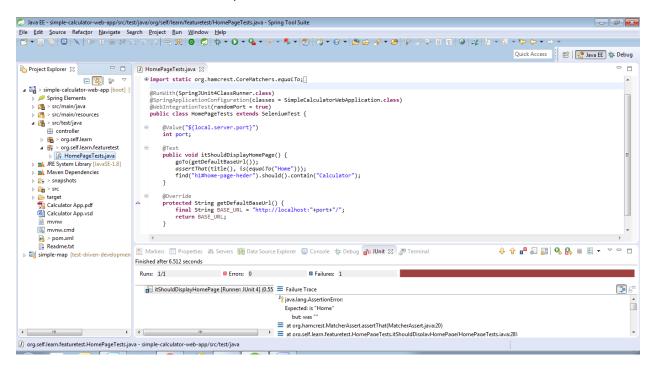
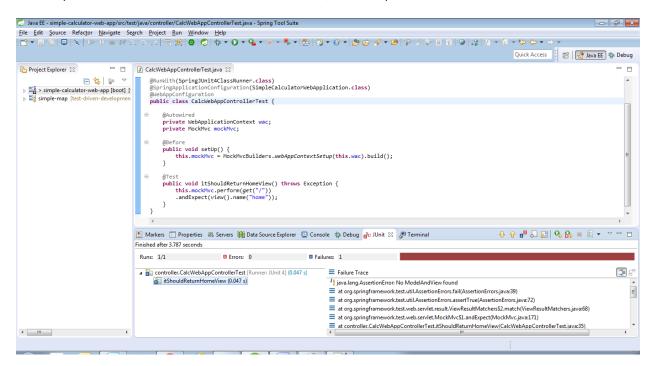
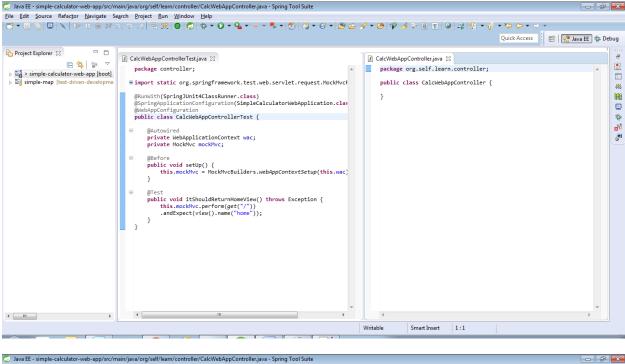
Let's start with a feature test... As expected, it fails!

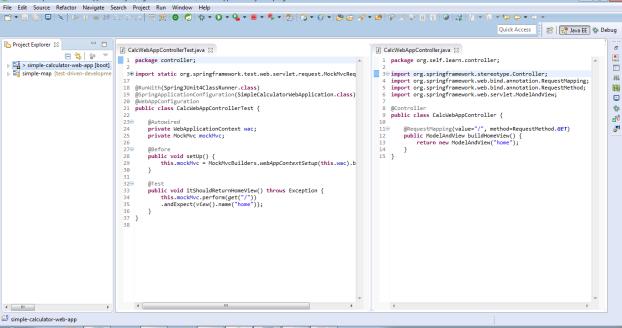


Let's hop on to our controller test which fails as well, as we expect it to.

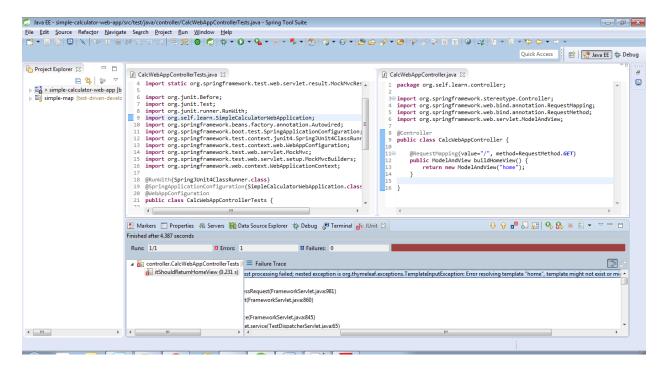


Let's put some implementation together for the controller...

