

Ruling Database Testing with DBUnit Rules

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In this article I'm going to talk about [DBUnit Rules](#), a small open source project I maintain which aims to simplify database testing [1: In the context of this article, database testing stands for [JUnit](#) integration tests which depend on a **relational** database so application business logic that depend on a database can be tested without mocking.].

Chapter 1. Introduction

DBUnit Rules integrates **JUnit** and **DBUnit** through **JUnit rules** and, in case of **CDI** based tests, a **CDI interceptor**. This powerful combination lets you easily prepare the database state for testing through **xml, json, xls or yaml** files.

Most inspiration of DBUnit Rules was taken from **Arquillian extension persistence** a library for database **in-container integration tests**.

Source code for the upcoming examples can be found at github here:
<https://github.com/rmpestano/dbunit-rules-sample>

Chapter 2. Setup DBUnit Rules

First thing to do is to add DBUnit Rules core module to your test classpath:

```
<dependency>
  <groupId>com.github.dbunit-rules</groupId>
  <artifactId>core</artifactId>
  <version>0.8.0</version>
  <scope>test</scope>
</dependency>
```

Secondly we need a database, for testing I recommend [HSQLDB](#) which is a very fast in-memory database, here is its maven dependency:

```
<dependency>
  <groupId>org.hsqldb</groupId>
  <artifactId>hsqldb</artifactId>
  <version>2.3.4</version>
  <scope>test</scope>
</dependency>
```

Later A JPA provider will be needed, in this case Hibernate will be used:

```
<dependency>
  <groupId>org.hibernate</groupId>
  <artifactId>hibernate-core</artifactId>
  <version>4.2.8.Final</version>
  <scope>provided</scope>
</dependency>
<dependency>
  <groupId>org.hibernate</groupId>
  <artifactId>hibernate-entitymanager</artifactId>
  <version>4.2.8.Final</version>
  <scope>test</scope>
</dependency>
```

And the entity manager persistence.xml:

src/test/resources/META-INF/persistence.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<persistence version="2.0" xmlns="http://java.sun.com/xml/ns/persistence" xmlns:xsi=
"http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation=
"http://java.sun.com/xml/ns/persistence
http://java.sun.com/xml/ns/persistence/persistence_2_0.xsd">
  <persistence-unit name="rulesDB" transaction-type="RESOURCE_LOCAL">

    <provider>org.hibernate.ejb.HibernatePersistence</provider>
    <class>com.github.dbunit.rules.sample.User</class>

    <properties>
    <property name="hibernate.dialect" value="org.hibernate.dialect.HSQLDialect"
/>
    <property name="javax.persistence.jdbc.driver" value="org.hsqldb.jdbcDriver"
/>
    <property name="javax.persistence.jdbc.url" value=
"jdbc:hsqldb:mem:test;DB_CLOSE_DELAY=-1" />
    <property name="javax.persistence.jdbc.user" value="sa" />
    <property name="javax.persistence.jdbc.password" value="" />
    <property name="hibernate.hbm2ddl.auto" value="create-drop" />
    <property name="hibernate.show_sql" value="true" />
    </properties>

  </persistence-unit>
</persistence>
```

and finally the JPA entity which our tests will work on:

```
@Entity
public class User {

    @Id
    @GeneratedValue
    private long id;

    private String name;
```

Now we are ready to rule our database tests!

Chapter 3. Example

Create a yaml file which will be used to prepare database (with two users) before the test:

src/test/resources/dataset/users.yml

```
user: ①
- id: 1 ②
  name: "@realpestano"
- id: 2
  name: "@dbunit"
```

① Table name is followed by `:`, we can have multiple tables in the same file.

② Table rows are separated by `-`.



Be careful with **spaces**, wrong indentation can lead to invalid dataset (principally in **yaml** datasets).



For more dataset examples, [look here](#).

And the JUnit test:

```
@RunWith(JUnit4.class)
public class DBUnitRulesCoreTest {

    @Rule
    public EntityManagerProvider emProvider = EntityManagerProvider.instance("rulesDB
"); ①

    @Rule
    public DBUnitRule dbUnitRule = DBUnitRule.instance(emProvider.connection()); ②

