Angular course

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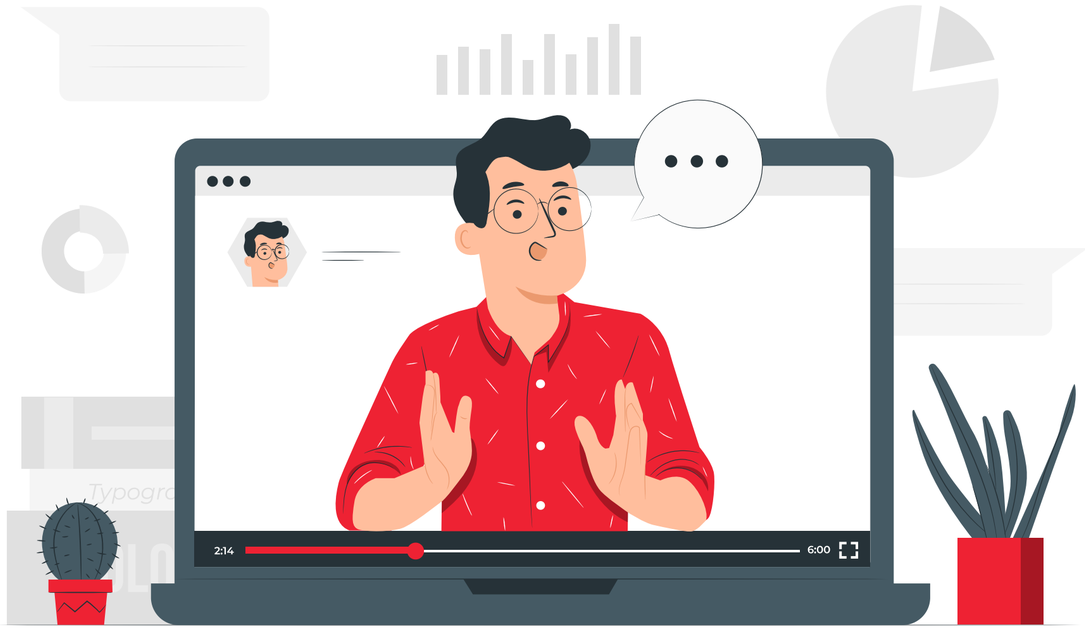
Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Logistics

- Schedules
- Lunch & breaks
- Other questions ?

About me



Getting started

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Table of Contents

- **Getting started**
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Client-server architecture

- Refers to a mode of **communication** between 2 computers
  - → the client sends a **request** to the server
  - → the server sends the **response** back to the client
- This communication generally uses the HTTP **protocol** (but other protocols exist…)
- Each HTTP **message** between the client and the server generally consists of 2 parts
  - → the **headers**, which contain contextual metadata
  - → the **body**, which contains the transmitted data

Client-server architecture - Example

- **headers** of a document request, sent by the client (a web browser)

```
GET /home HTTP/1.1
Accept: text/html
Accept-Encoding: gzip
```

- **body** of the response, returned by the server (a web page)

```
<!doctype html>
<html lang="en">
  <head>
    <title>Home</title>
    <link href="styles.css" rel="stylesheet" />
  </head>
  <body>
    <app-root></app-root>
    <script src="main.js"></script>
  </body>
</html>
```

😉 *This is not a random example, it's in fact the typical server return for an Angular application*

Web browser technologies

- A web browser is a software capable of displaying **web pages**
- Web pages are built around 3 main technologies
  - → **HTML**
  - → **CSS**
  - → **JavaScript**

HTML - HyperText Markup Language

- HTML is a **HyperText Markup Language** used to **structure the content** of web pages

```
<h1>Google Chrome is a web browser</h1>

<p> <a href="https://www.google.com/chrome/">More infos</a> </p>

<img src="https://www.google.com/chrome/static/images/chrome-logo-m100.svg" />
```

- Tag syntax
  - → **opening `<tag>`** and **closing `</tag>`** tags (such as **`h1`**, **`p`**, **`a`**, ...) with content in between
  - → **self-closing `<tag />`** tags (such as **`img`**, ...) with no content
  - → **attributes `attribute-name="value"`** (such as **`href`**, **`src`**, ...) applicable to opening and self-closing tags
  - → the **content** (between the opening and closing tags) may contain other *nested tags*

CSS - Cascading Style Sheets

- CSS is a **rules-based language** used to control the visual **formatting** of web pages

```
<button>Valider</button>

<style>
  button {
    padding: 15px;
    background-color: yellow;
  }
</style>
```

- Syntax of **rules**
  - → **selector** targeting one or more elements of the web page: **`selector { ... }`**
  - → **declarations** applying to this selector: **`property: value;`**
- A style sheet can be defined in a **`<style>`** tag, or in an external file
  - → **`<link href="styles.css" rel="stylesheet" />`**

JavaScript JS

- JavaScript is a **scripting language** used to add **interactivity** to web pages

```
<button onclick="showAlert()">Valider</button>

<script>
  function showAlert() {
    window.alert('Button clicked!');
  }
</script>
```

- A script can be defined in a **`<script>`** tag, or in an external file

  → **`<script src="main.js"></script>`**

HTML - CSS - JavaScript

- All 3 technologies are indeed present in the web page given above as an example
  - → **HTML:** all the tags in the document
  - → **CSS:** loaded by the **`styles.css`** file
  - → **JavaScript:** loaded by the **`main.js`** file

```html
<!doctype html>
<html lang="en">
  <head>
    <title>Home</title>
    <link href="styles.css" rel="stylesheet" />
  </head>
  <body>
    <app-root></app-root>
    <script src="main.js"></script>
  </body>
</html>
```

😉 *Later, we'll explain the role of the **`<app-root>`** tag in relation to **Angular**...*

Technologies outside the web browser

- Ultimately, an Angular application **runs** in a web browser
- The artefacts of such an application are therefore HTML, CSS and JavaScript files, which the browser knows how to interpret
- However, an Angular application is **built** using additional technologies (not understood by the browser), which improve the developer experience and the quality of the artefacts
- These technologies, used only during the development phase, are mainly
  - → **TypeScript**
  - → **Node.js**
  - → **NPM**
  - → **Vite**

TypeScript

- TypeScript is a **superset** of JavaScript, which improves and secures the production of JavaScript code
- Unlike JavaScript, TypeScript is a **typed programming language**

```
// JavaScript
let data;          // There is no constraint on the possible values
data = 1;          // ✅ Here it's a `number`
data = true;       // ✅ And here it's a `boolean`
```

```
// TypeScript
let data: number; // Only values of type `number` are allowed
data = 1;          // ✅ Here the assignment is valid
data = true;       // ❌ And here the assignment is invalid
```

TypeScript

- A TypeScript program must be **transpiled into JavaScript** before it can be executed in the web browser
- Transpilation simply involves **removing the typing** to make it a valid JavaScript program
- TypeScript is used in the **development phase** whereas JavaScript is used in the **execution phase**

Node.js

- Node.js is a technology that allows JavaScript code to be executed **outside the browser**
- With Node.js, the **execution context** for JavaScript is your **operating system**
- Node.js can, for example, access your file system, find out the characteristics of your processor, etc...

```
# Running the following commands in your computer's Terminal ...
node
process.arch # ... returns for example: `x64` (Intel 64-bit processor)
```

In a web browser, on the other hand, JavaScript's execution context is the web page with which it interacts. JavaScript can, for example, know the user's preferred language, the size of the browser window, etc...

```
# Running the following command in your browser's console ...
window.innerWidth # ... returns for example: `1135` (window width in px)
```

NPM (Node package Manager)

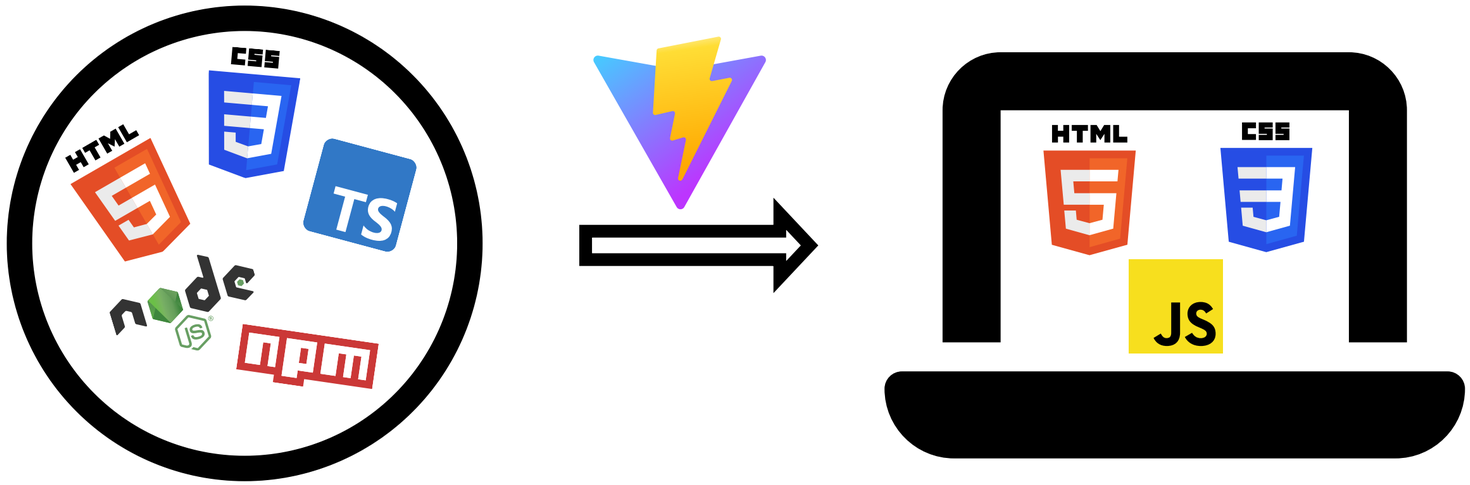
- NPM is the **package manager** for the Node.js JavaScript runtime environment
- Provides programs and libraries for the JavaScript ecosystem in the form of downloadable packages from a **registry**
- Example of installing a package and then using it

```
# Running the following command in a Terminal,
# will install the `@angular/cli` package on your computer
npm install --global @angular/cli

# Once the package has been installed, it globally provides the `ng` command,
# which for example, lets you generate an Angular application skeleton
ng new
```

Vite

- Vite is a **build tool** for modern web applications
- Main features
  - → **development server** (dev server)
  - → **build artefacts command** (bundler)



Angular

- A web framework that enables developers to **create fast, reliable applications**
- Announced in 2014, it's a total rewrite of **AngularJS** (although some concepts remain)
- First release of **Angular 2** in September 2016
- Major release every 6 months
- Last major version **`20`** released in May 2025
- Maintained by a dedicated team at **Google**

Angular - The big picture 1/2

- In the **development phase**, you write components in TypeScript
  - → Angular has a component-based architecture
  - → and use plain HTML templates

```
import { Component } from '@angular/core';
import { bootstrapApplication } from '@angular/platform-browser';

@Component({
  selector: 'app-root',
  template: '<p>Hello world!</p>',
})
class App {}

bootstrapApplication(App);
```

(for the moment, let's leave aside the code implementation details and focus on the big picture...)

Angular - The big picture 2/2

- In the **execution phase** (once the app has been built and is running in a web browser), Angular tries to bootstrap the application

  → it searches the web page for the tag corresponding to the component's **CSS selector**

  → it then renders the component's **HTML template** inside this tag

```
<app-root>
  <p>Hello world!</p>
</app-root>
```

😉 *You now know the role of the **`<app-root>`** tag in relation to **Angular**, which was present in the web page given above as an example*

In-depth resources

- **HTML - CSS - JavaScript:** https://developer.mozilla.org
- **TypeScript:** https://www.typescriptlang.org
- **Node.js:** https://nodejs.org
- **NPM:** https://npmjs.com
- **Vite:** https://vitejs.dev
- **Angular:** https://angular.dev

Getting started - Questions

Getting started - Lab 1

Workspace

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Table of Contents

- Getting started
- **Workspace**
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Workspace

An Angular workspace is **structured** by the following parts

- `package.json`
- `tsconfig.json`
- `angular.json`
- `src/app/*`

Workspace - package.json

The presence of a **`package.json`** file indicates that the directory is the root of a **Node.js** project

- Scripts can be run using the shell command **`npm run <scriptName>`**

```
{
  "scripts": {
    "ng": "ng",
    "start": "ng serve",
    "build": "ng build",
    "watch": "ng build --watch --configuration development",
    "test": "ng test"
  }
}
```

Workspace - package.json

- **Dependencies** of the Angular framework are scoped under `@angular/*`

```
{
  "dependencies": {
    "@angular/animations": "...",
    "@angular/common": "...",
    "@angular/compiler": "...",
    "@angular/core": "...",
    "@angular/forms": "...",
    "@angular/platform-browser": "...",
    "@angular/platform-browser-dynamic": "...",
    "@angular/router": "..."
  },
  "devDependencies": {
    "@angular/build": "...",
    "@angular/cli": "...",
    "@angular/compiler-cli": "...",
  }
}
```

Workspace - package.json

- Angular also depends on some **third-party libraries**

```
{
  "dependencies": {
    "rxjs": "...",
    "tslib": "...",
    "zone.js": "..."
  },
  "devDependencies": {
    "typescript": "..."
  }
}
```

Workspace - tsconfig.json

The presence of a **`tsconfig.json`** file indicates that the directory is the root of a **TypeScript** project

- Specifies the root files and the **compiler options** required to compile the project
- Supplies **Angular specific options** to the compiler

```
{
  "compilerOptions": {
    "strict": true,
    "experimentalDecorators": true,
    ...
  },
  "angularCompilerOptions": {
    "strictInputAccessModifiers": true,
    "strictTemplates": true,
    ...
  }
}
```

Workspace - angular.json

The presence of an **`angular.json`** file indicates that the directory is the root of an **Angular** project

- Provides workspace-wide and project-specific **configuration** defaults
- These are used for build and development tools provided by the **Angular CLI**

```
{
  "projects": {
    "zenika-ng-website": {
      "sourceRoot": "src",
      "projectType": "application",
      "prefix": "app",
      "architect": {
        "build": {},
        "serve": {},
        "test": {},
      }
    }
  }
}
```

Workspace - angular.json

- The build **`"options"`** in the architect section are frequently used

```
{
  "projects": {
    "zenika-ng-website": {
      "architect": {
        "build": {
          "options": {
              "index": "src/index.html",
              "browser": "src/main.ts",
              "polyfills": ["zone.js"],
              "tsConfig": "tsconfig.app.json",
              "assets": [{ "glob": "**/*", "input": "public" }],
              "styles": ["src/styles.css"]
          }
        }
      }
    }
  }
}
```

Workspace - src/app/*

- **`index.html`**: final **document** of the Single Page Application (SPA)
- **`main.ts`**: **entry point** of the app (from which Vite builds the JavaScript bundle)
- **`app/app.*`**: **main component** of the app (the one used to bootstrap the app)
- **`styles.css`**: **global styles** of the app
- **`public/*`**: **resources** of the app (images, pdf, ...)

