# JUnit 5 Workshop

JUnit 5 Workshop 1

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## Reference

If at any point during this workshop, you want to explore another feature, see the

<http://junit.org/junit5/docs/current/user-guide>.

## Step 0 Install tools

The required software is described at

<https://www.selikoff.net/2018/02/04/setup-for-devnexus-workshop-bdd-with-spock-and-junit-5/>

## Step 1 Baseline

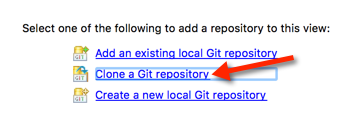
In this workshop, we are going to be new developers on the atlanta-tourism project. The project currently uses JUnit 4. The goal of step 1 is to confirm we have a known good state to start with.

### Step 1.1 – Clone latest code and instructions

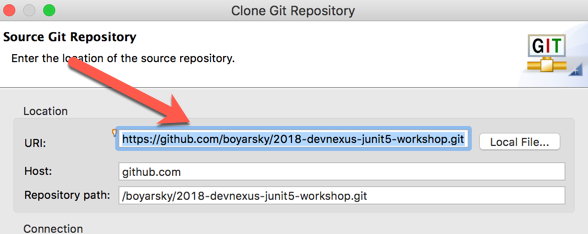
Clearly, the first thing we have to do is pull the latest code for the project! The repository is <https://github.com/boyarsky/2018-devnexus-junit5-workshop.git>

**Using Eclipse:**

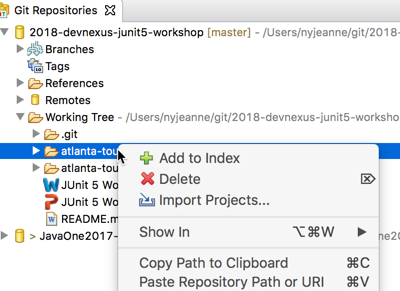
1. Change to Git perspective
2. Click “Clone Git repository”



1. Paste <https://github.com/boyarsky/2018-devnexus-junit5-workshop.git> into URL field



1. Click next/next/finish including all defaults
2. Expand “2018-devnexus-junit5-workshop”
3. Expand “Working Tree”



1. Right click “atlanta-tourism”
2. Choose “Import projects”
3. Click Finish (this will create the project in Eclipse)
4. Switch back to Java perspective

**Using IntelliJ:**

If you aren’t familiar with IntelliJ and Gradle, I recommend not using IntelliJ for this workshop. I have a lot more experience with Eclipse so will be able to help you better ☺.

**Using Git Bash:**

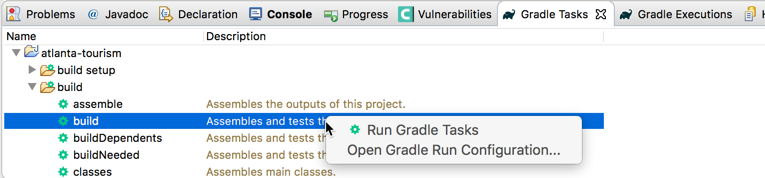
git clone <https://github.com/boyarsky/2018-devnexus-junit5-workshop.git>

### Step 1.2 – Run project with Gradle

This project currently uses JUnit 4. We want to make sure that we can run builds now before changing anything. After all, we want a known good state before writing code. This workshop supports Eclipse, IntelliJ and standalone Gradle so you can choose which you prefer.

**Eclipse**

1. Choose the Gradle tasks view
2. If the list is blank
   1. Right click project > Convert > Add gradle nature
   2. Press refresh in the Gradle tasks view to reload
3. Drill down into the project and build folder
4. Right click “build” and choose “Run Gradle Tasks”



1. This will switch you to the “Gradle Executions” tab where you can see a green/red status.
2. Switch to the Console view to see the details.
3. Check the output has “BUILD SUCCESS” near the end
4. You should also see a message that counts the tests:

SUCCESS (27 tests, 26 successes, 0 failures, 1 skipped)

**IntelliJ**

If you aren’t familiar with Gradle in IntelliJ, I recommend using Eclipse or command line Gradle.