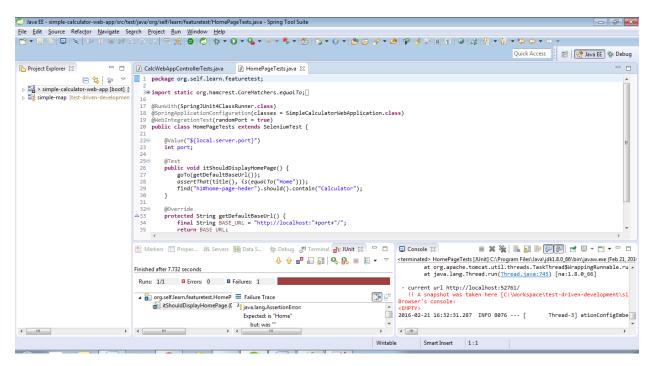




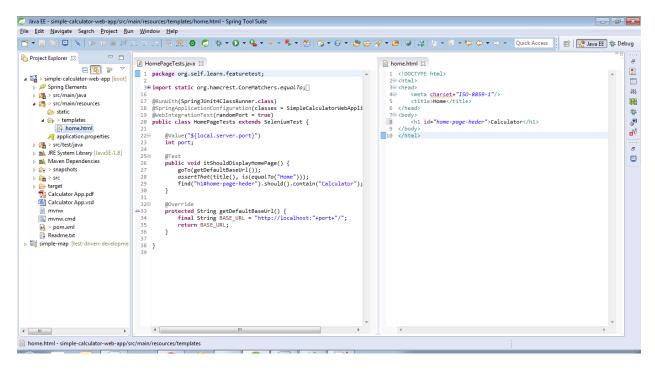
Let's run the test again... It still fails since we have not created a view ("home") yet...



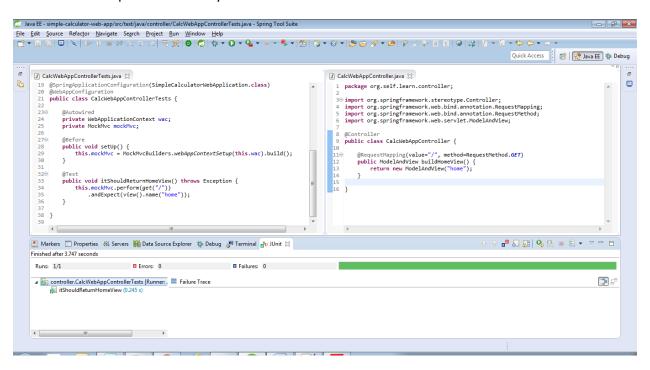
Let's re-run the Home Page Feature Test too, which fails as expected...

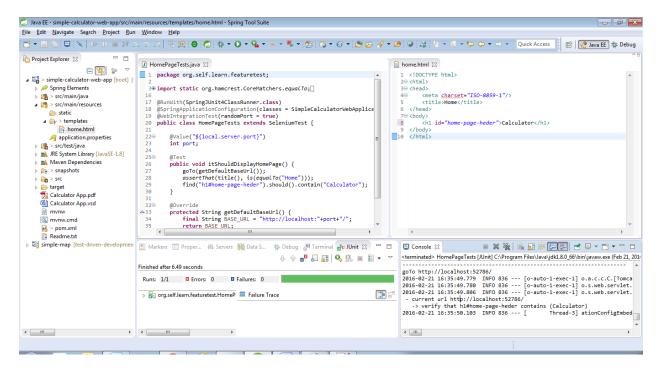


Let's put our home view together. It's a simple HTML doing exactly what the test is expecting it to do. Let's re-run our tests now...



The tests did complete successfully this time.





We will now write a few other tests and corresponding implementations (one after another of course) as per wireframe. I am providing screenshot with the final set of tests and implementation for reference...

```
💋 Java EE - simple-calculator-web-app/src/test/java/org/self/learn/featuretest/HomePageTests.java - Spring Tool Suite
<u>File Edit Source Refactor Navigate Search Project Run Window Help</u>
Quick Access 🔛 🥵 Java EE 🎋 Debug

☑ HomePageTests.java 
☒ <a>
☒ home.html ☒</a>

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                     @Test | simple:calculator-web-app/src/main/resources/templates/home.html |
public void itshouldDisplayFormWithOperandIAndOperandZAndOperationAndCalculateButton() {
    goTo(getDeFaultBaseUrl());
6
                           find("form").should()
    .find("#operand1_container").should().exist()
    .find("#operand2_container").should().exist()
    .find("#operation_container").should().exist()
    .find("#calculate_button_container").should().exist();
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                      public void itShouldDisplayOperand1LabelAndInputOfTypeText() {
                            goTo(getDefaultBaseUrl());
                                                                                                                                                                                                                                                                                                   ⊜
                            //Cd3 selection 3 style
find("div#operand1_container > label#operand1_label").withText("Operand 1:").should().beDisplayed();
find("div#operand1_container > input[type=text]").should().exist();
                     @Test
public void itShouldDisplayOperand2LabelAndInputOfTypeText() {
    goTo(getDefault8aseUrl());
                            //Object Style
find("diw#operand2_container").should()
    .find("label#operand2_label").withText("Operand 2:").should().beDisplayed()
    .find("input[type=text]").should().exist();
                      public void itShouldDisplayAppropriateDropdownOptions() {
    goTo(getDefaultBaseUrl());
                           find("#operation_container").should()
    .find("#operation label").should().contain("Operation:")
    .find("#operation").should()
                                                                                                                                                                         Writable
                                                                                                                                                                                               Smart Insert 73:21
```