When running the **`ng build`** shell command all these files are compiled and combined to produce the final application bundle ready for production (mainly HTML, CSS and JavaScript files)

```
ng build
```

When the build is complete, the application bundle is in the **`dist/`** directory

Angular CLI

- The Angular CLI is a command-line interface tool that you use to
  - → **initialize**
  - → **develop**
  - → **scaffold**
  - → **maintain** applications
- It is usually installed globally on your system

```
npm install -g @angular/cli
```

- Here are some of the commands available

```
ng new my-app-name
ng serve
ng test
ng build
```

Angular CLI - Generate 1/3

The **`generate`** (or simply **`g`**) command is often used to quickly scaffold the different parts of an Angular application

```
# Generate components
ng generate component menu
ng g c product

# Generate services
ng generate service catalog-resource
ng g s basket-resource

# Generate pipes
ng generate pipe sort-array

# And many more ...
```

You can easily get help for each type of CLI command

```
ng --help
ng generate --help
ng generate component --help
```

Angular CLI - Generate 2/3

- From Angular v2 to v19, all files generated by the CLI were suffixed with their type (**`*.component.ts`**, **`*.directive.ts`**, **`*.service.ts`**, ...)
- Starting with **Angular v20**, this is no longer the case, as the Angular guide style has been simplified

Here's the code generated by the command **`ng generate component menu`** in the two different implementations

```ts
/* Angular 2, ... , 18, 19 */

// menu.component.ts
import { Component } from '@angular/core';

@Component({
  selector: 'app-menu',
  templateUrl: './menu.component.html',
  styleUrl: './menu.component.css',
})
export class MenuComponent {}
```

```ts
/* Angular 20, ... */

// menu.ts
import { Component } from '@angular/core';

@Component({
  selector: 'app-menu',
  templateUrl: './menu.html',
  styleUrl: './menu.css',
})
export class Menu {}
```

😉 *This course is based on the latest style guide recommandations*

Angular CLI - Generate 3/3

- When updating from Angular 19 to 20, the following configuration is added to the **`angular.json`** file to preserve the previous behavior

```
{
  "schematics": {
    "@schematics/angular:component":    { "type": "component"  },
    "@schematics/angular:directive":    { "type": "directive"  },
    "@schematics/angular:service":      { "type": "service"    },
    "@schematics/angular:guard":        { "typeSeparator": "." },
    "@schematics/angular:interceptor": { "typeSeparator": "." },
    "@schematics/angular:module":       { "typeSeparator": "." },
    "@schematics/angular:pipe":         { "typeSeparator": "." },
    "@schematics/angular:resolver":     { "typeSeparator": "." }
  }
}
```

Workspace - Questions

Workspace - Lab 2

Technical prerequisites

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Table of Contents

- Getting started
- Workspace
- **Technical prerequisites**
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Typescript - Types 1/2

- Two ways to define variables: **`const`** and **`let`**
- Type examples: **`boolean`**, **`number`**

```
const alwaysTrue: boolean = true;

let age: number = 32;
age = 33;
age = 'Carl';            // ✘ Type 'string' is not assignable to type 'number'
```

- Type inference: used to provide type information when there is no explicit type annotation

```
const alwaysTrue = true; // is still of type `boolean`

let age = 32;             // is still of type `number`
age = 33;
age = 'Carl';            // ✘ is still throwing the same Type error
```

Typescript - Types 2/2

- More type examples: **`string`**, **`array`**, **`object`**

```
const name: string = 'Carl';

const nameList: string[] = ['Carl', 'Laurent'];

const products: { title: string; price: number } = { title: 'Tee-shirt', price: 8.5 };
```

- Type **`any`** may be necessary in some cases, but should be avoided wherever possible

```
let notSure: any = 4;
notSure = true;
```

Typescript - Functions 1/2

- 3 types of functions: ***named***, ***anonymous*** and ***arrow***

```
function sayHello(message: string): void { /* ... */ }

const sayHello = function(message: string): void { /* ... */ };

const sayHello = (message: string): void => { /* ... */ };
```

⚠️ *Note that the arrow functions treat the resolution of the* ***`this`*** *keyword differently, but this is beyond the scope of this course*

Typescript - Functions 2/2

- TypeScript allows typing for arguments and return value
  - → Set **default** argument value with **=**
  - → Define **optional** argument with **?**
  - → Use **`return`** keyword to return a value

```
function getFullName(lastName = 'Doe', firstName?: string): string {

  return firstName ? `${firstName} ${lastName}` : lastName;
}
```

Typescript - Classes 1/4

Classes and interfaces are similar to those in Object Oriented Programming (OOP)

- Classes are composed of one **constructor**, **properties** and **methods**
- Explicitly defining a constructor is optional
- Properties and methods are accessible with **`this`** keyword

```
class Person {
  name = '';

  constructor() {} // this is optional

  sayHello() {
    console.log(`Hello, I'm ${this.name}!`);
  }
}

const person = new Person();
person.name = 'Carl';
person.sayHello(); // ⟶ Hello, I'm Carl!
```

Typescript - Classes 2/4

- 3 scopes for encapsulation: **`public`**, **`protected`** and **`private`**
  - → **`public`** is the default scope
  - → private scope alternative: using standard JavaScript private field (using hash **#** prefix)

```
class Demo {
  prop1 = 1;
  protected prop2 = true;
  private prop3 = 'Secret';

  #prop4 = 'Big secret'; // ⟵ standard JavaScript private field

  method1() {}
  protected method1() {}
  private method3() {}

  #method4() {} // ⟵ standard JavaScript private field
}
```

Typescript - Classes 3/4

- TypeScript provides a shortcut to **link constructor arguments to class properties**

The following shortcut...

```
class Person {
  constructor(public firstName: string) {}
}
```

...is equivalent to

```
class Person {
  public firstName: string;

  constructor(firstName: string) {
    this.firstName = firstName;
  }
}
```

Typescript - Classes 4/4

- Possibility to have "**getter**" and "**setter**"

```
class Person {
  constructor(public firstName: string, public lastName: string) {}

  get fullName(): string {
    return `${this.firstName} ${this.lastName}`;
  }

  set fullName(value: string): void {
    const [firstName, lastName] = value.split(' ');
    this.firstName = firstName;
    this.lastName = lastName;
  }
}

const person = new Person('John', 'Doe');
console.log(person.fullName); // ⟶ John Doe

person.fullName = 'Jean Dupont';
console.log(person.firstName); // ⟶ Jean
console.log(person.lastName); // ⟶ Dupont
```

Typescript - Interfaces

- Can be used to define object shape

```
interface Person {
  name: string;
  age: number;
}

const person: Person = { name: 'John Doe', age: 33 };
```

- Can be used on classes with the **`implements`** keyword

```
interface Musician {
  play(): void;
}

class TrumpetPlayer implements Musician {
  play(): void {
    console.log('I play trumpet!');
  }
}
```

Typescript - Generics

- Similar to generics in *Java* or *C#*
- Generics need typing at instantiation

```
class Log<T> {
  log(value: T) {
    console.log(value);
  }
}

const logOfNumber = new Log<number>();
logOfNumber.log(5);
logOfNumber.log(6);


const logOfString = new Log<string>();
logOfString.log('Hello');
logOfString.log('world!');
```

TypeScript - Decorators

- A Decorator is a special kind of declaration that can be attached to a class declaration, method, accessor, property, or parameter
- Decorators can be used to **observe**, **modify** or **replace** the value to which they are applied
- Decorators use the form **`@expression`**, where **`expression`** must evaluate to a **function** that will be **called at runtime** with information about the decorated declaration

```
function MyClassDecorator(/* ... */) { /* ... */ }

function MyMethodDecorator(/* ... */) { /* ... */ }

@MyClassDecorator
class Foo {

  @MyMethodDecorator
  bar() {}
}
```

NPM - Commands 1/2

- Set up a directory as an npm package by creating a **`package.json`** file
  (created automatically when you generates your application with the Angular CLI)

```
npm init
```

- Download a package and install it in **`./node_modules`** directory

```
npm install <packageName>
```

- Install a package globally on your system
  (mostly used to install CLI tools such as the Angular CLI)

```
npm install -g <packageName>
```

NPM - Commands 2/2

- Update a package

```
npm update <packageName>
```

- Remove a package

```
npm remove <packageName>
```

NPM - Package versioning 1/2

Package versions generally follow the semver (semantic versioning) standard

```
{
  "name": "<packageName>",
  "version": "<major>.<minor>.<patch>"
}
```

- **`major`**: might introduce breaking changes
- **`minor`**: can add new features but in a retro-compatible way
- **`patch`**: bug fixes

Example:

```
{
  "name": "my-awesome-package",
  "version": "1.2.3"
}
```

NPM - Package versioning 2/2

Allowing a range of versions when **installing** or **updating** a package

- `1.2.3` will install the **exact** version
- `~1.2.3` will install any **patch** update such as
  - → `1.2.4`
  - → `1.2.5`
  - → `1.2.99`
- `^1.2.3` will install any **minor** update such as
  - → `1.2.3`
  - → `1.3.0`
  - → `1.99.0`

For a given dependency, the exact version installed is locked in the `package-lock.json` configuration file

NPM - Angular package versioning

Angular package versions strongly follow the semver standard

- Most of the framework dependencies accepts **minor** updates such as
  - → `"@angular/core": "^XX.0.0"`
  - → `"@angular/common": "^XX.0.0"`
- Some of them only accepts **patch** updates such as
  - → `"@angular/cli": "~XX.0.0"`

To update the Angular package versions of your project use the command `ng update`

In-depth resources:

- Angular update guide
- Angular version compatibility (with Node.js, TypeScript, ...)

Technical prerequisites - Questions

Components

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- **Components**
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Components - Definition 1/3

- Components are the **main building blocks** of Angular applications
- Each component represents a **part of a larger web page**
- Organizing an application into components helps **provide structure to your project**, clearly separating code into specific parts that are easy to maintain and grow over time

Components - Definition 2/3

- Defined with the **`@Component`** class decorator, which provides the component's metadata
  - → must have a **`selector`** so that it can be inserted into any other component template
  - → must have a **`template`** (or **`templateUrl`**) that defines what is to be displayed

```
import { Component } from '@angular/core';

@Component({
  selector: 'app-hello',
  template: '<p>Hello world!</p>',
})
export class Hello {}
```

Components - Definition 3/3

- You build an application by composing multiple components together
- A component that depends on other components must import them in order to use them in its template

```
import { Component } from '@angular/core';
import { Hello } from './hello/hello.ts';

@Component({
  selector: 'app-root',
  imports: [Hello],
  template: `
    <h1>My Awesome App</h1>
    <app-hello />
  `,
})
export class App {}
```

😉 *The **App** component is the only one to be **bootstrapped**. Its selector (**`app-root`**) is searched for in the web page. All other components are necessarily **imported** by the main component or its children.*

Component - Template

- The template can be configured in two ways:
  - → using a **`template`** property: string literal (as shown above)
  - → using a **`templateUrl`** property: path to an HTML file (relative to the component)

```ts
// app.ts

import { Component } from '@angular/core';

@Component({
  selector: 'app-root',
  templateUrl: './app.html',
})
export class App {}
```

```html
<!-- app.html -->

<h1>My Awesome App</h1>
```

Component - Styles

The styles can be configured in two ways:

- using a **`styles`** property that contains the expected CSS rules

```
@Component ({
  styles: `h1 { font-weight: normal; }`
})
export class App {}
```

- using a **`styleUrl`** property that indicates a path to **`.css`** (or **`.scss`**) file

```
@Component ({
  styleUrl: './app.css'
})
export class App {}
```

```
/* app.css */

h1 { font-weight: normal; }
```

Template syntax - Text interpolation

- Uses the syntax **`{{ expression }}`**
- The **`expression`** is converted into a **`string`** and displayed as such
- Angular defines a precise syntax for these expressions
  - → accepts basic JavaScript expressions
  - → more: https://angular.dev/guide/templates
- All **`public`** or **`protected`** component properties can be used in the template
- An expression used in template must not change the component state

```
@Component ({
  selector: 'app-product-card',
  template: `<p>{{ product?.title }}</p>`
})
export class ProductCard {
  protected product?: Product;
}
```

Template syntax - Property binding

- Generic syntax for setting the value of a **DOM property**
- Using the syntax **`[propertyName]="expression"`**

```
<button [disabled]="isUnchanged">Save</button>  <!-- HTML property -->

<app-checkout-form [formData]="data" />         <!-- Component input -->
```

- Angular provides a special syntax for applying dynamic **`class`** and **`style`** properties

```
<p [class.highlight]="isHighlight">Hello</p>

<button [style.color]="isHighlight ? 'orange': 'black'">Save</button>
```

Template syntax - Attribute binding

- Generic syntax for setting the value of an **HTML attribute**
- Using the syntax **`[attr.attributeName]="expression"`**
- Pay attention to the difference between "DOM properties" and "HTML attributes"!

