
XITRUM



Xitrum Scala Web Framework Guide

Release 3.25.0

Ngoc Dao, Takeharu Oshida

August 14, 2015

1	Introduction	3
1.1	Features	3
1.2	Contributors	4
2	Tutorial	5
2.1	Create a new empty Xitrum project	5
2.2	Run	5
2.3	Import the project to Eclipse	6
2.4	Import the project to IntelliJ	6
2.5	Autoreload	6
2.5.1	Run with IDEs	7
2.5.2	Run with SBT	7
2.5.3	DCEVM	7
2.6	Ignore files	7
3	Action and view	9
3.1	Normal action	9
3.2	FutureAction	9
3.3	Actor action	9
3.4	Respond to client	10
3.5	Respond template view file	10
3.5.1	Type casting currentAction	11
3.5.2	Mustache	12
3.5.3	CoffeeScript	12
3.6	Layout	13
3.6.1	Layout without separate file	14
3.6.2	Pass layout directly to respondView	14
3.7	Inline view	14
3.8	Render fragment	15
3.9	Respond view of other action	15
3.9.1	One action - multiple views	16
3.10	Component	16
4	RESTful APIs	19
4.1	Route cache	19
4.2	Route order with first and last	20
4.3	Multiple paths for one action	20
4.4	Dot in route	20

4.5	Regex in route	20
4.6	Catch the rest of path	21
4.7	Link to an action	21
4.8	Redirect to another action	21
4.9	Forward to another action	22
4.10	Determine is the request is Ajax request	22
4.11	Anti-CSRF	22
4.12	antiCsrfInput and antiCsrfToken	23
4.13	SkipCsrfCheck	23
4.14	Manipulate collected routes	23
4.15	Getting entire request content	24
4.16	Documenting API with Swagger	24
5	Template engines	27
5.1	Config template engine	27
5.2	Remove template engine	27
5.3	Create your own template engine	27
6	Postbacks	29
6.1	Layout	29
6.2	Form	30
6.3	Non-form	30
6.4	Confirmation dialog	31
6.5	Extra params	31
6.6	Display animation image while Ajax is loading	31
7	XML	33
7.1	Unescape XML	33
7.2	Group XML elements	33
7.3	Render XHTML	34
8	JavaScript and JSON	35
8.1	JavaScript	35
8.1.1	Add JavaScript fragments to view	35
8.1.2	Respond JavaScript directly without view	36
8.2	JSON	36
8.3	Plugin for Knockout.js	36
9	Async response	37
9.1	WebSocket	38
9.2	SockJS	39
9.3	Chunked response	40
9.3.1	Forever iframe	41
9.3.2	Event Source	42
10	Static files	43
10.1	Serve static files on disk	43
10.2	index.html fallback	44
10.3	404 and 500	44
10.4	Serve resource files in classpath with WebJars convention	44
10.4.1	WebJars	44
10.4.2	Save resource file inside .jar file with WebJars convention	45
10.4.3	Respond a file in classpath	45
10.5	Client side cache with ETag and max-age	45
10.6	GZIP	46

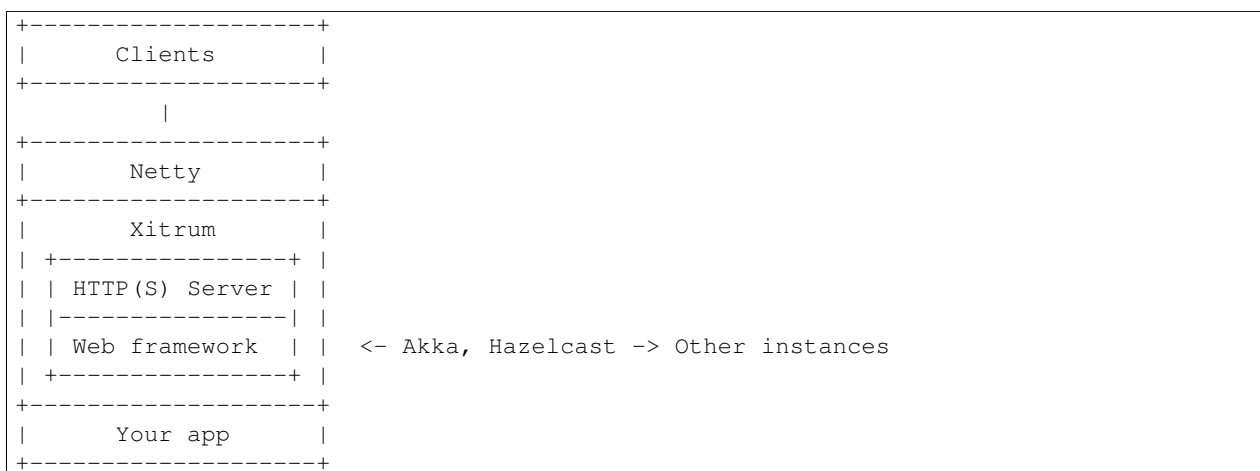
10.7	Server side cache	46
11	Serve flash socket policy file	47
12	Scopes	49
12.1	Request	49
12.1.1	Kinds of params	49
12.1.2	Accessing params	49
12.1.3	“at”	49
12.1.4	“atJson”	50
12.1.5	RequestVar	51
12.2	Cookie	51
12.2.1	Allowed characters in cookie	52
12.3	Session	52
12.3.1	session.clear()	53
12.3.2	SessionVar	53
12.3.3	Session stores	54
12.3.4	Client side session store vs Server side session store	54
12.4	object vs. val	55
13	Validation	57
13.1	Default validators	57
13.2	Write custom validators	58
14	File upload	59
14.1	Ajax style upload	59
15	Action filters	61
15.1	Before filters	61
15.2	After filters	61
15.3	Around filters	62
15.4	Execution order of filters	62
16	Server-side cache	63
16.1	Cache page or action	63
16.2	Cache object	64
16.3	Remove cache	64
16.4	Config	65
16.5	How cache works	65
16.6	xitrum.util.LocalLruCache	66
17	I18n	67
17.1	Write internationalized messages in source code	67
17.2	Extract messages to pot files	68
17.3	Where to save po files	68
17.4	Set language	69
17.5	Validation messages	69
17.6	Plural forms	70
17.7	Date and number format	70
18	Log	71
18.1	Use object xitrum.Log directly	71
18.2	Use trait xitrum.Log	71
18.3	Don’t have to check log level before logging	71
18.4	Config log level, log output file etc.	72

18.5	Log to Fluentd	72
19	Deploy to production server	73
19.1	Package directory	73
19.2	Customize xitrum-package	73
19.3	Connect a Scala console to a running JVM process	74
19.4	Install Oracle JDK on CentOS or Ubuntu manually	74
19.5	Start Xitrum in production mode when the system starts	75
19.6	Set up port forwarding	76
19.7	Tune Linux for massive connections	76
19.7.1	Increase open file limit	76
19.7.2	Tune kernel	77
19.7.3	Note about backlog	77
19.8	HAProxy tips	78
19.9	Nginx tips	78
19.10	Deploy to Heroku	78
19.10.1	Sign up and create repository	78
19.10.2	Create Procfile	78
19.10.3	Change port setting	78
19.10.4	See log level	79
19.10.5	Create alias for xitrum-package	79
19.10.6	Push to Heroku	79
20	Clustering with Akka and Hazelcast	81
21	Netty handlers	83
21.1	Netty handler architecture	83
21.2	Custom handlers	84
21.3	Xitrum default handlers	84
22	Metrics	87
22.1	Collect metrics	87
22.1.1	Heap memory and CPU	87
22.1.2	Action metrics	88
22.1.3	Collect your custom metrics	88
22.2	Publish metrics	89
22.2.1	Xitrum default viewer	89
22.2.2	Jconsole viewer	90
22.2.3	Display metrics with custom viewer	90
22.2.4	Save metrics	91
23	HOWTO	93
23.1	Basic authentication	93
23.1.1	Config basic authentication for the whole site	93
23.1.2	Add basic authentication to an action	93
23.2	Load config files	94
23.2.1	JSON file	94
23.2.2	Properties file	94
23.2.3	Typesafe config file	94
23.3	Serialize and deserialize	95
23.4	Encrypt data	95
23.5	Multiple sites at the same domain name	96
23.6	Convert Markdown text to HTML	96
23.7	Monitor file change	96
23.8	Temporary directory	97

23.9 Stream videos	97
24 Dependencies	99
24.1 Dependency libraries	99
24.2 Related projects	101

There are also Japanese, Korean, Russian, and Vietnamese versions.

Introduction



Xitrum is an async and clustered Scala web framework and HTTP(S) server fusion on top of [Netty](#) and [Akka](#).

From [a user](#):

Wow, this is a really impressive body of work, arguably the most complete Scala framework outside of Lift (but much easier to use).

[Xitrum](#) is truly a full stack web framework, all the bases are covered, including wtf-am-I-on-the-moon extras like ETags, static file cache identifiers & auto-gzip compression. Tack on built-in JSON converter, before/around/after interceptors, request/session/cookie/flash scopes, integrated validation (server & client-side, nice), built-in cache layer ([Hazelcast](#)), i18n a la GNU gettext, Netty (with Nginx, hello blazing fast), etc. and you have, wow.

1.1 Features

- Typesafe, in the spirit of Scala. All the APIs try to be as typesafe as possible.
- Async, in the spirit of Netty. Your request processing action does not have to respond immediately. Long polling, chunked response (streaming), WebSocket, and SockJS are supported.
- Fast built-in HTTP and HTTPS web server based on [Netty](#) (HTTPS can use Java engine or native OpenSSL engine). Xitrum's static file serving speed is [similar to that of Nginx](#).
- Extensive client-side and server-side caching for faster responding. At the web server layer, small files are cached in memory, big files are sent using NIO's zero copy. At the web framework layer you have can declare

page, action, and object cache in the Rails style. [All Google's best practices](#) like conditional GET are applied for client-side caching. You can also force browsers to always send request to server to revalidate cache before using.

- [Range requests](#) support for static files. Serving movie files for smartphones requires this feature. You can pause/resume file download.
- [CORS](#) support.
- Routes are automatically collected in the spirit of JAX-RS and Rails Engines. You don't have to declare all routes in a single place. Think of this feature as distributed routes. You can plug an app into another app. If you have a blog engine, you can package it as a JAR file, then you can put that JAR file into another app and that app automatically has blog feature! Routing is also two-way: you can recreate URLs (reverse routing) in a typesafe way. You can document routes using [Swagger Doc](#).
- Classes and routes are automatically reloaded in development mode.
- Views can be written in a separate [Scalate](#) template file or Scala inline XML. Both are typesafe.
- Sessions can be stored in cookies (more scalable) or clustered [Hazelcast](#) (more secure). Hazelcast also gives in-process (thus faster and simpler to use) distributed cache, you don't need separate cache servers. The same is for pubsub feature in Akka.
- [jQuery Validation](#) is integrated for browser side and server side validation.
- i18n using [GNU gettext](#). Translation text extraction is done automatically. You don't have to manually mess with properties files. You can use powerful tools like [Poedit](#) for translating and merging translations. gettext is unlike most other solutions, both singular and plural forms are supported.

Xitrum tries to fill the spectrum between [Scalatra](#) and [Lift](#): more powerful than Scalatra and easier to use than Lift. You can easily create both RESTful APIs and postbacks. [Xitrum](#) is controller-first like Scalatra, not [view-first](#) like Lift. Most people are familiar with controller-first style.

See [related projects](#) (page 99) for a list of demos, plugins etc.

1.2 Contributors

Xitrum is open source, please join its [Google group](#).

Contributors are listed in the order of their [first contribution](#).

(*): Currently active core members.

- [Ngoc Dao](#) (*)
- [Linh Tran](#)
- [James Earl Douglas](#)
- [Aleksander Guryanov](#)
- [Takeharu Oshida](#) (*)
- [Nguyen Kim Kha](#)
- [Michael Murray](#)

Tutorial

This chapter shortly describes how to create and run a Xitrum project. **It assumes that you are using Linux and you have installed Java.**

2.1 Create a new empty Xitrum project

To create a new empty project, download [xitrum-new.zip](#):

```
wget -O xitrum-new.zip https://github.com/xitrum-framework/xitrum-new/archive/master.zip
```

Or:

```
curl -L -o xitrum-new.zip https://github.com/xitrum-framework/xitrum-new/archive/master.zip
```

2.2 Run

The de facto standard way of building Scala projects is using [SBT](#). The newly created project has already included SBT 0.13 in `sbt` directory. If you want to install SBT yourself, see its [setup guide](#).

Change to the newly created project directory and run `sbt/sbt run`:

```
unzip xitrum-new.zip
cd xitrum-new
sbt/sbt run
```

This command will download all [dependencies](#) (page 99), compile the project, and run the class `quickstart.Boot`, which starts the web server. In the console, you will see all the routes:

```
[INFO] Load routes.cache or recollect routes...
[INFO] Normal routes:
GET / quickstart.action.SiteIndex
[INFO] SockJS routes:
xitrum/metrics/channel xitrum.metrics.XitrumMetricsChannel websocket: true, cookie_needed: false
[INFO] Error routes:
404 quickstart.action.NotFoundError
500 quickstart.action.ServerError
[INFO] Xitrum routes:
GET /webjars/swagger-ui/2.0.17/index xitrum.routing.SwaggerUiVersion
GET /xitrum/xitrum.js xitrum.js
GET /xitrum/metrics/channel xitrum.sockjs.Greeting
```

```

GET      /xitrum/metrics/channel/:serverId/:sessionId/eventsource  xitrum.sockjs.EventSourceRece
GET      /xitrum/metrics/channel/:serverId/:sessionId/htmlfile    xitrum.sockjs.HtmlFileReceive
GET      /xitrum/metrics/channel/:serverId/:sessionId/jsonp      xitrum.sockjs.JsonPPollingRece
POST     /xitrum/metrics/channel/:serverId/:sessionId/jsonp_send    xitrum.sockjs.JsonPPollingSen
WEBSOCKET /xitrum/metrics/channel/:serverId/:sessionId/websocket      xitrum.sockjs.WebSocket
POST     /xitrum/metrics/channel/:serverId/:sessionId/xhr            xitrum.sockjs.XhrPollingReceiv
POST     /xitrum/metrics/channel/:serverId/:sessionId/xhr_send       xitrum.sockjs.XhrSend
POST     /xitrum/metrics/channel/:serverId/:sessionId/xhr_streaming  xitrum.sockjs.XhrStreamingRece
GET      /xitrum/metrics/channel/info                                xitrum.sockjs.InfoGET
WEBSOCKET /xitrum/metrics/channel/websocket                        xitrum.sockjs.RawWebSocket
GET      /xitrum/metrics/viewer                                       xitrum.metrics.XitrumMetricsV
GET      /xitrum/metrics/channel/:iframe                       xitrum.sockjs.Iframe
GET      /xitrum/metrics/channel/:serverId/:sessionId/websocket xitrum.sockjs.WebSocketGET
POST     /xitrum/metrics/channel/:serverId/:sessionId/websocket      xitrum.sockjs.WebSocketPOST
[INFO] HTTP server started on port 8000
[INFO] HTTPS server started on port 4430
[INFO] Xitrum started in development mode

```

On startup, all routes will be collected and output to log. It is very convenient for you to have a list of routes if you want to write documentation for 3rd parties about the RESTful APIs in your web application.

Open <http://localhost:8000/> or <https://localhost:4430/> in your browser. In the console you will see request information:

```
[INFO] GET quickstart.action.SiteIndex, 1 [ms]
```

2.3 Import the project to Eclipse

You can use [Eclipse](#) to write Scala code.

From the project directory, run:

```
sbt/sbt eclipse
```

.project file for Eclipse will be created from definitions in build.sbt. Now open Eclipse, and import the project.

2.4 Import the project to IntelliJ

You can also use [IntelliJ](#), which also has very good support for Scala.

To generate project files for IDEA, run:

```
sbt/sbt gen-idea
```

2.5 Autoreload

You can autoreload .class files (hot swap) without having to restart your program. However, to avoid performance and stability problems, you should only autoreload .class files while developing (development mode).

2.5.1 Run with IDEs

While developing, when you run project in advanced IDEs like Eclipse or IntelliJ, by default the IDEs will automatically reload code for you.

2.5.2 Run with SBT

When you run with SBT, you need to open 2 console windows:

- One to run `sbt/sbt run`. This will run the program and reload .class files when they are changed.
- One to run `sbt/sbt ~compile`. Whenever you edit source code files, this will compile the source code to .class files.

In the sbt directory, there's `agent7.jar`. It's in charge of reloading .class files in the current working directory (and its subdirectories). If you see the `sbt/sbt` script, you'll see the option like `-javaagent:agent7.jar`.

2.5.3 DCEVM

Normal JVM only allows only changing method bodies. You may use [DCEVM](#), which is an open source modification of the Java HotSpot VM that allows unlimited redefinition of loaded classes.

You can install DCEVM in 2 ways:

- [Patch](#) your existing Java installation.
- Install a [prebuilt](#) version (easier).

If you choose to patch:

- You can enable DCEVM permanently.
- Or set it as an “alternative” JVM. In this case, to enable DCEVM, every time you run `java` command, you need to specify `-XXaltjvm=dcevm` option. For example, you need to add `-XXaltjvm=dcevm` option to the `sbt/sbt` script.

