

# Hands-On Lab: Running Test Cases with Coverage

**Estimated time needed:** 30 minutes

Welcome to the **Running Test Cases with Coverage** lab. Test coverage is the percentage of lines of code that execute during all of the tests. High test coverage gives you confidence that a large amount of code is executed during testing. In turn, the more lines of code that execute through tests, the more confident you can be that your code works as expected.

In this lab, you will learn how to improve your test coverage by generating a test coverage report, interpreting the report to determine which lines of code do not have test cases, and writing test cases to cover those lines.

## Learning Objectives

After completing this lab, you will be able to:

- Generate a test coverage report
- Interpret a test coverage report to determine which lines of code are not covered by test cases
- Write enough new test cases to reach 100% test coverage

## About Theia

Theia is an open-source IDE (Integrated Development Environment) that can be run on desktop or on cloud. You will be using the Theia IDE to do this lab. When you log into the Theia environment, you are presented with a 'dedicated computer on the cloud' exclusively for you. This is available to you as long as you work on the labs. Once you log off, this 'dedicated computer on the cloud' is deleted along with any files you may have created. So, it is a good idea to finish your labs in a single session. If you finish part of the lab and return to the Theia lab later, you may have to start from the beginning. Plan to work out all your Theia labs when you have the time to finish the complete lab in a single session.

## Set Up the Lab Environment

You have a little preparation to do before you can start the lab.

### Open a Terminal

Open a terminal window by using the menu in the editor: Terminal > New Terminal.

In the terminal, if you are not already in the `/home/projects` folder, change to your project folder now.

- 1.
1. `cd /home/project`

Copied! Executed!

### Clone the Code Repo

Now get the code that you need to test. To do this, use the `git clone` command to clone the git repository:

- 1.
1. `git clone https://github.com/ibm-developer-skills-network/duwjsx-tdd_bdd_PracticeCode.git`

Copied! Executed!

### Change into the Lab Folder

Once you have cloned the repository, change to the lab directory:

- 1.
1. `cd duwjsx-tdd_bdd_PracticeCode/labs/04_test_coverage`

Copied! Executed!

### Install Python Dependencies

The final preparation step is to use pip to install the Python packages needed for the lab:

```
1. 1
1. pip install -r requirements.txt
```

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Executed!

You are now ready to start the lab.

Optional

If working in the terminal becomes difficult because the command prompt is very long, you can shorten the prompt using the following command:

```
1. 1
1. export PS1="[\\[\\033[01;32m\\]\\u\\[\\033[00m\\]: \\[\\033[01;34m\\]\\W\\[\\033[00m\\]]\\$ "
```

Copied!

Executed!

Open the Code Editor

In the IDE, navigate to the duwjsx-tdd\_bdd\_PracticeCode/labs/04\_test\_coverage folder. This folder contains all of the source code that you will use for this lab.

```
1. 1
2. 2
3. 3

1. duwjsx-tdd_bdd_PracticeCode
2. └─ labs
3.   └─ 04_test_coverage
```

Copied!

You will do all your editing work in the file tests/test\_account.py. To get started, click the button below to open up that file in the code editor.

Open test\_account.py in IDE

Start by Running the Tests

Before writing any code, you should always check that the test cases are passing. Otherwise when they fail, you won’t know if you broken the code, or if the code was broken before you started.

Let’s run nosetests and produce a coverage report to identify the lines that are missing code coverage:

```
1. 1
1. nosetests
```

Copied!

Executed!

Your initial report should look like this:

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

1. Name          Stmt% Miss Cover Missing
2. -----
3. models/_init_.py      6      0 100%
4. models/account.py    40     13  68%  26, 30, 34-35, 45-48, 52-54, 74-75
5. -----
6. TOTAL              46     13  72%
7. -----
8. Ran 2 tests in 0.349s
```

Copied!

You are starting with **72%** test coverage. Your goal is to reach **100%**! Let's go look at the first missed line, line **26** in `account.py` to see if we can write a test case for it.

## Step 1: Missing Line 26

The coverage report indicated that line 26 in `account.py` doesn't have a test case that executes it.

### Your Task

To increase your test coverage, first investigate line 26 in `models/account.py`. This file is in the `model` package from the root of the repo.

To open `models/account.py`, you can click the button below:

Open **account.py** in IDE

You should see the following code on lines 25 and 26.

```
1. 1
2. 2

1. def __repr__(self):
2.     return '<Account %r>' % self.name
```

Copied!

Notice that this method is one of the magic methods that is called to represent the class when printing it out.

Your task is to add a new test case in `test_account.py` that calls the `__repr__()` method on an `Account`.

▼ Click here for a hint.

Call the `__repr__()` method by using the `str()` function on `account`.

### Solution

▼ Click here for the solution.

Paste this code into `test_account.py`. Be sure to indent properly.