**Gradle**

1. Open a command line (Unix, DOS, PowerShell, Cygwin or Git Bash)
2. cd to your project directory
3. gradlew build (or ./gradlew build)
4. After it runs, check the output has “BUILD SUCCESS” near the end along with SUCCESS (27 tests, 26 successes, 0 failures, 1 skipped)

## Step 2 – Convert to JUnit 5

JUnit 5 is available and we want to use it. The goal of step 2 is run all the JUnit 4 style tests using a JUnit 5 runner. This is the first step in migration on a real project. Once all the plumbing is ready, it will be time to actually use JUnit 5 syntax.

### Step 2.1 – Update build.gradle

The following walk you through updating the Gradle build file to use JUnit 5 with legacy JUnit 4 support. If you aren’t familiar with Gradle (or aren’t sure what the updated build.gradle should look like based on these steps), feel free to look at the [solution guide build.gradle](https://github.com/boyarsky/2018-devnexus-junit5-workshop/blob/master/atlanta-tourism-solution/solution-build.gradle).

1. Add variables above the Java plugin line for Java. The first two are always required. The third is so you can run JUnit 3 or 4 tests.

ext.junitPlatformVersion = '1.0.3'

ext.junitJupiterVersion = '5.0.3'

ext.junitVintageVersion = '4.12.3'

apply plugin: 'java'

1. Add the following plugins in addition to Java:

apply plugin: 'eclipse'

apply plugin: 'idea'

apply plugin: 'org.junit.platform.gradle.plugin'

1. Add the following to the test compile section without deleting any of the current lines:

testCompile("org.junit.jupiter:junit-jupiter-api:${junitJupiterVersion}")

testRuntime("org.junit.jupiter:junit-jupiter-engine:${junitJupiterVersion}")

testCompile("org.junit.jupiter:junit-jupiter-params:${junitJupiterVersion}")

testRuntime("org.junit.vintage:junit-vintage-engine:${junitVintageVersion}")

// to make Eclipse and IntelliJ happy

testRuntime("org.junit.platform:junit-platform-launcher:${junitPlatformVersion}")

1. Add the following to the beginning of the build.gradle file:

buildscript {

repositories {

mavenCentral()

}

dependencies {

classpath 'org.junit.platform:junit-platform-gradle-plugin:1.0.3'

}

}

1. Add the following to the end of the build.gradle file:

junitPlatform {

details 'tree'

}

### Step 2.2 – Run Gradle build

1. See step 1.2 for a review of how to run a Gradle build.
2. Check in the console output how many tests were run. You should see the same number of tests as before:

Test run finished after 2527 ms

[ 20 containers found ]

[ 0 containers skipped ]

[ 20 containers started ]

[ 0 containers aborted ]

[ 20 containers successful ]

[ 0 containers failed ]

[ 27 tests found ]

[ 1 tests skipped ]

[ 26 tests started ]

[ 0 tests aborted ]

[ 26 tests successful ]

[ 0 tests failed ]

1. What’s this about 20 containers? If you scroll up in the output, you’ll see the tree that JUnit 5 put together to run the tests. We have:

|  |  |  |
| --- | --- | --- |
| **# Containers** | **Title** | **Description** |
| 1 | JUnit Jupiter | Doesn’t run any tests as haven’t written/migrated to JUnit 5 APIs yet. |
| 1 | JUnit Vintage | The outermost container for all the tests we have |
| 9 | Test classes | Each test class is a container |
| 9 | Parameterized test | Each parameter in a parameterized test counts as a container. |

Remember that Gradle is smart enough not to run the tests again if nothing has changed. If you want to run them again, run “clean” first.

