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Java vs. Rust Comparison

Why Fluvio was built on Rust for blazingly fast and memory-efficient performance and security

Continuous Intelligence Platform

This is a comparison between Java and Rust. Java is a popular programming language used by developers; however, Rust has many advantages when it comes to performance, and security.

Fluvio uses async processing for significantly lower latency.

With no runtime or garbage collector, it can power performance-critical services, run on embedded devices, and easily integrate with other languages. Latency stays predictable at high throughputs over P99, which means that 99% of the requests should be faster than given latency. In other words, only 1% of the requests are allowed to be slower. Rust is also completely memory safe which separates it from Java with its strong safety guarantees.

Fluvio is an open-source data streaming platform that aggregates, correlates, and applies programmable intelligence to data in motion. Powered by Rust, Fluvio provides low-latency, high-performance programmable streaming on cloud-native architecture. Fluvio is written in Rust, a programming language designed for code safety and performance. For instance, a **benchmark** comparison between Rust and Java on a simple web server implementation revealed that Rust outperforms Java in many areas:

Performance Test	Java	Rust	Improvement
Latency (Fibonacci)	1,900 ms	57.71 ms	~30x
Memory	1,498 Mb	16.94 Mb	~80x
Idle Memory	162 Mb	0.36 Mb	~450x
CPU Utilization	73%	24%	~3x
Program Size	27 Mb	3.7 Mb	~8x

These values are derived from a simple web server implementation and can be significantly higher in large programs with many libraries and dependencies. Fluvio also takes advantage of other Rust capabilities, such as:

- **Asynchronous Code** to scale out workloads effortlessly
- **Fearless Concurrency** to leverage the CPU's full power
- **Zero-copy** for fast I/O wherever possible

While other data streaming platforms use polling to consume messages, Fluvio uses async processing for significantly lower latency. Fluvio runs in pods and can collect millions of events per second with just a few dedicated servers. Our technology can chain servers and can scale up to virtually any number of concurrent connections.

Security

On December 10th, 2021, an alert by **CERT New Zealand** that **CVE-2021-44228**, a remote code execution flaw in Log4j, was already being exploited in the wild, created havoc across all industries. Warnings have been issued by several national cybersecurity agencies, including the **Cybersecurity and Infrastructure Security Agency** (CISA) and the **UK's National Cyber Security Centre** (NCSC). On December 15th, the **Log4j software bug** was said to potentially cause 'incalculable' damage by CNET. All Java applications could be affected by this CERT.

Rust is memory safe

Rust won't compile programs that attempt unsafe memory usage. Most memory errors are discovered when a program is running. Rust's syntax and language metaphors ensure that common memory-related problems in other languages—null or dangling pointers, data races, and so on—never make it into production. The compiler flags those issues and forces them to be fixed before the program ever runs.

Fluvio is designed with security and privacy in mind. Fluvio producers, consumers, and other clients must authenticate with a target Cloud cluster and download security certificates before they are authorized access. The platform uses the certificates with TLS to encrypt all communication between the clients and the cluster.

Conclusion

When it comes to Java, this programming language is significantly slower than Rust. Rust delivers faster startup times and smaller memory footprint on top of it. Java uses Garbage Collection for memory management, which decreases performance. Nearly 70% of the vulnerabilities that the **Microsoft Security Response Center** (MSRC) processes are classified as memory-safety issues, so eliminating the class of vulnerabilities is critical to better security.

> With no runtime or garbage collector, Rust can power performance-critical services, run on embedded devices, and easily integrate with other languages.

About InfinyOn

InfinyOn, a real-time data streaming company, has architected a programmable platform for data in motion built on Rust and enables continuous intelligence for connected apps. SmartModules enable enterprises to intelligently program their data pipelines as they flow between producers and consumers for real-time services. With InfinyOn Cloud, enterprises can quickly correlate events, apply business intelligence, and derive value from their data. To learn more, please visit infinyon.com.