# Category Theory Reading Club
# 1st Season: 2026 January-February[1]

*"Whatever you think maths is … let go of it now. This is going to be different."*

— (Cheng, 2015)

## Contents



## Introduction

Can you know someone by knowing her friends? Yes, it is common wisdom that persons are more or less defined by their relationships with others. But did you know that there is a famous mathematical result, the Yoneda Lemma, that states and proves exactly this wisdom? The lemma is part of category theory, the *mathematics of mathematics*. It is a new foundation for mathematics, computer science, physics and perhaps intelligence[2] itself.

If this theory is so cool and important, why you haven't heard about it? It is often considered to be highly inaccessible: you need to be familiar with all of mathematics before learning category theory. This reading club aims to show that this is false. With a *friendly, collaborative, no-questions-are-silly approach*, we will go through introductory material. By sharing our thought processes, we will bring the highly abstract ideas down to earth.

Heavy-weight modern mathematics can be understood in a café style social environment. (Perhaps it is the best way to learn.)

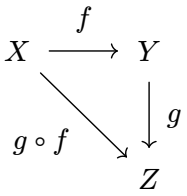
Do you want catch up with the cutting edge of mathematics? but no time for going through hundreds of years of mathematical publications? Then, this reading club might be the right place for you. Come for the shortcut, stay for the discussion.

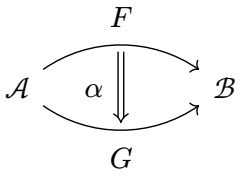
Category theory has a unique visual way of representing ideas. Only as a sampler, without any explanations, here are two simple diagrams. The left diagram represents *composition*, the right

[1] Check the Infinity Room website for up-to-date scheduling information. https://egri-nagy.github.io/infinity-room/

[2] Speaking of intelligence, we need to dispel a common misunderstanding. AIs cannot answer all mathematical questions. Even if they could, that would not diminish the need for human understanding of mathematical ideas.

one encodes the more advanced idea of *natural transformations* (again, just take in the visuals, nothing is explained here).




## Rules of joining

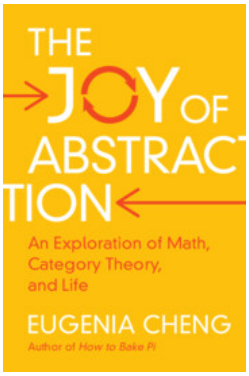
There is no membership, you can come, listen, and go anytime. No background in advanced mathematics needed.

If you want to join the discussion, we ask you a favour. You read a bit from these books and let us know how it went. Was it possible to understand? What made it difficult? As we try to make the topic accessible, your report will be a highly valued contribution.

## Recommended Reading

The literature of category theory is already vast, even if we only look at the (supposedly) introductory texts. Here is our (easy) choice.

### The main text




The best middle ground formal and informal introductions is possibly the *Joy of Abstraction* (Cheng, 2022), written in a truly friendly style, but containing serious mathematics. For the ease of finding this book, here is the cover. This is the main text for this season. It is available in the library and there is always a copy in the Infinity Room. We also have extra copies for participants.

For more background, there was a reading club at the Topos Institute, where the author herself posted explainer videos. https://topos.institute/events/joa-bookclub/

For a collection of definitions, see her lecture notes: https://egri-nagy.github.io/infinity-room/DOCS/2002_categorynotes_cheng.pdf. These notes alone, of course, are unreadable. They should be used for referencing purposes, almost like a dictionary.

### Other Books

*How to Bake Pi* (Cheng, 2015) is about recipes, baking cakes, but brings in category theoretical ideas when talking about those. It is a light read in the style of popular science books (or popular mathematics books if that category exists).

*Category Theory for Computing Science* (Barr & Wells, 1995) is a classic treatise. Since it has a computing viewpoint, it is a bit more concrete than a pure mathematics book would be. Still, it is a very thick mathematical monograph.

### Papers

(Porter et al., 2006) describes categories as a way of modelling comparison and analogy, the basic tools in science in particular, and in thinking in general.

(Mazur, 2008) is a prime example of how philosophical and mathematical writing can blend. It discusses how category theory provides a different type of foundation for mathematics.

(Spivak, 2017), written by one of the leaders of the *applied category theory* movement, offers an alternative to the usual quantitative mathematical models (e.g., differential equations), to capture ideas directly.

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For more information contact `egri-nagy` at `aiu.ac.jp`.