### Step 2.3 – Run unit tests in IDE

If you are choosing to use the Gradle command line for this workshop, skip this step and continue to step 3. For those using an IDE, the output is more interesting in the IDE view. Especially with parameterized tests.

**Eclipse**

1. Right click atlanta-tourism project
2. Gradle > Refresh Gradle Project
3. Right click atlanta-tourism project
4. Run As > JUnit test
5. Note that we still have the 27 tests with one skipped for the count.

**Intellij**

If you don’t know how to run unit tests in IntelliJ, you can switch to Eclipse or just use Gradle.

Again, a non-zero number of tests should run. The number of “tests” will appear different because Gradle is reporting on the number of test methods and Eclipse is counting the parameterized test runs individually.

## Step 3 – Convert basic tests to JUnit 5

Now that we’ve seen JUnit 5 can run JUnit 4 tests, it is time to convert tests to JUnit 5.

### Step 3.1 – Update the CentennialOlympicParkTest

This test uses the most basic features of JUnit; literally just a setup method and a few assertions.

1. Change the static import to:

**import** **static** org.junit.jupiter.api.Assertions.\*;

Notice that there is a new package naming convention for JUnit 5 containing “jupiter.” Having a new package name allows running existing tests without wholesale changes. Also, note that the **Assert** class has been renamed to **Assertions**.

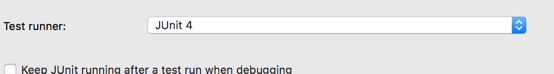
1. Change the regular import to follow the new naming convention as well so JUnit 5 can find the annotations:

**import** org.junit.jupiter.api.\*;

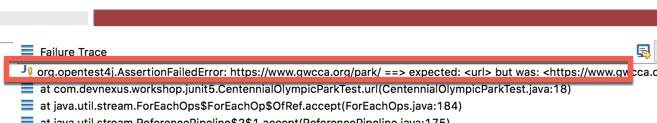
1. Speaking of annotations, the @Before annotation has been renamed to @BeforeEach so change that too.
2. One more compiler error to fix. In JUnit 5, the String message parameter is the last parameter instead of the first one. Just fix the assertion in oldestForLastMessage() to make the code compile:

*assertEquals*(1976, actual.getAge(), "oldest");

1. Now that the test compile, run the tests again. You should get one failing test. If you do not have a failing test, change your run configuration in the IDE to use JUnit 5. For example, in Eclipse, Run > Run Configuration… and change the test runner to JUnit 5:



1. Notice that the AssertionFailedError comes from opentest4j; which got pulled in as a transitive dependency. (IntelliJ hides this message.) Also note that there is a bunch of Java 8 stack trace below the code that actually caused the error.



1. Now you can fix the failing test by changing the parameter order:

*assertEquals*("https://www.gwcca.org/park/", park.getUrl(), "url");

1. Run the test again and you get a green bar.

### Step 3.2 – Update the ParkBuildingTest

Your turn. Try to migrate the ParkBuildingTest class to JUnit 5. There’s only one thing that we haven’t seen yet. The @BeforeClass annotation has been renamed to @BeforeAll. I bet you can guess what the @AfterClass annotation was renamed to!

This time there aren’t step by step instructions because you already have all the information you need to convert it. Feel free to check out the solution guide if you aren’t sure.

*Note for real life projects: I wanted my codebase to be fully JUnit 5 so I didn’t have to look at the imports to read an assertion. Changing assertions, imports and annotations by hand got old fast so I wrote a tool to automate it:*

[*https://github.com/boyarsky/convert-junit4-to-junit5*](https://github.com/boyarsky/convert-junit4-to-junit5)

*(IntelliJ does some of this now; it didn’t when I was first migrating.)*

### Step 3.3 – Migrate assertThat

Let’s try to migrate CentennialOlympicParkEnumTest. Try doing the same thing as for ParkBuildingTest. Uh oh. There’s no assertThat in Jupiter.