Example: **`role`** is a valid HTML attribute of the **`<div>`** tag, but there's no such DOM property!

```
<div role="status">OK</div>
```

```
<div [attr.role]="expression">OK</div>
```

```
<div [role]="expression">NOT OK</div>

<!-- ❌ Can't bind to 'role' since it isn't a known property of 'div'. -->
```

Template syntax - Event binding

- Generic syntax for listening to an event of an HTML element
- Using the syntax **`(eventName)="expression"`**

```
<button (click)="handler()">Save</button>                    <!-- HTML event -->

<app-checkout-form (formSubmitted)="onFormSubmitted()" />    <!-- Component output -->
```

- Angular provides a special syntax for handling "pseudo" events

```
<input (keyup.enter)="onEnter()" />
```

Template syntax - Event binding | $event

- In this example, we listen to the **`input`** event of the **`<input />`** element

```
@Component ({
  selector: 'app-demo',
  template: `<input [value]="name" (input)="updateName($event.target)" />`,
})
export class Demo {
  name = 'Carl';

  updateName(eventTarget: EventTarget | null) {
    this.name = (eventTarget as HTMLInputElement).value;
  }
}
```

- **`$event`** refers to the native browser DOM **`InputEvent`**
- We achieve a *two-way data binding* using both property and event bindings

  → the **class** property **`name`** and the **template** input **`value`** will always be in sync

Component - Input 1/3

- Use the **`input()`** function to declare a component class property as input
- To read the value contained in the input, you need to call it as a function

```
import { Component, input } from '@angular/core';

@Component ({
  selector: 'app-counter',
  template: `<p>{{ count() }}</p>`
})
export class Counter {
  count = input<number>(0);
}
```

- Inputs without a default value have an implicit **`undefined`** value

```
count = input<number>(); // is equivalent to `input<number | undefined>();`
```

Component - Input 2/3

- Use the **`input.required()`** function to declare a component class property as required input

```ts
import { Component, input } from '@angular/core';

@Component ({
  selector: 'app-counter',
  template: `<p>{{ count() }}</p>`
})
export class Counter {
  count = input.required<number>();
}
```

- When using the component, Angular will throw an error if the required input is missing

```ts
<app-counter />

<!-- ❌ Required input 'count' from component Counter must be specified. -->
```

Component - Input 3/3

- The consumer of this component must bind to the required input in its template

```
import { Component } from '@angular/core';
import { Counter } from './counter/counter.ts';

@Component ({
  selector: 'app-root',
  imports [Counter],
  template: `<app-counter [count]="parentCount" />`
})
export class App {
  protected parentCount = 5;
}
```

Component - Output 1/2

- Use the **`output()`** function to declare a component class property as output

```
import { Component, output } from '@angular/core';

@Component ({
  selector: 'app-counter',
  template: `<button (click)="onClick()">{{ count }}</button>`
})
export class Counter {
  protected count = 0;

  countChange = output<number>();

  protected onClick() {
    this.count += 1;
    this.countChange.emit(this.count);
  }
}
```

Component - Output 2/2

- The consumer of this component can bind to the event in its template

```
import { Component } from '@angular/core';
import { Counter } from './counter/counter.ts';

@Component ({
  selector: 'app-root',
  imports [Counter],
  template:
    `<app-counter (countChange)="updateCount($event)" />
     <p>Count: {{ parentCount }}</p>`
})
export class App {
  protected parentCount: number | undefined = undefined;

  protected updateCount(count: number) {
    this.parentCount = count;
  }
}
```

- **Output events** are never propagated to the consumer's parent component, whereas **native DOM events** are (event bubbling)

Component - Model input 1/4

- Use the **`model()`** function to declare a component class property as model input
- Unlike regular inputs, model inputs allow the component author to write values into the property

```
import { Component, model } from '@angular/core';

@Component ({
  selector: 'app-counter',
  template: `<button (click)="onClick()">{{ count }}</button>`
})
export class Counter {
  count = model<number>(0);

  protected onClick() {
    this.count.update((count) ⇒ count + 1);
  }
}
```

Component - Model input 2/4

- The consumer of this component can bind to both "property" and "event" in its template

```
import { Component } from '@angular/core';
import { Counter } from './counter/counter.ts';

@Component ({
  selector: 'app-root',
  imports [Counter],
  template: `
    <app-counter [count]="parentCount" (countChange)="updateCount($event)" />
  `
})
export class App {
  protected parentCount = 5;

  protected updateCount(count: number) {
    this.parentCount = count;
  }
}
```

- The **`output`** name is based on the **`input`** name but with the suffix: **`"Change"`**

Component - Model input 3/4

- Use the "Banana in a box" [🍌] syntax to easily achieve two-way data binding

```
import { Component } from '@angular/core';
import { Counter } from './counter/counter.ts';

@Component ({
  selector: 'app-root',
  imports [Counter],
  template: `
    <app-counter [(count)]="parentCount" />
  `
})
export class App {
  protected parentCount = 5;

  protected updateCount(count: number) {
    this.parentCount = count;
  }
}
```

Component - Model input 4/4

- Unlike **`input`**s which are "realony", **`model`**s are "writable"

```
@Component({ ... })
export class Counter {
  count = model(0);
  constructor() {
    console.log(this.count());          // ⟵ output: 0

    this.count.set(1);
    console.log(this.count());          // ⟵ output: 1

    this.count.update((c) ⇒ c + 1);
    console.log(this.count());          // ⟵ output: 2
  }
}
```

- **`input`** and **`model`** are in fact "**signals**"
- **`.set()`** and **`.update()`** methods are part of the signals API
- Signals play a crucial role in the Angular reactivity model and whole chapter is devoted to them later in the course

Components - Questions

Components - Lab 3

Unit testing

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- **Unit testing**
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Unit testing - Introduction

Testing your Angular application helps you check that your application is working as you expect.

To test an application, you need two functional building blocks:

- A **test runner** that identifies and runs the files containing the tests
- An **assertion library** that verifies the expected behavior

Out of the box, Angular uses **Karma** as test runner and **Jasmine** as assertion library.

By default, test files are identified by the pattern: `*.spec.ts`.

Unit testing - Jasmine

- Organize your tests using **`describe`** and **`it`** functions
- Follow the 3 steps pattern in each test: *"Given"*, *"When"*, *"Then"*
- Identify the thing being tested using **`expect`**
- Use matchers to verify the expected behavior: **`toBe`**, **`toBeTrue`**, **`toBeTruthy`**, **`toContain`**, ...

```
describe('boolean variable', () => {
  let value?: boolean;

  it('should be inverted when using "!" operator', () => {
    // Given
    value = true;

    // When
    value = !value;

    // Then
    expect(value).toBe(false); // equivalent to `expect(value).toBeFalse();`
  });
});
```

Unit testing - Jasmine | Hooks

- Use hooks to setup and teardown your tests using:

  → **`beforeEach`**, **`afterEach`**, **`beforeAll`**, **`afterAll`**

```
describe('boolean variable', () => {
  let value?: boolean;

  beforeEach(() => {
    // Given
    value = true;
  });

  it('should be inverted when using "!" operator', () => {
    // When
    value = !value;

    // Then
    expect(value).not.toBeTrue(); // ⟵ notice the usage of `.not`
  });
});
```

Unit testing - Jasmine | Spies

- Use spy to watch how a method is been used during the test
- Create a spy: **`jasmine.createSpy`** or **`spyOn`**
- Spy matchers: **`toHaveBeenCalled`**, **`toHaveBeenCalledWith`**, **`and.returnValue`**, ...

```
// Given
class Counter {
  count = 0;

  increment() { this.count += 1; this.log('increment'); }

  log(message: string) { console.log('Counter:', message); }
}
const count = new Counter();
const logSpy = spyOn(count, 'log'); // ⟵ Spying on the `log` method

// When
count.increment();

// Then
expect(logSpy).toHaveBeenCalledWith('increment');
```

Unit testing - Angular environment

- Angular provides a powerful testing environment called **`TestBed`**
- Angular testing configuration is reset for every test (executed in **`beforeEach`**)

```
import { TestBed } from '@angular/core/testing';

describe('my feature', () => {
  beforeEach(async () => {
    await TestBed.configureTestingModule({ /* Test setup */ }).compileComponents();
  });

  it('should work', () =>  /* ... */ });

  it('should work too', () =>  /* ... */ });
});
```

Unit testing - Components

- Components combine an HTML template and a TypeScript class
- You should test that they work together as intended
- **`TestBed`** helps you create the component's host element as if it were rendered in the DOM
- The **`fixture`** gives you access to the component instance and its host element
- In the tests you must **`detectChanges`** manually verifying that the DOM state is correct

```
import { ComponentFixture, TestBed } from '@angular/core/testing';
import { AppComponent } from './app.component';

await TestBed.configureTestingModule({ imports: [AppComponent] }).compileComponents();

let fixture = TestBed.createComponent(AppComponent);

let component = fixture.componentInstance;
let hostElement = fixture.nativeElement;

fixture.detectChanges();
```

Unit testing - Components | Strategies

- Class testing
  - → **pros:** easy to setup, easy to write, most usual way to write unit tests
  - → **cons:** does not make sure your component behave the way it should
- DOM testing
  - → **pros:** make sure your component behave exactly the way it should
  - → **cons:** harder to setup, Harder to write

✅ Overall, **DOM testing is more robust**, but require more work to setup

Unit testing - Example 1

- Let's test a simple counter component with no dependencies

```
import { Component, model } from '@angular/core';

@Component({
  selector: 'app-counter',
  template: '<button (click)="increment()">{{ count }}</button>'
})
export class CounterComponent {
  count = model(0);

  protected increment() {
    this.count.update((count) => count + 1);
  }
}
```

Unit testing - Example 1

- Test setup

```
import { ComponentFixture, TestBed } from '@angular/core/testing';
import { CounterComponent } from './counter.component';

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

  beforeEach(async () => {
    await TestBed.configureTestingModule({
      imports: [CounterComponent],
    }).compileComponents();

    fixture = TestBed.createComponent(CounterComponent);

    fixture.detectChanges(); // ⟵ The template state needs to be initialized manually
  });
});
```

Unit testing - Example 1

- (1/2) Actual Tests

```ts
import { By } from '@angular/platform-browser';

it('should display 0', () => {
  // Getting element using `debugElement`
  const button = fixture.debugElement.query(By.css('button')).nativeElement;

  expect((button as HTMLButtonElement).textContent).toContain(0);
});

it('should increment the count when clicking', () => {
  // Getting element using `nativeElement`
  const button = (fixture.nativeElement as HTMLElement).querySelector('button');

  button?.click(); // ⟵ The class state get automatically updated
  expect(fixture.componentInstance.count()).toBe(1); // ⟵ Class testing

  fixture.detectChanges(); // ⟵ The template state update needs to be triggered manually
  expect(button?.textContent).toContain(1); // ⟵ DOM testing
});
```

Unit testing - Example 1

- (2/2) Actual Tests

```
it('should call count "update" method when clicking', () => {
  const countUpdateSpy =
    spyOn(fixture.componentInstance.count, 'update').and.callThrough();

  const button = (fixture.nativeElement as HTMLElement).querySelector('button');
  button?.click();

  expect(countUpdateSpy).toHaveBeenCalledWith(1);
});
```

Unit testing - Example 2

- Let's test a more complex component with dependencies
- We're going to explore *two different approaches* to test this use case

```
import { Component } from '@angular/core';

@Component({
  selector: 'app-number-parity',
  template: `
    <app-counter [(count)]="count" />

    <span>{{ count % 2 ? 'is odd' : 'is even' }}</span>
  `,
})
export class NumberParityComponent {
  count = 0;
}
```

Unit testing - Example 2 | First approach

- (1/2) Test setup *with implicit dependency import*

```
import { ComponentFixture, TestBed } from '@angular/core/testing';
import { By } from '@angular/platform-browser';
import { NumberParityComponent } from './number-parity.component';

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

  beforeEach(async () => {
    await TestBed.configureTestingModule({
      imports: [NumberParityComponent] // <-- `CounterComponent` also imported
    }).compileComponents();

    fixture = TestBed.createComponent(NumberParityComponent);
    component = fixture.componentInstance;
    fixture.detectChanges();
  });
});
```

Unit testing - Example 2 | First approach

- (2/2) Actual Tests *accessing the dependency* (the child component instance)

```
it('should bind parent "count" to child component', () => {
  const counterComponent: CounterComponent =
    fixture.debugElement.query(By.directive(CounterComponent)).componentInstance;

  // Accessing the child component properties
  expect(counterComponent.count).toBe(component.count);
});

it('should be "odd" when child component emits', () => {
  const counterComponent: CounterComponent =
    fixture.debugElement.query(By.directive(CounterComponent)).componentInstance;

  // Accessing the child component methods
  counterComponent.count.set(1);
  fixture.detectChanges();

  const span = (fixture.nativeElement as HTMLElement).querySelector('span');
  expect(span?.textContent).toContain('odd');
});
```

