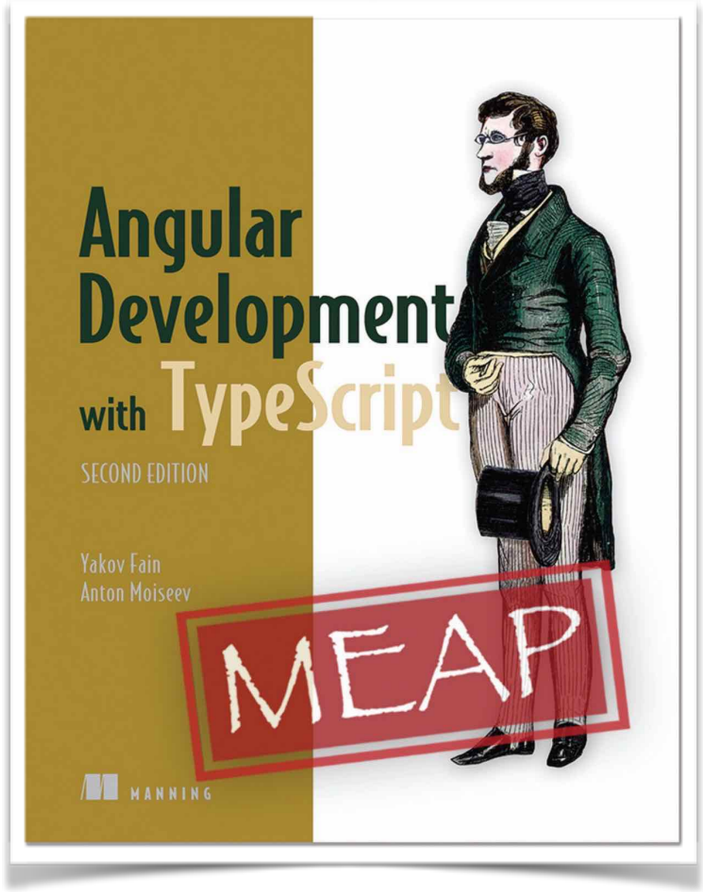
Angular Development with TypeScript

Unit 1: First steps with Angular

by Yakov Fain

About myself

- Work for Farata Systems
- Angular consultant and trainer
- Java Champion
- Co-authored two editions of the book “Angular Development with TypeScript”



- Working on a Manning book “TypeScript Quickly”

@yfain

Pre-requisites

- Download and install the current version of Node.js from **https://nodejs.org**

- Install one of these IDEs:
  - Visual Studio Code (**https://code.visualstudio.com**)
  - WebStorm (**https://www.jetbrains.com/webstorm**).

- If you have Angular CLI older than 7.0.0, uninstall it by running the following command:

  `npm uninstall @angular/cli -g`

- Install the latest Angular CLI:
  `npm install @angular/cli -g`

- Check that you have Angular CLI 7 installed by running the following command:
  `ng version`

Code samples

- Download and unzip the workshop handouts from https://goo.gl/W3zkbR
- Install the software listed in the pre-requisites slide

In this unit

- Angular modules and components
- npm package manager
- Getting started with Angular CLI
- Intro to TypeScript
- Intro to templates and bindings

Angular

- Component-based framework
- Declarative templates
- Dependency Injection
- Single-pass change detection
- Router
- Integrated RxJS library

Main artifacts

- **Component** - a class that includes UI (a template)
- **Directive** - a class with the code to perform actions on components but has no UI of its own
- **Service** - a class where you put business logic of your app
- **Pipe** - a transformer function that can be used in templates
- **Module** - a class that lists components, directives, service providers, other modules, pipes.

The landing page of an Auction app

Online Auction About Services Contact

Product title:

Title

Product price:

Price

Product category:

Search

800×300

320×150

First Product 24.99
This is a short description. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
★★★★☆ 4.3 stars

320×150

Second Product 64.99
This is a short description. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
★★★☆☆ 3.5 stars

320×150

Third Product 74.99
This is a short description. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
★★★★☆ 4.2 stars

320×150

Fourth Product 84.99
This is a short description. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
★★★☆☆ 3.9 stars

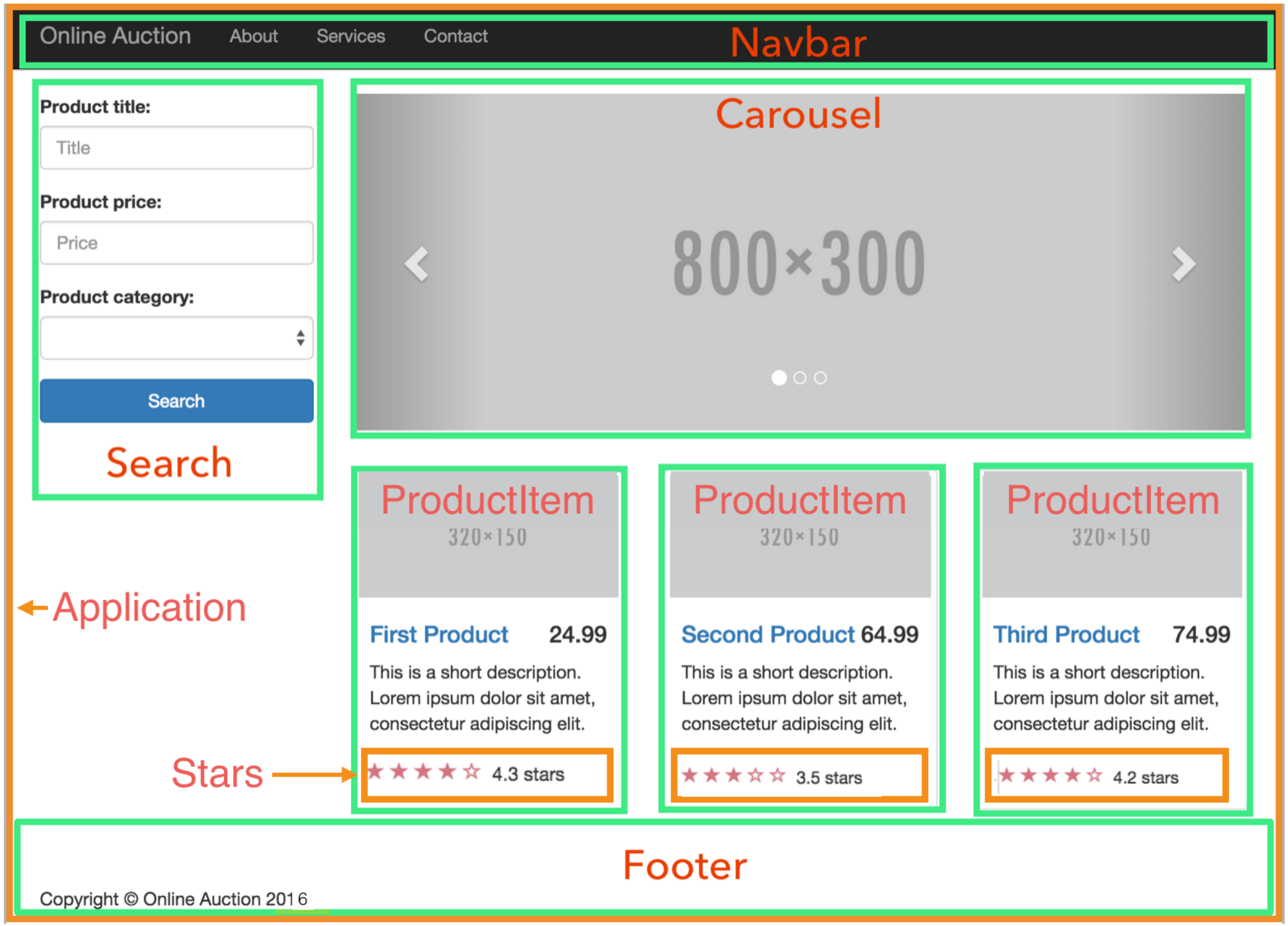
320×150

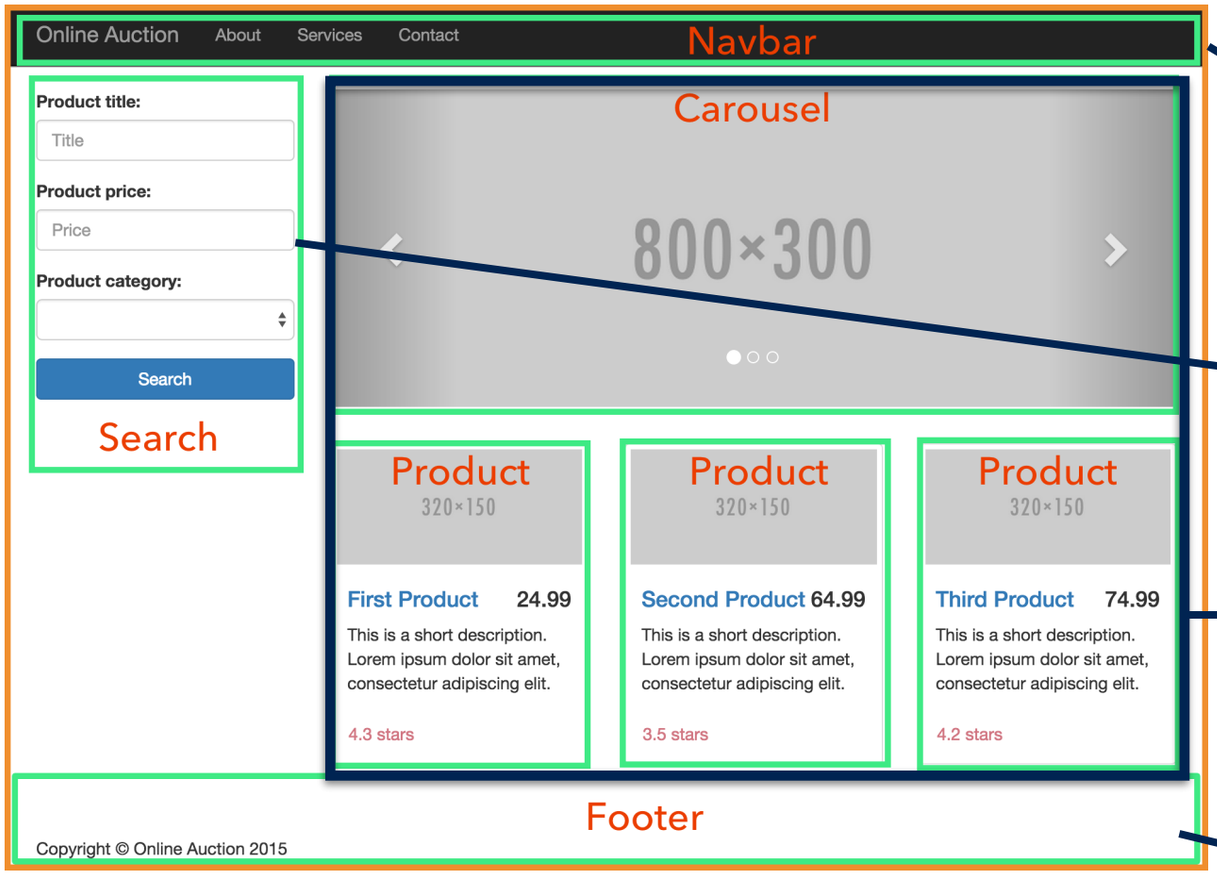
Fifth Product 94.99
This is a short description. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
★★★★★ 5 stars

320×150

Sixth Product 54.99
This is a short description. Lorem ipsum dolor sit amet, consectetur adipiscing elit.
★★★★☆ 4.6 stars