If you use IDEs like Eclipse or IntelliJ, you need to configure them to use DCEVM (not the default JVM) to run your project.

If you use SBT, you need to configure the `PATH` environment variable so that the `java` command is from DCEVM (not from the default JVM). You still need the `javaagent` above, because although DCEVM supports advanced class changes, it itself doesn't reload classes.

See [DCEVM - A JRebel free alternative](#) for more info.

2.6 Ignore files

Normally, these file should be [ignored](#) (not committed to your SVN or Git repository):

```
. *
log
project/project
project/target
target
tmp
```

Action and view

To be flexible, Xitrum provides 3 kinds of actions: normal `Action`, `FutureAction`, and `ActorAction`.

3.1 Normal action

```
import xitrum.Action
import xitrum.annotation.GET

@GET("hello")
class HelloAction extends Action {
  def execute() {
    respondText("Hello")
  }
}
```

Because the action will run on directly Netty's IO thread, it should not do blocking processing that may take a long time, otherwise Netty can't accept new connections or send response back to clients.

3.2 FutureAction

```
import xitrum.FutureAction
import xitrum.annotation.GET

@GET("hello")
class HelloAction extends FutureAction {
  def execute() {
    respondText("hi")
  }
}
```

The action will run on the same thread pool for `ActorAction` (see below), separated from the thread pool of Netty.

3.3 Actor action

If you want your action to be an Akka actor, extend `ActorAction`:

```
import scala.concurrent.duration._

import xitrum.ActorAction
import xitrum.annotation.GET

@GET("actor")
class HelloAction extends ActorAction {
  def execute() {
    // See Akka doc about scheduler
    import context.dispatcher
    context.system.scheduler.scheduleOnce(3 seconds, self, System.currentTimeMillis())

    // See Akka doc about "become"
    context.become {
      case pastTime =>
        respondInlineView(s"It's $pastTime Unix ms 3s ago.")
    }
  }
}
```

An actor instance will be created when there's request. It will be stopped when the connection is closed or when the response has been sent by `respondText`, `respondView` etc. methods. For chunked response, it is not stopped right away. It is stopped when the last chunk is sent.

The actor will run on the thread pool of the Akka actor system named "xitrum".

3.4 Respond to client

From an action, to respond something to client, use:

- `respondView`: responds view template file, with or without layout
- `respondInlineView`: responds embedded template (not separate template file), with or without layout
- `respondText("hello")`: responds a string without layout
- `respondHtml("<html>...</html>")`: same as above, with content type set to "text/html"
- `respondJson(List(1, 2, 3))`: converts Scala object to JSON object then responds
- `respondJs("myFunction([1, 2, 3])")`
- `respondJsonP(List(1, 2, 3), "myFunction")`: combination of the above two
- `respondJsonText("[1, 2, 3]")`
- `respondJsonPText("[1, 2, 3]", "myFunction")`
- `respondBinary`: responds an array of bytes
- `respondFile`: sends a file directly from disk, very fast because [zero-copy](#) (aka send-file) is used
- `respondEventSource("data", "event")`

3.5 Respond template view file

Each action may have an associated [Scalate](#) template view file. Instead of responding directly in the action with the above methods, you can use a separate view file.

scr/main/scala/mypackage/MyAction.scala:

```
package mypackage

import xitrum.Action
import xitrum.annotation.GET

@GET("myAction")
class MyAction extends Action {
  def execute() {
    respondView()
  }

  def hello(what: String) = "Hello %s".format(what)
}
```

scr/main/scalate/mypackage/MyAction.jade:

```
- import mypackage.MyAction

!!! 5
html
  head
    != antiCsrfMeta
    != xitrumCss
    != jsDefaults
    title Welcome to Xitrum

  body
    a(href={url}) Path to the current action
    p= currentAction.asInstanceOf[MyAction].hello("World")

    != jsForView
```

- `xitrumCss` includes the default CSS for Xitrum. You may remove it if you don't like `xitrum-framework`
- `jsDefaults` includes jQuery, jQuery Validate plugin etc. should be put at layout's `<head>`.
- `jsForView` contains JS fragments added by `jsAddToView`, should be put at layout's bottom.

In templates you can use all methods of the class `xitrum.Action`. Also, you can use utility methods provided by Scalate like `unescape`. See the [Scalate doc](#).

The default Scalate template type is `Jade`. You can also use `Mustache`, `Scaml`, or `Ssp`. To config the default template type, see `xitrum.conf` file in the config directory of your Xitrum application.

You can override the default template type by passing "jade", "mustache", "scaml", or "ssp" to `respondView`.

```
val options = Map("type" -> "mustache")
respondView(options)
```

3.5.1 Type casting `currentAction`

If you want to have exactly instance of the current action, cast `currentAction` to the action you wish.

```
p= currentAction.asInstanceOf[MyAction].hello("World")
```

If you have multiple lines like above, you can cast only one time:

```
- val myAction = currentAction.asInstanceOf[MyAction]; import myAction._  
  
p= hello("World")  
p= hello("Scala")  
p= hello("Xitrum")
```

3.5.2 Mustache

Must read:

- [Mustache syntax](#)
- [Scalate implementation](#)

You can't do some things with Mustache like with Jade, because Mustache syntax is stricter.

To pass things from action to Mustache template, you must use `at`:

Action:

```
at("name") = "Jack"  
at("xitrumCss") = xitrumCss
```

Mustache template:

```
My name is {{name}}  
{{xitrumCss}}
```

Note that you can't use the below keys for `at` map to pass things to Scalate template, because they're already used:

- “context”: for Sclate utility object, which contains methods like `unescape`
- “helper”: for the current action object

3.5.3 CoffeeScript

You can embed CoffeeScript in Scalate template using `:coffeescript` filter:

```
body  
  :coffeescript  
    alert "Hello, Coffee!"
```

Output:

```
<body>  
  <script type='text/javascript'>  
    <![CDATA[  
      (function() {  
        alert("Hello, Coffee!");  
      }).call(this);  
    </script>  
</body>
```

But note that it is [slow](#):

```
jade+javascript+1thread: 1-2ms for page  
jade+coffesscript+1thread: 40-70ms for page  
jade+javascript+100threads: ~40ms for page  
jade+coffesscript+100threads: 400-700ms for page
```

You pre-generate CoffeeScript to JavaScript if you need speed.

3.6 Layout

When you respond a view with `respondView` or `respondInlineView`, Xitrum renders it to a `String`, and sets the `String` to `renderedView` variable. Xitrum then calls `layout` method of the current action, finally Xitrum responds the result of this method to the browser.

By default `layout` method just returns `renderedView` itself. If you want to decorate your view with something, override this method. If you include `renderedView` in the method, the view will be included as part of your layout.

The point is `layout` is called after your action's view, and whatever returned is what responded to the browser. This mechanism is simple and straight forward. No magic. For convenience, you may think that there's no layout in Xitrum at all. There's just the `layout` method and you do whatever you want with it.

Typically, you create a parent class which has a common layout for many views:

`src/main/scala/mypackage/AppAction.scala`

```
package mypackage
import xitrum.Action

trait AppAction extends Action {
  override def layout = renderViewNoLayout[AppAction]()
}
```

`src/main/scalate/mypackage/AppAction.jade`

```
!!! 5
html
  head
    != antiCsrfMeta
    != xitrumCss
    != jsDefaults
    title Welcome to Xitrum

  body
    != renderedView
    != jsForView
```

`src/main/scala/mypackage/MyAction.scala`

```
package mypackage
import xitrum.annotation.GET

@GET("myAction")
class MyAction extends AppAction {
  def execute() {
    respondView()
  }

  def hello(what: String) = "Hello %s".format(what)
}
```

`src/main/scalate/mypackage/MyAction.jade:`

```
- import mypackage.MyAction
```

```
a(href={url}) Path to the current action
p= currentAction.asInstanceOf[MyAction].hello("World")
```

3.6.1 Layout without separate file

AppAction.scala

```
import xitrum.Action
import xitrum.view.DocType

trait AppAction extends Action {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCsrfMeta}
        {xitrumCss}
        {jsDefaults}
        <title>Welcome to Xitrum</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

3.6.2 Pass layout directly to respondView

```
val specialLayout = () =>
  DocType.html5(
    <html>
      <head>
        {antiCsrfMeta}
        {xitrumCss}
        {jsDefaults}
        <title>Welcome to Xitrum</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )

respondView(specialLayout _)
```

3.7 Inline view

Normally, you write view in a Scalate file. You can also write it directly:

```
import xitrum.Action
import xitrum.annotation.GET
```

```
@GET("myAction")
class MyAction extends Action {
  def execute() {
    val s = "World" // Will be automatically HTML-escaped
    respondInlineView(
      <p>Hello <em>{s}</em>!</p>
    )
  }
}
```

3.8 Render fragment

Suppose MyAction.jade is at: scr/main/scalate/mypackage/MyAction.jade

If you want to render the fragment file in the same directory: scr/main/scalate/mypackage/_MyFragment.jade

```
renderFragment[MyAction] ("MyFragment")
```

If MyAction is the current action, you can skip it:

```
renderFragment ("MyFragment")
```

3.9 Respond view of other action

Use the syntax `respondView[ClassName]()`:

```
package mypackage

import xitrum.Action
import xitrum.annotation.{GET, POST}

@GET("login")
class LoginFormAction extends Action {
  def execute() {
    // Respond scr/main/scalate/mypackage/LoginFormAction.jade
    respondView()
  }
}

@POST("login")
class DoLoginAction extends Action {
  def execute() {
    val authenticated = ...
    if (authenticated)
      redirectTo[HomeAction]()
    else
      // Reuse the view of LoginFormAction
      respondView[LoginFormAction]()
  }
}
```

3.9.1 One action - multiple views

If you want to have multiple views for one:

```
package mypackage

import xitrum.Action
import xitrum.annotation.GET

// These are non-routed actions, for mapping to view template files:
// scr/main/scalate/mypackage/HomeAction_NormalUser.jade
// scr/main/scalate/mypackage/HomeAction_Moderator.jade
// scr/main/scalate/mypackage/HomeAction_Admin.jade
trait HomeAction_NormalUser extends Action
trait HomeAction_Moderator extends Action
trait HomeAction_Admin extends Action

@GET("")
class HomeAction extends Action {
  def execute() {
    val userType = ...
    userType match {
      case NormalUser => respondView[HomeAction_NormalUser]()
      case Moderator => respondView[HomeAction_Moderator]()
      case Admin => respondView[HomeAction_Admin]()
    }
  }
}
```

Using additional non-routed actions like above seems to be tedious, but this way your program will be typesafe.

You can also use String to specify template location:

```
respondView("mypackage/HomeAction_NormalUser")
respondView("mypackage/HomeAction_Moderator")
respondView("mypackage/HomeAction_Admin")
```

3.10 Component

You can create reusable view components that can be embedded to multiple views. In concept, a component is similar to an action:

- But it does not have routes, thus `execute` method is not needed.
- It does not “responds” a full response, it just “renders” a view fragment. So inside a component, instead of calling `respondXXX`, please call `renderXXX`.
- Just like an action, a component can have none, one, or multiple associated view templates.

```
package mypackage

import xitrum.{FutureAction, Component}
import xitrum.annotation.GET

class CompoWithView extends Component {
  def render() = {
    // Render associated view template, e.g. CompoWithView.jade
    // Note that this is renderView, not respondView!
  }
}
```



```
    renderView()
  }
}

class CompoWithoutView extends Component {
  def render() = {
    "Hello World"
  }
}

@GET("foo/bar")
class MyAction extends FutureAction {
  def execute() {
    respondView()
  }
}
```

MyAction.jade:

```
- import mypackage._

!= newComponent[CompoWithView]().render()
!= newComponent[CompoWithoutView]().render()
```

RESTful APIs

You can write RESTful APIs for iPhone, Android applications etc. very easily.

```
import xitrum.Action
import xitrum.annotation.GET

@GET("articles")
class ArticlesIndex extends Action {
  def execute() {...}
}

@GET("articles/:id")
class ArticlesShow extends Action {
  def execute() {...}
}
```

The same for POST, PUT, PATCH, DELETE, and OPTIONS. Xitrum automatically handles HEAD as GET with empty response body.

For HTTP clients that do not support PUT and DELETE (like normal browsers), to simulate PUT and DELETE, send a POST with `_method=put` or `_method=delete` in the request body.

On web application startup, Xitrum will scan all those annotations, build the routing table and print it out for you so that you know what APIs your application has, like this:

```
[INFO] Routes:
GET /articles      quickstart.action.ArticlesIndex
GET /articles/:id quickstart.action.ArticlesShow
```

Routes are automatically collected in the spirit of JAX-RS and Rails Engines. You don't have to declare all routes in a single place. Think of this feature as distributed routes. You can plug an app into another app. If you have a blog engine, you can package it as a JAR file, then you can put that JAR file into another app and that app automatically has blog feature! Routing is also two-way: you can recreate URLs (reverse routing) in a typesafe way. You can document routes using [Swagger Doc](#).

4.1 Route cache

For better startup speed, routes are cached to file `routes.cache`. While developing, routes in `.class` files in the `target` directory are not cached. If you change library dependencies that contain routes, you may need to delete `routes.cache`. This file should not be committed to your project source code repository.

4.2 Route order with first and last

When you want to route like this:

```
/articles/:id --> ArticlesShow
/articles/new --> ArticlesNew
```

You must make sure the second route be checked first. `First` is for this purpose:

```
import xitrum.annotation.{GET, First}

@GET("articles/:id")
class ArticlesShow extends Action {
  def execute() {...}
}

@First // This route has higher priority than "ArticlesShow" above
@GET("articles/new")
class ArticlesNew extends Action {
  def execute() {...}
}
```

Last is similar.

4.3 Multiple paths for one action

```
@GET("image", "image/:format")
class Image extends Action {
  def execute() {
    val format = paramo("format").getOrElse("png")
    // ...
  }
}
```

4.4 Dot in route

```
@GET("articles/:id", "articles/:id.:format")
class ArticlesShow extends Action {
  def execute() {
    val id      = param[Int]("id")
    val format = paramo("format").getOrElse("html")
    // ...
  }
}
```

4.5 Regex in route

Regex can be used in routes to specify requirements:

```
GET("articles/:id<[0-9]+>")
```

4.6 Catch the rest of path

/ character is special thus not allowed in param names. If you want to allow it, the param must be the last and you must write like this:

```
GET("service/:id/proxy/*")
```

The path below will match:

```
/service/123/proxy/http://foo.com/bar
```

To extract the `/*` part:

```
val url = param("/*") // Will be "http://foo.com/bar"
```

4.7 Link to an action

Xitrum tries to be typesafe. Don't write URL manually. Do like this:

```
<a href={url[ArticlesShow] ("id" -> myArticle.id)}>{myArticle.title}</a>
```

4.8 Redirect to another action

Read to know [what redirection is](#).

```
import xitrum.Action
import xitrum.annotation.{GET, POST}

@GET("login")
class LoginInput extends Action {
  def execute() {...}
}

@POST("login")
class DoLogin extends Action {
  def execute() {
    ...
    // After login success
    redirectTo[AdminIndex]()
  }
}

GET("admin")
class AdminIndex extends Action {
  def execute() {
    ...
    // Check if the user has not logged in, redirect him to the login page
    redirectTo[LoginInput]()
  }
}
```

You can also redirect to the current action with `redirectToThis()`.

4.9 Forward to another action

Use `forwardTo[AnotherAction]()`. While `redirectTo` above causes the browser to make another request, `forwardTo` does not.

4.10 Determine is the request is Ajax request

Use `isAjax`.

```
// In an action
val msg = "A message"
if (isAjax)
  jsRender("alert(" + jsEscape(msg) + ")")
else
  respondText(msg)
```

4.11 Anti-CSRF

For non-GET requests, Xitrum protects your web application from [Cross-site request forgery](#) by default.

When you include `antiCsrfMeta` in your layout:

```
import xitrum.Action
import xitrum.view.DocType

trait AppAction extends Action {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCsrfMeta}
        {xitrumCss}
        {jsDefaults}
        <title>Welcome to Xitrum</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

The `<head>` part will include something like this:

```
<!DOCTYPE html>
<html>
  <head>
    ...
    <meta name="csrf-token" content="5402330e-9916-40d8-a3f4-16b271d583be" />
    ...
  </head>
  ...
</html>
```

The token will be automatically included in all non-GET Ajax requests as X-CSRF-Token header sent by jQuery if you include `xitrum.js` in your view template. `xitrum.js` is included in `jsDefaults`. If you don't use `jsDefaults`, you can include `xitrum.js` in your template like this:

```
<script type="text/javascript" src={url[xitrum.js]}></script>
```

4.12 antiCsrfInput and antiCsrfToken

Xitrum takes CSRF token from X-CSRF-Token request header. If the header does not exist, Xitrum takes the token from `csrf-token` request body param (note: not param in the URL).

