Testing in Angular

.NET CORE

Testing your application offers the benefits of improved application design, preemptive refactoring, and helps prevent breaking legacy code when adding new features

https://medium.com/swlh/angular-unit-testing-jasmine-karma-step-by-step-e3376d110ab4

Testing in Angular – Overview

https://angular.io/guide/testing
https://jasmine.github.io/pages/docs_home.html

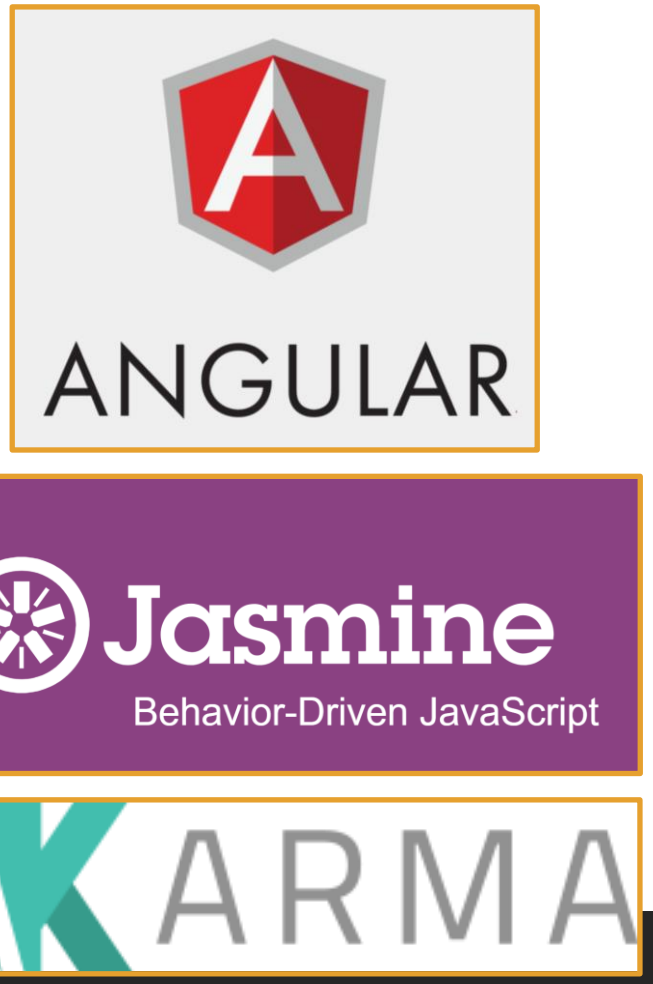
When you run ng new in the command line, the ***Angular CLI*** downloads, installs, and configures everything needed to test an ***Angular*** application with the ***Jasmine*** test framework and ***Karma*** test runner.

Any default project is immediately ready to test and to have test suites built.

The ng test command (command line) builds the app in "watch mode" and launches the ***Karma*** test runner.

Jasmine and ***Karma*** work together to run your tests and output test results to the command line and to a browser window that displays the results of the tests.

ng test also watches for any code changes and re-runs the tests every time there are new saved changes to the code base.



Jasmine Testing Framework

https://jasmine.github.io/
https://jasmine.github.io/setup/nodejs.html

Jasmine is a development framework for testing ***JavaScript*** code. It does not depend on any other ***JavaScript*** frameworks. It does not require a DOM and it has a simple syntax for easily written tests.

For ***Angular***, ***Jasmine*** is installed along with the default ***Angular*** Application created with ng new.

You can also add it locally to your project as a ***Node.js*** package if you don't already have it.

There is also a global install. Click here to learn how.

1. //If needed, install Jasmine locally
   - npm install --save-dev jasmine
2. //Then initialize a Jasmine project with default configuration
   - npx jasmine init
3. //Then generate Jasmine folders and spec (test) files
   - jasmine examples
4. //Run your tests
   - npx jasmine

Karma Test Runner

https://karma-runner.github.io/latest/index.html

Karma is a tool which spawns a web server that executes source code against test code for each browser connected. The results of each test are displayed via the command line to the developer.

Karma also automatically launches the browser window which receives a context page. At this point, the test framework (***Jasmine***) runs the tests and reports results by messaging through the client page. Jasmine and Karma work together to run tests and display results.

Karma watches all files specified in its configuration file. When changes are saved to these files, ***Karma*** sends a signal to run the tests again.

Karma - Installation

https://karma-runner.github.io/latest/index.html
https://karma-runner.github.io/5.0/intro/installation.html

Jasmine and ***Angular*** install ***Karma*** automatically. ***Angular*** does it along with the default ***Angular*** Application created with ng new.

