

**Server as a function
with http4k**

Your Server as a Function

Marius Eriksen

Twitter Inc.

marius@twitter.com

Abstract

Building server software in a large-scale setting, where systems exhibit a high degree of concurrency and environmental variability, is a challenging task to even the most experienced programmer. Efficiency, safety, and robustness are paramount—goals which have traditionally conflicted with modularity, reusability, and flexibility.

We describe three abstractions which combine to present a powerful programming model for building safe, modular, and efficient server software: Composable *futures* are used to relate concurrent, asynchronous actions; *services* and *filters* are specialized functions used for the modular composition of our complex server software.

Finally, we discuss our experiences using these abstractions and techniques throughout Twitter’s serving infrastructure.

Categories and Subject Descriptors D.1.1 [*Programming techniques*]: Applicative (Functional) Programming; D.1.3 [*Programming techniques*]: Concurrent Programming; D.1.3 [*Program-*

Services Systems boundaries are represented by asynchronous functions called *services*. They provide a symmetric and uniform API: the same abstraction represents both clients and servers.

Filters Application-agnostic concerns (e.g. timeouts, retries, authentication) are encapsulated by *filters* which compose to build services from multiple independent modules.

Server operations (e.g. acting on an incoming RPC or a timeout) are defined in a declarative fashion, relating the results of the (possibly many) subsequent sub-operations through the use of future combinators. Operations are phrased as *value transformations*, encouraging the use of immutable data structures and, we believe, enhancing correctness through simplicity of reasoning.

Operations describe *what* is computed; execution is handled separately. This frees the programmer from attending to the minutiae of setting up threads, ensuring pools and queues are sized cor-

Finagle

Finagle is an extensible RPC system for the JVM, used to construct high-concurrency servers. Finagle implements uniform client and server APIs for several protocols, and is designed for high performance and concurrency. Most of Finagle's code is protocol agnostic, simplifying the implementation of new protocols.

Finagle is written in Scala, but provides both Scala and Java idiomatic APIs.

- [GitHub project](#)
- [User's guide](#)
- [Developer's Guide](#)
- [API documentation](#)
- [Gitter channel](#)
- [Google group](#)
- [Blog](#)

Contributing

We feel that a welcoming community is important and we ask that you follow Twitter's [Open Source Code of Conduct](#) in all interactions with the community. Finagle is actively maintained by Twitter's infrastructure team, but we have [many external contributors](#) as well. The master branch represents the most recent published release while active development happens on the develop branch. Before endeavoring on large changes, please discuss them with the [Google groups](#) to receive feedback and suggestions. For all patches, please review our [contributing docs](#).



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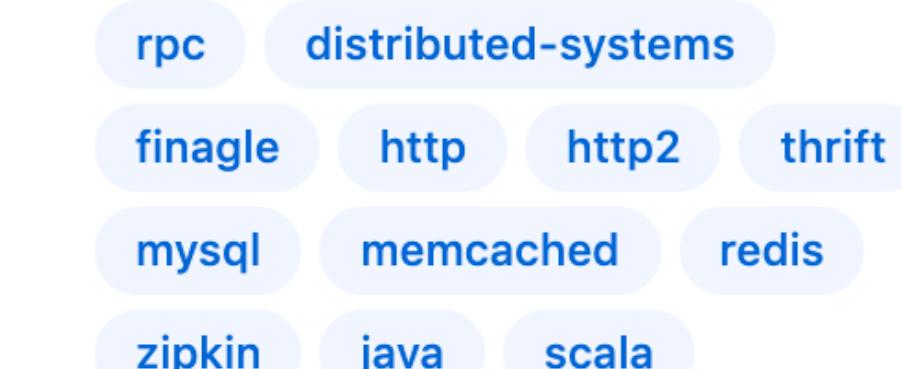
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About

A fault tolerant, protocol-agnostic RPC system

twitter.github.io/finagle



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[Finagle 20.10.0](#) Latest
19 days ago

