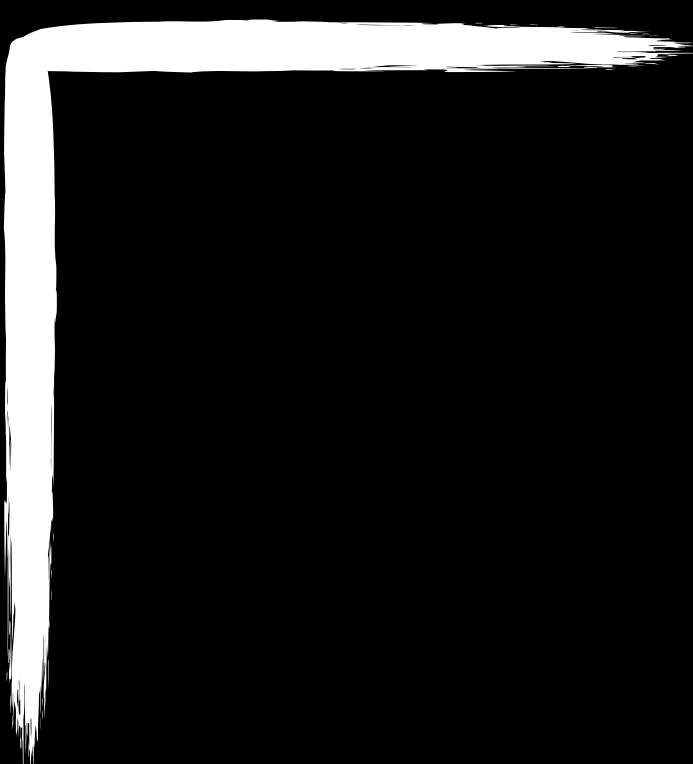
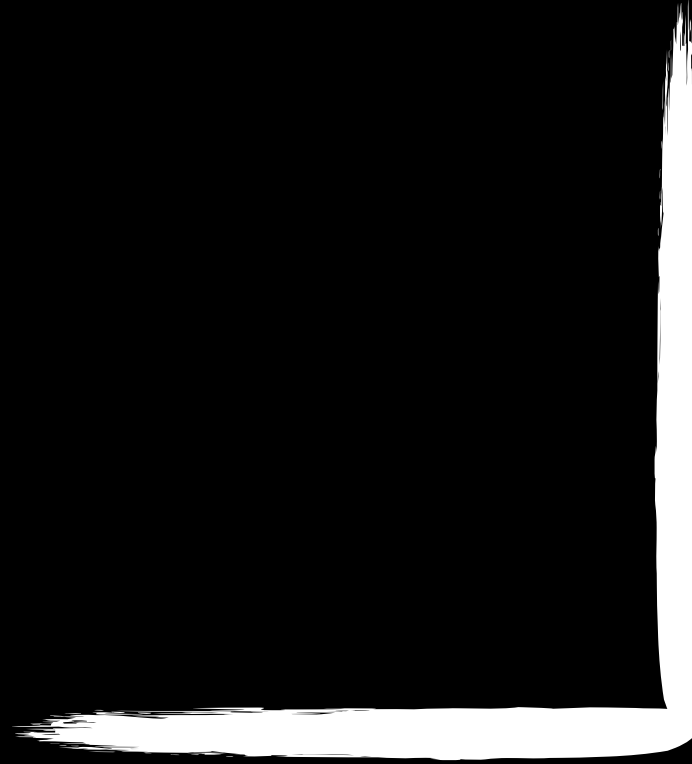


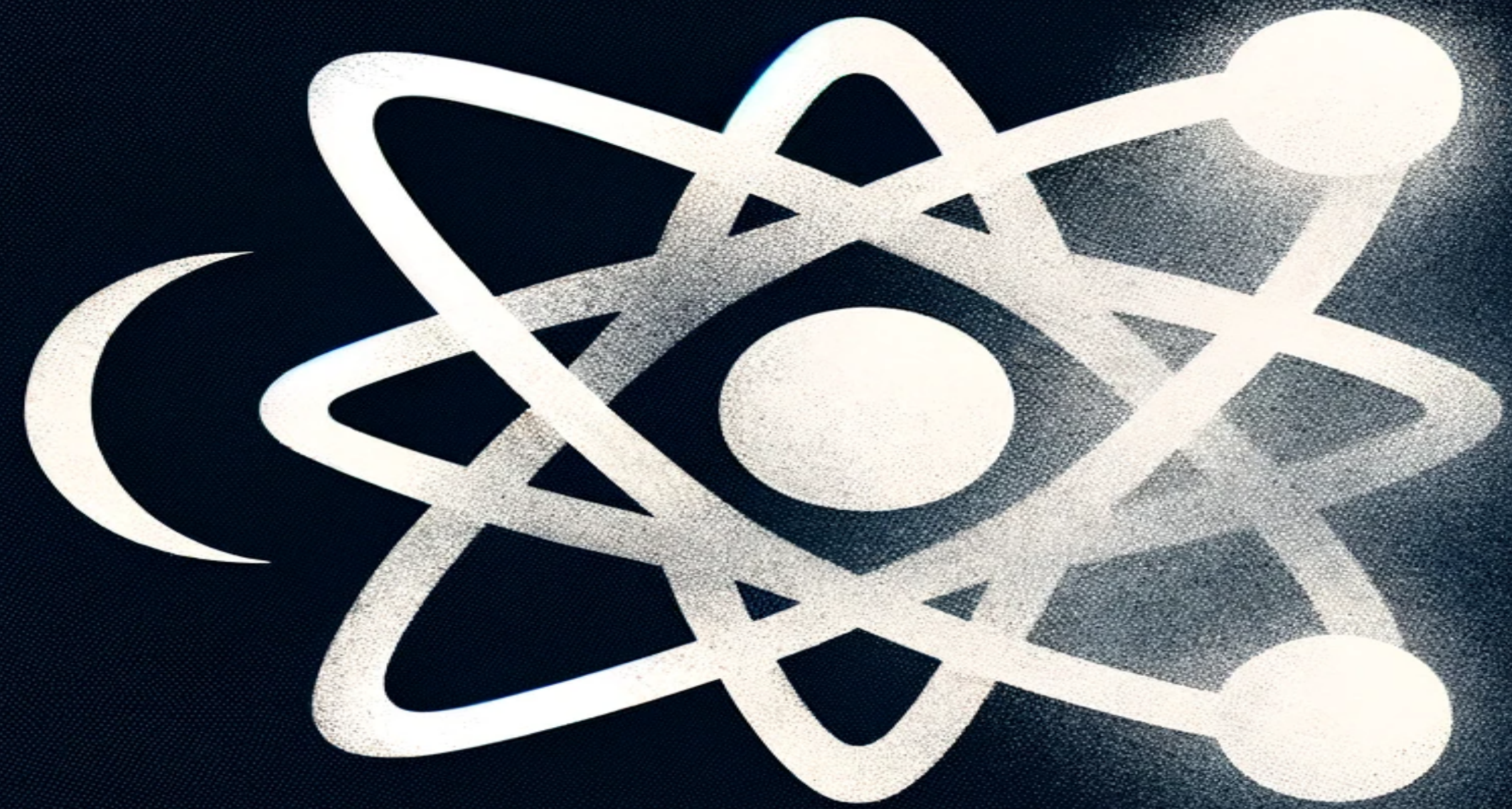


Philosophy of Science I

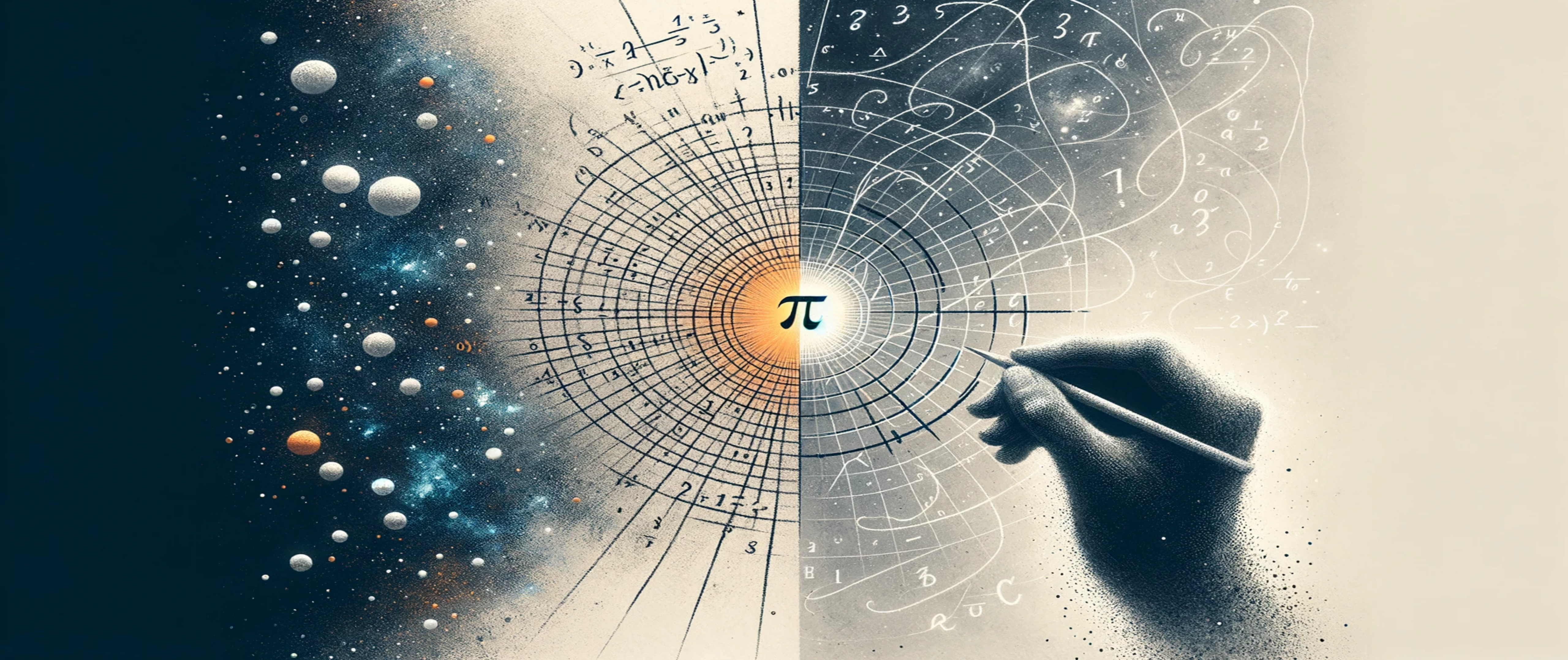
26th January 2024

Session 1 - Why do we care?





Is God a scientific theory?

