Unit Testing

Error and Exception Handling, Unit Testing, Test Cases, Assertions

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#JS-CORE

Error Handling

Concepts, Examples, Exceptions

Types of Errors

There are **three types** of errors in programming:

- **Syntax Errors** - occur at compile time.
- **Runtime Errors** - occur during execution (after compilation).
- **Logical Errors** - occur when you make a mistake in the logic that drives your script and you do not get the result you expected.

Error Handling - Concepts

A function failed to do what its name suggests should:

- Return a special value (e.g. **undefined** / **false** / **-1**).
- Throw an **exception** / **error**.

```
let str = "Hello, SoftUni";
console.log(str.indexOf("Sofia")); // -1
// Special case returns a special value to indicate "not found".
```

Error Handling

The fundamental **principle** of error handling says that a function (method) should either:

- Do what its **name** suggest
- Indicate a **problem**
- Any other behavior is **incorrect**

Error Handling - Exceptions (Errors)

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Exception - a function is unable to do its work (**fatal error**).

```
let arr = new Array(-1);   // Uncaught RangeError
```

```
let bigArr = new Array(9999999999); // RangeError
```

```
let index = undefined.indexOf("hi"); // TypeError
```

```
console.log(asfd);      // Uncaught ReferenceError
```

```
console.print('hi');          // Uncaught TypeError
```

Error Handling - Special Values

```
let sqrt = Math.sqrt(-1); // NaN (special value)
```

```
let sub = "hello".substring(2, 1000); // llo
let sub = "hello".substring(-100, 100); // hello
// Soft error - substring still does its job: takes all
available chars
```

```
let inv = new Date("Christmas"); // Invalid Date
let dt = inv.getDate(); // NaN
```

Unexpected (Not Obvious) Behavior

In JavaScript, the **first** month (January) is month number **0**, so December **returns** month **number 11**.

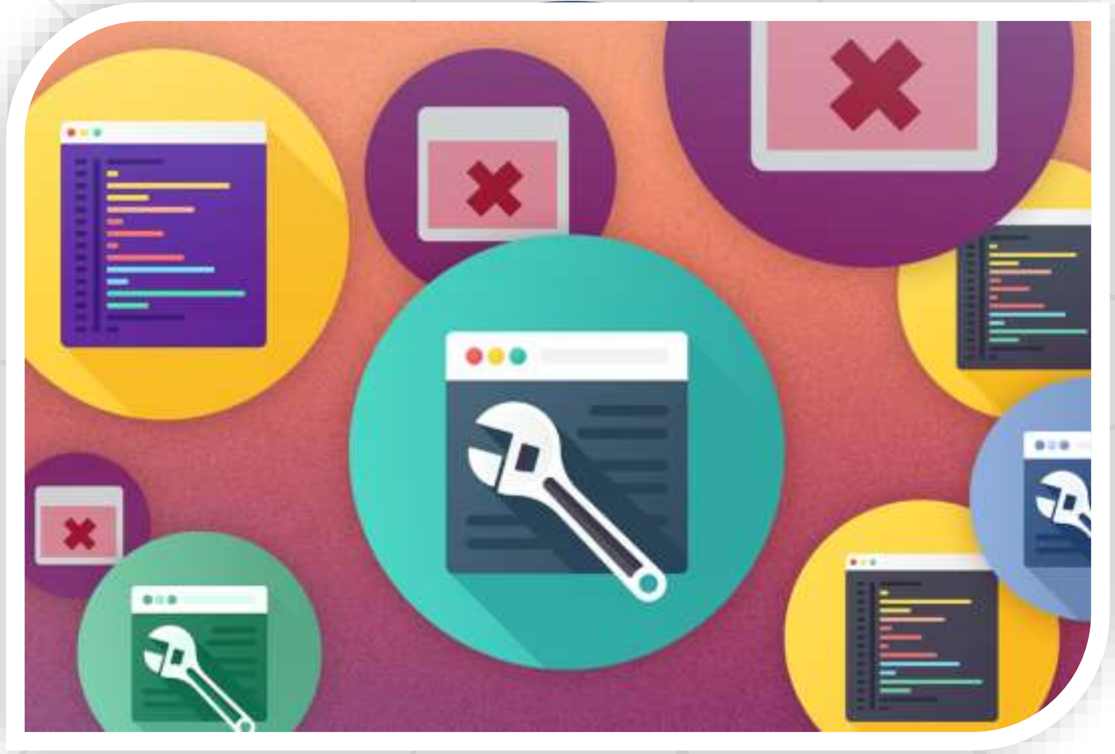
```
let date = new Date(2016, 1, 20);    // Feb 20 2016
```

```
let date1 = new Date(1, 1, 1);       // Feb 01 1901
```

```
let dateMinus1 = new Date(-1, -1, -1); // Nov 29 -2
```

```
let dateNext = new Date(2016, 1, 30)   // Mar 01 2016 (next month)
```

```
let datePrev = new Date(2016, -1, 30); // Dec 30 2015 (prev month)
```



Exception Handling

Throwing / Catching Errors

Throwing Errors (Exceptions)

The **throw** statement lets you create custom errors

- **General Error**
  - throw new Error("**Invalid state**")
- **Range Error**
  - throw new RangeError("**Invalid index**")
- **Type Error**
  - throw new TypeError("**String expected**")
- **Reference Error**
  - throw new ReferenceError("**Missing age**")

Try - catch

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- The **try** statement lets you test a block of code for errors.
- The **catch** statement lets you handle the error.
- **Try** and **catch** come in pairs:

```
try {
  // Code that can throw an exception
  // Some other code → not executed in case of error!
} catch (ex) {
  // This code is executed in case of exception
  // Ex holds the info about the exception
}
```

Exception Properties

- An **Error object** with properties will be created.

```
try {
  throw new RangeError("Invalid range.");
  console.log("This will not be executed.");
} catch (ex) {
  console.log("Exception object: " + ex);
  console.log("Type: " + ex.name);
  console.log("Message: " + ex.message);
  console.log("Stack: " + ex.stack);
}
```

Unit Testing

Definition, Structure, Examples, Frameworks

Unit Testing

A **unit test** is a piece of code that checks whether a piece of functionality is working as expected.

