
Xitrum Guide

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INTRODUCTION

```
+-----+
|   Your app   |
+-----+
|   Xitrum fusion   |
| +-----+ |
| | Web framework | | <-- Akka, Hazelcast --> Other instances
| |-----| |
| | HTTP(S) Server | |
| +-----+ |
+-----+
|   Netty   |
+-----+
```

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

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](#). 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.

- Routes are automatically collected in the spirit of JAX-RS (but without annotations!) 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.
- 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 is recommended when using continuations-based actions, since serialized continuations are usually too big to store in cookies. Hazelcast also gives in-process (thus faster and simpler to use) distributed cache and pubsub, you don't need separate cache and pubsub servers.
- [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.

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

1.2 Samples

- [Xitrum Demos](#)
- [Xitrum Modularized Demo](#)
- [Comy](#)

TUTORIAL

This chapter 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/ngocdaothanh/xitrum-new/archive/master.zip
```

Or:

```
curl -L -o xitrum-new.zip https://github.com/ngocdaothanh/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 0.11.3-2 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*, compile the project, and run the class `quickstart.Boot`, which starts the web server. In the console, you will see all the routes:

```
[INFO] Routes:
GET / quickstart.controller.Site#index
GET /xitrum/routes.js xitrum.routing.JSRoutesController#routes
[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:

```
[DEBUG] GET quickstart.controller.Site#index, 1 [ms]
```

DEVELOPMENT FLOW WITH SBT, ECLIPSE, AND JREBEL

This chapter assumes that you have installed Eclipse and [Scala plugin for Eclipse](#).

3.1 Ignore files

Create a new project as described at the [tutorial](#). These should be ignored:

```
. *  
log  
project/project  
project/target  
routes.cache  
target
```

3.2 Import the project to Eclipse

Many people 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.

3.3 Install JRebel

In development mode, you start the web server with `sbt/sbt run`. Normally, when you change your source code, you have to press CTRL+C to stop, then run `sbt/sbt run` again. This may take tens of seconds everytime.

With [JRebel](#) you can avoid that. JRebel provides free license for Scala developers!

Install:

1. Apply for a [free license for Scala](#)
2. Download and install JRebel using the license above

3. Add `-noverify -javaagent:/path/to/jrebel/jrebel.jar` to the `sbt/sbt` command line

Example:

```
java -noverify -javaagent:"$HOME/opt/jrebel/jrebel.jar" \  
-Xmx1024m -XX:MaxPermSize=128m -Dsbt.boot.directory="$HOME/.sbt/boot" \  
-jar `dirname $0`/sbt-launch.jar "$@"
```

3.4 Use JRebel

1. Run `sbt/sbt run`
2. In Eclipse, try editing a Scala file, then save it

The Scala plugin for Eclipse will automatically recompile the file. And JRebel will automatically reload the generated .class files.

If you use a plain text editor, not Eclipse:

1. Run `sbt/sbt run`
2. Run `sbt/sbt ~compile` in another console to compile in continuous/incremental mode
3. In the editor, try editing a Scala file, and save

The `sbt/sbt ~compile` process will automatically recompile the file, and JRebel will automatically reload the generated .class files.

`sbt/sbt ~compile` works fine in bash and sh shell. In zsh shell, you need to use `sbt/sbt "~compile"`, or it will complain “no such user or named directory: compile”.

Currently routes are not reloaded, even in development mode with JRebel.

CONTROLLER, ACTION, AND VIEW

What do you create web applications for? There are 2 main use cases:

- 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. In Xitrum, there are 2 kinds of actions: *RESTful actions* and *postback actions*.

4.1 Respond to client

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

- `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
- `respondWebSocket`: responds a WebSocket text frame
- `respondEventSource("data", "event")`

4.2 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.

`src/main/scala/mypackage/MyController.scala`:

```
package mypackage
import xitrum.Controller

class MyController extends Controller {
  def index = GET {
    respondView()
  }

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

src/main/scalate/mypackage/MyController/index.jade:

```
- import mypackage.MyController

!!! 5
html
  head
    != antiCSRFMeta
    != xitrumCSS
    != jsDefaults
    title Welcome to Xitrum

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

    != jsForView
```

- `xitrumCSS` includes the default CSS for Xitrum. You may remove it if you don't like.
- `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.Controller`. Also, you can use utility methods provided by Scalate like `unescape`. See the [Scalate doc](#).

