, one could use wooden parts on a plywood platform to control wooden balls. When such a machine stepped through its logic, a virtual human would take its first steps in its virtual universe.

What is this strange phenomenon that creates consciousness and pain from a jerking pile of wooden pieces?

If a huge number of moving wooden components can create pain, then what does one moving piece of wood create?

Can current physics even describe this action?

No man-made device is perfect, and wooden <sup>™</sup> is no exception. Friction, tolerances, and things like that introduce resonances and other unintentional vibrations to the operation of wooden <sup>™</sup>. If the actual logic in the wooden <sup>™</sup> creates a virtual universe with pain and consciousness, then what do these unintentional side effects create? Do they get reflected in some form into the created virtual world too?

Would the virtual fellow in its virtual universe discover these in the form of strange quantum foam? Would it observe them as strange cosmic background radiation with 2.725 K temperature?

Maybe so; at least it would be difficult to argue why large movements of wooden components would count, but their small resonances would not.

How would the clock speed of the machine running the simulation appear in the created simulated universe? Would it observe that particles in its universe appear to follow some strange abstract square wave function, whose origin it could not explain, but which it might end up calling Wintel's abstract square wave function?

In addition to Turing machines, it is easy to picture other systems creating virtual universes. One possible source of consciousness could be the surface of a sea. In theory, waves and ripples of a sea could describe a DNA simulation in which conscious observers marvel at the wonderful properties of their universe (like those caused by heavy rain during the annual monsoon season).

One could also use a thermostat to describe any procedure by controlling the temperature. The temperature could vary in time so that the thermostat would go through the binary code of the DNA procedure. Of course, the simulated fellow would be totally unaware of the fact that a trivial thermostat is responsible for the illusion of its existence. Obviously, the thermostat itself cannot be regarded as conscious by any means. Correspondingly, running such DNA simulations on any type of computer does not make the computer itself conscious or pain-sensitive. It is still the very same trivial <sup>TM</sup> stepping through its symbol tape without any choice. However, the running <sup>TM</sup> creates a virtual parallel universe in which a conscious human wonders about free will.

The whole universe, with its planets and stars, could be the source of a consciousness.

What do the five billion human beings create when walking along streets and passing through doors on their way to work? For example, a person walking through two subsequent doors implements the logical operation called **AND**. If one can pass through using either the left or right door, then one gets the **OR** operation.

Could even a regular pencil and a piece of paper be the source of consciousness? Start writing down the evolution of DNA with pencil and pen, and soon virtual people suffer tooth pain in their virtual universe. Both pencil and ballpoint pen should work equally well. Due to the higher friction, the temperature of the cosmic background radiation in a universe created with pencil might be a bit higher though!

So we can play with electrons, or even wooden components, to create virtual universes that duplicate the structures in our universe. Because the simulated fellow would be a virtual duplicate of its real-world counterpart, it too will start exploring its universe, sooner or later (we did!). It will discover that it can create things like Turing Machines. Sooner or later, it would build one and simulate its own existence. The procedure the virtual fellow uses to simulate its own existence is the same procedure that we real-world humans used to create the first simulation level. In other words:

```
virtual_1 = DNA(virtual_0)
```

And apparently this stack of nested simulations would continue forever, or as long as there is enough information in the sub-simulation to describe yet another sub-simulation. We know that the virtual fellow we created in our simulation, as well as the virtual fellow our simulated fellow created, are both virtual. We know it because we created it all in a Turing Machine whose deterministic operation we know precisely. Therefore, the above two equations can be unified into one equation of the form:

```
r_{n+1} = DNA(r_n);
```

The axiomatic `DNA()` procedure that maps our real world  $r_n$  to a virtual world  $r_{n+1}$  is exactly the same procedure that maps the virtual world  $r_{n+1}$  to another virtual world  $r_{n+2}$ . There is no single

parameter in the equation that would make us real fellows distinctive from these simulated fellows. The only logical conclusion one can draw from this is that this universe of ours is precisely as virtual by nature as the universes we create in our computers. With recursive procedures, it is very difficult to argue that one recursion level would somehow be more real than the others. Just like with the case of the simulated fellow, we real-world fellows don't see that it is all virtual by nature.

