

# Milestone 1

due at midnight on Mon Feb 1 (125 points)

For this milestone, we're going to gain a little more experience with Java and build a tiny web server application. We will use the Spark framework at <http://sparkjava.com/>.

## Basic Spark project

1. To get started, create a fresh IntelliJ project named sparkdemo. Don't use a project template. Make sure the **Project location** is a new sparkdemo directory beneath your cs164s16 repository directory.

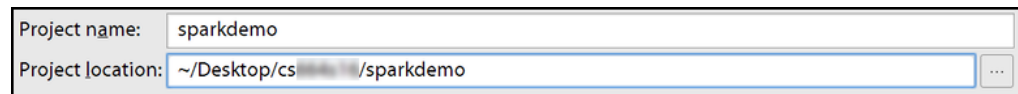


Figure 1: Project name and location

2. Once the new project is open, you can use **VCS » Enable VCS Integration**, as we did in the [Hello project](#). Commit and push to the Git server as often as you like. When you have a commit candidate that you think is your final submission, **please include #milestone1 in the commit message** – I will search for that when figuring out what to grade.
3. Now we want to set up the libraries we'll use. Go to **File » Project Structure** and select **Libraries** from the left panel. Then hit the green plus sign in the next column and select **From Maven**. In the search box, type (or paste) `com.sparkjava:spark-core:2.3` and hit the search icon. Once it finds it, you can press **OK**. Confirm that you want to incorporate the library into your sparkdemo module.
4. Repeat those steps to also add the library `com.sparkjava:spark-template-handlebars:2.3`.
5. In your `src` directory, create a new Java class called `SparkDemo`. At the top of the file, before the class declaration, add:

```
import static spark.Spark.*;
```

6. Inside the class declaration, create a main method like this:

```
public static void main(String[] args) {  
    get("/hello", (request, response) -> "Hello Spark!");  
}
```

7. Select **Run » Run...** from the menu, and choose SparkDemo as the class to run.
8. You should see some output like:

```
[Thread-0] INFO org.eclipse.jetty.util.log - Logging initialized @437ms
[Thread-0] INFO spark.webserver.JettySparkServer - == Spark has ignited ...
[Thread-0] INFO spark.webserver.JettySparkServer - >> Listening on 0.0.0.0:4567
[Thread-0] INFO org.eclipse.jetty.server.Server - jetty-9.3.2.v20150730
[Thread-0] INFO org.eclipse.jetty.server.ServerConnector - Started ...
[Thread-0] INFO org.eclipse.jetty.server.Server - Started @793ms
```

The important part is that “Listening on 0.0.0.0:4567” – it indicates that your server is ready to be tested. Switch to any web browser and enter `http://localhost:4567/hello` into the address bar. You should see the “Hello Spark!” message.

9. Your web server continues running until you explicitly stop it using the red square button to the left of the program output. On my system, the stop button changes to a skull, and then you have to press it one more time to really kill the program.

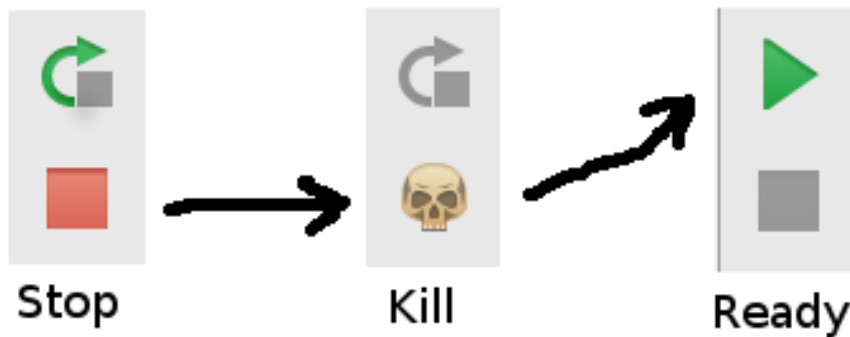


Figure 2: Stop and kill the running server before starting a new one

If you try to run the server again while another instance is running, you’ll see an error message like:

```
java.net.BindException: Address already in use
```