If you want to have exactly instance of the current controller, cast `currentController` to the controller you wish.

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`.

```
respondView(Map("type" -> "mustache"))
```

4.2.1 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 controller object

4.3 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 controller, 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/AppController.scala`

```
package mypackage
import xitrum.Controller

trait AppController extends Controller {
  override def layout = renderViewNoLayout(classOf[AppController])
}
```

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

```
!!! 5
html
  head
    != antiCSRFMeta
    != xitrumCSS
    != jsDefaults
    title Welcome to Xitrum

  body
    != renderedView
    != jsForView
```

`src/main/scala/mypackage/MyController.scala`

```
package mypackage
import AppController

class MyController extends AppController {
  def index = GET {
```

```
    respondView()
  }

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

scr/main/scalate/mypackage/MyController/index.jade:

```
- import mypackage.MyController

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

4.3.1 Without separate layout file

AppController.scala

```
import xitrum.Controller
import xitrum.view.DocType

trait AppController extends Controller {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCSRFMeta}
        {xitrumCSS}
        {jsDefaults}
        <title>Welcome to Xitrum</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

4.3.2 Pass layout directly in respondView

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

respondView(specialLayout _)
```


4.4 Inline view

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

```
import xitrum.Controller

class MyController extends Controller {
  def index = GET {
    val s = "World" // Will be automatically escaped
    respondInlineView(
      <p>Hello <em>{s}</em>!</p>
    )
  }
}
```

4.5 Render fragment

If you want to render the fragment file `scr/main/scalate/mypackage/MyController/_myfragment.jade`:

```
renderFragment(classOf[MyController], "myfragment")
```

If `MyController` is the current controller, you can skip it:

```
renderFragment("myfragment")
```

4.6 Controller object

From a controller, to refer to an action of another controller, use controller object like this:

```
import xitrum.Controller

object LoginController extends LoginController
class LoginController extends Controller {
  def login = GET("login") {...}

  def doLogin = POST("login") {
    ...
    // After login success
    redirectTo(AdminController.index) // <-- HERE
  }
}

object AdminController extends AdminController
class AdminController extends Controller {
  def index = GET("admin") {
    ...
    // Check if the user has not logged in, redirect him to the login page
    redirectTo(LoginController.login) // <-- HERE
  }
}
```

In short, you create controller object and call action methods on it.

4.6.1 Caveat

From controller class, do not import everything in controller object like this:

```
object LoginController extends LoginController
class LoginController extends Controller {
  import LoginController._
  ...
}
```

Doing that will cause many strange runtime error in the Xitrum framework, like this:

```
java.lang.NullPointerException: null
  at xitrum.scope.request.RequestEnv.request(RequestEnv.scala:58) ~[xitrum_2.9.2.jar:1.9.8]
  at xitrum.scope.request.ExtEnv$class.cookies(ExtEnv.scala:26) ~[xitrum_2.9.2.jar:1.9.8]
  ...
```

RESTFUL APIS

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

```
import xitrum.Controller

class Articles extends Controller {
  pathPrefix = "articles"

  def index = GET {...}
  def show  = GET("/:id") {...}
}
```

The same for POST, PUT, PATCH, DELETE, and OPTIONS. HEAD is automatically handled by Xitrum as GET.

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.controller.Articles#index
GET /articles/:id quickstart.controller.Articles#show
```

Routes are automatically collected in the spirit of JAX-RS (but without annotations!) 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.

5.1 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.

5.2 Route order with first and last

When you want to route like this:

```
/articles/:id --> Articles#show
/articles/new --> Articles#nevv
```

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

```
class Articles extends Controller {
  pathPrefix = "articles"

  def show = GET("/:id") {...}
  def nevv = first.GET("new") {...}
}
```

last is similar.

5.3 Regex in route

Regex can be used in routes to specify requirements:

```
def show = GET("/articles/:id<[0-9]+>") { ... }
```

5.4 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.Controller
import xitrum.view.DocType

trait AppController extends Controller {
  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 sent by jQuery.

5.5 antiCSRFInput

If you manually write form in Scalate template, use `antiCSRFInput`:

```
form(method="post" action={Admin.addGroup.url})
  != antiCSRFInput

  label Group name *
  input.required(type="text" name="name" placeholder="Required")
  br

  label Group description
  input(type="text" name="desc")
  br

  input(type="submit" value="Add")
```

5.6 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 you controller:

```
import xitrum.{Controller, SkipCSRFCheck}

trait API extends Controller with SkipCSRFCheck

class LogPositionAPI extends API {
  pathPrefix = "api/positions"
  def log = POST {...}
}

class CreateTodoAPI extends API {
  pathPrefix = "api/todos"
  def create = POST {...}
}
```

5.7 Read entire request body

To get the entire request body, use `request.getContent`. It returns `ChannelBuffer`, which has `toString(Charset)` method.

