Lab9-Report

Tests List

1. Our CI/CD pipeline includes various testing techniques: unit tests, integration smoke tests and documentation javadoc tests.

```
run-unit-tests:
    stage: test
    script:
        - "mvn $MAVEN_CLI_OPTS -Dmaven.main.skip=true -Dtest=!lsea/controllers/* test -
DfailIfNoTests=false"
    needs:
        - validate-project

run-api-tests:
    stage: test
    script:
        - "mvn $MAVEN_CLI_OPTS -Dmaven.main.skip=true -Dtest=lsea/controllers/* test"
    needs:
        - validate-project

test-javadoc:
    stage: test
    script:
        - mvn javadoc:javadoc
        - test -d target/site/apidocs/
    needs:
        - validate-project
```

2. Our test suites covers various scenarios, including:
    1. Non-trivial business logic tests
    2. No cookie (Controller)
    3. No content (Controller)
    4. Invalid token (Controller)
    5. Different special cases if exist
3. Our test should cover all business logic code, including:
    1. Integration tests of all endpoints of controller
    2. Unit tests of all Entity's methods which are used in business logic.

Controller tests

Business Logic	**Test Name**	**Test Result**	**Test Description**
Index Controller	sanityCheck	200	This test only have this response, which response to check the sanity.
Log Controller - CreateOne	testCreateOne	200	Successfully create a log.

Business Logic	**Test Name**	**Test Result**	**Test Description**
Log Controller - CreateOne	testCreateOneWithoutCookie	403 "No cookies found"	Forbid when no cookie.
Log Controller - CreateOne	testCreateOneWithoutContent	422 "Something went wrong"	UnprocessableEntity when no content.
Log Controller - CreateOne	testCreateOneWithInvalidToken	403 "Invalid token"	Forbid when token is invalid.
Log Controller - GenerateData	testGenerateDataIsOK	200	Successfully generate data.
Log Controller - GenerateData	testGenerateDataNoContent()	4422 "Something went wrong"	UnprocessableEntity when no content.
Log Controller - GenerateData	testGenerateDataNoCookie	403 "No cookies found"	Forbid when no cookie.
Log Controller - GenerateData	testGenerateDataInvalidToken	403 "Invalid token"	Forbid when token is invalid.
Management Controller - Analysis Longest Log	testAnalysisLongestIsOK	200	Successfully analysis longest log.
Management Controller - Analysis Longest Log	testAnalysisLongestNoContent	422 "Something went wrong"	UnprocessableEntity when no content.
Management Controller - Analysis Longest Log	testAnalysisLongestNoCookie	403 "No cookies found"	Forbid when no cookie.
Management Controller - Analysis Longest Log	testAnalysisLongestInvalidToken	403 "Invalid token"	Forbid when token is invalid.
Management Controller - Analysis Shortest Log	testAnalysisShortestIsOK	200	Successfully analysis shortest log.
Management Controller - Analysis Shortest Log	testAnalysisShortestNoContent	422 "Something went wrong"	UnprocessableEntity when no content.
Management Controller - Analysis Shortest Log	testAnalysisShortestNoCookie	403 "No cookies found"	Forbid when no cookie.