- Allow developers to see **where** (and **why**) **errors occur**.

```
function sortNums(arr) {
    arr.sort((a,b) => a - b);
}
```

```
let nums = [2, 15, -2, 4];
sortNums(nums);

if (JSON.stringify(nums) === "[-2,2,4,15]") {
    console.error("They are equal!");
}
```

Unit Tests Structure

The **AAA** Pattern: **Arrange**, **Act**, **Assert**

```
// Arrange all necessary preconditions and inputs
let nums = [2, 15, -2, 4];
// Act on the object or method under test
sortNums(nums);
// Assert that the obtained results are what we expect
if (JSON.stringify(nums) === "[-2,2,4,15]"){
    console.error("They are equal!");
}
```

Unit Testing Frameworks

- JS Unit Testing:
  - Mocha, QUnit, Unit.js, Jasmine
- Assertion frameworks (perform checks):
  - Chai, Assert.js, Should.js
- Mocking frameworks (mocks and stubs):
  - Sinon, JMock, Mockito, Moq

Mocha and Chai

Unit Testing with Mocha and Chai

What is Mocha?

Feature-rich JS test framework

- Provides common testing functions including **it**, **describe** and the **main function** that runs tests.

```
describe("title", function() {
  it("title", function() {…});
});
```

- Usually used together with **Chai**.

What is Chai?

Chai is a **library** with many assertions

- It allows to use a lot of different assertions such as **assert.equal**.

```
let assert = require("chai").assert;
describe("pow", function() {
   it("2 raised to power 3 is 8", function() {
    assert.equal(pow(2, 3), 8);
  });
});
```

WebStorm Configuration

Installing Mocha and Chai

- Installing Mocha and Chai through **npm**

```
npm -g install mocha
```

```
npm -g install chai
```

- Check if Mocha is installed

```
mocha --version
```

- Install via **npm** and use the **chai.js** file found within the download.

```
<script src="./node_modules/chai/chai.js"></script>
```

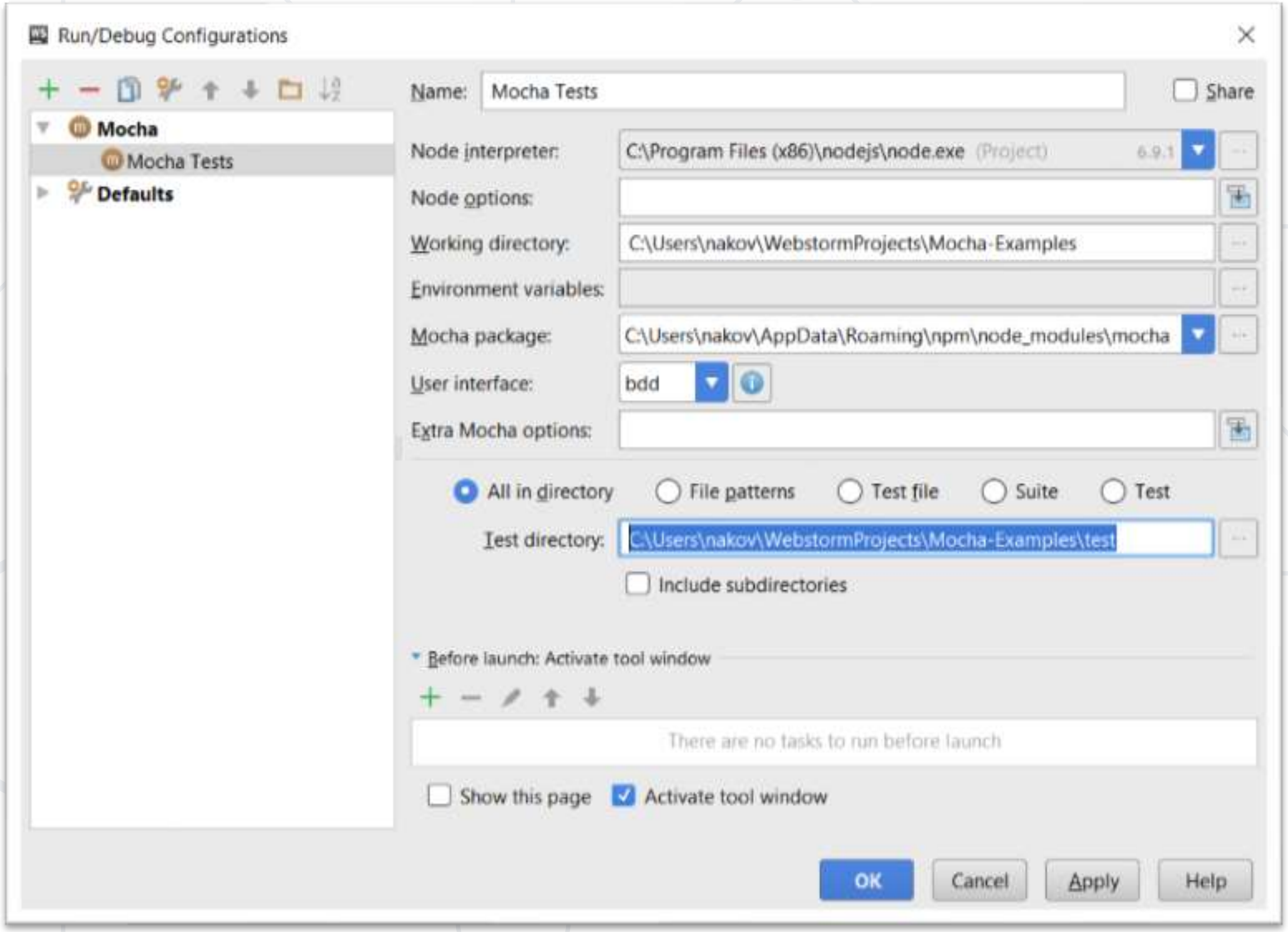
Configuring NODE_PATH

- By default Node.js does not find its globally-installed modules.
- You need to set the **NODE_PATH** environment variable.

```
rem for any future sessions
setx NODE_PATH %AppData%\npm\node_modules
rem for current session
set NODE_PATH=%AppData%\npm\node_modules
```

- You may need to restart your IDE after changing **NODE_PATH**.