There is apparently one very serious problem with the simulation hypothesis: entropy. It is an extremely difficult job to build a system that can simulate even one human DNA strain, let alone a complete human being. There are six billion of us, not to mention other animals, plants, bacteria, and such. Our Milky Way galaxy consists of hundreds of billions of stars similar to our Sun, and hundreds of billions of galaxies have been observed.

Those sub-simulations would soon run out of information!

Despite their purely virtual nature, these abstract constructions contain very nice features. Pain and joy are very cool properties for us conscious human beings. Could there even be some procedures of feelings that evolution hasn't implemented yet for us? Could we have those when we end up in heaven?

Those unknown human experiences could certainly explain the behavior of my wife; she is obviously running all of the procedures simultaneously.

In one Arnold Schwarzenegger movie [4], people switched between the real world and the movie world. I never liked the movie because the idea felt way too absurd to me. Silly me.





# Chapter 13

## Time

### 13.1 The Problem of Time

Time is a problem.

In many equations of physics, time appears merely as a parameter. One can replace  $t$  with  $-t$  and the equations continue to work just fine. As far as the formal laws are concerned, there seems to be nothing that enforces a preferred direction of time.

A software programmer can easily implement a model of a universe using modern programming languages and simulation frameworks. Such a simulation would typically have a time slider. The animator can move the slider forward or backward at will, and the simulated universe responds accordingly. Slide it forward and someone gets eaten by a T-Rex. Slide it backward and the victim walks away unharmed.

In the real universe, however, there is no visible time slider. There is no external animator adjusting the present moment. Time flows, but only in one direction. We remember the past, not the future. Causes precede effects. Broken things do not spontaneously reassemble.

Yet the fundamental equations themselves seem largely indifferent to this asymmetry. This tension between lived experience and formal theory is the core of the problem of time.

### 13.2 General Relativity vs. Quantum Mechanics

The two most successful theories of modern physics—General Relativity and Quantum Mechanics—paint strikingly different pictures of time.

In General Relativity, time is not an external parameter but part of a four-dimensional geometric structure called spacetime. Space and time are interwoven, and their geometry is determined dynamically by the distribution of mass and energy. Objects trace world-lines through this geometry, and what we perceive as the present is simply a three-dimensional cross-section of a four-dimensional

structure.

In this framework, there is no universal, continuously flowing time. Each observer measures their own proper time along their world-line. Different observers experience time at different rates depending on their motion and gravitational environment. A common interpretation of General Relativity—the so-called block universe view—suggests that past, present, and future events all coexist within the spacetime manifold. Whether this interpretation is ontologically correct remains a matter of debate, but it is consistent with the theory.

Cosmological observations indicate that the universe has evolved from a hot, dense early state roughly 13.8 billion years ago and that its large-scale expansion is currently accelerating. This evolution is not represented as motion through time toward a single point, but as the unfolding of spacetime geometry itself.

Quantum Mechanics offers a very different perspective. In quantum theory, physical systems are described by wavefunctions that encode all available information about their states. These wavefunctions evolve deterministically in time according to the Schrödinger equation, yet the outcomes of measurements are fundamentally probabilistic.

Importantly, quantum mechanics does not render time itself indeterminate. The uncertainty lies in observable quantities, not in the existence or continuity of time. Time remains an external parameter in standard formulations of quantum mechanics, unlike in General Relativity where it is part of the dynamical structure.

Some speculative theories suggest the existence of a smallest meaningful time scale, often associated with the Planck time, but this is not a prediction of quantum mechanics itself. It is an indication that our current theories may break down at extreme scales, and that a deeper framework—quantum gravity—may be required.

