

Functional Programming Summary



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What is functional programming and how do we use that technology at Nubank?

Find out what is a functional paradigm, how it differs from other paradigms and how we use that technology at Nubank.

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16 Dec, 22 Engineering by Bruno Rodrigues – Senior Engineering Manager at Nubank

If you work with technology or are curious about it, you've probably already heard of functional programming. It isn't anything new, but it's getting increasingly more attention due to the technological changes we've been going through.

What is functional programming?

Functional programming is a programming paradigm, that is, the way of doing something. In programming, it is the methodology used to write codes.

The functional paradigm is based on a very old model of computation called lambda calculus. The lambda calculus was created in 1930 by Alonzo Church (who was a professor of famous

mathematician Allan Turing) and it was the foundation for the creation of LISP – a family of programming languages developed by John McCarthy in 1958.

In order to know what functional programming is, however, it is important to understand other famous programming paradigms: imperative programming and object-oriented programming (OOP).

Imperative Programming

The most famous programming paradigm. In imperative languages – such as C and PHP –, codes are written as a list of actions or commands that are run by a computer. They are like orders given to the machine, which is why it is called imperative programming.

Object-Oriented Programming

As for object-oriented programming, a programmer creates data in the form of fields, known as attributes, and codes in the form of procedures, known as methods. One of its characteristics is that the procedure of an object can access or even change the data fields of the object with which it is associated.

As a simple example, imagine that a car is an object and its attributes are its doors, color, etc. You could have a method in which the procedure would be to open the car door and another one to close the car door.

A few examples of object-oriented programming languages are Java, Python, and Ruby. Other languages, such as JavaScript and PHP, support object orientation.

Functional Programming

When we understand other paradigm types, it becomes easier to understand the functional paradigm.

Unlike imperative and object-oriented programming, functional programming considers everything as a function. There isn't a list of instructions or objects to be run by the computer, but rather a sequence of mathematical functions that together will solve a problem.

That means that in the functional paradigm, functions are pure, do not change the state of the object and give emphasis to expressions and statements, instead of following instructions.

In the example with the car, if we create a pure function to open the car door, that function will not change the car, which is the initial input. You must explicitly use the result of the function, which would be the car with the door open, instead of accessing the initial input, as this is the car with the door closed.

Besides that, there are no variables in the functional paradigm, only constants. This translates into more objective codes with constants that, generally speaking, do not change. A few examples of functional languages are Clojure, Haskell, and Elixir.

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What are the benefits of functional programming?

As said before, the code in functional programming tends to be more objective and shorter than in other paradigm types because you are able to isolate the pure functions that will obtain the logic of your business from the functions that are called mutable, which are operations that actually change

the object, such as modifying data in a database, for example.

Another benefit is that, since it is based on mathematical functions, the functional paradigm prompts the use of the concept of immutability. An example of that would be a simple mathematical function, such as $f(x) = x + 2$. Whenever we use the same value for that function, it will provide an equal, immutable result.

Because of that, code maintenance and eventual changes are easier to apply. It is simpler to add tests and isolate a function in order to make analyses and correct flaws.

It may seem like a small detail, but by having an immutable code, we are sure that when we test it, the code will not act in an unexpected way in a production environment.

In addition to that, functional languages are friendlier to the implementation of parallel computing, meaning that different parts of the system are run smoothly by different processors. That can be explained by the fact that the codes are predictable and immutable, with no side effects. How do we use functional programming at Nubank?

When Nubank was founded in 2013, we looked for technology that could help us reach our business goals, maintain efficiency and scale up in a safe and sustainable way.

At that moment, the functional paradigm seemed to be the best option for the challenges we had to face. Because of that, we ended up adopting Clojure as the main language for our services and Datomic as our database.

The principle of immutability of the functional paradigm aligned with Datomic is crucial for a financial institution because, as an append-only database, Datomic keeps an operation history. With that we can, for example, reprocess all Nubank's data since day one, if necessary, or recompute the operations of a specific day.

The functional paradigm also helps with the process of internationalizing Nubank. The financial system logic of a country may be different from the logic of another country, but it is not necessary to build it from scratch. It is enough to just rewrite the financial system logic and reuse the other parts of the system.