```
val body = request.getContent.toString(io.netty.util.CharsetUtil.UTF_8)
```


POSTBACKS

Please see the following links for the idea about postback:

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

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

6.1 Layout

`AppController.scala`

```
import xitrum.Controller
import xitrum.view.DocType

trait AppController extends Controller {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCSRFMeta}
        {xitrumCSS}
        {jsDefaults}
        <title>Welcome to Xitrum</title>
      </head>
      <body>
        {renderedView}
        {jsForView}
      </body>
    </html>
  )
}
```

6.2 Form

`Articles.scala`

```
import xitrum.validator._

class Articles extends AppController {
  pathPrefix = "articles"
```

```
def show = GET(":id") {
  val id = param("id")
  val article = Article.find(id)
  respondInlineView(
    <h1>{article.title}</h1>
    <div>{article.body}</div>
  )
}

def newv = first.GET("new") { // first: force this route to be matched before "show"
  respondInlineView(
    <form data-postback="submit" action={create.url}>
      <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>
  )
}

def create = POST {
  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 `create`.
`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={AuthenticateController.logout.postbackurl}>Logout</a>
```

Clicking the link above will trigger the postback to logout action of `AuthenticateController`.

6.4 Confirmation dialog

If you want to display a confirmation dialog:

```
<a href="#" data-postback="click"
  action={AuthenticateController.logout.postbackurl}
  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={Articles.destroy.url("id" -> item.id)}
  data-extra="_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={Site.search.url}>
  Search:
  <input type="text" name="keyword" />

  <a class="pagination"
    href="#"
    data-postback="click"
    data-extra="#myform"
    action={Site.search.url("page" -> page)}>{page}</a>
</form>
```

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

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={urlFor[LogoutAction]}>Logout</a>
    </xml:group>
  else
```

```
<xml:group>
  <a href={urlFor[LoginAction]}>Login</a>
  <a href={urlFor[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 MyController extends ApplicationController {
  def index = GET {
    ...
    jsAddToView("alert('Hello')")
    ...
    jsAddToView("alert('Hello again')")
    ...
    respondView(<p>My view</p>)
  }
}
```

In your layout, call `jsForView`:

```
import xitrum.Controller
import xitrum.view.DocType

trait ApplicationController extends Controller {
  override def layout = DocType.html5(
    <html>
      <head>
        {antiCSRFMeta}
        {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(AuthenticateController.login)
```

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.Json  
  
case class Person(name: String, age: Int, phone: Option[String])  
val person1 = Person("Jack", 20, None)  
val json    = Json.generate(person)  
val person2 = Json.parse(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](#).

ASYNCR RESPONSE

List of responding methods:

- `respondView`: responds HTML with or without layout
- `respondInlineView`
- `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
- `respondWebSocket("text")`: responds a WebSocket text frame
- `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:

```
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 xitrum.Controller  
  
class HelloWebSocket extends Controller {  
  def echo = WEBSOCKET("echo") {  
    // If you don't want to accept the connection, call channel.close()  
    acceptWebSocket(new WebSocketHandler {  
      def onOpen() {  
        logger.debug("onOpen")  
      }  
  
      def onMessage(message: String) {  
        // Send back data to the WebSocket client  
        respondWebSocket(message.toUpperCase)  
      }  
  
      def onClose() {  
        logger.debug("onClose")  
      }  
    })  
  }  
}
```

To get URL to the above WebSocket action:

```
object HelloWebSocket extends HelloWebSocket  
  
// Probably you want to use this in Scalate view etc.  
val url = HelloWebSocket.echo.webSocketAbsoluteUrl
```

9.2 SockJS

SockJS is a browser JavaScript library that provides a WebSocket-like object. 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);  
  };  
</script>
```



```

    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.{Controller, SockJsHandler}
import xitrum.handler.Server
import xitrum.routing.Routes

class EchoSockJsHandler extends SockJsHandler {
  // controller: the controller just before switching to this SockJS handler,
  // you can use extract session data, request headers etc. from it
  def onOpen(controller: Controller) {}

  def onMessage(message: String) {
    // Send back data to the SockJS client
    send(message)
  }

  def onClose() {}
}

object Boot {
  def main(args: Array[String]) {
    Routes.sockJs(classOf[EchoSockJsHandler], "echo")
    Server.start()
  }
}

```

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 and Hazelcast](#).

9.3 Chunked response

1. Call `response.setChunked(true)`
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.