Other approaches highlight the tension further. The Wheeler–DeWitt equation, for example, describes a formalism in which time does not appear explicitly at all. String-theoretic models allow scenarios in which the Big Bang is not the beginning of time, but a transition between different geometric phases. None of these ideas has yet produced a complete and experimentally verified theory.

Despite their differences, both General Relativity and Quantum Mechanics share an important feature: their fundamental equations are largely time-symmetric. They do not, by themselves, explain why time appears to flow in one direction only.

### 13.3 Strange Temporal Phenomena

At small scales, nature exhibits behaviors that appear to challenge our classical intuitions about time.

Quantum tunneling allows particles to appear on the other side of potential barriers that would be impenetrable in classical physics. While tunneling does involve subtle temporal behavior, it does not occur instantaneously or without time entirely, even if its timing is difficult to define precisely.

Entangled particles exhibit correlations that persist across arbitrary distances. Measuring one particle instantaneously constrains the state of its partner. However, no information is transmitted faster than light; the correlations cannot be used for communication.

Photons traveling along null geodesics experience zero proper time between emission and absorption. From the photon's own perspective—if such a perspective could be meaningfully defined—no time elapses during its journey. This is a geometric property of spacetime, not a violation of causality.

None of these phenomena, however, reverse the arrow of time. They stretch our intuitions, but they do not allow macroscopic objects—or observers—to move backward into their own past.

## 13.4 Entropy and the Arrow of Time

Since the fundamental equations do not impose a temporal direction, it is often argued that the arrow of time arises from the second law of thermodynamics. In an isolated system, entropy tends to increase. This provides a statistical distinction between past and future.

Stephen Hawking famously illustrated this using a video recording. A film showing entropy decreasing—shattered objects reassembling, smoke returning to cigarettes—immediately appears unnatural. Entropy allows us to distinguish whether a process is running forward or backward.

Entropy also underlies biological time. Living systems require ordered energy sources. We eat food that is highly structured and expel waste that is more disordered. A universe in which entropy decreased would not support life as we know it.

Yet this explanation raises a deeper question: why should entropy increase at all? Why does the universe begin in a state of such extraordinarily low entropy?

## 13.5 Information and Time

A complementary way to frame the arrow of time is through information.

In an isolated system, total information cannot be created or destroyed—only transformed and redistributed. This principle is implicit in unitarity and in modern understandings of black hole physics.

From this perspective, time is not something one moves through freely. It is an ordering of information transformations. Each moment encodes the complete informational state of the universe at that stage.

Now consider what travel to the past would imply. A macroscopic object appearing from the future would introduce a large amount of mass-energy and information into an otherwise closed system without any causal precursor. An 80 kg human corresponds to roughly  $7 \times 10^{18}$  J of energy. Such an appearance would violate global information accounting and render thermodynamics meaningless.

The arrow of time, then, is not merely psychological, nor purely statistical. It is a structural

consequence of information conservation. The past is fixed because its information has already been distributed. The future appears open because multiple informational rearrangements remain compatible with the present.

Time flows forward because it must.

## 13.6 Humans as Axiomatic System

### 13.6.1 Basic Assumptions

Let's start with the following assumptions:

1. DNA encodes the blueprint for consciousness.
2. DNA obeys physical laws.

It should be noted that these are observable assumptions, and as such, they cannot be definitively proven. However, the observational evidence supporting them is strong.

The first assumption posits that the human genome encodes all the information required to construct a conscious, pain-sensitive human being within this universe and its observed laws of physics.

The second assumption states that DNA is composed solely of ordinary physical matter. It is made of the same matter as everything else and is governed by the same physical laws, with no non-physical or supernatural influences affecting its operation.

It then follows that humans, unlike what Roger Penrose speculates, must be implementations of axiomatic systems. Consequently, consciousness could be described using the principles of mathematics.