```
1. 1
2. 2
3. 3
4. 4
5. 5

1. def test_repr(self):
2.     """Test the representation of an account"""
3.     account = Account()
4.     account.name = "Foo"
5.     self.assertEqual(str(account), "<Account 'Foo'>")
```

Copied!

## Step 2: Missing Line 30

Run `nosetests` again to ensure line 26 is now covered through testing and to determine the next line of code for which you should write a new test case:

```
1. 1

1. nosetests
```

Copied! Executed!

If you completed the previous step correctly, your test coverage report should look like this:

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
```

7. 7  
8. 8

1. Name	Stmts	Miss	Cover	Missing
2. -----				
3. models/_init_.py	6	0	100%	
4. models/account.py	40	12	70%	30, 34-35, 45-48, 52-54, 74-75
5. -----				
6. TOTAL	46	12	74%	
7. -----				
8. Ran 3 tests in 0.387s				

Copied!

Note that your overall test coverage increased from 72% to 74% and the new report does not list line 26 in the Missing column. The next line of code listed under that column is 30. Examine this line in `account.py` to find out what that code is doing.

## Your Task

You should see the following code on lines 28 through 30.

```

1. 1
2. 2
3. 3

1. def to_dict(self) -> dict:
2.     """Serializes the class as a dictionary"""
3.     return {c.name: getattr(self, c.name) for c in self.__table__.columns}

```

Copied!

Notice that this code is the `to_dict()` method. Your task is to add a new test case in `test_account.py` that executes the `to_dict()` method on an `Account`.

## Solution

▼ Click here for the solution.

Paste this code into `test_account.py`. Be sure to indent properly.

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10

1. def test_to_dict(self):
2.     """ Test account to dict """
3.     data = ACCOUNT_DATA[self.rand] # get a random account
4.     account = Account(**data)
5.     result = account.to_dict()
6.     self.assertEqual(account.name, result["name"])
7.     self.assertEqual(account.email, result["email"])
8.     self.assertEqual(account.phone_number, result["phone_number"])
9.     self.assertEqual(account.disabled, result["disabled"])
10.    self.assertEqual(account.date_joined, result["date_joined"])

```

Copied!

## Step 3: Missing Lines 34-35

Run `nosetests` again to ensure line 30 is now covered through testing and to determine the next line of code for which you should write a new test case:

```

1. 1

1. nosetests

```

Copied!

Executed!

If you completed the previous steps correctly, your test coverage report should look like this:

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

```

```

1. Name           Stmts  Miss  Cover   Missing
2. -----
3. models/__init__.py      6      0   100%
4. models/account.py     40     11    72%   34-35, 45-48, 52-54, 74-75
5. -----
6. TOTAL                 46     11    76%
7. -----
8. Ran 4 tests in 0.368s

```

Copied!

Note that your overall test coverage increased from 74% to 76%. The next lines of code listed in the Missing column are 34-35. Examine these lines in `account.py` to find out what that code is doing.

## Your Task

You should see the following code on lines 34 and 35.

```

1. 1
2. 2
3. 3
4. 4

1. def from_dict(self, data: dict) -> None:
2.     """Sets attributes from a dictionary"""
3.     for key, value in data.items():
4.         setattr(self, key, value)

```

Copied!

Notice that this code is the `from_dict()` method. Your task is to add a new test case in `test_account.py` that executes the `from_dict()` method on an `Account`.

## Solution

▼ Click here for the solution.

Paste this code into `test_account.py`. Be sure to indent properly.

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9

1. def test_from_dict(self):
2.     """ Test account from dict """
3.     data = ACCOUNT_DATA[self.rand] # get a random account
4.     account = Account()
5.     account.from_dict(data)
6.     self.assertEqual(account.name, data["name"])
7.     self.assertEqual(account.email, data["email"])
8.     self.assertEqual(account.phone_number, data["phone_number"])
9.     self.assertEqual(account.disabled, data["disabled"])

```

Copied!

## Step 4: Missing Lines 45-48

Run `nosetests` again to ensure lines 34 and 35 are now covered through testing and to determine the next line of code for which you should write a new test case:

```

1. 1

```

1. nosetests

Copied! Executed!

If you completed the previous steps correctly, your test coverage report should look like this:

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

1. Name                Stmts   Miss  Cover    Missing
2. -----
3. models/__init__.py      6       0   100%
4. models/account.py     40       9    78%   45-48, 52-54, 74-75
5. -----
6. TOTAL                 46       9    80%
7. -----
8. Ran 5 tests in 0.377s

```

Copied!

Your test coverage increased to **80%**! Good job!

## Your Task

Now examine lines 45-48 in `account.py` to find out what that code is doing.