Business Logic	Test Name	Test Result	Test Description
Management Controller - Analysis Shortest Log	testAnalysisShortestInvalidToken	403 "Invalid token"	Forbid when token is invalid.
Management Controller - Generate report	testGenerateReportIsOK	200 + `xlsx` file	Successfully generate report.
Management Controller - Generate report	testGenerateReportNoToken	403 "No token found in cookies"	Validation error when no token.
Management Controller - Test database	testDatabaseReport	200 + keys of map exist	Successfully test database.
User Controller - ping pong	testPing	200	This test only have this response, which is used for client to test if the server is alive.
User Controller - Create User	testCreateUserIsOK	200	Successfully create a user.
User Controller - Create User	testCreateUserNoContent	422 "Something went wrong"	UnprocessableEntity when no content.
User Controller - Create User	testCreateUserWithInvalidEmail	403 "`A validation error occured: email must match \"^[a-z0-9_.+-]+@[a-z0-9-]+\\.[a-z0-9-.]+$\"`"	Forbid when email is invalid.
User Controller - Create User	testAlreadyExistingUser	409 "User with email `xxxxx` already exists."	Conflict when user already exists.
User Controller - Authorize User	testAuthorizeUser	200	Successfully authorize a user.
User Controller - Authorize User	testAuthorizeUserWithWrongEmailOrPassword	403 "Invalid e-mail or password"	Forbid when email or password is wrong.
User Controller - Ban User	testBanUserAdminBan	200	Successfully ban a user.
User Controller - Ban User	testBanUserNotAdminBan	403	Forbid when user is not admin.
User Controller - Unban User	testUnbanAdminUnban	200	Successfully unban a user.
User Controller - Unban User	testUnbanNotAdminUnban	403	Forbid when user is not admin.
User Controller - Update User	testUpdateUserIsOK	200 - check user updated	Successfully update a user.

Business Logic	Test Name	Test Result	Test Description
User Controller - Update User	testUpdateUserInValidToken	403 "Invalid token"	Forbid when token is invalid.
User Controller - Update User	testUpdateUserNoContent	422 "Something went wrong"	UnprocessableEntity when no content.
User Controller - Update User	testUpdateUserNoCookie	403 "No cookies found"	Forbid when no cookie.
Website Controller - Create one	testCreateOneIsOK	200	Successfully create a website.
Website Controller - Create one	testCreateOneNoContent	422 "Something went wrong"	UnprocessableEntity when no content.
Website Controller - Create one	testCreateOneNoCookie	403 "No cookies found"	Forbid when no cookie.
Website Controller - Create one	testCreateOneInvalidToken	403 "Invalid token"	Forbid when token is invalid.
Website Controller - Delete one	testDeleteOneIsOK	200	Successfully delete a website.
Website Controller - Delete one	testDeleteOneNoCookie	403 "No cookies found"	Forbid when no cookie.
Website Controller - Delete one	testDeleteOneInvalidToken	403 "Invalid token"	Forbid when token is invalid.
Website Controller - Delete one	testDeleteOneNoWebsiteFound	404 "Website not found for this user"	Not found when this user doesn't contains this website.
Website Controller - Delete one	testDeleteOneNotOwner	403 "User has no permission to delete this website"	Forbid when this user is not the owner of this website.

Other Business Logic Unit Tests

Business Logic	Test Name	Test Situation
Log - create log	testCreateLog	assertEquals(createLogDto.getData(), log.getData());
Log - create log	testCreateLog	assertEquals(LogType.Success, log.getLogType());
Log - create log	testCreateLog	assertEquals(user.getId(), log.getUserId());

Business Logic	Test Name	Test Situation
Log - create log	testCreateLog	assertNotNull(log.getCreatedAt());
Log - create log	testCreateLog	assertEquals(user.toJson(), log.getUserCurrentState());
Log - dto - create log	testCreateLogWithInvalidLogType	assertThrows
UserGroup - create user group	testCreateUserGroup	Assertions.assertNotNull(userGroup.getId());
UserGroup - create user group	testCreateUserGroup	Assertions.assertEquals(dto.getName(), userGroup.getName());
UserGroup - create user group	testCreateUserGroup	Assertions.assertEquals(dto.getDescription(), userGroup.getDescription());
UserGroup - create user group	testCreateUserGroup	Assertions.assertEquals(GlobalPermissions.USER, userGroup.getGlobalPermission());
UserGroup - create user group	testCreateUserGroup	Assertions.assertNotNull(userGroup.getCreatedAt());
UserGroup - dto - create user group	testCreateUserGroupThrowsGenericForbiddenError()	assertThrows
UserGroup - To Json	testToJson	Not Null
UserGroupUser - Create	testCreate	Assertions.assertNotNull(userGroupUser);
UserGroupUser - Create	testCreate	Assertions.assertNotNull(userGroupUser.getId());
UserGroupUser - Create	testCreate	Assertions.assertEquals(UUID.fromString(userGroupId), userGroupUser.getUserGroupId());
UserGroupUser - Create	testCreate	Assertions.assertEquals(UUID.fromString(userId), userGroupUser.getUserId());
UserGroupUser - Create	testCreate	Assertions.assertEquals(GroupPermissions.REGULAR, userGroupUser.getGroupPermission());
UserGroupUser - dto - Create	testCreateWithInsufficientPermissions	assertThrows
UserGroupUser - dto - Create	testCreateWithSpectatorPermissions	assertThrows
User - Create	testCreate	Assertions.assertEquals(dto.getUsername(), createdUser.getUsername());

