

# Lab 3: Continuous Integration

*Software Testing 2021*

*2021/03/18*

# Parameterization & Exception

# Parameterization

- Execute a single test method **multiple times** with different parameters

# Parameterization - Example 1

Target function:

```
1 public class Numbers {  
2     public static boolean isOdd(int number) {  
3         return number % 2 != 0;  
4     }  
5 }
```

Test case:

```
1 @ParameterizedTest  
2 @ValueSource(ints = {1, 3, 5, -3, 15, Integer.MAX_VALUE}) // six numbers  
3 void isOdd_ShouldReturnTrueForOddNumbers(int number) {  
4     assertTrue(Numbers.isOdd(number));  
5 }
```

# Parameterization - Example 2

A static method that returns a **Stream** of Arguments:

```
1 private static Stream<Arguments> provideStringsForIsBlank() {  
2     return Stream.of(  
3         Arguments.of(null, true),  
4         Arguments.of("", true),  
5         Arguments.of(" ", true),  
6         Arguments.of("not blank", false)  
7     );  
8 }
```

Test case:

```
1 @ParameterizedTest  
2 @MethodSource("provideStringsForIsBlank")  
3 void isBlank_ShouldReturnTForNullOrEmptyS(String input, boolean expected) {  
4     assertEquals(expected, Strings.isBlank(input));  
5 }
```

# Exception

- **JUnit 5** Jupiter assertions API introduces the **assertThrows** method for asserting exceptions

# Exception - Example

```
1  @Test
2  public void whenExceptionThrown_thenAssertionSucceeds() {
3      Exception exception = assertThrows(NumberFormatException.class, () -> {
4          Integer.parseInt("1a");
5      });
6
7      String expectedMessage = "For input string";
8      String actualMessage = exception.getMessage();
9
10     assertTrue(actualMessage.contains(expectedMessage));
11 }
```

# Continuous Integration



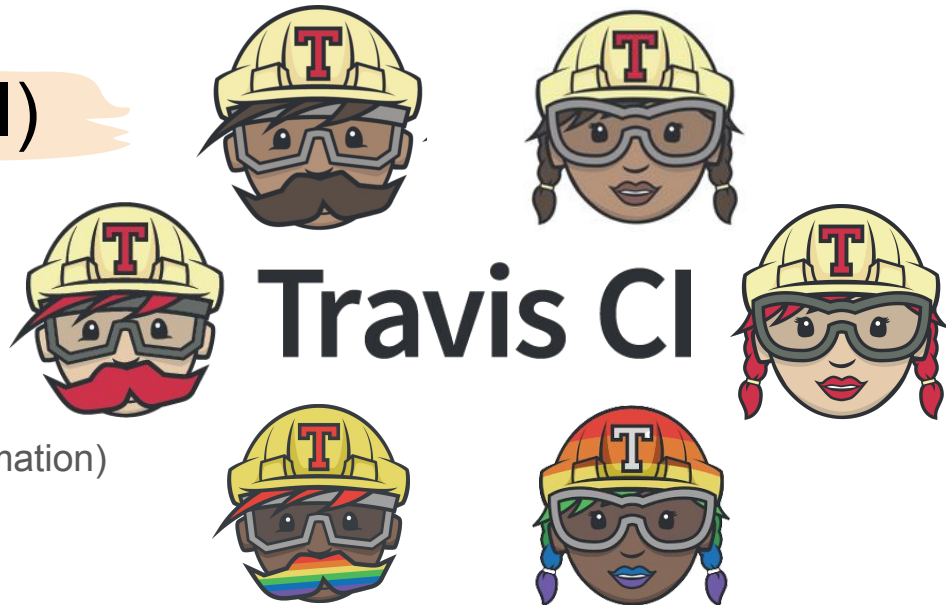
# Continuous Integration (CI)

- **Features**

- Build
- Test
- Source code analysis
- Other related work ... (deployment automation)

- **Advantages**

- Reduces risk
- Reduces manual and complex processes
- A deployable version can be generated at any time
- Increases system transparency
- Builds team confidence



# Jenkins

# Travis CI

The screenshot displays the Travis CI web interface in a browser window. The page title is "Travis CI - Test and Deploy". The main header includes navigation links: Dashboard, Changelog, Documentation, and Help. A search bar is located on the left. The repository being viewed is "a4865g / NYCU-Software-Testing-2021-Lab3-Demo", with a status badge indicating "build passing".