Configuring Mocha in WebStorm


Run/Debug Configurations

Mocha
Mocha Tests
Defaults

Name: Mocha Tests
[ ] Share

Node interpreter: C:\Program Files (x86)\nodejs\node.exe (Project) 6.9.1
Node options:
Working directory: C:\Users\nakov\WebstormProjects\Mocha-Examples
Environment variables:
Mocha package: C:\Users\nakov\AppData\Roaming\npm\node_modules\mocha
User interface: bdd
Extra Mocha options:

[✓ All in directory] File patterns Test file Suite Test

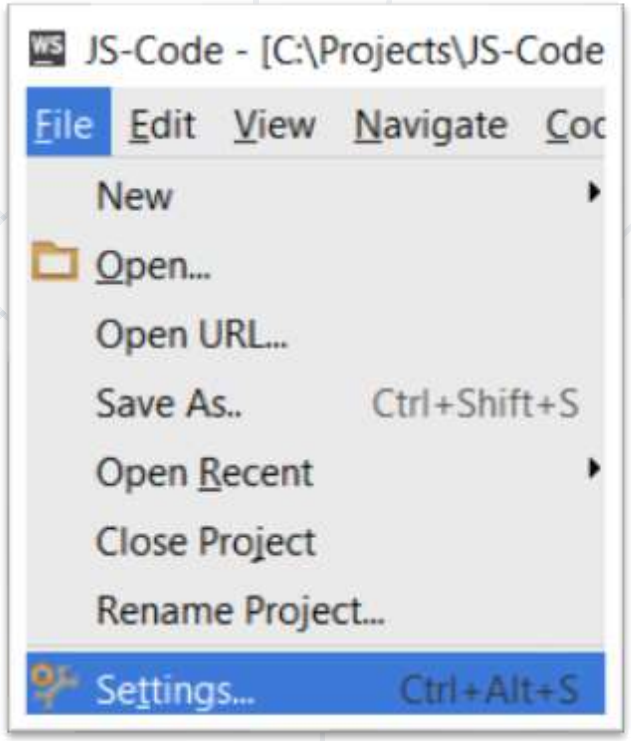
Test directory: C:\Users\nakov\WebstormProjects\Mocha-Examples\test
[ ] Include subdirectories

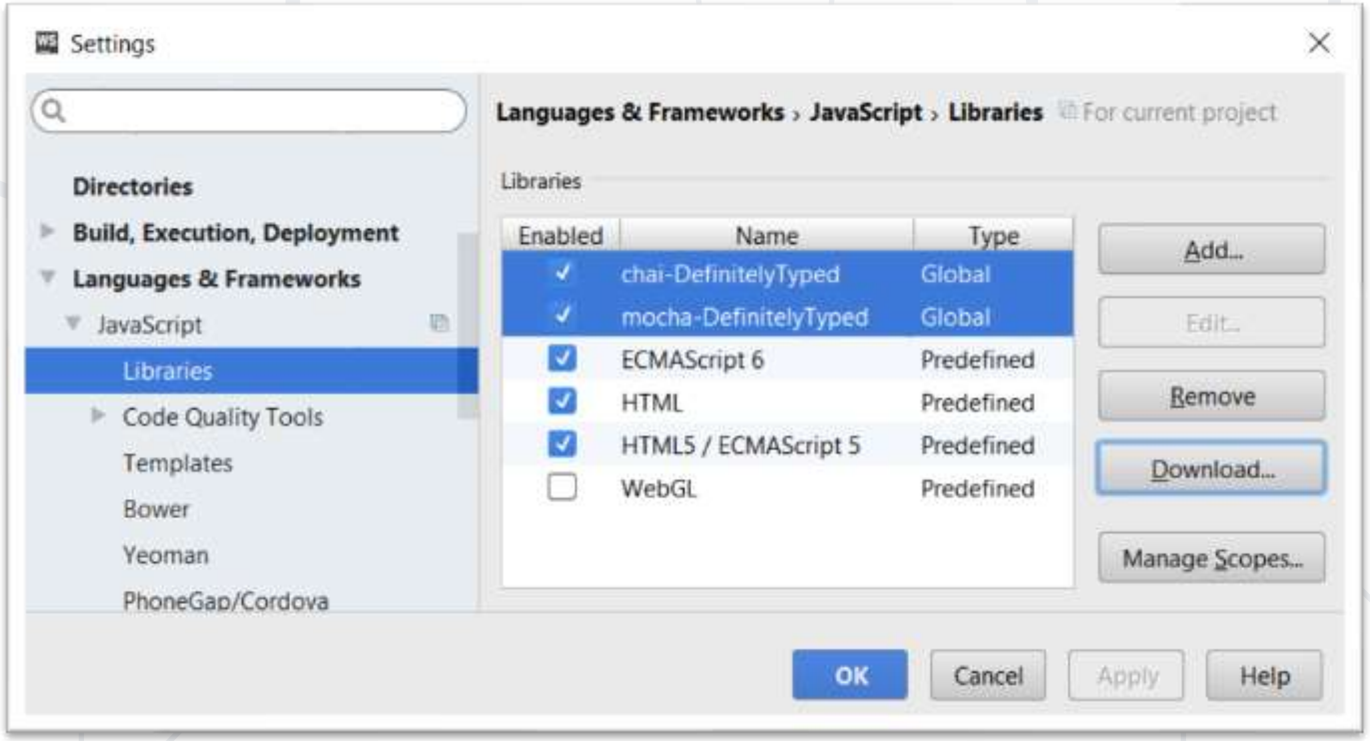
Before launch: Activate tool window
There are no tasks to run before launch

[ ] Show this page
[✓] Activate tool window

Configuring Libraries in WebStorm

- To get the "**auto complete**" and "**syntax checks**" working for Mocha and Chai, add them as **libraries** in WebStorm.