Now try it with the correct import:

**import** **static** org.hamcrest.MatcherAssert.*assertThat*;

That’s right. The *assertThat* method is no longer in core JUnit. It still works perfectly well though; just from inside Hamcrest.

This isn’t a great test though. If would only fail on the first enum value to fail the assert. It would have been far better to use a parameterized test. It was enough work in JUnit 4 to write a parameterized test. So it is easy to understand why it was easier to write a loop here. Let’s fix that now…

## Step 4 – Migrate Parameterized Tests

### Step 4.1 – Migrate CentennialOlympicParkEnumTest to a parameterized test

Let’s convert to a parameterized test and see how easy it is.

1. Copy CentennialOlympicParkEnumTest to CentennialOlympicParkEnumParamTest to preserve the original as a referenc.e
2. Change @Test to @ParameterizedTest. (The build file already has junit-jupiter-params so this works)
3. On the line below this annotation add the following to tell JUnit to call this method once with each enum value as a parameter:

@EnumSource(CentennialOlympicParkEnum.**class**)

1. Add imports to make the code compile:

**import** org.junit.jupiter.params.\*;

**import** org.junit.jupiter.params.provider.\*;

1. Add a method parameter:

CentennialOlympicParkEnum current

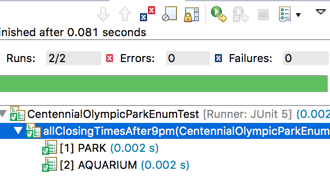
1. Remove the for loop so the method body only has two statements:

LocalTime ninePm = LocalTime.*of*(12 + 9, 0);

*assertThat*(current + " should close after 9pm",

current.closes(), *greaterThanOrEqualTo*(ninePm));

1. Run the unit tests and notice how the method was called twice:



1. Recall that we have 20 containers, 27 tests run and one skipped before adding this test class. How many do you think we will have now? Run the gradle build to see if you were right.

### Step 4.2 – Migrate OlympicsDatesTest

Next up, lets try a test in which the data was externalized so users could provide test data. The parameterized test reads from a file and builds tests for each of the scenarios. The logic to read the file and create the parameters is ugly, but does work. Let’s fix it, shall we?

1. This time we are going to replace the @Test annotation with an annotation with a parameter so the display name is printed nicely:

@ParameterizedTest(name = "{0}")

1. Now we have to tell JUnit where to find the CSV. It is worth noting that the file name doesn’t matter if the csv formatting is preserved. It is even smart enough to ignore comments! Also worth noticing is that JUnit is looking on the classpath so we don’t specify the directory src/test/resources anymore.

@CsvFileSource(resources = { "/olympics-tests.txt" })

1. Fix the imports like our previous parameterized test.
2. Next add the two parameters to the test method

LocalDate date, **boolean** expectedResult

1. Finally, delete all the unnecessary code: the @RunWith annotation, the two lines that begin with @Parameter and the entire static method. Feels good to remove that ugly code, doesn’t it. If you did this right, you have seven lines of not counting the imports or lines that only have a bracket on them.
2. Try to run the test. You’ll likely get an error about there not being runnable methods. (I see this inconsistently). No worries. Just add a dummy method and try again:

@Test

**public** **void** dummyTestSoRuns() {

// no op

}

### Step 4.3 – Refactor this test to use a ValueSource

Let’s suppose the users decided they don’t need to edit the test file and we don’t need it externalized. Now we can use a value source. A value source lets you pass hard coded values to the parameterized test. This is useful when the values are simple and known in advance. Even better we can have two parameterized test methods – one for the special dates and one for the others.

There’s only one thing that’s tricky: a value source can’t take a LocalDate as a parameter. This means we need to use a String type and do the conversion inside the test. Since this lab isn’t about the date APIs, here’s the method body. Try to figure out the method signature and annotations yourself.