An app is a tree of components packaged as one or more modules





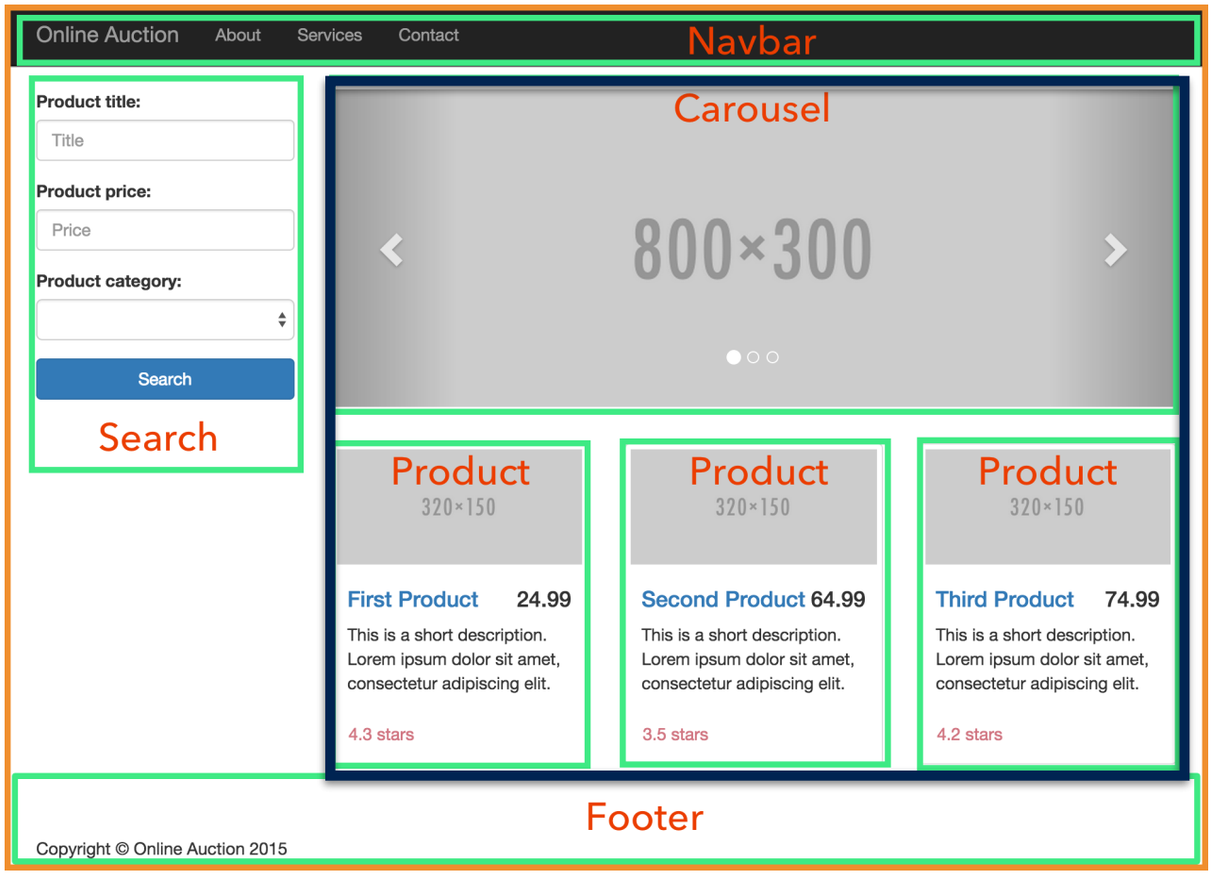

```
<auction-navbar></auction-navbar>

<div class="container">
  <div class="row">
    <div class="col-md-3">
      <auction-search></auction-search>
    </div>

    <div class="col-md-9">
      <router-outlet></router-outlet>
    </div>
  </div>
</div>

<auction-footer></auction-footer>
```

template




```
<auction-navbar></auction-navbar>

<div class="container">
  <div class="row">
    <div class="col-md-3">
      <auction-search></auction-search>
    </div>

    <div class="col-md-9">
      <router-outlet></router-outlet>
    </div>
  </div>
</div>

<auction-footer></auction-footer>
```

```
import {Component} from '@angular/core';
import {Product, ProductService} from './product.service';

@Component({
  selector: 'app-root',
  templateUrl: 'application.html',
  styleUrls: ['application.css']
})
export class AppComponent {
  products: Array<Product> = [];

  constructor(private productService: ProductService) {
    this.products = this.productService.getProducts();
  }
}
```

template, CSS

TypeScript

An Angular Module

- A module is class annotated with the decorator `@NgModule()`
- Lists all components, services, routes, et al.
- An app has at least one root module
- A typical app has one root and one or more feature modules

Angular modules doc: http://bit.ly/2cH2kay

Sample app.module.ts

ES6 modules

other modules

List of module components

Root component

```
import { BrowserModule } from ‘@angular/platform-browser';
import { NgModule } from '@angular/core';
import { FormsModule } from '@angular/forms';
import { HttpClientModule } from ‘@angular/common/http';
import { AppComponent } from './app.component';

@NgModule({
  declarations: [
    AppComponent
  ],
  imports: [
    BrowserModule,
    FormsModule,
    HttpClientModule
  ],

  bootstrap: [AppComponent]
})
export class AppModule { }
```

Installing Angular and dependencies

npm: Node Package Manager

- Install the latest version of Node.js form https://nodejs.org
- npm comes with Node.js
- The npmjs.org repository has 500K+ packages
- All packages required by Angular apps are installed from npmjs.org

Semantic Versioning

7.0.2

Major
breaking
changes

Minor
new features,
not breaking

Patch
bug fixes,
not breaking

https://docs.npmjs.com/misc/semver

Installing packages with npm

- Project dependencies are configured in the file package.json and are installed locally in the directory **node_modules**

- Installing the package xyz in your project's dir **node_modules**:
  npm install xyz

- Installing the package xyz globally:
  npm install xyz -g

package.json

Required for dev and prod

Required for dev

```
"dependencies": {
  "@angular/animations": "7.0.0",
  "@angular/common": "7.0.0",
  "@angular/compiler": "7.0.0",
  "@angular/core": "7.0.0",
  "@angular/forms": "7.0.0",
  "@angular/http": "7.0.0",
  "@angular/platform-browser": "7.0.0",
  "@angular/platform-browser-dynamic": "7.0.0",
  "@angular/router": "7.0.0",
  "core-js": "^2.4.1",
  "rxjs": "^6.1.0",
  "zone.js": "^0.8.26"
},
"devDependencies": {
  "@angular/cli": "7.0.2",
  "@angular/compiler-cli": "7.0.0",
  "@angular/language-service": "7.0.0",
  "@types/jasmine": "~2.8.9",
  "@types/jasminewd2": "~2.0.2",
  "@types/node": "~10.12.0",
  "codelyzer": "~4.5.0",
  "jasmine-core": "~3.2.1",
  "jasmine-spec-reporter": "~4.2.1",
  "karma": "~3.1.1",
  "karma-chrome-launcher": "~2.2.0",
  "karma-cli": "~1.0.1",
  "karma-coverage-istanbul-reporter": "^2.0.4",
  "karma-jasmine": "~1.1.0",
  "karma-jasmine-html-reporter": "^1.3.1",
  "protractor": "~5.4.1",
  "ts-node": "~7.0.1",
  "tslint": "~5.11.0",
  "typescript": "3.1.3",
  "@angular-devkit/build-angular": "~0.10.0"
}
```

Intro to Angular CLI

Docs: https://github.com/angular/angular-cli/wiki

Angular CLI features

- Scaffolding the project and creating a basic app
- Generating components, services, modules, etc.
- Dev web server
- Supports dev and prod builds
- Configuring test runners

Getting started with Angular CLI

- Install Angular CLI globally

  npm i @angular/cli -g

- Generate new project using the command **ng new**

Walkthrough 1.1

1. Install Angular CLI using the command window:

   npm i @angular/cli -g

2. Generate a new Angular project **hello-cli:**

   ng new hello-cli

3. cd hello-cli

4. Build the app bundles and start the app
   ng serve -o

Some *ng new* options

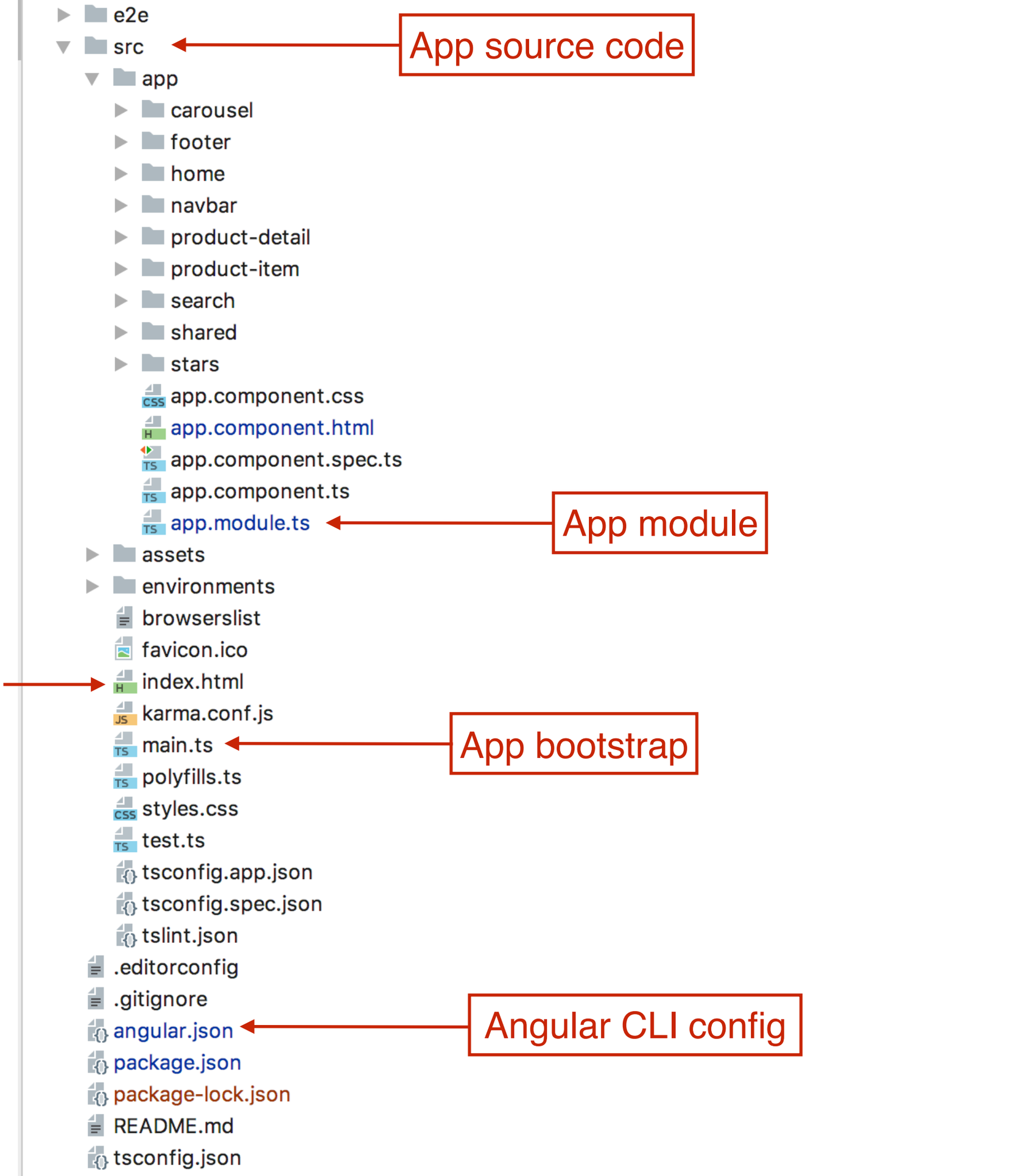
--routing

--inline-style

--inline-template

--skip-tests

Sample project structure



angular.json

One or more projects

app or library

bundled app goes here

Configuring environments

```
{
  "$schema": "./node_modules/@angular/cli/lib/config/schema.json",
  "version": 1,
  "newProjectRoot": "projects",
  "projects": {
    "hello-cli": {
      "root": "",
      "sourceRoot": "src",
      "projectType": "application",
      "prefix": "app",
      "schematics": {},
      "architect": {
        "build": {
          "builder": "@angular-devkit/build-angular:browser",
          "options": {
            "outputPath": "dist/hello-cli",
            "index": "src/index.html",
            "main": "src/main.ts",
            "polyfills": "src/polyfills.ts",
            "tsConfig": "src/tsconfig.app.json",
            "assets": [
              "src/favicon.ico",
              "src/assets"
            ],
            "styles": [
              "src/styles.css"
            ],
            "scripts": []
          },
          "configurations": {
            "production": {
              "fileReplacements": [
                {
                  "replace": "src/environments/environment.ts",
                  "with": "src/environments/environment.prod.ts"
                }
              ],
              "optimization": true,
              "outputHashing": "all",
              "sourceMap": false,
              "extractCss": true,
              "namedChunks": false,
              "aot": true,
              "extractLicenses": true,
              "vendorChunk": false,
              "buildOptimizer": true
            }
```

Generated app.component.ts: and app.component.html

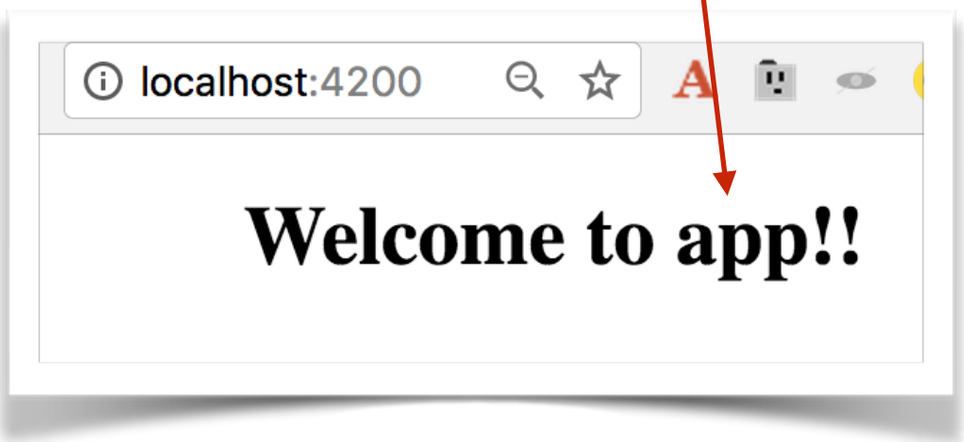
app.component.ts

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

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html',
  styleUrls: ['./app.component.css']
})
export class AppComponent {
  title = 'app';
}
```

app.component.html