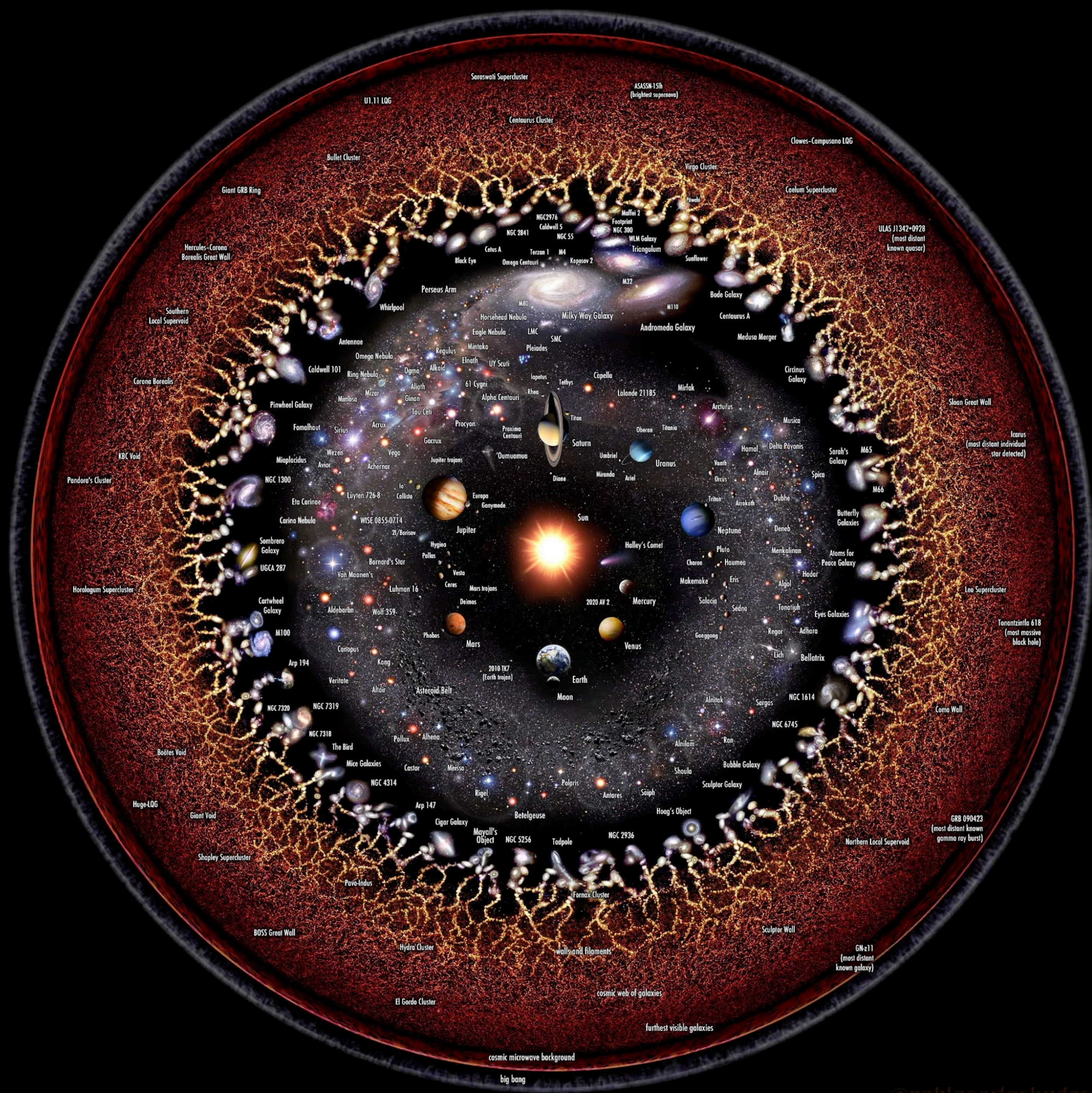


Is mathematics invented or discovered?



**Why is there something rather
than nothing?**

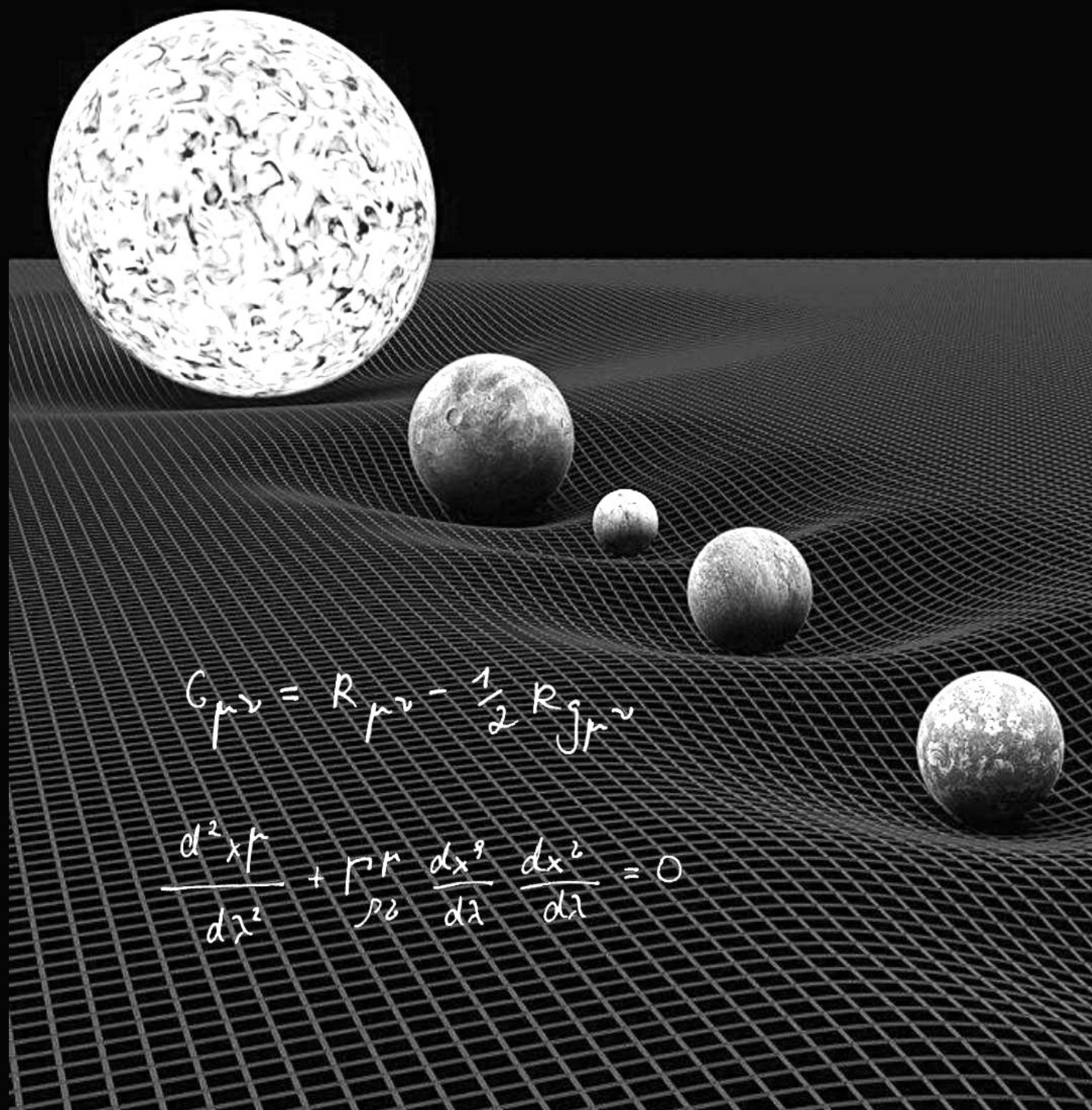
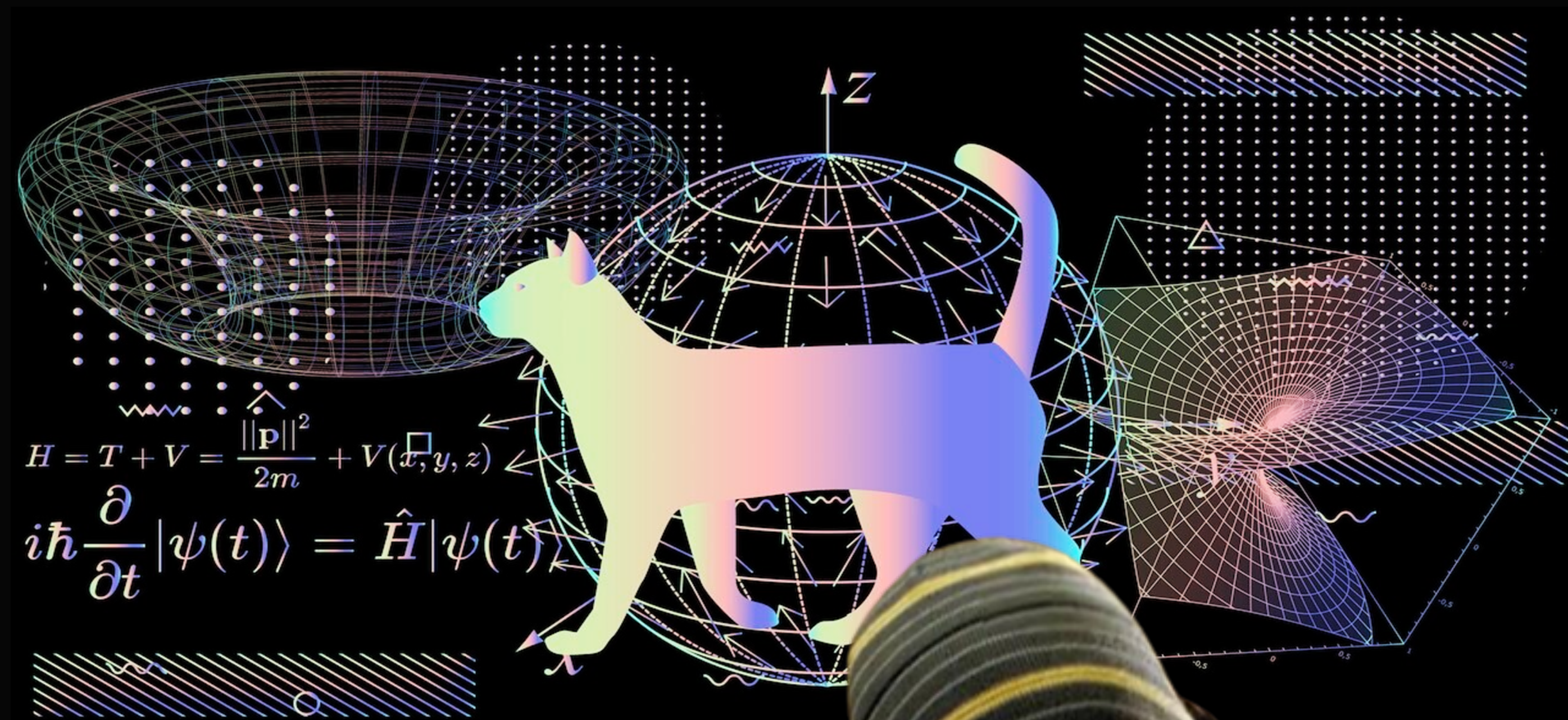
Who am I?



(Pablo Carlos Budassi)