LocalDate date = LocalDate.*parse*(formattedDate);

**boolean** actual = OlympicsDates.*isCompetitionDay*(date);

*assertFalse*(actual);

If you get stuck, the answer is inside: OlympicsDatesValueSourceTest.

### Step 4.4 – Refactor this test to use a MethodSource

Tired of this test yet? Hope not as we are going to give it one more go! This time we are going to use a method source and actually return the LocalDate elements so you no longer need to manually parse the dates.

Given these two static generator methods, can you figure out how to rewrite the parameterized tests to use them?

**public** **static** List<LocalDate> specialDateGenerator() {

**return** Arrays.*asList*(LocalDate.*of*(1996, 7, 19),

LocalDate.*of*(1996, 7, 20),

LocalDate.*of*(1996, 7, 31),

LocalDate.*of*(1996, 8, 3),

LocalDate.*of*(1996, 8, 4));

}

**public** **static** Stream<LocalDate> nonSpecialDateGenerator() {

**return** Stream.*of*(LocalDate.*of*(1996, 7, 18),

LocalDate.*of*(1996, 8, 5),

LocalDate.*of*(1997, 7, 18),

LocalDate.*of*(1995, 8, 1));

}

If you get stuck, the answer is in OlympicsDatesMethodSourceTest.

### Step 4.5 – Look at the hierarchy

1. Run a gradle build
2. Note the number of containers has gone down. This is because parameterized tests in JUnit 5 are organized by test method rather than by test data.
3. Run the tests in your IDE and see that the hierarchy is the same there.

## Step 5 – Migrate more features from JUnit 4

In this step we will finish migrating our JUnit 4 tests.

### Step 5.1 – Migrate Soft Assertions

Ok. So soft assertions aren’t part of JUnit 4. They are part of a separate library called AssertJ. But with JUnit 5 they are built into JUnit so we get to migrate them!

The idea of a soft assertion is that they wait until the group has completed to fail. That way you know how many/which ones fail rather than just the first one. Let’s try to migrate the GeorgiaAquariumTest class to JUnit 5.

1. Change the imports/annotations to JUnit 5 style. You know how to do that by now.
2. Get rid of the SoftAssert and assertAll lines.
3. Switch to the new built in API. The following example shows two assertions, but you should migrate all four. Note that the String parameter is the first parameter. That’s the header that groups them. Also note that Java 8 syntax (lambdas) is used so we can pass the assertions to be executed at runtime.

*assertAll*("lines",

() -> *assertTrue*(GeorgiaAquarium.*isShow*("Dolphin"), "Dolphin"),

// convert the other two lines

// remember that they are not all assertTrue!

);

1. Go into the build.gradle and delete the AssertJ dependency. We don’t need it anymore.

testCompile 'org.assertj:assertj-core:3.6.2'

1. Re-run the test to confirm it works.
2. Try changing one of the asserts so it fails. Run the test again to see the message. Then fix the test.

### Step 5.2 – Migrate Mockito code

Mockito code is really easy to migrate from JUnit 4 to 5. The GeorgiaAquariumWaitTest class uses Mockito. It’s up to date and uses the MockitoJUnitRunner. However, @RunWith is gone in JUnit 5. So let’s fix the code for GeorgiaAquariumWaitTest.

1. Guess what. The first step is to change the imports/annotations to JUnit 5 style. Don’t worry if the code doesn’t compile yet; just use the imports you are accustomed to.
2. There is only one line of code that doesn’t compile. Replace the Runner line with: @ExtendWith(MockitoExtension.**class**)
3. The code still doesn’t compile because you don’t have MockitoJUnitRunner yet. No worries. Let’s add it to the build.gradle now:

testCompile 'name.falgout.jeffrey.testing.junit5:mockito-extension:1.0.0'

1. Refresh in your IDE to see the new import.
2. Fix the imports and re-run the test to confirm it works. You may notice a “funky” import. The Mockito team hasn’t released an official extension yet so Jeffrey Falgout did.