If you manually write forms, and you don't use the meta tag and `xitrum.js` as described in the previous section, you need to use `antiCsrfInput` or `antiCsrfToken`:

```
form(method="post" action={url[AdminAddGroup]})
  != antiCsrfInput
```

```
form(method="post" action={url[AdminAddGroup]})
  input(type="hidden" name="csrf-token" value={antiCsrfToken})
```

4.13 SkipCsrfCheck

When you create APIs for machines, e.g. smartphones, you may want to skip this automatic CSRF check. Add the trait `xitrum.SkipCsrfCheck` to your action:

```
import xitrum.{Action, SkipCsrfCheck}
import xitrum.annotation.POST

trait Api extends Action with SkipCsrfCheck

@POST("api/positions")
class LogPositionAPI extends Api {
  def execute() {...}
}

@POST("api/todos")
class CreateTodoAPI extends Api {
  def execute() {...}
}
```

4.14 Manipulate collected routes

Xitrum automatically collect routes on startup. If you want to manipulate the routes, you can use `xitrum.Config.routes`.

Example:

```
import xitrum.{Config, Server}

object Boot {
  def main(args: Array[String]) {
    // You can modify routes before starting the server
    val routes = Config.routes
  }
}
```

```
// Remove routes to an action by its class
routes.removeByClass[MyClass]()

if (demoVersion) {
  // Remove routes to actions by a prefix
  routes.removeByPrefix("premium/features")

  // This also works
  routes.removeByPrefix("/premium/features")
}

...

Server.start()
}
```

4.15 Getting entire request content

Usually, when the request content type is not `application/x-www-form-urlencoded`, you may need to get the entire request content (and parse it manually etc.).

To get it as a string:

```
val body = requestContentString
```

To get it as JSON:

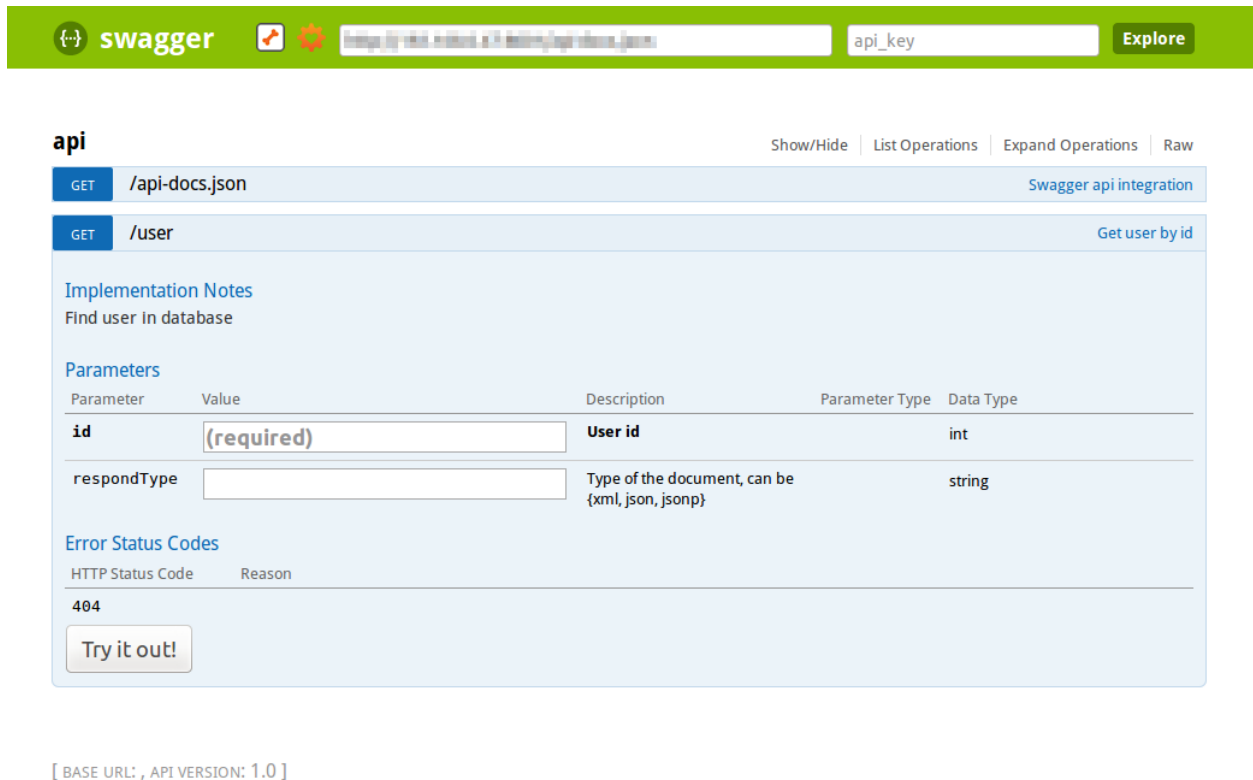
```
val myJValue = requestContentJValue // => JSON4S (http://json4s.org) JValue
val myMap = requestContentJson[Map[String, Int]]
```

If you want to full control, use `request.getContent`. It returns a `ByteBuf`.

4.16 Documenting API with Swagger

You can document your API with [Swagger](#) out of the box. Add `@Swagger` annotation on actions that need to be documented. Xitrum will generate `/xitrum/swagger.json`. This file can be used with [Swagger UI](#) to generate interactive API documentation.

Xitrum includes Swagger UI. Access it at the path `/xitrum/swagger-ui` of your program, e.g. <http://localhost:8000/xitrum/swagger-ui>.



The image shows the Swagger UI interface for an API. At the top, there's a green header with the Swagger logo, a search bar, and an 'api_key' input field with an 'Explore' button. Below the header, the API is titled 'api'. There are two endpoints listed: 'GET /api-docs.json' with a link to 'Swagger api integration', and 'GET /user' with a link to 'Get user by id'. The 'GET /user' endpoint is expanded, showing 'Implementation Notes' (Find user in database), 'Parameters' (a table with 'id' and 'respondType'), and 'Error Status Codes' (a table with '404'). A 'Try it out!' button is at the bottom.

api [Show/Hide](#) [List Operations](#) [Expand Operations](#) [Raw](#)

GET **/api-docs.json** [Swagger api integration](#)

GET **/user** [Get user by id](#)

Implementation Notes
Find user in database

Parameters

Parameter	Value	Description	Parameter Type	Data Type
id	(required)	User id		int
respondType		Type of the document, can be {xml, json, jsonp}		string

Error Status Codes

HTTP Status Code	Reason
404	

[Try it out!](#)

[BASE URL: , API VERSION: 1.0]

Let's see an example:

```
import xitrum.{Action, SkipCsrfCheck}
import xitrum.annotation.{GET, Swagger}

@Swagger(
  Swagger.Tags("APIs to create images"),
  Swagger.Description("Dimensions should not be bigger than 2000 x 2000"),
  Swagger.QueryString("text", "Text to render on the image, default: Placeholder"),
  Swagger.Produces("image/png"),
  Swagger.Response(200, "PNG image"),
  Swagger.Response(400, "Width or height is invalid or too big")
)

trait ImageApi extends Action with SkipCsrfCheck {
  lazy val text = param("text").getOrElse("Placeholder")
}

@GET("image/:width/:height")
@Swagger( // <-- Inherits other info from ImageApi
  Swagger.Summary("Generate rectangle image"),
  Swagger.IntPath("width"),
  Swagger.IntPath("height")
)

class RectImageApi extends Api {
  def execute {
    val width = param[Int]("width")
    val height = param[Int]("height")
    // ...
  }
}
```

```
@GET("image/:width")
@Swagger( // <-- Inherits other info from ImageApi
  Swagger.Summary("Generate square image"),
  Swagger.IntPath("width")
)
class SquareImageApi extends Api {
  def execute {
    val width = param[Int]("width")
    // ...
  }
}
```

JSON for Swagger will be generated when you access `/xitrum/swagger`.

Swagger UI uses the JSON above to generate interactive API doc.

Params other than `Swagger.IntPath` and `Swagger.QueryString` above: `BytePath`, `IntQuery`, `OptStringForm` etc. They are in the form:

- `<Value type><Param type>` (required parameter)
- `Opt<Value type><Param type>` (optional parameter)

Value type: `Byte`, `Int`, `Int32`, `Int64`, `Long`, `Number`, `Float`, `Double`, `String`, `Boolean`, `Date`, `DateTime`

Param type: `Path`, `Query`, `Body`, `Header`, `Form`

Read more about [value type](#) and [param type](#).

Template engines

The configured template engine will be called when `renderView`, `renderFragment`, or `respondView` (page 9) is called.

5.1 Config template engine

In `config/xitrum.conf`, template engine can be configured in one of the following 2 forms, depending on the engine you use:

```
template = my.template.EngineClassName
```

Or:

```
template {  
  "my.template.EngineClassName" {  
    option1 = value1  
    option2 = value2  
  }  
}
```

The default template engine is `xitrum-scalate`.

5.2 Remove template engine

If you create only RESTful APIs in your project, normally you don't call `renderView`, `renderFragment`, or `respondView`. In this case, you can even remove template engine from your project to make it lighter. Just remove or comment out the `templateEngine` in `config/xitrum.conf`.

Then remove template related configs from your project.

5.3 Create your own template engine

To create your own template engine, create a class that implements `xitrum.view.TemplateEngine`. Then set your class in `config/xitrum.conf`.

For an example, see `xitrum-scalate`.

Postbacks

There are 2 main use cases of web applications:

- To serve machines: you need to create RESTful APIs for smartphones, web services for other web sites.
- To serve human users: you need to create interactive web pages.

As a web framework, Xitrum aims to support you to solve these use cases easily. To solve the 1st use case, you use [RESTful actions](#) (page 19). To solve the 2nd use case, you can use the Ajax form postback feature in Xitrum. Please see the following links for the idea about postback:

- <http://en.wikipedia.org/wiki/Postback>
- <http://nitrogenproject.com/doc/tutorial.html>

Xitrum's postback feature is inspired by [Nitrogen](#).

6.1 Layout

AppAction.scala

```
import xitrum.Action
import xitrum.view.DocType

trait AppAction extends Action {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCsrftMeta}
        {xitrumCss}
        {jsDefaults}
        <title>Welcome to Xitrum</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

6.2 Form

Articles.scala

```
import xitrum.annotation.{GET, POST, First}
import xitrum.validator._

@GET("articles/:id")
class ArticlesShow extends AppAction {
  def execute() {
    val id      = param("id")
    val article = Article.find(id)
    respondInlineView(
      <h1>{article.title}</h1>
      <div>{article.body}</div>
    )
  }
}

@First // Force this route to be matched before "show"
@GET("articles/new")
class ArticlesNew extends AppAction {
  def execute() {
    respondInlineView(
      <form data-postback="submit" action={url[ArticlesCreate]}>
        <label>Title</label>
        <input type="text" name="title" class="required" /><br />

        <label>Body</label>
        <textarea name="body" class="required"></textarea><br />

        <input type="submit" value="Save" />
      </form>
    )
  }
}

@POST("articles")
class ArticlesCreate extends AppAction {
  def execute() {
    val title = param("title")
    val body  = param("body")
    val article = Article.save(title, body)

    flash("Article has been saved.")
    jsRedirectTo(show, "id" -> article.id)
  }
}
```

When submit JavaScript event of the form is triggered, the form will be posted back to ArticlesCreate. action attribute of <form> is encrypted. The encrypted URL acts as the anti-CSRF token.

6.3 Non-form

Postback can be set on any element, not only form.

An example with link:

```
<a href="#" data-postback="click" action={postbackUrl[LogoutAction]}>Logout</a>
```

Clicking the link above will trigger the postback to LogoutAction.

6.4 Confirmation dialog

If you want to display a confirmation dialog:

```
<a href="#" data-postback="click"
  action={url[LogoutAction]}
  data-confirm="Do you want to logout?">Logout</a>
```

If the user clicks “Cancel”, the postback will not be sent.

6.5 Extra params

In case of form element, you can add `<input type="hidden" ...` to send extra params with the postback.

For other elements, you do like this:

```
<a href="#"
  data-postback="click"
  action={url[ArticlesDestroy] ("id" -> item.id)}
  data-params="_method=delete"
  data-confirm={"Do you want to delete %s?".format(item.name)}>Delete</a>
```

You may also put extra params in a separate form:

```
<form id="myform" data-postback="submit" action={url[SiteSearch]}>
  Search:
  <input type="text" name="keyword" />

  <a class="pagination"
    href="#"
    data-postback="click"
    data-form="#myform"
    action={url[SiteSearch] ("page" -> page)}>{page}</a>
</form>
```

`#myform` is the jQuery selector to select the form that contains extra params.

6.6 Display animation image while Ajax is loading

If you want to display image like this while Ajax is loading



please call this JS snippet after including `jsDefaults` (which includes `xitrum.js`) in your view template:

```
xitrum.ajaxLoadingImg = 'path/to/your/image';
```


XML

Scala allow wrting literal XML. Xitrum uses this feature as its “template engine”:

- Scala checks XML syntax at compile time: Views are typesafe.
- Scala automatically escapes XML: Views are [XSS-free](#) by default.

Below are some tips.

7.1 Unescape XML

Use `scala.xml.Unparsed`:

```
import scala.xml.Unparsed

<script>
  {Unparsed("if (1 < 2) alert('Xitrum rocks');")}
</script>
```

Or use `<xml:unparsed>`:

```
<script>
  <xml:unparsed>
    if (1 < 2) alert('Xitrum rocks');
  </xml:unparsed>
</script>
```

`<xml:unparsed>` will be hidden in the output:

```
<script>
  if (1 < 2) alert('Xitrum rocks');
</script>
```

7.2 Group XML elements

```
<div id="header">
  {if (loggedIn)
    <xml:group>
      <b>{username}</b>
      <a href={url[LogoutAction]}>Logout</a>
    </xml:group>
  }
```

```
else
  <xml:group>
    <a href={url[LoginAction]}>Login</a>
    <a href={url[RegisterAction]}>Register</a>
  </xml:group>
</div>
```

`<xml:group>` will be hidden in the output, for example when the use has logged in:

```
<div id="header">
  <b>My username</b>
  <a href="/login">Logout</a>
</div>
```

7.3 Render XHTML

Xitrum renders views and layouts as XHTML automatically. If you want to render it yourself (rarely), pay attention to the code below.

```
import scala.xml.Xhtml

val br = <br />
br.toString           // => <br></br>, some browsers will render this as 2 <br />s
Xhtml.toXhtml(<br />) // => "<br />"
```

JavaScript and JSON

8.1 JavaScript

Xitrum includes jQuery. There are some jsXXX helpers.

8.1.1 Add JavaScript fragments to view

In your action, call `jsAddToView` (multiple times if you need):

```
class MyAction extends AppAction {
  def execute() {
    ...
    jsAddToView("alert('Hello')")
    ...
    jsAddToView("alert('Hello again')")
    ...
    respondInlineView(<p>My view</p>)
  }
}
```

In your layout, call `jsForView`:

```
import xitrum.Action
import xitrum.view.DocType

trait AppAction extends Action {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCsrftMeta}
        {xitrumCss}
        {jsDefaults}
      </head>
      <body>
        <div id="flash">{jsFlash}</div>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

8.1.2 Respond JavaScript directly without view

To respond JavaScript:

```
jsRespond("${'#error'}.html(%s)".format(jsEscape(<p class="error">Could not login.</p>)))
```

To redirect:

```
jsRedirectTo("http://cntt.tv/")  
jsRedirectTo[LoginAction]()
```

8.2 JSON

Xitrum includes [JSON4S](#). Please read about it to know how to parse and generate JSON.

To convert between Scala case object and JSON string:

```
import xitrum.util.SeriDeseri  
  
case class Person(name: String, age: Int, phone: Option[String])  
val person1 = Person("Jack", 20, None)  
val json    = SeriDeseri.toJson(person1)  
val person2 = SeriDeseri.fromJson[Person](json)
```

To respond JSON:

```
val scalaData = List(1, 2, 3) // An example  
respondJson(scalaData)
```

JSON is also neat for config files that need nested structures. See [Load config files](#) (page 93).

8.3 Plugin for Knockout.js

See <https://github.com/xitrum-framework/xitrum-ko>

Async response

List of normal responding methods:

- `respondView`: responds view template file, with or without layout
- `respondInlineView`: responds embedded template (not separate template file), with or without layout
- `respondText("hello")`: responds a string without layout
- `respondHtml("<html>...</html>")`: same as above, with content type set to "text/html"
- `respondJson(List(1, 2, 3))`: converts Scala object to JSON object then responds
- `respondJs("myFunction([1, 2, 3])")`
- `respondJsonP(List(1, 2, 3), "myFunction")`: combination of the above two
- `respondJsonText("[1, 2, 3]")`
- `respondJsonPText("[1, 2, 3]", "myFunction")`
- `respondBinary`: responds an array of bytes
- `respondFile`: sends a file directly from disk, very fast because [zero-copy](#) (aka send-file) is used
- `respondEventSource("data", "event")`

Xitrum does not automatically send any default response. You must explicitly call `respondXXX` methods above to send response. If you don't call `respondXXX`, Xitrum will keep the HTTP connection for you, and you can call `respondXXX` later.

To check if the connection is still open, call `channel.isOpen`. You can also use `addConnectionClosedListener`:

```
addConnectionClosedListener {
  // The connection has been closed
  // Unsubscribe from events, release resources etc.
}
```

Because of the async nature, the response is not sent right away. `respondXXX` returns [ChannelFuture](#). You can use it to perform actions when the response has actually been sent.