@pablocarlosbudassi

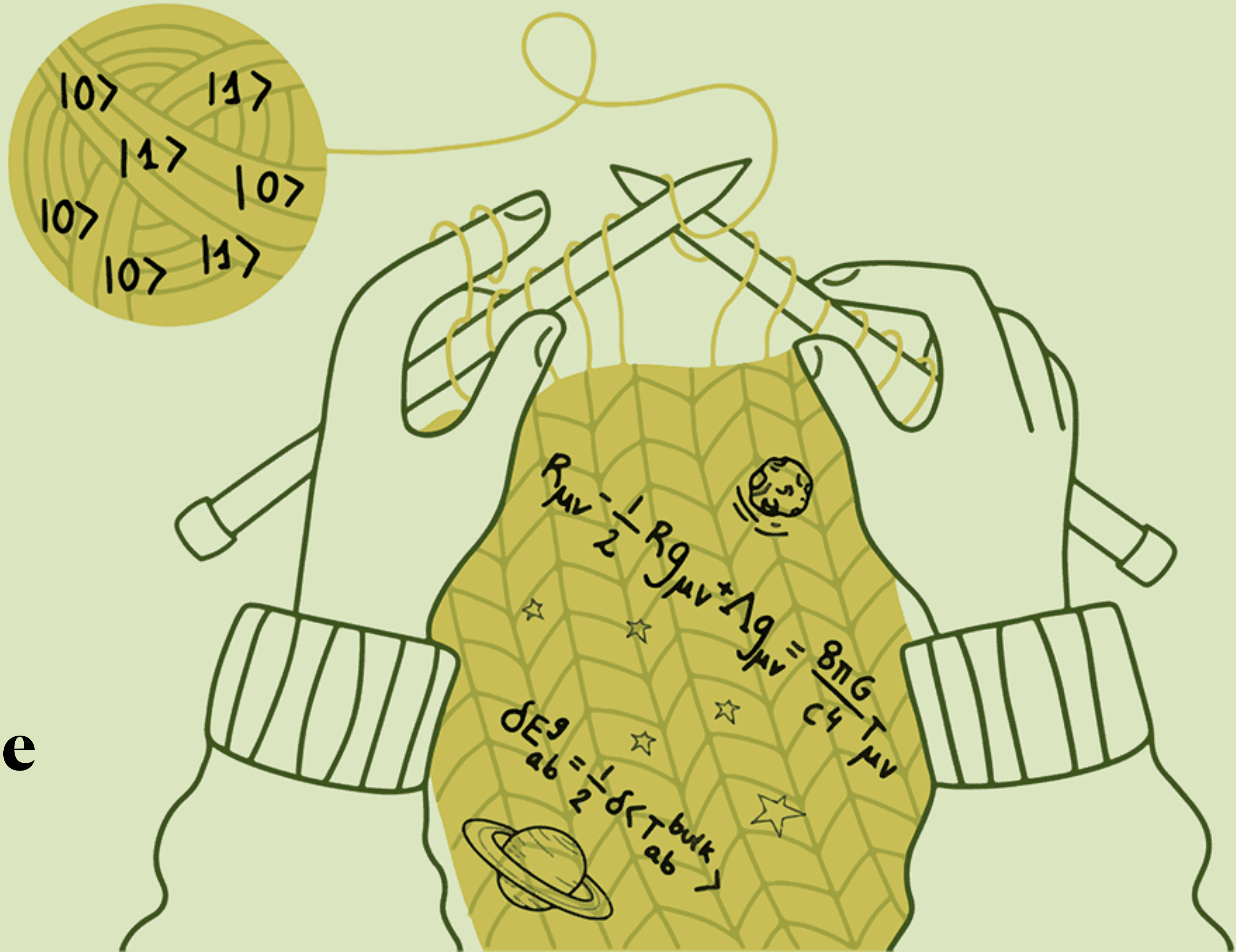
Quantum Mechanics

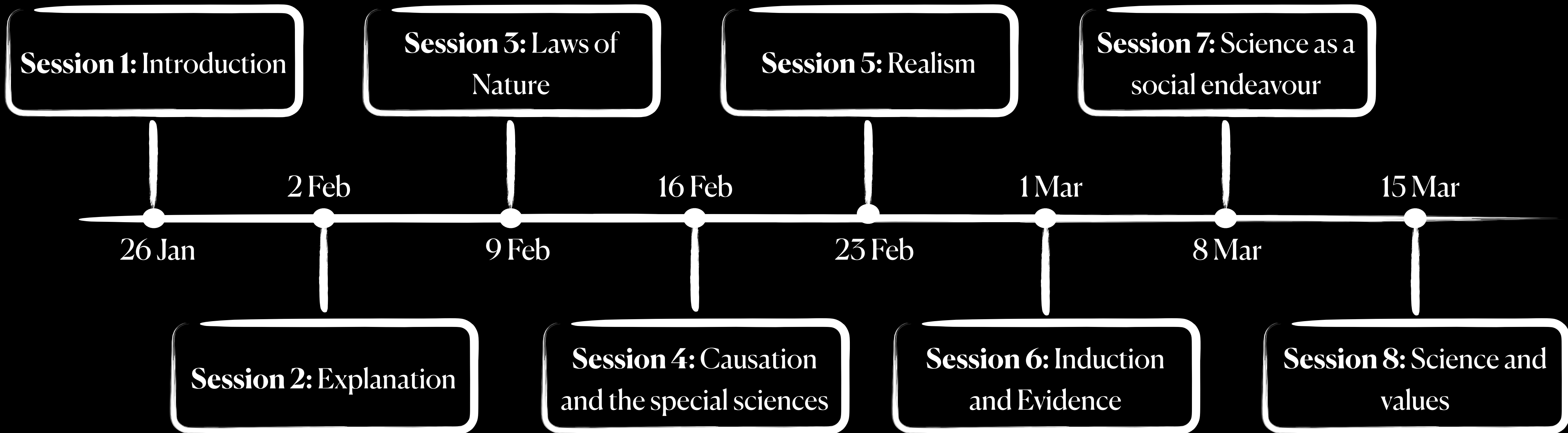


General Relativity



Is Spacetime Emergent?

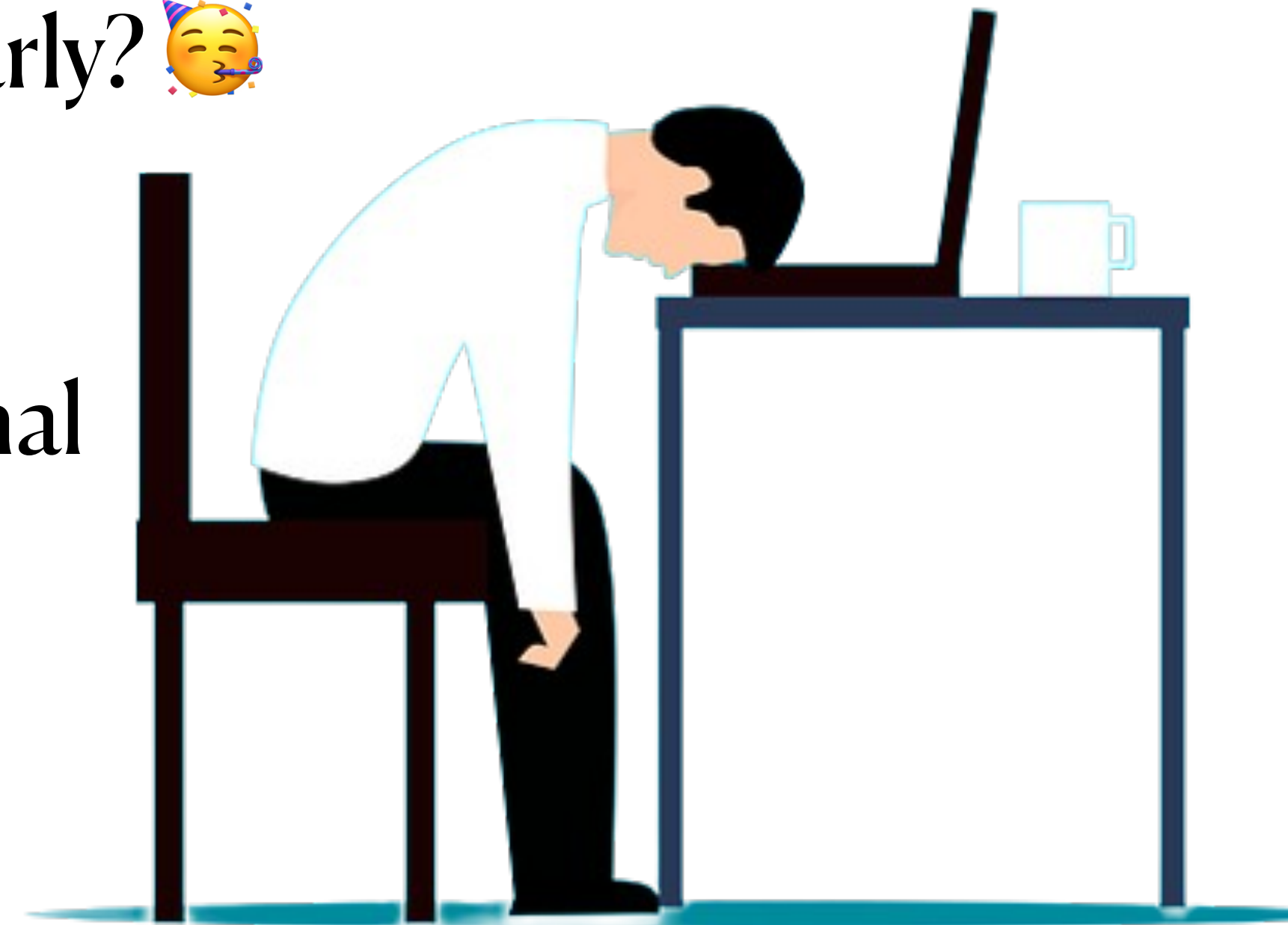




**Course
Content**

Session Structure

- 8 x 2.5 hour sessions
- Each session will be a mixture of lecture and discussion
- 15 minute break and possibly finish the session 15 mins early? 🥳
- The readings are drawn from Rosenberg and McIntyre's *Philosophy of Science: A Contemporary Introduction* + additional readings (SEP and research papers)



Preparation

- This course is 50% of full time study, so spend time outside of class preparing for the lectures
 - Read the required texts before our meetings (mainly chapter from the textbook, but for some sessions the required articles)
 - It is encouraged that you read the optional readings as well, especially for the topics you choose to write on
- Reading philosophy can be **HARD**
 - Don't be discouraged if you don't understand it all on the first reading. Try to take notes as you go
 - Revisit some, or all, of the chapters a second time to ensure that you have understood the material
- To prepare for the class discussion you should reflect on what you've read. Ask yourself:
 - Could I reconstruct the argument in the text? Do I agree/disagree with the conclusion, and why?
 - How might the proposed positions apply to a novel example?
- Come to class with at least one question you'd like to clarify/discuss



Setting up expectations...

- Attendance of **at least half** of the sessions is mandatory
- Content in class v. in materials
- Participation in class: one of the best ways of **‘doing philosophy’ is through discussion**
- Class environment
- **Respect:** you may (in fact you’re encouraged to) disagree with me, the textbook, and each other, but we will make sure that discussion stays friendly
- Balance: we’ll make sure that everyone gets the chance to participate in the discussions (e.g. everyone contributes at least every other week)
- Slides before/after class
- Feedback



“Don’t worry, the expectations are the same as ever ... only completely different.”