Note: Using “extend with” instead of “run with” is an opportunity. If you are using Spring and Mockito together, you haven’t been able to use the MockitoJUnitRunnner as only one @RunWith was allowed. JUnit 5 allows multiple @ExtendWith so you can now use both!

### Step 5.3 – Migrate tests with an expected exception

In JUnit 4, there were a variety of approaches for checking if an expected exception was thrown. Two of the three no longer work in JUnit , but there is a better way.

1. In EarthquakeTest, change the imports/annotations to JUnit 5. Remember you need a special import for assertThat().

If you’ve done this step correctly, the only compiler errors are in the rule annotation/instance variable, the noMessageChecking() test and the usingRule() test.

1. Now you know which two tests don’t work in JUnit 5. This is actually good as the code was harder to read with @Rule since it was split up. And the attribute encouraged ignoring the exception message. Say goodbye to them ☺.
2. Delete the rule and both tests containing code that doesn’t compile and run the remaining test. (All three tests are different styles of the same test scenario so safe to delete.) The remaining test should pass.
3. While the remaining test works, it can be rewritten in two statements without a try/catch. Notice the lambda expression that makes this possible. The first statement follows. The other asserts the message like before the changes.

ShakeException actual =

*assertThrows*(ShakeException.**class**, () -> earthquake.shake(**true**));

### Step 5.4 – Migrate tests with a timeout

There’s another attribute that was supported on @Test. It was less common, but it is also gone in JUnit 5 in favor of a better way.

1. Run the EarthquakeTimeoutTest and note how long it took to run.
2. Migrate the import/annotations to JUnit 5. Good at this yet? If you did it right, you have exactly one compiler error.
3. Figure out how many seconds the timeout is currently set to.
4. Remove the timeout parameter and parenthesis.
5. Replace the method body with:

*assertTimeout*(Duration.ofMillis(*6000)*,

() -> earthquake.waitForAftershock());

1. Run the test and confirm it took approximately the same amount of time as before you made changes.
2. Now we can improve the test. Change Duration.ofMillis(6000) to a duration that uses seconds so the code is easier to read.
3. Now try changing the duration to 1 second. Run the test and read the assertion message. Then change the duration back so the test passes.

### Step 5.5 – Skip tests

Time for an easy one. JUnit 5 changes the @Ignore annotation to @Disabled.

1. Add a System.out.println to ShakeExceptionTest. Does it run?
2. Convert the test to JUnit 5. You know everything you need to do this.
3. Run it again. Is there any output? (good to see the behavior remains the same)
4. Now try running your JUnit 5 test with @org.junit.Ignore. What happens? (This is why you can’t mix and match.)
5. Now change it back to disabled or delete the @Ignore altogether.

## Step 6 – Remove JUnit 4 support from the build file

Now that we’ve gotten rid of all the JUnit 4 syntax, we should remove JUnit 4 support from our project. That way nobody will be tempted to add more old code. Plus, we won’t be tempted by seeing the old imports.

1. Remove the junit.vintage.engine dependency.
2. Remove the junit.vintage.version property.
3. Remove the junit (4.12) dependency.
4. Re-run the Gradle build and watch it succeed.

If you get any failures, you probably missed an import on a prior step so go back and do that now.

## Step 7 – Playing with some new features

JUnit 5 has a number of new features. Let’s try some of them out. This section intentionally gives you less detail about what to type. Feel free to go back to the previous sections if you don’t remember the syntax. Also, there are multiple correct solutions. One of them is in the solution project.

### Step 7.1 – Using repeating tests

Sometimes it is useful to run the same exact test multiple times. For example, when testing multithreaded code, you want to make sure the same result occurs each team. We don’t have multi-threaded code here, but let’s write such a test anyway.