+ 111 releases

Packages

yufangong and jenkins	finagle/finagle-stats-core: Move	9710eec	2 days ago	7,268 commits
.github	Twitter OSS: Add ISSUE_TEMPLATE			4 years ago	
doc	finagle-core: Track offload task delays at a given rate			9 days ago	
finagle-base-http	[finagle-netty4-http] Extract test lib			2 months ago	
finagle-benchmark-thrift/src/...	Update Build files - deprecate [rz]globs (batch#9)			9 months ago	
finagle-benchmark	[finagle] declare dependencies explicitly			4 months ago	
finagle-core	finagle: Handle floating point errors when biasing for load i...			3 days ago	
finagle-example	finagle-example: Expand finagle binary helper function in ...			4 months ago	
finagle-exception	3rdparty: Upgrade scalatest to 3.1.2			4 months ago	
finagle-exp	finagle-core: Promote ThriftForwardingWarmUpFilter from ...			4 days ago	
finagle-grpc-context	[finagle-grpc-context] suppress CheckReturnValue			2 months ago	
finagle-http	Various core security ownership changes			last month	
finagle-http2	[csl targets] explicitly list out the runtime scoped depende...			3 months ago	
finagle-init	Corrected CSL team in PROJECT Files			3 months ago	

The Functional toolkit for Kotlin HTTP applications

http4k provides a simple and uniform way to serve, consume, and test HTTP services.

[Quick Start](#)

HTTP as a Function

```
val app = { request: Request ->
    Response(OK)
        .body("Hello, ${request.query("name")}!")
}
```



```
app.asServer(Jetty(9000)).start()
```

```
val client = ApacheClient()

val request = Request(GET, "http://localhost:9000")
    .query("name", "John Doe")

val response: Response = client(request)
```



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4.0.0.0 Latest
yesterday

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 daviddenton [skip travis] tweak	✓ 22fd412 7 hours ago	⌚ 5,090 commits
.github [skip travis] slack script	yesterday	
buildSrc remove jetty client, downgrade ktor	12 days ago	
gradle/wrapper upgrade gradle	yesterday	
http4k-aws switch testCompile dependencies to testImplementation/Api	9 days ago	
http4k-bom added BOM module	last month	
http4k-client don't use deprecated API	9 days ago	
http4k-cloudnative V4 - all deprecations from V3 removed	yesterday	
http4k-contract V4 - all deprecations from V3 removed	yesterday	
http4k-core tweak	yesterday	
http4k-format V4 - all deprecations from V3 removed	yesterday	
http4k-graphql switch testCompile dependencies to testImplementation/Api	9 days ago	
http4k-incubator switch testCompile dependencies to testImplementation/Api	9 days ago	
http4k-jsonrpc V4 - all deprecations from V3 removed	yesterday	

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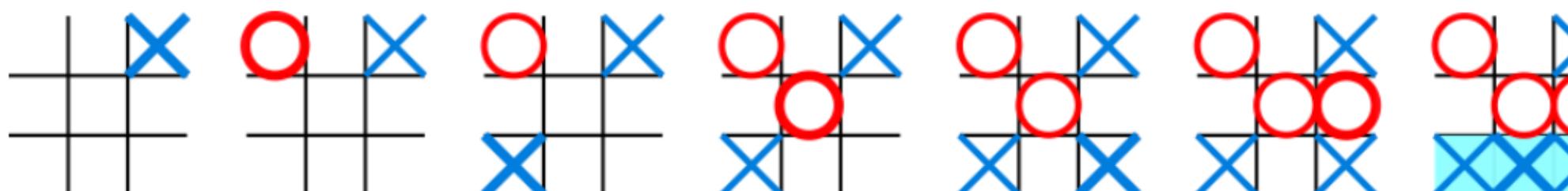
Tic-tac-toe

From Wikipedia, the free encyclopedia

"Tic Tac Toe" and *"Noughts and crosses"* redirect here. For other uses, see [Tic Tac Toe \(disambiguation\)](#) and [Noughts and crosses \(disambiguation\)](#).