```
// "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/
response.setChunked(true)

val generator = new MyCsvGenerator
val header = generator.getHeader
respondText(header, "text/csv")

while (generator.hasNextLine) {
    val line = generator.nextLine
    respondText(line)
}

respondLastChunk()
```

Notes:

- Headers are only sent on the first respondXXX call.
- *Page and action cache* cannot be used with chunked response.

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:

```
response.setChunked(true)

// 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")  
respondEventSource("data2") // Event name defaults to "message"
```


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
```

To refer to them:

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

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

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

10.2 404 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 handler, configure before starting web server:

```
import xitrum.routing.Routes
import xitrum.handler.Server
```

```
object Boot {
  def main(args: Array[String]) {
    Routes.error = classOf[My404And500ErrorHandlerController]
    Server.start()
  }
}
```

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

```
import xitrum.{Controller, ErrorController}

class My404And500ErrorHandlerController extends Controller with ErrorController {
  def error404 = errorAction {
    if (isAjax)
      jsRespond("alert(" + jsEscape("Not Found") + ")")
    else
      renderInlineView("Not Found")
  }

  def error500 = errorAction {
    if (isAjax)
      jsRespond("alert(" + jsEscape("Internal Server Error") + ")")
    else
      renderInlineView("Internal Server Error")
  }
}
```

10.3 Serve resource files in classpath

If you are a library developer and want to serve myimage.png from your library, which is a .jar file in classpath:

Save the file in your .jar under public directory:

```
public/my_lib/img/myimage.png
```

To refer to them in your source code:

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

It will become:

```

```

To send a static file inside an element (a .jar file or a directory) in classpath:

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

10.4 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, not based on Hazelcast.

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.

`urlForPublic` and `urlForResource` automatically add ETag to the URLs they generate. For example:

```
urlForResource("xitrum/jquery-1.6.4.js")
=> /resources/public/xitrum/jquery-1.6.4.js?xndGJVH0zA8q8ZJJelDz9Q
```

Xitrum also sets `max-age` and `Expires` header 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 `urlForPublic` and `urlForResource` also change. Its ETag cache is also updated because the cache key changes.

10.5 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.

10.6 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

SCOPES

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, List[String]]`:

1. `uriParams`: params after the `?` mark in the URL, example: `http://example.com/blah?x=1&y=2`
2. `bodyParams`: 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).

`fileUploadParams` is of type `scala.collection.mutable.Map[String, List[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
- `params("x")`: returns `List[String]`, throws exception if `x` does not exist
- `paramo("x")`: returns `Option[String]`
- `paramso("x")`: returns `Option[List[String]]`

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

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

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

```
class Articles extends ApplicationController {
  def show = GET(":id") {
    val (title, body) = ... // Get from DB
    at("title") = title
    respondInlineView(body)
  }
}
```

AppController.scala

```
import xitrum.Controller
import xitrum.view.DocType

trait ApplicationController extends Controller {
  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 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

```
class Articles extends ApplicationController {
  def show = GET(":id") {
    val (title, body) = ... // Get from DB
    RVar.title.set(title)
    respondInlineView(body)
  }
}
```

AppController.scala

```
import xitrum.Controller
import xitrum.view.DocType
```

```

trait ApplicationController extends Controller {
  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 cookie path etc.](#)

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 `Integer.MIN_VALUE`:

```

cookie.setMaxAge(Integer.MIN_VALUE)

```

Note that [Internet Explorer](#) does not support “max-age”, but Netty detects and outputs either “max-age” or “expires” properly. Don't worry!

If you want to sign your cookie value to prevent user from tampering, use `xitrum.util.SecureUrlSafeBase64.encrypt` and `xitrum.util.SecureUrlSafeBase64.decrypt`. For more information, see [How to encrypt data](#).