On the left sidebar, under "My Repositories", there are two entries:

- ✓ a4865g/NYCU-Software-Testing-2021-Lab3-Demo # 6
  - ⌚ Duration: 36 sec
  - 📅 Finished: about an hour ago
- ✓ a4865g/lab3\_test # 3
  - ⌚ Duration: 40 sec
  - 📅 Finished: 9 hours ago

The main content area shows the details for the selected build (a4865g/NYCU-Software-Testing-2021-Lab3-Demo # 6). It indicates that the build is successful (✓ master fix test failed) and that 6 tests passed. The build was committed by WuLearn and ran for 36 seconds. The build environment is specified as JDK: oraclejdk11 Java and AMD64.

Below the build details, there are tabs for "Job log" and "View config". The "Job log" tab is active, showing a detailed log of the build process. The log includes sections for Worker information, Build system information, and the installation of oraclejdk11. The log also shows the execution of a git clone command and the output of the java -Xmx32m -version command, which reports the OpenJDK Runtime Environment version 11.0.2.

# Travis CI - Homepage


Travis CI

Dashboard

Changelog

Documentation

Help



Search all repositories

🔍

My Repositories

Running (0/0)

🚦

✓ a4865g/lab3\_test # 3

🕒 Duration: 40 sec

📅 Finished: 10 minutes ago

○ a4865g/

🕒 Duration:

○ a4865g/

🕒 Duration:

○ a4865g/

🕒 Duration:

○ a4865g/

🕒 Duration:

○ a4865g/

🕒 Duration:

🔒 a4865g / lab3\_test

🐙

build passing

Current

Branches

Build History

Pull Requests

More options

☰

✓ master Update README.md

🔗 Commit 2ce0226

🔗 Compare 300f325...2ce0226

🔗 Branch master

👤 WuLearn

🔗 #3 passed

🕒 Ran for 40 sec

📅 10 minutes ago

🔄 Restart build

🐛 Debug build

🔧 JDK: oraclejdk11 Java

💻 AMD64

Job log

View config

✕ Remove log

📄 Raw log

1 Worker information worker\_info 0.06s

6

7 Build system information system\_info 0.01s



161

Top


# Travis CI - Sync

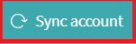
Travis CI

[Dashboard](#) [Changelog](#) [Documentation](#) [Help](#)

MY ACCOUNT

 **WuLearn**




ORGANIZATIONS

You are not currently a member of any organization.

MISSING AN ORGANIZATION?


[Review and add your authorized organizations.](#)


 **WuLearn**


@a4865g


[Repositories](#) [Settings](#) [Plan](#) [Migrate](#) [Plan usage](#)


GitHub Apps Integration





 Filter GitHub repositories


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 Settings


 Settings

 Settings

 Settings

 Settings

 Settings

 Settings

# Travis CI - Build

Travis CI

Dashboard Changelog Documentation Help

Search all repositories

My Repositories Running (0/0) +

✓ a4865g/lab3\_test # 3

⌚ Duration: 40 sec

📅 Finished: 7 hours ago

a4865g/

⌚ Duration

a4865g/

⌚ Duration

a4865g/

⌚ Duration

a4865g/

⌚ Duration

a4865g/

⌚ Duration

a4865g/

⌚ Duration

make sure your correct repo

a4865g / NYCU-Software-Testing-2021-Lab3-Demo

build unknown

Current Branches Build History Pull Requests


More options

Settings

Requests

Caches

Trigger build



No builds for this repository

Want to start testing this project on Travis CI?

Read the Docs on Getting Started

# Travis CI - Build (Trigger)

## Trigger a custom build

Beta Feature



Custom builds exist only on Travis CI and will not appear in your Git history.