It is important to say that using a functional language makes things easier, but it is not the only thing necessary to reach that goal. The concept of platformization we use and the C4 model also have an influence on that.

But at the end of the day, it is like playing with Legos: If a piece does not fit, it is easy to exchange it for another one without losing everything that was already built. – Concept of modular software architecture

That way, we can use all the benefits of functional programming to build solutions that give back people's control over their own money, regardless of the country they are in.

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Article #1 Summary

Important Topics:

1. Introduction to functional programming.
2. Comparison with other paradigms: imperative programming and object-oriented programming (OOP).
3. Functional programming's core principles: pure functions, immutability, and mathematical functions.
4. Advantages of functional programming: shorter, objective code, ease of maintenance, and parallel computing.
5. Functional programming's application at Nubank, including the use of Clojure and Datomic.
6. The concept of modular software architecture and platformization in functional programming.

Updated List of Topics Discussed:

- Introduction to functional programming.
- Comparison with other programming paradigms (imperative, object-oriented).
- Core principles of functional programming (pure functions, immutability).
- Benefits of functional programming (code simplicity, maintenance, parallelism).
- Practical applications in real-world systems (Nubank's use case).
- Modular software architecture and platformization.

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Four episodes into our journey exploring real-world Clojure stories, fascinating patterns have emerged from our conversations with leaders at Quuppa, CodeScene, Catermonkey, and Griffin. While each company's domain is distinct – from indoor positioning technology to banking infrastructure – their experiences reveal compelling insights about how Clojure influences not just code but entire organizations.

Building Teams and Projects

The journey to adopting Clojure often begins with practical challenges. At Quuppa, they needed better ways to handle data serialization in their enterprise system. Catermonkey's Marten Sytema had already built a working product in Java but saw the potential for faster iteration with Clojure. Griffin recognized how Clojure's immutable-by-default nature perfectly matched banking's inherent requirements. Each team's path was different, but they all faced similar questions about building and growing Clojure teams.

The Hiring Reality

The smaller Clojure talent pool, often seen as a limitation, has proven to be an unexpected advantage. As James Trunk from Griffin puts it,

"The advantage of fishing in a smaller pond with bigger fish is it's easier to catch the bigger fish."

James Trunk, Griffin

Rather than requiring Clojure experience, successful teams look for developers with functional programming backgrounds or, more importantly, the right mindset. Experience with Haskell, Erlang,

OCaml, or even Scala often indicates developers who will understand Clojure's approach.

Location doesn't have to be a constraint, either. When Catermonkey, based in a rural part of the Netherlands, needed to grow its team, it found that remote work eliminated geographical limitations. More importantly, it discovered that Clojure works as a natural filter, attracting developers who deeply understand and are excited about functional programming principles.

The Learning Curve Myth

Despite concerns about Clojure's learning curve, teams consistently report success in onboarding new developers. Clojure's learning curve reputation seems based more on misconceptions than reality.

First, any competent developer can learn Clojure quickly because the core concepts are simple – it's mostly functions and data. The challenge isn't technical complexity but adjusting to a different way of thinking. As Griffin found, developers with functional programming backgrounds adapt particularly well, having already made this mental shift.

Second, being unfamiliar with traditional enterprise patterns can actually be an advantage. When Quuppa brought in fresh graduates, they picked up Clojure naturally – they had no preconceptions about how systems "should" be built. They didn't have to unlearn complex inheritance hierarchies or intricate design patterns.

This matches what Marten observed at Catermonkey – developers who embrace Clojure's approach become productive quickly. The learning curve isn't so much steep as it is different. Instead of memorizing frameworks and patterns, developers learn to compose simple tools effectively.

The tooling complaints often cited as a barrier seem outdated. Modern editors like VS Code with Calva provide smooth onboarding experiences. The REPL quickly becomes a natural part of the development workflow once developers experience its benefits.

What these teams found isn't that Clojure is easy to learn, but that learning it is worthwhile. The investment pays off in increased productivity and capability.

How Clojure Shapes Development

Clojure's influence on development goes beyond technical advantages – it fundamentally changes what teams can achieve and how they work together.