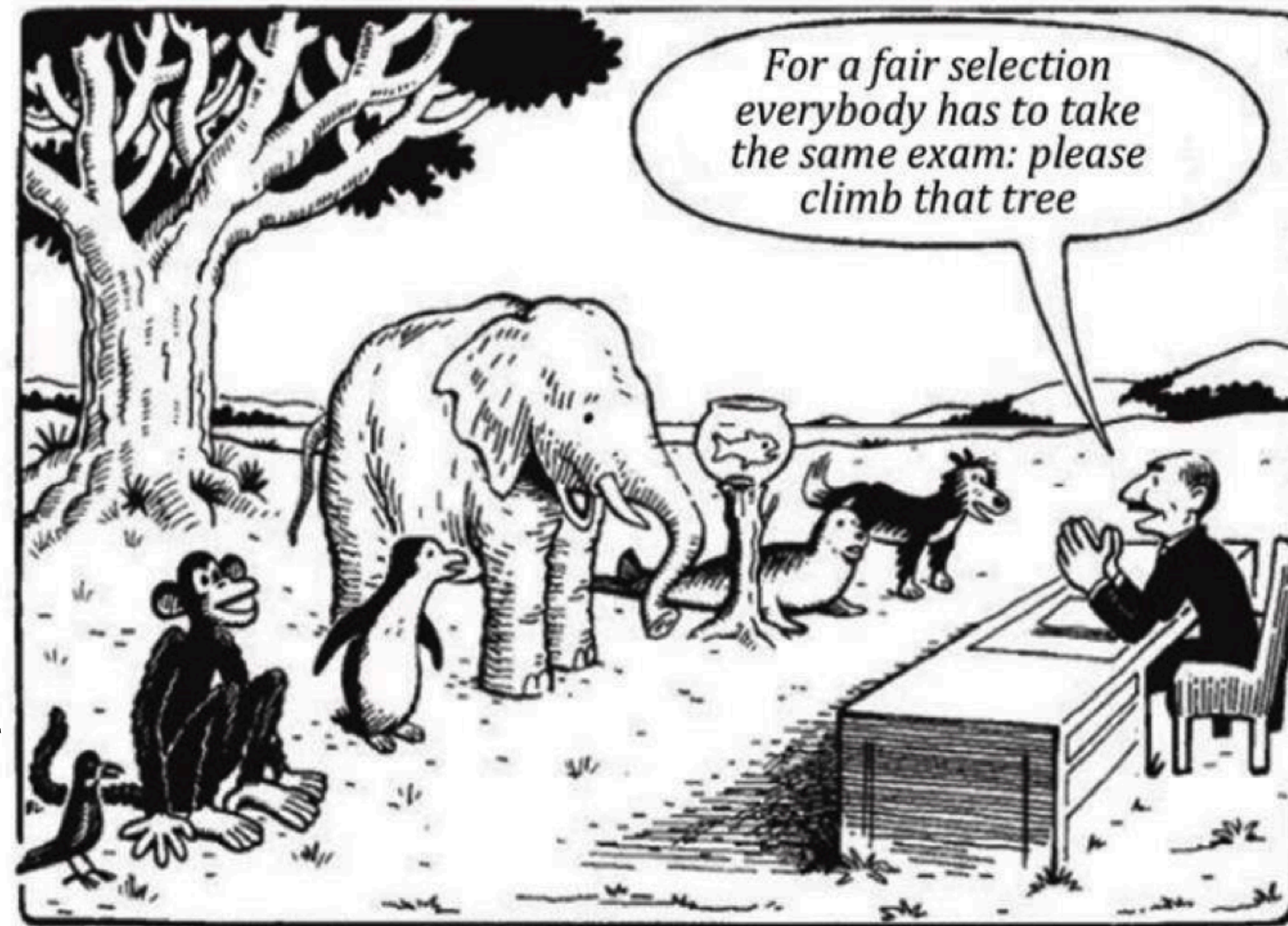
Assessment

- There will be **two writing assignments** for this course

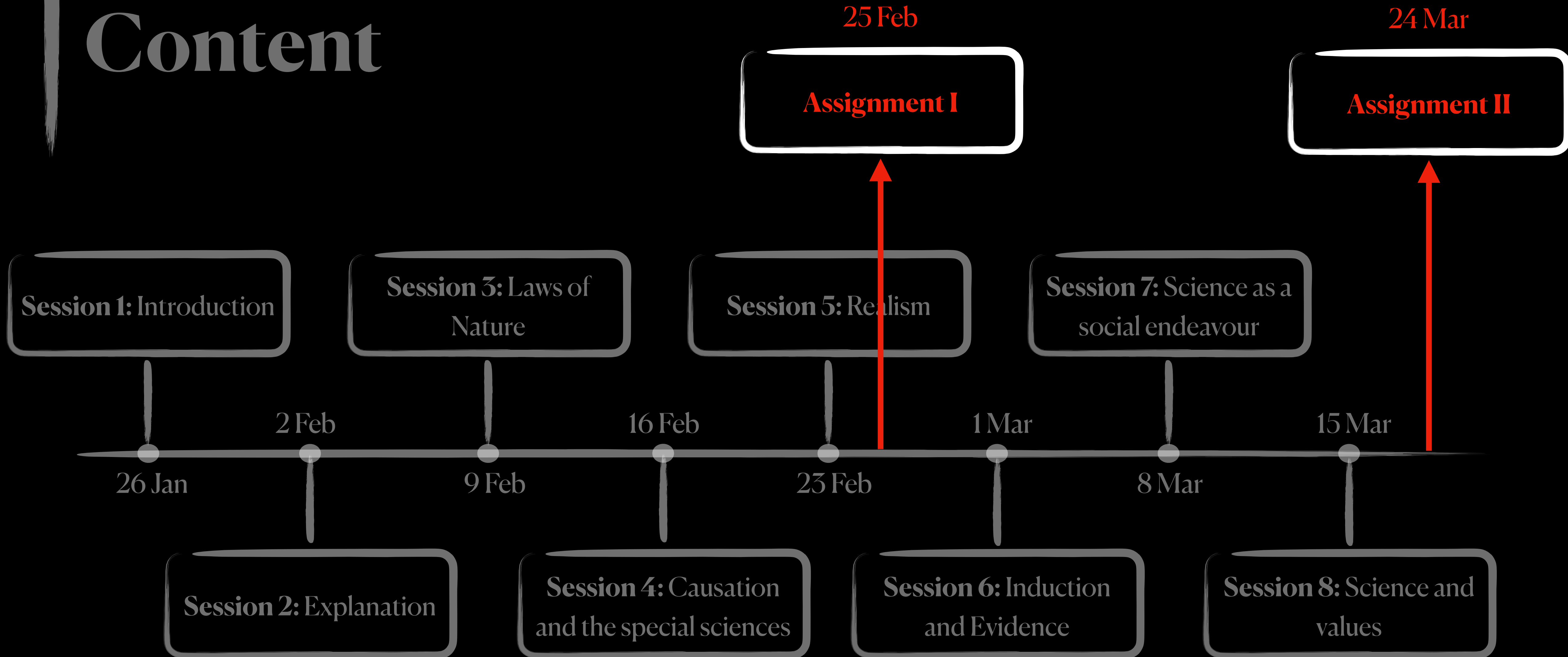
- The first will focus on argument reconstruction
- The second will require original argumentation in context of a debate in philosophy of science

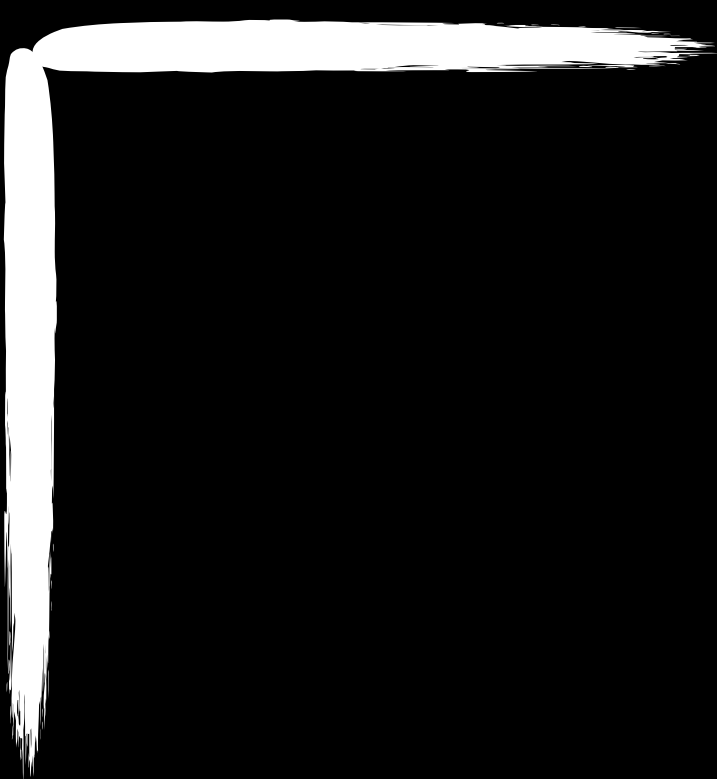
- More information about grading criteria later. For now:

- Each assignment will be graded on a 1-5 scale
- At least a 1 is required on both to pass the course
- The overall course grade will be determined by the sum of the two individual assignments



Course Content



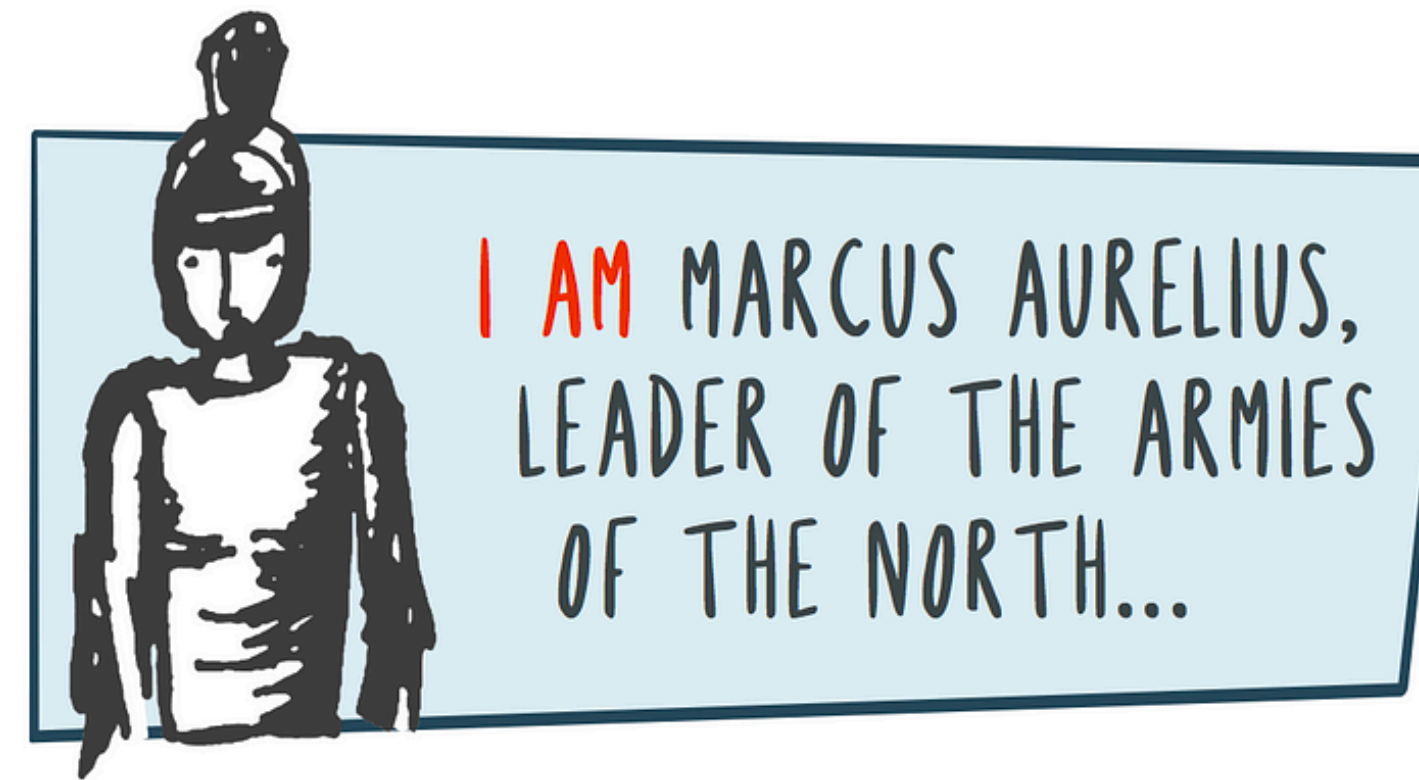


Questions?

WAYS OF INTRODUCING YOURSELF...

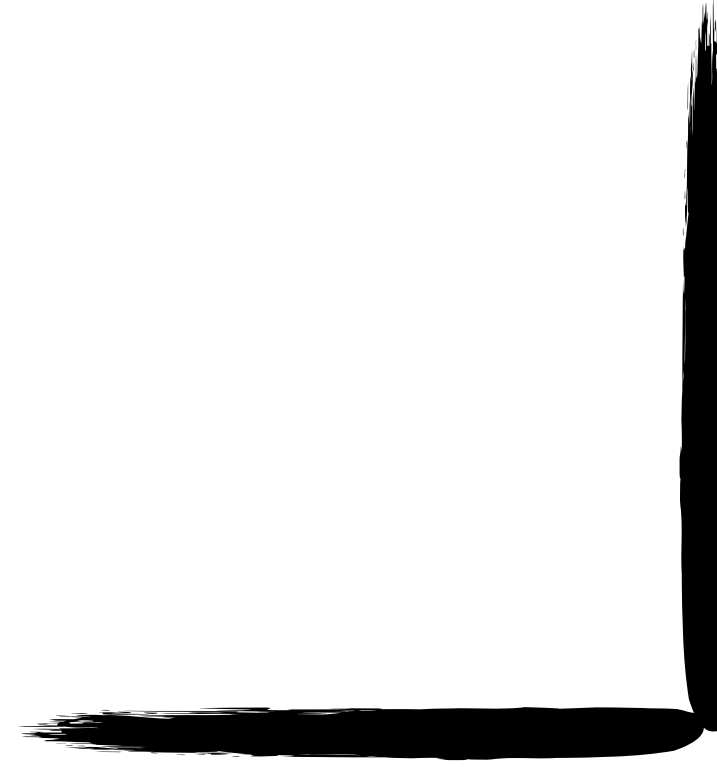
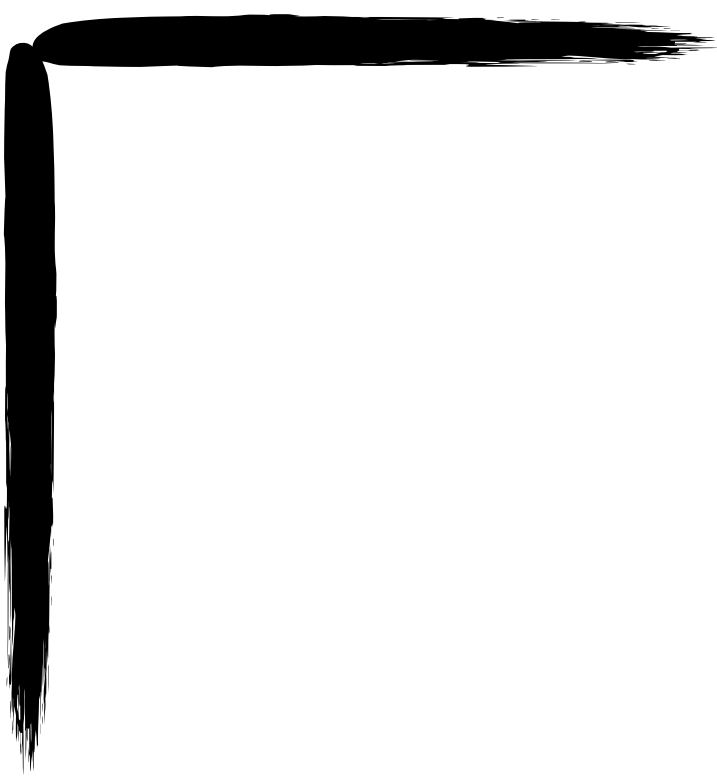
Who are you?