Unit testing - Example 2 | Second approach

- (1/2) Test setup *allowing unknown HTML elements*

```
import { CUSTOM_ELEMENTS_SCHEMA } from '@angular/core';
import { CounterComponent } from '../counter/counter.component';
// The rest of the imports ...

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

  beforeEach(async () => {
    await TestBed
      .configureTestingModule({ imports: [NumberParityComponent] })
      .overrideComponent(NumberParityComponent, {
        remove: { imports: [CounterComponent] },
        add: { schemas: [CUSTOM_ELEMENTS_SCHEMA] },
      })
      .compileComponents();

    // The rest of the setup ...
  });
});
```

Unit testing - Example 2 | Second approach

- (2/2) Actual Tests using

  → **`debugElement.properties`** and **`debugElement.triggerEventHandler`**

```
it('should bind parent "count" to child component', () => {
  const debugElement = fixture.debugElement.query(By.css('app-counter'));

  // Accessing bindings on the child element
  expect(debugElement.properties['count']).toBe(component.count);
});

it('should be "odd" when child component emits', () => {
  const debugElement = fixture.debugElement.query(By.css('app-counter'));

  // Triggering events on the child element
  debugElement.triggerEventHandler('countChange', 1);
  fixture.detectChanges();

  const span = (fixture.nativeElement as HTMLElement).querySelector('span');
  expect(span?.textContent).toContain('odd');
});
```

Unit testing - Questions

Unit testing - Lab 4

Control flow

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- **Control flow**
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Control flow

- Angular templates support control flow blocks that let you **conditionally show, hide, and repeat elements**
- The most common control flows are
  - → `@if`
  - → `@for`
  - → `@switch`

😉 *Another control flow is* ***`@defer`*** *block, but its study goes beyond the scope of this course*

Control flow - @if 1/2

- Conditionally display content with **`@if {}`**, **`@else if {}`** and **`@else {}`**

```
@if (todos === undefined) {

  <p>Please wait, your todo list is being loaded...</p>

} @else if (todos.length === 0) {

  <p>Your todo list is empty.</p>

} @else {

  <p>You have {{ todos.length }} todos in your list.</p>
}
```

*In this example, we assume that the property **`todos: Todo[]`** is defined on the component class*

Control flow - @if 2/2

- The `@if` conditional supports saving the result of the conditional expression into a variable for reuse inside of the block

```
@if (todos === undefined) {

  <p>Please wait, your todo list is being loaded...</p>

} @else if (todos.length; as todosLength) {

  <p>You have {{ todosLength }} todos in your list.</p>
}
```

Control flow - @for 1/3

- Repeat content with the **`@for`** block

```
<ul>
  @for (todo of todos; track todo.id) {

    <li>{{ todo.title }}</li>

  }
</ul>
```

- The **`track`** expression allows Angular to maintain a relationship between your data and the DOM nodes on the page
- This allows Angular to optimize performance by executing the minimum necessary DOM operations when the data changes

Control flow - @for 2/3

- Inside **`@for`** blocks, several implicit variables are always available

```
<ul>
  @for (todo of todos; track todo.id; let index = $index, count = $count) {

    <li>{{ index + 1 }}/{{ count }} {{ todo.title }}</li>

  }
</ul>
```

- Here's the list of the implicit variables which are self-explanatory

  → **`$count`**, **`$index`**, **`$first`**, **`$last`**, **`$even`**, **`$odd`**

Control flow - @for 3/3

- Providing a fallback for **`@for`** blocks with the **`@empty`** block

```
<ul>
  @for (todo of todos; track todo.id; let index = $index, count = $count) {

    <li>{{ index + 1 }}/{{ count }} {{ todo.title }}</li>

  } @empty {

    <li>Your todo list is empty.</li>
  }
</ul>
```

Control flow - @switch

- Conditionally display content with the **`@switch`** block

```
@switch (todos.length) {
  @case (0) {
    <p>Your todo list is empty.</p>
  }

  @case (1) {
    <p>You have one todo in your list.</p>
  }

  @default {
    <p>You have {{ todos.length }} todos in your list.</p>
  }
}
```

Control flow - Questions

Control flow - Lab 5

Directives

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- **Directives**
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Directives

- Live in the **component template**
- Needs a **host element** to be attached to
- Adds **additional behavior** to host elements in your template
- Defined in a single place, it can be used in several components
- Angular offers several **built-in directives** to manage forms, lists, styles, and what users see

Directives

There are 3 types of directives:

- **Attribute directive**: change the appearance or behavior of DOM elements
- **Structural directive**: change the DOM layout by adding and removing DOM elements
- **Component**: yes! components are in fact directives that embed their own template

Note:

- Components have already been covered
- Structural directives are complex and beyond the scope of this course

✅ Therefore, we'll only cover **attribute directives**

Built-in attr. directives - NgStyle

- The **`ngStyle`** directive adds CSS styles
- Takes an object with CSS properties as keys

```
import { Component } from '@angular/core';
import { NgStyle } from '@angular/common';

@Component ({
  selector: 'app-font-size-selector',
  imports: [NgStyle],
  template: `
    <h1 [ngStyle]="{ 'font-size': currentSize + 'px' }">Example<h1>
    Change size: <input type="number" [value]="currentSize" (input)="changeSize($event)">
  `
})
export class FontSizeSelectorComponent {
  currentSize = 20;
  changeSize(event: Event) {
    this.currentSize = Number((event.target as HTMLInputElement).value);
  }
}
```

Built-in attr. directives - NgClass 1/2

- The `ngClass` directive adds CSS classes conditionally
- Can be used in addition to the standard class attribute
- Three syntaxes coexist:
  - → `[ngClass]=" 'class1 class2' "`
  - → `[ngClass]=" ['class1', 'class2'] "`
  - → `[ngClass]=" { 'class1': hasClass1, 'class2': hasClass2 } "`
- The last syntax is the most commonly used

Built-in attr. directives - NgClass 2/2

- Example of using the **`ngClass`** directive

```
import { Component } from '@angular/core';
import { NgClass } from '@angular/common';

@Component ({
  selector: 'app-toggle-highlight',
  imports: [NgClass],
  template: `
    <div [ngClass]="{ 'highlight': isHighlighted }">
      {{ isHighlighted ? 'On' : 'Off' }}
    </div>

    <button (click)="isHighlighted = !isHighlighted">Toggle</button>
  `,
  styles: [`
    .highlight { background-color: yellow }
  `]
})
export class ToggleHighlightComponent {
  isHighlighted = false;
}
```

Attribute directive - Custom

- To create a custom directive, add the **`@Directive`** decorator on a class
- **`ElementRef`** gives you access to the host element
- **`Renderer2`** let you change the appearance or behavior of the host element

```
import { Directive, ElementRef, Renderer2, inject } from '@angular/core';

@Directive({ selector: '[appHighlight]' })
export class HighlightDirective {
  constructor() {
    const elementRef = inject(ElementRef);
    const renderer = inject(Renderer2);

    renderer.listen(elementRef.nativeElement, 'mouseenter', () => {
      renderer.setStyle(elementRef.nativeElement, 'backgroundColor', 'yellow');
    });
    renderer.listen(elementRef.nativeElement, 'mouseleave', () => {
      renderer.setStyle(elementRef.nativeElement, 'backgroundColor', null);
    });
  }
}
```

Attribute directive - Usage

- Import the directive **`class`** in your component
- Use the directive **`selector`** to attach it to DOM elements in the component template

```
import { Component } from '@angular/core';
import { HighlightDirective } from './highlight.directive.ts';

@Component({
  selector: 'app-root',
  imports: [HighlightDirective],
  template: `<p appHighlight> Highlight me! </p>`,
})
export class AppComponent {}
```

- At runtime, if we open the Chrome inspector, we can verify that the style has been correctly applied to the paragraph

```
<p style="background-color: yellow"> Highlight me! </p>
```

Attribute directive - Host element

- When possible, instead of the **`Renderer2`**, use the **`host`** metadata to configure *host binding* and *host listener*

```
import { Directive } from '@angular/core';

@Directive ({
  selector: '[appHighlight]',
  host: {
    '[style.backgroundColor]': 'currentColor',
    '(mouseenter)': 'onMouseEnter()',
    '(mouseleave)': 'onMouseLeave()',
  }
})
export class HighlightDirective {
  currentColor?: string;

  onMouseEnter() { this.currentColor = 'yellow'; }

  onMouseLeave() { this.currentColor = undefined; }
}
```

- Note that **`host`** property also applies to component metadata

Attribute directive - Input and Output 1/2

- Use **`input`** and **`output`** functions to make the directive configurable

```
import { Directive, input, output } from '@angular/core';

@Directive ({
  selector: '[appHighlight]',
  host: { /* ...same bindings as previous slide... */ }
})
export class HighlightDirective {
  currentColor?: string;
  highlightColor = input('yellow', { alias: 'appHighlight' });
  highlighted = output<boolean>();

  onMouseEnter() {
    this.currentColor = this.highlightColor();
    this.highlighted.emit(true);
  }
  onMouseLeave() {
    this.currentColor = undefined;
    this.highlighted.emit(false);
  }
}
```

Attribute directive - Input and Output 2/2

- Use regular property binding and event binding on the host element

```
import { Component } from '@angular/core';

@Component({
  selector: 'app-root',
  template: `
    <p
      [appHighlight]="highlightColor"
      (highlighted)="highlightedHandler($event)"
    >
      Highlight me!
    </p>
  `,
})
export class AppComponent {
  highlightColor = 'green';

  highlightedHandler(highlighted: boolean) {
    console.log('Is highlighted?', highlighted);
  }
}
```

Directives - Testing

- Create a wrapper component for DOM testing purposes

```
import { Component } from '@angular/core';
import { ComponentFixture, TestBed } from '@angular/core/testing';
import { HighlightDirective } from './highlight.directive';

@Component({
  selector: 'app-wrapper',
  imports: [HighlightDirective],
  template: '<div appHighlight>Highlight</div>',
})
class WrapperComponent {}

describe('HighlightDirective', () => {
  let fixture: ComponentFixture<WrapperComponent>;
  let hostElement: HTMLElement;
  beforeEach(async () => {
    await TestBed.configureTestingModule({ imports: [WrapperComponent] }).compileComponents();
    fixture = TestBed.createComponent(WrapperComponent);
    hostElement = fixture.nativeElement.querySelector('[appHighlight]') as HTMLElement;
  });
});
```

Directives - Questions

Directives - Lab 6

Signals

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- **Signals**
- Services
- Pipes
- Http
- Routing
- Forms
- Appendix

Signals - Definition

- A signal is a **wrapper around a value** that **notifies interested consumers** when that value changes
- Signals **can contain any value**, from primitives to complex data structures
- You **read a signal**'s value by calling its **getter function**, which allows Angular to **track where the signal is used**
- Signals may be either **writable** or **read-only**

😉 *Later, we'll talk about a process called **synchronization** to understand when and why you should **use signals rather than raw values** to manage the state of your application...*

Signals - signal

- Use **`signal`** function to create a writable signal

```ts
import { signal } from '@angular/core';

const count = signal<number>(0);

console.log(count());                    // ⟵ output: 0

count.set(1);

console.log(count());                    // ⟵ output: 1

count.update((c) ⇒ c + 1);

console.log(count());                    // ⟵ output: 2
```

Signals - computed

- Use **`computed`** function to derive signal from other signals
- Re-evaluated only when the signals on which they depend change
- Computed signals are read-only

```
import { signal, computed } from '@angular/core';

const count = signal<number>(0);

const isEven = computed(() => count() % 2 === 0);

console.log(isEven());                // ⟵ output: true

count.set(1);

console.log(isEven());                // ⟵ output: false

count.update((c) => c + 1);

console.log(isEven());                // ⟵ output: true
```

Signals - effect

- Use **`effect`** function to run "side-effect", whenever one or more signal values change
- Re-evaluated only when the signals on which they depend change
- Effect signals run at least once

```
import { signal, effect } from '@angular/core';

const count = signal<number>(0);

effect(() => {
  console.log('The current count is: ', count()); // ⟵ Will output: 0, 1, 2
});

count.set(1);

count.update((c) => c + 1);
```

Signals - Synchronization process 1/3

- The goal of synchronization is to keep the **UI** in sync with the **state** of the application
- This is a very complex process, formerly called **Change detection** and still based today on a third-party library called **Zone.js**
- In other words, for now, Zone.js is responsible for telling Angular when to trigger its change detection process and update the UI to reflect the state of the application
- Understanding Zone.js goes beyond the scope of this course
- However, Angular is moving towards **Zoneless** applications
- In this new era, **signals** will play a crucial role in enabling Angular to know exactly when and which parts of the UI needs to be synchronized

As a rule of thumb

- if the part of the **state to be rendered in your templates** only **changes through signals**
- then your app should be **ready to go Zoneless**

Signals - Synchronization process 2/3

- Enabling Zoneless in your application is still an experimental feature

```
import {
  ApplicationConfig,
  // provideZoneChangeDetection,
  provideExperimentalZonelessChangeDetection,
} from '@angular/core';

export const appConfig: ApplicationConfig = {
  providers: [
    // provideZoneChangeDetection({ eventCoalescing: true }),   // ⟵ Default

    provideExperimentalZonelessChangeDetection(),               // ⟵ Zoneless
  ],
};
```