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6

1. def update(self):
2.     """Updates an account to the database"""
3.     logger.info("Saving %s", self.name)
4.     if not self.id:
5.         raise DataValidationError("Update called with empty ID field")
6.     db.session.commit()

```

Copied!

Notice that this code is the `update()` method. Your task is to add a new test case in `test_account.py` that executes the `update()` method on an `Account`.

## Solution

▼ Click here for the solution.

Paste this code into `test_account.py`. Be sure to indent properly.

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10

1. def test_update_an_account(self):
2.     """ Test Account update using known data """
3.     data = ACCOUNT_DATA[self.rand] # get a random account
4.     account = Account(**data)
5.     account.create()
6.     self.assertIsNotNone(account.id)
7.     account.name = "Foo"
8.     account.update()
9.     found = Account.find(account.id)
10.    self.assertEqual(found.name, "Foo")

```

Copied!

## Step 5: Missing Line 47

Run nosetests again to ensure lines 45 through 48 are now covered through testing and to determine the next line of code for which you should write a new test case:

1. 1
1. nosetests

Copied!

Executed!

This time your results should look like this:

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

1. Name                Stmts  Miss  Cover   Missing
2. -----
3. models/__init__.py    6      0   100%
4. models/account.py    40      4    90%   47, 52-54
5. -----
6. TOTAL                 46      4    91%
7. -----
8. Ran 6 tests in 0.366s

```

Copied!

You've reached **91%** test coverage! But what happened with line 47? The previous test you wrote covered lines 45 through 48, but the coverage report still lists line 47 in the Missing column. Obviously, some conditional logic was not executed in that previous test.

## Your Task

Review lines 45-48 of `account.py` to see what that code is doing.

```

1. 1
2. 2

1. if not self.id:
2.     raise DataValidationError("Update called with empty ID field")

```

Copied!

Notice that line 47 only executes if the `update()` method is called with an `id` that is `None`. Your task is to add a new test case in `test_account.py` that executes the `update()` method and causes this line of code to run?

## Solution

▼ Click here for the solution.

Paste this code into `test_account.py`. Be sure to indent properly.

```

1. 1
2. 2
3. 3
4. 4
5. 5
6. 6

1. def test_invalid_id_on_update(self):
2.     """ Test invalid ID update """
3.     data = ACCOUNT_DATA[self.rand] # get a random account
4.     account = Account(**data)
5.     account.id = None
6.     self.assertRaises(DataValidationError, account.update)

```

Copied!

## Step 6: Missing Lines 53-54

Run `nosetests` again to ensure line 47 is now covered through testing and to determine the next line of code for which you should write a new test case:

```
1. 1
1. nosetests
```

Copied! Executed!

This time your results should look like this:

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

1. Name                Stmts   Miss  Cover    Missing
2. -----
3. models/__init__.py      6      0   100%
4. models/account.py     40      3    92%   52-54
5. -----
6. TOTAL                  46      3    93%
7. -----
8. Ran 7 tests in 0.385s
```

Copied!

## Your Task

Examine lines 52-54 of `account.py` to see what that code is doing.

```
1. 1
2. 2
3. 3
4. 4
5. 5

1. def delete(self):
2.     """Removes an account from the data store"""
3.     logger.info("Deleting %s", self.name)
4.     db.session.delete(self)
5.     db.session.commit()
```

Copied!

Notice that lines 52-54 are the `delete()` method. Your task is to add a new test case in `test_account.py` that executes the `delete()` method on an `Account`.

## Solution

▼ Click here for the solution.

Paste this code into `test_account.py`. Be sure to indent properly.

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8

1. def test_delete_an_account(self):
2.     """ Test Account update using known data """
3.     data = ACCOUNT_DATA[self.rand] # get a random account
4.     account = Account(**data)
5.     account.create()
6.     self.assertEqual(len(Account.all()), 1)
7.     account.delete()
8.     self.assertEqual(len(Account.all()), 0)
```



Copied!

# Step 7: 100% Test Coverage

Run nosetests one last time to see what your test coverage is:

- 1. 1
- 1. nosetests

Copied! Executed!

## Success!

You’ve finally reached 100% code coverage with no missing lines!

```
1. 1
2. 2
3. 3
4. 4
5. 5
6. 6
7. 7
8. 8
9. 9
10. 10

1. Name           Stmts  Miss  Cover   Missing
2. -----
3. models/__init__.py      6      0   100%
4. models/account.py     40      0   100%
5. -----
6. TOTAL                 46      0   100%
7. -----
8. Ran 8 tests in 0.415s
9.
10. OK
```

Copied!

# Conclusion

## Congratulations on Completing the Test Coverage Lab

You did it! You wrote enough test cases to execute every line of code in the account module. You now know that every line of code works when you test it with some known data. However, your code could still have bugs that will only reveal themselves when you send bad or unexpected data into your code. Never give up writing new test cases that cover more possibilities.

## Author(s)

John Rofrano

## Changelog

Date	Version	Changed by	Change Description
2022-04-14	1.0	Rofrano	Create new Lab
2022-04-16	1.1	Zach Rash	Proofread and edit

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