Agile Software Development

Produced by

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eLearning support unit

Pacemaker Tests

- Model
- API
- Serializer

pacemaker model

```
public class User
{
  static Long   counter = 0l;

  public Long   id;
  public String firstName;
  public String lastName;
  public String email;
  public String password;

  public Map<Long, Activity> activities = new HashMap<>();

  //...
}
```

```
public class Activity
{
  static Long   counter = 0l;

  public Long   id;
  public String type;
  public String location;
  public double distance;

  public List<Location> route = new ArrayList<>();

  //...
}
```

```
public class Location
{
  static Long   counter = 0l;

  public Long  id;
  public float latitude;
  public float longitude;

  //...
}
```

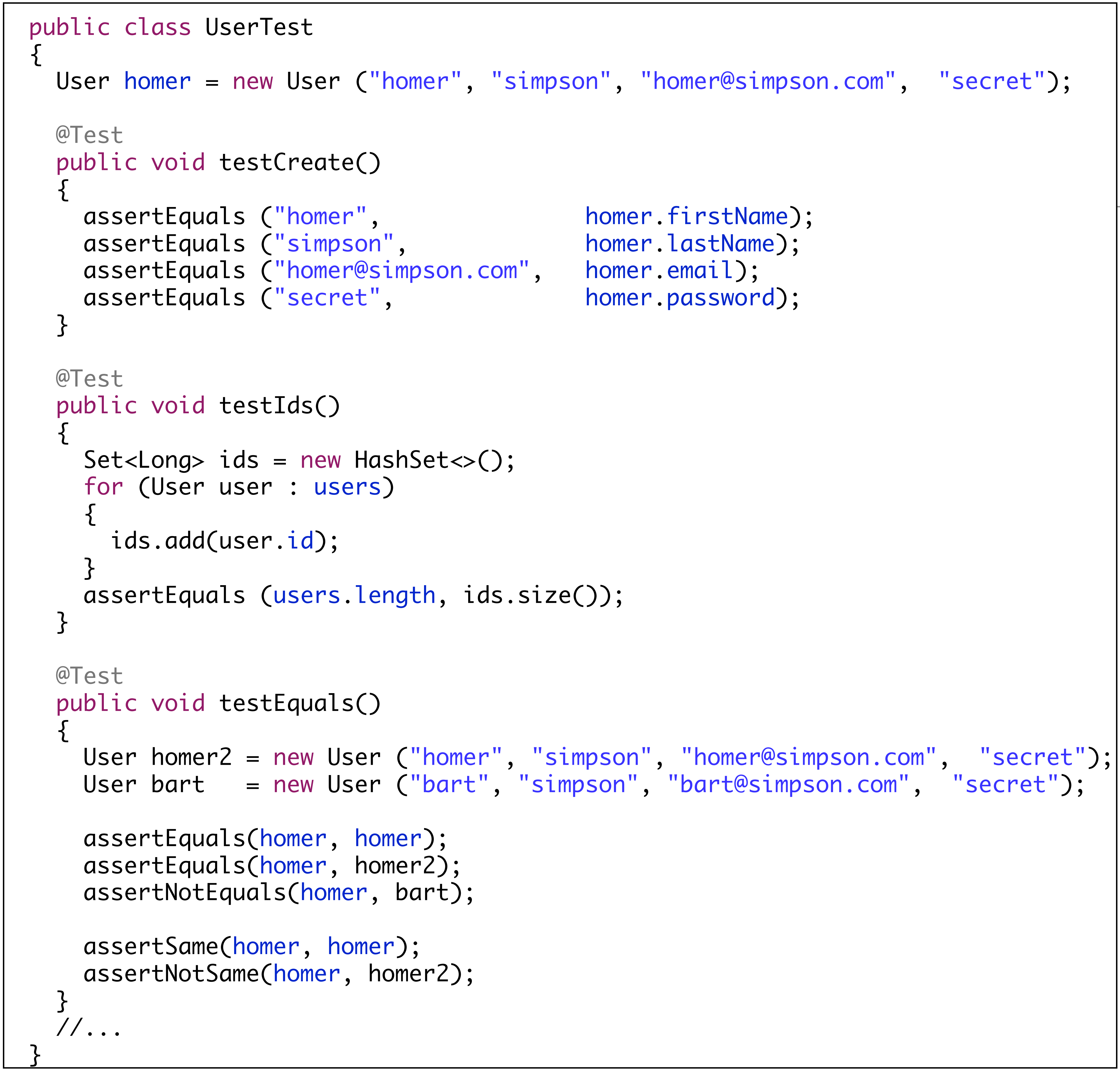
pacemaker model - equals/toString/hashCode

```
public class User
{
   //...
  @Override
  public String toString()
  {
    return toStringHelper(this).addValue(id)
                               .addValue(firstName)
                               .addValue(lastName)
                               .addValue(password)
                               .addValue(email)
                               .addValue(activities)
                               .toString();
  }
  @Override
  public boolean equals(final Object obj)
  {
    if (obj instanceof User)
    {
      final User other = (User) obj;
      return Objects.equal(firstName,   other.firstName)
          && Objects.equal(lastName,    other.lastName)
          && Objects.equal(email,       other.email)
          && Objects.equal(password,    other.password)
          && Objects.equal(activities,  other.activities);
    }
    else
    {
      return false;
    }
  }
  @Override
  public int hashCode()
  {
     return Objects.hashCode(this.id, this.lastName, this.firstName, this.email, this.password);
  }
}
```

pacemaker fixtures

```
public class Fixtures
{
  public static User[] users =
  {
    new User ("marge", "simpson", "marge@simpson.com",  "secret"),
    new User ("lisa",  "simpson", "lisa@simpson.com",   "secret"),
    new User ("bart",  "simpson", "bart@simpson.com",   "secret"),
    new User ("maggie","simpson", "maggie@simpson.com", "secret")
  };

  public static Activity[] activities =
  {
    new Activity ("walk",  "fridge", 0.001),
    new Activity ("walk",  "bar",    1.0),
    new Activity ("run",   "work",   2.2),
    new Activity ("walk",  "shop",   2.5),
    new Activity ("cycle", "school", 4.5)
  };

  public static Location[] locations =
  {
    new Location(23.3, 33.3),
    new Location(34.4, 45.2),
    new Location(25.3, 34.3),
    new Location(44.4, 23.3)
  };
}
```