Business Logic	Test Name	Test Situation
User - Create	testCreate	Assertions.assertEquals(dto.getEmail(), createdUser.getEmail());
User - Create	testCreate	Assertions.assertNotEquals(dto.getPassword(), createdUser.getPassword());
User - Ban	testBan	Assertions.assertNotNull(user.getBannedAt());
User - Ban	testBan	Assertions.assertEquals(adminId, user.getBannedById());
User - Ban	testBan	Assertions.assertEquals(banReason, user.getBanReason());
User - UnBan	testUnBan	Assertions.assertNull(user.getBannedAt());
User - UnBan	testUnBan	Assertions.assertNull(user.getBannedById());
User - UnBan	testUnBan	Assertions.assertNull(user.getBanReason());
User - isBanned	testIsBanned	Assertions.assertTrue(user.isBanned());
User - Change Password	testChangePassword	assertThrows verifyPassword
User - Verify Password	testVerifyPassword	Assertions.assertDoesNotThrow(() -> user.verifyPassword(correctPassword));
User - Verify Password	testVerifyPassword	Assertions.assertThrows(GenericForbiddenError.class, () -> user.verifyPassword(incorrectPassword));
User - jwt token	testGetJwtToken	Assertions.assertNotNull(jwtToken);
User - jwt token	testVerifyToken	Assertions.assertEquals(user.getId(), userId);
User - jwt token	testVerifyToken	Assertions.assertThrows(GenericForbiddenError.class, () -> User.verifyToken("invalid_token"));
User - to json	testToJson	Assertions.assertNotNull(user.toJson());
Website - Create	testCreateWebsite	assertNotNull(website.getId());
Website - Create	testCreateWebsite	assertEquals(createWebsiteDto.getDisplayName(), website.getDisplayName());
Website - Create	testCreateWebsite	assertEquals(user, website.getUser());
Website - Create	testCreateWebsite	assertNotNull(website.getCreatedAt());
Website - Create	testCreateWebsite	assertEquals(createWebsiteDto.getRedirectUrl(), website.getRedirectUrl());
Website - Create	testCreateWebsite	assertNotNull(website.getPrivateKey());
Website - Create	testCreateWebsite	assertFalse(website.getIsActive());

Business Logic	Test Name	Test Situation
Website - Create	testCreateWebsite	assertEquals(website.getCreatedAt(), website.getUpdatedAt());
Website - deep clone	testDeepClone	assert for each field

Special statement

`Test should avoid loops instructions`. We have one places have loops, but it is used for deep clone test to check each needed field has been deeply cloned.

Other notes

Mock

We use `mock` when testing with business components. In controller, we use `MockMvc` to send requests to the endpoints, and for other business components we use `Mockito`.