### BRANCH

master

### CUSTOM COMMIT MESSAGE

Commit message

### CUSTOM CONFIG

Enter config as YAML

Trigger custom build

# Travis CI - Build (Failed)

Travis CI

 [Dashboard](#) [Changelog](#) [Documentation](#) [Help](#)



Search all repositories

My Repositories

Running (0/0)

+

✗ a4865g/NYCU-Software-Testi # 4

🕒 Duration: 37 sec

📅 Finished: 2 minutes ago

✓ a4865g/lab3\_test # 3

🕒 Duration: 40 sec

📅 Finished: 8 hours ago

○ a4865g/

🕒 Duration: -

a4865g / NYCU-Software-Testing-2021-Lab3-Demo  build failing

Current

Branches

Build History

Pull Requests

> Build #4

More options

✗ master if test failed

🔗 #4 failed

🔄 Restart build

🔗 Commit 5397f40

🔗 Branch master

 WuLearn

 </> JDK: oraclejdk11 Java

 AMD64

Job log

View config

# Travis CI - Build (Success)

Travis CI

 [Dashboard](#) [Changelog](#) [Documentation](#) [Help](#)



[My Repositories](#) [Running \(0/0\)](#) [+](#)

✓ a4865g/NYCU-Software-Testi # 1

🕒 Duration: 38 sec

📅 Finished: about a minute ago

✓ a4865g/lab3\_test # 3

🕒 Duration: 40 sec

📅 Finished: 7 hours ago

📄

a4865g / NYCU-Software-Testing-2021-Lab3-Demo



build

passing

Current

Branches

Build History

Pull Requests

> Build #1

More options

⋮

✓ master .travis.yml

🔗 Commit a89c82e

🔗 Branch master

 WuLearn

🔗 JDK: oraclejdk11 Java

🔗 AMD64

📁 #1 passed

🕒 Ran for 38 sec

📅 about a minute ago

🔄 Restart build

☐ a4865g/

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# Travis CI

- Travis CI
  - <https://travis-ci.com/> (For: private / public repo) **(Please use it for this Lab)**
  - <https://travis-ci.org/> (For: public repo) **(Will be shutting down in several weeks)**
- [\[DevOps\] Travis CI - Step/Job/Stage](#)



Lab

# Lab - Part A

- Test *java.util.PriorityQueue class* with Junit.
  - import java.util.PriorityQueue;
- Parameterization
  - Each testcase : { *random array* } , { *correct array* }.
    - *Random array* means to specify **your own input array**.
    - *Correct array* means the **PriorityQueue polling correct order** instead of using toArray().
    - e.g. `arguments(new int[]{5, 4, 2, 3}, new int[]{2, 3, 4, 5});`
  - Your test must have at least **5** unique testcases.
- Exception
  - You have to test at least **3** unique Exceptions that is thrown by PriorityQueue.
  - The same type of exception in different ways is accepted.

# Lab - Part A (Example)

```
1 public class PriorityQueueTest {
2     static Stream<Arguments> stringIntAndListProvider() {
3         //TODO return Stream
4     }
5     @ParameterizedTest(name="#{index} - Test with Argument={0},{1}")
6     @MethodSource("stringIntAndListProvider")
7     public void PriorityQueue_RunTest(int[] random_array,int[] correct_array){
8         PriorityQueue<Integer> test = new PriorityQueue<Integer>();
9         int index=0;
10        Integer s;
11        int[] result=new int[random_array.length];
12
13        //TODO random_array add to PriorityQueue
14
15        //TODO get PriorityQueue result
16
17        assertEquals(correct_array,result);
18    }
19    //TODO 3 unique Exceptions
20 }
```




# Lab - Part A (Example)

▼ ✓ Test Results	124 ms
▼ ✓ PriorityQueueTest	124 ms
▼ ✓ PriorityQueue_RunTest(int[], int[])	113 ms
✓ #1 - Test with Argument=[3, 1, 2],[1, 2, 3]	100 ms
✓ #2 - Test with Argument=[-3, -1, -2, 5],[-3, -2, -1, 5]	2 ms
✓ #3 - Test with Argument=[3, -2, -5, -1, 2],[-5, -2, -1, 2, 3]	3 ms
✓ #4 - Test with Argument=[-3, 1, 11, 0, 9, 3],[-3, 0, 1, 3, 9, 11]	5 ms
✓ #5 - Test with Argument=[3, 7, 2, -1, -2],[-2, -1, 2, 3, 7]	3 ms
✓ whenExceptionThrown_thenOfferEisNull()	8 ms
✓ whenExceptionThrown_thenInitialCapacityNotGreaterThanOne()	2 ms
✓ whenExceptionThrown_thenNoElementCanRemove()	1 ms


# Lab - Part B



- Travis-CI
  - Authorize Travis CI with your Github account.
  - Make sure that Travis CI can be built and test automatically.
- Github
  - Deploy your **Part A (PriorityQueueTest.java)** on Github in public.
  - The name of repository is your student id.
  - You have to commit twice:
    - Pass all test cases
    - Unable to pass one of the test cases
  - Add *Travis CI status image* and *screenshots* (both pass and fail) to your *README.md*.
- Submit your Github repository link to E3.