- You also need to remove **`"zone.js"`** and **`"zone.js/testing"`** in your angular.json configuration file
- Then you can safely uninstall Zone.js by running the command **`npm uninstall zone.js`**

Signals - Synchronization process 3/3

😉 *A deeper understanding of the synchronization process goes beyond the scope of this course*

- In-depth resources: https://angular.dev/guide/experimental/zoneless

Signals - Usage in components

- When a signal changes, Angular will automatically re-render the templates that depend on it
- This process is highly efficient, whether the signal is modified in the component itself or in another part of the application

```
import { Component, signal } from '@angular/core';

@Component ({
  selector: 'app-counter-delay',
  template: `<button (click)="increment()">{{ count() }}</button>`
})
export class CounterDelayComponent {
  count = signal(0);

  increment() {
    // Angular will correctly synchronize the UI with the updated signal value,
    // even if the signal mutation occurs asynchronously!
    setTimeout(() => this.count.update((count) => count + 1), 1000);
  }
}
```

Signals - Component input and model

Note that the **`input`** and **`model`** functions, mentioned in the chapter on components, are in fact signals. This design makes communication between components highly reactive.

```
import { Component, model, signal } from '@angular/core';

@Component ({
  selector: 'app-counter',
  template: `<button (click)="increment()">{{ count() }}</button>`
})
export class CounterComponent {
  count = model(0);
  increment() { this.count.update((count) => count + 1); }
}

@Component ({
  selector: 'app-root',
  imports: [CounterComponent],
  template: `<app-counter [(count)]="appCount" /> <p>{{ appCount() }}</p>`
})
export class AppComponent {
  appCount = signal(0);
}
```

Signals - Questions

Signals - Lab 7

Services

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- **Services**
- Pipes
- Http
- Routing
- Forms
- Appendix

Services - In a nutshell

- A broad category encompassing any value or feature that an application needs

```
import { ApplicationConfig, Component, inject } from '@angular/core';

export class ApiService {                              // ⟵ 1. Defining
  fetchMsg() { return { data: 'Hello World!' }; }
}

export const appConfig: ApplicationConfig = {
  providers: [ApiService],                             // ⟵ 2. Providing
};

@Component({
  selector: 'app-root',
  template: '<h1>{{ msg.data }}</h1>',
})
export class AppComponent {
  private apiService = inject(ApiService);             // ⟵ 3. Injecting
  msg = this.apiService.fetchMsg();                    // ⟵ 4. Consuming
}
```

Services - Injectable

- If a service has dependencies, use the **`@Injectable`** decorator to enable dependency injection for the service itself
- This is only required if you are using "Constructor-based dependency injection"

```
import { Injectable, ApplicationConfig } from '@angular/core';
import { HttpClient, provideHttpClient, withFetch } from '@angular/common/http';

@Injectable()
export class ApiService {
  // Service dependency requires `@Injectable` decorator
  constructor(private httpClient: HttpClient) {}

  fetchMsg() {
    return this.httpClient.get('/api/msg');
  }
}

export const appConfig: ApplicationConfig = {
  providers: [provideHttpClient(withFetch()), ApiService],
};
```

Services - Injectable | providedIn

- Use **`providedIn`** metadata to **provide a service globally** right from its definition
- This is usefull even for "Function-based dependency injection"

```
import { Injectable, ApplicationConfig } from '@angular/core';
import { HttpClient } from '@angular/common/http';

@Injectable({
  providedIn: 'root'  // ⟵ Service is automatically provided at `ApplicationConfig` level
})
export class ApiService {
  private httpClient = inject(HttpClient);

  fetchMsg() {
    return this.httpClient.get('/api/msg');
  }
}

export const appConfig: ApplicationConfig = {
  providers: [],      // ⟵ It is no longer necessary to provide it manually!
};
```

Services - Component providers

- Use **`providers`** metadata of the component decorator to **provide a service locally**
- The service lifecycle (creation and destruction) follows the component lifecycle
- A service provided in a component can also be injected into its child components

```
@Component ({
  selector: 'app-parent',
  providers: [ParentService],
  imports: [ChildComponent],
  template: '<app-child />',
})
export class ParentComponent {
  parentService = inject(ParentService);
}

@Component ({ selector: 'app-child', template: '...' })
export class ChildComponent {
  parentService = inject(ParentService); // Get the service from the `ParentComponent` injector
}
```

Services - Injectors

- Responsible for providing dependencies to components, services, ...
- An application can have more than one injector, but **within an injector every dependency is a singleton**

```
import { Component, Injectable, inject } from '@angular/core';

@Injectable({ providedIn: 'root' })
export class DataService { data?: string; }

@Component({ selector: 'app-setter', template: '...', })
export class SetterComponent {
  constructor() { inject(DataService).data = 'Hello World!'; }
}

@Component({ selector: 'app-getter', template: '<h1>{{ data }}</h1>' })
export class GetterComponent {
  private dataService = inject(DataService);

  get data() { return this.dataService.data; } // ⟵ 'Hello World!'
}
```

Services - Injectors hierarchy

- During a dependency injection
  - → the local injector tries to **find a compatible provider**
  - → if it can't find one, it forwards the request to its **parent injector**
  - → and so on up to the application's **main injector**
  - → if no provider can be found, Angular **throws an error**
- In a typical Angular application, **most services are provided globally** at the application configuration level
- However, it is sometimes useful to **delegate part of a component's logic to a dedicated service**, which is then **provided at the component level itself**

Services - Providers | ClassProvider

- So far we've provided services by adding them to the **`provider`** array

```
import { ApplicationConfig } from '@angular/core';

export const appConfig: ApplicationConfig = {
  providers: [ApiService],
};
```

- It is in fact a shorthand of the class provider, whose full syntax is

```
import { ApplicationConfig, ClassProvider } from '@angular/core';

export const appConfig: ApplicationConfig = {
  providers: [
    {
      provide: ApiService,
      useClass: ApiService
    }
  ] satisfies ClassProvider,
};
```

Services - Providers | ValueProvider

- Use **`InjectionToken`** and **`ValueProvider`** to provide primitive values (such as **`string`**, **`number`**, ...)

```
import {
  InjectionToken, ValueProvider, ApplicationConfig, Component, inject
} from '@angular/core';

const APP_TITLE = new InjectionToken<string>('app title');

const appTitleProvider: ValueProvider = { provide: APP_TITLE, useValue: 'My Awesome App' };

export const appConfig: ApplicationConfig = {
  providers: [appTitleProvider],
};

@Component({ /* ... */ })
export class AppComponent {
  appTitle = inject(APP_TITLE); // ⟵ 'My Awesome App'
}
```

*Note that there's also a **`FactoryProvider`**, but its study goes beyond the scope of this course*

Services - App Initializer

- Use an "app initializer" when you need asynchronous data to be available before the application is bootstrapped
- If needed, you can **`inject`** dependencies into the initializer

```
import { ApplicationConfig, provideAppInitializer } from '@angular/core';
import { Observable } from 'rxjs';

export const appConfig: ApplicationConfig = {
  providers: [
    provideAppInitializer((): Observable<unknown> | Promise<unknown> | void => {
      // In this example, we restore the user's status before bootstrapping the application
      return inject(UserService).fetchUser();
    })
  ],
};
```

Services - Testing in isolation

- You can configure the providers in your **`TestBed`**
- Powerful mechanism that isolates the element you really want to test
- Use **`TestBed.inject`** to access the service instance in your test

In the following example, we test a component in isolation, replacing the service with a stub:

```
import { TestBed } from '@angular/core/testing';

describe('AppComponent', () => {
  let apiService: ApiService;

  beforeEach(async () => {
    await TestBed.configureTestingModule({
      imports: [AppComponent],
      providers: [{ provide: ApiService, useClass: ApiStubService }],
    }).compileComponents();

    apiService = TestBed.inject(ApiService); // ⟵ Get the `ApiStubService`
  });
});
```

Services - Questions

Services - Lab 8

Pipes

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- **Pipes**
- Http
- Routing
- Forms
- Appendix

Pipes - Definition

- Special operator in Angular template expressions
- Transform data declaratively in your template
- Transformation function are declared once and then used across multiple templates
- Angular provides a lots of pipes for common use cases...

```
import {
  LowerCasePipe, UpperCasePipe, TitleCasePipe,
  CurrencyPipe, DecimalPipe, PercentPipe,
  DatePipe, JsonPipe, SlicePipe, KeyValuePipe,
} from '@angular/common';
```

- ... but you can also create custom pipes based on your business logic

Pipes - Usage in template

- Are applied using the "|" symbol
- Can be chained
- Additional parameters can be passed using the ":" symbol

```
import { Component } from '@angular/core';
import { DatePipe, UpperCasePipe, CurrencyPipe } from '@angular/common';

@Component({
  selector: 'app-root',
  imports: [DatePipe, UpperCasePipe, CurrencyPipe]
  template: `
    <p>{{ myDate | date }}</p>                              <!-- 29 août 2023 -->
    <p>{{ myDate | date | uppercase }}</p>                  <!-- 29 AOÛT 2023 -->
    <p>{{ myPrice | currency : 'EUR' : 'symbol' }}</p>  <!-- 123,46 €     -->
  `,
})
export class AppComponent {
  myDate = new Date();
  myPrice = 123.456789;
}
```

Pipes - Custom

- Can be generated using Angular CLI: **`ng generate pipe <pipeName>`**
- Use the **`@Pipe`** decorator on a class
- Class must implement the **`PipeTransform`** interface (i.e. the **`transform`** method)

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

@Pipe({ name: 'joinArray' })
export class JoinArrayPipe implements PipeTransform {
  transform(value: (string | number)[], separator = ' '): string {
    return value.join(separator);
  }
}
```

- Usage example:

```
<p>List: {{ ['apple', 'orange', 'banana'] | joinArray : ' / ' }}</p>

<!-- List: apple / orange / banana -->
```

Pipes - Configuration

Some Angular pipes can be configured globally

Here's an example with the `CurrencyPipe`

- Depending on the locale:
  - → should display `$3.50` for United States (this is the default behavior)
  - → should display `3,50 $` for France
- You may also need to configure the default symbol to be `€` instead of `$`:
  - → should display `€3.50` for United States
  - → should display `3,50 €` for France

Pipes - Configuration | CurrencyPipe

- Here's the configuration to display the currency in EUR for France (`3,50 €`)

```ts
// src/app/app.config.ts

import { ApplicationConfig, LOCALE_ID, DEFAULT_CURRENCY_CODE } from '@angular/core';

// Defines how to format currency, date, ... in french
import { registerLocaleData } from '@angular/common';
import localeFr from '@angular/common/locales/fr';
registerLocaleData(localeFr);

export const appConfig: ApplicationConfig = {
  providers: [
    { provide: LOCALE_ID, useValue: 'fr' },
    { provide: DEFAULT_CURRENCY_CODE, useValue: 'EUR' },
  ],
};
```

Pipes - Usage in class

- Can be instantiated directly in TypeScript code (using **`new`** operator)
- Can also be injected like any provider...
  - → ...but must be provided in the **`providers`** array (Component or ApplicationConfig)
  - → the injected pipe will respect the global configuration, if any

```
import { Component, inject } from '@angular/core';
import { CurrencyPipe, UpperCasePipe } from '@angular/common';

@Component ({ selector: 'app-root', providers: [CurrencyPipe] })
class AppComponent {
  constructor() {
    console.log(new UpperCasePipe().transform('Hello World!'));    // ⟵ HELLO WORLD!

    console.log(inject(CurrencyPipe).transform(123.456789));       // ⟵ 123,46 €
  }
}
```

Pipes - Pure

- Transformation function can be marked as "pure" if it has the following properties:
  - → the function return values are identical for identical arguments
  - → the function has no side effects
- When Angular re-evaluate a template, it will only re-evaluate the pipe if its input value **reference** has changed
- Pipes are pure by default

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

@Pipe({ name: 'fancy' /*, pure: true */ })
export class FancyPipe implements PipeTransform {
  transform(value: string): string {
    return `Fancy ${value}`;
  }
}
```

Pipes - Impure 1/2

- Angular always re-evaluate "impure" pipe, even if its input value **reference** has not changed
  - → Should be used for input value such as **`Array`** or **`Object`** that may be mutated over time

Example: because Angular's **`JsonPipe`** is defined as **`impure`**, after clicking on the button, the mutated object will be properly displayed in the UI.

```
import { Component } from '@angular/core';
import { JsonPipe } from '@angular/common';

@Component({
  selector: 'app-root',
  imports: [JsonPipe],
  template:
    `<pre>{{ data | json }}</pre>

    <button (click)=" data.msg = 'Bye' ">Mutate</button>`,
})
export class AppComponent {
  data = { msg: 'Hello' };
}
```

Pipes - Impure 2/2

- Let's look again at the custom pipe used as an example earlier

  → It should be defined as **`impure`** because its input is an **`Array`** that may be mutated

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

@Pipe({ name: 'joinArray', pure: false }) // ⟵ Should be impure!
export class JoinArrayPipe implements PipeTransform {
  transform(value: (string | number)[], separator = ' '): string {
    return value.join(separator);
  }
}

@Component({
  selector: 'app-root',
  template: `{{ appList | joinArray }}
    <button (click)=" appList.push('kiwi') ">Mutate</button>`, // ⟵ Mutation
})
export class AppComponent {
  appList = ['apple', 'orange', 'banana'];
}
```

Pipes - Testing

- A Pipe is nothing but a function!
- Instantiate the pipe in a **`beforeEach`** hook
- Call the **`transform`** method to test all possible cases

```
import { JoinArrayPipe } from './pipes/join-array.pipe';

describe('JoinArrayPipe', () => {
  let pipe;

  beforeEach(() => {
    pipe = new JoinArrayPipe();
  });

  it('should works', () => {
    const output = pipe.transform(['apple', 'orange', 'banana'], ', ');

    expect(output).toEqual('apple, orange, banana');
  });
});
```

Pipes - Questions

Pipes - Lab 9

PHP
CSS
HTML
<HTML>
<HEAD>
<TITLE> Lorem ipsum </TITLE>
</HEAD>
<BODY>
<H1> Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam</H1>
<P> <IMG SRC= "Lorem ipsum"></P>

Http

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- **Http**
- Routing
- Forms
- Appendix

Http - Getting started 1/5

- Let's use the **`jsonplaceholder`** API to display todo items

```
const TODOS_URL = 'https://jsonplaceholder.typicode.com/todos';
```

- Here's the **`Todo`** item interface...