UserTest (1)



```java
public class UserTest
{
  User homer = new User ("homer", "simpson", "homer@simpson.com",  "secret");

  @Test
  public void testCreate()
  {
    assertEquals ("homer",               homer.firstName);
    assertEquals ("simpson",             homer.lastName);
    assertEquals ("homer@simpson.com",   homer.email);
    assertEquals ("secret",              homer.password);
  }

  @Test
  public void testIds()
  {
    Set<Long> ids = new HashSet<>();
    for (User user : users)
    {
      ids.add(user.id);
    }
    assertEquals (users.length, ids.size());
  }

  @Test
  public void testEquals()
  {
    User homer2 = new User ("homer", "simpson", "homer@simpson.com",  "secret");
    User bart   = new User ("bart", "simpson", "bart@simpson.com",  "secret");

    assertEquals(homer, homer);
    assertEquals(homer, homer2);
    assertNotEquals(homer, bart);

    assertSame(homer, homer);
    assertNotSame(homer, homer2);
  }
  //...
}
```

UserTest (2)

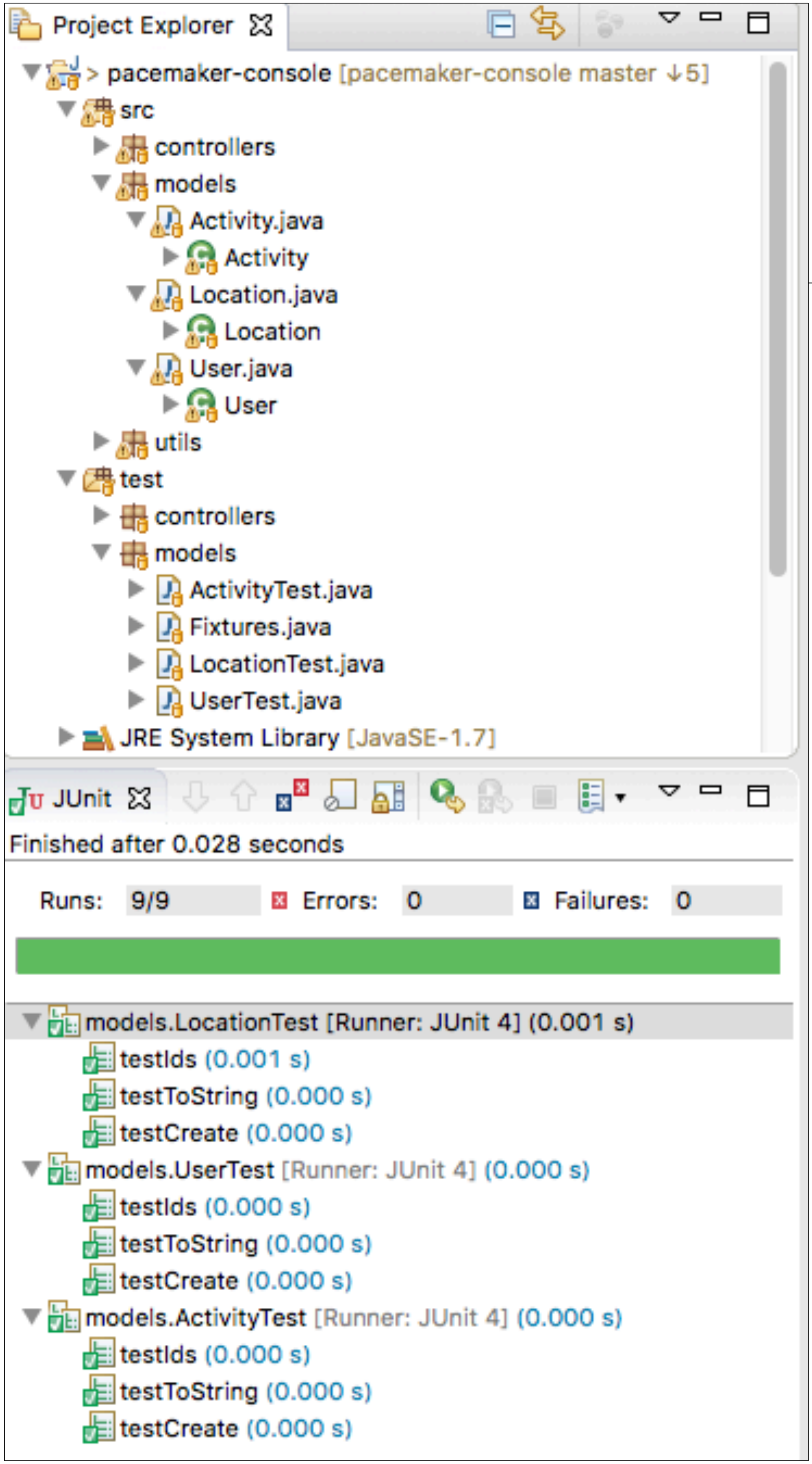
```
public class UserTest
{
  User homer = new User ("homer", "simpson", "homer@simpson.com",  "secret");

  //...

  @Test
  public void testToString()
  {
    assertEquals ("User{" + homer.id + ", homer, simpson, secret, homer@simpson.com, {}}",
                                                                        homer.toString());
  }
}
```