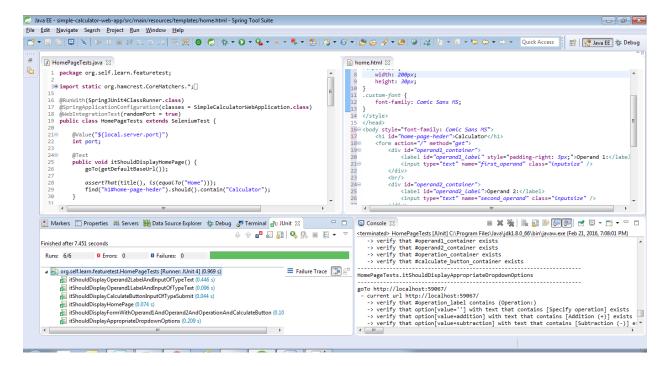
```
💋 Java EE - simple-calculator-web-app/src/test/java/org/self/learn/featuretest/HomePageTests.java - Spring Tool Suite
 \underline{\text{File}} \quad \underline{\text{Edit}} \quad \underline{\text{Source}} \quad \text{Refactor} \quad \underline{\text{N}} \text{avigate} \quad \text{Se}\underline{\text{arch}} \quad \underline{\text{Project}} \quad \underline{\text{Run}} \quad \underline{\text{W}} \text{indow} \quad \underline{\text{Help}}
  | 🗂 ▼ 🖫 🖫 🗎 🗎 № 💵 🗎 № 7.2. Э. 1.1 | 元 元 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10 | ○ 10
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    ☐ HomePageTests.java 
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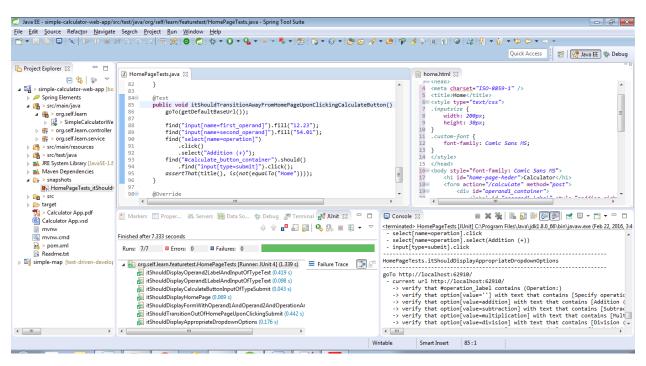
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                    55 56 57 58 59 60 61 62 63 64 65 66 66 67 70 71 72 73 74 88 83 84 65 86 86 87 88 89 90 91 91
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find("div#operand2_container").should()
    find("label=operand2_label").withText("Operand 2:").should().beDisplayed()
    find("input[typertext]").should().exist();
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             W
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                                                          @Test
public void itShouldDisplayAppropriateDropdownOptions() {
    goTo(getDefaultBaseUrl());
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                                                                         find("#operation_container").should()
.find("#operation_label").should().contain("Operation:")
.find("#operation").should()
.find("option(value=')").withText("Specify operation").should().exist()
.find("option(value=addition]").withText("Addition (+)").should().exist()
.find("option[value=subtraction]").withText("Subtraction (-)").should().exist()
.find("option[value=multiplication]").withText("Multiplication (')").should().exist()
.find("option[value=division]").withText("Multiplication (')").should().exist()
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                                                            @Test
public void itShouldDisplayCalculateButtonInputOfTypeSubmit() {
    goTo(getDefaultBaseUrl());
                                                                           find("#calculate_button_container").should()
   .find("input[type=submit][value=Calculate]").should().exist();
                                                          @Override
protected String getDefaultBaseUrl() {
   final String BASE_URL = "http://localhost:"+port+"/";
   return BASE_URL;
                                            4
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```

Note that we are only concerned about displaying the home page up to this point

```
Java EE - simple-calculator-web-app/src/main/resources/templates/home.html - Spring Tool Suite
  <u>File Edit Source Navigate Search Project Run Window Help</u>
  ☐ HomePageTests.java 🖺 home.html 🛭
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height: 30px;
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   html/head/style/#text
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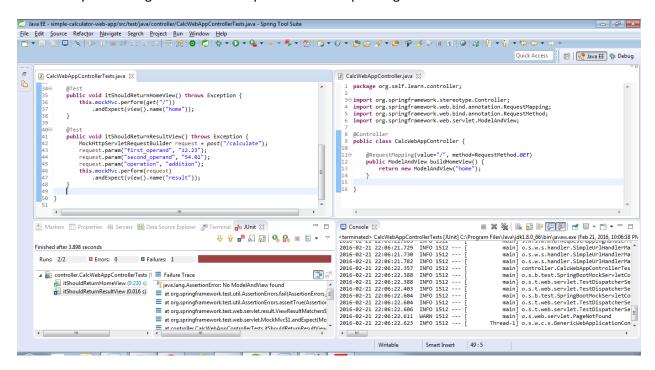
I also wrote a test case to verify transition away from home page upon clicking Calculate button