Karma runs on ***Node.js*** and is available as an ***NPM*** package. If you install ***Karma*** manually, it is recommended to install ***Karma*** locally in the project's directory.

These steps install ***karma***, ***karma-jasmine***, ***karma-chrome-launcher*** and ***jasmine-core*** packages into ***node_modules*** in your current working directory and save them as devDependencies in package.json

1. //Install Karma in the app root directory
   - npm install karma --save-dev
2. //Install plugins that your project needs
   - npm install karma-jasmine karma-chrome-launcher jasmine-core --save-dev
3. //Run Karma:
   - ./node_modules/karma/bin/karma start

Angular Testing – Set-up

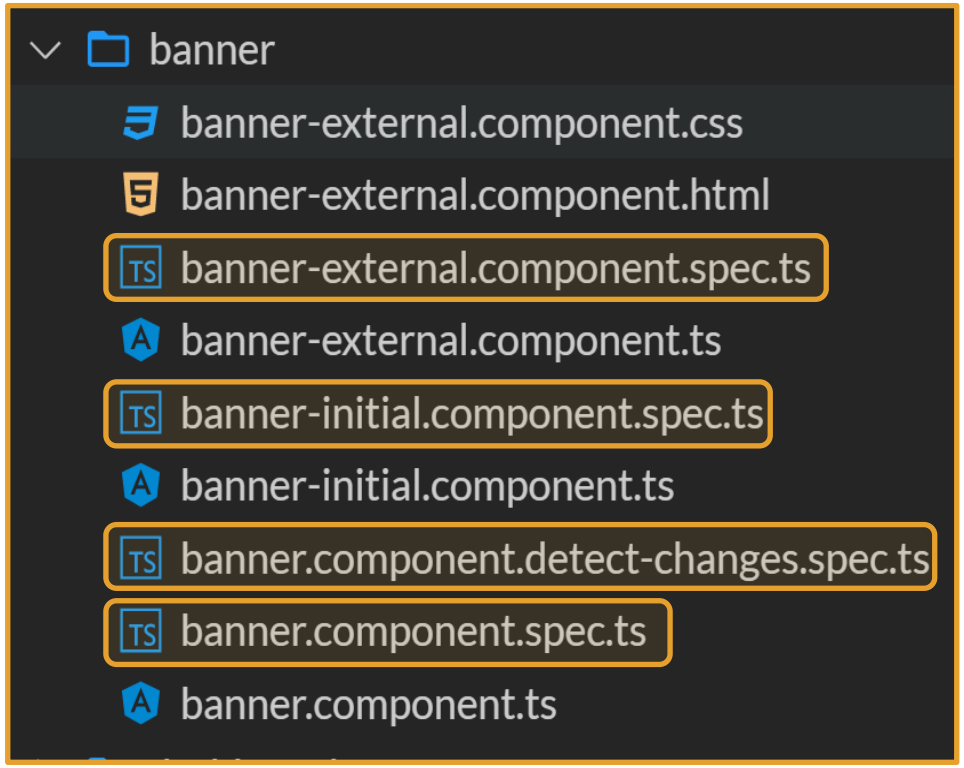
https://angular.io/guide/testing#test-file-name-and-location

Testing bests practices:

- Put ***Unit Test*** "spec" files in the same folder as the component or source code files they test.
- Put ***Integration Test*** "spec" files in a general "Tests" folder.
- Implement Continuous Integration with ***Circle CI*** or ***Travis CI***.

All test files have extension .spec.ts, so that they can be identified as files with tests.

This example shows the banner component. I contains all the associated files for a banner. The .spec.ts files hold the tests for the banner.



Testing Components

https://angular.io/guide/testing-components-basics#cli-generated-tests
https://jasmine.github.io/tutorials/mocking_ajax

The command ng generate component [componentName] creates a new component for you in a app/[componentName] folder with a .css, .html, .spec.ts, and .ts files preconfigured.
The testing file is the .spec.ts file. It has some testing already set up for you.

```
import { async, ComponentFixture, TestBed } from '@angular/core/testing';
import { BannerComponent } from './banner.component';

describe('BannerComponent', () => {
  let component: BannerComponent;
  let fixture: ComponentFixture<BannerComponent>;

  beforeEach(async(() => {
    TestBed.configureTestingModule({
      declarations: [ BannerComponent ]//declares which component to test
    })
    .compileComponents();
  }));

  beforeEach(() => {
    fixture = TestBed.createComponent(BannerComponent);
    component = fixture.componentInstance;
    fixture.detectChanges();
  });

  it('should create', () => {
    expect(component).toBeDefined();//verify the component is created
  });
});
```

Angular Testing Template

https://angular.io/guide/testing-components-basics#cli-generated-tests
https://medium.com/swlh/angular-unit-testing-jasmine-karma-step-by-step-e3376d110ab4

The basic template for an ***Angular*** test is fairly simple.