ActivityTest

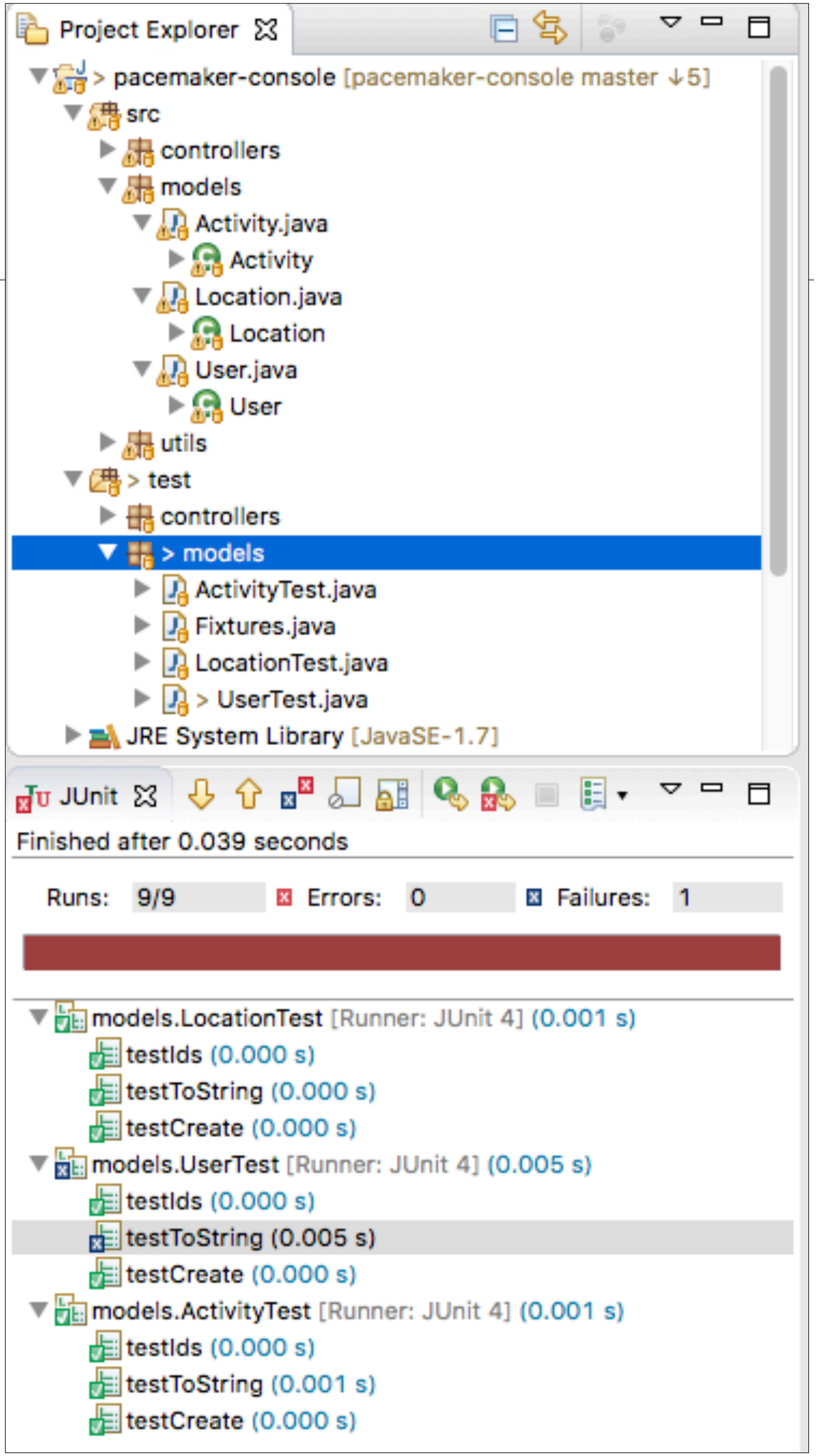
```
public class ActivityTest
{
  Activity test = new Activity ("walk",  "fridge", 0.001);

  @Test
  public void testCreate()
  {
    assertEquals ("walk",          test.type);
    assertEquals ("fridge",        test.location);
    assertEquals (0.0001, 0.001,   test.distance);
  }

  @Test
  public void testToString()
  {
    assertEquals ("Activity{" + test.id + ", walk, fridge, 0.001, []}",
                                                              test.toString());
  }
}
```

LocationTest

```
public class LocationTest
{
  @Test
  public void testCreate()
  {
    assertEquals (0.01, 23.3, locations[0].latitude);
    assertEquals (0.01, 33.3, locations[0].longitude);
  }

  @Test
  public void testIds()
  {
    assertNotEquals(locations[0].id, locations[1].id);
  }

  @Test
  public void testToString()
  {
    assertEquals ("Location{" + locations[0].id + ", 23.3, 33.3}",
                                                       locations[0].toString());
  }
}
```



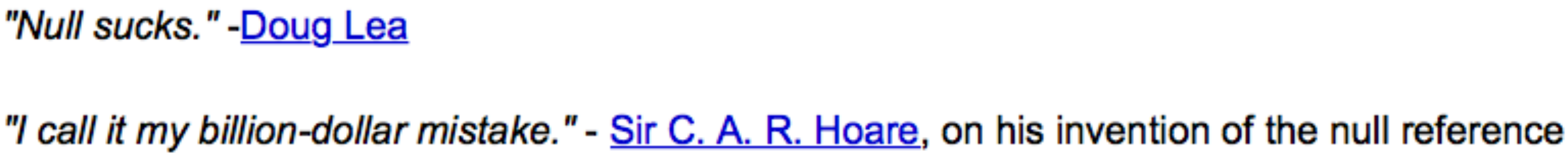
```
Project Explorer
▼ > pacemaker-console [pacemaker-console master ↓5]
  ▼ src
    ▶ controllers
    ▼ models
      ▼ Activity.java
        ▶ Activity
      ▼ Location.java
        ▶ Location
      ▼ User.java
        ▶ User
    ▶ utils
  ▼ test
    ▶ controllers
    ▼ models
      ▶ ActivityTest.java
      ▶ Fixtures.java
      ▶ LocationTest.java
      ▶ UserTest.java
  ▶ JRE System Library [JavaSE-1.7]

JUnit
Finished after 0.028 seconds
Runs: 9/9    Errors: 0    Failures: 0

▼ models.LocationTest [Runner: JUnit 4] (0.001 s)
    testIds (0.001 s)
    testToString (0.000 s)
    testCreate (0.000 s)
▼ models.UserTest [Runner: JUnit 4] (0.000 s)
    testIds (0.000 s)
    testToString (0.000 s)
    testCreate (0.000 s)
▼ models.ActivityTest [Runner: JUnit 4] (0.000 s)
    testIds (0.000 s)
    testToString (0.000 s)
    testCreate (0.000 s)
```



```
Project Explorer
▼ > pacemaker-console [pacemaker-console master ↓5]
  ▼ src
    ▶ controllers
    ▼ models
      ▼ Activity.java
        ▶ Activity
      ▼ Location.java
        ▶ Location
      ▼ User.java
        ▶ User
    ▶ utils
  ▼ > test
    ▶ controllers
    ▼ > models
      ▶ ActivityTest.java
      ▶ Fixtures.java
      ▶ LocationTest.java
      ▶ > UserTest.java
  ▶ JRE System Library [JavaSE-1.7]

JUnit
Finished after 0.039 seconds
Runs: 9/9    Errors: 0    Failures: 1

▼ models.LocationTest [Runner: JUnit 4] (0.001 s)
    testIds (0.000 s)
    testToString (0.000 s)
    testCreate (0.000 s)
▼ models.UserTest [Runner: JUnit 4] (0.005 s)
    testIds (0.000 s)
    testToString (0.005 s)
    testCreate (0.000 s)
▼ models.ActivityTest [Runner: JUnit 4] (0.001 s)
    testIds (0.000 s)
    testToString (0.001 s)
    testCreate (0.000 s)
```

A note on the Optional Class

Guava and Java 8

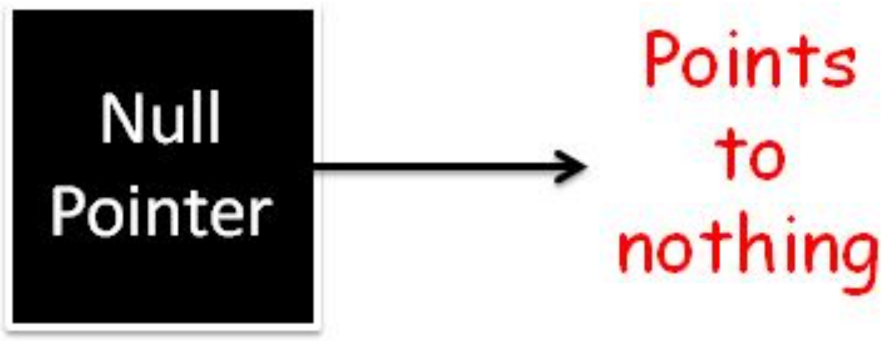


"Null sucks." -Doug Lea

"I call it my billion-dollar mistake." - Sir C. A. R. Hoare, on his invention of the null reference

- Careless use of null can cause a staggering variety of bugs.