Tic-tac-toe (American English), **noughts and crosses** (British English), or **Xs and Os** is a paper-and-pencil game for two players, *X* and *O*, who take turns marking the spaces in a 3×3 grid. The player who succeeds in placing three of their marks in a horizontal, vertical, or diagonal row is the winner.

The following example game is won by the first player, *X*:



Players soon discover that the [best play](#) from both parties leads to a [draw](#). Hence, tic-tac-toe is most often played by young children, who often have not yet discovered the optimal strategy.

Because of the simplicity of tic-tac-toe, it is often used as a [pedagogical](#) tool for teaching the concepts of good [sportsmanship](#) and the branch of [artificial intelligence](#) that deals with the searching of [game trees](#). It is straightforward to write a [computer program](#) to play tic-tac-toe perfectly or to enumerate the 765 essentially different positions (the [state space complexity](#)) or the 26,830 possible games up to rotations and reflections (the [game tree complexity](#)) on this space.^[1]

The game can be generalized to an m, n, k -game in which two players alternate placing stones of their own color on an $m \times n$ board, with the goal of getting k of their own color in a row. Tic-tac-toe is the $(3, 3, 3)$ game.^[2] Heron's generalized tic-tac-toe is an even broader generalization of tic-tac-toe. It can also be

Tic-tac-toe

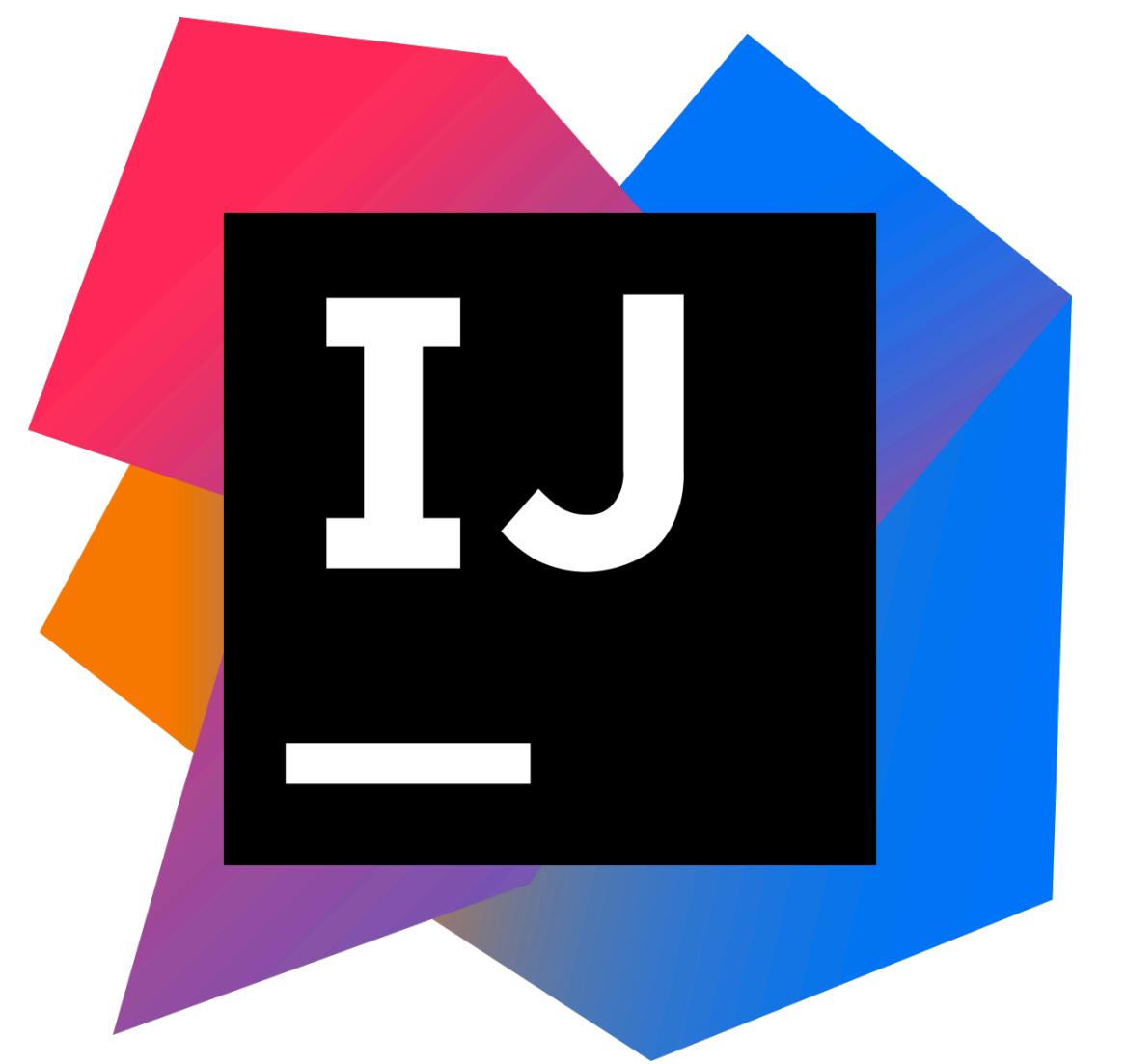


A completed game of Tic-tac-toe

Genre(s)	Paper-and-pencil game
Players	2
Setup time	Minimal
Playing time	~1 minute
Random chance	None
Skill(s) required	Strategy , tactics, observation
Synonym(s)	Noughts and crosses Xs and Os

GameFrontend

GameBackend





**There are
more http4k
things...**

- more clients/servers

- more clients/servers
- more JSON/XML libs

- more clients/servers
- more JSON/XML libs
- more template engines

- more clients/servers
- more JSON/XML libs
- more template engines
- serverless platforms

- approval tests

- approval tests
- contract tests

- approval tests
- contract tests
- chaos testing

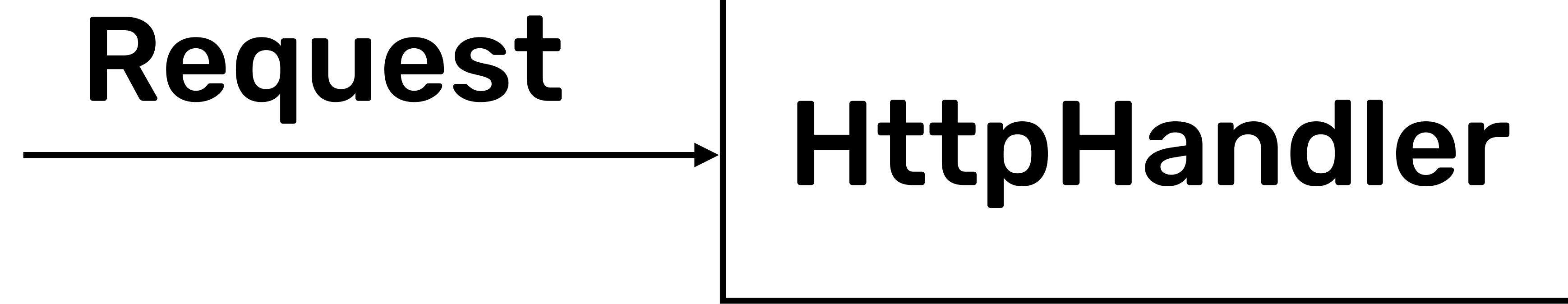
- approval tests
- contract tests
- chaos testing
- record/replay traffic