```html
<div style="text-align:center">
  <h1>
    Welcome to {{title}}!!
  </h1>
  </div>
...
```



ng generate (ng g)

- Component: **ng g c**
- Service: **ng g s**
- Module: **ng g m**
- Directive: **ng g d**
- Class: **ng g cl**
- Pipe: **ng g p**
- Help: **ng help generate**

ng generate samples

- ng g m shipping
- ng g c product
- ng g c product -is -it -spec false

- ng g s product

Intro to TypeScript

Watch my video training “TypeScript Essentials” at
https://goo.gl/RjVKH2

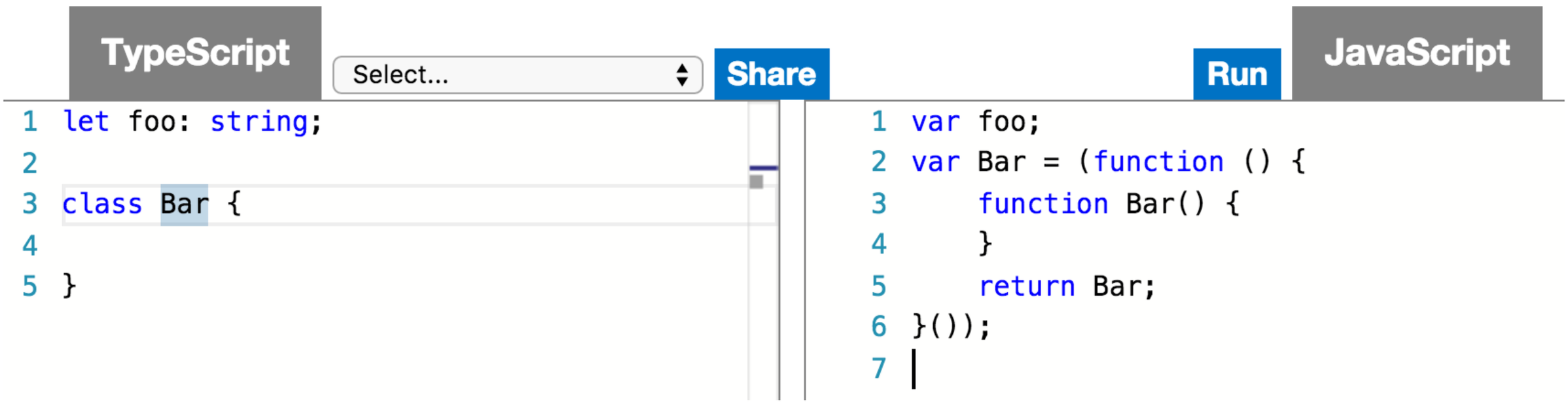
What's TypeScript

- A superset of JavaScript created by Microsoft.
- Increases your productivity in writing JavaScript
- Supports types, classes, interfaces, generics, annotations
- Compiles code into a human-readable JavaScript
- Supports ES6, ES7, and ES8

Transpiling TypeScript Interactively

http://www.typescriptlang.org/play

TypeScript → JavaScript (ES5)



Classes

TypeScript → JavaScript (ES5)

```typescript
class Person {
    firstName: string;
    lastName: string;
    age: number;
    ssn: string;
}

var p = new Person();

p.firstName = "John";
p.lastName = "Smith";
p.age = 29;
p.ssn = "123-90-4567";
```

```javascript
var Person = (function () {
    function Person() {
    }
    return Person;
})();
var p = new Person();
p.firstName = "John";
p.lastName = "Smith";
p.age = 29;
p.ssn = "123-90-4567";

```

Arrow Function Expressions

```
let getName = () => 'John Smith';

console.log(`The name is ` + getName());
```

Anonymous function

TypeScript | Select... | Share

```
1 let getName = () => 'John Smith';
2 console.log(`The name is ` + getName());
```

Run | JavaScript

```
1 var getName = function () { return 'John Smith';
2 console.log("The name is " + getName());
3
```

A Class With Constructor

TypeScript → JavaScript (ES5)

TypeScript | Select... | Share | Run | JavaScript

```typescript
class Person {

    constructor(public firstName: string,
        public lastName: string, public age: number,  private _ssn: string) {
    }
}

var p = new Person("John", "Smith", 29, "123-90-4567");
console.log("Last name: " + p.lastName + " SSN: " + p._ssn);
```

```javascript
var Person = (function () {
    function Person(firstName, lastName, age, _ssn) {
        this.firstName = firstName;
        this.lastName = lastName;
        this.age = age;
        this._ssn = _ssn;
    }
    return Person;
}());
var p = new Person("John", "Smith", 29, "123-90-4567");
console.log("Last name: " + p.lastName + " SSN: " + p._ssn);
```

Inheritance

Classical syntax → Prototypal

TypeScript | Select... | Share

```typescript
class Person {

    constructor(public firstName: string,
        public lastName: string, public age: number,
        private _ssn: string) {
    }
}

class Employee extends Person{

}
```

Run | JavaScript

```javascript
var __extends = this.__extends || function (d, b) {
    for (var p in b) if (b.hasOwnProperty(p)) d[p] = b[p];
    function __() { this.constructor = d; }
    __.prototype = b.prototype;
    d.prototype = new __();
};
var Person = (function () {
    function Person(firstName, lastName, age, _ssn) {
        this.firstName = firstName;
        this.lastName = lastName;
        this.age = age;
        this._ssn = _ssn;
    }
    return Person;
})();
var Employee = (function (_super) {
    __extends(Employee, _super);
    function Employee() {
        _super.apply(this, arguments);
    }
    return Employee;
})(Person);
```

Generics

TypeScript | Select... | Share

```ts
class Person {
    name: string;
}

class Employee extends Person{
    department: number;
}

class Animal {
    breed: string;
}

var workers: Array<Person> = [];

workers[0] = new Person();
workers[1] = new Employee();
workers[2] = new Animal();
```

Compile time error

Run | JavaScript

```js
var __extends = (this && this.__extends) || function (d, b) {
    for (var p in b) if (b.hasOwnProperty(p)) d[p] = b[p];
    function __() { this.constructor = d; }
    d.prototype = b === null ? Object.create(b) : (__.prototy
};
var Person = (function () {
    function Person() {
    }
    return Person;
})();
var Employee = (function (_super) {
    __extends(Employee, _super);
    function Employee() {
        _super.apply(this, arguments);
    }
    return Employee;
})(Person);
var Animal = (function () {
    function Animal() {
    }
    return Animal;
})();
var workers = [];
workers[0] = new Person();
workers[1] = new Employee();
workers[2] = new Animal();
```

No Errors

Interfaces as Custom Types

TypeScript

Select... Share

```typescript
interface IPerson {

    firstName: string;
    lastName: string;
    age: number;
    ssn?: string;
}

class Person  {

    constructor(public config: IPerson) {
    }
}

var aPerson: IPerson = {
    firstName: "John",
    lastName: "Smith",
    age: 29
}

var p = new Person(aPerson);
console.log("Last name: " + p.config.lastName );
```

Run JavaScript

```javascript
var Person = (function () {
    function Person(config) {
        this.config = config;
    }
    return Person;
})();
var aPerson = {
    firstName: "John",
    lastName: "Smith",
    age: 29
};
var p = new Person(aPerson);
console.log("Last name: " + p.config.lastName);

```

No interfaces here

Interfaces and `implements`

```typescript
interface IPayable{

  increasePay(percent: number): void
}

class Employee implements IPayable{

    increasePay(percent: number): void {
        // increase salary
    }
}

class Contractor implements IPayable{

    increasePay(percent: number): void {
        // increase hourly rate
    }
}

var workers: Array<IPayable> = [];
workers[0] = new Employee();
workers[1] = new Contractor();

workers.forEach(worker => worker.increasePay(30));
```

```javascript
var Employee = (function () {
    function Employee() {
    }
    Employee.prototype.increasePay = function (percent) {
        // increase salary
    };
    return Employee;
})();
var Contractor = (function () {
    function Contractor() {
    }
    Contractor.prototype.increasePay = function (percent) {
        // increase hourly rate
    };
    return Contractor;
})();
var workers = [];
workers[0] = new Employee();
workers[1] = new Contractor();
workers.forEach(function (worker) { return worker.increasePay(30);
```

No interfaces
in JavaScript

Destructuring

```
function getStock(){

    return {
        symbol: "IBM",
        price: 100.00,
        open: 99.5,
        volume:100000
    };
}

let {symbol, price} = getStock();

console.log(`The price of ${symbol} is ${price}`);

```

```
function getStock() {
    return {
        symbol: "IBM",
        price: 100.00,
        open: 99.5,
        volume: 100000
    };
}
var _a = getStock(), symbol = _a.symbol, price = _a.price;
console.log("The price of " + symbol + " is " + price);


```

TypeScript Compiler: tsc

- Install the typescript compiler **tsc** globally:

  npm install typescript -g

- To compile **main.ts** into **main.js** (ES5 target):

tsc --t ES5 main.ts

Sample tsconfig.json

```
{
  "compilerOptions": {
    "target": "ES5",
    "module": "commonjs",
    "experimentalDecorators": true
  }
}
```

Compiler's options: https://www.typescriptlang.org/docs/handbook/compiler-options.html

Walkthrough 1.2

1. Install tsc globally by running the following command in your command prompt window:
   npm i -g typescript

2. Switch to the directory **unit1/w2**

3. Review the code in main.ts

4. Compile main.ts using options from tsconfig.json:
   tsc

5. Open the newly created file main.js - it's a valid JavaScript code (ES5).

6. Change the target in tsconfig.json to be ES6

7. Compile main.ts again:
   tsc

8. Open the newly created file main.js - it's a valid JavaScript code (ES6).

Typescript Type Definitions

Type definition files

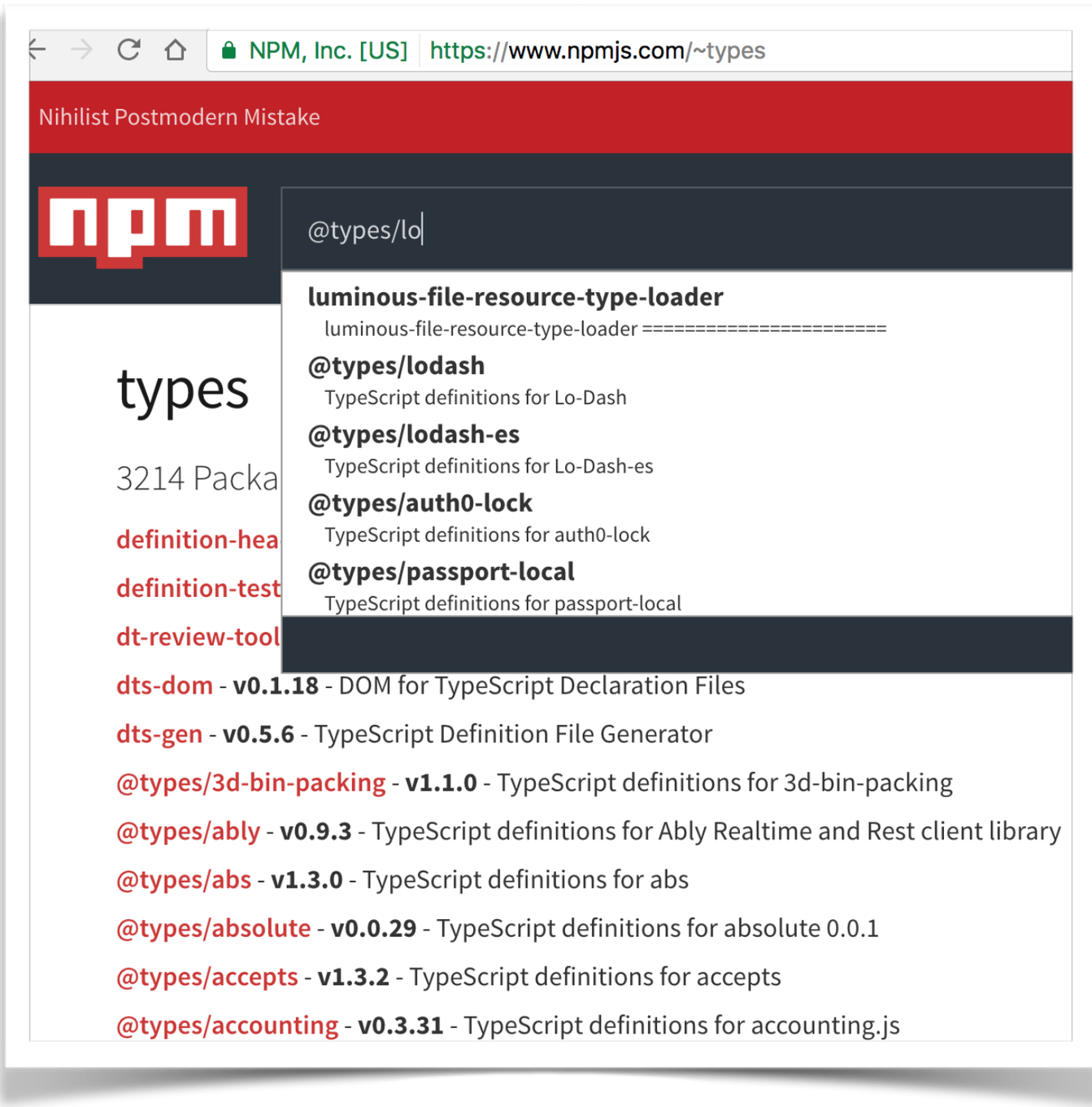
- Type definition files (***.d.ts***) contain declarations of types for JavaScript libraries

- ***.d.ts*** files help IDE with a type-ahead help

- TypeScript static analyzer uses ***.d.ts*** files to report errors

- npmjs.org has 5K+ of *d.ts files
- https://www.npmjs.com/~types
- Install type definitions, e.g.