# Lab - Part B (Status Image)


 master ▾  1 branch  0 tags

[Go to file](#) [Add file ▾](#) [Code ▾](#)

 **a4865g** Update README.md

 0f56126 13 seconds ago  7 commits

 src/test/java	fix test failed	2 hours ago
 .gitignore	add gitignore	10 hours ago
 .travis.yml	.travis.yml	10 hours ago
 Lab3_DEMO.iml	finish	10 hours ago
 README.md	Update README.md	13 seconds ago
 pom.xml	finish	10 hours ago

README.md 

## NYCU-Software-Testing-2021-Lab3-Demo

build

passing

# Lab - Part B (Screenshot)

The screenshot shows the Travis CI dashboard. The top navigation bar includes 'Travis CI', 'Dashboard', 'Changelog', 'Documentation', and 'Help'. A search bar is on the left. The main content area displays the repository 'a4865g / NYCU-Software-Testing-2021-Lab3-Demo' with a 'build passing' status. Below this, there are tabs for 'Current', 'Branches', 'Build History', 'Pull Requests', and 'Build #1'. The 'Build #1' tab is active, showing a successful build for the 'master' branch. The build details include the commit 'a89c82e', the branch 'master', and the build status 'WuLearn'. The build configuration is shown as 'JDK: oraclejdk11 Java' and 'AMD64'. The build duration is 38 seconds, and it finished about a minute ago. A 'Restart build' button is visible.

```
802 [INFO]
803 [INFO] -----
804 [INFO] T E S T S
805 [INFO] -----
806 [INFO] Running PriorityQueueTest
807 [INFO] Tests run: 8, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.151 s - in PriorityQueueTest
808 [INFO]
809 [INFO] Results:
810 [INFO]
811 [INFO] Tests run: 8, Failures: 0, Errors: 0, Skipped: 0
812 [INFO]
813 [INFO]
814 [INFO] --- maven-jar-plugin:2.4:jar (default-jar) @ Lab3_DEMO ---
```



# Lab - Part B (Screenshot)

Travis CI Dashboard Changelog Documentation Help

Search all repositories

a4865g / NYCU-Software-Testing-2021-Lab3-Demo Build #4 failed

My Repositories Running (0/0) +

Current Branches Build History Pull Requests > Build #4 More options

✖ a4865g/NYCU-Software-Test: # 4  
Duration: 37 sec  
Finished: 2 minutes ago

✔ a4865g/lab3\_test # 3  
Duration: 40 sec  
Finished: 8 hours ago

○ a4865g/NCTU-2020-R-Program  
Duration: -

✖ master if test failed #4 failed  
Commit 5397f48  
Branch master  
WuLearn  
JDK: oraclejdk11 Java  
AMD64  
Ran for 37 sec  
2 minutes ago  
Restart build

Job log View config

```
[ERROR] Failures:
[ERROR] PriorityQueueTest.PriorityQueue_RunTest:37 array contents differ at index [0], expected: <1> but was: <2>
[ERROR] PriorityQueueTest.PriorityQueue_RunTest:37 array contents differ at index [0], expected: <-3> but was: <-2>
[ERROR] PriorityQueueTest.PriorityQueue_RunTest:37 array contents differ at index [0], expected: <-5> but was: <-4>
[ERROR] PriorityQueueTest.PriorityQueue_RunTest:37 array contents differ at index [0], expected: <-3> but was: <-2>
[ERROR] PriorityQueueTest.PriorityQueue_RunTest:37 array contents differ at index [0], expected: <-2> but was: <-1>
[INFO]
[ERROR] Tests run: 8, Failures: 5, Errors: 0, Skipped: 0
[INFO]
[INFO] -----
[INFO] BUILD FAILURE
[INFO] -----
[INFO] Total time: 12.096 s
[INFO] Finished at: 2021-03-17T17:27:46Z
[INFO] -----
```

## Lab - Part B (Hint)

- Create your own **pom.xml** and **.travis.yml**.
  - *Maven: pom.xml*
  - *Travis-CI: .travis.yml*
- In the pom.xml, version of **junit-jupiter** would be **5.5.2** with **JDK 11**.