    @Test
    @DataSet("users.yml") ③
    public void shouldListUsers() {
        List<User> users = em(). ④
            createQuery("select u from User u").
            getResultList();
        assertThat(users).
            isNotNull().
            isEmpty().
            hasSize(2);
    }
}
```

① EntityManagerProvider is a JUnit rule that initializes a JPA entity manager before each **test class**. **rulesDB** is the name of persistence unit;

- ② DBUnit rule reads **@DataSet** annotations and initializes database before each **test method**. This rule only needs a **JDBC** connection to be created.
- ③ The dataSet configuration itself, [see here](#) for all available configuration options.
- ④ **em()** is a shortcut (`import static com.github.dbunit.rules.util.EntityManagerProvider.em;`) for the EntityManager that was initialized by EntityManagerProvider rule.

Chapter 4. Transactions

EntityManagerProvider rule provides entity manager transactions so you can insert/delete entities in your tests:

```
@Test
@DataSet("users.yml")
public void shouldUpdateUser() {
    User user = (User) em().
        createQuery("select u from User u where u.id = 1").
        getSingleResult();
    assertThat(user).isNotNull();
    assertThat(user.getName()).isEqualTo("@realpestano");
    tx().begin(); ①
    user.setName("@rmpestano");
    em().merge(user);
    tx().commit();
    assertThat(user.getName()).isEqualTo("@rmpestano");
}

@Test
@DataSet("users.yml")
public void shouldDeleteUser() {
    User user = (User) em().
        createQuery("select u from User u where u.id = 1").
        getSingleResult();
    assertThat(user).isNotNull();
    assertThat(user.getName()).isEqualTo("@realpestano");
    tx().begin();
    em().remove(user);
    tx().commit();
    List<User> users = em().
        createQuery("select u from User u ").
        getResultList();
    assertThat(users).
        hasSize(1);
}
```

① `tx()` is a shortcut for the entity manager transaction provided by EntityManagerProvider.

Chapter 5. Database assertion with ExpectedDataSet

Consider the following datasets:

src/test/resources/dataset/users.yml

```
user: ①
- id: 1 ②
  name: "@realpestano"
- id: 2
  name: "@dbunit"
```

and expected dataset:

src/test/resources/dataset/expectedUser.yml

```
user:
- id: 2
  name: "@dbunit"
```

And the following test:

```
@Test
@DataSet("users.yml")
@ExpectedDataSet(value = "expectedUser.yml", ignoreCols = "id") ①
public void shouldAssertDatabaseUsingExpectedDataSet() {
    User user = (User) em().
        createQuery("select u from User u where u.id = 1").
        getSingleResult();
    assertThat(user).isNotNull();
    tx().begin();
    em().remove(user);
    tx().commit();
}
```

① Database state after test will be compared with dataset provided by `@ExpectedDataSet`.

If database state is not equal then an assertion error is thrown, example imagine in test above we've deleted user with `id=2`, error would be:



```
junit.framework.ComparisonFailure: value (table=USER, row=0, col=name)
Expected :@dbunit
Actual   :@realpeano
<Click to see difference>
    at
org.dbunit.assertion.JUnitFailureFactory.createFailure(JUnitFailureFac
tory.java:39)
    at
org.dbunit.assertion.DefaultFailureHandler.createFailure(DefaultFailur
eHandler.java:97)
    at
org.dbunit.assertion.DefaultFailureHandler.handle(DefaultFailureHandle
r.java:223)
    at
com.github.dbunit.rules.assertion.DataSetAssert.compareData(DataSetAss
ert.java:94)
```

5.1. Regular expressions

Expected datasets also allow `regex` in datasets:

src/test/resources/dataset/expectedUsersRegex.yml

```
user:
- id: "regex:\\d+"
  name: regex:^expected user.* #expected user1
- id: "regex:\\d+"
  name: regex:.*user2$ #expected user2
```