```
npm i @types/lodash --save
```



Declarative Templates

Declaring templates and styles

- Component's UI is declared in `template` or `templateURL` properties of `@Component` annotation

```
@Component({
  selector: 'app-root',
  template: '<h1>Hello World!</h1>'
})
```

- If HTML is short - use `template`
- If HTML is long - use `templateURL` and keep the markup in a separate file
- For styles you can use either `styles` or `stylesURL`.

```
@Component({
  selector: 'app-root',
  stylesURL: '[app.component.css]',
  template: '<h1>Hello World!</h1>'
})
```

Multi-line template strings

Use back ticks to write multi-line templates

```
@Component({
  selector: 'auction-home-page',
  …
  styleUrls: [‘home.component.css'],
  template: `
    <div class="row carousel-holder">
      <div class="col-md-12">
        <auction-carousel></auction-carousel>
      </div>
    </div>
    <div class="row">
      <div class="col-md-12">
        <div class="form-group">
          <input placeholder="Filter products by title” type="text">
        </div>
      </div>
    </div>
  `
})
```

Data Binding

- Data binding allows to keep the view and underlying data in sync
- UI elements can be bound to component properties
- Events can be bound to functions or expressions

Unidirectional Binding

From code to template:

Text interpolation

<h1>Hello {{ name }}!</h1>

<span [hidden]="isZipcodeValid">Zip code is not valid

Property binding

A class variable

Unidirectional Binding

From template to code:

<button **(click)**="placeBid()">Place Bid</button>

DOM event

<input **(input)**=“onInputEvent()” />

Custom event

<price-quoter (lastPrice)="priceQuoteHandler($event)">
</price-quoter>

Property and Event Binding

```
@Component({
  selector: 'one-way-binding',
  template: `
      <h1>{{name}}</h1>

      <button (click)="changeName()">Change Name</button>
  `
})
class AppComponent {

  name = "Mary Smith";

  changeName(){
    this.name = "Bill Smart";
  }
}
```

Two-way Binding with ngModel

```
@Component({
    selector: 'two-way-binding',
    template: `<input type='text' placeholder= "Enter shipping address"
                  [(ngModel)] = “shippingAddress"/>

                <button (click)="shippingAddress='123 Main Street'">Set Default Address</button>
                <p>The shipping address is {{shippingAddress}}</p>
                `
})
class AppComponent {

    shippingAddress: string;
}
```

Walkthrough 1.3 (start)

- In your IDE open **unit1/w3/bindings** and in its Terminal window run this command:
  npm i

- Review the code **in src/app/one-way/ one.way.component.ts**

- Bundle up and run the app oneway in the browser:
  ng serve oneway -o

- Press the button **Change name**. One-way binding works.

- In the terminal window stop the web server (Ctrl-C)

Walkthrough 1.3 (end)

- Review the code in **src/app/two-way/app.component.ts**
- Stop the dev server if running (Ctrl-C)
- Build and run the app twoway:
  ng serve twoway -o

- Type some text in the input field - the binding from UI to the property `shippingAddress` works
- Click the button to programmatically change property `shippingAddress` - the binding works

What have we learned

- Angular CLI generates the new app and all its dependencies
- TypeScript compiler options are configured in **tsconfig.json**
- npm install downloads all dependencies listed in **package.json**
- You can configure multiple apps in the file **angular.json**
- An Angular component is a class annotated with `@Component`
- An app requires at least one class decorated with `@NgModule()`
- A component's HTML is specified in `template` or `templateURL`
- Angular supports both one-way and two-way data binding

Angular Development with TypeScript

Unit 2: App navigation with the router

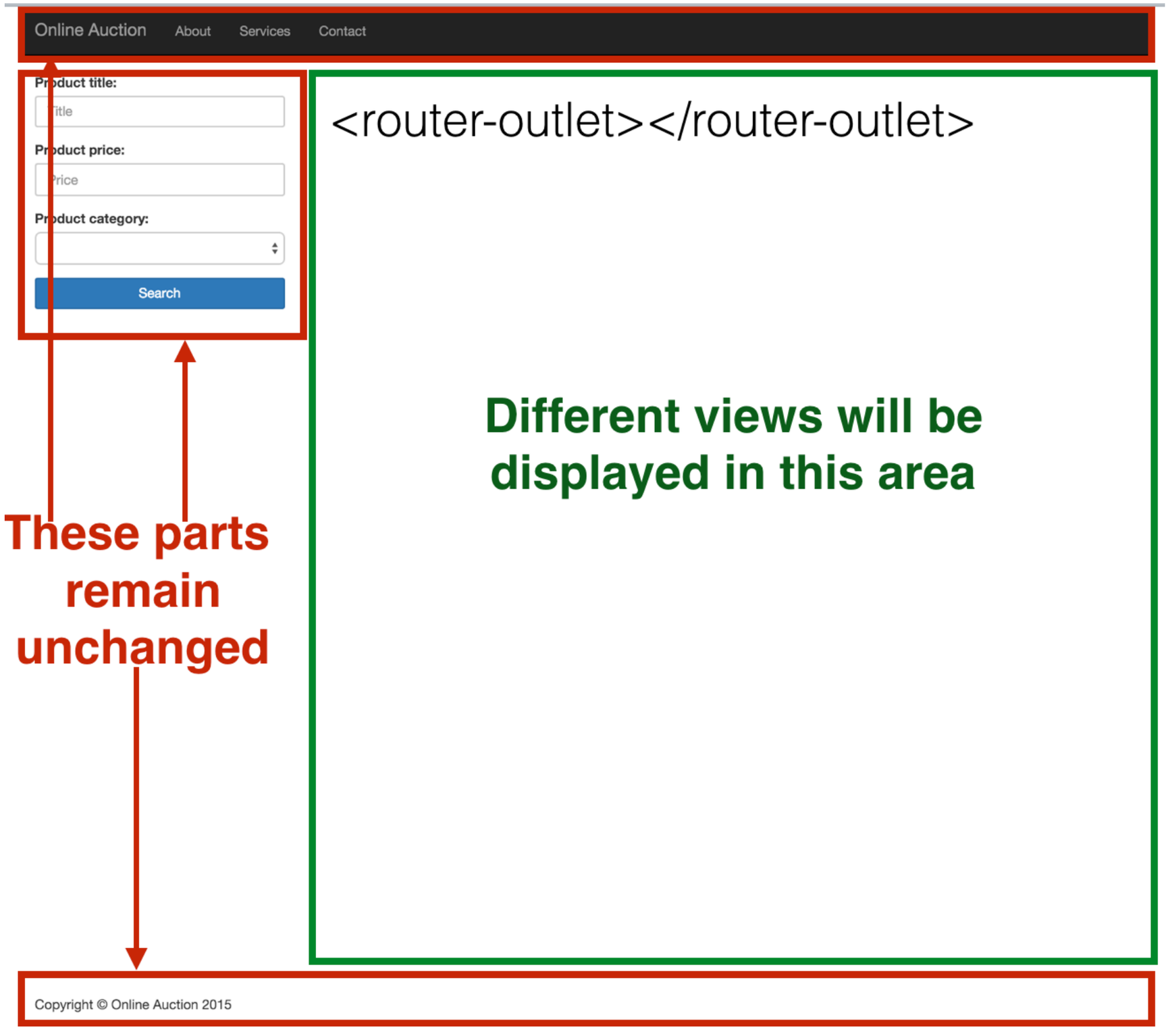
In this unit

- Main router elements
- Configuring routes
- Passing data to routes
- Child routes
- Guarding routes
- Lazy loading of modules

Single-Page Apps (SPA)

- SPA don’t refresh the entire page to display different views
- SPA is a collection of view states: Home, Product Detail, Shipping etc.
- The Router allows the user to navigate from one view to another within the SPA

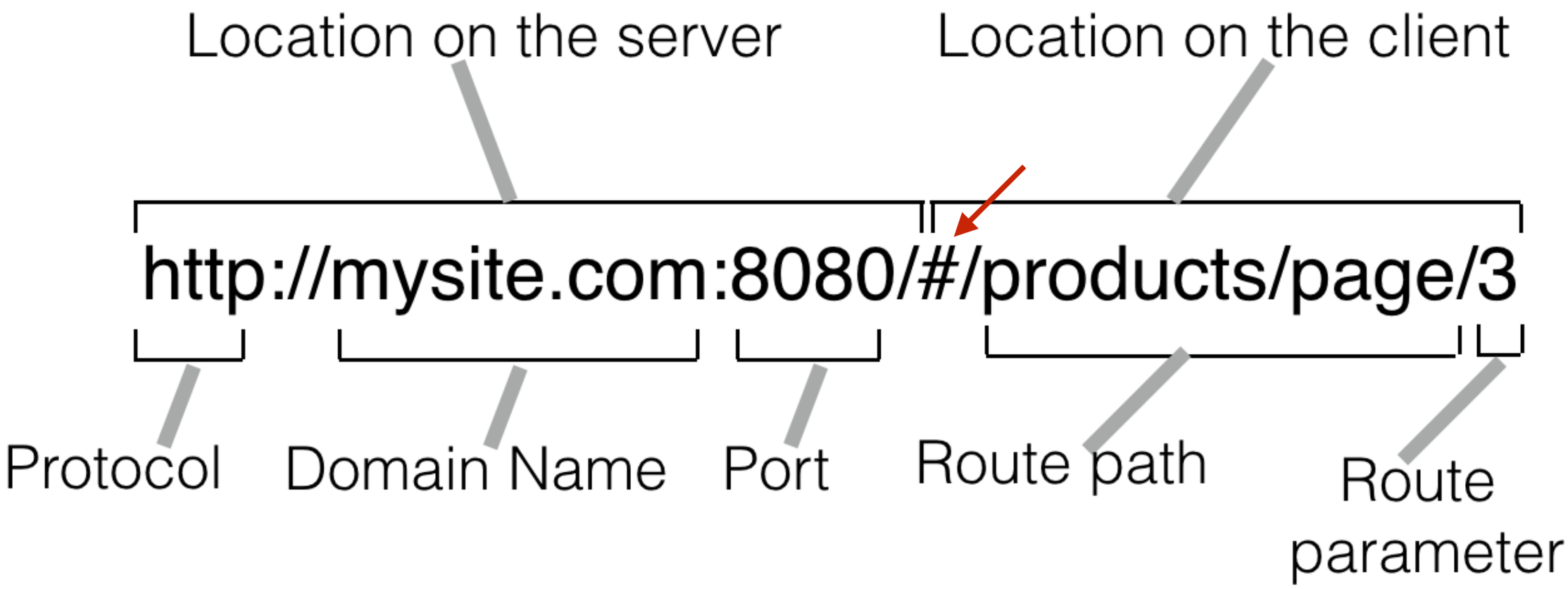
Router Outlet



Location Strategies

- **HashLocationStrategy** - a hash sign (#) is added to the URL, and the fragment after the hash identifies the route on the client.
- **PathLocationStrategy** - a History API based strategy works only in the browsers that support HTML5.

Location Strategies: Hash-based




```
@NgModule({
…
    providers: [{provide: LocationStrategy, useClass: HashLocationStrategy}],
    bootstrap: [ ApplicationComponent ]
})
export class AppModule { }
```

Location Strategies: History API

http://mysite.com:8080/products/page/3

no hash

```
@NgModule({
…
    providers: [{provide: APP_BASE_HREF, useValue: '/'}],
    bootstrap: [ ApplicationComponent ]
})
export class AppModule { }
```

APP_BASE_HREF affects how the router resolves routerLink and router.navigate() calls within the app

<base href="..."> affects how the browser resolves URLs when loading static resources like <link>, <script>, and <img>.

Sample routes configuration

app.routing.ts

```
import { Routes, RouterModule } from '@angular/router';
import {HomeComponent} from "./home";
import {ProductDetailComponent} from "./product";

const routes: Routes = [
    {path: '',        component: HomeComponent},
    {path: 'product', component: ProductDetailComponent}
];

export const routing = RouterModule.forRoot(routes); // config for the root module
```

The root module

```
...
import {LocationStrategy, HashLocationStrategy} from ‘@angular/common';

import {routing} from './components/app.routing';

@NgModule({
    imports:      [ BrowserModule, routing ],
    declarations: [ AppComponent, HomeComponent, ProductDetailComponent],

    providers:[{provide: LocationStrategy, useClass: HashLocationStrategy}],

    bootstrap:    [ AppComponent ]
})
class AppModule { }
```

Navigation using template links

```
@Component({
    selector: 'app',
    template: `
        <a [routerLink]="['/']">Home</a>
        <a [routerLink]="['/product']">Product Details</a>

        <router-outlet></router-outlet>
    `
})
export class AppComponent {}
```

Home Product Details

Home Component

[routerLink] replaced with href

Elements Console Sources Network Timeline Pro