## Response function

The syntax used in the “Hello Spark” example above is that of a Java 8 higher-order function, also called a “lambda expression”:

```
(request, response) -> "Hello Spark!"
```

It is a function that takes two parameters: a request object and a response object, and then it returns something, in this case a string. If our function needs to be a little more complex, we can use curly braces and return, as with normal methods. That version would look like this:

```
(request, response) -> {  
    return "Hello Spark!";  
}
```

Expand your “Hello” response function as shown, and test it again. In the context of the get statement, it will look like this:

```
get("/hello", (request, response) -> {  
    return "Hello Spark!";  
});
```

Now we can begin to do some more complicated things in the response function. Let’s say, for example, we want to count how many times the page is accessed. Add a class variable **outside** of the main method:

```
static int counter = 0;
```

Then, your response function can update the variable and use it in the message.

```
get("/hello", (request, response) -> {  
    counter++;  
    return "Hello Spark #" + counter;  
});
```

Restart the server and test the /hello page again. Each time you reload it, the counter should increment. This counter is only in memory though, each time you restart the server it gets set back to zero. Later on we’ll learn how to have data persist across server restarts.

## HTML template

In the previous section, we used Java string concatenation to pull together a constant message with some variable data:

```
return "Hello Spark #" + counter;
```

As our pages and the data on them get more complex, composing them with Java strings becomes extremely tedious. That's what HTML templates are for.

There are tons of HTML templating languages, and many are supported by Spark. The one I'm going to recommend is [Handlebars](#). You should have already added the `spark-template-handlebars` library to your project.

To use a template, we need to make two changes to the code, and then create template files within our project. Let's do the code changes first.

Instead of returning a string, we're going to return a `ModelAndView` object. This pairs together some data with the name of the template to use to display it. Then we also have to specify the template engine to use. Here is the basic format:

```
get("/hello", (request, response) -> {  
    return new ModelAndView(null, "hello.html");  
}, new HandlebarsTemplateEngine());
```

If your IDE doesn't automatically import `ModelAndView` and/or `HandlebarsTemplateEngine`, you can manually add:

```
import spark.ModelAndView;  
import spark.template.handlebars.HandlebarsTemplateEngine;
```

at the top of the file. After restarting the server and reloading the `/hello` page, you should see "500 Internal Server Error." For the detailed error message, look in the IntelliJ Run console. It will show something like

```
org.eclipse.jetty.io.RuntimeIOException:  
  java.io.FileNotFoundException:  
    /templates/hello.html
```

So the problem is that we haven't provided the `hello.html` file.

**Adding the template files properly is a little tricky**, so pay close attention to these steps. In IntelliJ, select **File » Project Structure** from the menu, and then select **Modules** in the left pane.

The **Sources** section in the main part of the dialog shows you your file tree. Right-click on the top-level folder (probably called `sparkdemo`) and select **New Folder**. Name your folder `resources`. Once the folder appears, right-click *that* folder and select **Resources**. The summary at the right should distinguish the source folder from the resource folder.

You can click **OK** to dismiss the Project Structure dialog.

Now there should be your `resources` folder in the project pane to the left. Right-click on that and select **New » Directory**. Name your directory `templates`. Then

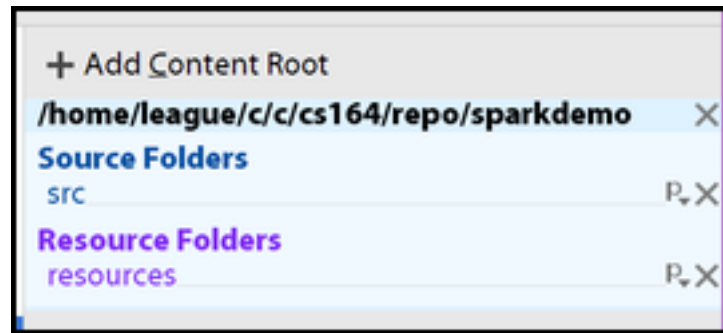


Figure 3: Source and resource folders

right-click on templates and select **New » HTML File**. Name it `hello.html`. It will give you a template HTML file with a head and body. In the `<body>` section, add this:

```
<h1>Hello from my template!</h1>
```

Now, restart the server again and reload the `/hello` page. You should see the “Hello from my template” heading instead of the 500 error.