For example, if you want to close the connection after the response has been sent:

```
import io.netty.channel.{ChannelFuture, ChannelFutureListener}

val future = respondText("Hello")
future.addListener(new ChannelFutureListener {
  def operationComplete(future: ChannelFuture) {
```

```
    future.getChannel.close()
  }
})
```

Or shorter:

```
respondText("Hello").addListener(ChannelFutureListener.CLOSE)
```

9.1 WebSocket

```
import scala.runtime.ScalaRunTime
import xitrum.annotation.WEBSOCKET
import xitrum.{WebSocketAction, WebSocketBinary, WebSocketText, WebSocketPing, WebSocketPong}

@WEBSOCKET("echo")
class EchoWebSocketActor extends WebSocketAction {
  def execute() {
    // Here you can extract session data, request headers etc.
    // but do not use respondText, respondView etc.
    // To respond, use respondWebSocketXXX like below.

    log.debug("onOpen")

    context.become {
      case WebSocketText(text) =>
        log.info("onTextMessage: " + text)
        respondWebSocketText(text.toUpperCase)

      case WebSocketBinary(bytes) =>
        log.info("onBinaryMessage: " + ScalaRunTime.stringOf(bytes))
        respondWebSocketBinary(bytes)

      case WebSocketPing =>
        log.debug("onPing")

      case WebSocketPong =>
        log.debug("onPong")
    }
  }

  override def postStop() {
    log.debug("onClose")
    super.postStop()
  }
}
```

An actor will be created when there's request. It will be stopped when:

- The connection is closed
- WebSocket close frame is received or sent

Use these to send WebSocket frames:

- `respondWebSocketText`
- `respondWebSocketBinary`
- `respondWebSocketPing`

- `respondWebSocketClose`

There's no `respondWebSocketPong`, because Xitrum will automatically send pong frame for you when it receives ping frame.

To get URL to the above WebSocket action:

```
// Probably you want to use this in Scalate view etc.
val url = websocketAbsUrl[EchoWebSocketActor]
```

9.2 SockJS

SockJS is a browser JavaScript library that provides a WebSocket-like object, for browsers that don't support WebSocket. SockJS tries to use WebSocket first. If that fails it can use a variety of ways but still presents them through the WebSocket-like object.

If you want to work with WebSocket API on all kind of browsers, you should use SockJS and avoid using WebSocket directly.

```
<script>
  var sock = new SockJS('http://mydomain.com/path_prefix');
  sock.onopen = function() {
    console.log('open');
  };
  sock.onmessage = function(e) {
    console.log('message', e.data);
  };
  sock.onclose = function() {
    console.log('close');
  };
</script>
```

Xitrum includes the JavaScript file of SockJS. In your view template, just write like this:

```
...
html
  head
    != jsDefaults
...
```

SockJS does require a **server counterpart**. Xitrum automatically does it for you.

```
import xitrum.{Action, SockJsAction, SockJsText}
import xitrum.annotation.SOCKJS

@SOCKJS("echo")
class EchoSockJsActor extends SockJsAction {
  def execute() {
    // To respond, use respondSockJsXXX like below

    log.info("onOpen")

    context.become {
      case SockJsText(text) =>
        log.info("onMessage: " + text)
        respondSockJsText(text)
    }
  }
}
```

```
override def postStop() {  
  log.info("onClose")  
  super.postStop()  
}  
}
```

An actor will be created when there's a new SockJS session. It will be stopped when the SockJS session is closed.

Use these to send SockJS frames:

- `respondSockJsText`
- `respondSockJsClose`

See [Various issues and design considerations](#):

Basically cookies are not suited for SockJS model. If you want to authorize a session, provide a unique token on a page, send it as a first thing over SockJS connection and validate it on the server side. In essence, this is how cookies work.

To config SockJS clustering, see [Clustering with Akka](#) (page 81).

9.3 Chunked response

To send [chunked response](#):

1. Call `setChunked`
2. Call `respondXXX` as many times as you want
3. Lastly, call `respondLastChunk`

Chunked response has many use cases. For example, when you need to generate a very large CSV file that does may not fit memory, you can generate chunk by chunk and send them while you generate:

```
// "Cache-Control" header will be automatically set to:  
// "no-store, no-cache, must-revalidate, max-age=0"  
//  
// Note that "Pragma: no-cache" is linked to requests, not responses:  
// http://palizine.plynt.com/issues/2008Jul/cache-control-attributes/  
setChunked()  
  
val generator = new MyCsvGenerator  
  
generator.onFirstLine { line =>  
  val future = respondText(header, "text/csv")  
  future.addListener(new ChannelFutureListener {  
    def operationComplete(future: ChannelFuture) {  
      if (future.isSuccess) generator.next()  
    }  
  })  
}  
  
generator.onNextLine { line =>  
  val future = respondText(line)  
  future.addListener(new ChannelFutureListener {  
    def operationComplete(future: ChannelFuture) {  
      if (future.isSuccess) generator.next()  
    }  
  })  
}
```



```

    }
  })
}

generator.onLastLine { line =>
  val future = respondText(line)
  future.addListener(new ChannelFutureListener {
    def operationComplete(future: ChannelFuture) {
      if (future.isSuccess) respondLastChunk()
    }
  })
}

generator.generate()

```

Notes:

- Headers are sent on the first `respondXXX` call.
- You can send optional trailing headers at `respondLastChunk`
- [Page and action cache](#) (page 63) cannot be used with chunked response.

Using chunked response together with `ActorAction`, you can easily implement [Facebook BigPipe](#).

9.3.1 Forever iframe

Chunked response [can be used](#) for [Comet](#).

The page that embeds the iframe:

```

...
<script>
  var functionForForeverIframeSnippetsToCall = function() {...}
</script>
...
<iframe width="1" height="1" src="path/to/forever/iframe"></iframe>
...

```

The action that responds `<script>` snippets forever:

```

// Prepare forever iframe

setChunked()

// Need something like "123" for Firefox to work
respondText("<html><body>123", "text/html")

// Most clients (even curl!) do not execute <script> snippets right away,
// we need to send about 2KB dummy data to bypass this problem
for (i <- 1 to 100) respondText("<script></script>\n")

```

Later, whenever you want to pass data to the browser, just send a snippet:

```

if (channel.isOpen)
  respondText("<script>parent.functionForForeverIframeSnippetsToCall()</script>\n")
else
  // The connection has been closed, unsubscribe from events etc.
  // You can also use ``addConnectionClosedListener``.

```

9.3.2 Event Source

See <http://dev.w3.org/html5/eventsource/>

Event Source response is a special kind of chunked response. Data must be UTF-8.

To respond event source, call `respondEventSource` as many time as you want.

```
respondEventSource("data1", "event1") // Event name is "event1"
respondEventSource("data2")           // Event name is set to "message" by default
```

Static files

10.1 Serve static files on disk

Project directory layout:

```
config
public
  favicon.ico
  robots.txt
  404.html
  500.html
  img
    myimage.png
  css
    mystyle.css
  js
    myscript.js
src
build.sbt
```

Xitrum automatically serves static files inside `public` directory. URLs to them are in the form:

```
/img/myimage.png
/css/mystyle.css
/css/mystyle.min.css
```

To refer to them:

```
<img src={publicUrl("img/myimage.png")} />
```

To serve normal file in development environment and its minimized version in production environment (`mystyle.css` and `mystyle.min.css` as above):

```
<img src={publicUrl("css", "mystyle.css", "mystyle.min.css")} />
```

To send a static file on disk from your action, use `respondFile`.

```
respondFile("/absolute/path")
respondFile("path/relative/to/the/current/working/directory")
```

To optimize static file serving speed, you can avoid unnecessary file existence check with `regex` filter. If request url does not match `pathRegex`, Xitrum will respond 404 for that request.

See `pathRegex` in `config/xitrum.conf`.

10.2 index.html fallback

If there's no route (no action) for URL `/foo/bar` (or `/foo/bar/`), Xitrum will try to look for static file `public/foo/bar/index.html` (in the "public" directory). If the file exists, Xitrum will respond it to the client.

10.3 404 and 500

`404.html` and `500.html` in `public` directory are used when there's no matching route and there's error processing request, respectively. If you want to use your own error handler:

```
import xitrum.Action
import xitrum.annotation.{Error404, Error500}

@Error404
class My404ErrorHandlerAction extends Action {
  def execute() {
    if (isAjax)
      jsRespond("alert(" + jsEscape("Not Found") + ")")
    else
      renderInlineView("Not Found")
  }
}

@Error500
class My500ErrorHandlerAction extends Action {
  def execute() {
    if (isAjax)
      jsRespond("alert(" + jsEscape("Internal Server Error") + ")")
    else
      renderInlineView("Internal Server Error")
  }
}
```

Response status is set to 404 or 500 before the actions are executed, so you don't have to set yourself.

10.4 Serve resource files in classpath with WebJars convention

10.4.1 WebJars

WebJars provides a lot of web libraries that you can declare as a dependency in your project.

For example, if you want to use [Underscore.js](#), declare in your project's `build.sbt` like this:

```
libraryDependencies += "org.webjars" % "underscorejs" % "1.6.0-3"
```

Then in your `.jade` template file:

```
script(src={webJarsUrl("underscorejs/1.6.0", "underscore.js", "underscore-min.js")})
```

Xitrum will automatically use `underscore.js` for development environment and `underscore-min.js` for production environment.

The result will look like this:

```
/webjars/underscorejs/1.6.0/underscore.js?XOKgP8_KIpqz9yUqZ1aVzw
```

If you want to use the same file for both environments:

```
script(src={webJarsUrl("underscorejs/1.6.0/underscore.js")})
```

Dependencies of a dependency are automatically downloaded. If you see that the version you want is not selected (you can confirm by running `sbt xitrum-package` and see files in the created directory `target/xitrum/lib`), you can force it with `dependencyOverrides`. For example, if you see that jQuery 2.x is selected, but you want to support Internet Explorer 6, 7, or 8, you need to force jQuery 1.x like this:

```
dependencyOverrides += "org.webjars" % "jquery" % "1.11.3"
```

10.4.2 Save resource file inside .jar file with WebJars convention

If you are a library developer and want to serve `myimage.png` from your library, which is a .jar file in classpath, save `myimage.png` in your .jar file with [WebJars](#) convention, example:

```
META-INF/resources/webjars/mylib/1.0/myimage.png
```

To serve it:

```
<img src={webJarsUrl("mylib/1.0/myimage.png")} />
```

In both development and production environments, the URL will be:

```
/webjars/mylib/1.0/myimage.png?xyz123
```

10.4.3 Respond a file in classpath

To respond a file inside an classpath element (a .jar file or a directory), even when the file is not saved with [WebJars](#) convention:

```
respondResource("path/relative/to/the/classpath/element")
```

Ex:

```
respondResource("akka/actor/Actor.class")
respondResource("META-INF/resources/webjars/underscorejs/1.6.0/underscore.js")
respondResource("META-INF/resources/webjars/underscorejs/1.6.0/underscore-min.js")
```

10.5 Client side cache with ETag and max-age

Xitrum automatically adds [ETag](#) for static files on disk and in classpath.

ETags for small files are MD5 of file content. They are cached for later use. Keys of cache entries are (file path, modified time). Because modified time on different servers may differ, each web server in a cluster has its own local ETag cache.

For big files, only modified time is used as ETag. This is not perfect because not identical file on different servers may have different ETag, but it is still better than no ETag at all.

`publicUrl` and `webJarsUrl` automatically add ETag to the URLs they generate. For example:

```
webJarsUrl("jquery/2.1.1/jquery.min.js")  
=> /webjars/jquery/2.1.1/jquery.min.js?0CHJg7lucpG00lzB-y6-mQ
```

Xitrum also sets `max-age` and `Expires` headers to **one year**. Don't worry that browsers do not pickup a latest file when you change it. Because when a file on disk changes, its `modified time` changes, thus the URLs generated by `publicUrl` and `webJarsUrl` also change. Its ETag cache is also updated because the cache key changes.

10.6 GZIP

Xitrum automatically gzips textual responses. It checks the `Content-Type` header to determine if a response is textual: `text/html`, `xml/application` etc.

Xitrum always gzips static textual files, but for dynamic textual responses, for overall performance reason it does not gzips response smaller than 1 KB.

10.7 Server side cache

To avoid loading files from disk, Xitrum caches small static files (not only textual) in memory with LRU (Least Recently Used) expiration. See `small_static_file_size_in_kb` and `max_cached_small_static_files` in `config/xitrum.conf`.

Serve flash socket policy file

Read about flash socket policy:

- http://www.adobe.com/devnet/flashplayer/articles/socket_policy_files.html
- http://www.lightsphere.com/dev/articles/flash_socket_policy.html

The protocol to serve flash socket policy file is different from HTTP. To serve:

1. Modify `config/flash_socket_policy.xml` appropriately
2. Modify `config/xitrum.conf` to enable serving the above file

12.1 Request

12.1.1 Kinds of params

There are 2 kinds of request params: textual params and file upload params (binary).

There are 3 kinds of textual params, of type `scala.collection.mutable.Map[String, Seq[String]]`:

1. `queryParams`: params after the `?` mark in the URL, example: <http://example.com/blah?x=1&y=2>
2. `bodyTextParams`: params in POST request body
3. `pathParams`: params embedded in the URL, example: `GET("articles/:id/:title")`

These params are merged in the above order as `textParams` (from 1 to 3, the latter will override the former).

`bodyFileParams` is of type `scala.collection.mutable.Map[String, Seq[FileUpload]]`.

12.1.2 Accessing params

From an action, you can access the above params directly, or you can use accessor methods.

To access `textParams`:

- `param("x")`: returns `String`, throws exception if `x` does not exist
- `paramo("x")`: returns `Option[String]`
- `params("x")`: returns `Seq[String]`, `Seq.empty` if `x` does not exist

You can convert text params to other types (`Int`, `Long`, `Fload`, `Double`) automatically by using `param[Int]("x")`, `params[Int]("x")` etc. To convert text params to more types, override `convertTextParam`.

For file upload: `param[FileUpload]("x")`, `params[FileUpload]("x")` etc. For more details, see [Upload chapter](#) (page 59).

12.1.3 “at”

To pass things around when processing a request (e.g. from action to view or layout) you can use `at`. `at` type is `scala.collection.mutable.HashMap[String, Any]`. If you know Rails, you'll see `at` is a clone of `@` of Rails.

Articles.scala

```
@GET("articles/:id")
class ArticlesShow extends AppAction {
  def execute() {
    val (title, body) = ... // Get from DB
    at("title") = title
    respondInlineView(body)
  }
}
```

AppAction.scala

```
import xitrum.Action
import xitrum.view.DocType

trait AppAction extends Action {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCsrfMeta}
        {xitrumCss}
        {jsDefaults}
        <title>{if (at.isDefinedAt("title")) "My Site - " + at("title") else "My Site"}</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

12.1.4 “atJson”

atJson helper method automatically converts at ("key") to JSON. It is useful when you need to pass model from Scala to JavaScript.

atJson("key") is equivalent to `xitrum.util.SeriDeseri.toJson(at("key"))`:

Action.scala

```
case class User(login: String, name: String)

...

def execute() {
  at("user") = User("admin", "Admin")
  respondView()
}
```

Action.ssp

```
<script type="text/javascript">
  var user = ${atJson("user")};
  alert(user.login);
  alert(user.name);
</script>
```

12.1.5 RequestVar

at in the above section is not typesafe because you can set anything to the map. To be more typesafe, you should use RequestVar, which is a wrapper around at.

RVar.scala

```
import xitrum.RequestVar

object RVar {
  object title extends RequestVar[String]
}
```

Articles.scala

```
@GET("articles/:id")
class ArticlesShow extends AppAction {
  def execute() {
    val (title, body) = ... // Get from DB
    RVar.title.set(title)
    respondInlineView(body)
  }
}
```

AppAction.scala

```
import xitrum.Action
import xitrum.view.DocType

trait AppAction extends Action {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCsrfMeta}
        {xitrumCss}
        {jsDefaults}
        <title>{if (RVar.title.isDefined) "My Site - " + RVar.title.get else "My Site"}</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

12.2 Cookie

Read Wikipedia about [cookies](#).

Inside an action, use requestCookies, a Map[String, String], to read cookies sent by browser.

```
requestCookies.get("myCookie") match {
  case None          => ...
  case Some(string) => ...
}
```

To send cookie to browser, create an instance of `DefaultCookie` and append it to `responseCookies`, an `ArrayBuffer` that contains `Cookie`.

```
val cookie = new DefaultCookie("name", "value")
cookie.setHttpOnly(true) // true: JavaScript cannot access this cookie
responseCookies.append(cookie)
```

If you don't set cookie's path by calling `cookie.setPath(cookiePath)`, its path will be set to the site's root path (`xitrum.Config.withBaseUrl("/")`). This avoids accidental duplicate cookies.

To delete a cookie sent by browser, send a cookie with the same name and set its max age to 0. The browser will expire it immediately. To tell browser to delete cookie when the browser closes windows, set max age to `Long.MinValue`:

```
cookie.setMaxAge(Long.MinValue)
```

Internet Explorer does not support “max-age”, but Netty detects and outputs either “max-age” or “expires” properly. Don't worry!

Browsers will not send cookie attributes back to the server. They will **only send the cookie name-value pairs**.

If you want to sign your cookie value to prevent user from tampering, use `xitrum.util.SeriDeseri.toSecureUrlSafeBase64` and `xitrum.util.SeriDeseri.fromSecureUrlSafeBase64`. For more information, see [How to encrypt data](#) (page 93).

