

Unit Testing and Error Handling

Error Types, Modules, Unit Testing, Mocha & Chai



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#js-advanced

1. Error Handling

- Error Types
- Exceptions & try/catch block

2. Unit Testing

- The AAA Pattern

3. Modules

4. Mocha & Chai





Error Handling

Concepts, Examples, Exceptions

Error Handling



- The fundamental **principle** of error handling says that a function (method) should either:
 - Do what its **name** suggests
 - Indicate a **problem**
 - Any other behavior is **incorrect**

- A function failed to do what its name suggests should:
 - Return a special value (e.g. **undefined** / **false** / **-1**)
 - Throw an **exception** / **error**
 - Exceptions indicate **abnormal** execution **circumstances**

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

- There are **three types** of errors in programming:
 - **Syntax Errors** - during parsing
 - **Runtime Errors** - occur during execution
 - After compilation, when the application is running
 - **Logical Errors** - occur when a mistake has been made in the logic of the script and the expected result is incorrect
 - Also known as bugs

Error Handling – Exceptions (Errors)

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

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

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

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

```
console.log(George); // ReferenceError
```

```
console.print('hi'); // 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  
// Error avoidance - invalid ranges are adjusted
```

```
let invalid = new Date("Christmas"); // Invalid Date  
let date = invalid.getDate(); // NaN
```

Problem: Sub Sum

- Sum a **range** of elements in **array** from **startIndex** to **endIndex**
 - Receive three parameters: **array**, **startIndex**, **endIndex**
- Handle **special cases**:
 - First parameter is **not** array → return **NaN**
 - **startIndex** < 0 → assume **startIndex** = 0
 - **endIndex** > **array**.length-1 → assume **endIndex** = **array**.length-1

```
function solve(array, startIndex, endIndex) {  
  if (Array.isArray(array) == false) {  
    return NaN;  
  }  
  if (startIndex < 0) {startIndex = 0; }  
  if (endIndex > array.length - 1) {  
    endIndex = array.length - 1;  
  }  
  return array  
    .slice(startIndex, endIndex + 1)  
    .map(Number)  
    .reduce((acc, x) => acc + x, 0);  
}
```

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

- The **try** statement tests a block of code for **errors**
- The **catch** statement **handles** 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 is 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

Unit Testing

- A **unit test** is a piece of code that checks whether certain functionality **works as expected**
- Allows developers to see **where & 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 Testing



- Testing enables the following:
- **Easier maintenance** of the code base
 - Bugs are found ASAP
- **Faster development**
 - The so called "Test-driven development"
 - Tests before code
- **Automated way to find code wrongness**
 - If most of the features have tests, running them shows their correctness

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!");  
}
```

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





JS Modules

Definition, Import, Export

Modules

- A **set of functions** to be included in applications
- Group related behavior
- Resolve naming collisions
 - **http.get(url)** and **students.get()**
- Expose only public behavior
 - They do not populate the global scope with unnecessary objects



a module for loading
indicator

```
const loading = {  
  show() { },  
  hide() { },  
};
```

ECMAScript Modules (ESM)

- **ESM** == **official standard format** to package JS code
 - Became standard with ES6 (ECMAScript 2015)
- Uses the **import/export** syntax
- Supports **asynchronous** loading
 - More suitable for modern web development
- Natively supported in browsers
- **Node.js** added **support** for ESM
 - Integration is still evolving

- **import** is used to **import** modules

```
import express from 'express'  
// For NPM packages
```

```
import { myFunction, myVariable } from './myModule.js'  
// For importing specific exports from a an internal file
```

```
import * as myUtils from './utility.js'  
// For importing everything from a file as an object
```

- **import** statements are processed **before** the module's code runs
- ESM syntax
 - Default import

```
import defaultExport from 'module-name'
```

- Named import

```
import { export1 } from 'module-name'
```

- Import everything

```
import * as name from 'module-name'
```


- **export** is used to **expose items** from a module

```
export const myVariable = 42;  
// Exporting a constant
```

```
export function myFunction() {...}  
// Exporting a function
```

```
export default class MyClass {...}  
// Exporting a class as the default export
```

- When the **imported value changes** in the **exporting module**, it also **updates** in the **importing module**

- ESM syntax

- Default export

```
export default myFunctionOrClass;
```

- Named export

```
export default myFunctionOrClass;
```

- Aggregating modules (doesn't include the default export)