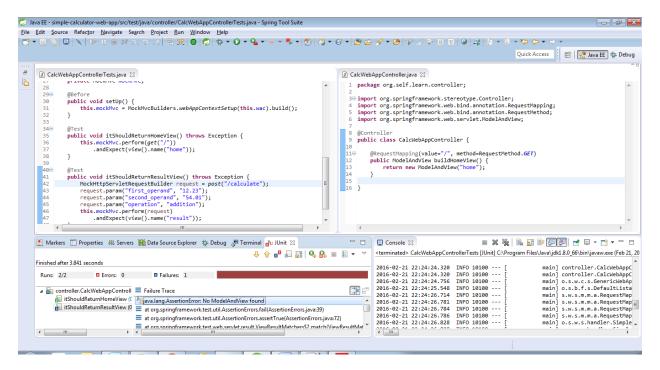
Now let's write a few test cases for the result page. When run, we expect the tests to fail and so they do...

```
Java EE - simple-calculator-web-app/src/test/java/org/self/learn/featuretest/ResultPageTests.java - Spring Tool Suite
<u>File Edit Source Refactor Navigate Search Project Run Window Help</u>
 Quick Access Plava EE 🎋 Debug
       ResultPageTests.java 🛭 🖺 home.html import net.codestory.simplelenium.beleniumlest;
         12
3 @Runwith(SpringJUnit4ClassRunner.class)
14 @SpringApplicationConfiguration(classes = SimpleCalculatorWebApplication.class)
15 @WebIntegrationTest(random@ort = true)
16 public class ResultPageTests extends SeleniumTest {
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                     @Value("${local.server.port}")
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                     public void itShouldCaculateResultWithValidInput() {
                                                                                                                                                                                                                                                                                          8
                           goTo(getDefaultBaseUrl());
                           find("input[name=first_operand]").fill("20");
find("input[name=second_operand]").fill("20");
find("select[name=operation]")
   .click()
   .select("Addition (+)");
                                                                                                                                                                                                                                                                                         ▣
                          find("#calculate_button_container").should()
    .find("input[type=submit]").click().should()
         .find("diwresult").should()
         .not().beEmpty()
         .contain("40");
                           verifyResutPageHeaderAndHomeLink();
         38 | }
                    private void verifyResutPageHeaderAndHomeLink() {
   find("hi#home-page-heder"), withText("Caculator").should().beDisplayed();
   find("div#home_link_Container").should()
        .find("a#home_link[href=/]").withText("Home").should().exist();
          410
                     @Override
                                                                                                                                                                                          Smart Insert 38:1
```

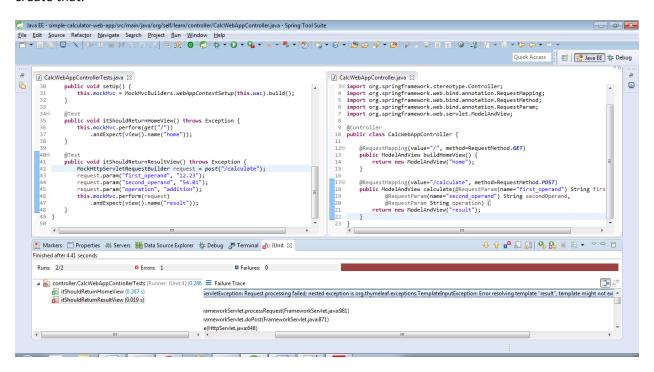
We will require adding a controller end point and corresponding view to take care of this...



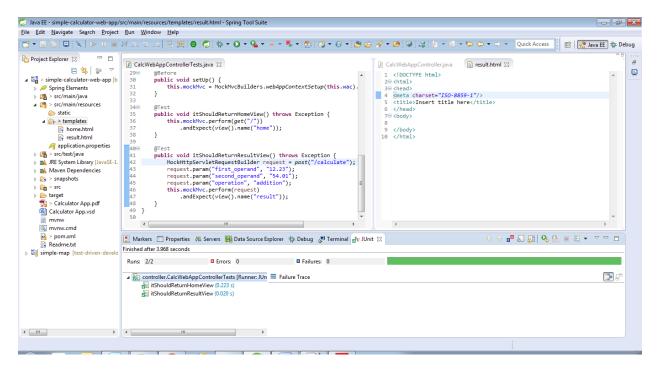
Here is the test case I have put together... which fails as expected. Let's implement the endpoint "/calculate"



Although the endpoint exists now, the test still fails because the view "result" does not exist yet. Let's go create that.



I just wrote an empty HTML and re-ran the test. The test did complete successfully this time...