### 13.6.2 Church-Turing Thesis

Let us make a third assumption:

3. Church–Turing Thesis holds.

It states that all physical processes can, in principle, be simulated by a device known as a Turing machine. The thesis has never been formally proven, but if it were false, we would have good reason to worry about keeping our money in bank accounts.

From these three assumptions it follows that humans can be simulated by a Turing machine—or, in its modern incarnation, a computer.

### 13.6.3 DNA Simulation Thought Experiments

Suppose we digitize a human genome and run it on a computer simulating a universe governed by the same laws of physics as our own. As the simulation executes, the DNA evolves into a conscious, pain-sensitive observer. The simulated human experiences an expanding universe where time flows from past to future, and tooth pain is real.

#### Optimizing Code

All software programs consist of two kinds of information: code and data. In a DNA simulation, the code would describe the laws of physics, such as quantum mechanics and gravity. The data would include the digitized DNA and a sufficiently large section of the surrounding universe, as creating a simulated human in an empty space would likely lead to psychosis.

|codecodecodecodecodecodecodecode|datadatadatadatadatadatadatadata|

A well-known technique for optimizing slow, CPU-intensive code is to use lookup tables, which replace computation with precomputed data. For example, one can replace all `sqrt()` computations:

```
result = sqrt(arg);
```

with precomputed values:

```
result = sqrt_lookuptable[arg];
```

Empirically, software programs yield identical results regardless of how the result was computed.  $2 + 2 = 4$ , and it does not matter if we replace all  $2 + 2$  equations in our code with precomputed value of 4. This optimization therefore cannot affect the simulation's output, nor the observer's experience of time or pain. Delaying or accelerating computation affects only the external runtime, not the internal state transitions of the simulated system.

However, this optimization has the effect of reducing the amount of code and increasing the amount of data in our DNA simulation:

|codecodecodecodecodecode|datadatadatadatadatadatadatadatadatadatadata|

Now, imagine we gradually optimize the DNA simulation by replacing algorithmic components (e.g., `sqrt()`) with lookup tables. As a consequence, the number of CPU cycles required to run the simulation decreases. Suppose we take this optimization to the extreme: all computation is replaced by a static dataset encoding the entire execution trace.

|datadatadatadatadatadatadatadatadatadatadatadatadatadatadatadata|

As a result, we don't have anything to run in a computer. It is just a massive hard drive containing all procedures precomputed.

Does the observer still experience time and pain?

The answer, within the axiomatic model, is yes. Affirming otherwise would imply the existence of a new physical constant in our books of physics: a minimum code-data ratio required for the Church–Turing thesis to hold, or for consciousness to emerge.

Temporal structure and pain, therefore, must emerge from the internal relationships among states, not from the external runtime. From the internal perspective of the simulated observer, time still flows from past to future and pain is real.

As a conclusion, a static dataset can fully specify a universe containing conscious observers with subjective time. Consequently, time and pain must be properties of simulated observers, not fundamental properties of the universe.

### Multi-threaded Simulation

When a single DNA simulation—let's call her Alice—runs on a computer, the execution trace is easy to study. Every CPU instruction drives the computer (and Alice) to a new state. From Alice's perspective, time flows forward, and the effect of each CPU cycle can be mapped to a simulated particle in her world.

$$| \text{Alice} | \text{Alice} | \text{Alice} | \text{Alice} | \dots |$$

However, consider a system running multiple DNA simulations concurrently—say, Alice and Bob—where thread scheduling is governed by quantum randomness. The resulting execution trace interleaves their simulated lives in segments of unpredictable length.

$$| \text{Alice} \text{Alice} \text{Ali} | \text{Bob} \text{Bob} \text{B} | \text{Alice} \text{A} | \text{Bob} \text{Bo} | \text{Alic} | \text{Bob} \text{B} \dots |$$

Since both single- and multi-threaded computers are computationally equivalent, each observer must experience a coherent, continuous timeline.