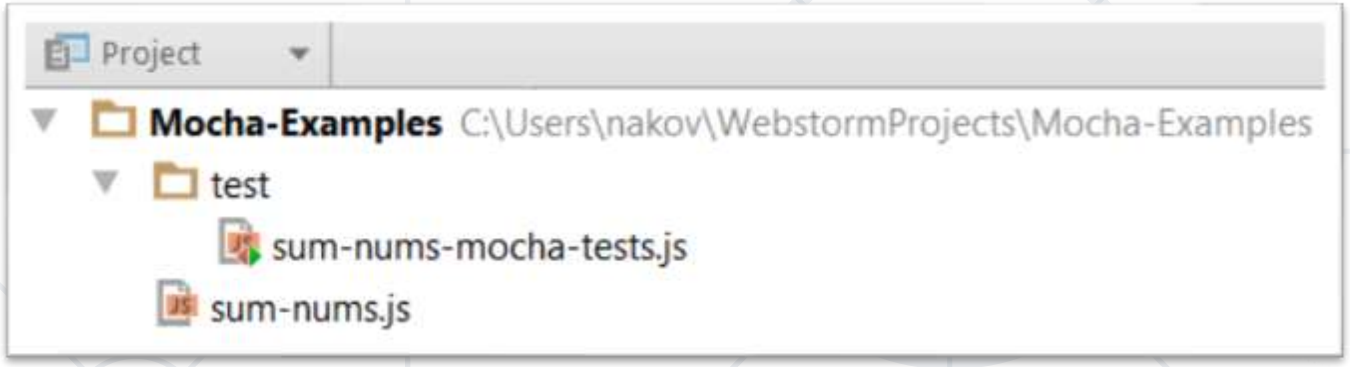


Libraries

Enabled	Name	Type
✓	chai-DefinitelyTyped	Global
✓	mocha-DefinitelyTyped	Global
✓	ECMAScript 6	Predefined
✓	HTML	Predefined
✓	HTML5 / ECMAScript 5	Predefined
	WebGL	Predefined

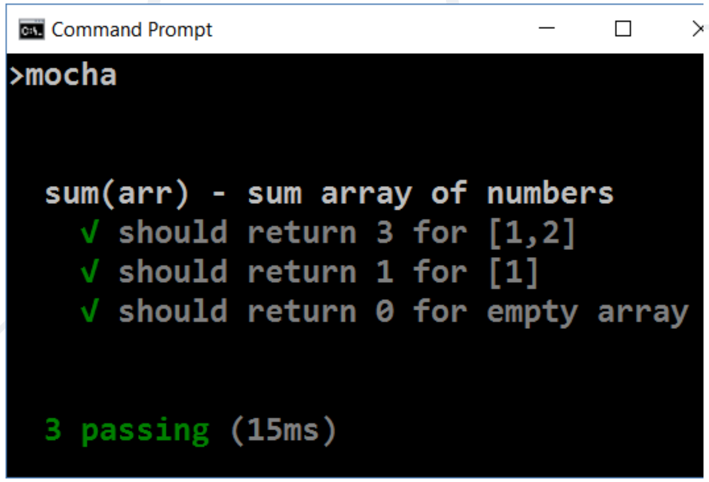
Running Mocha

1. Create folder **"test"** in your JS project.



```
Mocha-Examples C:\Users\nakov\WebstormProjects\Mocha-Examples
  test
    sum-nums-mocha-tests.js
  sum-nums.js
```

2. Put your test code in **test/{test-group-name}.js**
3. Run **mocha** from the console



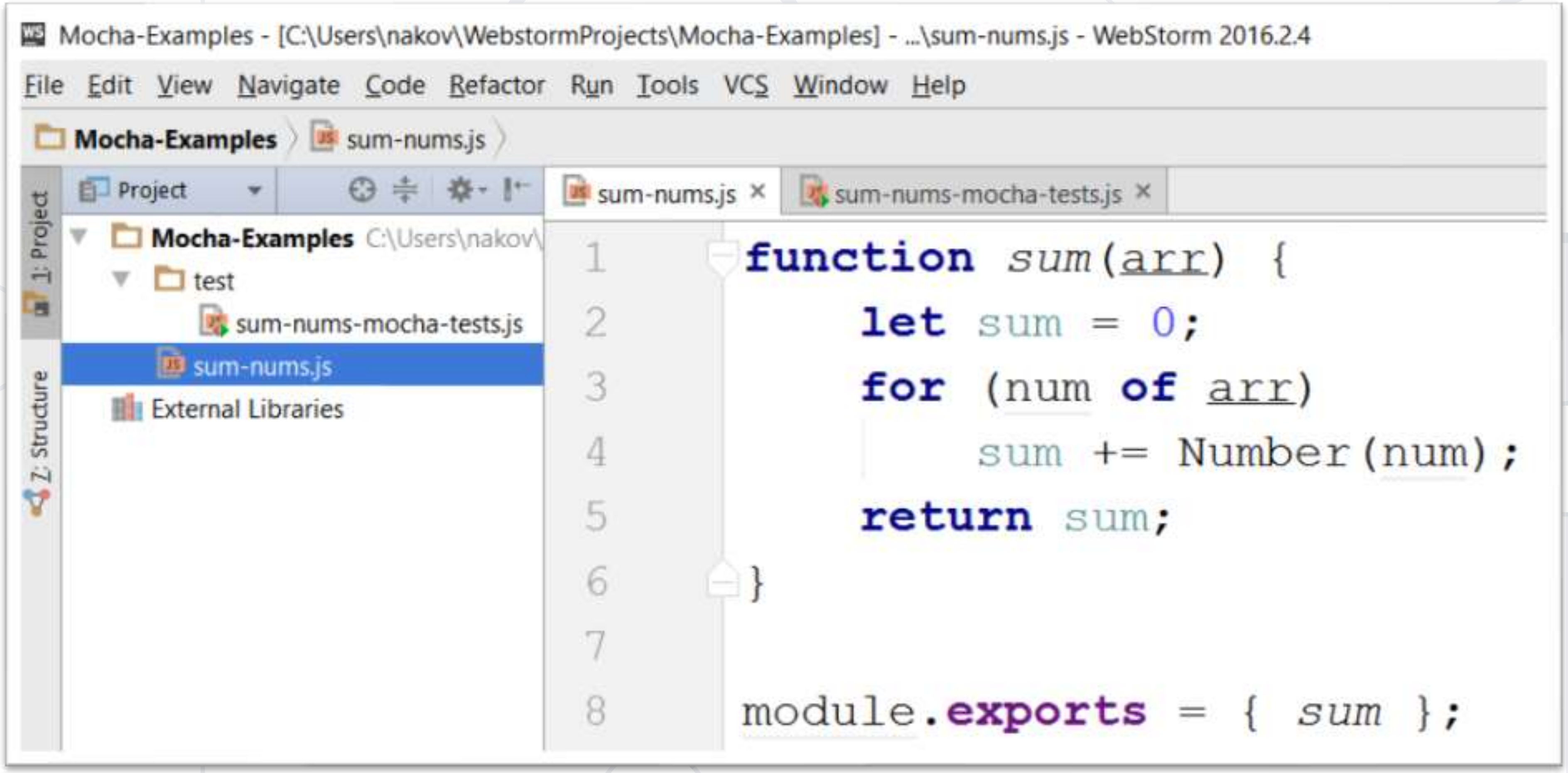
```
>mocha


  sum(arr) - sum array of numbers
    √ should return 3 for [1,2]
    √ should return 1 for [1]
    √ should return 0 for empty array


  3 passing (15ms)
```