- Null is highly ambiguous, e.g., Map.get(key) can return null because
  - the value in the map is null,
  - or the value is not in the map.



- i.e. Null can mean failure, can mean success, can mean almost anything. Using something other than null makes your meaning clear.

Why use the Optional Class?

*“**Optional** is primarily used for two things:*

to make it clearer what you would've meant by null,

and in method return values to make sure the caller takes care of the ‘absent’ case”.

http://stackoverflow.com/questions/11561789/guava-optional-how-to-use-the-correct

Where should we use the Optional Class?

*“We **certainly** don't advocate replacing every nullable value with an Optional everywhere in your code -- we certainly don't do that within Guava itself!*

A lot of this will have to be your decision – there's no universal rule, it's a relatively subjective judgement.”

Guava Contributor

http://stackoverflow.com/questions/11561789/guava-optional-how-to-use-the-correct

A brief discussion on use of the optional class: http://stackoverflow.com/questions/18681243/should-i-use-java8-guava-optional-for-every-method-that-may-return-null

Optional (Guava Component version)

```
Optional<Activity> activity = Optional.fromNullable(activitiesIndex.get(id));
if (activity.isPresent())
{
  activity.get().route.add(new Location(latitude, longitude));
}
```

- **Optional** is an immutable object used to contain a not-null object.
- **Optional** object is used to represent null with an absent value.
- This class has various utility methods to facilitate the code to handle:
    - values as available (present) or
    - values as not available (absent)
- instead of checking null values.

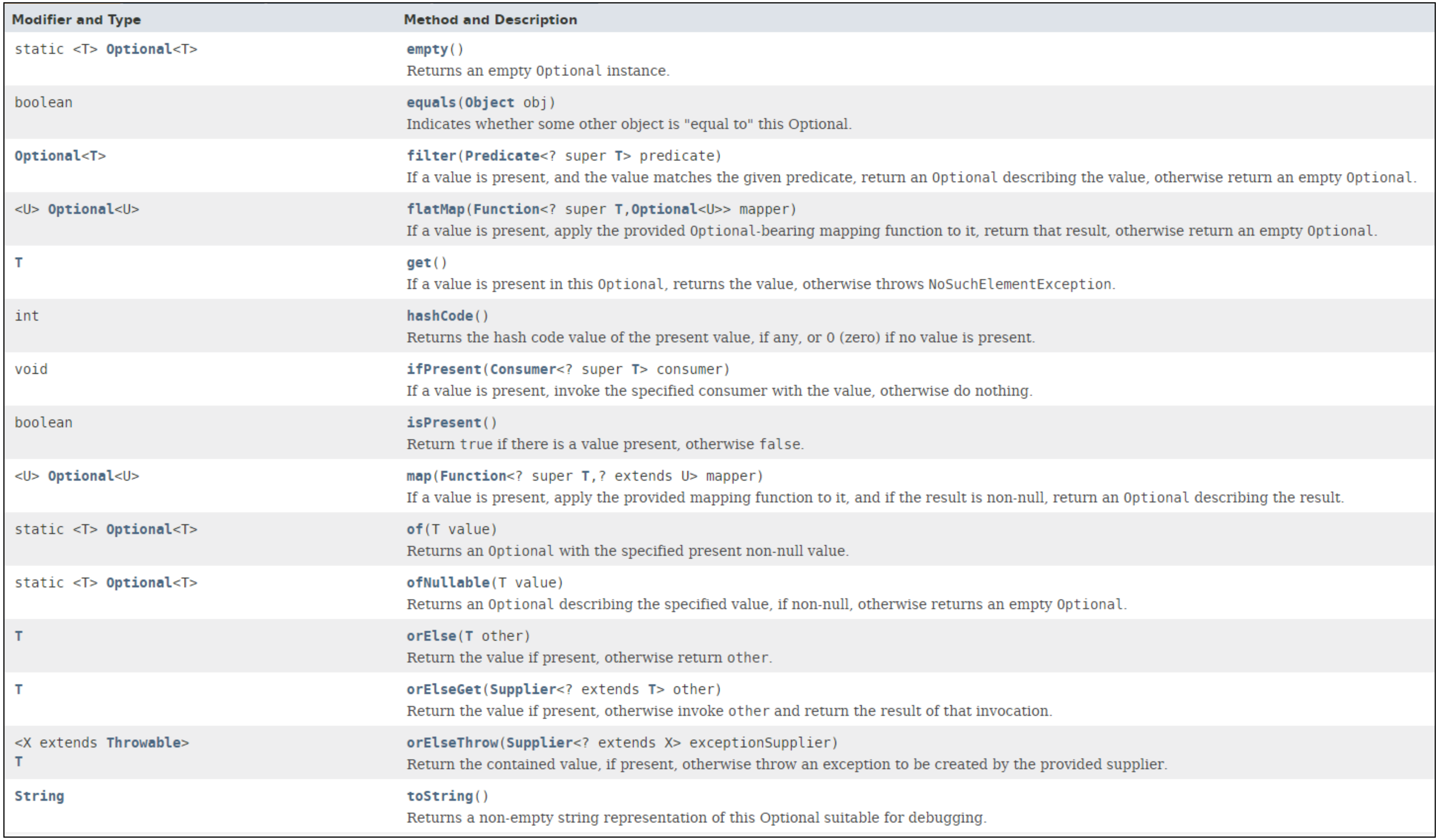
Optional in the Guava Component

```
Optional<Activity> activity = Optional.fromNullable(activitiesIndex.get(id));
if (activity.isPresent())
{
  activity.get().route.add(new Location(latitude, longitude));
}
```

- activitiesindex.get(id) will return null if id not present.
- Wrap this in a ‘Optional’ wrapper object - noting that the object it wraps may be null.
- Use ‘isPresent’ to determine wrapped object is null or not.

Optional in JDK 8

“A container object which may or may not contain a non-null value.”