```
@Test
@DataSet(cleanBefore = true) ①
@ExpectedDataSet("expectedUsersRegex.yml")
public void shouldAssertDatabaseUsingRegex() {
    User u = new User();
    u.setName("expected user1");
    User u2 = new User();
    u2.setName("expected user2");
    tx().begin();
    em().persist(u);
    em().persist(u2);
    tx().commit();
}
```

① You don't need to initialize a dataset but can use `cleanBefore` to clear database before testing.



When you use a dataset like `users.yml` in `@DataSet` dbunit will use `CLEAN_INSERT` seeding strategy (by default) for all declared tables in dataset. This is why we didn't needed `cleanBefore` in any other example tests.

Chapter 6. Scriptable datasets

DBUnit Rules enables scripting in dataset for languages that implement JSR 233 - Scripting for the Java Platform, [see this article](#) for more information.

For this example we will introduce another JPA entity:

```
@Entity
public class Tweet {

    @Id
    @GeneratedValue
    private long id;

    @Size(min = 1, max = 140)
    private String content;

    private Integer likes;

    @Temporal(TemporalType.DATE)
    private Date date;

    @ManyToOne(fetch = FetchType.LAZY)
    User user;
```

6.1. Javascript scriptable dataset

Following is a dataset which uses Javascript:

src/test/resources/datasets/dataset-with-javascript.yml

```
tweet:
- id: 1
  content: "dbunit rules!"
  likes: "js:(5+5)*10/2" ①
  user_id: 1
```

① **js:** prefix enables javascript in datasets.

and the junit test:

```

@Test
@DataSet(value = "dataset-with-javascript.yml",
        cleanBefore = true, ①
        disableConstraints = true) ②
public void shouldSeedDatabaseUsingJavaScriptInDataset() {
    Tweet tweet = (Tweet) emProvider.em().createQuery("select t from Tweet t where
t.id = 1").getSingleResult();
    assertThat(tweet).isNotNull();
    assertThat(tweet.getLikes()).isEqualTo(50);
}

```

① As we don't declared `User` table in dataset it will not be cleared by `CLEAN_INSERT` seeding strategy so we need `cleanBefore` to avoid conflict with other tests that insert users.

② Disabling constraints is necessary because `Tweet` table depends on `User`.

if we do not disable constraints we will receive the error below on dataset creation:

```

Caused by: org.dbunit.DatabaseUnitException: Exception processing table name='TWEET'
    at
org.dbunit.operation.AbstractBatchOperation.execute(AbstractBatchOperation.java:232)
    at org.dbunit.operation.CompositeOperation.execute(CompositeOperation.java:79)
    at
com.github.dbunit.rules.dataset.DataSetExecutorImpl.createDataSet(DataSetExecutorImpl.
java:127)
    ... 21 more
Caused by: java.sql.SQLIntegrityConstraintViolationException: integrity constraint
violation: foreign key no parent; FK_OH8MF7R69JSK6IISPTIAOCC6L table: TWEET
    at org.hsqldb.jdbc.JDBCUtil.sqlException(Unknown Source)

```



If we declare `User` table in `dataset-with-javascript.yml` dataset we can remove `cleanBefore` and `disableConstraints` attributes.

6.2. Groovy scriptable dataset

Javascript comes by default in JDK but you can use other script languages like `Groovy`, to do so you need to add it to test classpath:

pom.xml

```

<dependency>
    <groupId>org.codehaus.groovy</groupId>
    <artifactId>groovy-all</artifactId>
    <version>2.4.6</version>
    <scope>test</scope>
</dependency>

```

If Groovy is not present in classpath we'll receive a *warn message* (maybe we should fail, what do

you think?):

```
WARNING: Could not find script engine with name groovy in classpath
```

Here's our Groovy based dataset:

src/test/resources/datasets/dataset-with-groovy.yml

```
tweet:
- id: "1"
  content: "dbunit rules!"
  date: "groovy:new Date()" ①
  user_id: 1
```

① **groovy**: prefix enables javascript in datasets.

And here is the test:

```
@Test
@DataSet(value = "dataset-with-groovy.yml",
        cleanBefore = true,
        disableConstraints = true)
public void shouldSeedDatabaseUsingGroovyInDataset() throws ParseException {
    Tweet tweet = (Tweet) emProvider.em().createQuery("select t from Tweet t where
t.id = '1'").getSingleResult();
    assertNotNull(tweet);
    SimpleDateFormat sdf = new SimpleDateFormat("yyyy-MM-dd");//remove time
    Date now = sdf.parse(sdf.format(new Date()));
    assertEquals(tweet.getDate(),now);
}
```

Chapter 7. Multiple databases

Multiple databases can be tested by using multiple DBUnit rule and Entity manager providers:

```
package com.github.dbunit.rules.sample;

import com.github.dbunit.rules.DBUnitRule;
import com.github.dbunit.rules.api.dataset.DataSet;
import com.github.dbunit.rules.api.dataset.DataSetExecutor;
import com.github.dbunit.rules.api.dataset.DataSetModel;
import com.github.dbunit.rules.connection.ConnectionHolderImpl;
import com.github.dbunit.rules.dataset.DataSetExecutorImpl;
import com.github.dbunit.rules.util.EntityManagerProvider;
import org.junit.Rule;
import org.junit.Test;
import org.junit.runner.RunWith;
import org.junit.runners.JUnit4;

import static org.assertj.core.api.Assertions.assertThat;

/**
 * Created by pestano on 23/07/15.
 */

@RunWith(JUnit4.class)
public class MultipleDataBasesTest {

    @Rule
    public EntityManagerProvider emProvider = EntityManagerProvider.instance("pu1");

    @Rule
    public EntityManagerProvider emProvider2 = EntityManagerProvider.instance("pu2");

    @Rule
    public DBUnitRule rule1 = DBUnitRule.instance("rule1", emProvider.connection()); ①

    @Rule
    public DBUnitRule rule2 = DBUnitRule.instance("rule2", emProvider2.connection());

    @Test
    @DataSet(value = "users.yml", executorId = "rule1") ②
    public void shouldSeedDatabaseUsingPu1() {
        User user = (User) emProvider.em().
            createQuery("select u from User u where u.id = 1").getSingleResult();
        assertThat(user).isNotNull();
        assertThat(user.getId()).isEqualTo(1);
    }

    @Test
```



```

@DataSet(value = "users.yml", executorId = "rule2")
public void shouldSeedDatabaseUsingPu2() {
    User user = (User) emProvider2.em().
        createQuery("select u from User u where u.id = 1").getSingleResult();
    assertThat(user).isNotNull();
    assertThat(user.getId()).isEqualTo(1);
}

@Test ③
public void shouldSeedDatabaseUsingMultiplePus() {
    DataSetExecutor exec1 = DataSetExecutorImpl.
        instance("exec1", new ConnectionHolderImpl(emProvider.connection()));
    DataSetExecutor exec2 = DataSetExecutorImpl.
        instance("exec2", new ConnectionHolderImpl(emProvider2.connection()));

    //programmatic seed db1
    exec1.createDataSet(new DataSetModel("users.yml"));

    exec2.createDataSet(new DataSetModel("dataset-with-javascript.yml")); //seed
db2

    //user comes from database represented by pu1
    User user = (User) emProvider.em().
        createQuery("select u from User u where u.id = 1").getSingleResult();
    assertThat(user).isNotNull();
    assertThat(user.getId()).isEqualTo(1);

    //tweets comes from pu2
    Tweet tweet = (Tweet) emProvider.em().createQuery("select t from Tweet t where
t.id = 1").getSingleResult();
    assertThat(tweet).isNotNull();
    assertThat(tweet.getLikes()).isEqualTo(50);
}
}

```

- ① rule1 is the id of DataSetExecutor, the component responsible for database initialization in DBUnit Rules.
- ② here we match dataset executor id in @DataSet annotation so in this test we are going to use database from pu1.
- ③ For multiple databases in same test we need to initialize database state programmatically.

Chapter 8. Ruling database in CDI tests

For CDI based tests we are going to use [DeltaSpike test control module](#) and [DBUnit rules CDI](#).

The first enables CDI in JUnit tests and the second enables DBUnit through a CDI interceptor.

8.1. Classpath dependencies

First we need DBUnit CDI: .pom.xml

```
<dependency>
  <groupId>com.github.dbunit-rules</groupId>
  <artifactId>cdi</artifactId>
  <version>0.8.0</version>
  <scope>test</scope>
</dependency>
```

And also DeltaSpike control module:

```

<dependency> ①
  <groupId>org.apache.deltaspike.core</groupId>
  <artifactId>deltaspike-core-impl</artifactId>
  <version>${ds.version}</version>
  <scope>test</scope>
</dependency>