1. Start with a describe() that has two parameters:
   - A string declaring the function or component to test.
   - A callback function containing the actions to take.
2. describe()'s callback function has zero parameters but lists all the actions to take on the component.
   1. beforeEach() helps set up the environment for each test.
   2. it() declares an individual test. it() has two parameters. The first says what is the expected result and the second contains a callback with expect().
   3. expect() is similar to assert() in C#.

```
describe('BannerComponent (inline template)', () => {
  let component: BannerComponent;
  let fixture: ComponentFixture<BannerComponent>;
  let h1: HTMLElement;

  beforeEach(() => {
    TestBed.configureTestingModule({
      declarations: [ BannerComponent ],
    });
    fixture = TestBed.createComponent(BannerComponent);
    // BannerComponent test instance
    component = fixture.componentInstance;
    h1 = fixture.nativeElement.querySelector('h1');
  });

  it('no title in the DOM after createComponent()', () => {
    expect(h1.textContent).toEqual('');
  });

  it('should display original title', () => {
    fixture.detectChanges();
    expect(h1.textContent).toContain(component.title);
  });
});
```

beforeEach, beforeAll()

https://angular.io/guide/testing-components-basics#beforeeach
https://jasmine.github.io/api/edge/global.html#beforeAll
https://jasmine.github.io/api/edge/global.html#beforeEach

Rather than duplicate the TestBed configuration for each test, ***Jasmine*** provides beforeEach() and beforeAll() to set up the environment for the tests. beforeEach() runs before each it() test and beforeAll() runs once before all the it() tests.

Here, in beforeEach(),

- Testbed declares which component will be tested,
- Testbed creates fixture (the complete mock component),
- extracts the ***component*** class from fixture.
- Extracts the 'h1' tag from the component .html.

```
describe('BannerComponent (inline template)', () => {
  let component: BannerComponent;
  let fixture: ComponentFixture<BannerComponent>;
  let h1: HTMLElement;

  beforeEach(() => {
    TestBed.configureTestingModule({
      declarations: [ BannerComponent ],
    });
    fixture = TestBed.createComponent(BannerComponent);
     // BannerComponent test instance
    component = fixture.componentInstance;
    h1 = fixture.nativeElement.querySelector('h1');
  });

  it('no title in the DOM after createComponent()', () => {
    expect(h1.textContent).toEqual('');
  });

  it('should display original title', () => {
    fixture.detectChanges();
    expect(h1.textContent).toContain(component.title);
  });
});
```

it() and expect()

https://jasmine.github.io/tutorials/your_first_suite
https://jasmine.github.io/api/edge/global.html#it

Specs are defined by calling the global ***Jasmine*** function it(), which takes a string and a callback function.

- The string serves as the title of the spec. It is used to describe what the spec does and expects.
- The callback function is the spec (test). It contains one or more expectations that test the state of the code.

An expect() is an assertion that evaluates to true or false.

- expect() takes a value, called the “actual”.
- It is chained with a “Matcher” function (toBe(), toEqual(), toHaveBeenCalled(), etc), which takes the expected value.
- A spec with all true expectations is a passing spec.
- If there is even one false expectation, the spec fails.

```
describe("A suite is a function", () => {
  var a;

  it("and so is a spec", function() {
    a = true;

    expect(a).toBe(true);
    expect(a).not.toBe(false);
  });
});
```

Testing with TestBed

https://angular.io/guide/testing-services#testing-services-with-the-testbed
https://angular.io/guide/testing-utility-apis#testbed-class-summary
https://duncanhunter.gitbook.io/testing-angular/testbed-and-fixtures

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TestBed API is an ***Angular*** testing utility. ***TestBed*** creates a dynamically-constructed ***Angular module*** (for testing) that emulates a module in your application.

Use ***TestBed*** when:

- tests require creating the ***component's*** host element in the browser DOM and verifying the components interaction with it.
- You need to create a component and its dependencies all at once.