Modifier and Type	Method and Description
`static <T> Optional<T>`	`empty()` Returns an empty `Optional` instance.
`boolean`	`equals(Object obj)` Indicates whether some other object is "equal to" this Optional.
`Optional<T>`	`filter(Predicate<? super T> predicate)` If a value is present, and the value matches the given predicate, return an `Optional` describing the value, otherwise return an empty `Optional`.
`<U> Optional<U>`	`flatMap(Function<? super T,Optional<U>> mapper)` If a value is present, apply the provided `Optional`-bearing mapping function to it, return that result, otherwise return an empty `Optional`.
`T`	`get()` If a value is present in this `Optional`, returns the value, otherwise throws `NoSuchElementException`.
`int`	`hashCode()` Returns the hash code value of the present value, if any, or 0 (zero) if no value is present.
`void`	`ifPresent(Consumer<? super T> consumer)` If a value is present, invoke the specified consumer with the value, otherwise do nothing.
`boolean`	`isPresent()` Return `true` if there is a value present, otherwise `false`.
`<U> Optional<U>`	`map(Function<? super T,? extends U> mapper)` If a value is present, apply the provided mapping function to it, and if the result is non-null, return an `Optional` describing the result.
`static <T> Optional<T>`	`of(T value)` Returns an `Optional` with the specified present non-null value.
`static <T> Optional<T>`	`ofNullable(T value)` Returns an `Optional` describing the specified value, if non-null, otherwise returns an empty `Optional`.
`T`	`orElse(T other)` Return the value if present, otherwise return `other`.
`T`	`orElseGet(Supplier<? extends T> other)` Return the value if present, otherwise invoke `other` and return the result of that invocation.

`<X extends Throwable>`
`T`
	`orElseThrow(Supplier<? extends X> exceptionSupplier)`
	Return the contained value, if present, otherwise throw an exception to be created by the provided supplier.

`String`	`toString()` Returns a non-empty string representation of this Optional suitable for debugging.

Pacemaker Tests

- Model
- API
- Serializer

PacemakerAPI (1)

- Implement the core features of the pacemaker service.

- Not concerned with UI at this stage.

```
public class PacemakerAPI
{
  private Map<Long,   User>   userIndex       = new HashMap<>();
  private Map<String, User>   emailIndex      = new HashMap<>();
  private Map<Long, Activity> activitiesIndex = new HashMap<>();

  //...

  public Collection<User> getUsers ()
  {
    return userIndex.values();
  }

  public  void deleteUsers()
  {
    userIndex.clear();
    emailIndex.clear();
  }

  public void deleteUser(Long id)
  {
    User user = userIndex.remove(id);
    emailIndex.remove(user.email);
  }

  public Activity createActivity(Long id,  String type,
                                   String location, double distance)
  {
    Activity activity = null;
    Optional<User> user = Optional.fromNullable(userIndex.get(id));
    if (user.isPresent())
    {
      activity = new Activity (type, location, distance);
      user.get().activities.put(activity.id, activity);
      activitiesIndex.put(activity.id, activity);
    }
    return activity;
  }
```

PacemakerAPI (2)

```
public class PacemakerAPI
{
  private Map<Long,   User>   userIndex       = new HashMap<>();
  private Map<String, User>   emailIndex      = new HashMap<>();
  private Map<Long, Activity> activitiesIndex = new HashMap<>();

  //...

  public Activity getActivity (Long id)
  {
    return activitiesIndex.get(id);
  }

  public void addLocation (Long id, float latitude, float longitude)
  {
    Optional<Activity> activity = Optional.fromNullable(activitiesIndex.get(id));
    if (activity.isPresent())
    {
      activity.get().route.add(new Location(latitude, longitude));
    }
  }
}
```

PacemakerAPI

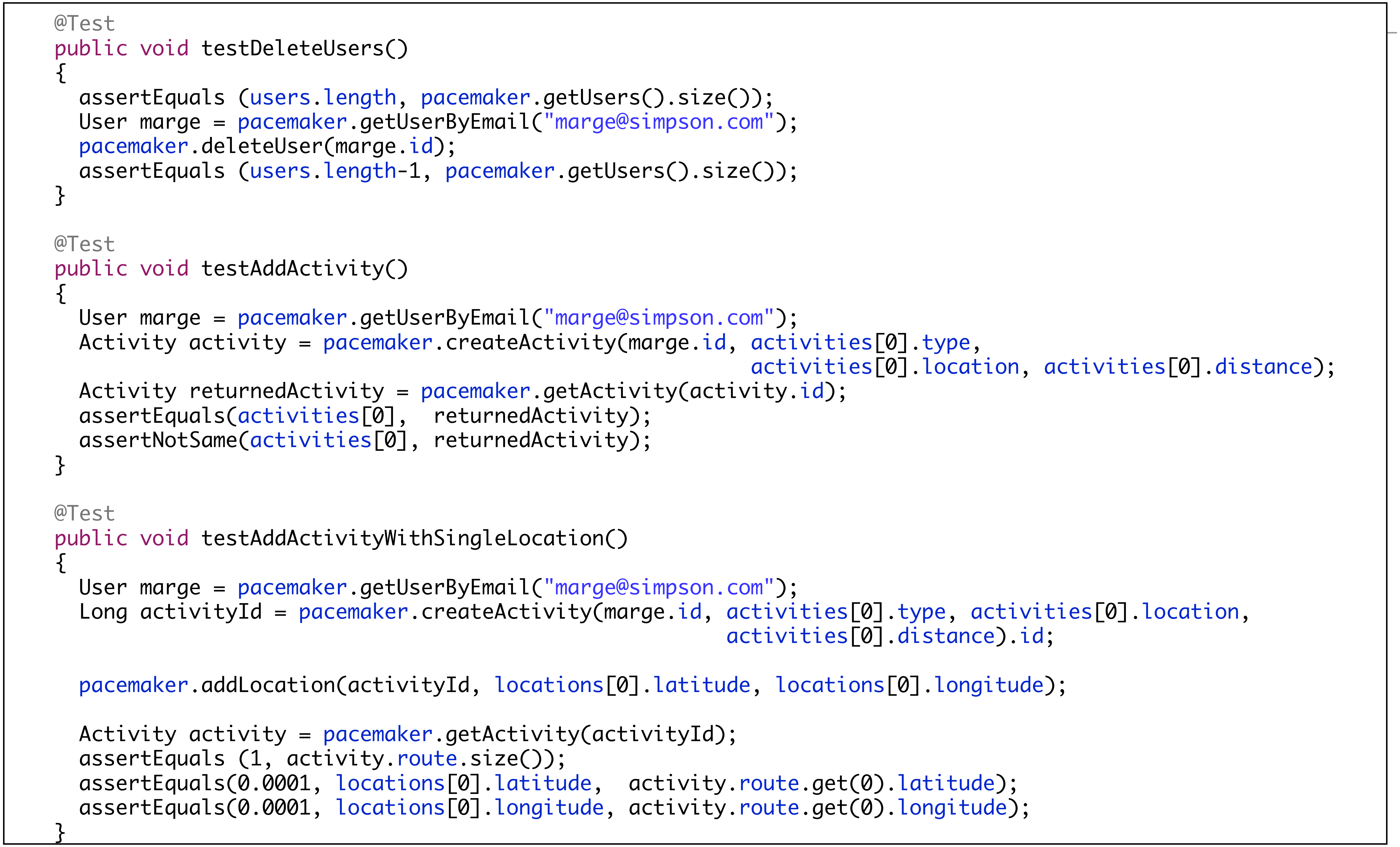
```java
public class PacemakerAPI
{
  private Map<Long,   User>   userIndex       = new HashMap<>();
  private Map<String, User>   emailIndex      = new HashMap<>();
  private Map<Long, Activity> activitiesIndex = new HashMap<>();

  //...

  public Collection<User> getUsers ()
  {
    return userIndex.values();
  }

  public  void deleteUsers()
  {
    userIndex.clear();
    emailIndex.clear();
  }

  public void deleteUser(Long id)
  {
    User user = userIndex.remove(i
    emailIndex.remove(user.email);
  }

  public Activity createActivity(L
                                 S

  {
    Activity activity = null;
    Optional<User> user = Optional
    if (user.isPresent())
    {
      activity = new Activity (typ
      user.get().activities.put(ac
      activitiesIndex.put(activity
    }
    return activity;
  }
```

```java
public class PacemakerAPI
{
  private Map<Long,   User>   userIndex       = new HashMap<>();
  private Map<String, User>   emailIndex      = new HashMap<>();
  private Map<Long, Activity> activitiesIndex = new HashMap<>();

  //...

  public Activity getActivity (Long id)
  {
    return activitiesIndex.get(id);
  }

  public void addLocation (Long id, float latitude, float longitude)
  {
    Optional<Activity> activity = Optional.fromNullable(activitiesIndex.get(id));
    if (activity.isPresent())
    {
      activity.get().route.add(new Location(latitude, longitude));
    }
  }
}
```