```
export * from 'module-name';
```

- **CommonJS** == **official standard format** to package JS code
 - Older, but still **widely used**
 - Especially in existing Node.js projects
- Uses the **require()/module.exports** syntax
- Supports **synchronous** loading
 - Modules are loaded one by one
- **Transitioning** from CommonJS to ESM takes **time** and **effort**
 - There are still dependencies **only** available as CommonJS modules

- **require()** is used to **import** modules

```
const http = require('http');  
// For NPM packages
```

```
const myModule = require('./myModule.js');  
// For internal modules
```

- **Internal** modules need to be **exported before** being required
- In **Node.js** each file has its own scope

- Whatever value has **module.exports**, will be the value when using **require**

```
const myModule = () => {...};  
module.exports = myModule;
```

- To **export more than one** function, the value of **module.exports** will be an **object**

```
module.exports = {  
  toCamelCase: convertToCamelCase,  
  toLowerCase: convertToLowerCase  
};
```

package.json

- Serves as a **manifest**
 - Organizes the project's **metadata**
 - Project's name
 - Project's version
 - Etc.
 - Manages its **dependencies**
 - Lists the **packages** the project uses
 - Specifies versions
 - Lists all **scripts** that the project needs



dependencies vs devDependencies

■ dependencies

- **Libraries** that are necessary for the app to run and function correctly in **production**
 - Frameworks
 - Utility libraries

■ devDependencies

- **Libraries** that are necessary for the app **development**
 - Testing frameworks
 - Build tools
- Not included in production build



- **package.json** is used for specifying versions of each package
 - Uses semantic versioning (semver) syntax
 - Three-part version notation **Major.Minor.Patch**
- Specify exact versions or use symbols to allow for updates
 - **"libraryName": "1.0.0"** → pins the version to exactly 1.0.0
 - **"libraryName": "^1.0.0"** → allows updates to any 1.x.x version
 - **"libraryName": "~1.0.0"** → allows updates to any 1.0.x version

Installing Libraries with NPM

- To install a library and add it to the '**dependencies**' in the package.json, open the **terminal** in VS Code and write the following **command**

```
npm install <library_name> --save
```

- To install a library as a **development dependency**, use the following command

```
npm install <library_name> --save-dev
```

- Running these commands, **modifies** the **package.json** file



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?

- A library with many assertions
- Allows the usage of 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);
  });
});
```

- To install **frameworks** and **libraries**, use the CMD
 - Installing **Mocha** and **Chai** through **npm**

```
npm init -y
```

```
npm install chai
```

```
npm install mocha
```



```
npm init -y
```

```
npm i chai mocha
```



- To load a library, we need to **require** it

```
const 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);
  });
});
```

Unit Testing Approaches



- **"Code First"** (code and test) approach
 - Classical approach
- **"Test First"** approach
 - Test-driven development (**TDD**)