**One thing to
remember...**

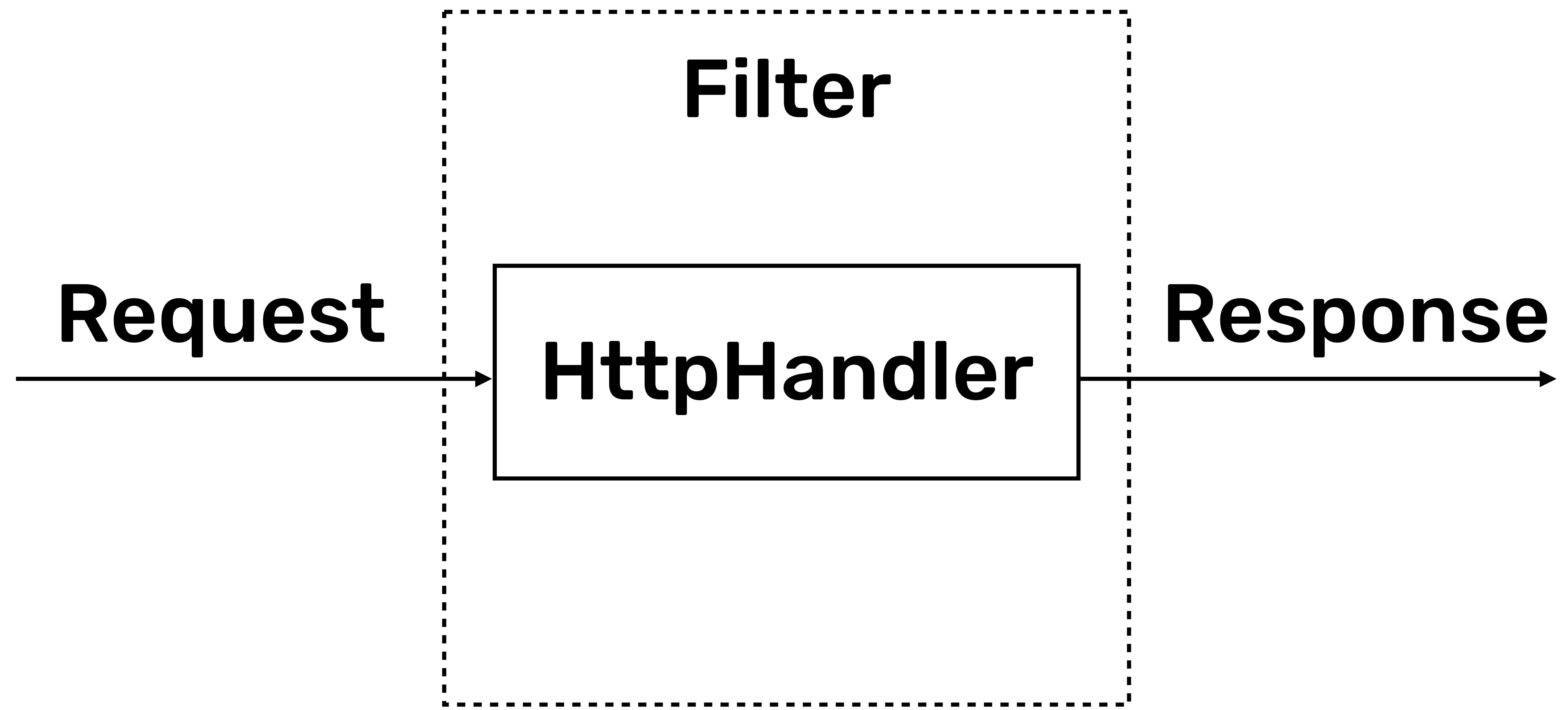
**Client and server
have the same
type signature!**

HttpHandler

Request







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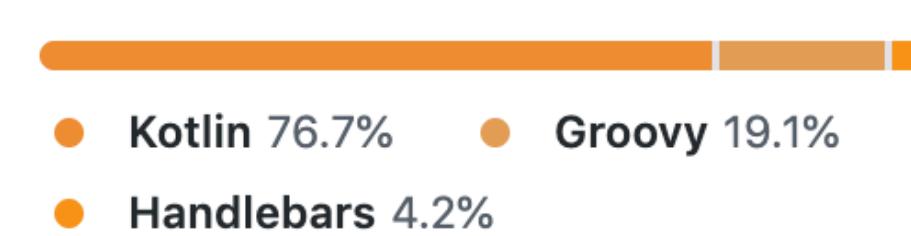
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dkandalov updated readme	✓ 16fe270 13 days ago	⌚ 30 commits
.github/workflows added git workflow	4 months ago	
.live-plugins liveplugin with tictactoe4kProjectPopup	2 months ago	
gradle/wrapper updated dependencies	2 months ago	
slides updated slides	2 months ago	
src/test misc updates	13 days ago	
.gitignore initial commit	11 months ago	
build.gradle.kts misc updates	13 days ago	
gradlew initial commit	11 months ago	
gradlew.bat initial commit	11 months ago	
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settings.gradle.kts kotlin 1.4-M1; gradle 6.3	9 months ago	