1. Create a test named CentennialOlympicParkRepeatingTest
2. Create an empty method with the signature:

@RepeatedTest(value=100)

**void** tooEarly() {

}

1. This will run an empty test 100 times. Try it out and watch the number of tests go up.
2. Now implement the method so that it calls OlympicDates.*isCompetitionDay*(date) with a random date in the year 2015 once per repetition and asserts that the result is false.
3. This is not a good use case for a repeated test because there is a better way. Do you know why?
4. Create another method called stillTooEarly() but this time use a @MethodSource. (if you still don’t know which type of test would be better, search this file for MethodSource)
5. Run the tests in this class again. Confirm there are 200 tests in the output for this class (240 in total) and that the names of the tests from the method source are clear.
6. Before writing this repeated test, there were 18 containers and 40 tests in the suite. Can you predict how many there will be now? Run a gradle build to see if you are right.

### Step 7.2 – Displaying names

You can display any string instead of the class or method name. Let’s give this a shot.

1. Open CentennialOlympicParkRepeatingTest
2. Right before the class definition add:

@DisplayName("Repeating vs Parameterized")

1. Right before the Repeating test, add an annotation with another name.
2. Run the test and see the nice English names.
3. If you speak another language, try adding a character from that language.
4. For the parameterized test try using this String. (You might get prompted to save in a different encoding. Say ok if you do). What gets output?

"π is fun. Even \uD83D\uDE38 like π."

### Step 7.2 – Tags

One of our tests is slow. It takes two seconds to run. Let’s indicate that so we can easily skip it.

1. Run all the tests and note how many were run
2. Open EarthquakeTimeoutTest
3. Add @Tag("slow") before the class declaration.
4. Run all the tests again. The same number should have run.
5. Replace your build.gradle file’s junit section with:

junitPlatform {

details 'tree'

filters {

tags {

exclude 'slow'

}

}

}

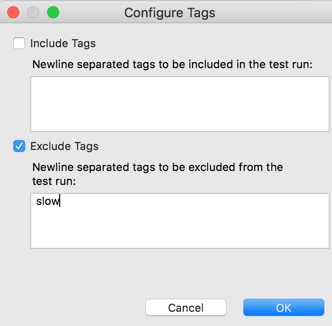
1. Now run the tests again and confirm that one fewer run.

**Eclipse**

1. Right click the atlanta-tourism project and choose Run with > JUnit Test. Note that all of them ran.
2. Right click the atlanta-tourism project and choose Run with > Run Configurations
3. Select the atlanta-tourism configuration.
4. Click configuration for the tags:



1. Choose to exclude the slow tests:



1. Click ok
2. At the top of the window add “without slow” to the name field.
3. Click run
4. Notice one less test gets run.
5. Bonus: Try to figure out how to create both “slow” and “not slow” configurations. (Ask me if you get stuck)

**IntelliJ**

I couldn’t find this feature in IntelliJ. If anyone knows where it is, let me know and I’ll update the lab instructions! (I did find a suggestion to run as a Gradle test so

### Step 7.3 – Write a test from scratch (putting it together)

We’ve converted a lot of tests, but now let’s write a test from scratch. My solution is in FromScratchTest

Can you write a test class in JUnit 5 that:

1. Before the any of the tests are run, code an assumption the test is running on whatever operating system you are using. For example, if you are on a Mac, check that it is running on a Mac. Hint: System.getProperty(). Ensure this code is only run once.
2. Has a test that confirms first 20 primes starting with 5 are odd.
   1. If you feel comfortable with streams, do not use a loop anywhere in the program.
   2. If you do not feel comfortable with streams, make sure the test names are the prime numbers. For example, the first test should display as “5”, the second should display as “7”, etc.
3. Has a test that confirms Thread.sleep(1) does not take more than a half second to run and confirms this fact 20 times. (Do not use a loop)
4. Have a test that has an empty body and a display name that uses the String: “Good job, now go have a \uD83C\uDF7A”.
5. If you did this right, you have 41 tests in this class and a fun display message.