<dependency> ②
  <groupId>org.apache.deltaspike.modules</groupId>
  <artifactId>deltaspike-test-control-module-api</artifactId>
  <version>${ds.version}</version>
  <scope>test</scope>
</dependency>

<dependency> ②
  <groupId>org.apache.deltaspike.modules</groupId>
  <artifactId>deltaspike-test-control-module-impl</artifactId>
  <version>${ds.version}</version>
  <scope>test</scope>
</dependency>

<dependency> ③
  <groupId>org.apache.deltaspike.cdictrl</groupId>
  <artifactId>deltaspike-cdictrl-owb</artifactId>
  <version>${ds.version}</version>
  <scope>test</scope>
</dependency>

<dependency> ④
  <groupId>org.apache.openwebbeans</groupId>
  <artifactId>openwebbeans-impl</artifactId>
  <version>1.6.2</version>
  <scope>test</scope>
</dependency>

```

- ① DeltaSpike core module is base of all DeltaSpike modules
- ② Test control module api and impl
- ③ CDI control OWB dependency, it is responsible for bootstrapping CDI container
- ④ OpenWebBeans as CDI implementation

8.2. Configuration

For configuration we will need a beans.xml which enables DBUnit CDI interceptor:

/src/test/resources/META-INF/beans.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<beans xmlns="http://java.sun.com/xml/ns/javaee"
       xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
       xsi:schemaLocation="http://java.sun.com/xml/ns/javaee
http://java.sun.com/xml/ns/javaee/beans_1_0.xsd">

    <interceptors>
        <class>com.github.dbunit.rules.cdi.DBUnitInterceptor</class>
    </interceptors>
</beans>
```

And `apache-deltaspike.properties` to set our tests as CDI beans:

/src/test/resources/META-INF/apache-deltaspike.properties

```
deltaspike.testcontrol.use_test_class_as_cdi_bean=true
```

The test itself must be a CDI bean so DBUnit Rules can intercept it.

The last configuration needed is to produce a EntityManager for tests:

```
package com.github.dbunit.rules.sample.cdi;

import com.github.dbunit.rules.util.EntityManagerProvider;

import javax.enterprise.context.ApplicationScoped;
import javax.enterprise.inject.Produces;
import javax.persistence.EntityManager;

/**
 * Created by pestano on 09/10/15.
 */
@ApplicationScoped
public class EntityManagerProducer {

    private EntityManager em;

    @Produces
    public EntityManager produce() {
        return EntityManagerProvider.instance("rulesDB").em();
    }

}
```

This entityManager will be used as a bridge to JDBC connection needed by DBUnit Rules.

8.3. Example

Here is a test example:

```
@RunWith(CdiTestRunner.class) ❶
public class DBUnitRulesCDITest {

    @Inject
    EntityManager em; ❷

    @Test
    @UsingDataSet("users.yml") ❸
    public void shouldListUsers() {
        List<User> users = em.
            createQuery("select u from User u").
            getResultList();
        assertThat(users).
            isNotNull().
            isEmpty().
            hasSize(2);
    }
}
```

- ❶ DeltaSpike JUnit runner that enables CDI in tests;
- ❷ The EntityManager we produced in previous steps;
- ❸ This annotation enables DBUnit CDI interceptor which will prepare database state before the test execution.

All other features presented earlier, **except multiple databases**, are supported by DBUnit CDI.

Here is `ExpectedDataSet` example:

src/test/resources/datasets/expectedUsers.yml

```
user:
- id: 1
  name: "expected user1"
- id: 2
  name: "expected user2"
```

And the test:

```
@Test
@UsingDataSet(cleanBefore = true) //needed to activate interceptor (can be at
class level)
@ExpectedDataSet(value = "expectedUsers.yml",ignoreCols = "id")
public void shouldMatchExpectedDataSet() {
    User u = new User();
    u.setName("expected user1");
    User u2 = new User();
    u2.setName("expected user2");
    em.getTransaction().begin();
    em.persist(u);
    em.persist(u2);
    em.getTransaction().commit();
}
```



Since version *0.9.0* (To be released at the time of writing) transactions will be able to be managed automatically at test level (useful for expected datasets), see [example here](#).