PacemakerAPITest (1)

```java
public class PacemakerAPITest
{
  private PacemakerAPI pacemaker;

  @Before
  public void setup()
  {
    pacemaker = new PacemakerAPI(null);
    for (User user : users)
    {
      pacemaker.createUser(user.firstName, user.lastName, user.email, user.password);
    }
  }

  @After
  public void tearDown()
  {
    pacemaker = null;
  }

  @Test
  public void testUser()
  {
    assertEquals (users.length, pacemaker.getUsers().size());
    pacemaker.createUser("homer", "simpson", "homer@simpson.com", "secret");
    assertEquals (users.length+1, pacemaker.getUsers().size());
    assertEquals (users[0], pacemaker.getUserByEmail(users[0].email));
  }

  @Test
  public void testUsers()
  {
    assertEquals (users.length, pacemaker.getUsers().size());
    for (User user: users)
    {
      User eachUser = pacemaker.getUserByEmail(user.email);
      assertEquals (user, eachUser);
      assertNotSame(user, eachUser);
    }
  }
```

PacemakerAPITest (2)



```
@Test
public void testDeleteUsers()
{
  assertEquals (users.length, pacemaker.getUsers().size());
  User marge = pacemaker.getUserByEmail("marge@simpson.com");
  pacemaker.deleteUser(marge.id);
  assertEquals (users.length-1, pacemaker.getUsers().size());
}

@Test
public void testAddActivity()
{
  User marge = pacemaker.getUserByEmail("marge@simpson.com");
  Activity activity = pacemaker.createActivity(marge.id, activities[0].type,
                                                         activities[0].location, activities[0].distance);
  Activity returnedActivity = pacemaker.getActivity(activity.id);
  assertEquals(activities[0],  returnedActivity);
  assertNotSame(activities[0], returnedActivity);
}

@Test
public void testAddActivityWithSingleLocation()
{
  User marge = pacemaker.getUserByEmail("marge@simpson.com");
  Long activityId = pacemaker.createActivity(marge.id, activities[0].type, activities[0].location,
                                                       activities[0].distance).id;

  pacemaker.addLocation(activityId, locations[0].latitude, locations[0].longitude);

  Activity activity = pacemaker.getActivity(activityId);
  assertEquals (1, activity.route.size());
  assertEquals(0.0001, locations[0].latitude,  activity.route.get(0).latitude);
  assertEquals(0.0001, locations[0].longitude, activity.route.get(0).longitude);
}
```

PacemakerAPITest (3)

```
  @Test
  public void testAddActivityWithMultipleLocation()
  {
    User marge = pacemaker.getUserByEmail("marge@simpson.com");
    Long activityId = pacemaker.createActivity(marge.id, activities[0].type,
                                                         activities[0].location,
                                                         activities[0].distance).id;
    for (Location location : locations)
    {
      pacemaker.addLocation(activityId, location.latitude, location.longitude);
    }

    Activity activity = pacemaker.getActivity(activityId);
    assertEquals (locations.length, activity.route.size());
    int i = 0;
    for (Location location : activity.route)
    {
      assertEquals(location, locations[i]);
      i++;
    }
  }
}
```

Pacemaker Tests

- Model
- API
- Serializer

pacemaker persistence

```
public interface Serializer
{
  void push(Object o);
  Object pop();
  void write() throws Exception;
  void read() throws Exception;
}
```