Before I go and implement the HTML, let's try to create the model containing the actual result. Our "result" view will have nothing to display otherwise.

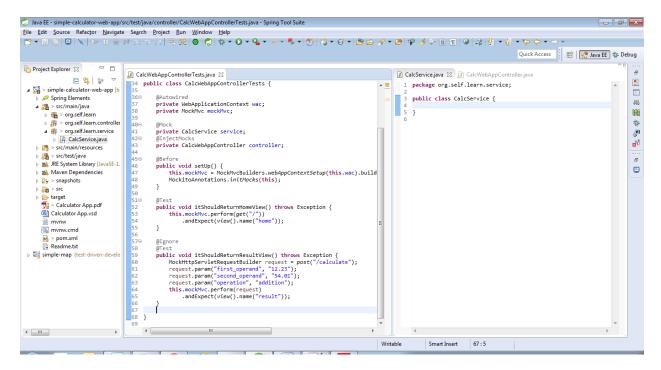
We will like to use a service class for the actual computation. But we do not have to implement it yet...

Note that I intend to create a mock of the service class and inject the same into controller...

```
💋 Java EE - simple-calculator-web-app/src/test/java/controller/CalcWebAppControllerTests.java - Spring Tool Suite
<u>File Edit Source Refactor Navigate Search Project Run Window Help</u>
Quick Access 🔛 😭 Java EE 🎋 Debug
 ☐ CalcWebAppControllerTests.java 🛭 🗓 CalcWebAppController.java
                                                                                                                                                                                      - -
       1 package controller;
                                                                                                                                                                                              3⊕ import static org.springframework.test.web.servlet.request.MockMvcRequestBuilders.get;[
       4 @RunWith(SpringJUnit4ClassRunner.class)
25 @SpringApplicationConfiguration(SimpleCalculatorWebApplication.class)
                                                                                                                                                                                              H
       26 @WebAppConfiguration
27 public class CalcWebAppControllerTests {
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                                                                                                                                                                                               *

             @Autowired
private WebApplicationContext wac;
private MockMvc mockMvc;
                                                                                                                                                                                              eJŮ
            @Mock
private CalcService service;
ArmiertMocks
                                                                                                                                                                                              •
              @InjectMocks
private CalcWebAppController controller;
                  ic void setUp() {
  this.mockMvc = MockMvcBuilders.webAppContextSetup(this.wac).build();
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              public void itShouldReturnHomeView() throws Exception {
                  this.mockMvc.perform(get("/"))
    .andExpect(view().name("home"));
             Smart Insert 33:10
```

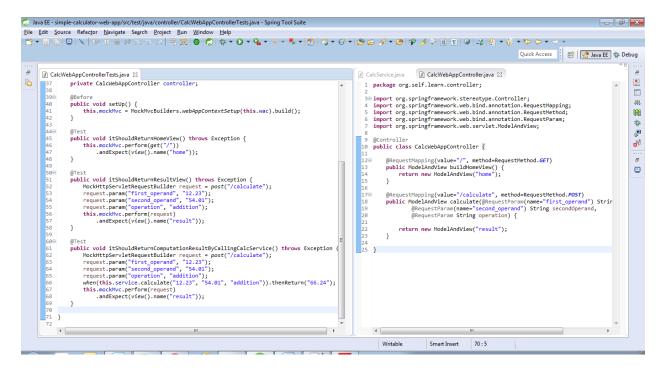
Let's create the service class skeleton to avoid compilation error