```
<!DOCTYPE html>
<html>
▶<head>…</head>
▼<body> == $0
  ▼<app>
    <a ng-reflect-router-link="/" ng-reflect-href="#/"
    href="#/">Home</a>
    <a ng-reflect-router-link="/product" ng-reflect-
    href="#/product" href="#/product">Product
    Details</a>
    <router-outlet></router-outlet>
   ▶<home _nghost-qsl-3>…</home>
  </app>
  <!-- Code injected by live-server -->
 ▶<script type="text/javascript">…</script>
 </body>
</html>
```

Programmatic navigation

- navigate()
- navigateByURL()

```
template: `
    <a [routerLink]="['/']">Home</a>
    <button (click)="navigateToProductDetail()>Product Details</button>
    <router-outlet></router-outlet>
`
```

```
class AppComponent {

    constructor(private _router: Router){}

    navigateToProductDetail(){
        this._router.navigate(["/product"]);
    }
}
```

Walkthrough 2.1

- In your IDE open the dir **unit2/router-samples**

- In the Terminal window run
  npm install

- In the src dir, review the code of the files app.routing, app.component, home.component, and product.component

- Run the **basic** app (configured in angular.json):
  ng serve basic -o

Passing parameters to a route

```
const routes: Routes = [
    {path: '',          component: HomeComponent},
    {path: 'product/:id', component: ProductDetailComponent}
];

@Component({
    selector: 'app',
    template: `
       <a [routerLink]="['/']">Home</a>
       <a [routerLink]="['/product', productId]">Product Details</a>
       <router-outlet></router-outlet>
    `
})
class AppComponent {

    productId = 1234;
}
```

Receiving params in a route: ActivatedRoute

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

@Component({
  selector: 'product',
  template: `<h1 class="product">Details for product {{productID}}</h1>`,
  styles: ['.product {background: cyan}']
})
export class ProductDetailComponent {
  productID: string;

  constructor(route: ActivatedRoute) {
    this.productID = route.snapshot.paramMap.get('id');
  }
}
```

You can also receive params by subscribing to an observable property of the ActivatedRoute

Walkthrough 2.2

- Review the code in the dir **params**

- In app.component.ts the ProductDetail links uses `product/:id` and renders `ProductDetailComponent` with1234 as product ID.

- Note that app.component.ts includes
  `productId: number = 1234;`

- Note the **product/:id** configuration in app.routing.ts

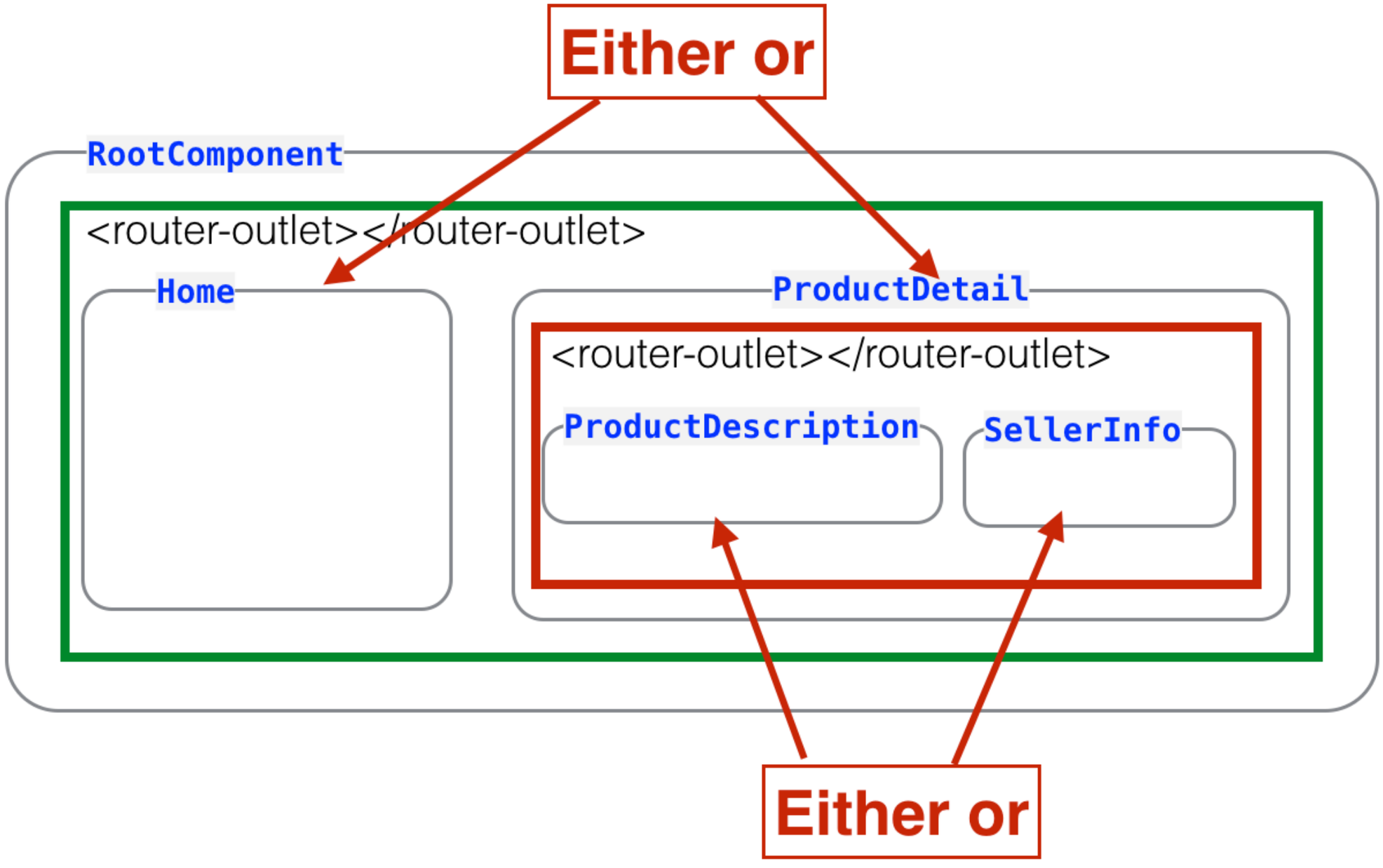
- Stop the dev server if running (Ctrl-C)

- Run the **params** app:
  ng serve params -o

- In the browser navigate to Product Detail. It renders
  “Product Detail for Product 1234”

Child Routes

A child component can have its own routes configured



Configuring child routes

Configure routes for child components using the `children` property of the configuration object

```
const routes: Routes = [
    {path: '',              component: HomeComponent},
    {path: 'product/:id', component: ProductDetailComponent,
      children: [
        {path: '',              component: ProductDescriptionComponent},
        {path: 'seller/:id', component: SellerInfoComponent}
      ]}
];

@Component({
    selector: 'app',
    template: `
        <a [routerLink]="['/']">Home</a>
        <a [routerLink]="['/product', 1234]">Product Details</a>
        <router-outlet></router-outlet>
    `
})
class AppComponent {}
```

Walkthrough 2.3

- Review the code of the files in the dir **child**

- ng serve child -o

- The main page is displayed. Click on the link Product with children, and it'll navigate to the `ProductDescription` route inside `ProductDetail`

- Click on the Seller Info link and it'll navigate to the `SellerInfo` route inside `ProductDetail`

- Note the URL in the browser: http://localhost:4200/#/product/1234/seller/5678

parent's route

child's route

Guard interfaces

- **CanActivate** mediates the navigation to a route
- **CanActivateChild** mediates the navigation to a child route
- **CanDeactivate** mediates the navigation away from the current route
- **Resolve** performs route data retrieval before route activation
- **CanLoad** mediates the navigation to a feature module loaded asynchronously

canActivate and canDeactivate

- **canActivate** - allows navigating **to** a route if a certain condition is met, e.g. the user is logged in

- **canDeactivate** - allows navigating **from** a route if a certain condition is met, e.g. prompting about saving changes

```
const routes: Routes = [
    {path: '',         component: HomeComponent},
    {path: 'login',    component: LoginComponent},
    {path: 'product', component: ProductDetailComponent,
        canActivate:[LoginGuard], canDeactivate:[UnsavedChangesGuard]}
];

export const routing = RouterModule.forRoot(routes);
```

Login Guard

```
@Injectable()
export class LoginGuard implements CanActivate{

    constructor(private router: Router){}

    canActivate() {

        // A call to the actual login service would go here
        // For now we'll just randomly return true or false

        const loggedIn = Math.random() < 0.5;

        if(!loggedIn){
            alert("You're not logged in and will be redirected to Login page");
            this.router.navigate(["/login"]);
        }

        return loggedIn;
    }
}
```

Unsaved Changes Guard

```
export class UnsavedChangesGuard implements
                                    CanDeactivate<ProductDetailComponent> {

  constructor(private _router:Router){}

  canDeactivate(component: ProductDetailComponent){

    if (component.name.dirty) {
      return window.confirm("You have unsaved changes. Still want to leave?");
    } else {
      return true;
    }
  }
}
```

The `dirty` property is a part of the Forms API

Unsaved Changes Guard

```
export class UnsavedChangesGuard implements CanDeactivate<ProductDetailComponent>{

  constructor(private _router:Router){}

  canDeactivate(component: ProductDetailComponent){

    if (component.name.dirty) {
      return window.confirm("You have unsaved changes. Still want to leave?");
    } else {
      return true;
    }
  }
}
```

```
@Component({
  selector: 'product',
  template: `<h1 class="product">Product Detail Component</h1>
             <input placeholder="Enter your name"
                    type="text" [formControl]="name">`,
  styles: ['.product {background: cyan}']
})
export class ProductDetailComponent{

   name: FormControl = new FormControl();
}
```

Walkthrough 2.4

- Review the code in the files in the dir **guards**
- ng serve guards -o
- Click on the Product Detail link and enter your name
- The app either navigates to `ProductDescription` route or shows a popup that you're not logged in and navigates to the Login view
- When `ProductDetail` is shown, click on the Home link, and you'll see the message asking if you want to save changes

Feature modules and lazy loading

Advantages of lazy loading

- The app startup time is shorter
- Splitting the app into modules allows creating reusable chunks of code, e.g. ShippingModule
- During bundling, the lazily loaded module is placed in a separate bundle
- The code is loaded only when the user navigates to the module

Root vs feature modules

Root module

```
@NgModule({
    imports: [ BrowserModule],
    declarations: [ AppComponent, HomeComponent,
                    ProductDetailComponent],
    bootstrap:    [ AppComponent ]
})
export class AppModule { }
```

Feature module

```
@NgModule({
    imports:      [ CommonModule,
                    RouterModule.forChild([
                    {path: '', component: LuxuryComponent}
                     ])
                  ],
    declarations: [ LuxuryComponent ]
})

export class LuxuryModule { }
```

Creating a lazy-loaded module

- Create a module that imports `CommonModule` and loads its routes using `forChild()`
- **Don't** import this module in your root app module
- In router configuration use the property `loadChildren` that has a string value

Routes config for lazy loading

```
@NgModule({
    imports: [ BrowserModule,
               RouterModule.forRoot([
                   {path: '',         component: HomeComponent},
                   {path: 'product', component: ProductDetailComponent},
                   {path: 'luxury',
                                      loadChildren: './luxury.module#LuxuryModule'}
               ])

           ],
    declarations: [ AppComponent, HomeComponent, ProductDetailComponent],
    providers:[{provide: LocationStrategy, useClass: HashLocationStrategy}],
    bootstrap:    [ AppComponent ]
})
export class AppModule { }
```

Lazy load

LuxuryModule

AppModule

```
chunk {inline} inline.bundle.js, inline.bundle.js.map
chunk {luxury.module} luxury.module.chunk.js, luxury.m
chunk {main} main.bundle.js, main.bundle.js.map (main)
chunk {polyfills} polyfills.bundle.js, polyfills.bundl
chunk {styles} styles.bundle.js, styles.bundle.js.map
chunk {vendor} vendor.bundle.js, vendor.bundle.js.map
```

Preloaders

- During the app launch, it can preload all lazy modules in the background while the user is interacting with your app
- Add `preloadingStrategy` to the routes config

```
RouterModule.forRoot([
    {path: '',         component: HomeComponent},
    {path: 'product', component: ProductDetailComponent},
    {path: 'luxury', loadChildren: './luxury.module#LuxuryModule' }
]
  ,
  {
   preloadingStrategy: PreloadAllModules
  })
```

- You can create a custom preloading strategy by creating a class that implements the `PreloadingStrategy` interface.