.configureTestingModjule() takes optional arrays of providers (services), declarations (components), imports, and schemas. It provides static class methods that either update or reference a global instance of the *TestBed*.

```
type TestModuleMetadata = {
  providers?: any[];
  declarations?: any[];
  imports?: any[];
  schemas?: Array<SchemaMetadata | any[]>;
};
```

```
13    beforeEach(() => {
14      TestBed.configureTestingModule({
15        declarations: [AppComponent],
16        providers: [
17          {
18            provide: AppService,
19            useValue: { getNames: () => (of([])) }
20          }
21        ]
22      });
23      fixture = TestBed.createComponent(AppComponent);
24      component = fixture.componentInstance;
25      appService = TestBed.get(AppService);
26    });
27
28    it('add 1+1 - PASS', () => {
29      expect(1 + 1).toEqual(2);
30    });
```

Spies

https://jasmine.github.io/api/edge/Spy
https://scriptverse.academy/tutorials/jasmine-spyon.html
https://www.tutorialspoint.com/jasminejs/jasminejs_spies.htm

In Angular (Jasmine), a ***Spy*** is used to stub a function. If you want to test a function without calling a dependent function to that function, Jasmine provides spyOn().

spyOn() takes two parameters:

1. The name of the object
2. The name of the method to be spied upon.

spyOn() replaces the spied function with a ***stub*** (a stand-in function). It does not execute the real method called. spyOn() can only be called on existing methods.

In this example, we see the original function above and the spec below. The function nextNumber is spied so what is being called when s.getNextNumber is invoked is not the actual function but a temporary stub.

```
function Number() {
   this.number = 2;
   this.nextNumber = function() {
      this.number = this.number + 1;
      return this.number;
   },
   this.getNextNumber = function() {
      return this.nextNumber();
   }
};
```

```
describe('spyOn() Number', function() {
   it('should be 3', function() {
      var s = new Number();
      spyOn(s, 'nextNumber');
      s.getNextNumber();
      expect(s.number).toEqual(3);
   });
});
```

Testing HTTP Services with Spies

https://stackblitz.com/angular/mkjgxjnxeak?file=src%2Fapp%2Fmodel%2Fhero.service.spec.ts
https://angular.io/guide/testing-services#testing-http-services
https://levelup.gitconnected.com/test-angular-components-and-services-with-http-mocks-e143d90fa27d

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Services that make HTTP calls to remote servers typically inject and delegate to the ***Angular HttpClient*** service.

You can test a data service with an injected ***HttpClient spy*** as you would test any service with a dependency.

```
describe ('HeroesService (with spies)', () => {
  let httpClientSpy: { get: jasmine.Spy };
  let heroService: HeroService;

  beforeEach(() => {
    // TODO: spy on other methods too
    httpClientSpy = jasmine.createSpyObj('HttpClient', ['get']);
    heroService = new HeroService(httpClientSpy as any);
  });
  it('should return expected heroes (HttpClient called once)', () => {
    const expectedHeroes: Hero[] =
      [{ id: 1, name: 'A' }, { id: 2, name: 'B' }];
    httpClientSpy.get.and.returnValue(asyncData(expectedHeroes));

    heroService.getHeroes().subscribe(
      heroes => expect(heroes).toEqual(expectedHeroes, 'expected heroes'),
      fail
    );
    expect(httpClientSpy.get.calls.count()).toBe(1, 'one call');
  });
});
```

Spying on Properties

https://jasmine.github.io/tutorials/spying_on_properties
https://jasmine.github.io/api/2.7/global.html#spyOnProperty

In Jasmine, anything a ***property spy*** can do, can be done with a ***function spy***, but potentially with different syntax. Use spyOnProperty() to create a "getter" or a "setter" ***spy***.

spyOnProperty(object, propertyName, (optional)accessType) takes an object (the ***component class***) as it's first parameter, the name of the property as it's second, and the type of ***spy*** ("getter" or "setter") as it's third. It returns a ***spy***.

```
it("allows you to create spies for either type", function() {
  spyOnProperty(someObject, "myValue", "get").and.returnValue(30);
  spyOnProperty(someObject, "myValue", "set").and.callThrough();
});
```

Spying on Properties

https://jasmine.github.io/tutorials/spying_on_properties
https://jasmine.github.io/api/2.7/global.html#spyOnProperty

You cannot refer to a property without calling its “getter” method. To gain access to the value of an existing ***spy***, save a ***reference*** to the ***spy*** for later changes.

```
beforeEach(function() {
  this.propertySpy = spyOnProperty(someObject, "myValue", "get").and.returnValue(1);
});

it("lets you change the spy strategy later", function() {
  this.propertySpy.and.returnValue(3);
  expect(someObject.myValue).toEqual(3);
});
```

Create a spy with several properties by passing an array as a third argument to createSpyObj().
To change the value of these properties use Object.getOwnPropertyDescriptor.

```
it("creates a spy object with properties", function() {
  let obj = createSpyObj("myObject", {}, { x: 3, y: 4 });
  expect(obj.x).toEqual(3);

  Object.getOwnPropertyDescriptor(obj, "x").get.and.returnValue(7);
  expect(obj.x).toEqual(7);
});
```

Testing Reactive Forms

https://angular.io/guide/forms-overview#testing
https://angular.io/guide/forms-overview#testing-reactive-forms
https://codecraft.tv/courses/angular/unit-testing/model-driven-forms/

Reactive forms can be tested without rendering the UI because they provide synchronous access to the ***form models*** and ***data models***.