Now, let's gradually shorten the number of CPU cycles until each thread is limited to running a single CPU cycle before switching. Let's also add more DNA simulations, like Robert, John, and Jill. As the number of concurrent simulations increases, the execution trace becomes increasingly fragmented. Additionally, modern multi-threaded systems often include many extra threads for operating system tasks, such as listening for network requests. In the limit of infinitely many perfectly interleaved simulations, the execution trace approaches pure white noise.

$$| \text{A} | \text{B} | \text{OS} | \text{R} | \text{J} | \text{OS} | \text{l} | \text{Ji} | \text{i} | \text{ce} | \text{b} | \text{ob} | \text{n} | \text{l} | \dots |$$

Are the simulated observers still conscious?

The answer, again within the axiomatic model, is yes. Empirically, multi-threaded computers function reliably regardless of how few CPU cycles are allocated per thread switch or how narrow the CPU's internal registers are. From each observer's internal perspective, time still flows from past to future.

This raises an obvious question: how does each conscious, simulated observer know which sequences belong to them and which do not, in order to remain conscious?

Conclusion: if there is any way to interpret the data of the execution trace as a "conscious observer," then that is exactly what happens: a conscious observer emerges. If the initial assumptions hold, consciousness, pain, and subjective time can emerge from static data that resembles pure static noise.

### 13.6.4 Causality

It is often assumed that a virtual universe only comes into existence when a simulation is actively executed—that the computer must be powered on for the simulated world to exist. If the simulation computer is never started, then no simulated virtual world emerges. No consciousness, definitely no pain.

However, pure static data (such as the full execution trace of a simulation) has no notion of time. The computer with its hard drive does not even need to be run. In fact, computation is irrelevant, as that information could exist even without computers to compute it. Therefore, one cannot argue that one created the other. What appears as static information, e.g., execution trace of a computer to us external observers, appears as an expanding universe and pain to the simulated human observing the data from inside. This relationship is representational, not causal.

The computer and the simulated universe must be two sides of the same coin: distinct arrangements of the same underlying information. And there is more than just two sides on the coin. Consider an execution trace of  $N$  bits. These bits can be arranged in  $2^N$  ways. Apparently, most of them describe chaotic universes with no conscious observers. One, however, describes our identical simulated twins—Alice, Bob, and others. And one describes something we call a computer, which is simulating a computationally heavy procedure—DNA.

### 13.6.5 Philosophical Zombies

Current technology does not yet allow for full-scale DNA simulations. However, were such a capability to exist, and assuming the three initial axioms hold true, we would have undoubtedly digitized our DNA multiple times to create conscious and pain-sensitive virtual twins of ourselves.

But would those digital twins of us truly be conscious and sense pain?

Philosopher David Chalmers proposed the concept of a philosophical zombie: a hypothetical being that is physically and behaviorally identical to a conscious human but lacks any subjective experience. Such a zombie would respond to pain stimuli in the exact same way a conscious person does—it would cry out, flinch, and try to avoid the source of pain—but it would not feel anything.

According to Chalmers, even with a perfect simulation, we would only be observing the physical processes. We still wouldn't know if there's a "ghost in the machine"—a feeling of what it's like to be that simulated being. A computer could be programmed to perfectly mimic the behavior of a person feeling pain without actually having the experience itself.

This goes back to philosopher the \*hard problem of consciousness\*. It appears that human conduct is not reducible to the operation of the human brain.

### 13.6.6 Pain Hypothesis — From Philosophy to Physics

Let's make a fourth assumption:

5. Pain has measurable effects.

This assumption brings the concept of pain from philosophy to physics. Just like gravity, pain is assumed to have observable consequences that are physically detectable and measurable. Formally:

$$\text{Human} \neq \text{Human} + \text{Pain}$$

The core argument is then as follows:

- Axiom 1: DNA encodes the blueprint for consciousness.
- Axiom 2: DNA obeys physical laws. From this, it follows that humans must be an axiomatic system.
- Axiom 3: Church–Turing thesis holds. From this, it follows that humans can be simulated.
- Axiom 4: Pain has measurable effects. From this, it follows that the simulated copy must experience pain and be conscious. Any difference in their behavior would disprove one of the initial axioms.