Sample Project

- Source code to be tested



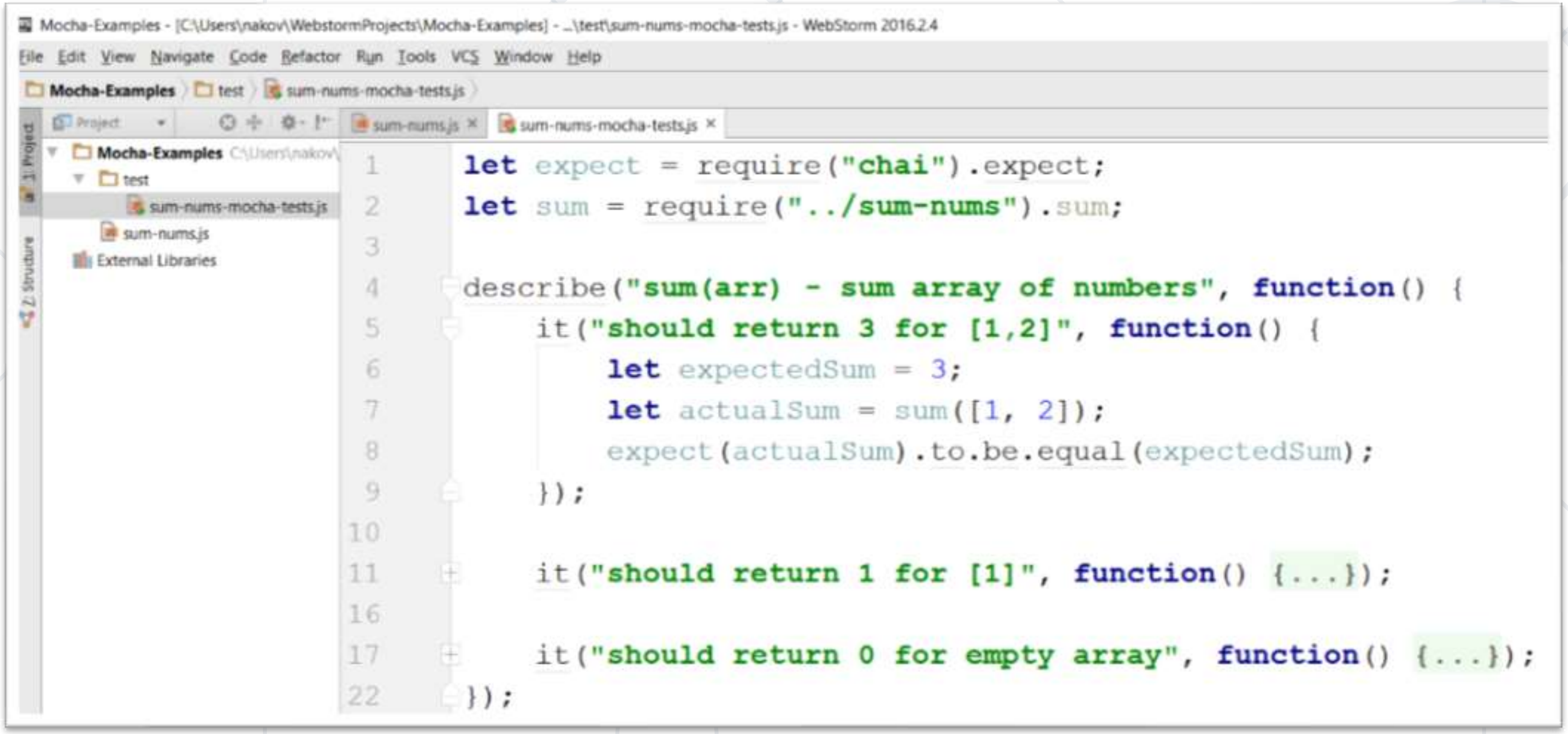
Mocha-Examples - [C:\Users\nakov\WebstormProjects\Mocha-Examples] - ...\sum-nums.js - WebStorm 2016.2.4
File Edit View Navigate Code Refactor Run Tools VCS Window Help
Mocha-Examples
sum-nums.js
Project
Mocha-Examples C:\Users\nakov\
test
sum-nums-mocha-tests.js
sum-nums.js
External Libraries
1: Project
Z: Structure
sum-nums.js
sum-nums-mocha-tests.js

```
function sum(arr) {
    let sum = 0;
    for (num of arr)
        sum += Number(num);
    return sum;
}

module.exports = { sum };
```

Sample Unit Tests

- Tests for the **sum(arr)** function.