In the below spec, status and data are queried and manipulated through the ***control*** without interacting with the ***change detection cycle***.

This test verifies the data flow from view to model in a ***reactive*** Form.

```
it('should update the value of the input field', () => {
  const input = fixture.nativeElement.querySelector('input');//Grab the "input" element from the form.
  const event = createNewEvent('input');                     //create an 'input' event to fire below

  input.value = 'Red';                                       //Set the value of the input to 'Red".
  input.dispatchEvent(event);                                //Fire off the event.

  //assert that the value in the model now matches the input.
  expect(fixture.componentInstance.favoriteColorControl.value).toEqual('Red');
});
```

Testing Template-driven Forms

https://angular.io/guide/forms-overview#testing
https://angular.io/guide/forms-overview#testing-template-driven-forms
https://codecraft.tv/courses/angular/unit-testing/model-driven-forms/

Writing tests with ***template-driven*** forms requires a detailed knowledge of the change detection process and an understanding of how ***directives*** run on each cycle to ensure that elements are queried, tested, or changed at the correct time.

This test verifies the data flows from view to model and model to view for a ***template-driven*** form.

```
it('should update the favorite color in the component', fakeAsync(() => {
  const input = fixture.nativeElement.querySelector('input'); //Grab the "input" element from the form.
  const event = createNewEvent('input');//create an 'input' event to fire below

  input.value = 'Red';                    //Set the value of the input to 'Red".
  input.dispatchEvent(event);             //Fire off the event.

  fixture.detectChanges();                //tell fixture to detect changes
  expect(component.favoriteColor).toEqual('Red');//assert that the value in the model now matches the input.
}));
```

Testing pipe()

https://angular.io/guide/testing-pipes

All ***pipe classes*** have one method, ***transform***. Transform converts the input value into a transformed output value.

The ***transform*** implementation rarely interacts with the DOM and most pipes have no dependence on Angular other than the ***@Pipe*** metadata and an interface

Consider a TitleCasePipe that capitalizes the first letter of each word. Here's an implementation with a regular expression.

```
import { Pipe, PipeTransform } from '@angular/core';

@Pipe({name: 'titlecase', pure: true})
/** Transform to Title Case: uppercase the first letter of
the words in a string. */
export class TitleCasePipe implements PipeTransform {
  transform(input: string): string {
    return input.length === 0 ? '' :
      input.replace(/\w\S*/g, (txt => txt[0].toUpperCase()
+ txt.substr(1).toLowerCase() ));
  }
}
```

```
describe('TitleCasePipe', () => {
  // This pipe is a pure, stateless function so no need for
BeforeEach
  const pipe = new TitleCasePipe();

  it('transforms "abc" to "Abc"', () => {
    expect(pipe.transform('abc')).toBe('Abc');
  });

  it('transforms "abc def" to "Abc Def"', () => {
    expect(pipe.transform('abc def')).toBe('Abc Def');
  });

  // ... more tests ...
});
```

Mocking AJAX calls

https://jasmine.github.io/tutorials/mocking_ajax

```
describe("mocking ajax", function() {

it("allows use in a single spec", function() {
    var doneFn = jasmine.createSpy('success');   //this is the mock response
    //'withMock()' takes a function that's called after AJAX had been mocked and is
automatically uninstalled afterwards.
     jasmine.Ajax.withMock(function() {              //this is normal AJAX retup
      var xhr = new XMLHttpRequest();                //but using withMock()
      xhr.onreadystatechange = function(args) {
        if (this.readyState == this.DONE) {
          doneFn(this.responseText);
        }
      };
      xhr.open("GET", "/reature.com/associates");//set up the request
      xhr.send();                                    //send the request
      expect(doneFn).not.toHaveBeenCalled();
      jasmine.Ajax.requests.mostRecent().respondWith({//tell doneFn how to respond
        "status" : 200,
        "responseText" : 'successful mock!'
      });
      expect(doneFn).toHaveBeenCalledWith('successful mock!');//assert
    });});});
```