If a system's behavior is entirely determined by its physical components and their interactions, a perfect copy should exhibit identical behavior. If a simulation is a perfect copy of those physical components, it must behave identically to the original. If the original's behavior is driven by the experience of pain, the simulation must have that experience too.

If consciousness and pain have measurable, physical effects, we can reason that in an axiomatic system, identical inputs must yield identical outputs. If the simulated human's output (its behavior) is different from the real human's, then the assumption that they are identical axiomatic systems is wrong. If their behavior is identical, then their internal states, including consciousness and pain, must also be identical.  $2 + 2$  holds for both bananas and apples.

Correspondingly, the P-Zombie is an impossibility. If Axioms 1–4 hold, the P-Zombie premise collapses:



- Axioms 2 and 3 state the system is an axiomatic, computable entity.
- Axiom 4 states that the experience of pain ( $P$ ) has a measurable, physical effect.

As soon as our technology allows for full-scale DNA simulations, we can test whether a simulated human experiences pain, and thus, whether this hypothesis is valid.

### 13.6.7 Conclusions

If the four assumptions hold, then consciousness, time, and even pain can emerge from the structure of information alone. The universe itself is nothing more—or nothing less—than a vast tapestry of information. Observers, particles, and the flow of time are just patterns woven into this tapestry, emerging wherever conditions allow.

Time appears to be a subjective property of us intelligent and conscious observers, illusion that we created in our minds rather than a fundamental property of the universe. The universe is informational and abstract by nature, and our everything in us observers can emerge even from static or noisy informational substrate.

Where did all the matter in the universe come from? The answer appears to be nowhere. There is no matter more than there is numbers, multiplications, or square roots. The nature of everything is fundamentally abstract and virtual by nature.



## Chapter 14

# Spectral Complexity and Induction

### 14.1 Kolmogorov Complexity and Algorithmic Induction

Algorithmic Kolmogorov complexity, while mathematically elegant, is ill-suited as a physical primitive. It is uncomputable, discontinuous, and defined only relative to symbolic machines. Physical systems, by contrast, evolve continuously, and any measure of description length must reflect this continuity.

In this work, we replace Kolmogorov complexity with *spectral complexity*, defined as the number and distribution of modes required to represent observer-relevant information.

### 14.2 Spectral Complexity

Spectral complexity is continuous, computable, and naturally aligned with physical representations such as wavefunctions and fields. Smooth, low-bandwidth descriptions dominate the space of stable observer histories, providing a physically grounded basis for induction without invoking abstract computation.

Spectral complexity is a compression principle, not a computation principle. It concerns the measure over representations, not execution on any substrate:

Brains do not execute algorithms; neural networks do not “run code”; intelligence is not a step-by-step symbolic procedure. Biological and artificial neural networks are continuous, distributed, massively parallel dynamical systems.

For example, no “for loop” runs in one’s head when seeing that  $2 + 2 = 4$  or imagining a smooth circle. And yet structure is recognized, compression occurs, and prediction is possible. Compression is therefore embodied in structure, not performed as a procedure.

### 14.3 Induction as Passive Selection

Induction in this framework is not something observers actively perform. It is a combinatorial consequence of the distribution of possible histories.

Returning to the movie library analogy: observers do not select, evaluate, or rank movies. Instead, one simply finds oneself inside a particular movie. The only reason some movies dominate is that there are vastly more compressed descriptions encoding smooth, stable observer histories than there are descriptions encoding chaotic, unstructured ones that preserve observer identity.