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()`.

```
class LoginController extends Controller {
  def login = GET("login") {
    ...
    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={urlFor[LoginAction]}>Login</a>
```

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

12.3.3 Session store

In config/xitrum.conf ([example](#)), you can config the session store:

```
...
"session": {
  // To store sessions on client side: xitrum.scope.session.CookieSessionStore
  // To store sessions on server side: xitrum.scope.session.HazelcastSessionStore
  // "store": "xitrum.scope.session.CookieSessionStore",
  "store": "xitrum.scope.session.HazelcastSessionStore",

  // If you run multiple sites on the same domain, make sure that there's no
  // cookie name conflict between sites
  "cookieName": "_session",

  // Key to encrypt session cookie etc.
  // Do not use the example below! Use your own!
  // If you deploy your application to several instances be sure to use the same key!
  "secureKey": "ajconghoaofuxahoi92chunghiaujivietnamlasdoclapjfltudoil98hanhphucup8"
}
...
```

If you run a cluster of Xitrum web servers and store sessions on server side, setup session replication by [configuring Hazelcast](#).

The two default session stores are enough for normal cases. But if you have a special case and want to implement your own session store, extend [SessionStore](#) and implement the two methods.

Then to tell Xitrum to use your session store, set its class name to xitrum.conf.

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

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](#) and provides validation helpers for server side.

13.1 Default validators

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

```
v(name: String, value: Any): Option[String]
e(name: String, value: Any)
```

If the validation check does not pass, `v` will return `Some(error message)`, `e` will throw `ValidationError(error message)`.

You can use validators anywhere you want.

Action example:

```
import xitrum.validator._

...
def create = POST("articles") {
  val title = param("tite")
  val body  = param("body")
  try {
    Required.e("Title", title)
    Required.e("Body",  body)
  } catch {
    case ValidationError(message) =>
      respondText(message)
      return
  }

  // 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 error message for you and respond it to the requesting client. This is convenient when writing web APIs.

```
val title = param("tite")
Required.e("Title", title)
val body  = param("body")
Required.e("Body",  body)
```

Model example:

```
import xitrum.validator._

case class Article(id: Int = 0, title: String = "", body: String = "") {
  // Returns Some(error message) or None
  def v =
    // Chain validators together
    Required.v("Title", title) orElse
    Required.v("Body", 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 `v` method. This method should returns `Some(error message)` or `None`.

UPLOAD

See also *Scopes chapter*.

14.1 Normal upload

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

`my_upload.scalate`:

```
form(method="post" action={MyController.myAction.url} enctype="multipart/form-data")
  != antiCSRFInput

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

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

`myAction`:

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

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

14.2 Ajax upload

See `xitrum.view.AjaxUpload`.

FILTERS

15.1 Before filters

Before filters are run before an action is run. They are functions that take no argument and return true or false. If a before filter returns false, all filters after it and the action will not be run.

```
import xitrum.Controller

class MyController extends Controller {
  beforeFilter {
    logger.info("I run therefore I am")
    true
  }

  // This method is run after the above filters
  def index = GET("before_filter") {
    respondInlineText("Before filters should have been run, please check the log")
  }
}
```

Before filters can be skipped using `skipBeforeFilter`.

```
import xitrum.Controller

class AppController extends Controller {
  val authenticate = beforeFilter {
    basicAuth("Realm") { (username, password) =>
      username == "foo" && password == "bar"
    }
  }
}

// This controller is protected by authentication
class AController extends AppController {
  def index = GET("secretplace") {
    respondText("secretplace")
  }
}

// This is not
class AnotherController extends AppController {
  skipBeforeFilter(authenticate)

  def index = GET("nothingspecial") {
```

```
        respondText("nothingspecial")
    }
}
```

You can use `only` or `except` with `beforeFilter`.

```
import xitrum.{Controller, SessionVar}

object SVar {
    object username extends SessionVar[String]
}

class Admins extends Controller {
    pathPrefix = "admin"

    beforeFilter(except = Seq(login, doLogin)) {
        val ret = SVar.username.isDefined
        if (!ret) {
            flash("Please login.")
            redirectTo(login)
        }
        ret
    }

    def index = GET {
        ...
    }

    // Display login form
    def login = GET("login") {
        ...
    }

    // Process login form
    def doLogin = POST("login") {
        ...
        // After success login
        session.clear()
        SVar.username.set(myusername)
        flash("You have successfully logged in.")
        redirectTo(index)
    }

    def logout = GET("logout") {
        session.clear()
        flash("You have logged out.")
        jsRedirectTo(Site.index)
    }
}
```

`only` and `except` can also be used with `skipBeforeFilter`.

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.Controller

class MyController extends Controller {
  def index = GET("after_filter") {
    respondText("After filter should have been run, please check the log")
  }

  afterFilter {
    logger.info("Run at " + System.currentTimeMillis())
  }
}
```

After filters can be skipped using `skipAfterFilter`. You can use `only` and `except` with `afterFilter` and `skipAfterFilter`.