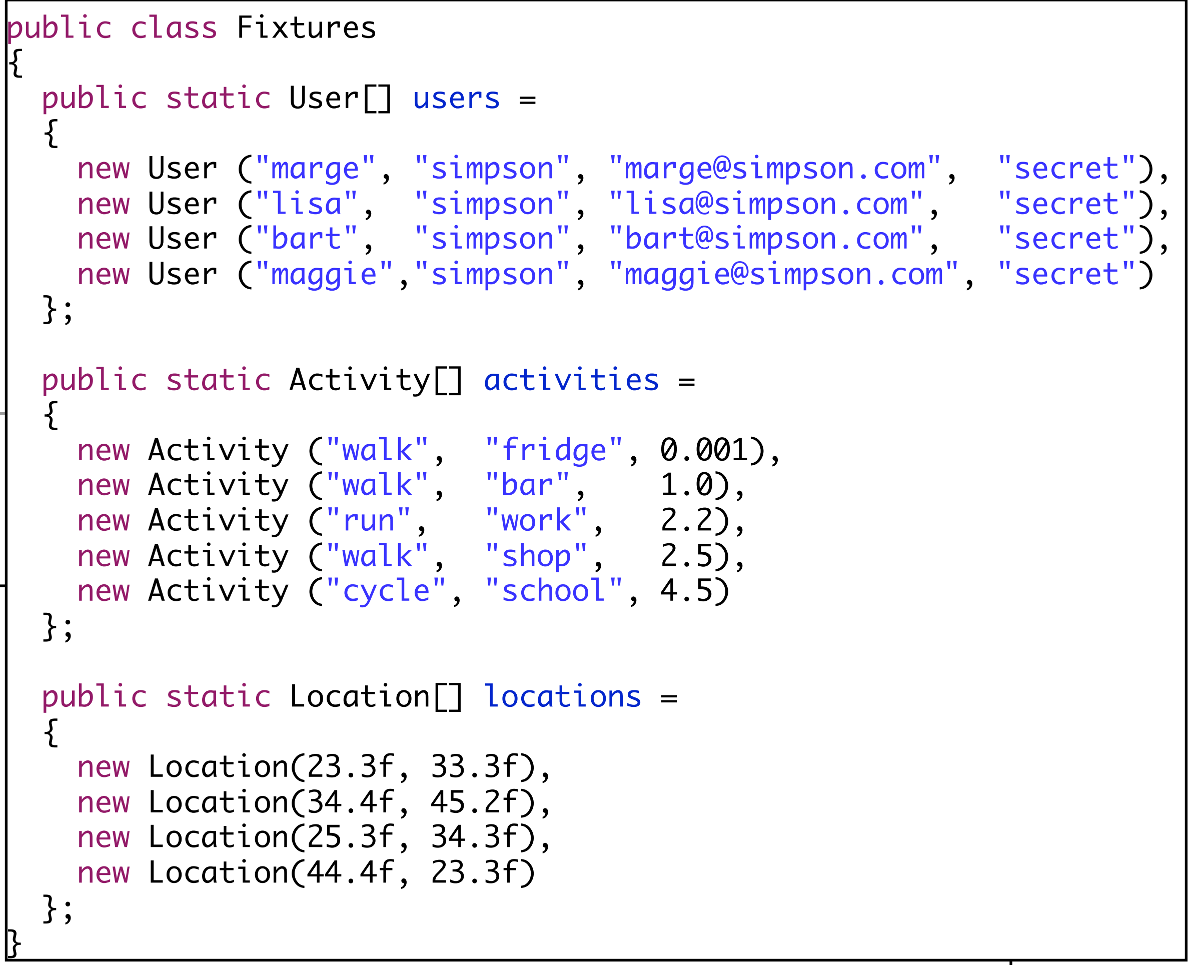
```
public class PacemakerAPI
{
  private Map<Long,   User>   userIndex       = new HashMap<>();
  private Map<String, User>   emailIndex      = new HashMap<>();
  private Map<Long, Activity> activitiesIndex = new HashMap<>();

  private Serializer serializer;

  public PacemakerAPI(Serializer serializer)
  {
    this.serializer = serializer;
  }

  @SuppressWarnings("unchecked")
  public void load() throws Exception
  {
    serializer.read();
    activitiesIndex = (Map<Long, Activity>) serializer.pop();
    emailIndex      = (Map<String, User>)   serializer.pop();
    userIndex       = (Map<Long, User>)     serializer.pop();
  }

  public void store() throws Exception
  {
    serializer.push(userIndex);
    serializer.push(emailIndex);
    serializer.push(activitiesIndex);
    serializer.write();
  }
}
```

XMLSerializer

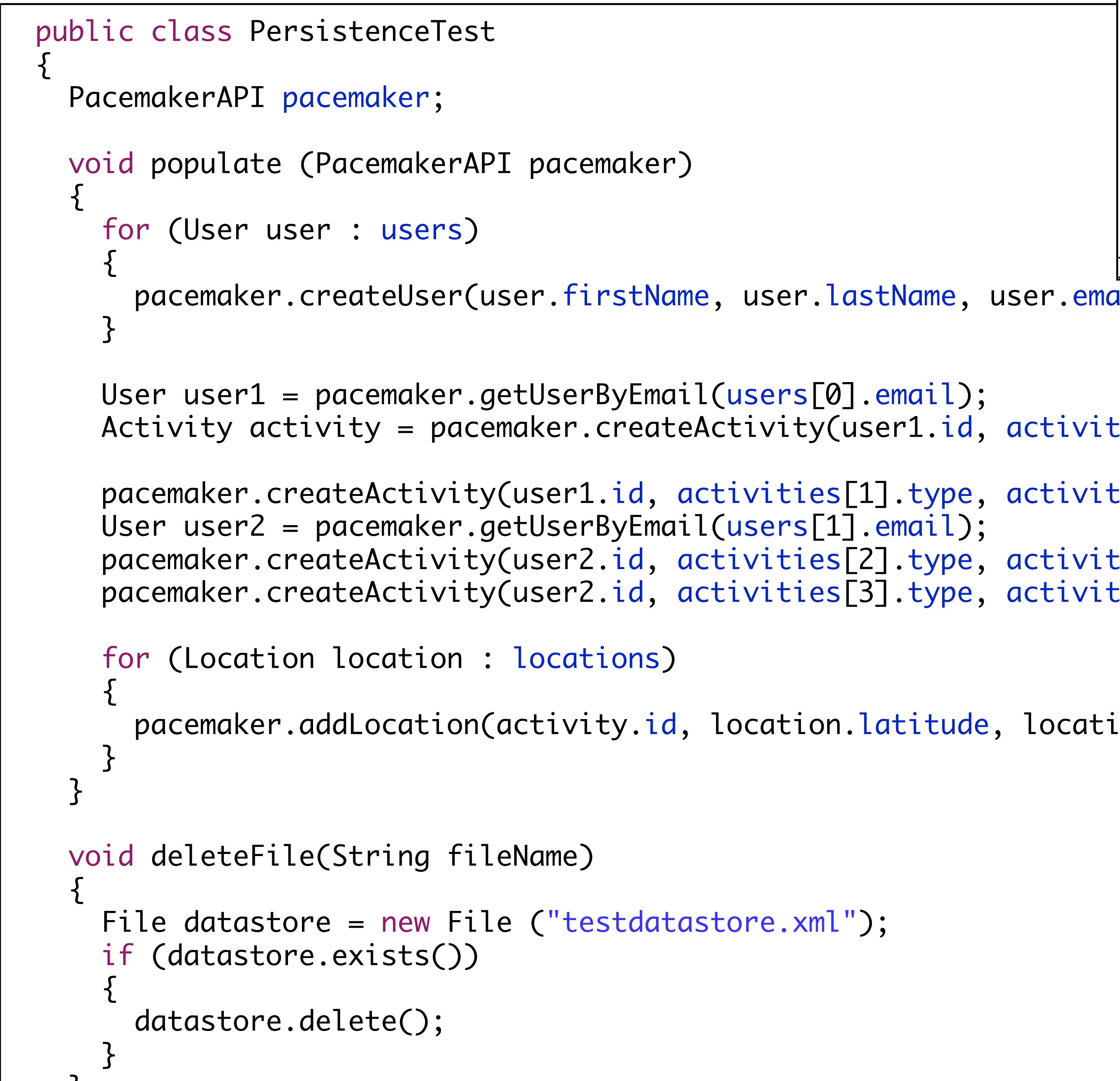
```
public class XMLSerializer implements Serializer
{
  private Stack stack = new Stack();
  private File file;

  public XMLSerializer(File file)
  {
    this.file = file;
  }

  public void push(Object o)
  {
    stack.push(o);
  }

  public Object pop()
  {
    return stack.pop();
  }

  @SuppressWarnings("unchecked")
  public void read() throws Exceptio
  {
    ObjectInputStream is = null;

    try
    {
      XStream xstream = new XStream(new DomDriver());
      is = xstream.createObjectInputStream(new FileReader(file));
      stack = (Stack) is.readObject();
    }
    finally
    {
      if (is != null)
      {
        is.close();
      }
    }
  }
```

```
  public void write() throws Exception
  {
    ObjectOutputStream os = null;

    try
    {
      XStream xstream = new XStream(new DomDriver());
      os = xstream.createObjectOutputStream(new FileWriter(file));
      os.writeObject(stack);
    }
    finally
    {
      if (os != null)
      {
        os.close();
      }
    }
  }
}
```