12.2.1 Allowed characters in cookie

You cannot use **arbitrary characters in cookie**. For example, if you need to use UTF-8 characters, you need to encode them. You can use `xitrum.util.UrlSafeBase64` or `xitrum.util.SeriDeseri`.

Write cookie example:

```
import io.netty.util.CharsetUtil
import xitrum.util.UrlSafeBase64

val value = """{"identity":"example@gmail.com","first_name":"Alexander"}"""
val encoded = UrlSafeBase64.noPaddingEncode(value.getBytes(CharsetUtil.UTF_8))
val cookie = new DefaultCookie("profile", encoded)
responseCookies.append(cookie)
```

Read cookie example:

```
requestCookies.get("profile").foreach { encoded =>
  UrlSafeBase64.autoPaddingDecode(encoded).foreach { bytes =>
    val value = new String(bytes, CharsetUtil.UTF_8)
    println("profile: " + value)
  }
}
```

12.3 Session

Session storing, restoring, encrypting etc. is done automatically by Xitrum. You don't have to mess with them.

In your actions, you can use `session`. It is an instance of `scala.collection.mutable.Map[String, Any]`. Things in `session` must be serializable.

For example, to mark that a user has logged in, you can set his username into the session:

```
session("userId") = userId
```

Later, if you want to check if a user has logged in or not, just check if there's a username in his session:

```
if (session.isDefinedAt("userId")) println("This user has logged in")
```

Storing user ID and pull the user from database on each access is usually a good practice. That way changes to the user are updated on each access (including changes to user roles/authorizations).

12.3.1 session.clear()

One line of code will protect you from session fixation.

Read the link above to know about session fixation. To prevent session fixation attack, in the action that lets users login, call `session.clear()`.

```
@GET("login")
class LoginAction extends Action {
  def execute() {
    ...
    session.clear() // Reset first before doing anything else with the session
    session("userId") = userId
  }
}
```

To log users out, also call `session.clear()`.

12.3.2 SessionVar

`SessionVar`, like `RequestVar`, is a way to make your session more typesafe.

For example, you want save username to session after the user has logged in:

Declare the session var:

```
import xitrum.SessionVar

object SVar {
  object username extends SessionVar[String]
}
```

After login success:

```
SVar.username.set(username)
```

Display the username:

```
if (SVar.username.isDefined)
  <em>{SVar.username.get}</em>
else
  <a href={url[LoginAction]}>Login</a>
```

- To remove the session var: `SVar.username.remove()`
- To reset the whole session: `session.clear()`

12.3.3 Session stores

Xitrum provides 3 session stores. In `config/xitrum.conf` you can config the session store you want:

CookieSessionStore:

```
# Store sessions on client side
store = xitrum.session.CookieSessionStore
```

LruSessionStore:

```
# Simple in-memory server side session store
store {
  "xitrum.local.LruSessionStore" {
    maxElems = 10000
  }
}
```

If you run multiple servers in a cluster, you can use [Hazelcast](#) to store cluster-aware sessions,

Note that when you use `CookieSessionStore` or `Hazelcast`, your session data must be serializable. If you must store unserializable things, use `LruSessionStore`. If you use `LruSessionStore` and still want to run a cluster of multiple servers, you must use a load balancer that supports sticky sessions.

The three default session stores above are enough for normal cases. If you have a special case and want to implement your own session store, extend [SessionStore](#) or [ServerSessionStore](#) and implement the abstract methods.

The config can be in one of the following 2 forms:

```
store = my.session.StoreClassName
```

Or:

```
store {
  "my.session.StoreClassName" {
    option1 = value1
    option2 = value2
  }
}
```

Store sessions at client side cookie when you can (serializable and [smaller than 4KB](#)), because it's more scalable. Store sessions at server side (memory or DB) when you must.

Good read: [Web Based Session Management - Best practices in managing HTTP-based client sessions](#).

12.3.4 Client side session store vs Server side session store

There are 2 kinds of session stores:

- Client side only
- Client side + server side combination

Client side only:

- Session data is stored in encrypted cookie at client.
- The server doesn't need to store anything.
- When a request comes in, the server will decrypt the data.

Client side + server side combination:

- A session has 2 parts: session ID and session data.
- The server keeps the session store, which is like a lookup table: ID -> data.
- The ID is also stored in encrypted cookie at client.
- When a request comes in, the server will decrypt the ID, and use the ID to lookup the data.
- This is like your credit card. Your money is not stored in the credit card, only your ID.

In both cases the client must always keep something in the cookie (encrypted data vs encrypted ID). “Store sessions at server side” only means storing session data at server side.

12.4 object vs. val

Please use `object` instead of `val`.

Do not do like this:

```
object RVar {
  val title    = new RequestVar[String]
  val category = new RequestVar[String]
}

object SVar {
  val username = new SessionVar[String]
  val isAdmin  = new SessionVar[Boolean]
}
```

The above code compiles but does not work correctly, because the Vars internally use class names to do look up. When using `val`, `title` and `category` will have the same class name “`xitrum.RequestVar`”. The same for `username` and `isAdmin`.

Validation

Xitrum includes [jQuery Validation plugin](#) for validation at client side and provides validation helpers for server side.

13.1 Default validators

Xitrum provides validators in `xitrum.validator` package. They have these methods:

```
check(value): Boolean
message(name, value): Option[String]
exception(name, value)
```

If the validation check does not pass, message will return `Some(error message)`, exception will throw `xitrum.exception.InvalidInput(error message)`.

You can use validators anywhere you want.

Action example:

```
import xitrum.validator.Required

@POST("articles")
class CreateArticle {
  def execute() {
    val title = param("title")
    val body = param("body")
    Required.exception("Title", title)
    Required.exception("Body", body)

    // Do with the valid title and body...
  }
}
```

If you don't try and catch, when the validation check does not pass, Xitrum will automatically catch the exception and respond the error message to the requesting client. This is convenient when writing web APIs or when you already have validation at the client side.

Model example:

```
import xitrum.validator.Required

case class Article(id: Int = 0, title: String = "", body: String = "") {
  def isValid = Required.check(title) && Required.check(body)
```

```
def validationMessage = Required.message(title) orElse Required.message(body)
}
```

See [xitrum.validator](#) package for the full list of default validators.

13.2 Write custom validators

Extend [xitrum.validator.Validator](#). You only have to implement `check` and `message` method.

You can also use [Commons Validator](#).

File upload

See also [Scopes chapter](#) (page 49).

In your upload form, remember to set `enctype` to `multipart/form-data`.

MyUpload.scilate:

```
form(method="post" action={url[MyUpload]} enctype="multipart/form-data")
  != antiCsrfInput

  label Please select a file:
  input(type="file" name="myFile")

  button(type="submit") Upload
```

In MyUpload action:

```
import io.netty.handler.codec.http.multipart.FileUpload

val myFile = param[FileUpload]("myFile")
```

`myFile` is an instance of `FileUpload`. Use its methods to get file name, move file to a directory etc.

Small files (less than 16 KB) will be saved in memory. Big files will be saved in the system temporary directory (or the directory specified by `xitrum.request.tmpUploadDir` in `xitrum.conf`), and will be deleted automatically when the connection is closed or when the response is sent.

14.1 Ajax style upload

There are many JavaScript libraries that support Ajax style upload. They use hidden iframe or Flash to send the `multipart/form-data` above to the server. If you are not sure which request parameter the libraries use in the form to send file, see Xitrum access log.

Action filters

15.1 Before filters

Before filters are run before an action is run. If a before filter responds something, all filters after it and the action will not be run.

```
import xitrum.Action
import xitrum.annotation.GET

@GET("before_filter")
class MyAction extends Action {
  beforeFilter {
    log.info("I run therefore I am")
  }

  // This method is run after the above filters
  def execute() {
    respondInlineView("Before filters should have been run, please check the log")
  }
}
```

15.2 After filters

After filters are run after an action is run. They are functions that take no argument. Their return value will be ignored.

```
import xitrum.Action
import xitrum.annotation.GET

@GET("after_filter")
class MyAction extends Action {
  afterFilter {
    log.info("Run at " + System.currentTimeMillis())
  }

  def execute() {
    respondText("After filter should have been run, please check the log")
  }
}
```

15.3 Around filters

```
import xitrum.Action
import xitrum.annotation.GET

@GET("around_filter")
class MyAction extends Action {
  aroundFilter { action =>
    val begin = System.currentTimeMillis()
    action()
    val end   = System.currentTimeMillis()
    val dt    = end - begin
    log.info(s"The action took $dt [ms]")
  }

  def execute() {
    respondText("Around filter should have been run, please check the log")
  }
}
```

If there are many around filters, they will be nested.

15.4 Execution order of filters

- Before filters are run first, then around filters, then after filters.
- If one of the before filters returns false, the rest (including around and after filters) will not be run.
- After filters are always run if at least an around filter is run.
- If an around filter decide not to call `action`, the inner nested around filters will not be run.

```
before1 -true-> before2 -true-> +-----+ --> after1 --> after2
                                | around1 (1 of 2) |
                                |  around2 (1 of 2) |
                                |   action         |
                                |  around2 (2 of 2) |
                                | around1 (2 of 2) |
                                +-----+
```

Server-side cache

Also see the chapter about [clustering](#) (page 81).

Xitrum provides extensive client-side and server-side caching for faster responding. At the web server layer, small files are cached in memory, big files are sent using NIO's zero copy. Xitrum's static file serving speed is [similar to that of Nginx](#). At the web framework layer you have can declare page, action, and object cache in the Rails style. [All Google's best practices](#) like conditional GET are applied for client-side caching.

For dynamic content, if the content does not change after created (as if it is a static file), you may set headers for clients to cache aggressively. In that case, call `setClientCacheAggressively()` in your action.

Sometimes you may want to prevent client-side caching. In that case, call `setNoClientCache()` in your action.

Server-side cache is discussed in more details below.

16.1 Cache page or action

```
import xitrum.Action
import xitrum.annotation.{GET, CacheActionMinute, CachePageMinute}

@GET("articles")
@CachePageMinute(1)
class ArticlesIndex extends Action {
  def execute() {
    ...
  }
}

@GET("articles/:id")
@CacheActionMinute(1)
class ArticlesShow extends Action {
  def execute() {
    ...
  }
}
```

The terms “page cache” and “action cache” came from [Ruby on Rails](#).

The order of processing a request is designed like this: (1) request -> (2) before filter methods -> (3) action's execute method -> (4) response

At the 1st request, Xitrum will cache the response for the time period specified. `@CachePageMinute(1)` or `@CacheActionMinute(1)` both mean caching for 1 minute. Xitrum only caches when the response status is “200

OK”. For example, response with status “500 Internal Server Error” or “302 Found” (redirect) will not be cached.

At the following requests to the same action, if the cached response is still within the specified time, Xitrum will just respond the cached response:

- For page cache, the order is (1) -> (4).
- For action cache, the order is (1) -> (2) -> (4), or just (1) -> (2) if one of the before filters return “false”.

So the difference is: For page cache, the before filters are not run.

Usually, page cache is used when the same response can be used for all users. Action cache is used when you want to run a before filter to “guard” the cached response, like checking if the user has logged in:

- If the user has logged in, he can use the cached response.
- If the user has not logged in, redirect him to the login page.

16.2 Cache object

You use methods in `xitrum.Config.xitrum.cache`, it’s an instance of `xitrum.Cache`.

Without an explicit TTL (time to live):

- `put(key, value)`

With an explicit TTL:

- `putSecond(key, value, seconds)`
- `putMinute(key, value, minutes)`
- `putHour(key, value, hours)`
- `putDay(key, value, days)`

Only if absent:

- `putIfAbsent(key, value)`
- `putIfAbsentSecond(key, value, seconds)`
- `putIfAbsentMinute(key, value, minutes)`
- `putIfAbsentHour(key, value, hours)`
- `putIfAbsentDay(key, value, days)`

16.3 Remove cache

Remove page or action cache:

```
removeAction[MyAction]
```

Remove object cache:

```
remove(key)
```

Remove all keys that start with a prefix:

```
removePrefix(keyPrefix)
```


With `removePrefix`, you have the power to form hierarchical cache based on prefix. For example you want to cache things related to an article, then when the article changes, you want to remove all those things.

```
import xitrum.Config.xitrum.cache

// Cache with a prefix
val prefix = "articles/" + article.id
cache.put(prefix + "/likes", likes)
cache.put(prefix + "/comments", comments)

// Later, when something happens and you want to remove all cache related to the article
cache.remove(prefix)
```

16.4 Config

The cache feature in Xitrum is provided by cache engines. You can choose the engine that suits your need.

In `config/xitrum.conf`, you can config cache engine in one of the following 2 forms, depending on the engine you choose:

```
cache = my.cache.EngineClassName
```

Or:

```
cache {
  "my.cache.EngineClassName" {
    option1 = value1
    option2 = value2
  }
}
```

Xitrum provides this one:

```
cache {
  # Simple in-memory cache
  "xitrum.local.LruCache" {
    maxElems = 10000
  }
}
```

If you have a cluster of servers, you can use [Hazelcast](#).

If you want to create your own cache engine, implement the [interface](#) `xitrum.Cache`.

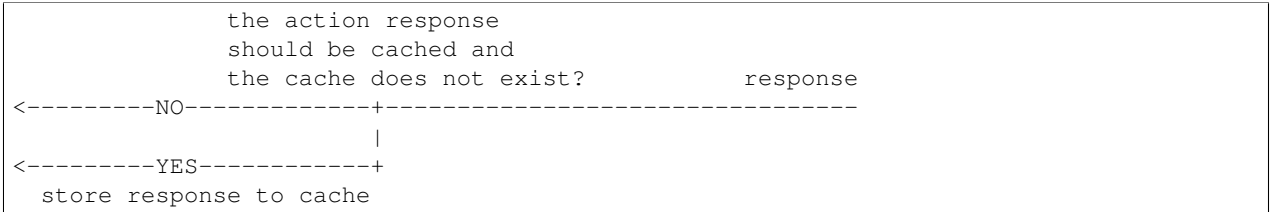
16.5 How cache works

Inbound:

```

                                the action response
                                should be cached and
request      the cache already exists?
-----+-----NO----->
      |
<-----YES-----+
      respond from cache
```

Outbound:



16.6 xitrum.util.LocalLruCache

The above cache is the cache shared by the whole system. If you only want a small convenient cache, you can use `xitrum.util.LocalLruCache`.

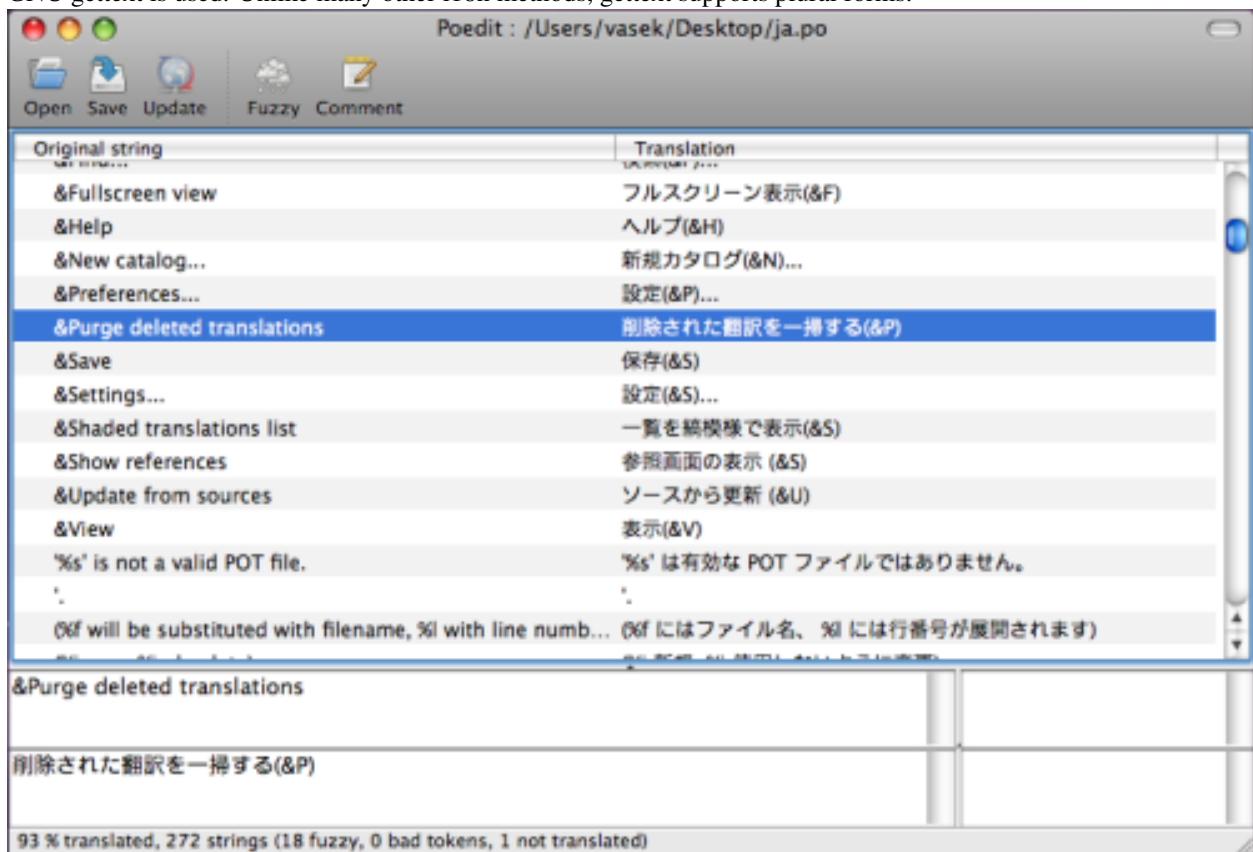
```
import xitrum.util.LocalLruCache

// LRU (Least Recently Used) cache that can contain 1000 elements.
// Keys and values are both of type String.
val cache = LocalLruCache[String, String](1000)
```

The returned cache is a [java.util.LinkedHashMap](#). You can call `LinkedHashMap` methods from it.