15.3 Around filters

```
import xitrum.Controller

class MyController extends Controller {
  aroundFilter { action =>
    val begin = System.currentTimeMillis()
    action()
    val end = System.currentTimeMillis()
    logger.info("The action took " + (end - begin) + " [ms]")
  }

  def index = GET("around_filter") {
    respondText("Around filter should have been run, please check the log")
  }
}
```

If there are many around filters, they will be nested. Around filters can be skipped using `skipAroundFilter`. You can use `only` and `except` with `aroundFilter` and `skipAroundFilter`.

15.4 Priority

- 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

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 controller.

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

Cache in the following section refers to server-side cache.

[Hazelcast](#) is integrated for page, action, and object cache. Of course you can use it for other things (distributed processing etc.) in your application.

With Hazelcast, Xitrum instances become in-process memory cache servers. You don't need separate things like Memcache. Please see the chapter about [clustering](#).

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

Cache works with async response.

16.1 Cache page or action

```
import xitrum.Controller

class MyController extends Controller {
  def index = cachePageMinute(1).GET {
    ...
  }

  def show = cacheActionMinute(1).GET(":id") {
    ...
  }
}
```

16.2 Cache object

You use methods in `xitrum.Cache`.

Without an explicit TTL (time to live):

- `put(key, value)`

Without 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.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

Hazelcast is powerful. It supports distributed cache. Please see its documentation.

config/hazelcast.xml sample:

```
<?xml version="1.0" encoding="UTF-8"?>
<hazelcast xsi:schemaLocation="http://www.hazelcast.com/schema/config hazelcast-basic.xsd"
  xmlns="http://www.hazelcast.com/schema/config"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
  <group>
    <name>myapp</name>
    <password>dev-pass</password>
  </group>

  <network>
    <port auto-increment="true">5701</port>
    <join>
      <multicast enabled="true">
        <multicast-group>224.2.2.3</multicast-group>
        <multicast-port>54327</multicast-port>
      </multicast>
      <tcp-ip enabled="true">
        <interface>127.0.0.1</interface>
      </tcp-ip>
    </join>
  </network>

  <!-- For page, action, object cache -->
  <map name="xitrum">
    <backup-count>0</backup-count>
    <eviction-policy>LRU</eviction-policy>
    <max-size>100000</max-size>
    <eviction-percentage>25</eviction-percentage>
  </map>
</hazelcast>
```

Note that Xitrum instances of the same group (cluster) should have the same `<group>/<name>`. Hazelcast provides a monitor tool, `<group>/<password>` is the password for the tool to connect to the group.

Please see [Hazelcast's documentation](#) for more information how to config config/hazelcast.xml.

16.5 How cache works

Upstream

```

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

Downstream

```

        the action response
        should be cached and
        the cache does not exist?           response
<-----NO-----+-----
|
<-----YES-----+
    store response to cache
```

I18N

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

17.1 Write internationalized messages in source code

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

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

In a controller or action, just call them. In other places like models, you need to pass the current controller 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*, 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.

```
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, call `setLanguage("ja, vi etc.")`.
- 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, call `getLanguage`.

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

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

```

    true
}

```

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

```


DEPLOY TO PRODUCTION SERVER

You may run Xitrum directly:

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

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

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

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](#).

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

18.1 HAProxy

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

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

18.2 Package directory

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

```
target/xitrum
  bin
    runner.sh
  config
    [config files]
  public
    [static public files]
  lib
    [dependencies and packaged project file]
```

18.3 Customize xitrum-package

By default `sbt/sbt xitrum-package` command simply copies `config` and `public` directories to `target/xitrum`. If you want it to copy additional files and directories (README, INSTALL, doc etc.), config

build.sbt like this:

TODO

18.4 Start Xitrum in production mode

bin/runner.sh is the script to run any object with main method. Use it to start the web server in production environment.