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Complete TDD'd example http4k application showcasing a lot of the http4k features for building apps

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About

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 daviddenton add autologin server	✓ 98e4887 2 days ago	⌚ 5,131 commits
📁 .github fix token used to trigger toolbox release	6 days ago	
📁 buildSrc add values support for automapping	7 days ago	
📁 gradle/wrapper upgrade gradle	14 days ago	
📁 http4k-aws switch testCompile dependencies to testImplementation/Api	22 days ago	
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📁 http4k-client don't use deprecated API	22 days ago	
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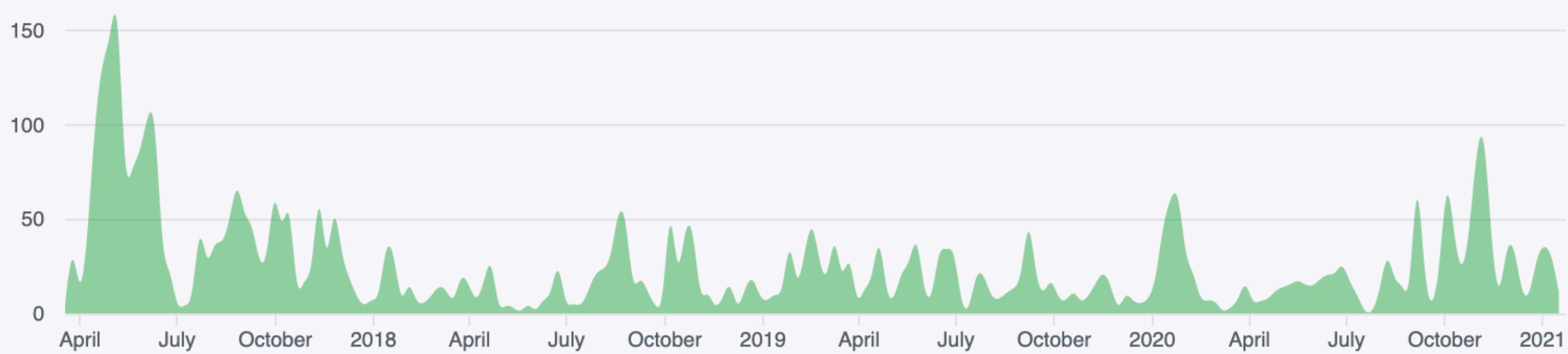
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Mar 19, 2017 – Jan 23, 2021

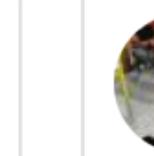
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Contributions to master, excluding merge commits

**daviddenton**

4,164 commits 253,372 ++ 201,752 --

#1

**s4nchez**

701 commits 43,243 ++ 32,219 --

#2





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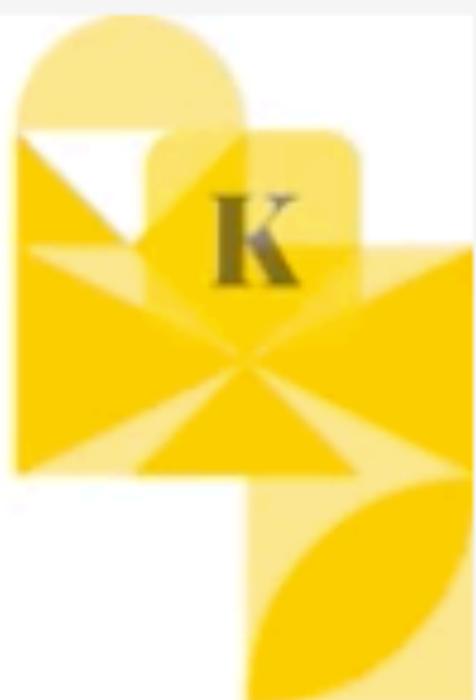
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Next On Track