Chapter 9. Ruling database in BDD tests

BDD and DBUnit are integrated by [DBUnit Rules Cucumber](#). It's a [Cucumber](#) runner which is CDI aware.

9.1. Configuration

Just add following dependency to your classpath:

pom.xml

```
<dependency>
  <groupId>com.github.dbunit-rules</groupId>
  <artifactId>cucumber</artifactId>
  <version>0.8.0</version>
  <scope>test</scope>
</dependency>
```

Now you just need to use **CdiCucumberTestRunner** to have [Cucumber](#), [CDI](#) and [DBUnit](#) on your BDD tests.

9.2. Example

First we need a feature file:

src/test/resources/features/search-users.feature

```
Feature: Search users
In order to find users quickly
As a recruiter
I want to be able to query users by its tweets.

Scenario Outline: Search users by tweet content

Given We have two users that have tweets in our database

When I search them by tweet content <value>

Then I should find <number> users
Examples:
| value      | number |
| "dbunit"  | 1      |
| "rules"   | 2      |
```

Then a dataset to prepare our database:

src/test/resources/datasets/usersWithTweet.json

```
{
  "USER": [
    {
      "id": 1,
      "name": "@realpestano"
    },
    {
      "id": 2,
      "name": "@dbunit"
    }
  ],
  "TWEET": [
    {
      "id": 1,
      "content": "dbunit rules json example",
      "date": "2013-01-20",
      "user_id": 1
    },
    {
      "id": 2,
      "content": "CDI rules",
      "date": "2016-06-20",
      "user_id": 2
    }
  ]
}
```

Now a Cucumber runner test entry point:

```
package com.github.dbunit.rules.sample.bdd;

import com.github.dbunit.rules.cucumber.CdiCucumberTestRunner;
import cucumber.api.CucumberOptions;
import org.junit.runner.RunWith;

/**
 * Created by rmpestano on 4/17/16.
 */
@RunWith(CdiCucumberTestRunner.class)
@CucumberOptions(features = "src/test/resources/features/search-users.feature")
public class DBUnitRulesBddTest {
}
```

And finally our cucumber step definitions:

```
package com.github.dbunit.rules.sample.bdd;
```



```

import com.github.dbunit.rules.cdi.api.UsingDataSet;
import com.github.dbunit.rules.sample.User;
import cucumber.api.PendingException;
import cucumber.api.java.en.Given;
import cucumber.api.java.en.Then;
import cucumber.api.java.en.When;
import org.hibernate.Criteria;
import org.hibernate.Session;
import org.hibernate.criterion.DetachedCriteria;
import org.hibernate.criterion.MatchMode;
import org.hibernate.criterion.Restrictions;
import org.hibernate.sql.JoinType;

import javax.inject.Inject;
import javax.persistence.EntityManager;
import java.util.List;

import static org.assertj.core.api.Assertions.assertThat;

/**
 * Created by pestano on 20/06/16.
 */
public class SearchUsersSteps {

    @Inject
    EntityManager entityManager;

    List<User> usersFound;

    @Given("^We have two users that have tweets in our database$")
    @UsingDataSet("usersWithTweet.json")
    public void We_have_two_users_in_our_database() throws Throwable {
    }

    @When("^I search them by tweet content \"([^\"]*)\"$")
    public void I_search_them_by_tweet_content_value(String tweetContent) throws
    Throwable {
        Session session = entityManager.unwrap(Session.class);
        usersFound = session.createCriteria(User.class).
            createAlias("tweets", "tweets", JoinType.LEFT_OUTER_JOIN).
            add(Restrictions.ilike("tweets.content", tweetContent, MatchMode.ANYWHERE))
            .list();
    }

    @Then("^I should find (\\d+) users$")
    public void I_should_find_number_users(int numberOfUsersFound) throws Throwable {
        assertThat(usersFound).
            isNotNull().
            hasSize(numberOfUsersFound).
            contains(new User(1)); //examples contains user with id=1
    }
}

```

```
}
```



Living documentation of *DBUnit Rules* is based on its [BDD tests](http://rmpestano.github.io/dbunit-rules/documentation.html), you can access it here: <http://rmpestano.github.io/dbunit-rules/documentation.html>.