```
interface Todo {
  id: number;
  title: string;
  completed: boolean;
}
```

- ...and the first two items of the API response

```
[
  { "id": 1, "title": "delectus aut autem", "completed": false },
  { "id": 2, "title": "quis ut nam facilis et officia qui", "completed": false },
  ...
]
```

Http - Getting started 2/5

- To enable Http capabilities to an app, add **`provideHttpClient()`** to the app configuration
- Optionally, add **`withFetch()`** option to use the browser's native **`fetch`** API

```
import { ApplicationConfig } from '@angular/core';
import { provideHttpClient, withFetch } from '@angular/common/http';

export const appConfig: ApplicationConfig = {
  providers: [
    provideHttpClient(withFetch()),                // ⟵ 1. Add provider
  ],
};
```

Http - Getting started 3/5

- Then use the **`HttpClient`** service in the component that needs to display the data

```
import { Component, inject } from '@angular/core';
import { JsonPipe } from '@angular/common';
import { HttpClient } from '@angular/common/http';

@Component({
  selector: 'app-todos',
  template: `<pre>{{ todos | json }}</pre>`
  imports: [JsonPipe],
})
export class TodosComponent {
  private httpClient = inject(HttpClient);          // ⟵ 2. Inject service

  protected todos?: Todo[];

  constructor() {
    this.httpClient
      .get<Todo[]>(TODOS_URL)                       // ⟵ 3. Define shape of GET request
      .subscribe((todos) ⇒ (this.todos = todos));   // ⟵ 4. Execute request and store response
  }
}
```

Http - Getting started 4/5

- While **`HttpClient`** can be injected and used directly from **components**
- It is recommended to create reusable, injectable **services** which encapsulate data access logic

```
import { Injectable, inject } from '@angular/core';
import { HttpClient } from '@angular/common/http';

@Injectable({
  providedIn: 'root'
})
export class TodosService {
  private httpClient = inject(HttpClient);

  fetch() {
    return this.httpClient.get<Todo[]>(TODOS_URL);
  }
}
```

- **Data source providers** (typically Services) should only **expose the shape of requests** and let **data source consumers** (typically Components) **subscribe** to them

Http - Getting started 5/5

- Therefore, in most cases, **do NOT subscribe in services** but in components only, allowing the consumer to react to every status of the request (**loading**, **error** and **fetched**) in the UI

```
import { Component, inject, signal } from '@angular/core';
import { JsonPipe } from '@angular/common';
import { TodosService } from './todos.service.ts';

@Component({
  selector: 'app-todo',
  template: `<pre>{{ todos() | json }}</pre>`,
  imports: [JsonPipe],
})
export class TodoComponent {
  private todosService = inject(TodosService);

  protected todos = signal<Todo[] | undefined>(undefined);

  constructor() {
    this.todosService.fetch().subscribe((todos) => this.todos.set(todos));
  }
}
```

Http - State management 1/2

- To share data between components, we need to store fetched data in a service facade
- ❌ However, the following implementation breaks the best pratice we just mentionned!

```
import { Injectable, inject, signal } from '@angular/core';
import { HttpClient } from '@angular/common/http';

@Injectable({
  providedIn: 'root'
})
export class TodosService {
  private httpClient = inject(HttpClient);

  todos = signal<Todo[] | undefined>(undefined);

  fetch(): void {
    this.httpClient
      .get<Todo[]>(TODOS_URL)
      .subscribe((todos) => this.todos.set(todos)); // ⟵ ❌ Do NOT subscribe in services!
  }
}
```

Http - State management 2/2

- ✅ We can still access fetched data before subscribing, using the **`.pipe(tap( ... ))`** pattern

```
import { Injectable, inject } from '@angular/core';
import { HttpClient } from '@angular/common/http';
import { Observable, tap } from 'rxjs';

@Injectable({
  providedIn: 'root'
})
export class TodosService {
  private httpClient = inject(HttpClient);

  private todos = signal<Todo[] | undefined>(undefined);

  fetch(): Observable<Todo[]> {
    return this.httpClient
      .get<Todo[]>(TODOS_URL)
      .pipe(tap((todos) => this.todos.set(todos))); // ⟵ ✅ Tapping into the data stream
  }
}
```

*But to understand this solution, we need to understand how the **`HttpClient`** methods work*

Http - Methods

- There are many **`HttpClient`** methods and they are highly configurable

```
class HttpClient {
  // --- Generic method (for advanced use cases) ---
  request<R>(method: string, url: string, options?: HttpOptions): Observable<R>;

  // --- Shorthand methods (enough in most cases) ---
  get<R>(url: string, options?: HttpOptions): Observable<R>;
  post<R>(url: string, body: any, options?: HttpOptions): Observable<R>;

  // .put(), .patch(), .delete(), ...
}

interface HttpOptions {
  headers?: HttpHeaders;
  params?: HttpParams;
  responseType?: 'json';
  // ...
}
```

- Each of these methods returns an **`Observable`**, but what are observables anyway?

Http - Observables

*The **`HttpClient`** service is built on top of **RxJS Observables**, but its study goes beyond the scope of this course*

- In a nutshell, an **Observable**
  - → represent a **stream of data** that can be subscribed to
  - → allowing **multiple values** to be emitted over time
- In the specific case of an **Http request**, the observable emits
  - → a **single value** if the request succeeds
  - → an **error** if the request fails (**`HttpErrorResponse`**)

Http - Error handling

- When subscribing
  - → use a **callback function** to handle Http **response** only
  - → use an **object** to handle Http **response** and **error**

```
// ——— Using a callback function ———

this.httpClient.get(TODOS_URL).subscribe(
  (response: Todo[]) => { /* Response handler ... */ }
);

// ——— Using an object ———

this.httpClient.get(TODOS_URL).subscribe(
  {
    next: (response: Todo[]) => { /* Response handler ... */ },
    error: (error: HttpErrorResponse) => { /* Error handler ... */ }
  }
);
```

Http - HttpClient | Pipe 1/3

- Remember that a request consists of at least two parts
  - → defining its shape, using: **`.get()`**, **`.post()`**, ...
  - → triggering its execution, using: **`.subscribe()`**
- But you can also transform the incoming response before calling the subscribe method
  - → using the **`.pipe()`** method to apply chainable operators

```
this.httpClient
  .get()                              // ⟵ 1. Definition
  .pipe(/* List of operators */)      // ⟵ 2. Transformation
  .subscribe();                       // ⟵ 3. Execution
```

- Both **`.pipe()`** and **`.subscribe()`** methods are parts of the Observable API

Http - HttpClient | Pipe 2/3

- Use the `map( ... )` operator to adapt the API response to your needs

```
import { map } from 'rxjs';

const TODO_1_URL = 'https://jsonplaceholder.typicode.com/todos/1';

this.httpClient
  .get<Todo>(TODO_1_URL)    // ⟵ { id: 1, title: "delectus aut autem", completed: false }

  .pipe(
    map((todo) ⇒ ({ title: todo.title })),           // ⟵ { title: "delectus aut autem" }
    map((todo: Pick<Todo, 'title'>) ⇒ todo.title)),  // ⟵ "delectus aut autem"
  )

  .subscribe((title: string) ⇒ {
    console.log(title);                              // ⟵ "delectus aut autem"
  });
```

Http - HttpClient | Pipe 3/3

- Use the **`tap( ... )`** operator to tap into the stream, handling side-effect without affecting the stream

```
import { tap } from 'rxjs';

const TODO_1_URL = 'https://jsonplaceholder.typicode.com/todos/1';

this.httpClient
  .get<Todo>(TODO_1_URL)          // ⟵ { id: 1, title: "delectus aut autem", completed: false }

  .pipe(
    tap((todo) ⇒ {
      this.todo = todo;           // ⟵ Side-effect
      return 'whatever';          // ⟵ Return value does NOT affect the stream
    }),
  )

  .subscribe((todo: Todo) ⇒ {
    console.log(todo);            // ⟵ { id: 1, title: "delectus aut autem", completed: false }
  });
```

Http - State management 1/3

- Let's revisit the solution shown above that uses the **`.pipe(tap( ... ))`** pattern

```
import { Injectable, inject } from '@angular/core';
import { HttpClient } from '@angular/common/http';
import { Observable, tap } from 'rxjs';

@Injectable({
  providedIn: 'root'
})
export class TodosService {                                    // ⟵ Data source provider
  private httpClient = inject(HttpClient);

  private _todos = signal<Todo[] | undefined>(undefined);      // ⟵ Encapsulate data
  todos = this._todos.asReadonly();                            // ⟵ Expose data

  fetch(): Observable<Todo[]> {
    return this.httpClient
      .get<Todo[]>(TODOS_URL)
      .pipe(tap((todos) ⇒ this._todos.set(todos)));            // ⟵ Handle side-effect
  }
}
```

Http - State management 2/3

- We subscribe in the component, which consumes centralised data and handles potential errors

```
import { Component, inject, signal } from '@angular/core';
import { JsonPipe } from '@angular/common';
import { TodosService } from './todos.service.ts';

@Component({
  selector: 'app-todos',
  templateUrl: 'todos.component.html',
  imports: [JsonPipe],
})
export class TodosComponent {                                  // ⟵ Data source consumer
  private todosService = inject(TodosService);

  todos = this.todosService.todos; // Data can be consumed here and in other components too ...
  hasError = signal(false);

  constructor() {
    // ... while fetching data can be done in one strategic place
    this.todosService.fetch().subscribe({ error: () ⇒ this.hasError.set(true) });
  }
}
```

Http - State management 3/3

- As already mentionned, we subscribe in the component (data source consumer) and not in the service (data source provider)
- Allowing the component to react to every status of the request (**loading**, **error** and **fetched**) in its template

```
<!-- todos.component.html -->

@if (todos() === undefined) {

  <p>Loading ...</p>

} @else if (hasError()) {

  <p>An error occured ...</p>

} @else {

  <pre>{{ todos() | json }}</pre>
}
```

Http - Testing 1/2

- Angular provides **`provideHttpClientTesting`** and **`HttpTestingController`** for mocking Http requests

```
import { provideHttpClient, withFetch } from '@angular/common/http';
import { provideHttpClientTesting, HttpTestingController } from '@angular/common/http/testing';
import { TestBed } from '@angular/core/testing';

describe('TodosService', () => {
  let service: TodosService;
  let httpTestingController: HttpTestingController;

  beforeEach(() => {
    TestBed.configureTestingModule({
      providers: [provideHttpClient(withFetch()), provideHttpClientTesting()],
    });

    service = TestBed.inject(TodosService);
    httpTestingController = TestBed.inject(HttpTestingController);
  });
});
```

Http - Testing 2/2

- The Controller can be injected into tests and used for mocking and flushing requests

```
describe('TodosService', () => {
  // ...

  it('should fetch and store todos', () => {
    const responseMock: Todo[] = [{ id: 1 } as Todo, { id: 2 } as Todo];

    service.fetch().subscribe((todos) => {
      expect(todos).toEqual(responseMock);
      expect(service.todos()).toEqual(responseMock);
    });

    const req = httpTestingController.expectOne('https://jsonplaceholder.typicode.com/todos');
    expect(req.request.method).toEqual('GET');
    req.flush(responseMock);

    httpTestingController.verify(); // assert that there are no outstanding requests
  });
});
```

Http - Questions

Http - Lab 10

PHP
CSS
HTML
<HTML>
<HEAD>
<TITLE> Lorem ipsum </TITLE>
</HEAD>
<BODY>
<H1> Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam</H1>
<P> <IMG SRC= "Lorem ipsum"></P>

Routing

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- **Routing**
- Forms
- Appendix

Routing

In a single-page app, you change what the user sees by showing or hiding portions of the display that correspond to particular components, rather than going out to the server to get a new page

- The Angular router allows to
  - → display different **views**
  - → at a defined **insertion point**
  - → depending on the **browser's URL**
- By default, the router is already provided in the **`app.config.ts`** file

```
import { ApplicationConfig } from '@angular/core';
import { provideRouter } from '@angular/router';
import { routes } from './app.routes';

export const appConfig: ApplicationConfig = {
  providers: [provideRouter(routes)],
};
```

Routing - Routes

- Define the routes of you app by associating different **components** to different **paths** in **`app.routes.ts`** file
- Define path **parameters** using the syntax **`:paramName`**
- Catch unknown paths using **wildcard** route **`**`**

  → and then redirect to a known path or display a dedicated "Not found" page

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  { path: '', component: HomeComponent, pathMatch: 'full' },

  { path: 'contacts', component: ContactListComponent },

  { path: 'contacts/:id', component: ContactComponent },

  { path: '**', redirectTo: '/' },                          // ⟵ Option 1. Redirect to home page
  // { path: '**', component: PageNotFoundComponent }, // ⟵ Option 2. Display "Not found" page
];
```