This is passive selection, not active inference. Existence, multiplicity, and measure suffice to explain why observers find themselves in highly structured, predictable worlds.

Intelligence feels effortless because compression is already embodied in the structure of the world. We see smooth circles without computing Fourier series, we know  $2 + 2 = 4$ , and neural networks recognize patterns without explicit rules.

### 14.4 Implications

The wavefunction is already the compressed form; geometry enforces stable boundaries; and discreteness limits resolution. Observers are born into these compressed, discretized, geometrically filtered worlds—they do not perform compression themselves.

Smooth, predictable worlds dominate observer measure because they admit maximal compression while preserving observer identity. Spectral complexity therefore provides a physically grounded replacement for algorithmic Kolmogorov complexity and underlies the emergence of lawful, comprehensible physics.

## Chapter 15

# Descriptive Paradigms of Information

### 15.1 Motivation

Any informational theory that attempts to unify quantum theory, spacetime geometry, and the existence of observers must ultimately confront a prior question: *What is information*. In what ways can information be described at all?

The purpose of this chapter is to identify and classify the irreducible paradigms by which information may be described, and to argue that these paradigms form a complete and minimal set.

We adopt the most conservative starting point possible: the existence of information as a static structure, without assuming time evolution, external interpretation, or predefined physical laws. Observers, when they appear, are treated as substructures of this information rather than as external agents.

### 15.2 Information as a Static Structure

Throughout this chapter, *information* refers to an abstract structure capable of supporting internal distinctions, correlations, and relations. No assumption is made regarding computation, execution, or external semantics. In particular:

- There is no external reader or interpreter.
- There is no privileged representation.
- There is no fundamental notion of time or process.

Physical laws, observers, and regularities are understood as internal, self-consistent relations within this structure.

The central question then becomes:

*What are the fundamentally distinct ways in which a given informational structure can be described?*

### 15.3 Criteria for a Descriptive Paradigm

A descriptive paradigm is defined here as a mathematically complete mode of description that:

1. Can represent arbitrary informational structures,
2. Possesses its own internal invariants,
3. Does not rely on another paradigm for semantic completeness,
4. Is not merely a meta-language describing relations between descriptions.

Under these criteria, many familiar mathematical frameworks (logic, computation, probability, category theory) do not qualify as independent paradigms, as they either presuppose an underlying description or operate at a meta-level.

### 15.4 The Three Irreducible Paradigms

We argue that exactly three such paradigms exist.

#### 15.4.1 Discrete (Set-Theoretic) Description

The discrete paradigm describes information as collections of distinguishable elements:

- Sets, sequences, graphs, bitstrings
- Identity, countability, combinatorial structure

This paradigm answers the question:

*What is distinguishable?*

Without a discrete description, the notion of information itself becomes undefined, as information requires distinguishability. Particle descriptions, events, and symbolic representations all fall within this paradigm.

### 15.4.2 Analytical (Spectral) Description

The analytical paradigm describes information in terms of global correlations:

- Functions, amplitudes, spectra
- Superposition, interference, global constraints

This paradigm answers the question:

*What correlations exist across the whole structure?*

Wavefunction-based descriptions in quantum theory are instances of this paradigm. Importantly, this description is static: it encodes relations, not processes. Compression and predictability arise here as structural properties, not computational procedures.

### 15.4.3 Geometric Description

The geometric paradigm describes information in terms of relational localization:

- Manifolds, metrics, neighborhoods, boundaries
- Locality, continuity, persistence

This paradigm answers the question:

*What is locally related to what?*

Geometry enables the notion of bounded subsystems and stable structures, which is essential for the emergence of observers as persistent informational entities.

## 15.5 Descriptive Equivalence and Non-Reducibility

Although all three paradigms can, in principle, be formally reduced to set theory, they are not descriptively reducible. Each captures invariants that the others do not:

- Discrete descriptions capture identity and countability.
- Analytical descriptions capture global correlation and spectral structure.
- Geometric descriptions capture locality and continuity.