Next, I want to write unit test cases for the controller by stubbing out service method using Mockito...

```
Java EE - simple-calculator-web-app/src/test/java/controller/CalcWebAppControllerTests.java - Spring Tool Suite
<u>File Edit Source Refactor Navigate Search Project Run Window Help</u>
  Quick Access 🔛 😭 Java EE 🎋 Debug
         @ CalcWebAppControllerTests.java @ ① CalcService.java ② ① CalcWebAppController.java
36 private CalcService service;
370 @InjectMocks
38 private CalcWebAppController controller;
                                                                                                                                                                                                                                                                                                                                                            A =
                                                                                                                                                                                                                                                                                                                                                                     •
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public void setUp() {
    this.mockMvc = MockMvcBuilders.webAppContextSetup(this.wac).build();
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                           public void itShouldReturnHomeView() throws Exception {
    this.mockMvc.perform(get("/"))
        .andExpect(view().name("home"));
                                                                                                                                                                                                                                                                                                                                                                      ⊜
                          @Test
public void itShouldReturnResultView() throws Exception {
    MockHttpServletRequestBuilder request = post("/calculate");
    request.param("first_operand", "12.23");
    request.param("operation", "54.01");
    request.param("operation", "addition");
    this.mockWvc.perform(request)
    .andExpect(view().name("result"));
}
                          @Test
public void itShouldReturnComputationResultByCallingCalcService() throws Exception {
    MockHttpServletRequestBuilder request = post("/calculate");
    request.param("first operand", "12.23");
    request.param("scond operand", "84.01");
    request.param("operation", "addition");
    when(this.service.calculate(firstOperand, secondOperand, operation)).thenReturn("66.24");
    this.mockMyc.mefrom(request)
                                   this.mockMvc.perform(request)
    .andExpect(view().name("result"));
           71 }
72
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```

I created a blank method in the service to address compilation issue.

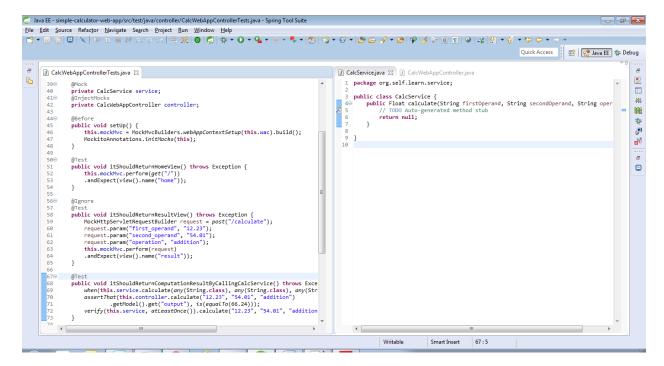


While we will create the calculate() method on the service class momentarily, let's make note of the test.

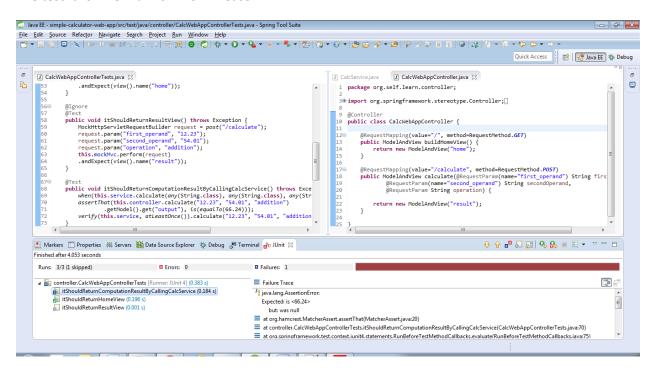
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<u>File Edit Source Refactor Navigate Search Project Run Window Help</u>
Quick Access 🔛 🥵 Java EE 🎋 Debug
🙎 🖟 CalcWebAppControllerTests.java 🛭 🖟 CalcWebAppController.java 📗 CalcService.java
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                                                                                                                                                                                                                                                 <u>•</u>
                                                                                                                                                                                                                                                  private CalcService service:
                 private CalcWebAppController controller:
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                 gerrore
public void setUp() {
    this.mockMvc = MockMvcBuilders.webAppContextSetup(this.wac).build();
    MockitAnnotations.initMocks(this);
                @Test
public void itShouldReturnHomeView() throws Exception {
   this.mockdvc.perform(get("/"))
   .andExpect(view().name("home"));
                                                                                                                                                                                                                                                  •
                 @Test
public void itShouldReturnResultView() throws Exception {
    MockHttpServletRequestBuilder request = post("/calculate");
    request.param("first_operand", "12.23");
    request.param("scond_operand", "34.01");
    request.param("operation", "addition");
    this.mockMvc.perform(request)
    .andExpect(view().name("result"));
                 Smart Insert 40 : 21
```

Compilation issues resolved after adding the auto generated method stub to the service class

N.B: I have ignored controller tests in the class for the time being



The test fails when ran for known reason...



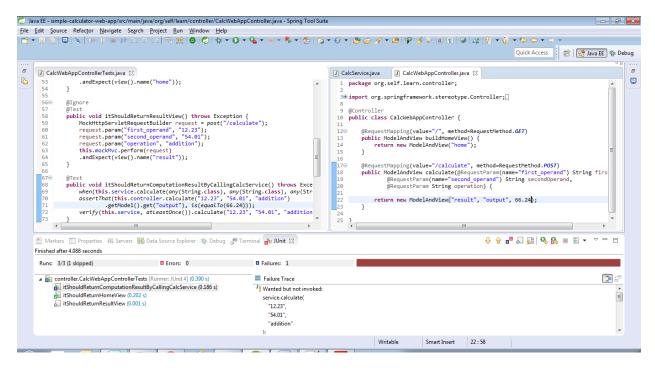
Next I tried to return a hard-coded response without making the actual service call. Although the Hamcrest assertion passes, the Mockito verification fails with the following error message:

```
Wanted but not invoked:
service.calculate(
 "12.23",
 "54.01",
 "addition"
```

); -> at

controller. Calc Web App Controller Tests. it Should Return Computation Result By Calling Calc Service (Calc Web App Controller Tests. java: 70)

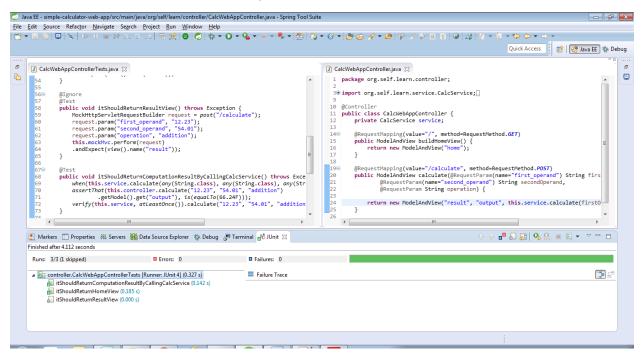
Actually, there were zero interactions with this mock.