```
bin/runner.sh quickstart.Boot
```

You may want to modify runner.sh to tune JVM settings. Also see config/xitrum.conf.

To start Xitrum in background when the system starts, [daemontools](#) is a very good tool. To install it on CentOS, see [this instruction](#).

18.5 Tune Linux for many connections

Good read:

- [Ipsysctl tutorial](#)
- [Iptables tutorial](#)

18.5.1 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`.

18.5.2 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
```

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

18.5.3 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
```


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:

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

SockJS sessions and [many data structures](#) are clustered out of the box thanks to [Akka](#) and [Hazelcast](#).

Please see `remote` in `config/akka.conf` and `hazelcastMode` in `config/xitrum.conf`, and read [Akka doc](#) and [Hazelcast's doc](#) to know how to config.

Sessions are stored in cookie by default. You don't need to worry how to share sessions among Xitrum instances. But if you use [HazelcastSessionStore](#), you may need to setup session replication by setting `backup-count` at the map `xitrum/session` in `config/hazelcast_cluster_or_lite_member.xml` to more than 0.

19.1 xitrum.Config.hazelcastInstance

Xitrum includes Hazelcast. You can also use Hazelcast in your Xitrum project.

To create a [distributed map](#):

```
import com.hazelcast.core.IMap
import xitrum.Config
val myMap = Config.hazelcastInstance.getMap("myMap").asInstanceOf[IMap[MyKeyType, MyValueType]]
```

To create a [distributed topic](#):

```
import xitrum.Config
val myTopic = Config.hazelcastInstance.getTopic[MyTopicEventType]("myTopicName")
```


HOWTO

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

20.1 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)
```

20.2 Basic authentication

20.2.1 Config basic authentication for the whole site

In `config/xitrum.conf`:

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

20.2.2 Add basic authentication to a controller

```
import xitrum.Controller

class MyController extends Controller {
    beforeFilter {
        basicAuth("Realm") { (username, password) =>
            username == "username" && password == "password"
        }
    }
}
```

20.3 Link to an action

Xitrum tries to be typesafe.

Don't write URL manually, use `urlFor` like this:

```
<a href={Articles.show.url("id" -> myArticle.id)}>{myArticle.title}</a>
```

20.4 Log

Xitrum actions extend trait `xitrum.Logger`, which provides `logger`. In any action, you can do like this:

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

Of course you can extend `xitrum.Logger` any time you want:

```
object MyModel extends xitrum.Logger {  
  ...  
}
```

In `build.sbt`, notice this line:

```
libraryDependencies += "ch.qos.logback" % "logback-classic" % "1.0.9"
```

This means that `Logback` is used by default. Logback config file is at `config/logback.xml`. You may replace Logback with any implementation of SLF4J.

20.5 Load config files

20.5.1 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 `bin/runner.sh`.

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: List[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

20.5.2 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")
```

20.5.3 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")
```

20.6 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

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

If you can combine the above operations in one step:

```
import xitrum.util.SecureUrlSafeBase64
```

```
val encrypted = SecureUrlSafeBase64.encrypt(mySerializableObject) // A String
val decrypted = SecureUrlSafeBase64.decrypt(encrypted).asInstanceOf[Option[mySerializableClass]]
```