Mocha-Examples - [C:\Users\nakov\WebstormProjects\Mocha-Examples] - ...\test\sum-nums-mocha-tests.js - WebStorm 2016.2.4
File Edit View Navigate Code Refactor Run Tools VCS Window Help
Mocha-Examples test sum-nums-mocha-tests.js
Project
sum-nums.js
sum-nums-mocha-tests.js
Mocha-Examples C:\Users\nakov\
test
sum-nums-mocha-tests.js
sum-nums.js
External Libraries
1: Project
Z: Structure

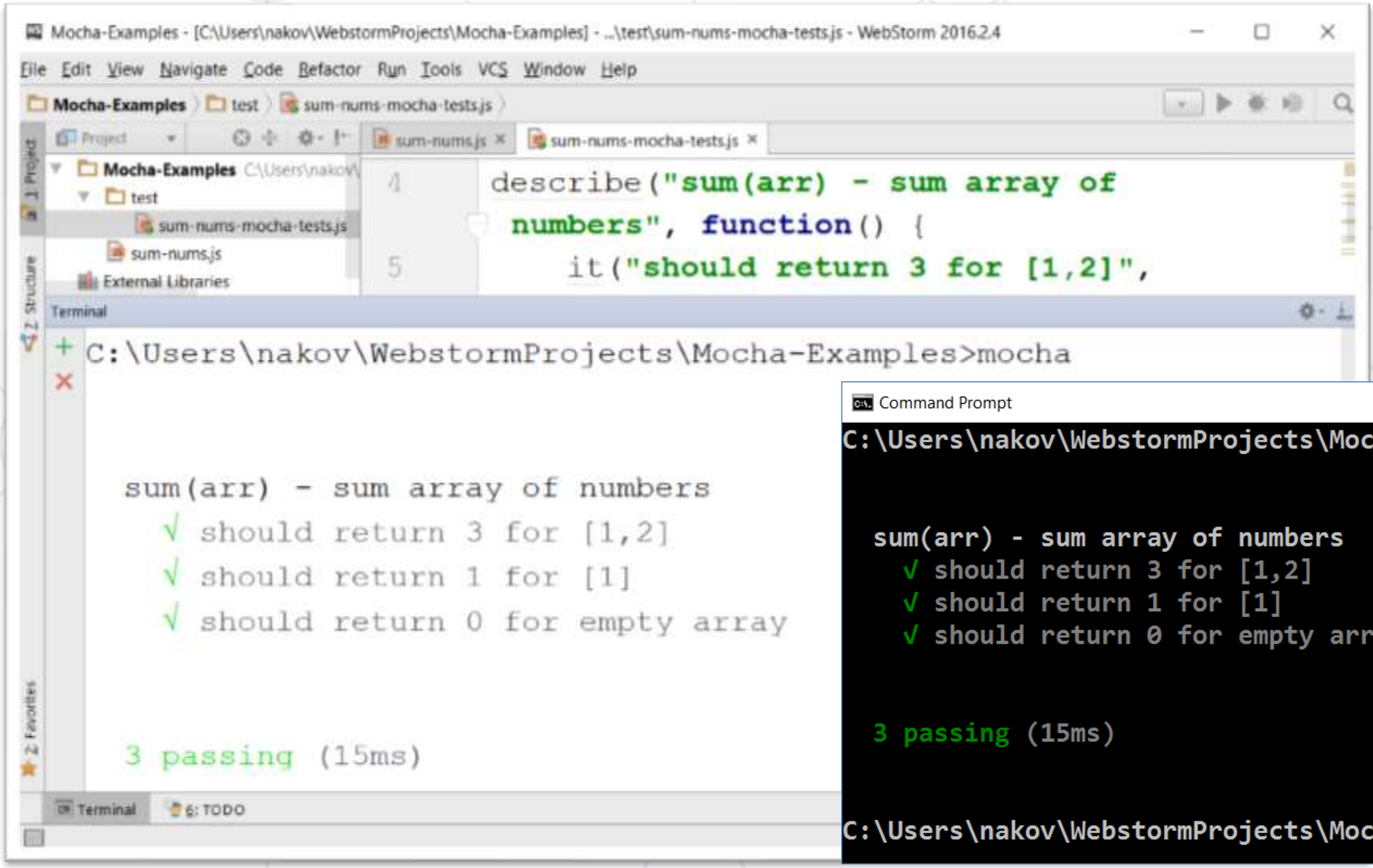
```javascript
let expect = require("chai").expect;
let sum = require("../sum-nums").sum;

describe("sum(arr) - sum array of numbers", function() {
    it("should return 3 for [1,2]", function() {
        let expectedSum = 3;
        let actualSum = sum([1, 2]);
        expect(actualSum).to.be.equal(expectedSum);
    });

    it("should return 1 for [1]", function() {...});

    it("should return 0 for empty array", function() {...});
});
```