# Bibliography

Barr, M., & Wells, C. (1995). *Category Theory for Computing Science*. Prentice Hall. http://www.tac.mta.ca/tac/reprints/articles/22/tr22abs.html

Cheng, E. (2015). *How to Bake Pi: Easy recipes for understanding complex maths*. Profile.

Cheng, E. (2022). *The Joy of Abstraction: An Exploration of Math, Category Theory, and Life*. Cambridge University Press.

Mazur, B. (2008). When is One Thing Equal to Some Other Thing?. In B. Gold & R. A. Simons (Eds.), *Proof and Other Dilemmas: Mathematics and Philosophy* (pp. 221–242). Mathematical Association of America. https://bpb-us-e1.wpmucdn.com/sites.harvard.edu/dist/a/189/files/2023/01/When-is-one-thing-equal-to-some-other-thing.pdf

Porter, T., Brown, R., & Sica, G. (2006). Category theory: an abstract setting for analogy and comparison. In *What Is Category Theory?* (2006th ed., pp. 257–274). https://groupoids.org.uk/pdffiles/Analogy-and-Comparison.pdf

Spivak, D. I. (2017). Categories as Mathematical Models. In *Categories for the Working Philosopher: Categories for the Working Philosopher*. Oxford University Press. https://arxiv.org/abs/1409.6067

# FAQ

### *But what is category theory? Is there a short definition?*

Category theory is very abstract. Consequently, it applies to many things, therefore it is difficult to give a short but meaningful definition. This quote comes close to that.

> "*In the end, mathematics is all about finding similarities between things, and category theory is about finding similarities between mathematical things.*"
>
> — (Cheng, 2015)

For instance, numbers capture the idea that collections can be similar in having the same number of things. Two apples and two bananas – forgetting the details leads to the abstract concept of two.

Studying shapes (topological spaces) and programming languages are seemingly very different topics, but both can be done with the tools of category theory. Therefore, category theory is *a general theory of mathematical structures*.

### *Why learning about category theory?*

"What's the point?" – this is a very good question. We should be asking this more often – when doomscrolling or binge-watching low quality videos… But back to mathematics, the effects are not direct. You will never use the Adjoint Functor Theorem in everyday life. However, you use your thinking skills all the time, and working with abstract ideas sharpens your intuition.

> "*I am convinced that my years of stretching my brain in those abstract ways enabled me to think more clearly about the world around me, and more easily make connections between situations, connections that others don't see.*"
>
> — (Cheng, 2022)

The applications of category theory are numerous. Instead of listing them, just look at where DeepMind (of the AlphaGo and AlphaFold fame) is going with its research about post-LLM AIs. See paper https://arxiv.org/pdf/2402.15332 , and video https://www.youtube.com/watch?v=AWqvBdqCAAE.

However, overemphasizing usefulness could hide the real reason. We do mathematics because it's fun. People love to understand things, the aha-moments. Pay attention to the moment and emotion you experience when you understand something that was incomprehensible and obscure days before. You reprogrammed your brain and you are enjoying it. That's the real payoff.

### *"I'm not good at math, maybe I should not join. Am I right?"*

No, you are wrong. A healthy human being, by definition, is good at working with abstract ideas. You cannot use genetics as an excuse, as it is not enough to account for the differences in mathematics knowledge among people.[3] Like few centimeters difference in height can be explained easily by genetical factors. However, if you see a person of average height (let's say 172 cm) and another one who is 237 meters high, then you would conclude that something else is going on, not just that they have different parents. Similarly, when you see someone struggling with fractions and another person doing symbolic integration in head, you need to ask, why the difference? There is no trick. Doing mathematics is a **positive feedback process**. The more you do it the more you get out of it. It is similar to becoming rich, the more financial resources you have the easier to make more money. Still, no one is saying that being a billionaire is due to genetics. The same logic should apply to mathematical understanding, with a big difference. In business, at a given time the money supply is finite, so when you get more money, others should lose the same amount. In mathematics, being "rich" in mathematical knowledge does not make it more difficult for others to achieve similar richness of understanding. Through communication, we have no limits on understanding mathematical ideas. **Welcome to the Infinity Room!**

Then, why do you feel that you are not good at mathematics? Simply because *you have not started it yet.*[4]

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[3] See the book-length eloquent argument for this in *Mathematica: A Secret World of Intuition and Curiosity* by David Bessis, 2024 – available in the library! .

[4] Unfortunately, grade-driven school mathematics does not count as doing mathematics. It is more like a negative feedback process.