Walkthrough 2.5

- Review the code in the files located in the dir **lazy**
- ng serve lazy -o
- Open Chrome Dev Tools on the **Network** tab and refresh
- Note that the browser loads **luxury.module.chunk.js** only when you click on the Luxury Item link
- Stop the dev server
- In lazy/app.module.ts uncomment the line with `preloadingStrategy`
- The app restarts and the Network tab shows that the file **luxury.module.chunk.js** was preloaded

What have we learned

- The router renders components in the designated area called router outlet
- Navigation to the routes can be done either by clicking on a link or programmatically
- The URL on the address bar of the browser is updated as the user navigates to the routes
- Parent components can pass data to routes
- Guards are used to mediate navigation to/from the route
- A child component can have its own route configuration
- The router can load modules either eagerly or lazily

Angular Development with TypeScript

Unit 3: Dependency injection

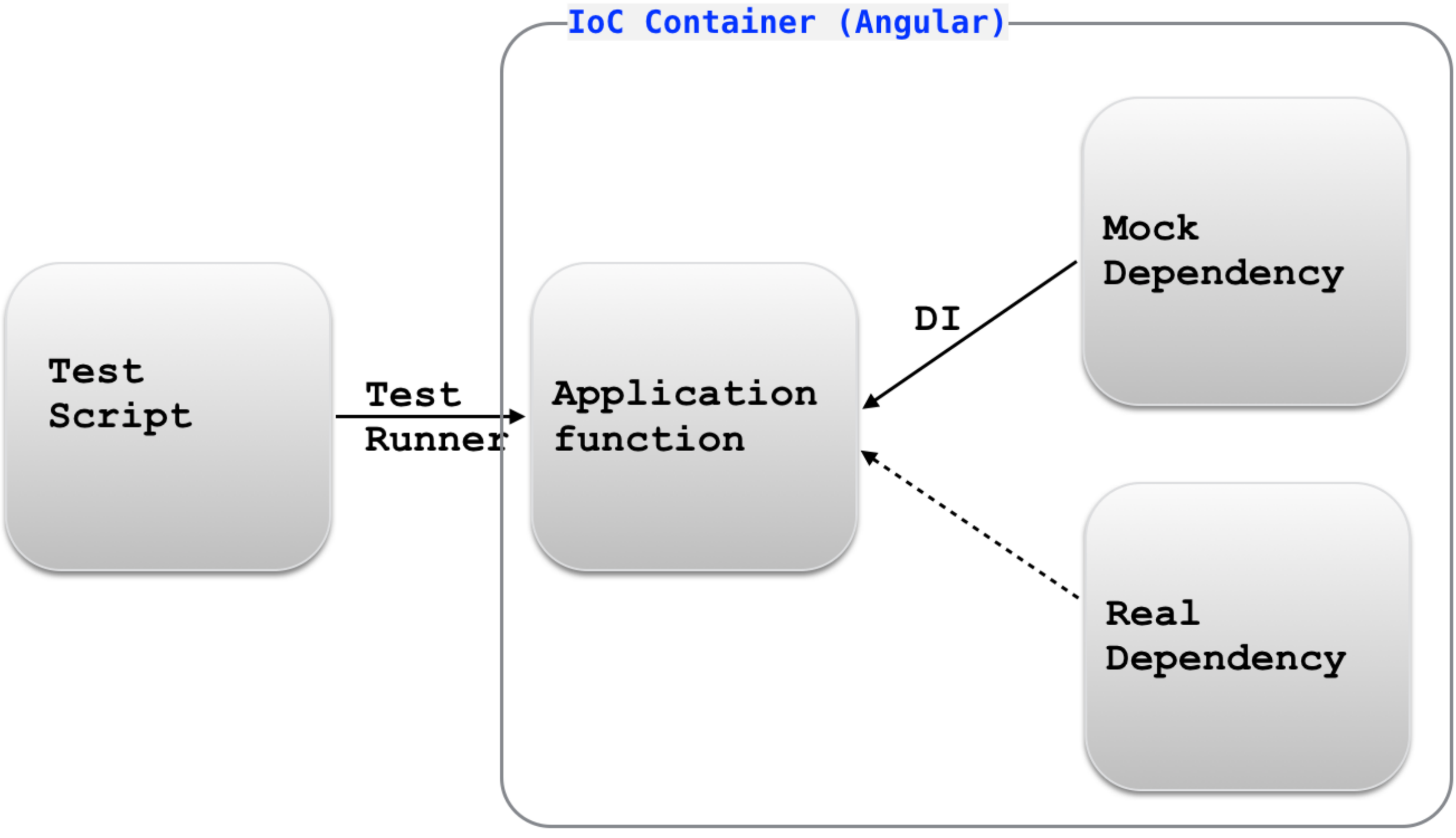
In this unit

- Benefits of dependency injection
- Providers and injectors
- Injecting using factories and values

Benefits of Dependency Injection

- Change the behavior of a component, service, function, etc) without modifying its code.
- Offers an easy way of swapping the objects that your app uses
- Simplifies testability of your app

DI: Simplified Testability



Dependency Injection in Angular

- Don’t instantiate classes with the `new` operator
- Angular creates and injects services into components
- Angular creates and injects values into variables

Dependency Injection in Angular

- Angular injects services into only via constructors
- Each component has **its own injector**
- You specify **a provider** so Angular knows **what** to inject

Where to declare providers?

- Providers allows you to map a *token*, to its concrete implementation
- Typically you define a provider on the app level to create a singleton

```
@NgModule({
 …
 providers:[{provide:ProductService,
             useClass:MockProductService}]
})
```

Token

Concrete implementation

You can define a provider inside `@Component` if need be.

Short notation for providers

When a token and a type have the same name, use the short notation:

```
@NgModule({
   …
  providers:[ProductService]
})
```

Injection point

- Angular injects values via the component's constructor:

```
constructor(productService: ProductService){
        productService.doSomething();
}
```

- If a component doesn't declare a provider, Angular checks component's parent, grandparent, etc.

Changing a provider

- To inject a **different** implementation of a service, change the provider:

```
{provide: ProductService, useClass: AnotherProductService}
```

- The component's constructor remains the same even when the concrete implementation changes:

```
constructor(productService: ProductService){...}
```

Token

Demo: generate a service with Angular CLI

- In IDE open your hello-cli project, and in the Terminal view run this:

  ng g s product -m app.module

- CLI generates product.service.ts and adds its provider to app.module.ts

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

@Injectable()
export class ProductService {

  constructor() { }

}
```

```
...
import { ProductService } from './product.service';

@NgModule({
  declarations: [
    AppComponent,
    ProductComponent
  ],
  imports: [
    BrowserModule,
    FormsModule,
    HttpModule
  ],
  providers: [ProductService],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

A simple injectable service

```
import {Injectable} from “@angular/core";


@Injectable()
export class ProductService {
  getProduct(): Product {
    // An HTTP request can go here
    return new Product( 0, "iPhone 7", 249.99, "The latest iPhone, 7-inch screen");
  }
}
```

```
export class Product {
  constructor(
    public id: number,
    public title: string,
    public price: number,
    public description: string) {
  }
}
```

Injecting ProductService

```
@Component({
  selector: 'di-product-page',
  template: `<div>
  <h1>Product Details</h1>
  <h2>Title: {{product.title}}</h2>
  <h2>Description: {{product.description}}</h2>
  <h2>Price: \${{product.price}}</h2>
</div>`
})

export class ProductComponent {
  product: Product;

  constructor( productService: ProductService) {
   this.product = productService.getProduct();
  }
}
```

Injection

Walkthrough 3.1

- In your IDE, open the directory unit3/di-samples
- Review the code in the directory basic
- npm install
- ng serve basic -o
- The app shows the info about iPhone7 provided by the injected `ProductService`

Angular 6 adds `provideIn`

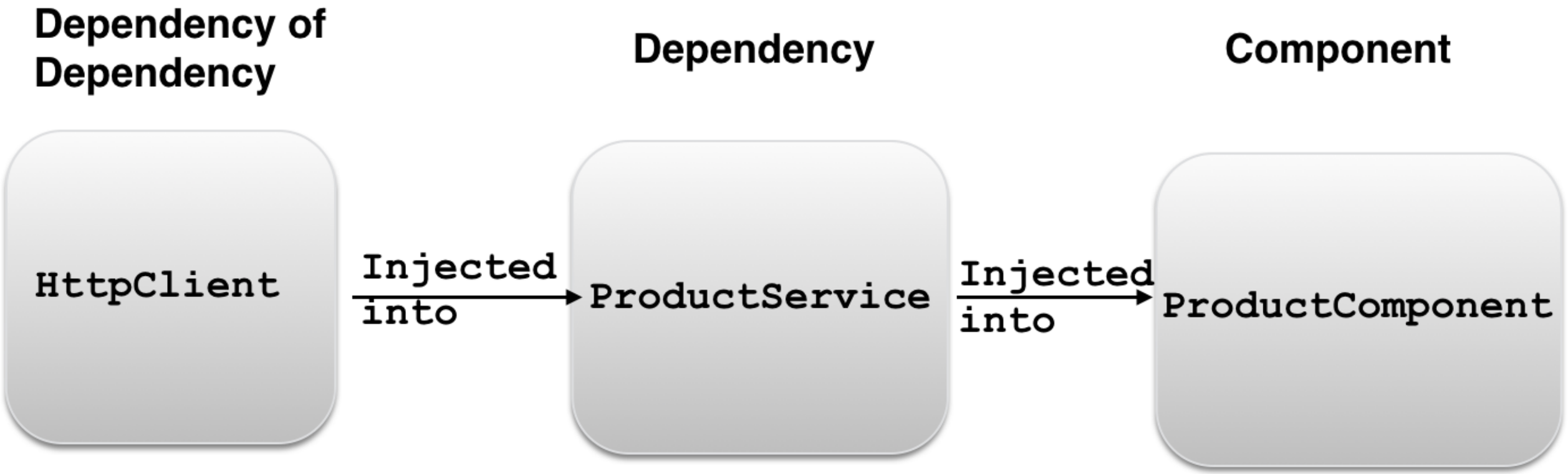
Generate a service:
ng g s product

The injectable decorator looks like this

```
@Injectable(
  provideIn: 'root'
)
```

No need to specify the provider in `@NgModule()`

Dependencies of dependencies



Dependencies of dependencies

Http providers

```
import {HttpClientModule}
                  from '@angular/common/http';
…


@NgModule({
    imports:      [ BrowserModule,
                    HttpClientModule],
    declarations: [ AppComponent,
                    ProductComponent],
    bootstrap:    [ AppComponent ]
})
class AppModule { }
```

Dependencies of dependencies

```
import {HttpClientModule}
                  from '@angular/common/http';
…


@NgModule({
    imports:      [ BrowserModule,
                    HttpClientModule],
    declarations: [ AppComponent,
                    ProductComponent],
    bootstrap:    [ AppComponent ]
})
class AppModule { }
```

```
import {HttpClient} from '@angular/common/http';

@Injectable()
export class ProductService {

   products:Observable;

   constructor(private http: HttpClient){

    this.products = this.http.get('products.json');
   }
  // other app code goes here
}
```

DI

Use `@Injectable()` if your service has dependencies.

```
export class ProductComponent {

  product: Product;

  constructor( productService: ProductService) {

 }
}
```

DI

Flavors of providers

The property `provide` can:

- map a token by `useClass`
- map a token by `useFactory`
- map a token by `useValue`

Injecting a value into a factory

```
export function productServiceFactory (isProd: boolean) {
  if (isProd){
    return new ProductService();
  } else{
    return new MockProductService();
  }
};

@Component({
  selector: 'product2',
  template: '{{product.title}}'
})
export class Product2Component {
  product: Product;

  constructor(productService: ProductService) {
    this.product = productService.getProduct();
  }
}
…
@NgModule({
  …
 providers: [{provide: ProductService, useFactory: productServiceFactory,
                                       deps: ['IS_PROD_ENVIRONMENT']},
             {provide: 'IS_PROD_ENVIRONMENT', useValue: environment.production}],
  bootstrap:    [ AppComponent ]
})
class AppModule { }
\
```

Factory

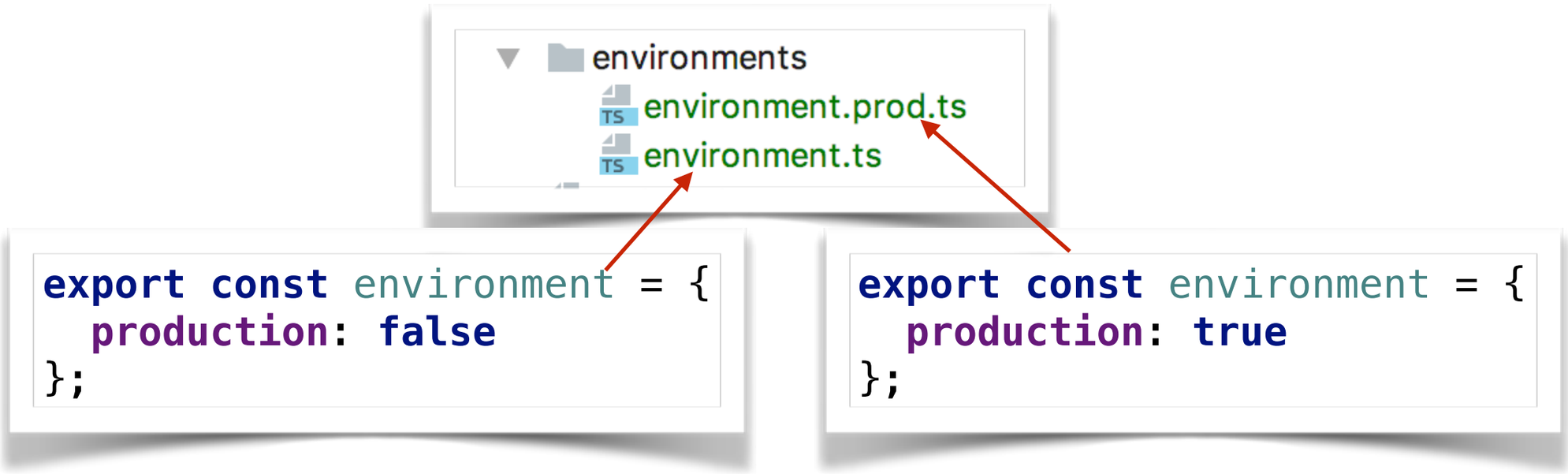
true or false

String as a token

Environment variables

- By default, **ng serve** uses dev environment settings from environment.ts

- Review the code in the directory environments in your project



Walkthrough 3.2

- Review the code in the **factory** folder. The app.module file has

  providers: [{**provide**: ProductService,
  useFactory: productServiceFactory, **deps**: [**'IS_PROD_ENVIRONMENT'**]}

- ng serve factory -o

- With dev build **'IS_PROD_ENVIRONMENT'** is false; the app shows two Samsungs.