Routing - RouterOutlet

- Define the insertion point using the **<router-outlet />** directive

```
import { Component } from '@angular/core';
import { RouterOutlet } from '@angular/router';

@Component ({
  selector: 'app-root',
  imports: [RouterOutlet],
  template: `
    <header>My Awesome App</header>

    <router-outlet />

    <footer>Copyright Zenika</footer>
  `
})
export class AppComponent {}
```

Routing - RouterLink 1/3

- Navigate between views using the **`routerLink`** directive

```
@Component ({
  selector: 'app-nav',
  template: `
    <a routerLink="/"> Home </a>

    <a routerLink="/contacts"> Contact list </a>

    <a routerLink="/contacts/1"> Contact 1 </a>

    <a [routerLink]="['/contacts', id]"> Contact {{ id }} </a>
  `
})
export class NavComponent {
  id = 2;
}
```

Routing - RouterLink 2/3

- Use **`routerLinkActive`** input to specify one or more CSS classes to be added when the linked route is active

```
@Component ({
  selector: 'app-nav',
  template: `
    <a routerLink="/" routerLinkActive="link-active"> Home </a>

    <a routerLink="/contacts" routerLinkActive="link-active"> Contact list </a>

    <a routerLink="/contacts/1" routerLinkActive="link-active"> Contact 1 </a>
  `,
  styles: `.link-active { color: blue }`,
})
export class NavComponent {}
```

Routing - RouterLink 3/3

- Use **`routerLinkActiveOptions`** input to add the classes only when the URL matches the link exactly

```
@Component ({
  selector: 'app-nav',
  template: `
    <a
      routerLink="/"
      [routerLinkActive]="['link-active']"
      [routerLinkActiveOptions]="{ exact: true }"
    >
      Home
    </a>
  `,
  styles: `.link-active { color: blue }`,
})
export class NavComponent {}
```

Routing - Router service

- Use the **`Router`** service to navigate programmatically on the component class side

```ts
import { Component, inject } from '@angular/core';
import { Router } from '@angular/router';

@Component ({
  selector: 'app-root',
  template: '<button (click)="navigate()">Go to contact list</button>'
})
export class AppComponent {
  private router = inject(Router);

  protected navigate() {
    this.router.navigate(['/contacts']); // Same as <a [routerLink]="['/contacts']">Contacts</a>
  }
}
```

😉 *Whenever possible, prefer using the **`routerLink`** directive on the component template side*

Routing - ActivatedRoute

- Use the **`ActivatedRoute`** service to observe route parameters

```ts
import { Component, inject } from '@angular/core';
import { ActivatedRoute, Params } from '@angular/router';
import { takeUntilDestroyed } from '@angular/core/rxjs-interop';

@Component ({
  template: 'Contact ID: {{ id }} (dynamic).'
})
export class ContactComponent {
  private activatedRoute = inject(ActivatedRoute);

  id!: number;

  constructor() {
    this.activatedRoute.params.pipe(takeUntilDestroyed()).subscribe((params: Params) => {
      this.id = Number(params['id']); // note: route parameters are always of type `string`
    });
  }
}
```

😉 *Note that **`params`** is an RxJS Observable*

Routing - ActivatedRoute | Snapshot

- Use the **`ActivatedRoute`** snapshot to retrieve route parameters once

```
import { Component, inject } from '@angular/core';
import { ActivatedRoute } from '@angular/router';

@Component ({
  template: 'Contact ID: {{ id }} (static).'
})
export class ContactComponent {
  private activatedRoute = inject(ActivatedRoute);

  id = Number(this.activatedRoute.snapshot.params['id']);
}
```

Routing - With component input binding 1/2

*Using **`ActivatedRoute`** requires the understanding of observables*

- Use **`withComponentInputBinding()`** in the router configuration to enable binding information from the router state directly to the component's inputs

```
import { ApplicationConfig } from '@angular/core';
import { provideRouter, withComponentInputBinding } from '@angular/router';
import { routes } from './app.routes';

export const appConfig: ApplicationConfig = {
  providers: [
    provideRouter(routes, withComponentInputBinding()),
  ],
};
```

Routing - With component input binding 2/2

- Define a **route parameter** named **`id`**

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  { path: 'contacts/:id', component: ContactComponent }
];
```

- In the routed view, define a **component input** with the same name

```
import { Component, inject, input, numberAttribute } from '@angular/core';
import { ActivatedRoute } from '@angular/router';

@Component ({
  template: 'Contact ID: {{ id }} (dynamic).'
})
export class ContactComponent {
  private activatedRoute = inject(ActivatedRoute);

  id = input.required<number>({ transform: numberAttribute });
}
```

Routing - Nested routes

- Use the **`children`** property to define nested views

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  {
    path: 'contacts/:id',
    component: ContactComponent,
    children: [
      { path: 'view', component: ViewContactComponent },
      { path: 'edit', component: EditContactComponent },
    ],
  },
];
```

*In this example, we assume that the template of the **`ContactComponent`** component contains the nested **`<router-outlet />`** directive*

Routing - Route title

- Use the **`title`** property to define a unique title for each route, so that they can be identified in the browser history

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  {
    path: '',
    component: HomeComponent,
    title: 'Home',
  },
  {
    path: 'contacts',
    component: ContactListComponent,
    title: 'Contacts',
  },
];
```

Routing - Guards

- Use route guards to **prevent users from navigating** to parts of an application **without authorization**
- Available route guards
  - → `canActivate`
  - → `canActivateChild`
  - → `canDeactivate`
  - → `canMatch`
  - → `resolve`

In this course, we wil focus on ***`canActivate`*** *and* ***`canMatch`*** *guards*

Routing - Guards | Can activate

- Define the guard by implementing the **`CanActivateFn`** interface

```
import { inject } from '@angular/core';
import { CanActivateFn, ActivatedRouteSnapshot } from '@angular/router';
import { ContactService } from './contact.service';

export const contactGuard: CanActivateFn = (snapshot: ActivatedRouteSnapshot) => {

  const id = snapshot.params['id']; // ⟵ Remember that the route path was: 'contacts/:id'

  return inject(ContactService).isAllowed(Number(id));
};
```

- Add the guard to the **`canActivate`** route configuration

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  { path: 'contacts/:id', component: ContactComponent, canActivate: [contactGuard] }
];
```

Routing - Guards | Can match

- Define the guard by implementing the **`CanMatchFn`** interface

```
import { inject } from '@angular/core';
import { CanMatchFn, Route, UrlSegment } from '@angular/router';
import { ContactService } from './contact.service';

export const contactGuard: CanMatchFn = (route: Route, segments: UrlSegment[]) => {

  const id = segments.at(1)?.path; // ⟵ Remember that the route path was: 'contacts/:id'

  return inject(ContactService).isAllowed(Number(id));
};
```

- Add the guard to the **`canMatch`** route configuration

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  { path: 'contacts/:id', component: ContactComponent, canMatch: [contactGuard] }
];
```

Routing - Guards | Difference in behaviour

- `canActivate: [...]`
  - → If all guards return `true`, navigation continues
  - → If any guard returns `false`, navigation is **cancelled**
- `canMatch: [...]`
  - → If all guards return `true`, navigation continues
  - → If any guard returns `false`, navigation is **skipped** for matching and **next route configurations are processed** instead

Routing - Guards | Redirect command

- The guard can eventually return a **`RedirectCommand`** to instruct the Router to redirect rather than continue processing the current path
- This is particularly usefull when a navigation is cancelled by a **`canActivate`** guard

```
import { inject } from '@angular/core';
import { CanActivateFn, Router, RedirectCommand } from '@angular/router';

export const contactGuard: CanActivateFn = () => {
  const authService = inject(AuthService);
  const router = inject(Router);

  if (!inject(AuthService).isLoggedIn()) {
    const loginPath = router.parseUrl('/login');
    return new RedirectCommand(loginPath, { skipLocationChange: true });
  }

  return true;
};
```

Routing - Lazy Loading 1/3

- Configure your routes to lazy load modules using **`loadComponent`**

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  {
    path: 'contacts',

    // Use lazy-loaded JavaScript module ...
    loadComponent: () => import('./contact-list/contact-list.component.ts').then(
      (module) => module.ContactListComponent
    ),

    // ... instead of eagerly-loaded component
    /* component: ContactListComponent, */
  },
];
```

Routing - Lazy Loading 2/3

- Use **`default`** export to get rid of **`.then((module) ⇒ ... )`** part

```
@Component({
  selector: 'app-contact-list',
  template: `... `,
})
export class ContactListComponent {}

export default ContactListComponent;
```

```
import { Routes } from '@angular/router';

export const routes: Routes = [
  {
    path: 'contacts',
    loadComponent: () ⇒ import('./contact-list/contact-list.component.ts'),
  },
];
```

Routing - Lazy Loading 3/3

- Lazy load routes using **`loadChildren`**

```ts
// src/app/app.routes.ts
import { Routes } from '@angular/router';

export const routes: Routes = [
  {
    path: 'contacts',
    loadChildren: () => import('./contacts/contacts.routes.ts'),
  },
];
```

```ts
// src/app/contacts/contacts.routes.ts
import { Routes } from '@angular/router';

export default [
  { path: '', component: ContactListComponent },
  { path: ':id', component: ContactComponent },
] satisfies Routes;
```

Routing - Questions

Routing - Lab 11

Forms

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- **Forms**
- Appendix

Forms - Modules 1/3

Angular provides 2 different ways to handle forms

- **Template-driven forms**
  - → the form is fully defined in the component *template*
  - → a TypeScript representation of the form is generated and managed by Angular
- **Reactive forms**
  - → the form is defined in the component *class*
  - → the form fields are then linked in the component template using property bindings
  - → you're responsible for ensuring the consistency of the form between the component and the template

Forms - Modules 2/3

Any form can be created using either of the following technique, but...

- **Template-driven forms**
  - → are recommended when form structure is not fixed over time
  - → example: fields are added/removed depending on a user's actions
- **Reactive forms**
  - → are recommended when you need to modify the form configuration programmatically over time
  - → example: changing a field validation requirement (from optional to required) depending on a user's actions

✅ The rest of this course focuses solely on Template-driven forms

Forms - Modules 3/3

- Import the **`FormsModule`** in your components
- Use the available directives such as **`ngModel`**

```
import { FormsModule } from '@angular/forms';
import { Component } from '@angular/core';

@Component({
  selector: 'app-root',
  imports: [FormsModule],
  template: `
    <input ngModel />
  `,
})
export class AppComponent {}
```

- Under the hood, the **`ngModel`** directive tracks the **value**, user **interaction**, and **validation status** of the control element (such as an **`<input />`**) to which it is attached

Forms - Getting started 1/2

- Angular reproduces the standard mechanisms of HTML forms...
- ...and supports common input types and their native validation attributes
- So, your template looks like something familiar!
- Here's a basic HTML form example with 3 fields:

  → **`name`**, **`email`** (both required) and **`message`** (optional)

```
<form>

  <input name="name" placeholder="Your name" type="text" required />

  <input name="email" placeholder="Your email" type="email" required />

  <textarea name="message" placeholder="Leave us a message (optional)"></textarea>

  <button type="submit">Submit</button>
</form>
```

Forms - Getting started 2/2

- In a component template, a **`<form>`** element defines an Angular form
  - → Angular automatically adds the **`ngForm`** directive to it
  - → so, don't add it manually!
- To register form fields such as **`<input />`**, you need to manually add the **`ngModel`** directive
  - → the **`name`** attribute is mandatory to register the field in the form

```
<form> <!— Under the hood, it looks like: `<form ngForm>` —>

  <input ngModel name="name" placeholder="Your name" type="text" required />

  <input ngModel name="email" placeholder="Your email" type="email" required />

  <textarea ngModel name="message" placeholder="Leave us a message (optional)"></textarea>

  <button type="submit">Submit</button>
</form>
```

Forms - Accessing ngForm & ngModel 1/2

- You can create template reference variables using the **#** symbol to access the underlying directives

```
<form #userForm="ngForm">

  <input #emailModel="ngModel" ngModel name="email" />

</form>
```

- Here, the template variable **`userForm`** holds the **`NgForm`** directive instance
- And the template variable **`emailModel`** holds the **`NgModel`** directive instance

These variables are very important and we will be using them throughout this chapter

😉 *But for now, let's look at where the names of the values **`xyz="ngForm"`** and **`xyz="ngModel"`** come from...*

Forms - Accessing ngForm & ngModel 2/2

When creating a custom directive, you can define the **`exportAs`** metadata and use the defined value to access the directive instance in your template

```
import { Directive, Component } from '@angular/core';

@Directive({ selector: 'appHello' exportAs: 'helloExportedName' })
export class HelloDirective {}

@Component({
  selector: 'app-root',
  imports: [HelloDirective],
  template: '<div appHello #myDirective="helloExportedName" #myDiv></div>',
})
export class AppComponent {}
```

- Here, the template variable **`myDirective`** holds the **`HelloDirective`** instance
- While the template variable **`myDiv`** simply holds the **`HTMLDivElement`** instance (default)

😉 *...so you've guessed that the **`NgModel`** directive metadata contains: **`{exportAs: 'ngModel'}`***

Forms - NgModel 1/4

Let's take a closer look at the **`NgModel`** directive

- Works even outside a **`<form>`** element (**`name`** attribute is not mandatory in this case)
- Provides access to several **properties** reflecting the **state of the form field**