Using mocks in Java testing is a common practice when testing business components, particularly in unit testing scenarios. A mock object is a simulated object that mimics the behavior of a real object, allowing to isolate the component under test and verify its interactions with dependencies. - Isolation - Control and Predictability - Speed and Efficiency - Reproducible Tests - Test Independence and Stability

Arrange-Act-Assert

Tests follow `Arrange-Act-Assert` pattern which is commented as `// Arrange`, `// Act`, `// Assert` in the code.

Example code:

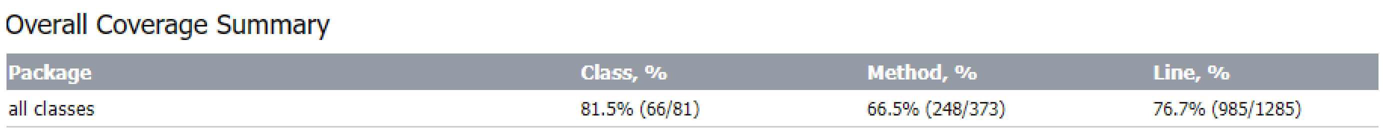
Here is part of codes from `ManagementControllerTest.java`:

```java
@RunWith(SpringRunner.class)
@SpringBootTest(classes = {LaboratoryApplication.class}, webEnvironment =
SpringBootTest.WebEnvironment.RANDOM_PORT)
@AutoConfigureMockMvc
@Transactional
public class ManagementControllerTest {

    /**
     * This is the MockMvc object that is used to send requests to the endpoints.
     */
    @Resource
    private MockMvc mockMvc;

    /**
     * This test method sends a Get request to the "/api/v1/management/analysis-longest-five"
     *
     * @throws Exception Exception of mockMvc.perform
     */
    @Test
    @DisplayName("Test of ManagementController")
    @Rollback
    public void testAnalysisLongestIsOK() throws Exception {
        // Arrange
        generateTestData();

        String userAuthRequest = "{\n" +
                "    \"password\": \"test_admin\",\n" +
                "    \"email\": \"test_admin@example.com\"\n" +
                "}";

        MvcResult result = mockMvc.perform(
                MockMvcRequestBuilders
                        .post("/api/v1/users/authorize")
                        .contentType("application/json;charset=UTF-8")
                        .content(userAuthRequest))
                .andReturn();

        Cookie cookie = result.getResponse().getCookie("token");

        MockHttpServletRequestBuilder requestBuilder = MockMvcRequestBuilders
                .get("/api/v1/management/analysis-longest-five")
                .param("numThreads", "5")
                .cookie(cookie)
                .contentType("application/json;charset=UTF-8");

        /* Requirement 9 */
        // isOK
        // Act
        mockMvc.perform(requestBuilder)
                // Assert
                .andExpect(MockMvcResultMatchers.status().isOk())
                .andExpect(MockMvcResultMatchers
                        .jsonPath("$.data[0].data")
                        .value("test data55555"))
                .andExpect(MockMvcResultMatchers
                        .jsonPath("$.data[4].data")
                        .value("test data999999999"))
                .andDo(MockMvcResultHandlers.print());

    }
}
```

Notes: As you can see we are using both `@Transactional` and `@Rollback` annotations.

It is because in this test class, there are two tests which are `testAnalysisLongestIsOK` and `testAnalysisShortestIsOK`, they will share the same `mockMvc` bean instance. They can pass the test independently, but if we run them together in the `CI/CD`, the second test will fail because the data in the mock instance has been changed by the first test. So we need to rollback the data after each test. Or we can arrange the tests before running them in the other method.