- Name
- Major
- Reason for taking this class
- Previous experience of philosophy

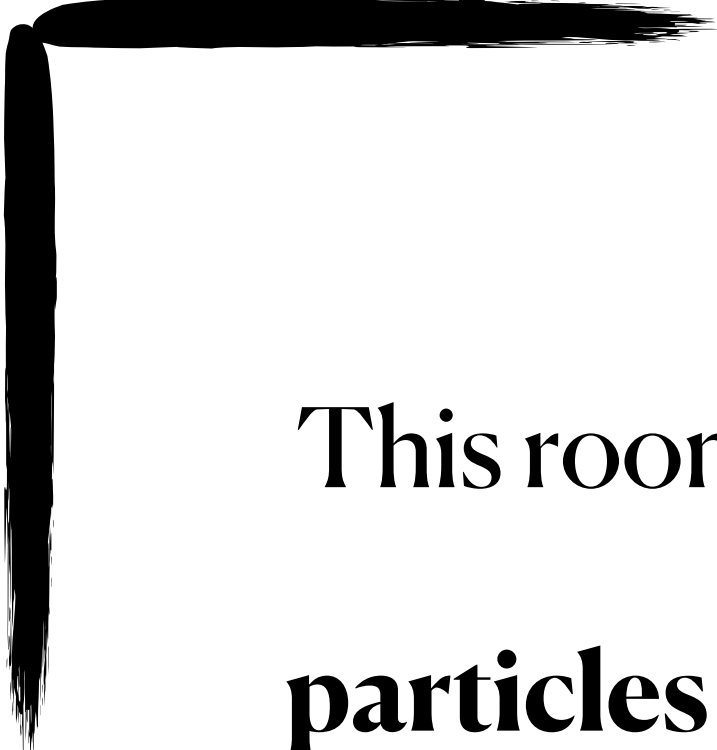


@bryanMMathers

Introduce yourself to your neighbour. After this, you'll introduce each other to the rest of the class.



Why do we care?



This room is filled with **quantum fields**. And each of these fields' excitations give rise to a plethora of **particles** that are bouncing against each other in a myriad of ways, creating all the **structures** we have around us. Some of these structures are solid as **tables and chairs**, while others are ethereal as the **electromagnetic fields** that are sewing together all our devices as a piece of fabric that joins antennas and satellites to dress the world. Perhaps still, the most interesting structures are the ones that are self-sustaining, self-propagating, self-referential, the ones which are **alive**. Among them, **us**. To remain alive, each and every one of us is currently consuming almost **10 liters of air per minute**, while our hearts beat dozens of times to distribute **oxygen** throughout our bodies to sustain our **homeostatic state**. Our bodies scramble all sort of **chemical compounds** while its constituents, the fundamental particles, **remain the same**.

While doing so, in our **brains** all the input information available in the world, most of which mapped and claimed as understood by us, is rendered into **unfathomable subjective experiences** through the exchange of chemical and electrical impulses by our **neurons**. These are the sorts of experiences that impinge in the world a sense of **beauty** and **meaning**, even when we contemplate that we all are simply **star dust**, as most of the chemical elements needed for life were forged by **exploding stars**. And there are a **hundred billion stars**, each with an average of **six planets** around only in our galaxy! And there are about a **hundred billion galaxies** in the **observable Universe**! And such a vast Universe is only possible due to the existence of yet unknown forms of matter and energy such as **dark matter** and **dark energy**.

The world is truly **absurd**!

Yet, somehow, this absurdity seems to fit in a paragraph, and can be discussed in this very room, by entities made of all this stuff. How is that possible? And how come have we been successful so far?

This is what philosophy of science is all about.

What is Philosophy?

“Philosophy deals with questions that the sciences cannot yet, or **ever**, address, and why that is the case.”

Q: What would be examples of such questions?

Q: Examples that used to be as such and became scientific?

Q: "Philosophy of Gaps"?



Natural Philosophy

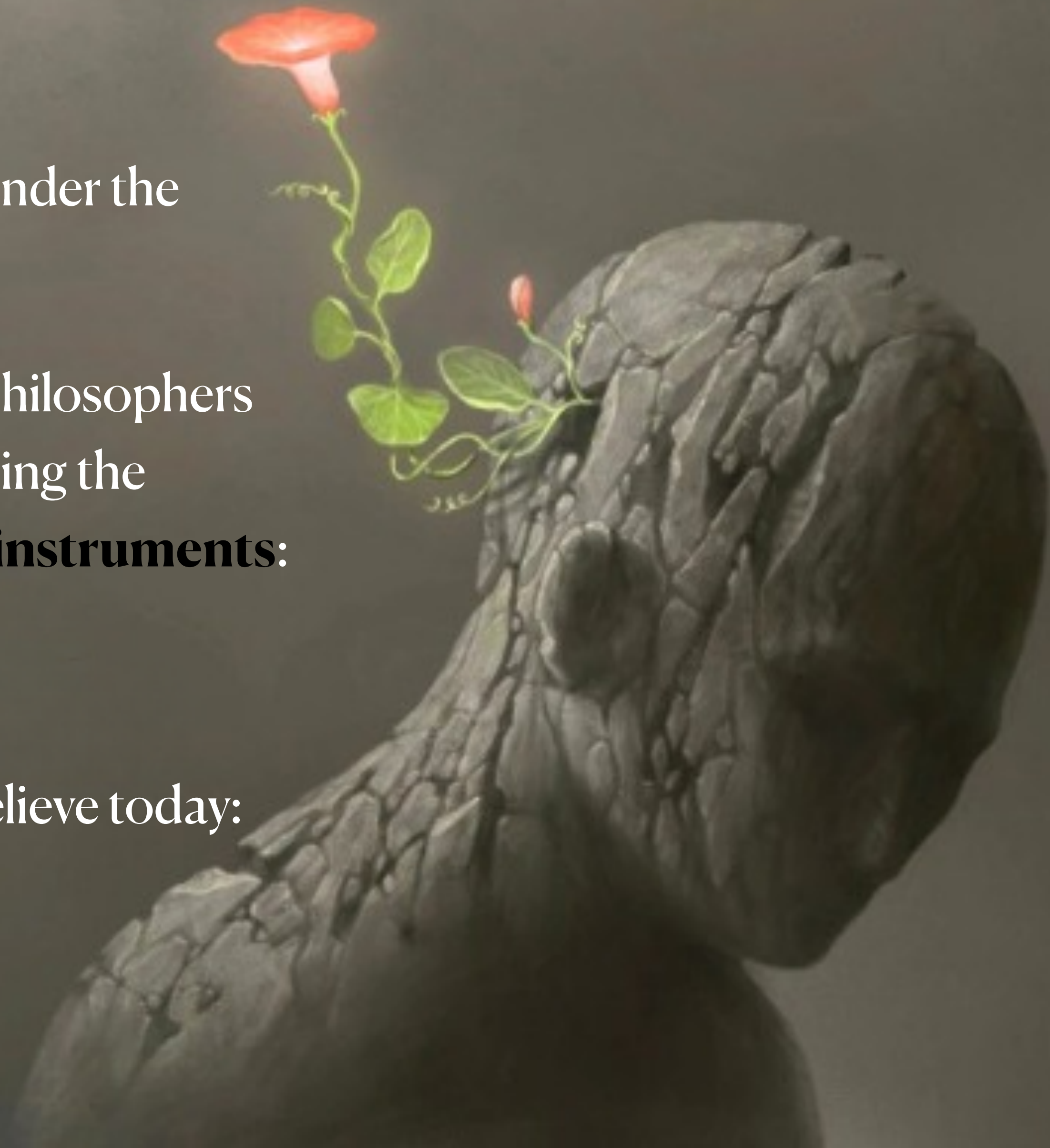
Modern science began to take shape in the 16th Century under the heading of 'natural philosophy'.

During the Scientific Revolution (1543 - c.1700), natural philosophers developed systemic knowledge about the world by emphasising the importance of **experiments** and the development of **novel instruments**:

- Telescopes, vacuum chambers, dissections, etc.

And they developed theories that we (to some extent) still believe today:

- Heliocentric, Newton's laws of mechanics, etc.



"Every science is a **child of philosophy**.
Each eventually moves out, but ends up
leaving 'baggage' at home."



BIOLOGY (1859)
Charles Darwin -
On the origin of species

SOCIOLOGY (1842)
Auguste Comte-
Cours de philosophie positive

ECONOMICS (1776)
Adam Smith-
The wealth of nations

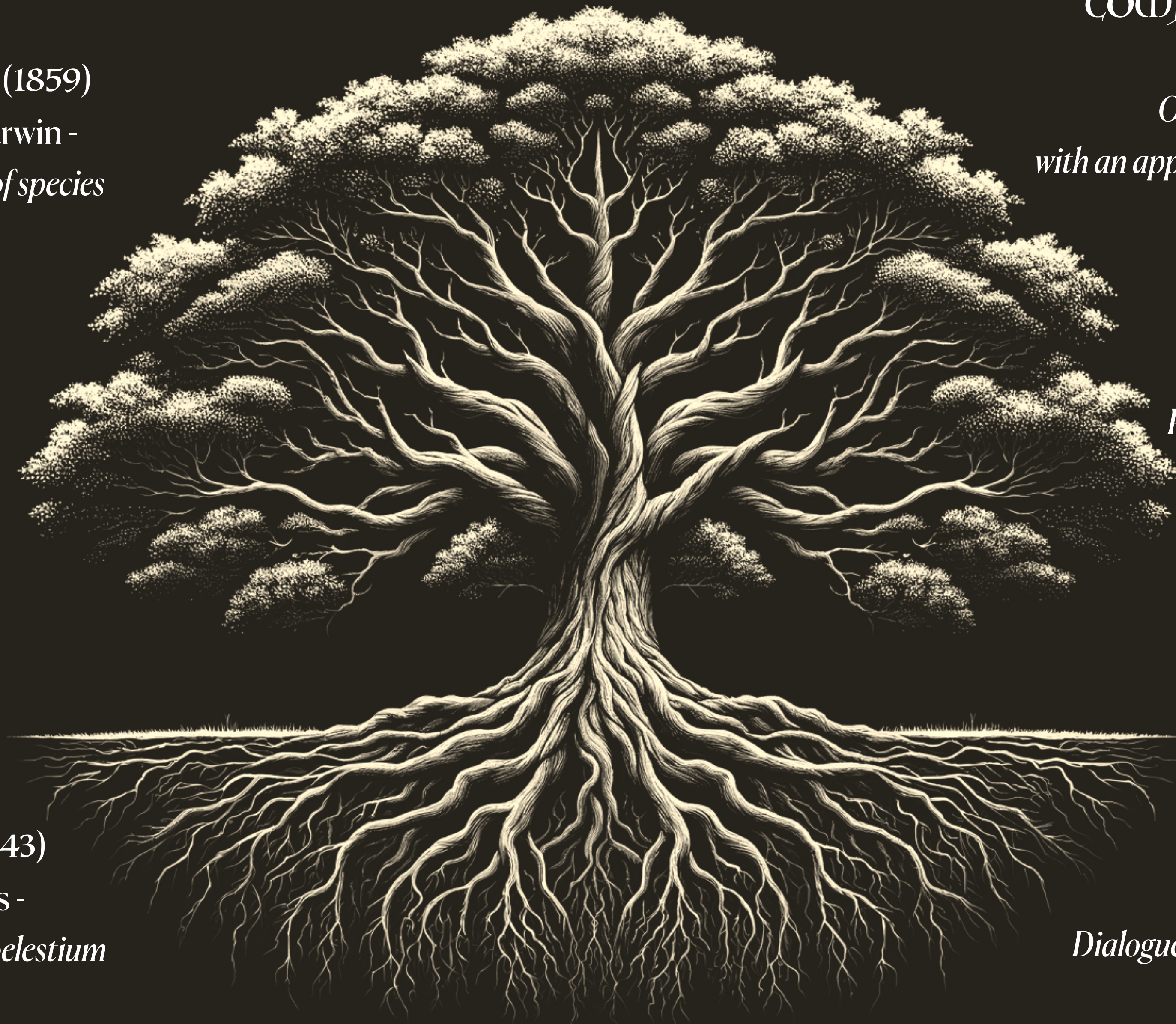
ASTRONOMY (1543)
Nicolas Copernicus -
De revolutionibus orbium coelestium

COMPUTER SCIENCE (1936)
Alan Turing-
*On computable numbers,
with an application to entscheidungsproblem*

PSYCHOLOGY (1874)
Wilhelm Wundt-
Principle of Physiological Psychology

CHEMISTRY (1789)
Antonie Lavoisier -
Traité Élémentaire de Chimie

PHYSICS (1638)
Galileo Galilei -
Dialogues concerning two new sciences



PHILOSOPHY

Q: What is missing?