I18n

GNU gettext is used. Unlike many other i18n methods, gettext supports plural forms.



17.1 Write internationalized messages in source code

`xitrum.Action` extends `xitrum.I18n`, which has these methods:

```
t("Message")
tc("Context", "Message")
```

In a action or action, just call them. In other places like models, you need to pass the current action to them and call `t` and `tc` on it:

```
// In an action
respondText(MyModel.hello(this))

// In the model
import xitrum.I18n
object MyModel {
  def hello(i18n: I18n) = i18n.t("Hello World")
}
```

17.2 Extract messages to pot files

Create an empty `i18n.pot` file in your project's root directory, then recompile the whole project.

```
sbt/sbt clean
rm i18n.pot
touch i18n.pot
sbt/sbt compile
```

`sbt/sbt clean` is to delete all `.class` files, forcing SBT to recompile the whole project. Because after `sbt/sbt clean`, SBT will try to redownload all [dependencies](#) (page 99), you can do a little faster with the command `find target -name *.class -delete`, which deletes all `.class` files in the `target` directory.

After the recompilation, `i18n.pot` will be filled with gettext messages extracted from the source code. To do this magic, [Scala compiler plugin technique](#) is used.

One caveat of this method is that only gettext messages in Scala source code files are extracted. If you have Java files, you may want to extract manually using `xgettext` command line:

```
xgettext -kt -ktc:1c,2 -ktn:1,2 -ktn:1c,2,3 -o i18n_java.pot --from-code=UTF-8 $(find src/main/java
```

Then you manually merge `i18n_java.pot` to `i18n.pot`.

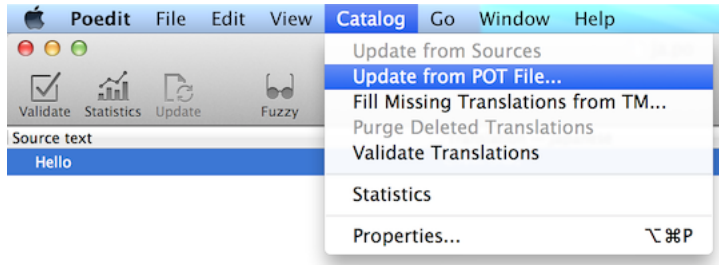
17.3 Where to save po files

`i18n.pot` is the template file. You need to copy it to `<language>.po` files and translate.

Xitrum monitors directories named `i18n` in classpath. If a `<language>.po` file in that directory is updated or added at runtime, Xitrum will automatically reload that `<language>.po` file.

```
src
  main
    scala
    view
    resources
      i18n
        ja.po
        vi.po
        ...
```

Use a tool like [Poedit](#) to edit po files. You can use it to merge newly created pot file to existing po files.



You can package po files in multiple JAR files. Xitrum will automatically merge them when running.

```
mylib.jar
  i18n
    ja.po
    vi.po
    ...

another.jar
  i18n
    ja.po
    vi.po
    ...
```

17.4 Set language

- To get languages set in the `Accept-Language` request header by the browser, call `browserLanguages`. The result is sorted by priority set by the browser, from high to low.
- The default current language is “en”. To set the current language, for example Japanese, call `language = "ja"`.
- To autoselect the most suitable language in resources, call `autoselectLanguage(resourceLanguages)`, where `resourceLanguages` is a list of available languages in `resources/i18n` directory and JAR files. If there’s no suitable language, the language is still the default “en”.
- To get the current language set above, use `language`.

In your action, typically in a before filter, to set language:

```
beforeFilter {
  val lango: Option[String] = yourMethodToGetUserPreferenceLanguageInSession()
  lango match {
    case None          => autoselectLanguage("ja", "vi")
    case Some(lang)    => language = lang
  }
}
```

17.5 Validation messages

jQuery Validation plugin provides `i18n error messages`. Xitrum automatically include the message file corresponding to the current language.

For server side default validators in `xitrum.validator` package, Xitrum also provide translation for them.

17.6 Plural forms

```
tn("Message", "Plural form", n)
tcn("Context", "Message", "Plural form", n)
```

Xitrum can only work correctly with Plural-Forms exactly listed at:

- [What are plural forms](#)
- [Translating plural forms](#)

Your plural forms must be exactly one of the following:

```
nplurals=1; plural=0
nplurals=2; plural=n != 1
nplurals=2; plural=n>1
nplurals=3; plural=n%10==1 && n%100!=11 ? 0 : n != 0 ? 1 : 2
nplurals=3; plural=n==1 ? 0 : n==2 ? 1 : 2
nplurals=3; plural=n==1 ? 0 : (n==0 || (n%100 > 0 && n%100 < 20)) ? 1 : 2
nplurals=3; plural=n%10==1 && n%100!=11 ? 0 : n%10>=2 && (n%100<10 || n%100>=20) ? 1 : 2
nplurals=3; plural=n%10==1 && n%100!=11 ? 0 : n%10>=2 && n%10<=4 && (n%100<10 || n%100>=20) ? 1 : 2
nplurals=3; plural=(n==1) ? 0 : (n>=2 && n<=4) ? 1 : 2
nplurals=3; plural=n==1 ? 0 : n%10>=2 && n%10<=4 && (n%100<10 || n%100>=20) ? 1 : 2
nplurals=4; plural=n%100==1 ? 0 : n%100==2 ? 1 : n%100==3 || n%100==4 ? 2 : 3
```

17.7 Date and number format

If you use Scalate template engine, by default the date and number format will be the format of the language of the current action.

If you want to use other format:

```
import java.text.{DateFormat, NumberFormat}

val myDateFormat    = ...
val myNumberFormat = ...
val options         = Map("date" -> myDateFormat, "number" -> myNumberFormat)
respondView(options)
```

18.1 Use object `xitrum.Log` directly

From anywhere, you can call like this directly:

```
xitrum.Log.debug("My debug msg")
xitrum.Log.info("My info msg")
...
```

18.2 Use trait `xitrum.Log`

If you want to have the information about where (which class) the log has been made, you should extend trait `xitrum.Log`:

```
package my_package
import xitrum.Log

object MyModel extends Log {
  log.debug("My debug msg")
  log.info("My info msg")
  ...
}
```

In file `log/xitrum.log` you will see that the log messages comes from `MyModel`.

Xitrum actions extend trait `xitrum.Log`, so in actions, you can do write:

```
log.debug("Hello World")
```

18.3 Don't have to check log level before logging

`xitrum.Log` is based on [SLF4S \(API\)](#), which is in turn based on [SLF4J](#).

Traditionally, before doing a heavy calculation to get a result to log, you have to check log level to avoid wasting CPU to do the calculation.

[SLF4S](#) automatically does the check, so you don't have to do the check yourself.

Before (this code doesn't work for the current Xitrum 3.13+ any more):

```
if (log.isTraceEnabled) {  
  val result = heavyCalculation()  
  log.trace("Output: {}", result)  
}
```

Now:

```
log.trace(s"Output: #{heavyCalculation()}")
```

18.4 Config log level, log output file etc.

In `build.sbt`, there's a line like this:

```
libraryDependencies += "ch.qos.logback" % "logback-classic" % "1.1.2"
```

This means that [Logback](#) is used by default. Logback config file is at `config/logback.xml`.

You may replace Logback with any other implementation of [SLF4J](#).

18.5 Log to Fluentd

[Fluentd](#) is a very popular log collector. You can configure Logback to send log (maybe from many places) to a Fluentd server.

First, add [logback-more-appenders](#) library to your project:

```
libraryDependencies += "org.fluentd" % "fluent-logger" % "0.2.11"  
  
resolvers += "Logback more appenders" at "http://sndyuk.github.com/maven"  
  
libraryDependencies += "com.sndyuk" % "logback-more-appenders" % "1.1.0"
```

Then, in `config/logback.xml`:

```
...  
  
<appender name="FLUENT" class="ch.qos.logback.more.appenders.DataFluentAppender">  
  <tag>mytag</tag>  
  <label>mylabel</label>  
  <remoteHost>localhost</remoteHost>  
  <port>24224</port>  
  <maxQueueSize>20000</maxQueueSize>  <!-- Save to memory when remote server is down -->  
</appender>  
  
<root level="DEBUG">  
  <appender-ref ref="FLUENT"/>  
  <appender-ref ref="OTHER_APPENDER"/>  
</root>  
  
...
```

Deploy to production server

You may run Xitrum directly:

```
Browser ----- Xitrum instance
```

Or behind a load balancer like HAProxy, or reverse proxy like Apache or Nginx:

```
Browser ----- Load balancer/Reverse proxy --+---- Xitrum instance1
                                                +---- Xitrum instance2
```

19.1 Package directory

Run `sbt/sbt xitrum-package` to prepare `target/xitrum` directory, ready to deploy to production server:

```
target/xitrum
  config
    [config files]
  public
    [static public files]
  lib
    [dependencies and packaged project file]
  script
    runner
    runner.bat
    scalive
    scalive.jar
    scalive.bat
```

19.2 Customize xitrum-package

By default `sbt/sbt xitrum-package` command is configured to copy directories `config`, `public`, and `script` to `target/xitrum`. If you want it to copy additional directories or files change `build.sbt` like this:

```
XitrumPackage.copy("config", "public", "script", "doc/README.txt", "etc.")
```

See [xitrum-package homepage](#) for more information.

19.3 Connect a Scala console to a running JVM process

In production environment, without prior setup, you can use [Scalive](#) to connect a Scala console to a running JVM process for live debugging.

Run `scalive` in the script directory:

```
script
runner
runner.bat
scalive
scalive.jar
scalive.bat
```

19.4 Install Oracle JDK on CentOS or Ubuntu manually

This guide is here for convenient reference. You can certainly install Java from a package manager.

Check installed alternatives:

```
sudo update-alternatives --list java
```

Output example:

```
/usr/lib/jvm/jdk1.7.0_15/bin/java
/usr/lib/jvm/jdk1.7.0_25/bin/java
```

Check machine environment (32 bit or 64 bit):

```
file /sbin/init
```

Output example:

```
/sbin/init: ELF 64-bit LSB shared object, x86-64, version 1 (SYSV), dynamically linked (uses shared l
```

Download JDK from [Oracle](#). There's a [trick](#) to download jdk without browser:

```
wget --no-cookies --header "Cookie: gpw_e24=http%3A%2F%2Fwww.oracle.com" "http://download.oracle.com
```

Unarchive and move it:

```
tar -xzvf jdk-7u45-linux-x64.tar.gz
sudo mv jdk1.7.0_45 /usr/lib/jvm/jdk1.7.0_45
```

Register commands as an alternative:

```
sudo update-alternatives --install "/usr/bin/java" "java" "/usr/lib/jvm/jdk1.7.0_45/bin/java" 1
sudo update-alternatives --install "/usr/bin/javac" "javac" "/usr/lib/jvm/jdk1.7.0_45/bin/javac" 1
sudo update-alternatives --install "/usr/bin/javap" "javap" "/usr/lib/jvm/jdk1.7.0_45/bin/javap" 1
sudo update-alternatives --install "/usr/bin/javaws" "javaws" "/usr/lib/jvm/jdk1.7.0_45/bin/javaws" 1
```

Chose new path with interactive shell:

```
sudo update-alternatives --config java
```

Output example:

There are 3 choices for the alternative java (providing /usr/bin/java).

Selection	Path	Priority	Status
* 0	/usr/lib/jvm/jdk1.7.0_25/bin/java	50001	auto mode
1	/usr/lib/jvm/jdk1.7.0_15/bin/java	50000	manual mode
2	/usr/lib/jvm/jdk1.7.0_25/bin/java	50001	manual mode
3	/usr/lib/jvm/jdk1.7.0_45/bin/java	1	manual mode

Press enter to keep the current choice[*], or type selection number: 3

update-alternatives: using /usr/lib/jvm/jdk1.7.0_45/bin/java to provide /usr/bin/java (java) in manual mode

Check version:

```
java -version
```

Output example:

```
java version "1.7.0_45"
Java(TM) SE Runtime Environment (build 1.7.0_45-b18)
Java HotSpot(TM) 64-Bit Server VM (build 24.45-b08, mixed mode)
```

Do also:

```
sudo update-alternatives --config javac
sudo update-alternatives --config javap
sudo update-alternatives --config javaws
```

19.5 Start Xitrum in production mode when the system starts

script/runner (for *nix) and script/runner.bat (for Windows) are the script to run any object with main method. Use it to start the web server in production environment.

```
script/runner quickstart.Boot
```

You may want to modify runner (or runner.bat) to tune [JVM settings](#). Also see config/xitrum.conf.

To start Xitrum in background on Linux when the system starts, a simple approach is to add a line to /etc/rc.local:

```
su - user_foo_bar -c /path/to/the/runner/script/above &
```

[daemontools](#) is another approach. To install it on CentOS, see [this instruction](#).

Or use [Supervisord](#). /etc/supervisord.conf example:

```
[program:my_app]
directory=/path/to/my_app
command=/path/to/my_app/script/runner quickstart.Boot
autostart=true
autorestart=true
startsecs=3
user=my_user
redirect_stderr=true
stdout_logfile=/path/to/my_app/log/stdout.log
stdout_logfile_maxbytes=10MB
stdout_logfile_backups=7
stdout_capture_maxbytes=1MB
```

```
stdout_events_enabled=false
environment=PATH=/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/sbin:/opt/aws/bin:~/bin
```

Other alternatives:

- [runit](#)
- [upstart](#)

19.6 Set up port forwarding

Xitrum listens on port 8000 and 4430 by default. You can change these ports in `config/xitrum.conf`.

You can update `/etc/sysconfig/iptables` with these commands to forward port 80 to 8000 and 443 to 4430:

```
sudo su - root
chmod 700 /etc/sysconfig/iptables
iptables-restore < /etc/sysconfig/iptables
iptables -A PREROUTING -t nat -i eth0 -p tcp --dport 80 -j REDIRECT --to-port 8000
iptables -A PREROUTING -t nat -i eth0 -p tcp --dport 443 -j REDIRECT --to-port 4430
iptables -t nat -I OUTPUT -p tcp -d 127.0.0.1 --dport 80 -j REDIRECT --to-ports 8000
iptables -t nat -I OUTPUT -p tcp -d 127.0.0.1 --dport 443 -j REDIRECT --to-ports 4430
iptables-save -c > /etc/sysconfig/iptables
chmod 644 /etc/sysconfig/iptables
```

Of course for example if you have Apache running on port 80 and 443, you have to stop it:

```
sudo /etc/init.d/httpd stop
sudo chkconfig httpd off
```

Good read:

- [Iptables tutorial](#)

19.7 Tune Linux for massive connections

Note that on Mac, JDKs suffer from a serious problem with IO (NIO) performance.

Good read:

- [Linux Performance Tuning \(Riak\)](#)
- [AWS Performance Tuning \(Riak\)](#)
- [Ipsysctl tutorial](#)
- [TCP variables](#)

19.7.1 Increase open file limit

Each connection is seen by Linux as an open file. The default maximum number of open file is 1024. To increase this limit, modify `/etc/security/limits.conf`:

```
* soft nofile 1024000
* hard nofile 1024000
```

You need to logout and login again for the above config to take effect. To confirm, run `ulimit -n`.

19.7.2 Tune kernel

As instructed in the article [A Million-user Comet Application with Mochiweb](#), modify `/etc/sysctl.conf`:

```
# General gigabit tuning
net.core.rmem_max = 16777216
net.core.wmem_max = 16777216
net.ipv4.tcp_rmem = 4096 87380 16777216
net.ipv4.tcp_wmem = 4096 65536 16777216

# This gives the kernel more memory for TCP
# which you need with many (100k+) open socket connections
net.ipv4.tcp_mem = 50576 64768 98152

# Backlog
net.core.netdev_max_backlog = 2048
net.core.somaxconn = 1024
net.ipv4.tcp_max_syn_backlog = 2048
net.ipv4.tcp_syncookies = 1

# If you run clients
net.ipv4.ip_local_port_range = 1024 65535
net.ipv4.tcp_tw_recycle = 1
net.ipv4.tcp_tw_reuse = 1
net.ipv4.tcp_fin_timeout = 10
```

Run `sudo sysctl -p` to apply. No need to reboot, now your kernel should be able to handle a lot more open connections.

19.7.3 Note about backlog

TCP does the 3-way handshake for making a connection. When a remote client connects to the server, it sends SYN packet, and the server OS replies with SYN-ACK packet, then again that remote client sends ACK packet and the connection is established. Xitrum gets the connection when it is completely established.

According to the article [Socket backlog tuning for Apache](#), connection timeout happens because of SYN packet loss which happens because backlog queue for the web server is filled up with connections sending SYN-ACK to slow clients.