Test Coverage Report

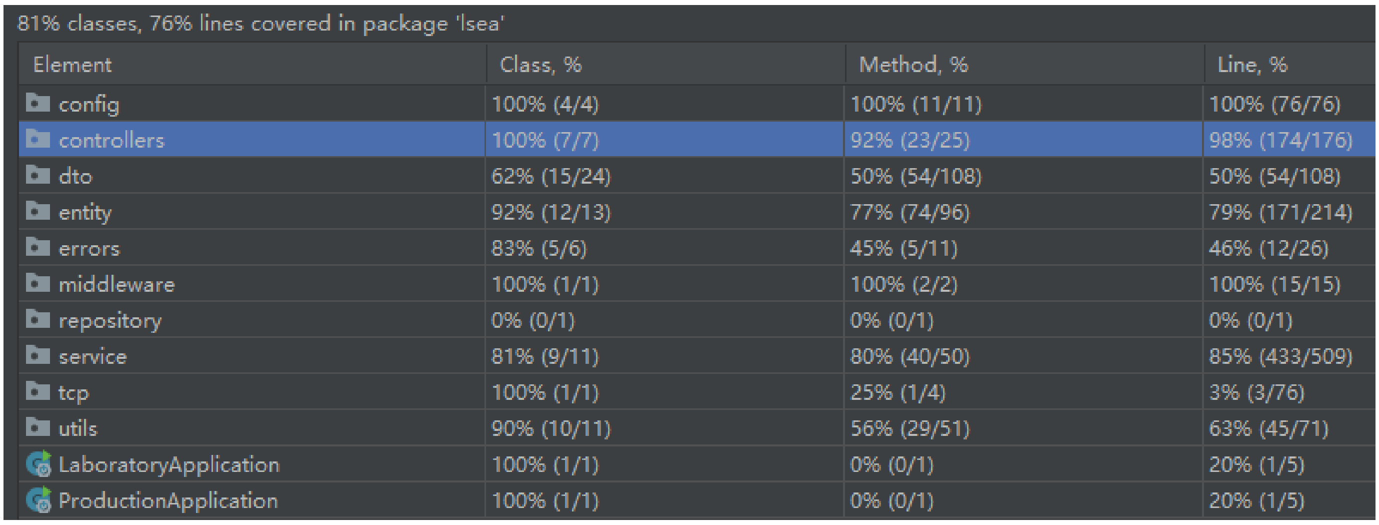


Overall Coverage Summary

Package	Class, %	Method, %	Line, %
all classes	81.5% (66/81)	66.5% (248/373)	76.7% (985/1285)

Figure 1. Overall Coverage Summary

From figure 1, we can see the overall coverage of test is 61/81 in class metrics, 248/373 in method metrics, 985/1285 in line metrics.

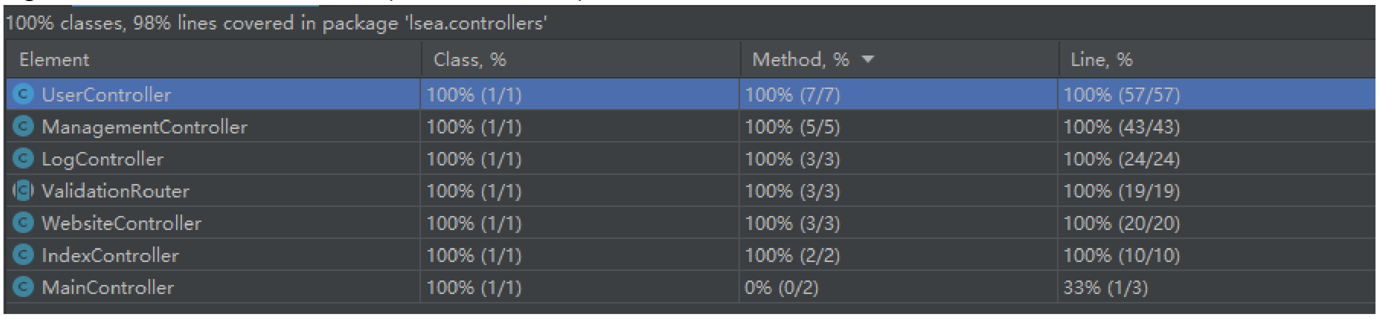


81% classes, 76% lines covered in package 'lsea'