  → **`untouched`**/**`touched`**, **`pristine`**/**`dirty`**, **`valid`**/**`invalid`**

```
@Component({
  selector: 'app-root',
  imports: [FormsModule],
  template: `
    <input required ngModel #model="ngModel" />

    <p>The field is {{ model.valid ? 'valid' : 'invalid' }}.</p>
  `,
})
export class AppComponent {}
```

Forms - NgModel 2/4

- Adds special **CSS classes** that reflect the state of the form field

  → **`ng-untouched`/`ng-touched`**, **`ng-pristine`/`ng-dirty`**, **`ng-valid`/`ng-invalid`**

```
@Component({
  selector: 'app-root',
  imports: [FormsModule],
  template: `
    <!-- 1. Initial state -->
    <input required ngModel class="ng-untouched ng-pristine ng-invalid" />

    <!-- 2. After the user has entered and leaved the input (without modification) -->
    <input required ngModel class="ng-touched ng-pristine ng-invalid" />

    <!-- 3. After the user has modified the input value -->
    <input required ngModel class="ng-touched ng-dirty ng-valid" />
  `,
  styles: [`.ng-valid{ color: green; }   .ng-touched.ng-invalid{ color: red; }`],
})
export class AppComponent {}
```

Forms - NgModel 3/4

- You can also define **your own CSS classes** and bind them using the **`NgModel`** properties

```
@Component({
  selector: 'app-root',
  imports: [FormsModule],
  template: `
    <input
      required

      ngModel
      #model="ngModel"

      [class.is-valid]="model.valid"
      [class.is-invalid]="model.touched && model.invalid"
    />
  `,
  styles: [`.is-valid { color: green; }   .is-invalid { color: red; }`],
})
export class AppComponent {}
```

Forms - NgModel 4/4

- Lets you achieve **two-way data binding** easily

```
@Component({
  selector: 'app-root',
  imports: [FormsModule],
  template: `
    <div>{{ data }}</div>

    <input [(ngModel)]="data" />

    <input [ngModel]="data" (ngModelChange)="data = $event" />

    <input #inputRef [value]="data" (input)="data = inputRef.value" />
  `,
})
export class AppComponent { data = ''; }
```

Forms - NgForm 1/2

Now let's take a closer look at the **`NgForm`** directive

Problem

- By default, browsers perform natively form fields validation
- But Angular needs to take full control over this process
- Native mechanism will therefore conflict with Angular mechanism

Solution

- Angular disables native validation by adding **`novalidate`** attribute automatically

  → so, don't add it manually!

```
<form></form> <!-- will become `<form novalidate></form>` in the DOM -->
```

Forms - NgForm 2/2

- Use the **`ngSubmit`** event to handle form submission
- Use the NgForm **`.value`** property to retrieve the entire form value as an object
- Use the NgForm **`.invalid`** (or **`.valid`**) property to determine the global form state

```
@Component({
  selector: 'app-root',
  imports: [FormsModule],
  template:
    `<form #userForm="ngForm" (ngSubmit)="submitForm(userForm.value)">

      <input ngModel name="name" required />
      <input ngModel name="email" type="email" required />
      <textarea ngModel name="message"></textarea>

      <button type="submit" [disabled]="userForm.invalid">Submit</button>
    </form>`,
})
export class AppComponent {
  submitForm(userFormValue: { name: string; email: string; message: string }) { /* ... */ }
}
```

Forms - Validators 1/3

- A form field may have one or more validators
- As we said, Angular supports all HTML5 standard validators:
  - → `required`, `minlength`, `maxlength`, `min`, `max`, `type` and `pattern`
- But you can create custom validators too
  - → we'll come back to this later...

Forms - Validators 2/3

- Use the **`.errors`** property on the **`NgModel`** directive the track the validation errors
- Here's an example with a form field that is *required* and must be a *valid email*

```
<input ngModel #emailModel="ngModel" required type="email" />

"{{ emailModel.errors | json }}"

<!--
  Depending on the field value, output might be:
    - "null"
    - "{ required: true }"
    - "{ email: true }"
-->
```

Forms - Validators 3/3

- Use the **`.hasError`** method on the **`NgModel`** directive to check the presence of a particular error

```
<input ngModel #emailModel="ngModel" required type="email" />

@if (emailModel.hasError('required')) {

  <span style="color:red">
    The email is required.
  </span>

} @else if (emailModel.hasError('email')) {

  <span style="color:red">
    The given email is not valid.
  </span>

}
```

Forms - Validators | Custom 1/2

- To create a custom validator, you need a **`Directive`** that implements the **`Validator`** interface

```ts
import { Directive, input } from '@angular/core';
import { AbstractControl, NG_VALIDATORS, ValidationErrors, Validator } from '@angular/forms';

@Directive({
  selector: '[appStartWith][ngModel]',
  providers: [{
    provide: NG_VALIDATORS, useExisting: StartWithDirective, multi: true
  }],
})
export class StartWithDirective implements Validator {
  startWith = input.required<string>({ alias: 'appStartWith' });

  validate(control: AbstractControl): ValidationErrors | null {
    if (typeof control.value !== 'string' || !control.value.startsWith(this.startWith())) {
      return { startWith: this.startWith() };   // ⟵ raise a validation error
    }
    return null;                                // ⟵ no error
  }
}
```

Forms - Validators | Custom 2/2

- Here's an example of how to use this custom validator

```
import { Component } from '@angular/core';
import { FormsModule } from '@angular/forms';
import { StartWithDirective } from './starts-with.directive';

@Component({
  selector: 'app-root',
  imports: [FormsModule, StartWithDirective],
  template: `
    <form>
      <input name="example" ngModel #model="ngModel" appStartWith="xyz" />

      @if (model.getError('startWith'); as expectedValue) {
        <span style="color: red">
          The value should start with: {{ expectedValue }}.
        </span>
      }
    </form>`,
})
export class AppComponent {}
```

Forms - Questions

Forms - Lab 12

PHP
CSS
HTML
<HTML>
<HEAD>
<TITLE> Lorem ipsum </TITLE>
</HEAD>
<BODY>
<H1> Lorem ipsum dolor sit amet, consect adipiscing elit, sed diam</H1>
<P> <IMG SRC= "Lorem ipsum"></P>

Appendix

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Table of Contents

- Getting started
- Workspace
- Technical prerequisites
- Components
- Unit testing
- Control flow
- Directives
- Signals
- Services
- Pipes
- Http
- Routing
- Forms
- **Appendix**

Appendix - Component view encapsulation 1/3

- By default, **component's styles are encapsulated** within the component's host element so that they **don't affect the rest of the application**

```
import { Component, ViewEncapsulation } from '@angular/core';

@Component ({
  selector: 'app-root',
  template: `<h1>Hello world</h1>`,
  styles: `h1 { color: red }`,
  encapsulation: ViewEncapsulation.Emulated, // ⟵ Default value
})
export class AppComponent {}
```

- At runtime, Angular adds **unique attributes** to achieve encapsulation

```
h1[_ngcontent-ng-529479] { color: blue }
```

```
<app-root _nghost-ng-529479>
  <h1 _ngcontent-ng-529479>Hello world</h1>
</app-root>
```

Appendix - Component view encapsulation 2/3

- Use **`:host {}`** pseudo class to style the component's host element

```
import { Component } from '@angular/core';

@Component ({
  selector: 'app-root',
  template: `<h1>My Awesome App</h1>`,
  styles: `:host { display: block }`,
})
export class AppComponent {}
```

- At runtime, Angular transforms the pseudo class into **unique attributes**

```
[_nghost-ng-529479] { display: block }
```

```
<app-root _nghost-ng-529479>
  <h1 _ngcontent-ng-529479>Hello world</h1>
</app-root>
```

Appendix - Component view encapsulation 3/3

- If needed, use **`ViewEncapsulation.None`** to disable component's encapsulation
- Then, all styles defined in the component are global and can therefore affect the entire page
  - → use with caution
  - → use fairly unique CSS selectors

```
import { Component, ViewEncapsulation } from '@angular/core';

@Component ({
  selector: 'app-root',
  template: `<h1 class="app-root__title">Hello world</h1>`,
  styles: `
    h1 { color: red }                 /* ❌ Looks dangerous, affects all <h1> tags in the page */

    .app-root__title { color: red }   /* ✅ Looks fine, uses a fairly unique CSS selector */
  `,
  encapsulation: ViewEncapsulation.None,
})
export class AppComponent {}
```

Appendix - Component projection 1/3

- Allows to put HTML content inside the tag of an Angular component
- The `<ng-content />` directive allows reinserting the content in the component template

```
@Component({ selector: 'app-card', template:
  `<article>
    <ng-content />
  </article>`
})
export class CardComponent {}

@Component ({ selector: 'app-root', template:
  `<app-card>
    <header>Title</header>
    <section>Content</section>
  </app-card>`
})
export class AppComponent {}
```

Appendix - Component projection 2/3

- Ability to have multiple insertion points using the **`select`** property
- The select value must be a valid **CSS selector** targeting the HTML fragment to be used

```
@Component({ selector: 'app-card', template:
  `<article>
    <header> <ng-content select="[card-title]" /> </header>
    <section> <ng-content select="[card-content]"/> </section>
  </article>`
})
export class CardComponent {}

@Component ({ selector: 'app-root', template:
  `<app-card>
    <span card-title>Title</span>
    <span card-content>Content</span>
  </app-card>`
})
export class AppComponent {}
```

Appendix - Component projection 3/3

- Use **<ng-container>** to avoid adding unnecessary tags

```
@Component({ selector: 'app-card', template:
  `<article>
    <header> <ng-content select="[card-title]" /> </header>
    <section> <ng-content select="[card-content]"/> </section>
  </article>`
})
export class CardComponent {}

@Component ({ selector: 'app-root', template:
  `<app-card>
    <ng-container card-title>Title</ng-container>
    <ng-container card-content>Content</ng-container>
  </app-card>`
})
export class AppComponent {}
```

Appendix - Component lifecycle

- It is possible to execute code using component lifecycle hooks
- More infos: https://angular.dev/guide/components/lifecycle

```
import {
  Component, OnChanges, OnInit, AfterContentInit, AfterViewInit, OnDestroy, SimpleChanges
} from '@angular/core';

@Component ({/* ... */})
export class AppComponent implements
  OnChanges, OnInit, AfterContentInit, AfterViewInit, OnDestroy {

    constructor() {/* Perform tasks that does NOT depend on the component's inputs */}

    ngOnInit(): void {/* Perform tasks that depend on the component's inputs */}

    ngAfterContentInit(): void {/* ... */}

    ngAfterViewInit(): void {/* ... */}

    ngOnDestroy(): void {/* ... */}
  }
```

Appendix - Component lifecycle | OnInit

- **`OnInit`** lifecycle hook is frequently used for initialization
- because you can safely read component **`input`**s when this hook is triggered

```ts
import { Component, OnInit, input } from '@angular/core';

@Component ({/* ... */})
export class PostsComponent implements OnInit {
  userId = input.required<string>();

  protected posts?: Post[];

  ngOnInit() {
    // Doing this is the `constructor` will fail!
    // Because the property `userId` is `undefined` at the time the constructor is executed.
    this.fetchUserPosts(this.userId()).then((posts) => (this.posts = posts));
  }

  private fetchUserPosts(): Promise<Post[]> {/* ... */}
}
```

Appendix - Component lifecycle | OnDestroy

- **`OnDestroy`** lifecycle hook is frequently used for cleaning component

```
import { Component, OnDestroy } from '@angular/core';

@Component ({
  selector: 'app-interval',
  template: '<p>{{ data }}</p>'
})
export class IntervalComponent implements OnDestroy {
  protected data = 0;

  private interval = setInterval(() => this.data++, 1000);

  ngOnDestroy() {
    clearInterval(this.interval);
  }
}
```

Appendix - Comp. lifecycle hooks | DestroyRef

- **`DestroyRef`** allows you to achieve the same result as **`ngOnDestroy`**

```
import { Component, DestroyRef } from '@angular/core';

@Component ({
  selector: 'app-interval',
  template: '<p>{{ data }}</p>'
})
export class IntervalComponent {
  protected data = 0;

  private interval = setInterval(() => this.data++, 1000);

  constructor() {
    inject(DestroyRef).onDestroy(() => clearInterval(this.interval));
  }
}
```

😉 *It is considered a more modern approach*

Appendix - Component queries 1/2

- It is possible to access template details from the class using **`viewChild`**
- Retrieved informations are available as soon as **`AfterViewInit`** has been triggered

```
import { Component, viewChild, OnInit, AfterViewInit } from '@angular/core';

@Component({
  selector: 'app-hello', template: `<h1>Hello world!</h1>`
})
export class HelloComponent {}

@Component({
  selector: 'app-root', template: `<app-hello />`
})
export class AppComponent implements OnInit, AfterViewInit {

  helloComponent = viewChild(HelloComponent);

  ngOnInit() { console.log(this.helloComponent()); }            // ⟵ output: undefined
  ngAfterViewInit() { console.log(this.helloComponent()); }     // ⟵ output: HelloComponent
}
```

Appendix - Component queries 2/2

- **`afterNextRender`** allows you to achieve (almost) the same result as **`AfterViewInit`**
- Invoked the next time the application finishes rendering

```
import { Component, viewChild, afterNextRender } from '@angular/core';

@Component({
  selector: 'app-hello', template: `<h1>Hello world!</h1>`
})
export class HelloComponent {}

@Component({
  selector: 'app-root', template: `<app-hello />`
})
export class AppComponent {

  helloComponent = viewChild(HelloComponent);

  constructor() {
    afterNextRender(() => console.log(this.helloComponent()));  // ⟵ output: HelloComponent
  }
}
```

Appendix - Questions

<app-end />

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