- Serve the prod version of the app:
  ng serve --prod factory -o

- With prod build **'IS_PROD_ENVIRONMENT'** is true; the app shows two iPhones.

- Check the app size of the prod build in the Network tab. It's ~130KB.

What have we learned

- Having a framework creating instances provide more flexibility in switching services

- Providers specify how to create instances while injectors create them

- If you didn’t specify a provider on a component level, Angular will look for one up the hierarchy

- Providers can be classes, factory functions, or values

- If a service requires injection of other services mark it as `@Injectable()`

Angular Development with TypeScript

Unit 4: Inter-component communications

In this unit

- @Input and @Output properties
- Using a parent component as a mediator
- Using an injectable service as a mediator
- Component lifecycle

Input and Output Properties

- Think of a component as a black box with entry and exit doors

- Properties marked as **`@Input()`** are used for getting data from the parent component

- The parent component can pass data to its child using bindings to input properties

- Properties marked as **`@Output()`** are used for sending events (and data) from a component

The parent binds to input props

```
@Component({
    selector: 'app',
    template: `
    <input type="text" placeholder="Enter stock (e.g. AAPL)"
                                    (change)="onInputEvent($event)">

    <br/>


    <order-processor [stockSymbol]="stock" quantity="100">
    </order-processor>
    `
})
class AppComponent {
    stock:string;

    onInputEvent({target}):void{
        this.stock=target.value;
    }
}
```

Input properties in a child

```
@Component({
  selector: 'order-processor',
  template: `
    <span *ngIf="!!stockSymbol">Buying {{quantity}} shares of {{stockSymbol}}</span>
  `,
  styles:[`:host {background: cyan;}`]
})
export class OrderProcessorComponent {

  @Input() quantity: number;
  @Input() stockSymbol: string;
}
```

Note the use of `*ngIf` directive

Walkthrough 4.1

- In your IDE open the directory **unit4/inter-component**
- npm i
- Review the code in the input directory
- ng serve input -o
- Enter a stock symbol and move the focus from the field
- The child component received the entered stock symbol

Output properties in a child

```
@Component({
    selector: 'price-quoter',
    template: `<strong>Inside PriceQuoterComponent:
                        {{stockSymbol}} {{price | currency:'USD'}}</strong>`,

    styles:[`:host {background: pink;}`]
})
class PriceQuoterComponent {

    @Output() lastPrice: new EventEmitter<IPriceQuote>();

    stockSymbol = "IBM";
    price:number;

    constructor() {
        setInterval(() => {    // can use Observable.interval() instead
            let priceQuote: IPriceQuote = {
                stockSymbol: this.stockSymbol,

                latestPrice: 100*Math.random()
            };

            this.price = priceQuote.latestPrice;

            this.lastPrice.emit(priceQuote);

        }, 1000);
    }
}
```

pipe

```
interface IPriceQuote {
    stockSymbol: string;
    latestPrice: number;
}
```

The parent listens to the lastPrice event

```
@Component({
    selector: 'app',
    template: `
      <price-quoter (lastPrice)="priceQuoteHandler($event)"></price-quoter><br>

      AppComponent received: {{stockSymbol}} {{price | currency:'USD'}}
    `
})
class AppComponent {

    stockSymbol: string;
    price:number;

    priceQuoteHandler(event:IPriceQuote) {
        this.stockSymbol = event.stockSymbol;
        this.price = event.latestPrice;
    }
}
```

Walkthrough 4.2

- Review the code in the output directory
- ng serve output -o
- Price quotes are generated and displayed in both the child and parent components

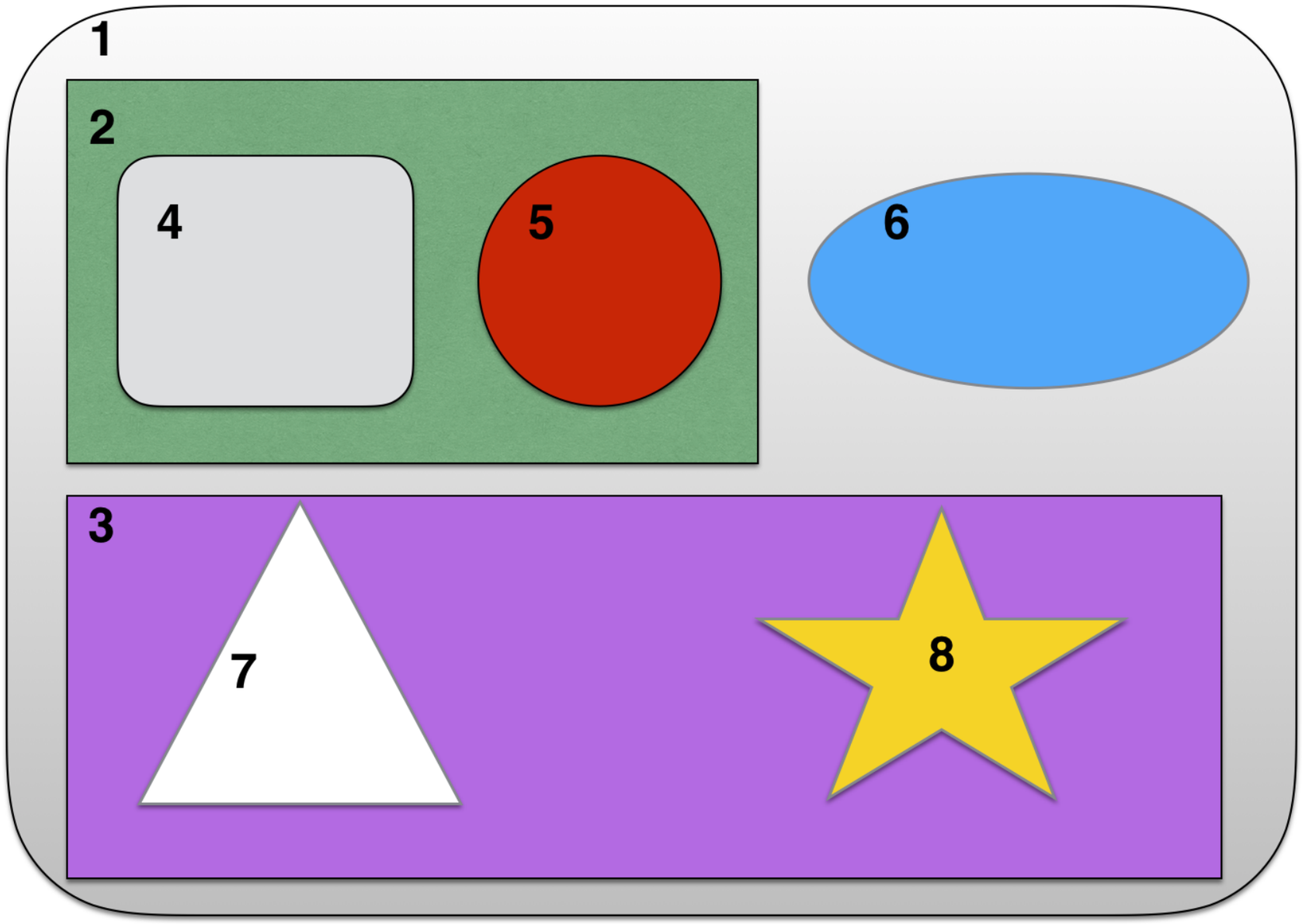
Implementing the Mediator Design Pattern

Loosely-Coupled Components

- The Mediator acts as a man in the middle
- A component A sends the data to a mediator, which passes the data to a component B
- Component A and Component B don't know about each other
- **A parent component** can mediate siblings' communications
- **An injectable service** can mediate communication between any components

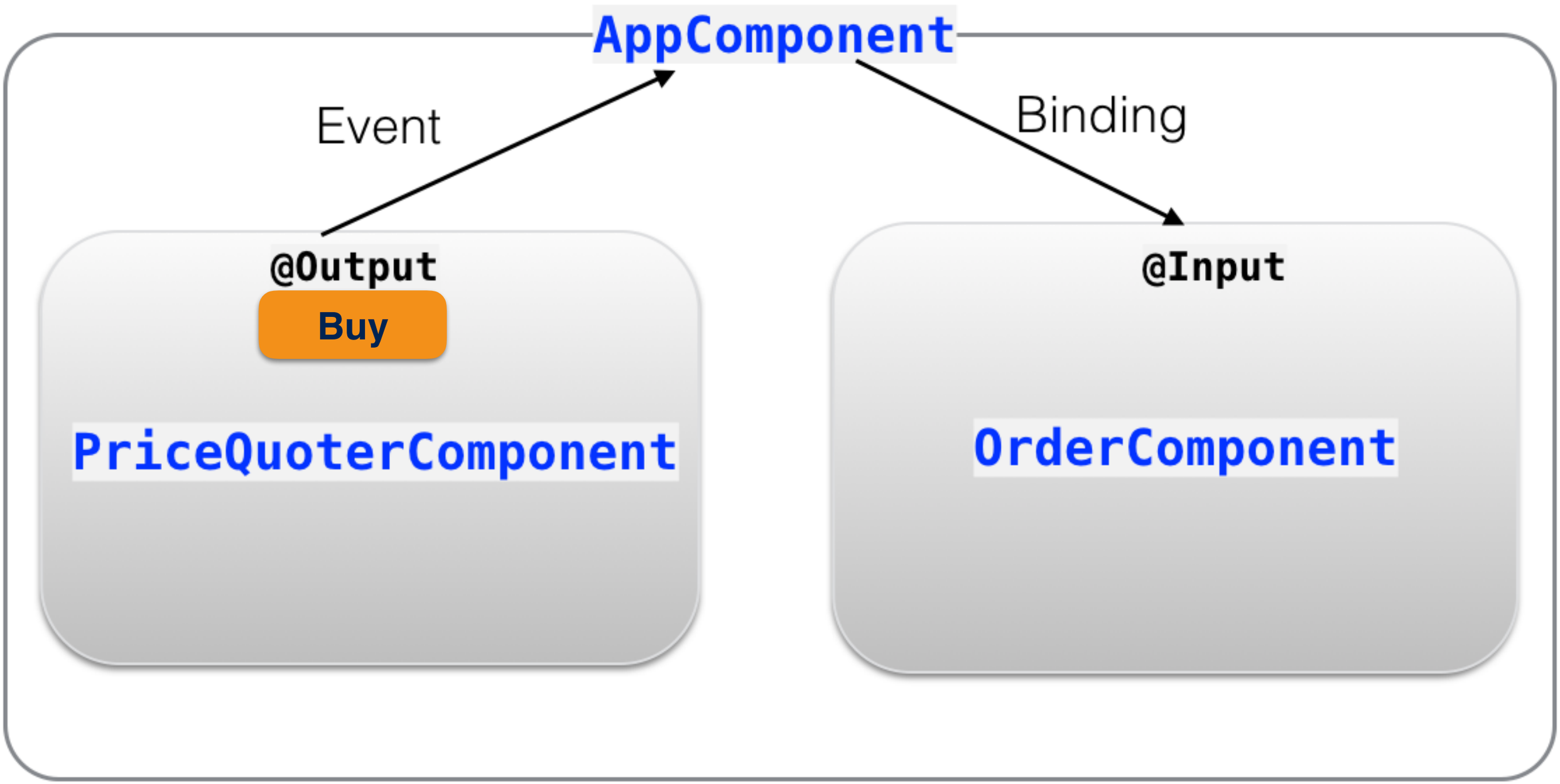
An Angular app as matryoshka dolls

Parent components as mediators



QUIZ: How the number 7 can send the data to number 6?