SecureUrlSafeBase64 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 = SecureUrlSafeBase64.encrypt(mySerializableObject, "my key")
val decrypted = SecureUrlSafeBase64.decrypt(encrypted, "my key").asInstanceOf[Option[mySerializableClass]]
```

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

20.7 Create your own template engine

The default template engine is Scalate. You can create and use your own template engine:

1. Create a class that implements `xitrum.view.TemplateEngine`
2. Set that class in `xitrum.conf`

For an example, see [xitrum-scalate](#).

NETTY HANDLERS

This chapter is a little advanced, normally you don't need to read.

[Rack](#), [WSGI](#), and [PSGI](#) have middleware architecture. You can create middleware and customize the order of middlewares. Xitrum is based on [Netty](#). Netty has the same thing called handlers.

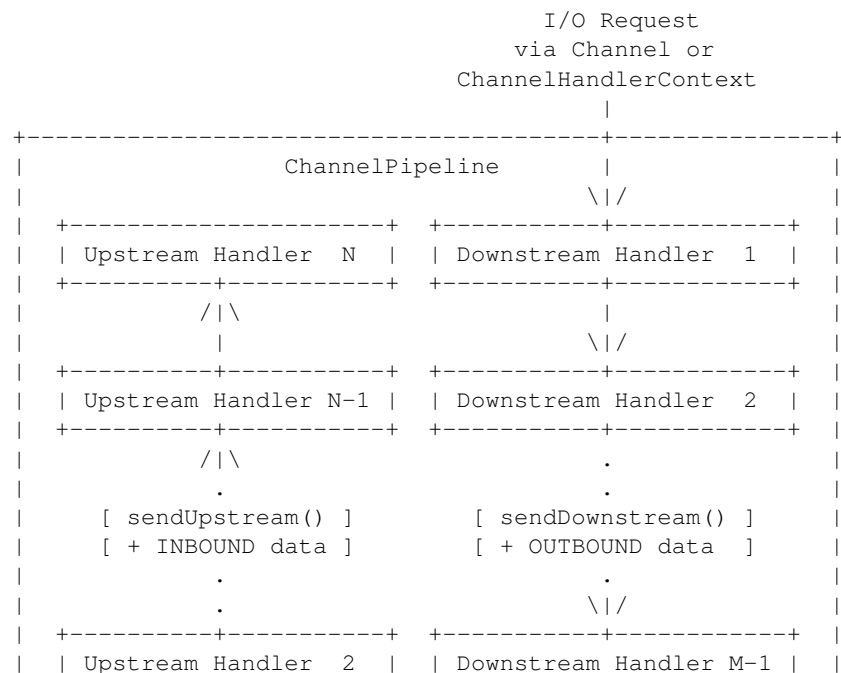
This chapter describes:

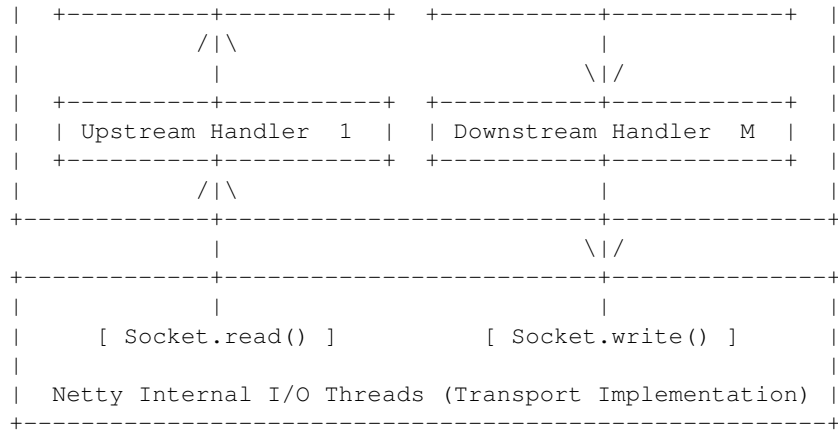
- Netty handler architecture
- Handlers that Xitrum provides and their default order
- How to create and use custom handler

21.1 Netty handler architecture

In Netty, there are 2 types of handlers: * upstream: the request direction client -> server * downstream: the response direction server -> client

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





21.2 Xitrum handlers

See `xitrum.handler.ChannelPipelineFactory`.

21.3 Channel attachement

`HttpRequest` is attached to the channel using `Channel#setAttachment`. Use `Channel#getAttachment` to get it back.

21.4 Channel close event

To act when the connection is closed, listen to the channel's close event: TODO

21.5 Custom handler

TODO: improve Xitrum to let user customize the order of handlers

DEPENDENCIES

This chapter lists all dependency libraries that Xitrum uses so that in your Xitrum project, you can use them directly if you want.

- [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.
- [Hazelcast](#): For distributing caches, server side sessions, and message queues.
- [Akka](#): For SockJS. Akka itself has this interesting dependency which is also used by Xitrum: [Typesafe Config](#).
- [xitrum-scalate](#), [Scalate](#), [Scalamd](#): For view template.
- [Rhino](#): For Scalate to compile CoffeeScript to JavaScript.
- [JSON4S](#): For parsing and generating JSON data. JSON4S depends on [Paranamer](#).
- [Javassist](#), [Sclasner](#): For scanning HTTP routes in controller classes in .class and .jar files.
- [Scaposer](#): For i18n.
- [Commons Lang](#): For escaping JSON data.
- [Twitter Chill](#): For serializing and deserializing cookies and sessions. Chill is based on [Kryo](#), [Objenesis](#), [Bijection](#), [ASM](#), [Commons Codec](#), [ReflectASM](#), [Uncommons Maths](#).
- [SLF4J](#), [Logback](#): For logging.