The beginning of Philosophy of Science

The natural philosophers in this period (e.g. Galileo, Bacon, Descartes, Newton, du Châtelet, etc.) spent time experimenting, theorizing, measuring, and so on.

But they also spent time reflecting on their methods, asking themselves why they thought engaging in these practices was the best way to proceed in learning about the world.

Of course they didn't distinguish between 'scientific' and 'philosophical' questions: it may be more useful to see their thought as part of a complete package.



What lies beyond Science?

- Unavoidable **gap between norms and descriptions**. Science seems to concern only with the descriptions
- Science uses logical reasoning, deductive and inductive arguments. But why are they reliable? Science seems to justify their use by simply making use of them, thus **begging the question!**

Q: Could science inform our norms?



MIND THE GAP

Gedanken experiment:

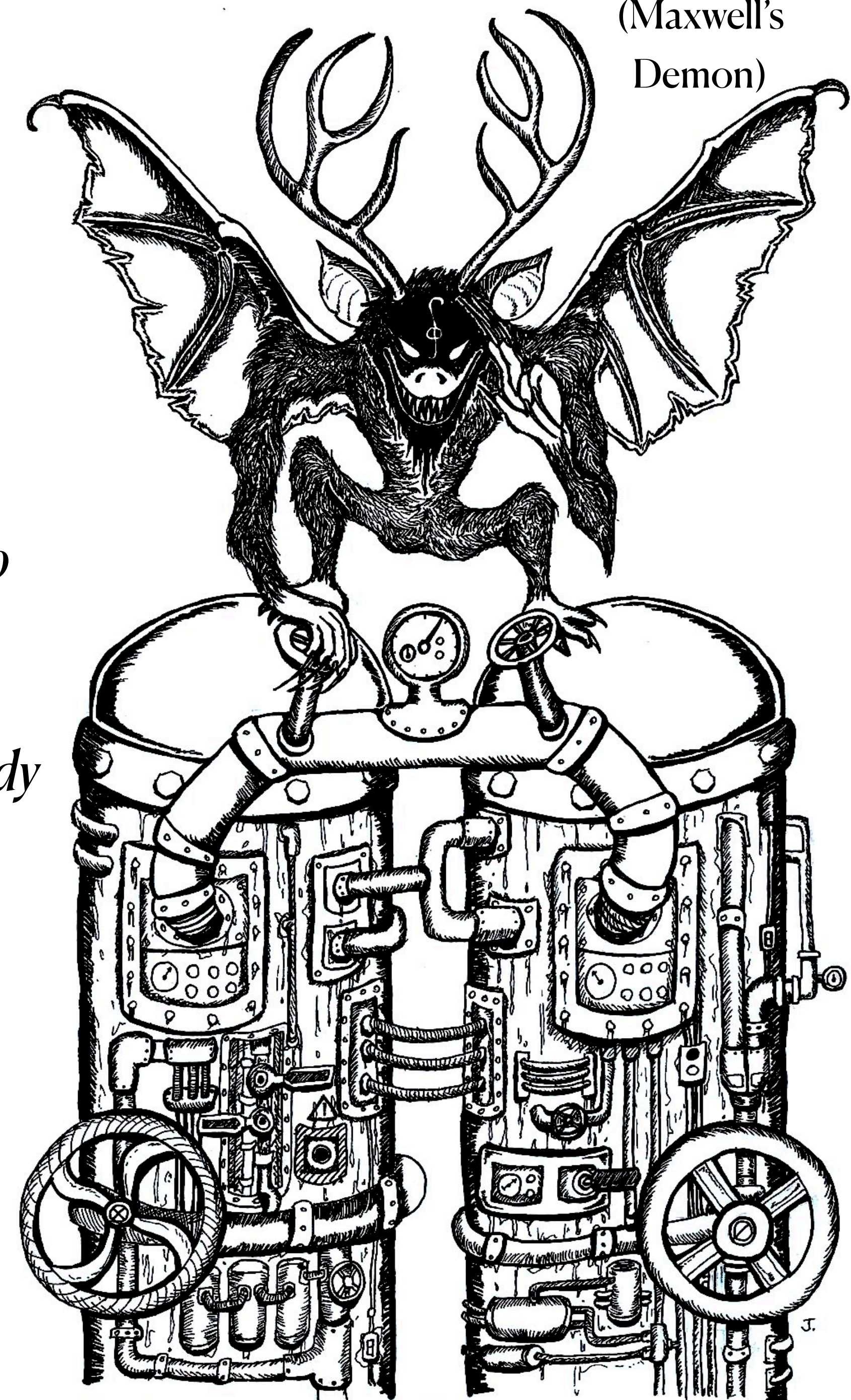
The end of Science = the end of Philosophy?

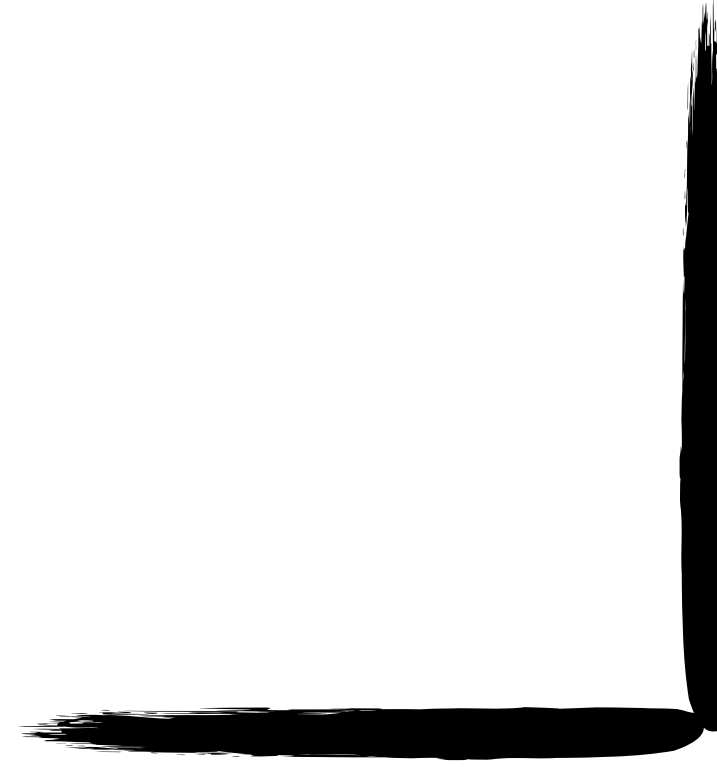
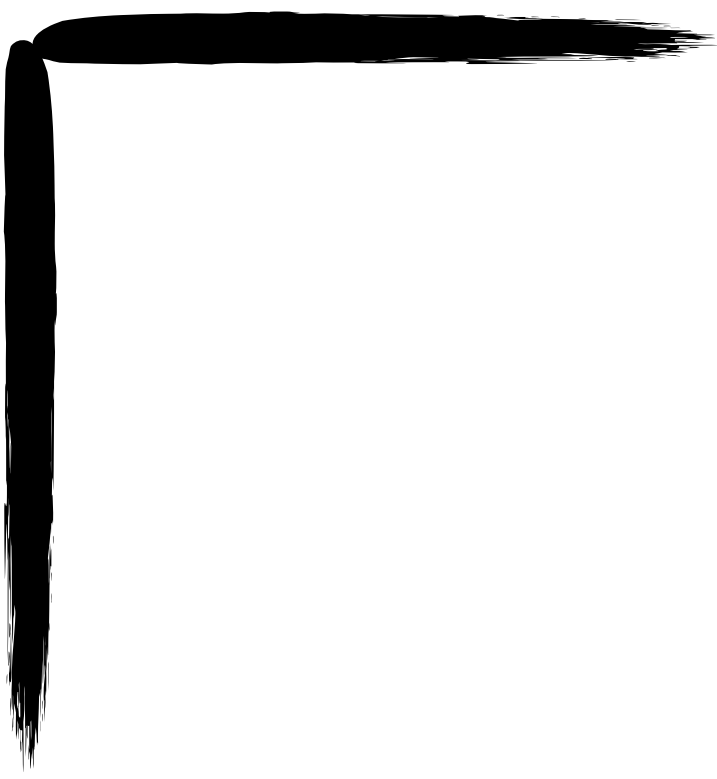
*"Imagine a god-like creature that could collect **all the information in the Universe**.*

*After processing it all, it would spell out the **ultimate laws ruling the world**. So far, so good. However, as these laws would account for all the possible different physical regimes, they would not be able to predict any new phenomena that were not already taken into account for their own derivation. Therefore, they would fail our most immediate, naive empirical expectations surrounding the development of new theories that are in place right now: testing theories in new regimes.*

These laws would be about fitting, not predicting.

(Maxwell's
Demon)





What is the sound of
red?



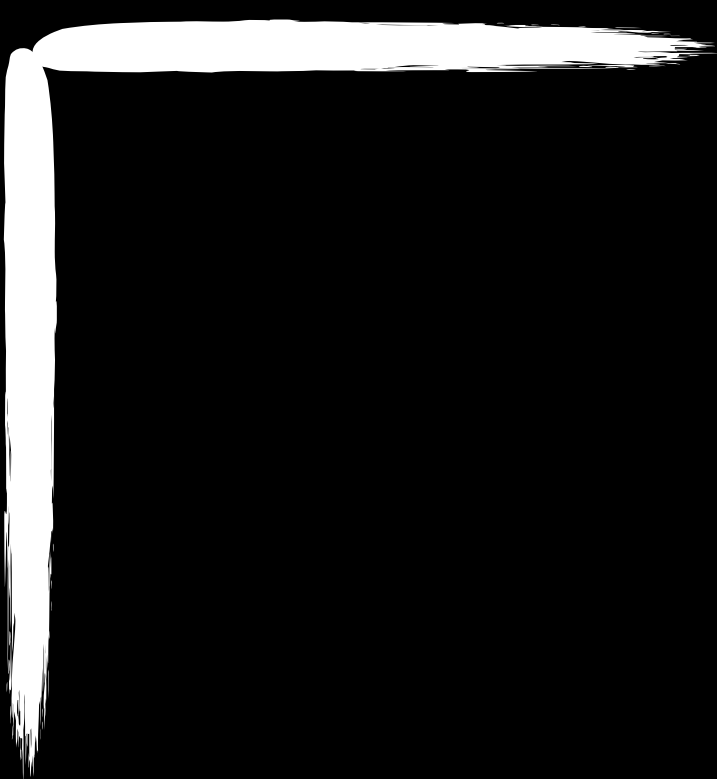
Some questions have been around since ever:

- **What's a number?**
- **What is time?**

Q: Others?

Are these **unanswerable questions** or **pseudo-questions**?

This very debate transcends science! It can quickly become “normative” and leading to demarcation issues about what science is about.



Questions?