Next let's try to actually invoke the service inside the controller and return what it returns. The following change should address the error above.

```
💋 Java EE - simple-calculator-web-app/src/main/java/org/self/learn/controller/CalcWebAppController.java - Spring Tool Suite
<u>File Edit Source Refactor Navigate Search Project Run Window Help</u>
Quick Access 🔛 😭 Java EE 🎋 Debug
 ☑ CalcWebAppControllerTests.java ☑ CalcWebAppController.java 🗵
       1 package org.self.learn.controller;
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                                                                                                                                                                             <u>•</u>
       3⊕ import org.self.learn.service.CalcService;[
                                                                                                                                                                             9
10 @Controller
11 public class CalcWebAppController {
12 private CalcService service;
13@ @RequestMapping(value=""", method=RequestMethod.GET)
14 public ModelAndView buildHomevStew() {
15 return new ModelAndView("home");
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              return new ModelAndView("result", "output", khis.service.calculate(firstOperand, secondOperand, operation)):
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26 }
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                                                                                                                  Smart Insert
```

Let's re-run the test after ignoring the Controller test for "/calculate" (which won't run just yet because the actual service instance is neither ready nor wired)



Note that we are able to unit test controller regardless service implementation availability...

I have written a few more unit test cases for the controller and provided the final screenshot for reference.

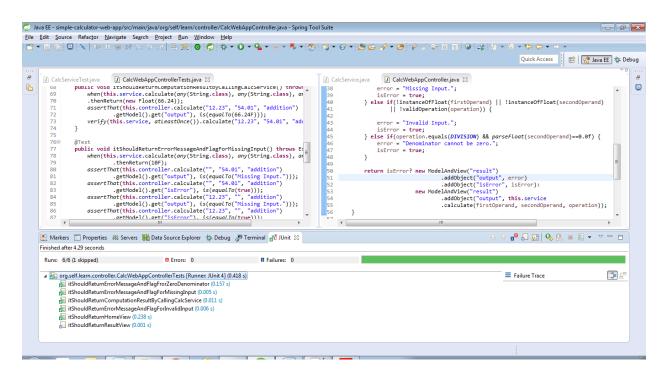
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💋 Java EE - simple-calculator-web-app/src/main/java/org/self/learn/controller/CalcWebAppController.java - Spring Tool Suite
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        Quick Access 🔛 😭 Java EE 🎋 Debug
                                                                                                                                                                                                                                                                                                                                                           ☐ CalcService.java ☐ CalcWebAppController.java 🗵