Ivan Sanchez & David Denton

[HTTP4K](#)

Writing Test Driven Apps with http4k



The Functional toolkit for Kotlin HTTP applications

http4k provides a simple and uniform way to serve, consume, and test HTTP services.

[Quick Start](#)

HTTP as a Function

```
val app = { request: Request ->
    Response(OK)
        .body("Hello, ${request.query("name")}!")
}
```



```
app.asServer(Jetty(9000)).start()
```

```
val client = ApacheClient()

val request = Request(GET, "http://localhost:9000")
    .query("name", "John Doe")

val response: Response = client(request)
```



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Quickstart

Rationale & concepts

Changelog

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http4k in action

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Overview

Meet http4k

Typesafe Websockets

TDDing http4k

Typesafe 12-factor config

Documenting http4k apps
with OpenApi3

Retrospective on v3

Nanoservices

Toolbox: Guns for show,
knives for a pro

http4k v4 - 17 platforms



http4k v4: 17 platforms and counting...

january 2021 / the http4k team

Well, at last it's here - after 3 years - http4k v4! Following on from the [retrospective](#) that we did on version 3, we've been busy polishing, tidying up the edges, and pushing out a bunch of changes to make the project sparkle. Ready? Then let's dive into the good stuff that's been going on at http4k Towers.

Four digits good, three digits bad. The new http4k versioning scheme

Ah yes - versioning - everyone's favourite topic. Part of the reason that http4k v3 has been around so long is that we've somewhat been abusing the [Semantic versioning](#) system, something which we've been unhappy with. Here's how it should work:

For Version <A>..<C>

A = We broke something on purpose. (Breaking API change)

B = Profit. (Feature / Improvement)

C = We broke something by accident. (Bug)

Up until now, both breaking and non-breaking API changes on v3 have been done through the second (B) digit of the version - which doesn't allow API users to know if they are expecting a break. At the same time, we wanted to keep major (A) version changes for when there's a big "marketing" release.



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Search



Thursday, February 13th



Jamie Hodkinson 09:49

Hi! We are responding with an input stream from a temporary file on disk.

```
Response(OK).body(tempFile.inputStream())
```

Is there any way to detect when the response has been fully read so that we can then delete the temp file on disk?



7 replies

Last reply 12 days ago

Friday, February 14th



Mehdi Mohammadi 23:47

Could anybody help that what is wrong with this code?

```
val app = { request: Request -> Response(OK).body("Hello, ${request.query("name")!}") }

val jettyServer = app.asServer(Jetty(9006)).start()
val client = WebSocketClient.blocking(Uri.of("wss://echo.websocket.org"), headers = listOf(Pair("a
header", "value")))

client.send(WsMessage("hello"))

// read all of the messages from the socket until it is closed (by the server).
// we expect to get one message back before the stream is closed.
client.received().toList().forEach(::println)
```

I am able to connect but I am not receiving any message. I want to develop a websocket client always send and receive messages to/from the server (edited)



14 replies

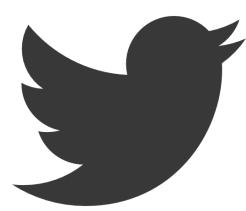
Last reply 1 day ago



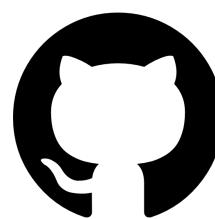
Message #http4k

Aa @ 😊

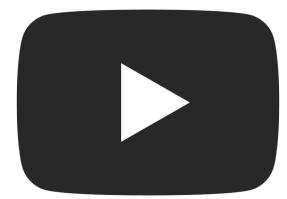
The End



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