Element	Class, %	Method, %	Line, %
config	100% (4/4)	100% (11/11)	100% (76/76)
controllers	100% (7/7)	92% (23/25)	98% (174/176)
dto	62% (15/24)	50% (54/108)	50% (54/108)
entity	92% (12/13)	77% (74/96)	79% (171/214)
errors	83% (5/6)	45% (5/11)	46% (12/26)
middleware	100% (1/1)	100% (2/2)	100% (15/15)
repository	0% (0/1)	0% (0/1)	0% (0/1)
service	81% (9/11)	80% (40/50)	85% (433/509)
tcp	100% (1/1)	25% (1/4)	3% (3/76)
utils	90% (10/11)	56% (29/51)	63% (45/71)
LaboratoryApplication	100% (1/1)	0% (0/1)	20% (1/5)
ProductionApplication	100% (1/1)	0% (0/1)	20% (1/5)

Figure 2. Overall Coverage Summary details

The coverage in controller is not 100% from this view, because we have one class file in controller never been used in business logic. We can see details from the report of controller part.



100% classes, 98% lines covered in package 'lsea.controllers'

Element	Class, %	Method, %	Line, %
UserController	100% (1/1)	100% (7/7)	100% (57/57)
ManagementController	100% (1/1)	100% (5/5)	100% (43/43)
LogController	100% (1/1)	100% (3/3)	100% (24/24)
ValidationRouter	100% (1/1)	100% (3/3)	100% (19/19)
WebsiteController	100% (1/1)	100% (3/3)	100% (20/20)
IndexController	100% (1/1)	100% (2/2)	100% (10/10)
MainController	100% (1/1)	0% (0/2)	33% (1/3)

Figure 3. Coverage Summary for Package: lsea.controllersy

From figure 3, we can see the overall coverage of test is 100% except for one class file which is mentioned above that never been used.

Appendix - Test Result From CI/CD

run-api-tests

```
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 44, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  01:14 min
[INFO] Finished at: 2023-06-09T14:34:13Z
[INFO] ------------------------------------------------------------------------
section_end:1686321253:step_script
[0Ksection_start:1686321253:archive_cache
[0K[0K[36;1mSaving cache for successful job[0;m[0;m
[32;1mCreating cache VERY_COOL_KEY-7...[0;m
.m2/repository: found 5033 matching artifact files and directories[0;m
Archive is up to date!                           [0;m
[32;1mCreated cache[0;m
section_end:1686321254:archive_cache
[0Ksection_start:1686321254:cleanup_file_variables
[0K[0K[36;1mCleaning up project directory and file based variables[0;m[0;m
section_end:1686321255:cleanup_file_variables
[0K[32;1mJob succeeded[0;m
```

run-unit-tests

```
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 21, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  50.128 s
[INFO] Finished at: 2023-06-06T02:07:08Z
[INFO] ------------------------------------------------------------------------
section_end:1686017228:step_script
[0Ksection_start:1686017228:archive_cache
[0K[0K[36;1mSaving cache for successful job[0;m[0;m
[32;1mCreating cache VERY_COOL_KEY-7...[0;m
.m2/repository: found 5033 matching artifact files and directories[0;m
Archive is up to date!                            [0;m
[32;1mCreated cache[0;m
section_end:1686017229:archive_cache
[0Ksection_start:1686017229:cleanup_file_variables
[0K[0K[36;1mCleaning up project directory and file based variables[0;m[0;m
section_end:1686017230:cleanup_file_variables
[0K[32;1mJob succeeded[0;m
```

test-javadoc

```
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  17.058 s
[INFO] Finished at: 2023-06-04T13:34:04Z
[INFO] ------------------------------------------------------------------------
$ test -d target/site/apidocs/
Saving cache for successful job
00:01
Creating cache VERY_COOL_KEY-7...
.m2/repository: found 5033 matching artifact files and directories
Archive is up to date!
Created cache
Cleaning up project directory and file based variables
00:01
Job succeeded
```