☑ CalcServiceTest.java ☑ CalcWebAppControllerTests.java ☒
                                                        @Test
public void itShouldReturnErrorMessageAndFlagForMissingInput() throws E:
when(this.service.calculate(amy(String.class), amy(String.class), a
.thenReturn(IBF);
assertThat(this.controller.calculate("", "54.01", "addition")
.getModel(), get("output"), is(equal To("Missing Input")));
assertThat(this.controller.calculate("", "54.01", "addition")
.getModel(), get("istpro"), is(equal To(True)));
assertThat(this.controller.calculate("12.23", "", "addition")
.getModel(), get("output"), is(equal To("Missing Input")));
assertThat(this.controller.calculate("12.23", "", "addition")
.getModel(), get("istpro"), is(equal To(True)));
assertThat(this.controller.calculate("12.23", "54.01", "")
.getModel(), get("output"), is(equal To("Missing Input")));
assertThat(this.controller.calculate("12.23", "54.01", "")
.getModel(), get("output"), is(equal To("Missing Input")));
assertThat(this.controller.calculate("12.23", "54.01", "")
.getModel(), get("istpro"), is(equal To(True)));
verify(this.service, never())
.calculate(any(String.class), any(String.class), any(String.
  6
                                                                                                                                                                                                                                                                                                                                                                                              @RequestWapping(value="/calculate", method=RequestMethod.POST)
public ModelAndView calculate(@RequestParam(name="first_operand") String firstOper
@RequestParam(name="second_operand") String secondOperand,
@RequestParam String operation) {
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                                                                                                                                                                                                                                                                                                                                                                                                            String error = null;
boolean isError = false;
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          *
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                                                                                                                                                                                                                                                                                                                                                                                                           error = "Missing Input.";
issrror = true;
} else if(!instanceOfFloat(firstOperand) || !instanceOfFloat(secondOperand)
|| !validOperation(operation)) {
                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          ⊜
                                                                                                                                                                                                                                                                                                                                                                                                           error = "Invalid Input.";
isError = true;
} else if(operation.equals(DIVISION) && parseFloat(secondOperand)==0.0f) {
  error = "Denominator cannot be zero.";
isError = true;
                                                      ### Public void itShouldReturnErrorMessageAndFlagForInvalidInput() throws Elember(this.service.calculate(ary(String.class), ary(String.class), ary
                                                                                                                                                                                                                                                                                                                                                                                                            private boolean validOperation(String operation) {
    final List(String) validOperations = Arrays.asiist("addition", "subtraction"
    return validOperations.contains(operation);
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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          51:17
```

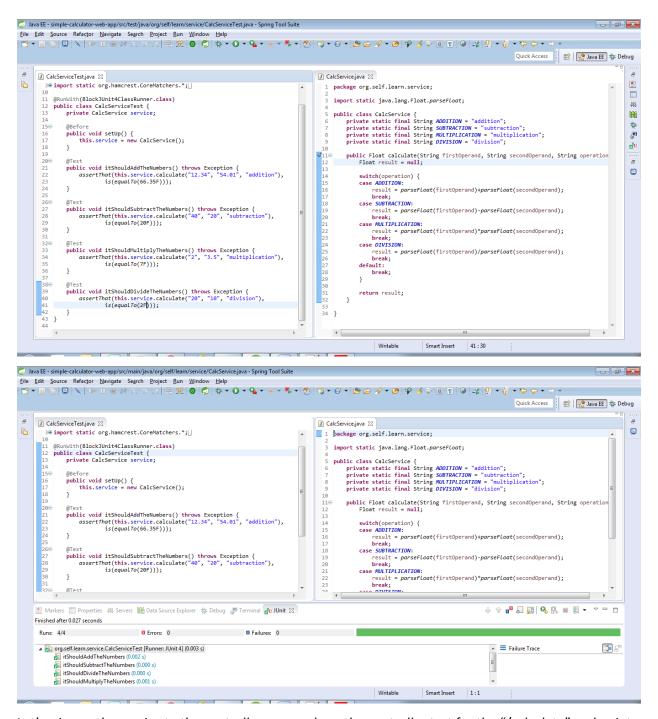
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☑ CalcServiceTest.java
☑ CalcWebAppControllerTests.java ※
                                                                                                                                     error = "Missing Input.";
isError = true;
} else if(linstanceOfFloat(firstOperand) || !instanceOfFloat(secondOperand)
|| !validOperation(operation)) {
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} else if(operation.equals(DIVISION) && parseFloat(secondOperand)==0.0f) {
error = "Denominator cannot be zero.";
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                                                                                                                                                 private boolean validOperation(String operation) {
    final List(String> validOperations = Arrays.aslist("addition", "subtraction",
    return validOperations.contains(operation);
                     GTest
public void itShouldReturnErrorMessageAndFlagFrorZeroDenominator() throw
when(this.service.calculate(any(String.class), any(String.class), an
.thenReturn(10F);
assertThat(this.controller.calculate("12.23", "0", "division")
.getModel().get("output"), is(equalTo("Denominator cannot be
assertThat(this.controller.calculate("12.23", "0", "division")
.getModel().get("isEroro"), is(equalTo(true)));
verify(this.service, never())
.calculate(any(String.class), any(String.class), any(String.clas)
                                                                                                                                                 private boolean instanceOfFloat(String secondOperand) {
                                                                                                                                                      parseFloat(secondOperand);
} catch(NumberFormatException e) {
  return false;
         128 }
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```

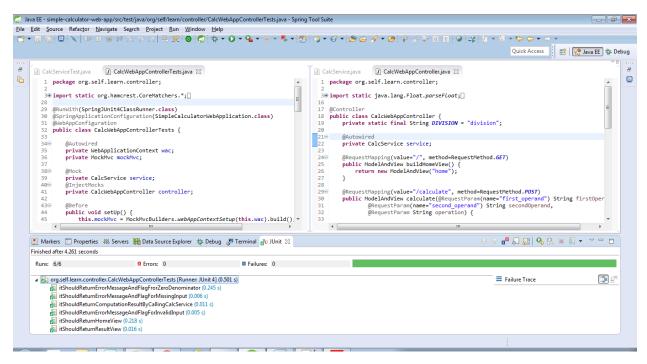
The test results are positive for all tests but the controller test for "/calculate"...



Let's get our service working... I will skip over to the final set of tests and implementation for the service as it is a much like another basic Java program.



Let's wire up the service to the controller now and run the controller test for the "/calculate" end point



Our Result page feature test will still fail... Let's fix the "result" view to get this working