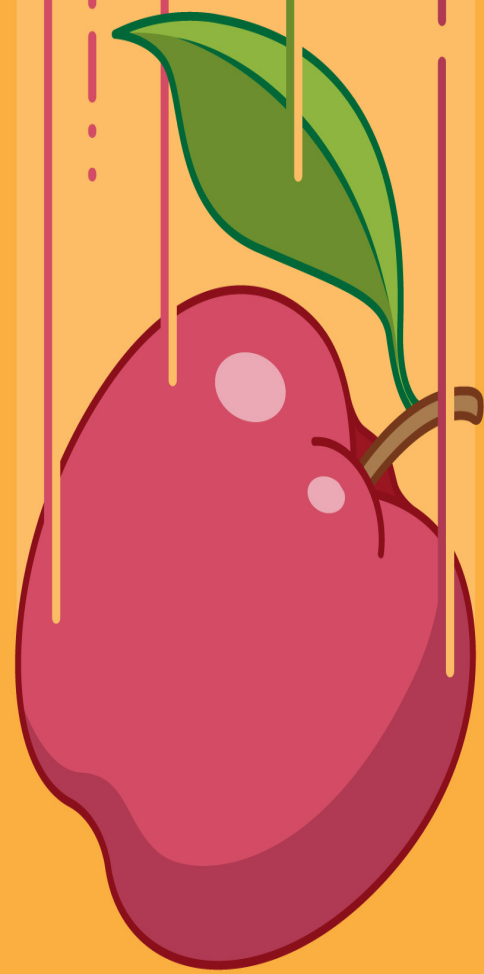
Habemus Philosophy of Science!

Since Descartes, most of the agenda of philosophy of science has been set by physics, then mathematics, and more recently life sciences. In particular, Descartes wanted to develop a physical theory deprived from purposes, e.g. non-teleological, as he was a firm believer on:

corpuscularianism: the view that the fundamental constituents of the universe were “atoms” and that all physical processes resulted from their interactions.

Q: What are the issues with this view?

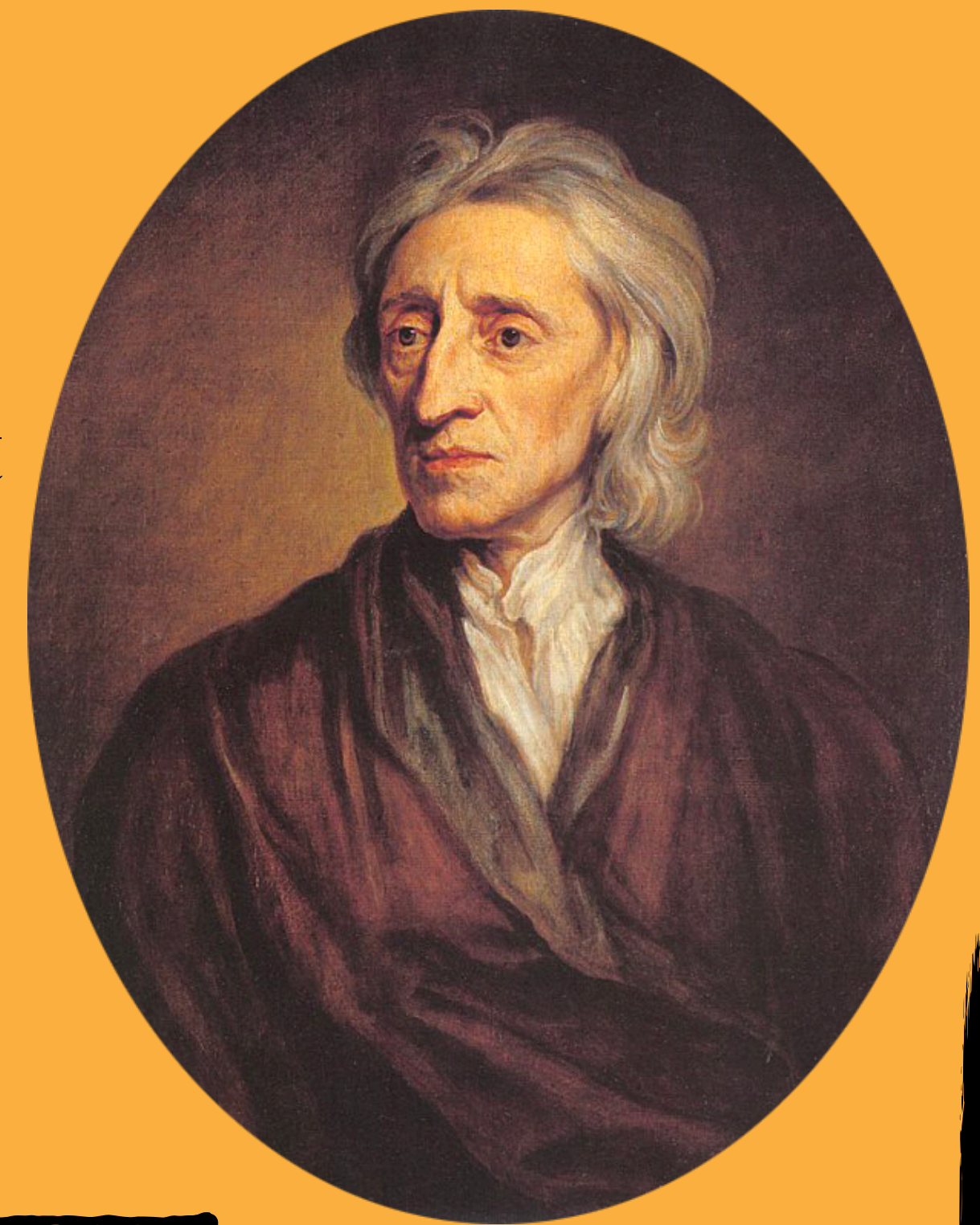




His views were challenged by gravity, that seemed to be transmitted at infinite speeds through nothing. Moreover, how could anyone have knowledge of these atoms **if we cannot observe them?**

For people like Locke, for instance, that wasn't an issue, as he posited that even our subjective experiences were coming from these atoms, even though they themselves didn't have properties such as taste, texture, etc.

This was known as **representative realism**.



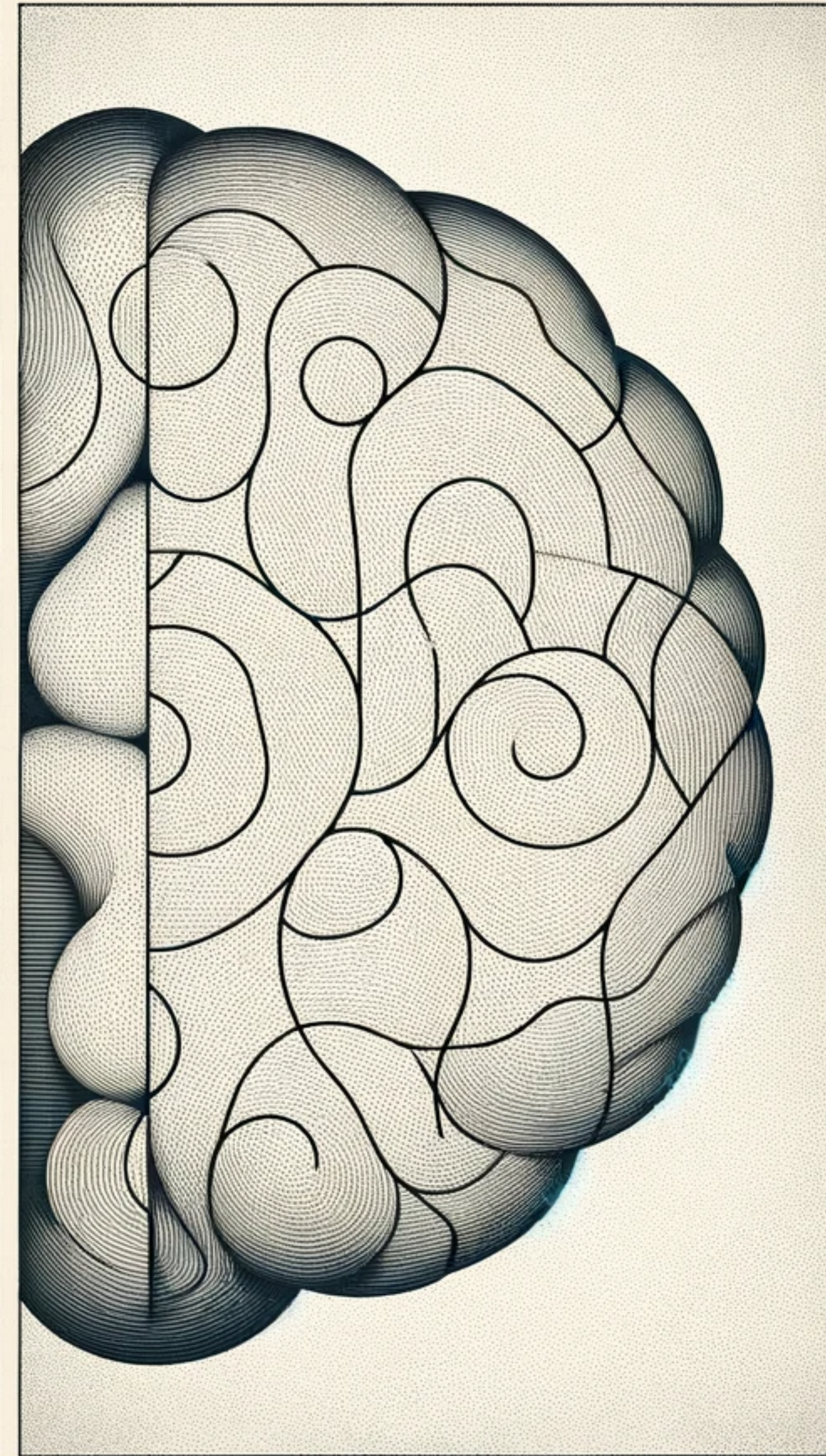
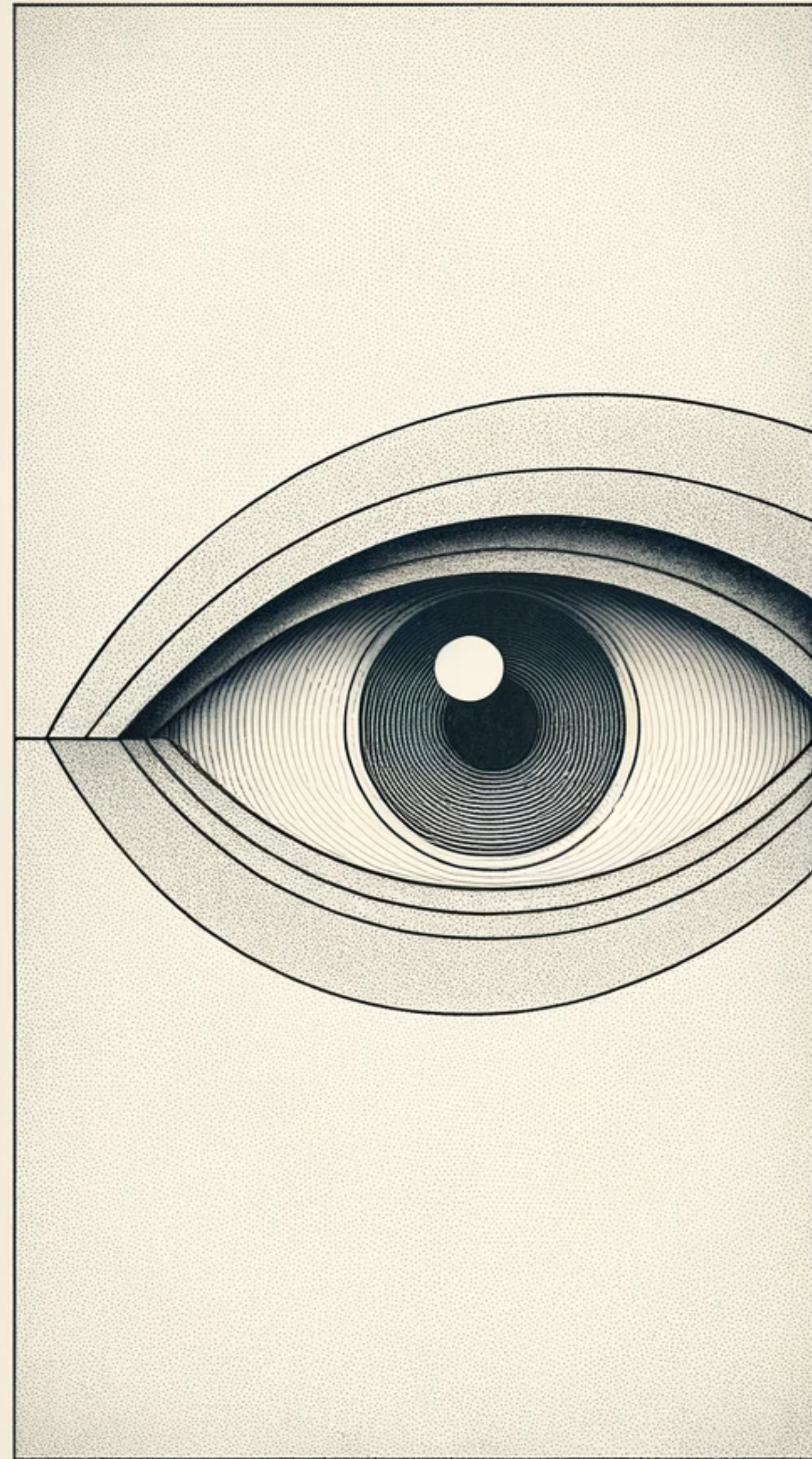
Q: How would that be possible? Is it possible today?