According to the [FreeBSD Handbook](#), the default value of 128 is typically too low for robust handling of new connections in a heavily loaded web server environment. For such environments, it is recommended to increase this value to 1024 or higher. Large listen queues also do a better job of avoiding Denial of Service (DoS) attacks.

The backlog size of Xitrum is set to 1024 (memcached also uses this value), but you also need to tune the kernel as above.

To check the backlog config:

```
cat /proc/sys/net/core/somaxconn
```

Or:

```
sysctl net.core.somaxconn
```

To tune temporarily, you can do like this:

```
sudo sysctl -w net.core.somaxconn=1024
```

19.8 HAProxy tips

To config HAProxy for SockJS, see [this example](#).

To have HAProxy reload config file without restarting, see [this discussion](#).

HAProxy is much easier to use than Nginx. It suits Xitrum because as mentioned in [the section about caching](#) (page 63), Xitrum serves static files [very fast](#). You don't have to use the static file serving feature in Nginx.

19.9 Nginx tips

If you use WebSocket or SockJS feature in Xitrum and want to run Xitrum behind Nginx 1.2, you must install additional module like [nginx_tcp_proxy_module](#). Nginx 1.3+ supports WebSocket natively.

Nginx by default uses HTTP 1.0 protocol for reverse proxy. If your backend server returns chunked response, you need to tell Nginx to use HTTP 1.1 like this:

```
location / {
    proxy_http_version 1.1;
    proxy_set_header Connection "";
    proxy_pass http://127.0.0.1:8000;
}
```

The [documentation](#) states that for http keepalive, you should also set `proxy_set_header Connection ""`;

19.10 Deploy to Heroku

You may run Xitrum at [Heroku](#).

19.10.1 Sign up and create repository

Following the [Official Document](#), sign up and create git repository.

19.10.2 Create Procfile

Create Procfile and save it at project root directory. Heroku reads this file and executes on start.

```
web: target/xitrum/script/runner <YOUR_PACKAGE.YOUR_MAIN_CLASS>
```

19.10.3 Change port setting

Because Heroku assigns port automatically, you need to do like this:

config/xitrum.conf:

```
port {
    http          = ${PORT}
    # https       = 4430
    # flashSocketPolicy = 8430 # flash_socket_policy.xml will be returned
}
```

If you want to use SSL, you need [add on](#).

19.10.4 See log level

config/logback.xml:

```
<root level="INFO">
  <appender-ref ref="CONSOLE"/>
</root>
```

Tail log from Heroku command:

```
heroku logs -tail
```

19.10.5 Create alias for xitrum-package

At deploy time, Heroku runs `sbt/sbt clean compile stage`. So you need to add alias for `xitrum-package`.

build.sbt:

```
addCommandAlias("stage", ";xitrum-package")
```

19.10.6 Push to Heroku

Deploy process is hooked by git push.

```
git push heroku master
```

See also [Official document for Scala](#).

Clustering with Akka and Hazelcast

Xitrum is designed in mind to run in production environment as multiple instances behind a proxy server or load balancer:

```
Load balancer/proxy server / Xitrum instance 1
                          ---- Xitrum instance 2
                          \ Xitrum instance 3
```

Cache, sessions, and SockJS sessions can be clustered out of the box thanks to [Akka](#) and [Hazelcast](#).

With Hazelcast, Xitrum instances become in-process memory cache servers. You don't need separate things like Memcache.

Please see `config/akka.conf`, and read [Akka doc](#) and [Hazelcast doc](#) to know how to config Akka and Hazelcast clustering.

Note: For sessions, you can also [store them at client side in cookie](#) (page 49).

Netty handlers

This chapter is advanced, you don't have to know to use Xitrum normally. To understand, you must have knowledge about [Netty](#).

[Rack](#), [WSGI](#), and [PSGI](#) have middleware architecture. Xitrum is based on [Netty](#) which has the same thing called handlers. You can create additional handlers and customize the channel pipeline of handlers. Doing this, you can maximize server performance for your specific use case.

This chapter describes:

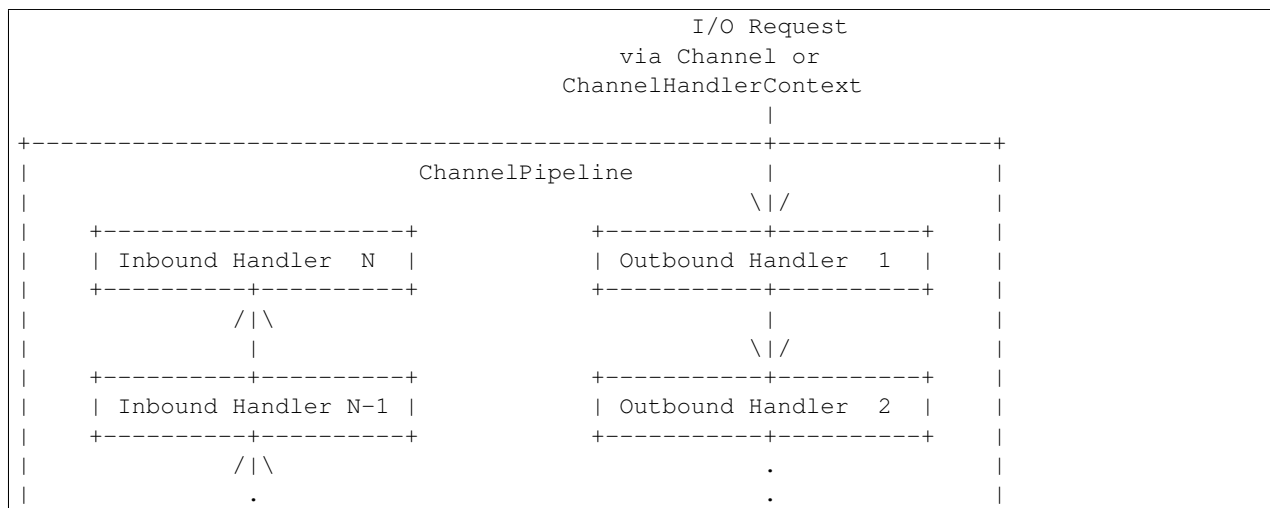
- Netty handler architecture
- Handlers that Xitrum provides and their default order
- How to create and use custom handler

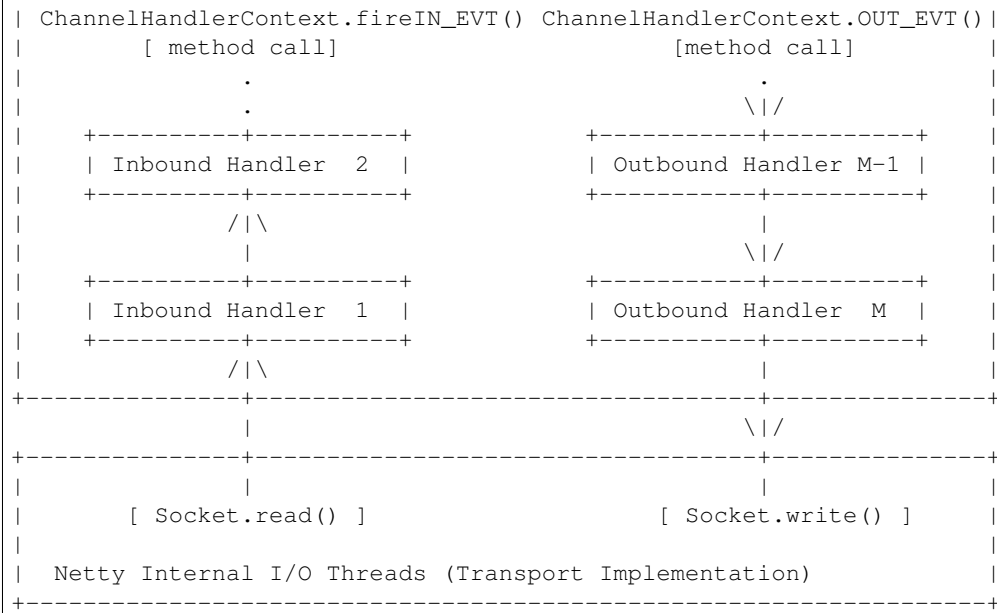
21.1 Netty handler architecture

For each connection, there is a channel pipeline to handle the IO data. A channel pipeline is a series of handlers. There are 2 types of handlers:

- Inbound: the request direction client -> server
- Outbound: the response direction server -> client

Please see the doc of [ChannelPipeline](#) for more information.





21.2 Custom handlers

When starting Xitrum server, you can pass in your own [ChannelInitializer](#):

```
import xitrum.Server

object Boot {
  def main(args: Array[String]) {
    Server.start(myChannelInitializer)
  }
}
```

For HTTPS server, Xitrum will automatically prepend SSL handler to the pipeline. You can reuse Xitrum handlers in your pipeline.

21.3 Xitrum default handlers

See [xitrum.handler.DefaultHttpChannelInitializer](#).

Sharable handlers (same instances are shared among many connections) are put in `DefaultHttpChannelInitializer` object above so that they can be easily picked up by apps that want to use custom pipeline. Those apps may only want a subset of default handlers.

For example, when an app uses its own dispatcher (not Xitrum's routing/dispatcher) and only needs Xitrum's fast static file serving, it may use only these handlers:

Inbound:

- `HttpRequestDecoder`
- `PublicFileServer`
- Its own dispatcher

Outbound:

- `HttpResponseEncoder`
- `ChunkedWriteHandler`
- `XSendFile`

Metrics

Xitrum collects JVM heap memory, CPU, and actions' execution status from each node of your application's Akka cluster. It publishes the metrics as JSON data. Xitrum also lets you publish your own metrics.

This metrics feature is based on the library [Coda Hale Metrics](#).

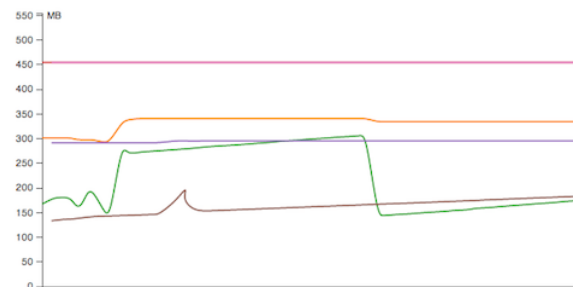
22.1 Collect metrics

22.1.1 Heap memory and CPU

JVM heap memory and CPU will be collected as [NodeMetrics](#) of Akka actor system from each node.

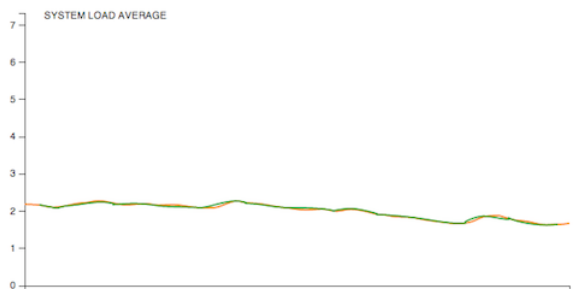
Heap memory:

Time	Node	Committed(MB)	Used(MB)	Max(MB)
2014/03/21 18:01:53	xitrum@127.0.0.1:2551#2097289586/302	167.3	455	
2014/03/21 18:01:58	xitrum@127.0.0.1:2552#1050982468/292	133.52	455	
2014/03/21 18:01:59	xitrum@127.0.0.1:2551#2097289586/302	179.61	455	
2014/03/21 18:02:02	xitrum@127.0.0.1:2551#2097289586/302	180.59	455	
2014/03/21 18:02:04	xitrum@127.0.0.1:2552#1050982468/292	136.14	455	
2014/03/21 18:02:04	xitrum@127.0.0.1:2552#1050982468/292	136.14	455	
2014/03/21 18:02:08	xitrum@127.0.0.1:2551#2097289586/302	181.74	455	
2014/03/21 18:02:07	xitrum@127.0.0.1:2552#1050982468/292	136.7	455	
2014/03/21 18:02:11	xitrum@127.0.0.1:2551#2097289586/298	160.48	455	
2014/03/21 18:02:10	xitrum@127.0.0.1:2552#1050982468/292	137.26	455	
2014/03/21 18:02:14	xitrum@127.0.0.1:2551#2097289586/298	164.34	455	
2014/03/21 18:02:17	xitrum@127.0.0.1:2551#2097289586/298	193.47	455	
2014/03/21 18:02:19	xitrum@127.0.0.1:2552#1050982468/292	142.06	455	
2014/03/21 18:02:20	xitrum@127.0.0.1:2551#2097289586/298	194.4	455	
2014/03/21 18:02:25	xitrum@127.0.0.1:2552#1050982468/292	142.86	455	
2014/03/21 18:02:22	xitrum@127.0.0.1:2552#1050982468/292	142.43	455	



CPU: Number of processors and load average

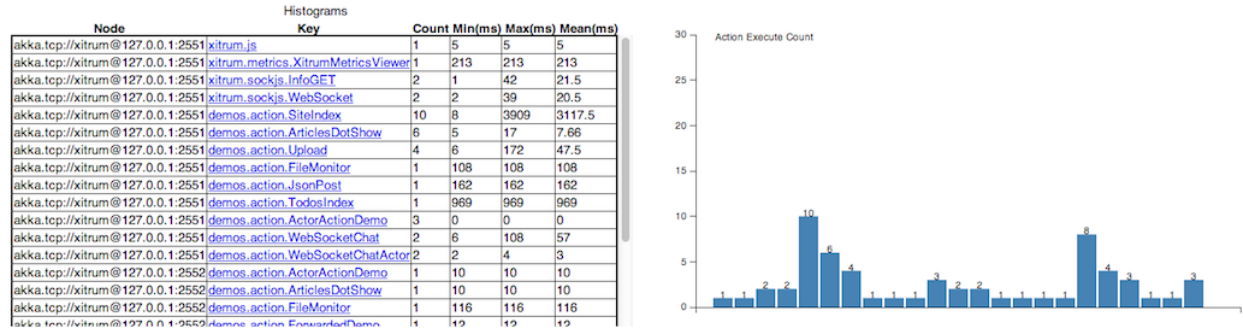
Time	Node	Processors	Load Average
2014/03/21 18:01:53	xitrum@127.0.0.1:2551#2097289586/4	2	1.8
2014/03/21 18:01:58	xitrum@127.0.0.1:2552#1050982468/4	2	1.7
2014/03/21 18:01:59	xitrum@127.0.0.1:2551#2097289586/4	2	1.7
2014/03/21 18:02:02	xitrum@127.0.0.1:2551#2097289586/4	2	0.7
2014/03/21 18:02:04	xitrum@127.0.0.1:2552#1050982468/4	2	0.7
2014/03/21 18:02:04	xitrum@127.0.0.1:2552#1050982468/4	2	0.7
2014/03/21 18:02:08	xitrum@127.0.0.1:2551#2097289586/4	2	1.5
2014/03/21 18:02:07	xitrum@127.0.0.1:2552#1050982468/4	2	1.5
2014/03/21 18:02:11	xitrum@127.0.0.1:2551#2097289586/4	2	2.2
2014/03/21 18:02:10	xitrum@127.0.0.1:2552#1050982468/4	2	1.5
2014/03/21 18:02:14	xitrum@127.0.0.1:2551#2097289586/4	2	2.2
2014/03/21 18:02:17	xitrum@127.0.0.1:2551#2097289586/4	2	2.8
2014/03/21 18:02:19	xitrum@127.0.0.1:2552#1050982468/4	2	2.8
2014/03/21 18:02:20	xitrum@127.0.0.1:2551#2097289586/4	2	2.8
2014/03/21 18:02:25	xitrum@127.0.0.1:2552#1050982468/4	2	1.7
2014/03/21 18:02:22	xitrum@127.0.0.1:2552#1050982468/4	2	1.7



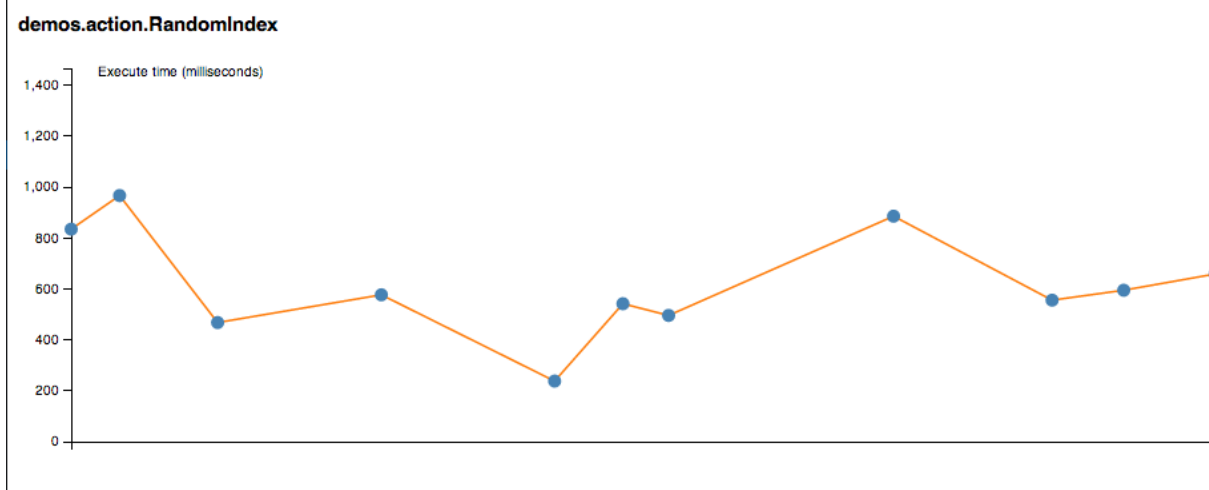
22.1.2 Action metrics

Xitrum measure actions' execution status of each node as a [Histogram](#). You can know how many times actions were executed, and execution time of non-async actions.