Right now, the model we’re passing is `null`:

```
new ModelAndView(null, "hello.html");
```

If we want to show some data in the template, we need to provide it there. We’ll use a Java `HashMap`, which is just a way to associate a key with a value — in this case both key and value will be strings. Within our response function:

```
HashMap<String,String> vars = new HashMap<>();  
counter++;  
vars.put("counter", Integer.toString(counter));  
return new ModelAndView(vars, "hello.html");
```

With that code, we are exporting the Java variable `counter` into a template variable also called `counter`. Now we can display the `counter` value by modifying our template:

```
<h1>Hello from my template!</h1>  
<p>This is access <b>number {{counter}}</b></p>
```

The double-curly braces are the Handlebars syntax for plugging in a value.

## Session

Finally, we'll experiment with the idea of a **session**. A session is a way to store some data particular to one user's browser. The server asks the browser to store a **session ID** as a cookie. When the browser loads the next page on the site, it sends back the session ID. In this way, the browser can keep track of who is accessing. (That's what it means to "log in" on a web site.) Spark has facilities for storing and retrieving data associated with the session ID.

Let's begin in your main program by adding a new response function for the `/login` path. We'll let the `/login` page take a query parameter called `user`, to specify who is logging in. So you would access `/login?user=Alice` to log in as Alice, or `/login?user=Bob` to log in as Bob. (We won't bother with storing and checking passwords at this stage.)

Here's the code that would go in `main`, after your `get` statement for `/hello`:

```
get("/login", (request, response) -> {
    String user = request.queryParams("user");
    request.session(true);
    request.session().attribute("user", user);
    response.redirect("/");
    return null;
});
```

In that code, we get the `user` parameter from the query string, then we initialize a session at associate `user` with the session. Finally we redirect to the home page, `/`.

You can stop and restart the server, and access the URL `http://localhost:4567/login?user=Candice` to test it out. Pretty much as soon as you hit enter, the URL will change back to the home page. That's the result of `response.redirect`. The home page, though, just displays a 404 (not found) error.

So we need a home page. As with `/hello`, let's create a `HashMap` and an `index.html` template, and pass the session `user` name into the template:

```
get("/", (request, response) -> {
    HashMap<String, String> data = new HashMap<String, String>();
    String user = request.session().attribute("user");
    data.put("username", user);
    return new ModelAndView(data, "index.html");
}, new HandlebarsTemplateEngine());
```

Stop and restart, and now you'll see the `/login?user=Candice` URL redirect to a 500 error. That's because we don't yet have the `index.html` template. Create it in the right place, next to the `hello.html` template.

In the body, add this code:

```
{{#if username}}
```

```
Welcome, {{username}}.
```

```
<a href="/logout">Log out</a>
```

```
{{else}}
```

```
You are not logged in.
```

```
<form method="get" action="/login">
```

```
  <input type="text" name="user" value="">
```

```
  <input type="submit" name="submit" value="Log in">
```

```
</form>
```

```
{{/if}}
```

Now if you restart and reload the home page, it should give you a “Welcome, Candice” message with a link to log out. So finally we need to implement the logout. We’ll do this just by removing the user attribute from the session data:

```
get("/logout", (request, response) -> {  
  request.session().removeAttribute("user");  
  response.redirect("/");  
  return null;  
});
```

As before, we redirect back to the home page. This time, it will give you a login form where you can type a user name. With this code, you can log out and log in as different people to your heart’s content.