Running the Tests

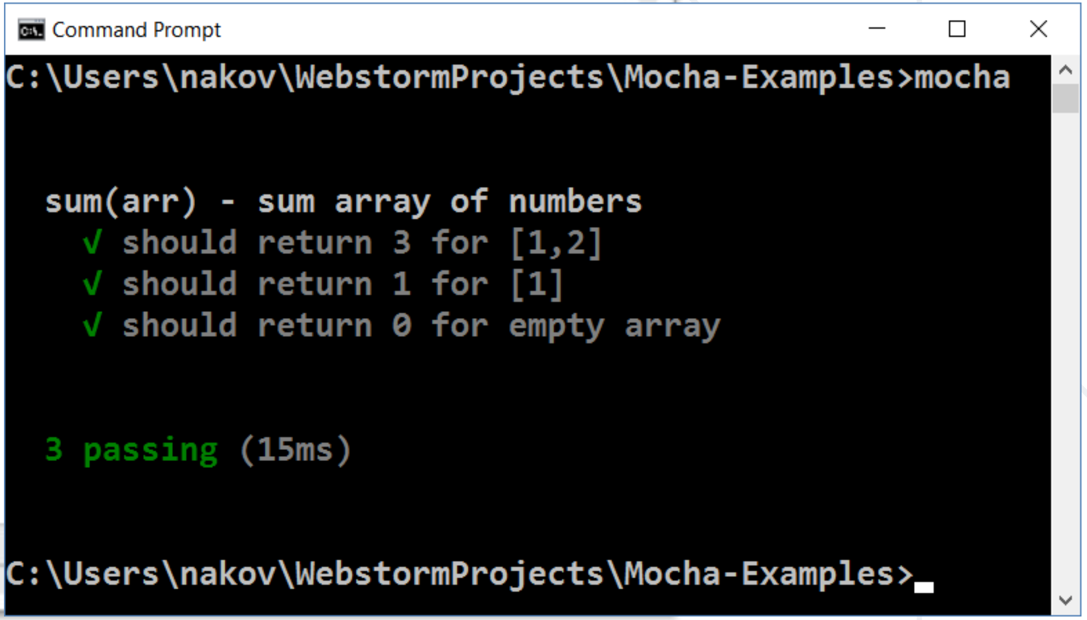

Mocha-Examples - [C:\Users\nakov\WebstormProjects\Mocha-Examples] - ...\test\sum-nums-mocha-tests.js - WebStorm 2016.2.4
File Edit View Navigate Code Refactor Run Tools VCS Window Help
Mocha-Examples test sum-nums-mocha-tests.js
Project
sum-nums.js
sum-nums-mocha-tests.js
Mocha-Examples C:\Users\nakov\
test
sum-nums-mocha-tests.js
sum-nums.js
External Libraries
Terminal
Terminal
6: TODO

```
describe("sum(arr) - sum array of
 numbers", function() {
   it("should return 3 for [1,2]",
```

```
C:\Users\nakov\WebstormProjects\Mocha-Examples>mocha


  sum(arr) - sum array of numbers
    √ should return 3 for [1,2]
    √ should return 1 for [1]
    √ should return 0 for empty array


  3 passing (15ms)
```



```
C:\Users\nakov\WebstormProjects\Mocha-Examples>mocha


  sum(arr) - sum array of numbers
    √ should return 3 for [1,2]
    √ should return 1 for [1]
    √ should return 0 for empty array


  3 passing (15ms)


C:\Users\nakov\WebstormProjects\Mocha-Examples>
```

VS Code Configuration

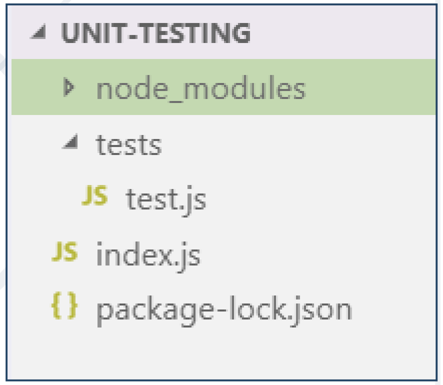
NPM Install

- Install **Mocha**:

```
npm install mocha
```

- Install **Chai**:

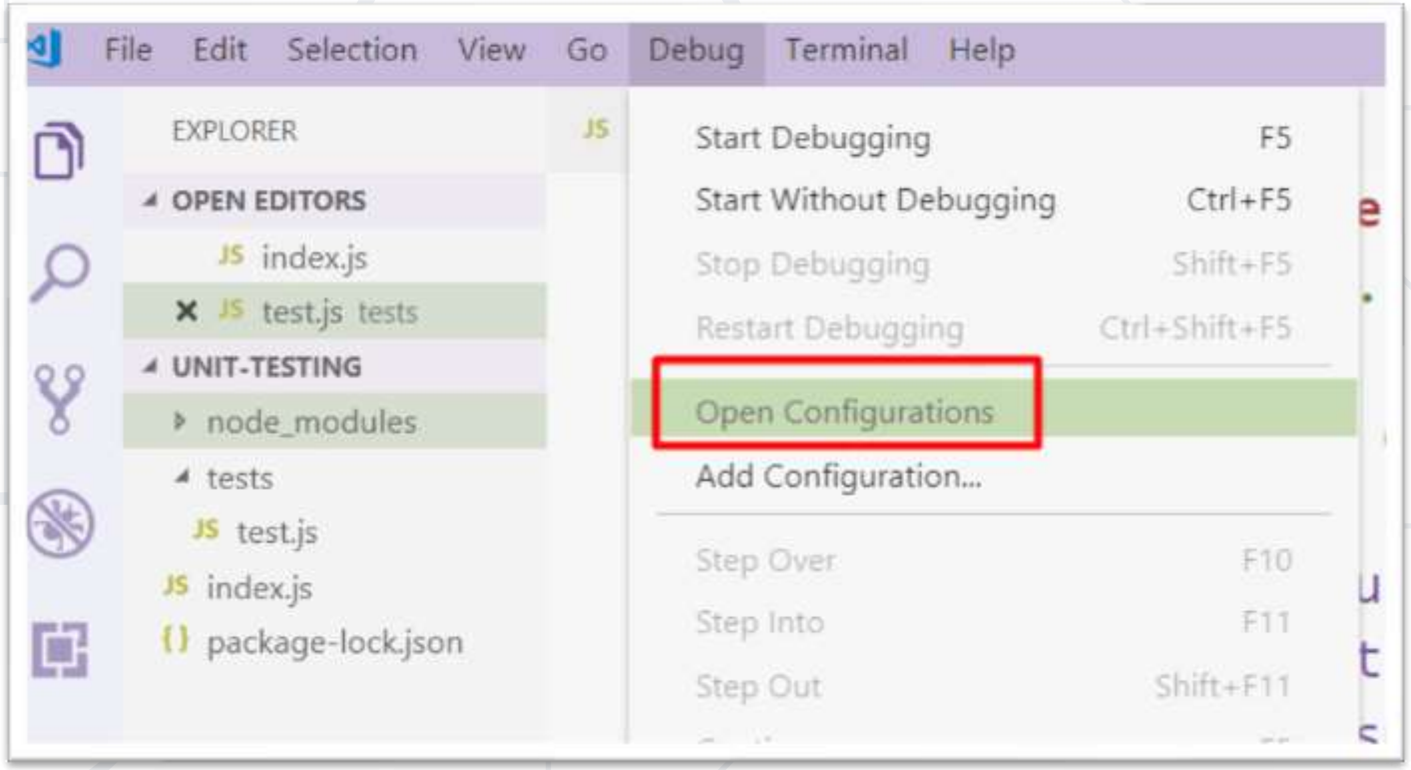
```
npm install chai
```



UNIT-TESTING
- node_modules
- tests
  - test.js
- index.js
- package-lock.json

Configuration - launch.json

1. Open your **launch.json** file:



Configuration - launch.json

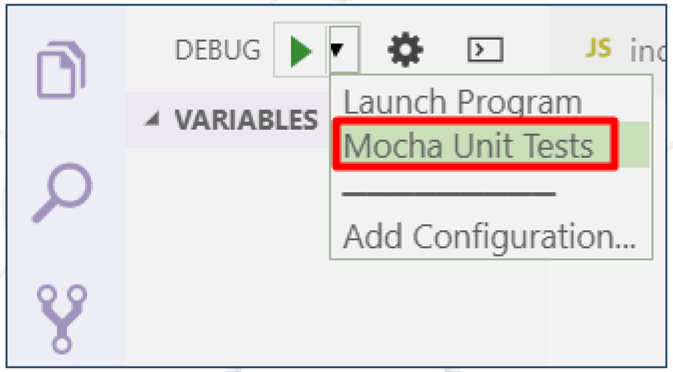
2. Add the following code:

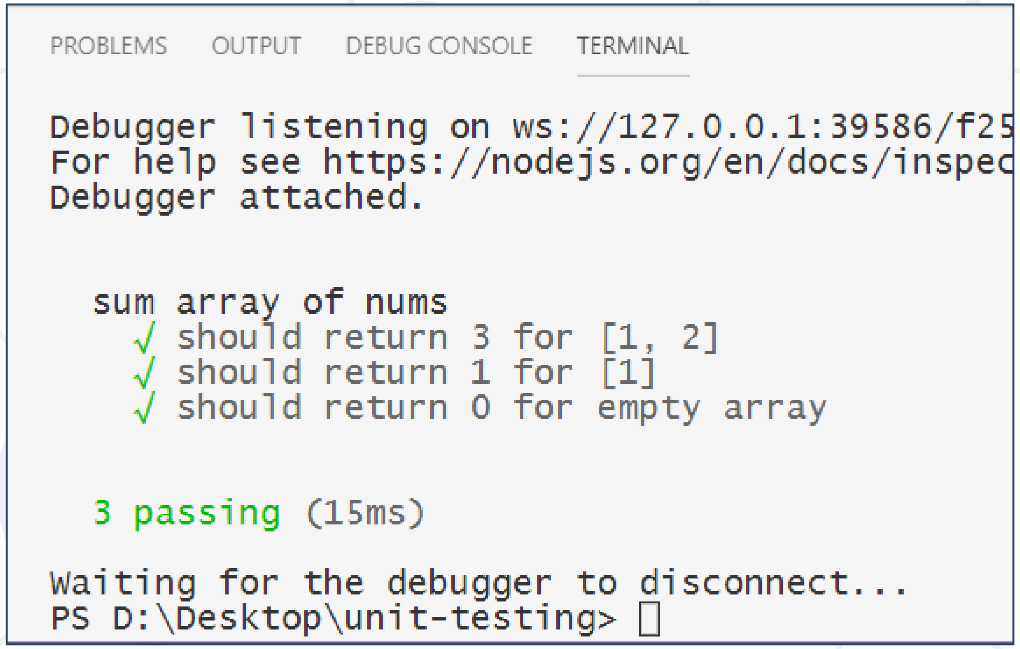
```
{
"type": "node",
"request": "launch",
"name": "Mocha Unit Tests",
"program":
"${workspaceFolder}node_modules\\.bin\\_mocha",
"runtimeArgs": [
"${workspaceFolder}/tests/test.js"
],
"console": "externalTerminal"
}
```

Path to your tests file

Configuration - launch.json

3. Choose debugging configuration:





```
Debugger listening on ws://127.0.0.1:39586/f25
For help see https://nodejs.org/en/docs/inspec
Debugger attached.


  sum array of nums
    √ should return 3 for [1, 2]
    √ should return 1 for [1]
    √ should return 0 for empty array


  3 passing (15ms)

Waiting for the debugger to disconnect...
PS D:\Desktop\unit-testing> 
```

Test Groups and Test Classes

```
let expect = require("chai").expect;
```

```
describe("Test group #1", function() {
  it("should… when…", function() {
    expect(actual).to.be.equal(expected);
  });
  it("should… when…", function() { … });
});
describe("Test group #2", function() {
  it("should… when…", function() {
    expect(actual).to.be.equal(expected);
  });
  …
});
```

Live Exercises

Unit-Testing

Summary

- A **function** should do what its **name suggests**.
- **Exceptions** are thrown when a function is **unable** to do its **work**.
- The **throw** statement lets you create **custom errors**.
- **Unit Tests** check whether a piece of code **works as expected**.
- **Mocha** is a JS **test framework** that is usually used together with **Chai** (**assertion library**).

Questions?

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