The Productivity Multiplier

These teams aren't choosing to stay small – Clojure enables them to handle complex challenges without needing large teams. Griffin built a banking-as-a-service platform with 40 engineers where similar projects typically require hundreds. This increased productivity shapes everything from how decisions are made to how problems are solved.

Their technical decision-making process is a direct result of this dynamic. Because the team is

naturally more focused, Griffin can afford thoughtful processes like anonymous voting on technical decisions. When your team is small enough that everyone understands the whole system, you can have genuine technical discourse rather than hierarchical decision-making.

Simple Tools, Complex Problems

The productivity advantage comes largely from Clojure's emphasis on simplicity. This isn't about avoiding complexity – it's about having the right tools to tackle it efficiently.

"If you can do it with a function that's like 10 lines, if you can do that, we try to do that instead of pulling a library for it."

Marten Sytema, Catermonkey

Griffin's experience shows how this translates to serious enterprise systems. Building a banking platform requires handling complex requirements around transactions, compliance, and scale. Yet they found Clojure "just gets out of your way and shows you, okay, here's data, here are the functions that work on that data, here's a pipeline." The language's focus on data transformation and simple composable functions lets them build sophisticated systems without the accidental complexity that typically drives the need for larger teams.

This combination of simplicity and power means teams can focus on actual business problems rather than managing complexity. They don't need layers of abstraction, elaborate frameworks, or large teams coordinating different system parts – they can build robust solutions with small, focused teams using simple tools effectively.

Long-Term Impact

The most compelling insights come from observing how these choices play out over time. CodeScene grew from a solo project to a team of 15 while maintaining the ability to innovate. Griffin scaled from 7 to over 40 engineers while building a robust banking platform. Catermonkey expanded from serving 15 customers to over 200 across multiple countries.

It's clear that choosing a programming language is never just a technical decision. It's a choice that shapes how teams work together, grow, and approach problems. In that light, these early conversations suggest that Clojure's real value might lie not just in its technical merits but in how it influences the entire practice of building and maintaining software systems.

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Article #2 Summary

Important Topics:

1. Real-world Clojure adoption stories from companies like Quuppa, CodeScene, Catermonkey, and Griffin.
2. The hiring approach for Clojure teams, focusing on functional programming experience over specific Clojure skills.

3. The learning curve of Clojure and how it's often misunderstood; teams report quick onboarding with a functional programming mindset.
4. Clojure's influence on team productivity, enabling small teams to handle complex challenges.
5. The emphasis on simple tools and composable functions to solve complex problems efficiently.
6. Long-term impact of Clojure on team growth, innovation, and scaling.

Updated List of Topics Discussed:

- Introduction to functional programming.
- Comparison with other programming paradigms (imperative, object-oriented).
- Core principles of functional programming (pure functions, immutability).
- Benefits of functional programming (code simplicity, maintenance, parallelism).
- Practical applications in real-world systems (Nubank's use case).
- Modular software architecture and platformization.
- Real-world adoption stories of Clojure in various companies.
- Hiring strategies for functional programming teams.
- Clojure's learning curve and the mindset shift.
- Impact of Clojure on team productivity and problem-solving.
- Emphasis on simple tools and composable functions.
- Long-term growth and scaling with Clojure.

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Published on December 3, 2024

In Deep Tech

Haskell is a Goated Programming Language That No One Uses

Haskell thrives in academia, where its theoretical underpinnings are studied and expanded. But beyond that, you would rarely find someone talking about it being used in any industry.

Haskell

Illustration by Nalini Nirad

by Mohit Pandey

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Despite its limited adoption, Haskell is often called a 'goated' programming language, attracting admiration for its elegance and power. However, its niche appeal and steep learning curve keep it on the fringes of mainstream programming.

Haskell is a purely functional programming language renowned for its strong static typing, immutability, and lazy evaluation.

But why do people not use Haskell anymore? "Haskell is perceived to be an impractical, academic

language. Therefore, people refuse to use it and instead try to translate lessons they learned from it to 'more practical' languages such as C++," a developer tried to answer that in a nutshell on Hacker News.

Thanks to Haskell's academic roots and the fact that it was developed by a community of researchers who prioritised theoretical brilliance over practicality, its functional programming paradigm emphasises immutability, strong typing, and purity, making it a dream for advanced developers who thrive on mathematical elegance.

