

# Ktor Basics

Ktor is a Kotlin based asynchronous web framework.

Backends need to be versatile and scalable. Developers should have a 'microservice mindset' to create more maintainable backend services.

## Why Ktor

- Kotlin based - concise and fun language to use
- Lightweight - low server start up time
- Asynchronous through co-routines - does NOT create a thread per request/response - scalable
- Runs on JVM and uses Gradle - runs on basic infrastructure (i.e. a docker container)
- Well documented and Easy to use (At least compared to Ruby and PHP). JetBrains always does a good job with their documentation.
- Modular - default project starts with one module
- Rich in features - authentication, data access, content negotiation, & more
- Flexible - currently supports 4 different servlet containers: Tomcat, Netty, Jetty, and CIO
- In development since 2015 and is well-maintained

## What is a Servlet Container?

- Web Container / Servlet Container / Servlet Engine : is used to manage the components like Servlets, JSP. It is a part of the web server.
- Web Server / HTTP Server: A server which is capable of handling HTTP requests, sent by a client and respond back with a HTTP response.
- Application Server / App Server: can handle all application operations between users and an organization's back end business applications or databases. It is frequently viewed as part of a three-tier application with: Presentation tier, logic tier, Data tier

## Which to Choose?

### Tomcat

- The most popular open source project under Apache
- Very well documented
- JSP parsing is very fast
- Flexible and scales easy
- Spring Boot uses Tomcat by default

## Jetty

- Uses less memory and is more lightweight thus offering speed and scalability
- Small and efficient with low maintenance costs
- Can server as a asynchronous server with some effort
- Open source with good community and support. Originated from the Eclipse foundation
- Widely used, though less so than Tomcat
- Built into several frameworks; GWT, JRuby, Grails, Scala/Lift & more
- If you want a light HTTP servlet container use Jetty.

## Netty

- An **asynchronous**, event-driven, non-blocking I/O, network application framework.
- You can write your own servlet container, but technically Netty in itself is a server framework not a container like Jetty
- Greatly simplifies network programming such as TCP and UDP socket servers.
- If you deal a lot with network protocols and want it to be non-blocking use Netty (usually for high-performance cases).

## CIO

- Stands for Configuration Interface Object
- Made by Oracle. Very poorly documented in my opinion. can't find any example usages for Java Servlets outside the documentation.
- The benefit of this one is it runs on Android and JVM
- I think Ktor support for CIO is still flakey as well. I would avoid this one.

For Ktor the buzzword is *asynchronous*, and I plan on experimenting with socket programming, so my choice is Netty.

Note: I think there is also support for Apache and Android as a built in http client engine but the documentation doesn't go into great detail

# Starting a Project

Either go to [start.ktor.io](https://start.ktor.io) or use the IntelliJ plugin to generate a project template. Select whatever add-ons you want but always make sure 'routing' is selected

Other add-ons I would consider basic:

- Status Pages - Allow the server to respond to thrown exceptions
- CallLogging - Logs Client Requests
- CSS/HTML DSL - You'll need these if you plan on hosting your html directly off ktor.
- PartialContent - Adds support for breaking up content and using paging
- Authentication Basic - Good starting point for security if you don't feel like setting up ldap
- ContentNegotiation - Automatic type conversion
- GSON - Helper library for handling JSON data

# The Kotlin Coroutine

The Kotlin coroutine is an asynchronous non-blocking job that can run on the same thread as other coroutines.

- Coroutine is achieved in Ktor using the `kotlinx.coroutines` library
- Runs in a context - many coroutines can share context and thread pool
- Ktor uses coroutines through the framework, which is why it performs so well.
- A coroutine function is decorated with "suspend"
- Other suspend functions can only be run from suspend functions
- A coroutine is usually started with the launch function in the DEFAULT context
- A coroutine can be tested or run by the main function by using the `runBlocking` function

# Installation and Configuration of Features

- Most features require a Gradle/Maven dependency
- use the `install` function. Configure it with a trailing Lambda as an argument.

```

install(CallLogging) {
    level = Level.INFO
    filter { call -> call.request.path().startsWith("/") }
}

install(Routing) {
    get("/") {
        call.respondText("Good evening World")
    }
}

```

## Common Features

- A common feature has one or more helper functions
- Routing is a common feature
- For a feature with helper functions, we can configure this feature after calling its install function
- For example:

```

install(Routing) {
    get("/") {
        call.respondText("Good evening World")
    }
}

```

can be separated into `install(Routing)` and

```

routing {
    get("/") {
        call.respondText("Good evening World")
    }
}

```

Although, this is a bad example, because Routing is installed by default so there's no need for `install(Routing)`

## Custom Features

You can build and install your own custom features. Most features intercept the pipeline at the `Application.Features` phase. That's all I'm going to say about that.

# Autoreload

- Detects changes on the classpath, meaning changes are made without having to restart the server. Very handy when making HTML changes
- Autoreload is an experimental feature only available with JDK8+. It can be enabled with IntelliJ or within the Gradle build
- Of course there is a cost to performance. Do not use this feature in production or while benchmarking
- `application.conf`
  - Chose folders to watch for classpath changes: `watch = [/module1, /module2]`
  - Usually we only deal with one module, so an example conf would be something like:

```
tor {  
  deployment {  
    port = 8080  
    port = ${?PORT}  
    watch = [ / ]  
  }  
  application {  
    modules = [cpm.exmple.ApplicationKt.module]  
  }  
}
```

## Gradle: Recompile

- Gradle can recompile the project on code changes: `gradle -t installDist`
- This compiles and listens for source code changes
- Using Gradle gives the most flexible autoreload setup, but requires JDK8+

# Call Logging - Log All Incoming Requests

- Enables us to choose specific routes for which we want to enable logging. You can have as many filters as you would like.

```
install(CallLogging) {  
    level = Level.INFO  
    filter { call -> call.request.path().startsWith("/mysection1") }  
}
```

## Metrics Statistics on the Usage of Endpoints

- There is a feature called DropwizardMetrics that monitors performance statistics like:
  - Number of threads
  - Number of Calls per endpoint
  - Memory Usage
  - And more...
- It can be configured to log statistics to a file or other places like JMX
- JXM Reporter allows us to expose metrics to the JMX so we can use the JConsole or jvisualvm to view metrics
- Slf4j Reporter outputs the metrics in the log every X seconds
- The following dependencies must be implemented:

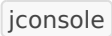
```
implementation("io.ktor:ktor-metrics:$ktor_version")  
implementation("io.dropwizard.metrics:metrics-jmx:4.0.0")
```

Then install the feature:

```
install(DropwizardMetrics) {  
    Slf4jReporter.forRegistry(registry)  
        .outputTo(log)  
        .convertRatesTo(TimeUnit.SECONDS)
```

```
.convertDurationsTo(TimeUnit.MILLISECONDS)
    .build()
    .start(15, TimeUnit.SECONDS)

JmxReporter.forRegistry(registry)
    .convertRatesTo(TimeUnit.SECONDS)
    .convertDurationsTo(TimeUnit.MILLISECONDS)
    .build()
    .start()
}
```

- This information is very useful for debugging performance
- Run `jconsole` in the terminal and select the running process to see visualizations on performance  3ffb8c0b3893bc3cc5d520cca391670b.png

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