It was a reaction to this idea that led philosophers and scientists towards the two main currents of epistemology we will study in this course:

Empiricism: **all** of our beliefs about the nature of things are justified by experience, observation, the collection of data, and experiments

Rationalism: *at least some* (usually central, important) of our beliefs about the nature of things are justified in some other way

**Q: Who identifies as a rationalist?
Who identifies as an empiricist? Why?**





**Q: Is science supposed to tell us how or why
things are the way they are?**

It didn't take long for people, like Berkeley, to realize the difficulty of the problem and to shift perspective to treat physical theories not as a knowledge of reality, but as a set of **instruments**.



On the other camp, **scientific realism** was being born with Leibniz and Kant, who argue that Newton's laws were so predictive that they couldn't be shorter than truth. At the same time, both had to resort to rationalism as they knew that experience alone couldn't ever establish **the laws** **necessity** let alone **their universality**.



<i>A posteriori</i> (beliefs justified by experience)	<i>A priori</i> (justified some other way)
e.g. the sky is blue today	e.g. mathematical statements ($2+2=4$)

Synthetic Truths (true statements due facts of the world)	Analytic Truths (due to their meaning)
e.g. there are 30 students in this course	e.g. every effect has a cause

Q: Are physical laws analytic or synthetic?

<i>A posteriori</i> (beliefs justified by experience)	<i>A priori</i> (justified some other way)
e.g. the sky is blue today	e.g. mathematical statements ($2+2=4$)

Synthetic Truths (true statements due facts of the world)	Analytic Truths (due to their meaning)
e.g. there are 30 students in this course	e.g. every effect has a cause

Although Kant made a compelling case for the *aprioriness*, later on we did find out that Newtonian mechanics was not necessary and not universal, and that was obtained through experience.



Around the same time as Kant, **David Hume** was an empiricist and argued that scientific laws are not necessary truths, just because we can only justify them on the basis of experience. In fact, he also posited that **a priori = analytic** and **a posterior = synthetic**. For Hume, math was simply definitions and their logical consequences, while scientific hypothesis cannot ever be seen as necessary as experience cannot establish that.

Modern Times!

Two main changes:

- formalization of logic and establishing the validity of syllogisms (certain mathematical knowledge is analytic)
- discovery of special and general theories of relativity (inspired by philosophical considerations – Einstein's empirical approach to length and time à la Hume).

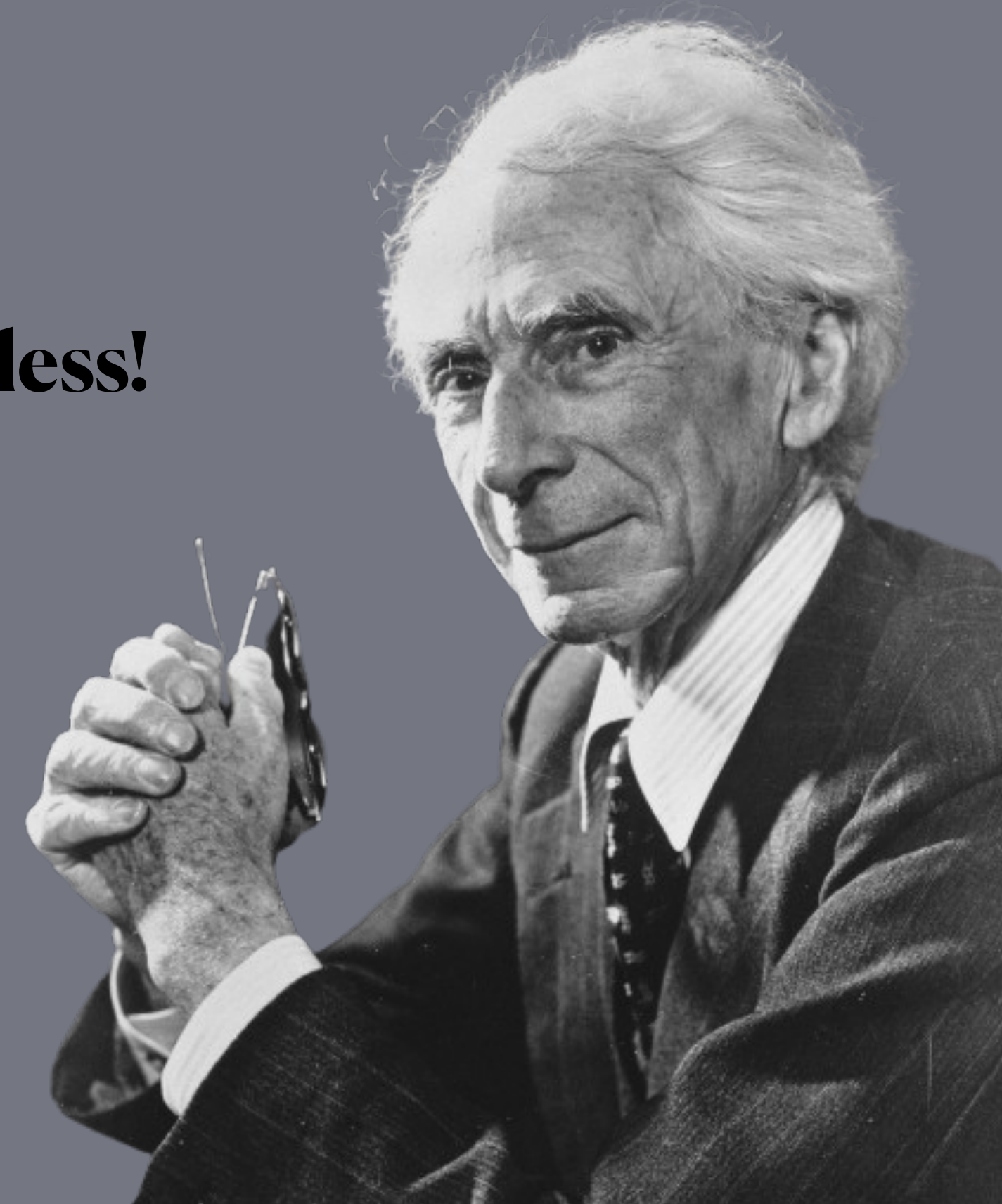
Both gave rise to **logical positivism/empiricism**: philosophy connected to science. The Vienna circle mostly represented such current of thought.



They would deny that once science was over there would be anything but pseudo-questions left. Their argument was based on two principles: principle of verification – a set of concepts had to take part in a statement that made a specific testable claim about experience to be scientifically intelligible, and that the claims of logic and mathematics were not testable but not meaningless either.

If a statement is neither, then it is not even wrong, it's meaningless!

That allowed them to take philosophy's role as to provide clear definitions and logical rules that would enable everyone to see why only science had cognitive significance.



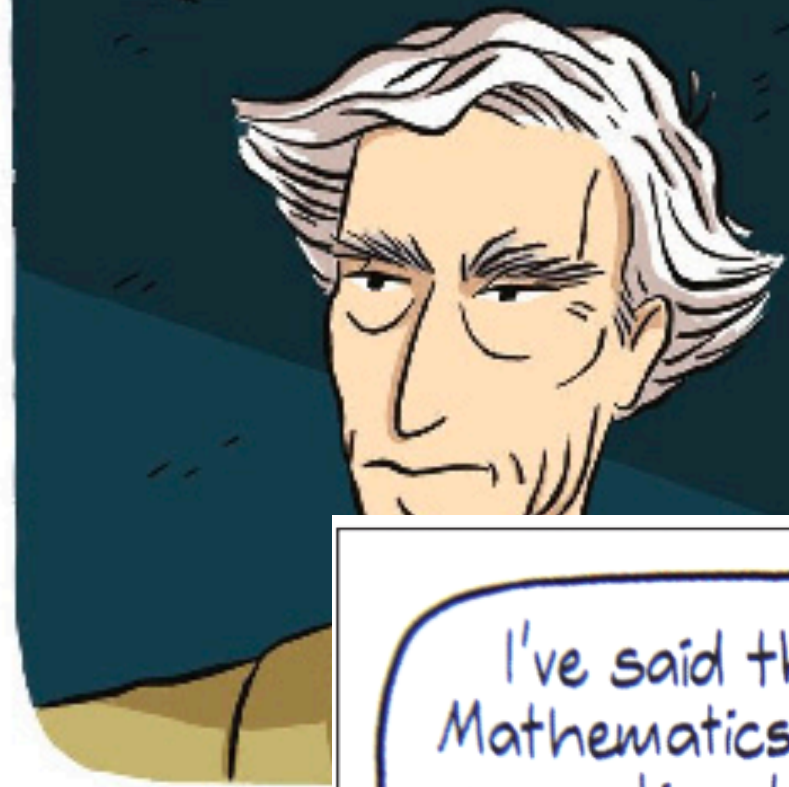
LOGICOMIX



AN EPIC SEARCH FOR TRUTH

APOSTOLOS DOXIADIS, CHRISTOS N. PAPADIMITRIOU,
ALECOS PAPADATOS, AND ANNIE DI BONNA

In those years, I was often accompanied by extreme inner tension.



My near-maniac passion for certain, absolute knowledge...



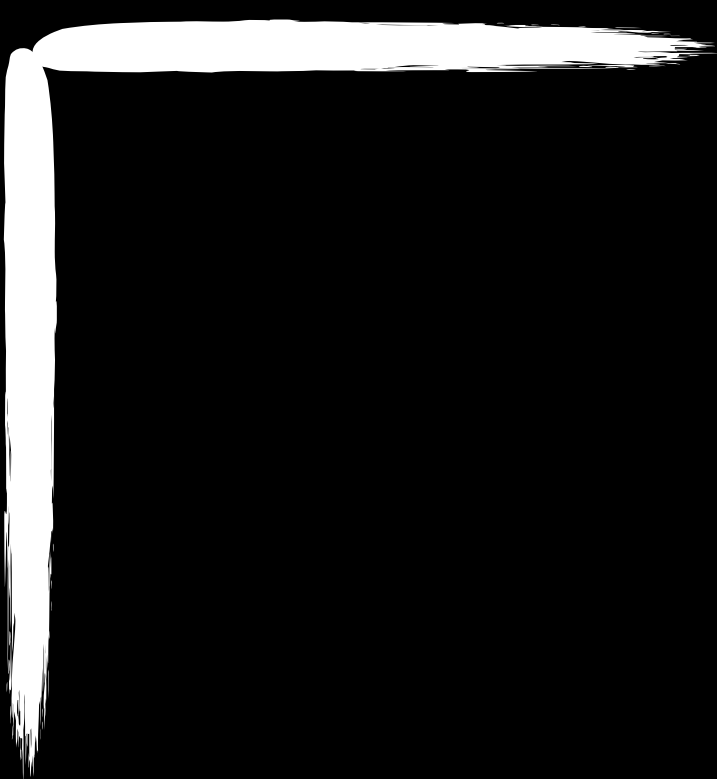
... Was doubtless made more intense by loneliness.



I've said that the Foundations of Mathematics were like a mythical turtle supporting the Cosmos. Yet, all we did when we tried to create solid ground for the beast to stand on... was...



...A tower of "turtles", all the way down!



Questions?

Next Time (Feb 2nd) - Explanation

To read (all on Athena):

- Rosenberg & McIntyre) – Chapter 3
- Lloyd & Anderson – “Empiricism, Objectivity, and Explanation”
(focus on Section 1)