But this was in 1980, when a group of researchers wanted to make a single language for functional programming, resulting in the birth of Haskell. In today's world, however, there are only some monetary benefits to learning Haskell.

According to the Stack Overflow Developer Survey 2024, Haskell developers receive a median salary of \$68,337, which is right in the middle of the chart. However, according to the same survey, Haskell is only used by 2% of the total respondents.

The language still appeals to many people, but not for its monetary benefits. Apart from xmonad, darcs, pandoc, and a few others, not many software programs were made using Haskell. And none of them have gained widespread popularity.

Designed for a Few, Not Many

Haskell is frequently employed in finance to build high-assurance systems, where correctness is paramount. Its strong type system and functional purity reduce bugs, making it easier to reason about code.

Moreover, the language's simple design makes it a natural fit for building compilers and tools that analyse other codebases. Unsurprisingly, Haskell thrives in academia, where its theoretical underpinnings are studied and expanded. But beyond that, you would rarely find someone talking about it being used in any industry.

The internet seems divided on Haskell's role in the programming landscape. A user on X quipped, "What I read: person angry because they do not understand Haskell," hinting at the elitist aura surrounding the language. Others, meanwhile, humorously celebrated figures like Lennart Augustsson, one of Haskell's prominent contributors, as "one of the craziest Chad engineers ever born."

Haskell vs Go is the new talk of the niche developer town that likes to argue about which language is better. Languages like Go were born out of pragmatic necessity. On the other hand, developers call Haskell the "three Chad engineers (one of whom is a cofounder of the industry with Dennis Ritchie) getting tired of waiting for C++ to compile."

Go's straightforward syntax and focus on productivity cater to large teams with diverse skill levels, emphasising simplicity over sophistication. "Haskell is designed for a single advanced programmer. Go is designed for a big team of average ones," remarked a developer, pointing at Haskell's steep learning curve and limited accessibility. In contrast, Go, with its practical, team-friendly design, excels at delivering software efficiently.

The divide between these philosophies underscores why Haskell remains a niche language, leaving even Python and JS behind. Though its power is undeniable, its usability often intimidates newcomers, while Go's design philosophy prioritises onboarding developers—even those fresh out

of college—quickly.

‘Why Can’t I Just Use Python?’

Developers say that people find it harder to convince others in their teams to use Haskell than simply go with what everybody else is using.

While Go, Python, and JS are celebrated for their pragmatism and adoption in large-scale projects, Haskell stands as a testament to what programming can achieve when designed with purity and elegance in mind. But in the current world, since no frameworks have been designed for the language, Haskell is on the possible brink of extinction.

Moreover, comparing programming languages has never benefited anyone anyway. “Haskell vs Go might be the worst, most nonsensical midwit debate I’ve ever seen,” said a user on X.

Haskell’s influence far exceeds its usage. It continues to inspire the future of programming languages and tools. While it may never dominate the industry, it remains a cherished gem for those who dare to dive into its depths, proving that sometimes, brilliance doesn’t need mass appeal to leave a lasting legacy.

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## Article #3 Summary

### Important Topics:

1. Haskell's niche appeal and its status as a “goated” language admired for elegance and theoretical brilliance.
2. The language's steep learning curve and how it has limited widespread adoption in industry.
3. Haskell's historical roots in academia, its use in finance and high-assurance systems, and its application in building compilers and tools.
4. The debate between Haskell's theoretical purity and Go's practical design, with Haskell being more suitable for advanced developers and Go for large teams with diverse skill levels.
5. Haskell's impact on programming despite its limited use, and how it continues to inspire future language design.
6. Challenges in convincing teams to adopt Haskell, compared to more pragmatic languages like Python, Go, and JavaScript.

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- Clojure's learning curve and the mindset shift.
- Impact of Clojure on team productivity and problem-solving.
- Emphasis on simple tools and composable functions.
- Long-term growth and scaling with Clojure.
- Haskell's theoretical brilliance vs. practical use in industry.

- Haskell's appeal in academia and niche applications (finance, compilers).
- Comparison with Go, Python, and JavaScript in terms of team adoption and usability.
- The influence of Haskell on future programming language development.

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