The Code and Test Approach

Write code

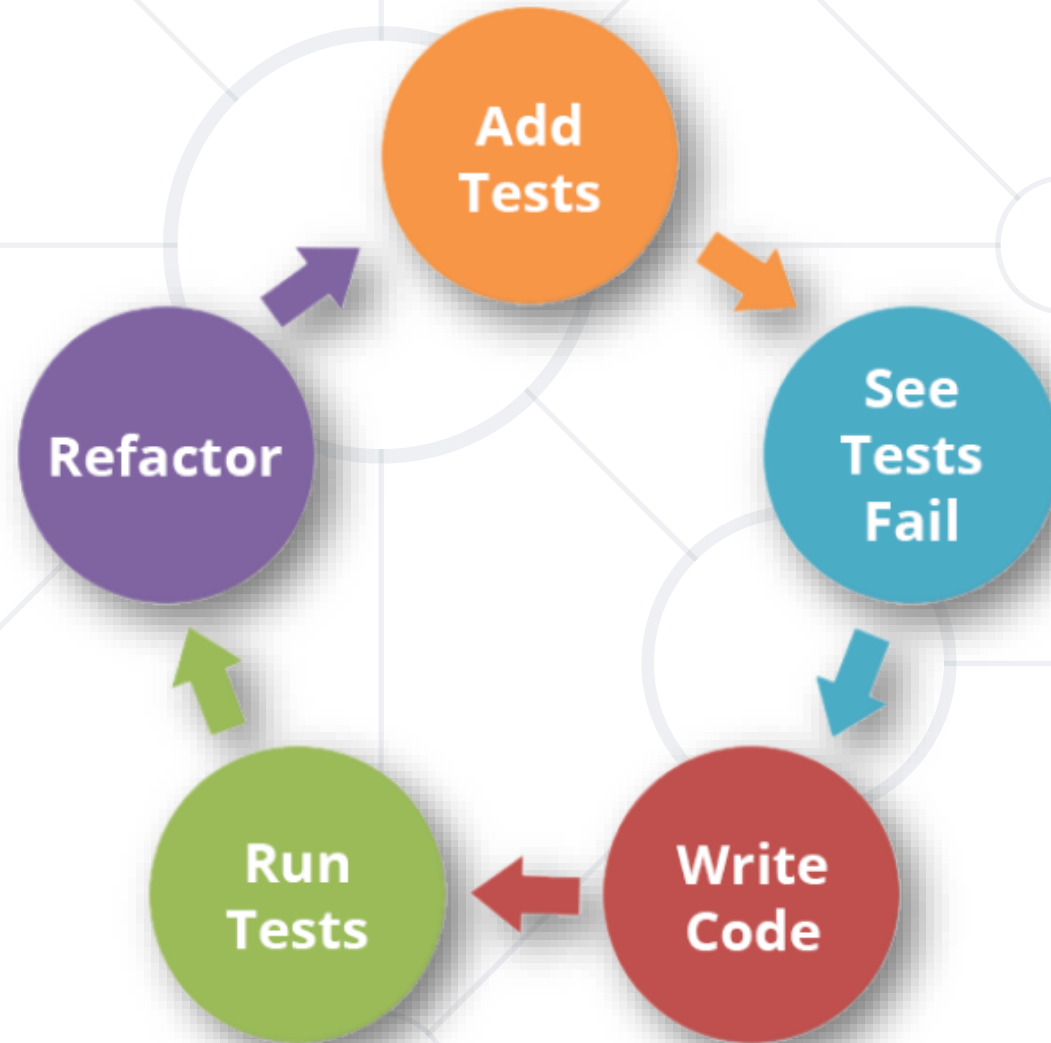
Write unit test

Run and succeed

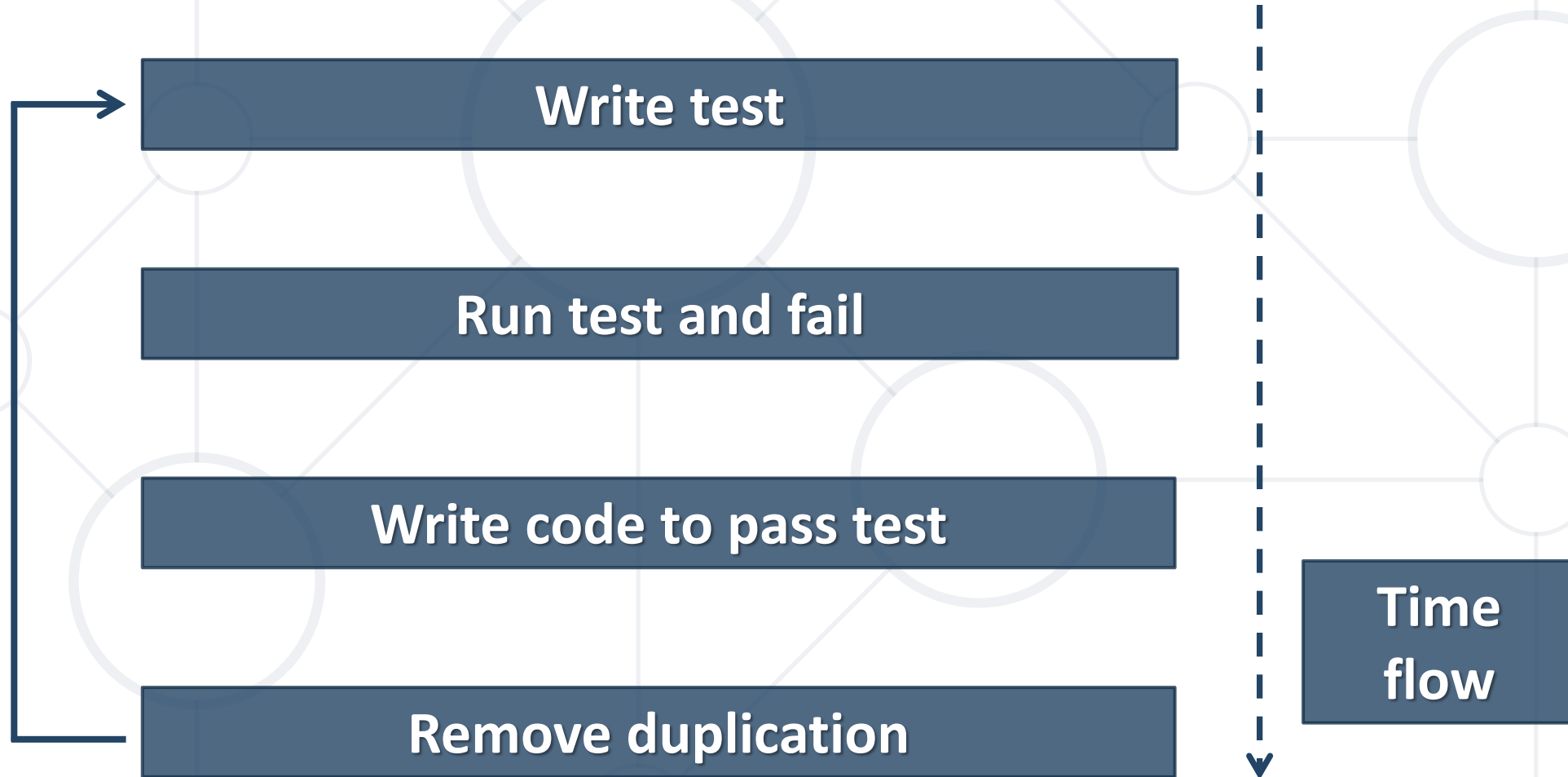


Time
flow

The Test-Driven Development Approach



Test-Driven Development (TDD)



Why TDD?

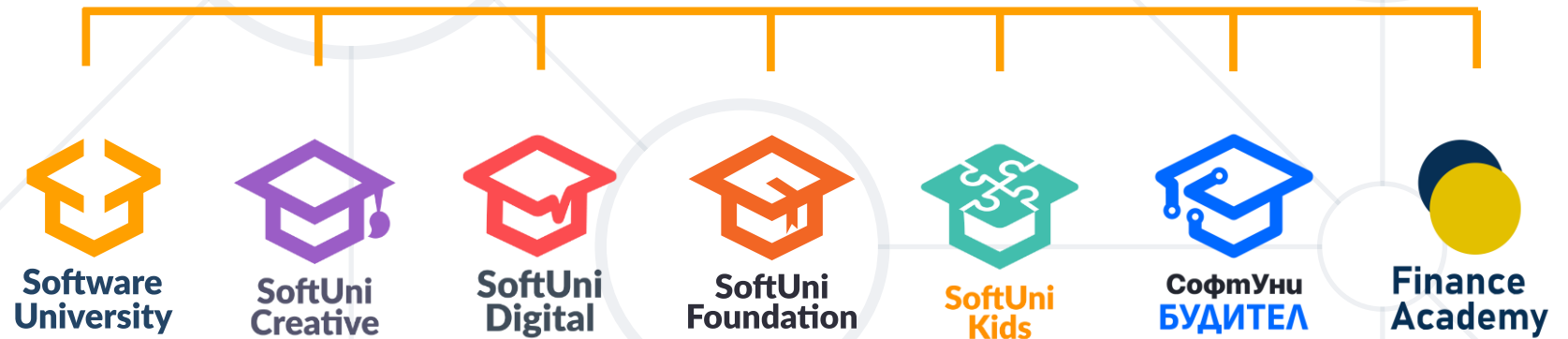
- **TDD** helps find design issues **early**
 - Avoids reworking
- Writing code to satisfy a test is a focused activity
 - Less chance of error
- Tests will be more comprehensive than if they are written after the code



- Errors in JavaScript
 - Types & **try/catch** statement
- Modules are a **set of functions** to be included in applications
- Unit tests **check** if certain functionality **works as expected**
- Mocha is a feature-rich **JS testing framework**
- Chain is an **assertion** library
- Different testing approaches



Questions?



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