Translations between these paradigms preserve informational content but not descriptive primitives. This establishes their equivalence without ontological hierarchy.

## 15.6 Absence of Additional Paradigms

It is natural to ask whether further independent paradigms exist. Common candidates fail under the criteria defined above:

- **Algebraic descriptions** reduce to discrete or analytical structures.
- **Logical and axiomatic systems** encode discrete syntax.
- **Probabilistic descriptions** assign measures to existing descriptions.
- **Computational descriptions** presuppose execution and time.
- **Category theory** functions as a meta-language relating descriptions.

No additional paradigm introduces new informational invariants beyond distinguishability, global correlation, and locality. Thus, the set of three paradigms is complete.

## 15.7 Observers as Internal Substructures

Within this framework, observers are not external entities but internally stable informational substructures. Their existence requires:

- Discrete distinguishability (identity),
- Analytical predictability (compression),
- Geometric boundaries (local persistence).

The observer and the observed universe are therefore jointly described within the same informational structure. No paradigm is observer-centric; rather, observers emerge as configurations that are simultaneously well-defined across all three paradigms.

## 15.8 Summary

We have identified three and only three irreducible descriptive paradigms of information:

1. Discrete (set-theoretic),
2. Analytical (spectral),
3. Geometric.



These paradigms are mutually equivalent, descriptively irreducible, and jointly sufficient to express all internally meaningful informational structure. Physical theories may privilege one paradigm for convenience, but no paradigm is fundamental. The consistency between them replaces the role traditionally assigned to physical laws.

This triadic structure provides a natural foundation for unifying quantum theory, spacetime geometry, and observer emergence within a single informational framework.

## 15.9 DNA Simulation

### 15.9.1 Thought Experiment

The current technology does not allow us to run full scale human DNA simulations yet. However, that does not prevent us from running it as a thought experiment. So we digitize a human genome and run it inside a sufficiently detailed computer simulation. We also simulate a sufficiently large world with it to avoid our simulated human to develop psychosis in empty space. Nine months later, in simulation time, our virtual copy takes its first breath in its simulated world.

### 15.9.2 The Nature of the Simulated World

How would such a simulated human perceive its environment? Would it sense the limited memory space of the computer running it? Would it be able to bump its head against the upper boundary of RAM and feel pain? Would the flipping of bits tickle its nose, or the rotation speed of a hard drive make it dizzy?

Would it eventually discover that its entire universe is driven by storage devices, memory chips, and an overclocked multi-core CPU?

### 15.9.3 Sense of Reality

The simulated human is not created *within* our universe. It does not consist of real-world particles such as electrons or quarks. Instead, it exists entirely within a virtual universe that we simulate alongside it. As a result, it has no access to our physical hardware. It cannot observe transistors, memory cells, voltages, or processor clocks.

The only thing the simulated human can study is the internal structure of its own virtual world.

Within that world, there are virtual particles, virtual forces, and virtual laws of physics. When the simulated human bangs its head against a simulated wall, the simulated particles in the wall respond exactly as the laws of that virtual universe dictate - including pain. To the simulated observer, the experience is indistinguishable from how real particles behave when we humans bang our heads against real walls.

Every measurement the simulated human performs inside its universe will be internally consistent.

The outcomes of experiments will match the predictions of the simulated physical laws, just as our measurements match the laws of physics in our own universe.

This is because both the real world and the simulated world are *axiomatic systems*. Mathematics does not care whether it is applied to apples, bananas, electrons, or bits. The statement “ $2 + 2 = 4$ ” holds regardless of the physical substrate that implements the system.

For the simulated human, its universe is not an approximation, an illusion, or a shadow of reality. It is *reality*. There is no experiment it could perform that would reveal the presence of the computer running the simulation, because that computer exists outside the axioms of its universe.

From the inside, the simulated universe would feel precisely as real as our universe feels to us.

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