Application [Metrics Status](#)



Latest execution time of a specific action:



22.1.3 Collect your custom metrics

In addition to default metrics above, you can collect your custom metrics. `xitrum.Metrics` is a shortcut for gauge, counter, meter, timer and histogram. Please read about [Coda Hale Metrics](#) and its [Scala implementation](#) to know how to use them.

Timer example:

```
import xitrum.{Action, Metrics}
import xitrum.annotation.GET

object MyAction {
  lazy val myTimer = Metrics.timer("myTimer")
}

@GET("my/action")
class MyAction extends Action {
  import MyAction._

  def execute() {
```



```

myTimer.time {
  // Something that you want to measure execution time
  ...
}
...
}

```

22.2 Publish metrics

Xitrum publish latest value of metrics as JSON format with specified interval. This is a volatile value and not be kept in persistently.

HeapMemory:

```

{
  "TYPE"      : "heapMemory",
  "SYSTEM"    : akka.actor.Address.system,
  "HOST"      : akka.actor.Address.host,
  "PORT"      : akka.actor.Address.port,
  "HASH"      : akka.actor.Address.hashCode,
  "TIMESTAMP" : akka.cluster.NodeMetrics.timestamp,
  "USED"      : Number as byte,
  "COMMITTED" : Number as byte,
  "MAX"       : Number as byte
}

```

CPU:

```

{
  "TYPE"           : "cpu",
  "SYSTEM"         : akka.actor.Address.system,
  "HOST"           : akka.actor.Address.host,
  "PORT"           : akka.actor.Address.port,
  "HASH"           : akka.actor.Address.hashCode,
  "TIMESTAMP"      : akka.cluster.NodeMetrics.timestamp,
  "SYSTEMLOADAVERAGE" : Number,
  "CPUCOMBINED"    : Number,
  "PROCESSORS"     : Number
}

```

MetricsRegistry will be parsed with [metrics-json](#).

22.2.1 Xitrum default viewer

Xitrum provides default metrics viewer at URL `/xitrum/metrics/viewer?api_key=<see xitrum.conf>`. This URL shows graphs like above. The graphs are created using [D3.js](#).

The URL can be generated with:

```

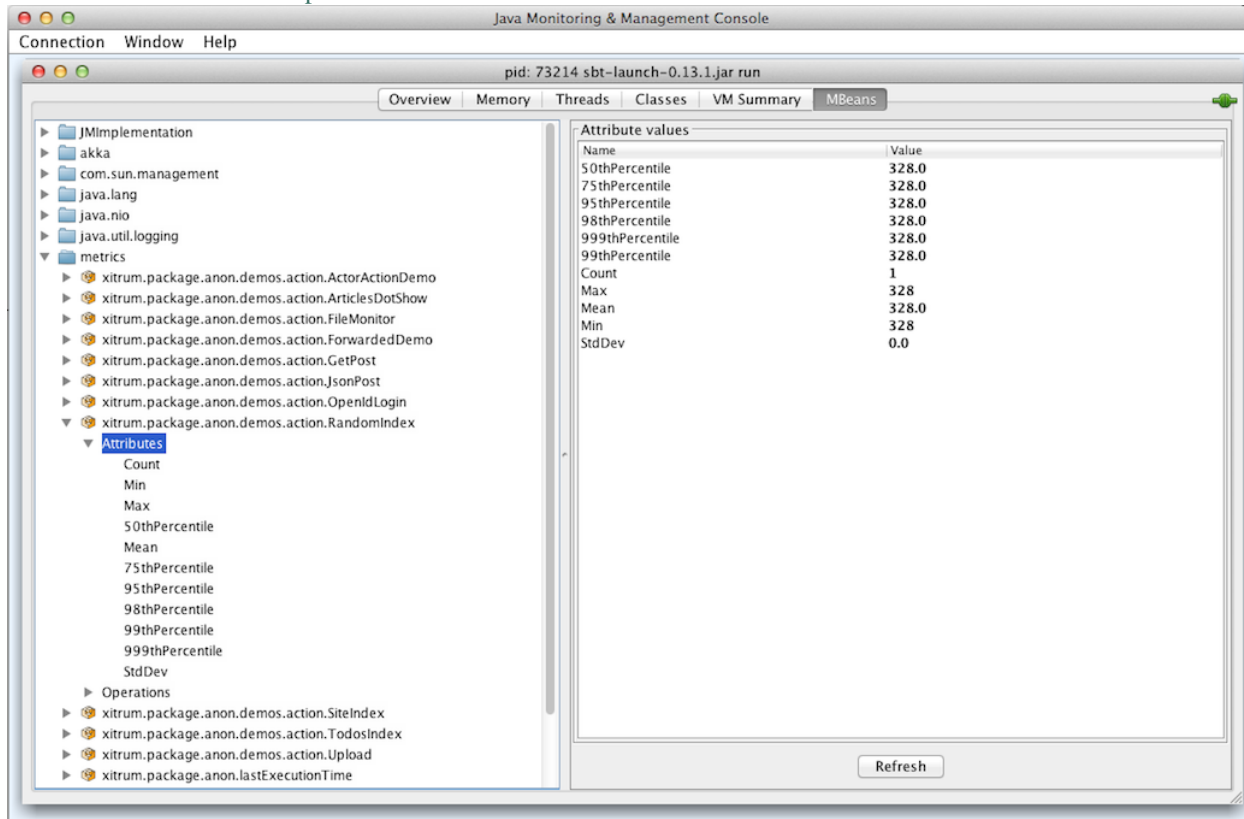
import xitrum.Config
import xitrum.metrics.XitrumMetricsViewer

url[XitrumMetricsViewer]("api_key" -> Config.xitrum.metrics.get.apiKey)

```

22.2.2 Jconsole viewer

You can see it with [JVM Reporter](#).



Start JMX reporter:

```
import com.codahale.metrics.JmxReporter

object Boot {
  def main(args: Array[String]) {
    Server.start()
    JmxReporter.forRegistry(xitrum.Metrics).build().start()
  }
}
```

Then run the `jconsole` command.

22.2.3 Display metrics with custom viewer

The metrics will be published at SockJS URL `xitrum/metrics/channel` as JSON. `jsAddMetricsNameSpace` is a convenient JavaScript snippet that Xitrum provides for creating connection to this endpoint.

Implement your own JSON handler, and call `initMetricsChannel` with your handler.

Action example:

```
import xitrum.annotation.GET
import xitrum.metrics.MetricsViewer
```

```

@GET("my/metrics/viewer")
class MySubscriber extends MetricsViewer {
  def execute() {
    jsAddMetricsNameSpace("window")
    jsAddToView("""
      function onValue(json) {
        console.log(json);
      }
      function onClose(){
        console.log("channel closed");
      }
      window.initMetricsChannel(onValue, onClose);
    """)
    respondView()
  }
}

```

22.2.4 Save metrics

To save memory, Xitrum doesn't remember old metrics values. If you want to save metrics to the database or files for later use, you need to implement your custom subscriber.

Example:

```

import akka.actor.Actor
import xitrum.metrics.PublisherLookup

class MySubscriber extends Actor with PublisherLookup {
  override def preStart() {
    lookUpPublisher()
  }

  def receive = {
    case _ =>
  }

  override def doWithPublisher(globalPublisher: ActorRef) = {
    context.become {
      // When run in multinode environment
      case multinodeMetrics: Set[NodeMetrics] =>
        // Save to DB or write to file.

      // When run in single node environment
      case nodeMetrics: NodeMetrics =>
        // Save to DB or write to file.

      case Publish(registryAsJson) =>
        // Save to DB or write to file.

      case _ =>
    }
  }
}

```


This chapter contains various small tips. Each tip is too small to have its own chapter.

23.1 Basic authentication

You can protect the whole site or just certain actions with [basic authentication](#).

Note that Xitrum does not support [digest authentication](#) because it provides a false sense of security. It is vulnerable to a man-in-the-middle attack. For better security, you should use HTTPS, which Xitrum has built-in support (no need for additional reverse proxy like Apache or Nginx just to add HTTPS support).

23.1.1 Config basic authentication for the whole site

In `config/xitrum.conf`:

```
"basicAuth": {  
  "realm":      "xitrum",  
  "username":   "xitrum",  
  "password":   "xitrum"  
}
```

23.1.2 Add basic authentication to an action

```
import xitrum.Action  
  
class MyAction extends Action {  
  beforeFilter {  
    basicAuth("Realm") { (username, password) =>  
      username == "username" && password == "password"  
    }  
  }  
}
```

23.2 Load config files

23.2.1 JSON file

JSON is neat for config files that need nested structures.

Save your own config files in “config” directory. This directory is put into classpath in development mode by build.sbt and in production mode by script/runner (and script/runner.bat).

myconfig.json:

```
{
  "username": "God",
  "password": "Does God need a password?",
  "children": ["Adam", "Eva"]
}
```

Load it:

```
import xitrum.util.Loader

case class MyConfig(username: String, password: String, children: Seq[String])
val myConfig = Loader.jsonFromClasspath[MyConfig] ("myconfig.json")
```

Notes:

- Keys and strings must be quoted with double quotes
- Currently, you cannot write comment in JSON file

23.2.2 Properties file

You can also use properties files, but you should use JSON whenever possible because it’s much better. Properties files are not typesafe, do not support UTF-8 and nested structures etc.

myconfig.properties:

```
username = God
password = Does God need a password?
children = Adam, Eva
```

Load it:

```
import xitrum.util.Loader

// Here you get an instance of java.util.Properties
val properties = Loader.propertiesFromClasspath("myconfig.properties")
```

23.2.3 Typesafe config file

Xitrum also includes Akka, which includes the [config library](#) created by the [company called Typesafe](#). It may be a better way to load config files.

myconfig.conf:

```
username = God
password = Does God need a password?
children = ["Adam", "Eva"]
```

Load it:

```
import com.typesafe.config.{Config, ConfigFactory}

val config    = ConfigFactory.load("myconfig.conf")
val username  = config.getString("username")
val password  = config.getString("password")
val children  = config.getStringList("children")
```

23.3 Serialize and deserialize

To serialize to `Array[Byte]`:

```
import xitrum.util.SeriDeseri
val bytes = SeriDeseri.toBytes("my serializable object")
```

To deserialize bytes back:

```
val option = SeriDeseri.fromBytes[MyType](bytes) // Option[MyType]
```

If you want to save to file:

```
import xitrum.util.Loader
Loader.bytesToFile(bytes, "myObject.bin")
```

To load from the file:

```
val bytes = Loader.bytesFromFile("myObject.bin")
```

23.4 Encrypt data

To encrypt data that you don't need to decrypt later (one way encryption), you can use MD5 or something like that.

If you want to decrypt later, you can use the utility Xitrum provides:

```
import xitrum.util.Secure

// Array[Byte]
val encrypted = Secure.encrypt("my data".getBytes)

// Option[Array[Byte]]
val decrypted = Secure.decrypt(encrypted)
```

You can use `xitrum.util.UrlSafeBase64` to encode and decode the binary data to normal string (to embed to HTML for response etc.).

```
// String that can be included in URL, cookie etc.
val string = UrlSafeBase64.noPaddingEncode(encrypted)

// Option[Array[Byte]]
val encrypted2 = UrlSafeBase64.autoPaddingDecode(string)
```

If you can combine the above operations in one step:

```
import xitrum.util.SeriDeseri

val mySerializableObject = new MySerializableClass

// String
val encrypted = SeriDeseri.toSecureUrlSafeBase64(mySerializableObject)

// Option[MySerializableClass]
val decrypted = SeriDeseri.fromSecureUrlSafeBase64[MySerializableClass](encrypted)
```

SeriDeseri uses [Twitter Chill](#) to serialize and deserialize. Your data must be serializable.

You can specify a key for encryption.

```
val encrypted = Secure.encrypt("my data".getBytes, "my key")
val decrypted = Secure.decrypt(encrypted, "my key")
```

```
val encrypted = SeriDeseri.toSecureUrlSafeBase64(mySerializableObject, "my key")
val decrypted = SeriDeseri.fromSecureUrlSafeBase64[MySerializableClass](encrypted, "my key")
```

If no key is specified, `secureKey` in `xitrum.conf` file in config directory will be used.

23.5 Multiple sites at the same domain name

If you want to use a reverse proxy like Nginx to run multiple different sites at the same domain name:

```
http://example.com/site1/...
http://example.com/site2/...
```

You can config `baseUrl` in `config/xitrum.conf`.

In your JS code, to have the correct URLs for Ajax requests, use `withBaseUrl` in `xitrum.js`.

```
# If the current site's baseUrl is "site1", the result will be:
# /site1/path/to/my/action
xitrum.withBaseUrl('/path/to/my/action')
```

23.6 Convert Markdown text to HTML

If you have already configured your project to use [Scalate template engine](#) (page 27), you only have to do like this:

```
import org.fusesource.scalamd.Markdown
val html = Markdown("input")
```

Otherwise, you need to add this dependency to your project's `build.sbt`:

```
libraryDependencies += "org.fusesource.scalamd" %% "scalamd" % "1.6"
```

23.7 Monitor file change

You can register callback(s) for [StandardWatchEventKinds](#) on files or directories.


```
import java.nio.file.Paths
import xitrum.util.FileMonitor

val target = Paths.get("absolute_path_or_path_relative_to_application_directory").toAbsolutePath
FileMonitor.monitor(FileMonitor.MODIFY, target, { path =>
  // Do some callback with path
  println(s"File modified: $path")

  // And stop monitoring if necessary
  FileMonitor.unmonitor(FileMonitor.MODIFY, target)
})
```

Under the hood, `FileMonitor` uses [Schwatcher](#).

23.8 Temporary directory

Xitrum projects by default (see `tmpDir` in `xitrum.conf`) uses `tmp` directory in the current working directory to save Scalate generated `.scala` files, big upload files etc.

To get path to that directory:

```
xitrum.Config.xitrum.tmpDir.getAbsolutePath
```

To create a new file or directory in that directory:

```
val file = new java.io.File(xitrum.Config.xitrum.tmpDir, "myfile")

val dir = new java.io.File(xitrum.Config.xitrum.tmpDir, "mydir")
dir.mkdirs()
```

23.9 Stream videos

There are many ways to stream videos. One easy way:

- Serve interleaved `.mp4` video files, so that users can play the videos while downloading.
- And use a HTTP server like Xitrum that supports [range requests](#), so that users can skip to a movie position that has not been downloaded.

You can use [MP4Box](#) to interleave movie file data by chunks of 500 milliseconds:

```
MP4Box -inter 500 movie.mp4
```

Dependencies

24.1 Dependency libraries

Xitrum includes some libraries. In your Xitrum project, you can use them directly if you want.



Main dependencies:

- **Scala**: Xitrum is written in Scala language.
- **Netty**: For async HTTP(S) server. Many features in Xitrum are based on those in Netty, like WebSocket and zero copy file serving.
- **Akka**: For SockJS. Akka depends on **Typesafe Config**, which is also used by Xitrum.

Other dependencies:

- [Commons Lang](#): For escaping JSON data.
- [Glokka](#): For clustering SockJS actors.
- [JSON4S](#): For parsing and generating JSON data. JSON4S depends on [Paranamer](#).
- [Rhino](#): For Scalate to compile CoffeeScript to JavaScript.
- [Scasner](#): For scanning HTTP routes in action classes in .class and .jar files.
- [Scaposer](#): For i18n.
- [Twitter Chill](#): For serializing and deserializing cookies and sessions. Chill is based on [Kryo](#).
- [SLF4S](#), [Logback](#): For logging.

Xitrum new project skeleton includes these tools:

- [scala-xgettext](#): For [extracting i18n strings](#) (page 67) from your .scala files when you compile them.
- [xitrum-package](#): For [packaging your project](#) (page 73), ready to deploy to production server.
- [Scalive](#): For connecting a Scala console to a running JVM process for live debugging.

24.2 Related projects

Demos:

- [xitrum-new](#): Xitrum new project skeleton.
- [xitrum-demos](#): Demos features in Xitrum.
- [xitrum-placeholder](#): Demos APIs that return images.
- [comy](#): Demos a simple URL shortening service.
- [xitrum-multimodule-demo](#): Example about creating multimodule [SBT](#) project.

Plugins:

- [xitrum-scalate](#): This is the default template engine in Xitrum, preconfigured in [Xitrum new project skeleton](#). You can replace it with other template engines, or totally remove it if your project doesn't need any template engine. It depends on [Scalate](#) and [Scalamd](#).
- [xitrum-hazelcast](#): For clustering cache and server side sessions.
- [xitrum-ko](#): Provides some convenient helpers for [Knockoutjs](#).

Other projects:

- [xitrum-doc](#): Source code of the [Xitrum Guide](#).
- [xitrum-hp](#): Source code of the [Xitrum Homepage](#).