PersistenceTest - fixtures

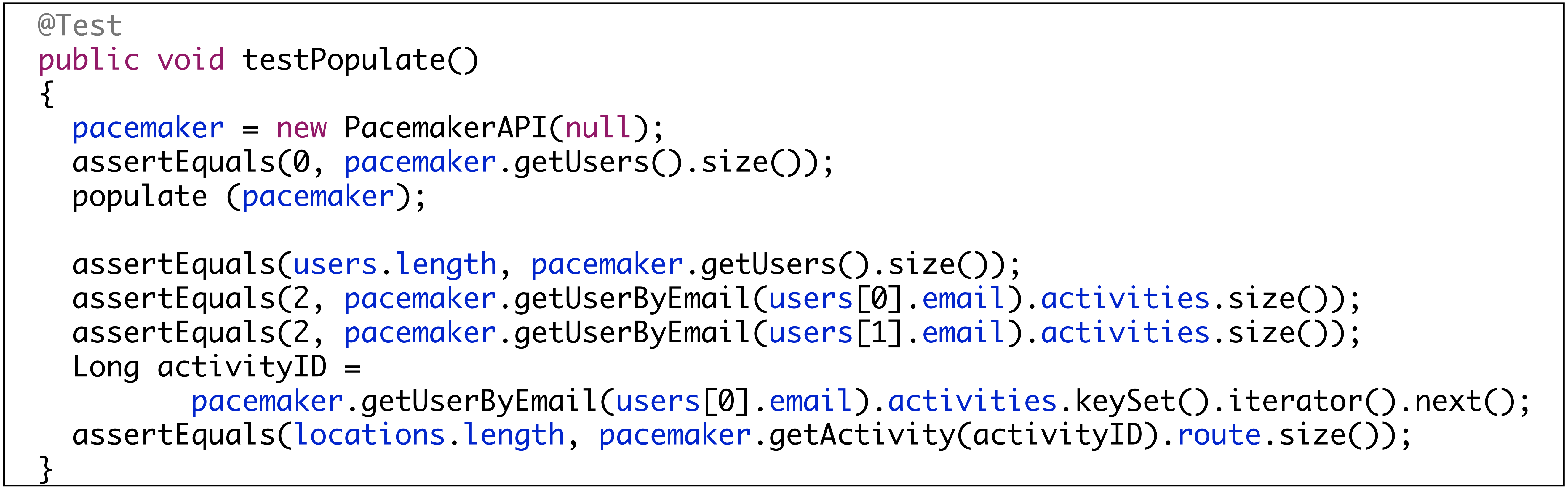


```
public class Fixtures
{
  public static User[] users =
  {
    new User ("marge", "simpson", "marge@simpson.com",  "secret"),
    new User ("lisa",  "simpson", "lisa@simpson.com",   "secret"),
    new User ("bart",  "simpson", "bart@simpson.com",   "secret"),
    new User ("maggie","simpson", "maggie@simpson.com", "secret")
  };

  public static Activity[] activities =
  {
    new Activity ("walk",  "fridge", 0.001),
    new Activity ("walk",  "bar",    1.0),
    new Activity ("run",   "work",   2.2),
    new Activity ("walk",  "shop",   2.5),
    new Activity ("cycle", "school", 4.5)
  };

  public static Location[] locations =
  {
    new Location(23.3f, 33.3f),
    new Location(34.4f, 45.2f),
    new Location(25.3f, 34.3f),
    new Location(44.4f, 23.3f)
  };
}
```



```
public class PersistenceTest
{
  PacemakerAPI pacemaker;

  void populate (PacemakerAPI pacemaker)
  {
    for (User user : users)
    {
      pacemaker.createUser(user.firstName, user.lastName, user.email, user.password);
    }

    User user1 = pacemaker.getUserByEmail(users[0].email);
    Activity activity = pacemaker.createActivity(user1.id, activities[0].type, activities[0].location,
                                                                     activities[0].distance);
    pacemaker.createActivity(user1.id, activities[1].type, activities[1].location, activities[1].distance);
    User user2 = pacemaker.getUserByEmail(users[1].email);
    pacemaker.createActivity(user2.id, activities[2].type, activities[2].location, activities[2].distance);
    pacemaker.createActivity(user2.id, activities[3].type, activities[3].location, activities[3].distance);

    for (Location location : locations)
    {
      pacemaker.addLocation(activity.id, location.latitude, location.longitude);
    }
  }

  void deleteFile(String fileName)
  {
    File datastore = new File ("testdatastore.xml");
    if (datastore.exists())
    {
      datastore.delete();
    }
```

Verify Fixture



```
@Test
public void testPopulate()
{
  pacemaker = new PacemakerAPI(null);
  assertEquals(0, pacemaker.getUsers().size());
  populate (pacemaker);

  assertEquals(users.length, pacemaker.getUsers().size());
  assertEquals(2, pacemaker.getUserByEmail(users[0].email).activities.size());
  assertEquals(2, pacemaker.getUserByEmail(users[1].email).activities.size());
  Long activityID =
         pacemaker.getUserByEmail(users[0].email).activities.keySet().iterator().next();
  assertEquals(locations.length, pacemaker.getActivity(activityID).route.size());
}
```

Serializer Test (XML)

```
@Test
public void testXMLSerializer() throws Exception
{
  String datastoreFile = "testdatastore.xml";
  deleteFile (datastoreFile);

  Serializer serializer = new XMLSerializer(new File (datastoreFile));

  pacemaker = new PacemakerAPI(serializer);
  populate(pacemaker);
  pacemaker.store();

  PacemakerAPI pacemaker2 =  new PacemakerAPI(serializer);
  pacemaker2.load();

  assertEquals (pacemaker.getUsers().size(), pacemaker2.getUsers().size());
  for (User user : pacemaker.getUsers())
  {
    assertTrue (pacemaker2.getUsers().contains(user));
  }
  deleteFile ("testdatastore.xml");
}
```