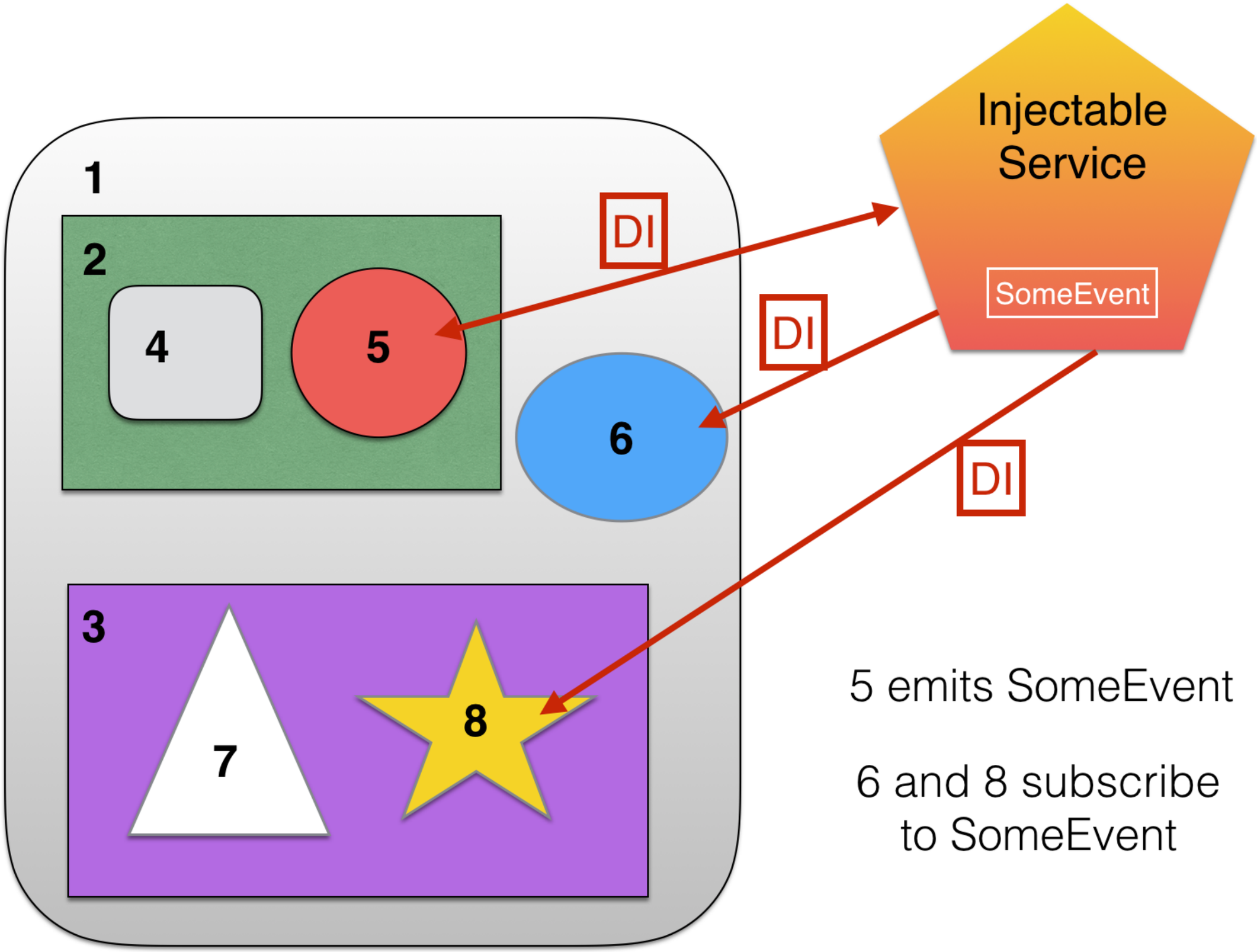
Parent as a mediator



Walkthrough 4.3

- Review the code in the mediator-parent directory
- ng serve mediator-parent -o
- Price quotes are generated by the `PriceQuoter` component
- When the user clicks the Buy button, the data is passed to the `OrderComponent` via the mediator (parent)

Injectable service as a mediator



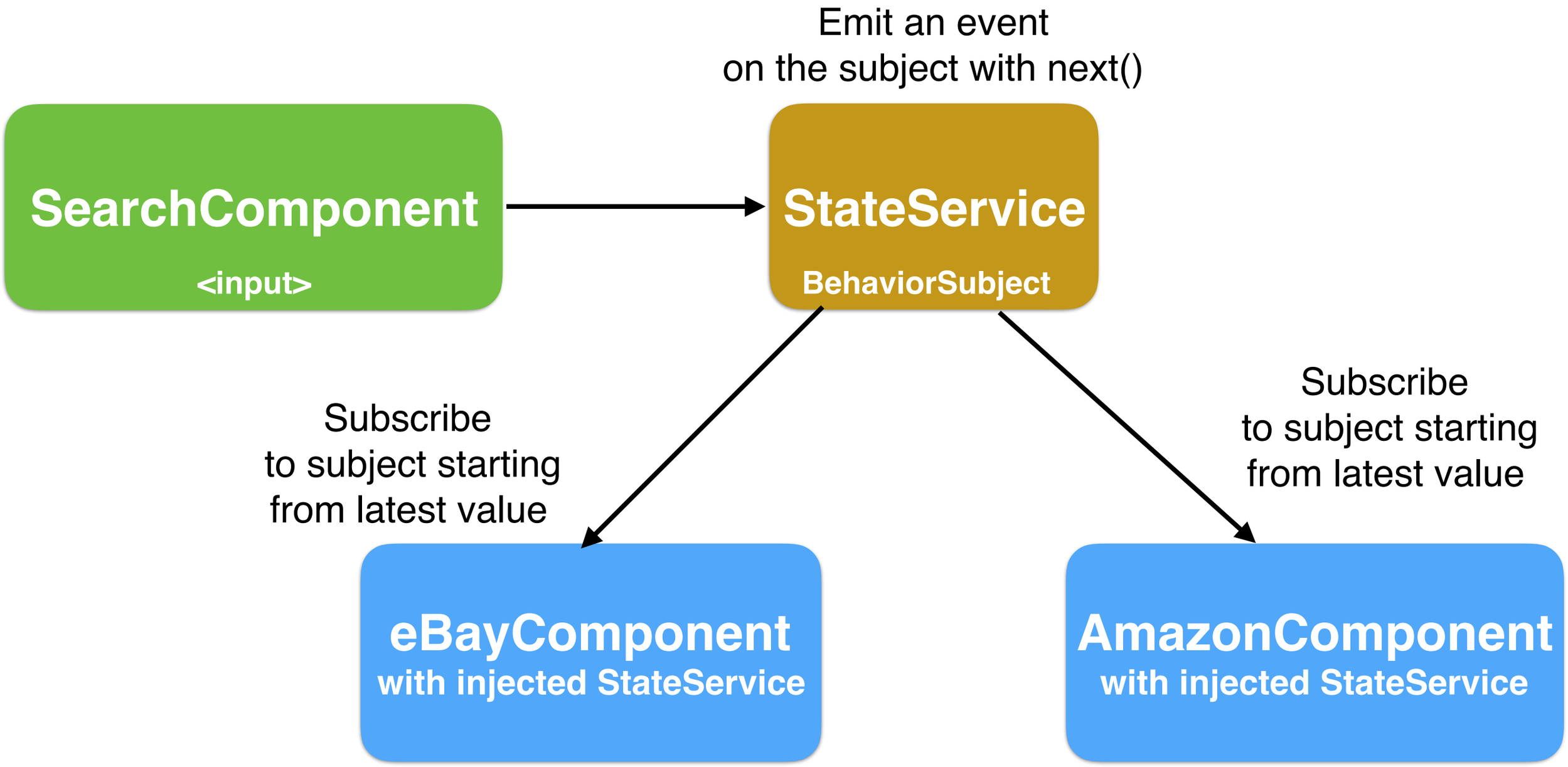
5 emits SomeEvent

6 and 8 subscribe
to SomeEvent

BehaviorSubject

- Includes an observable and observer(s)
- Remembers the last emitted value
- Every new subscriber gets the initial or last emitted value
- The last emitted value could represent your app state

Inter-component communications with BehaviorSubject



```ts
export class StateService{

  stateEvent: BehaviorSubject<string> = new BehaviorSubject('');

  set searchCriteria(value: string) {

    this.stateEvent.next(value);
  }
}
```

```ts
export class SearchComponent {

searchInput: FormControl;

constructor(private state: StateService){
  this.searchInput = new FormControl('');

  this.searchInput.valueChanges
    .debounceTime(300)
    .subscribe(searchValue =>
        this.state.searchCriteria = searchValue);
}
```

```ts
export class AmazonComponent implements OnDestroy{

  searchFor: string;
  subscription: Subscription;

  constructor(private state: StateService){

    this.subscription = state.getState()
      .subscribe(event => this.searchFor = event);
  }

  ngOnDestroy() {
    this.subscription.unsubscribe();  // a must
  }
}
```

EbayComponent uses async pipe instead of explicit subscription

Demo

- Review the code in the mediator-service directory

- ng serve mediator-service -o

- Enter any text in the search field of the top level component. The eBay component gets it from the state service via subscription

- Navigate to amazon. The `AmazonComponent` gets the value entered in the `SearchComponent`

- Add more text in the `SearchComponent`. `AmazonComponent` gets it via subscription

- Navigate back to eBay. The `EbayComponent` gets the latest text (i.e. state) from the service.

What have we learned

- Component receive data from their parents via `@Input` properties
- Components send data to their parents by emitting events via `@Output` properties
- The mediator design pattern is used for arranging inter-component communication in a loosely-coupled manner
- Using injectable services offers the most flexible way of inter-component communications

Angular Development with TypeScript

Unit 6: Reactive programming and Observable Streams

In this unit

- Intro to reactive programming
- Events as observables
- Observables in the router and forms
- Observable HTTP requests
- Shared subscriptions

RxJS Essentials

Watch my video training “RxJS Essentials”
at https://goo.gl/iN7M7S

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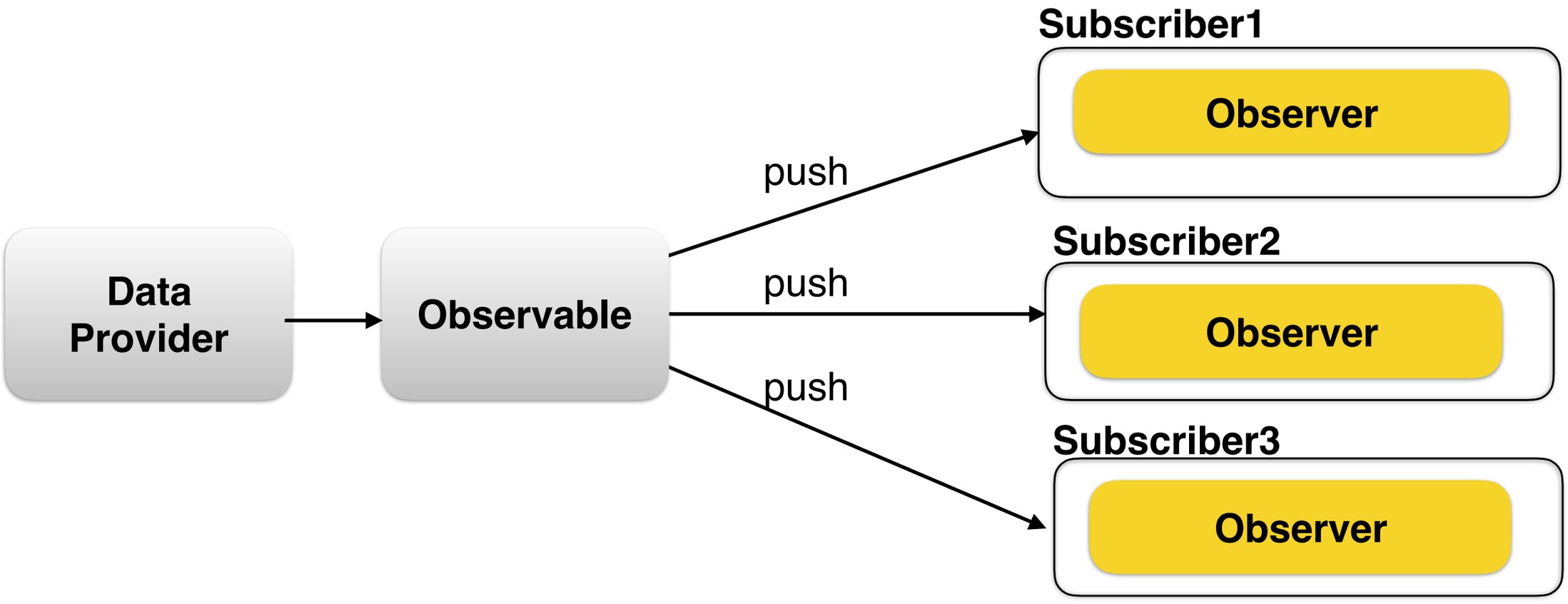
Main RxJS players

- **Observable** - data stream that pushes data over time
- **Observer** - consumer of an observable stream
- **Subscriber** - connects observer with observable
- **Operator** - en-route data transformation

Pushing data to subscribers



Subscribe to messages from `Observable` and handle them in the `Observer`

An Observable can:

- Subscribe/unsubscribe to its data stream
- Emit the next value to the observer
- Notify the observer about errors
- Inform the observer about the stream completion

An Observer can provide:

- A function to handle the next value from the stream
- A function to handle errors
- A function to handle end-of-stream

Creating an Observable

- from(myArray) - converts an array or Iterable into Observable
- Observable.create(myObserver) - returns an Observable that can invoke methods on myObserver
- of(1,2,3) - turns a sequence of values into an Observable
- fromEvent(myInput, ‘keyup’) - converts an event into an Observable
- interval(1000) - returns emits an integer every second

Demo
Observable.create()

https://codepen.io/yfain/pen/NMjgyp?editors=1111

An Operator

Observable →  → Observable

A transforming function

http://reactivex.io/rxjs/manual/overview.html#categories-of-operators

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Filter

Observable →  → Observable

```
observableProducts
    .filter(product => product.price < 8)
```

pure function

dot-chainable operators are deprecated

higher-order function

Marble Diagrams

http://rxmarbles.com

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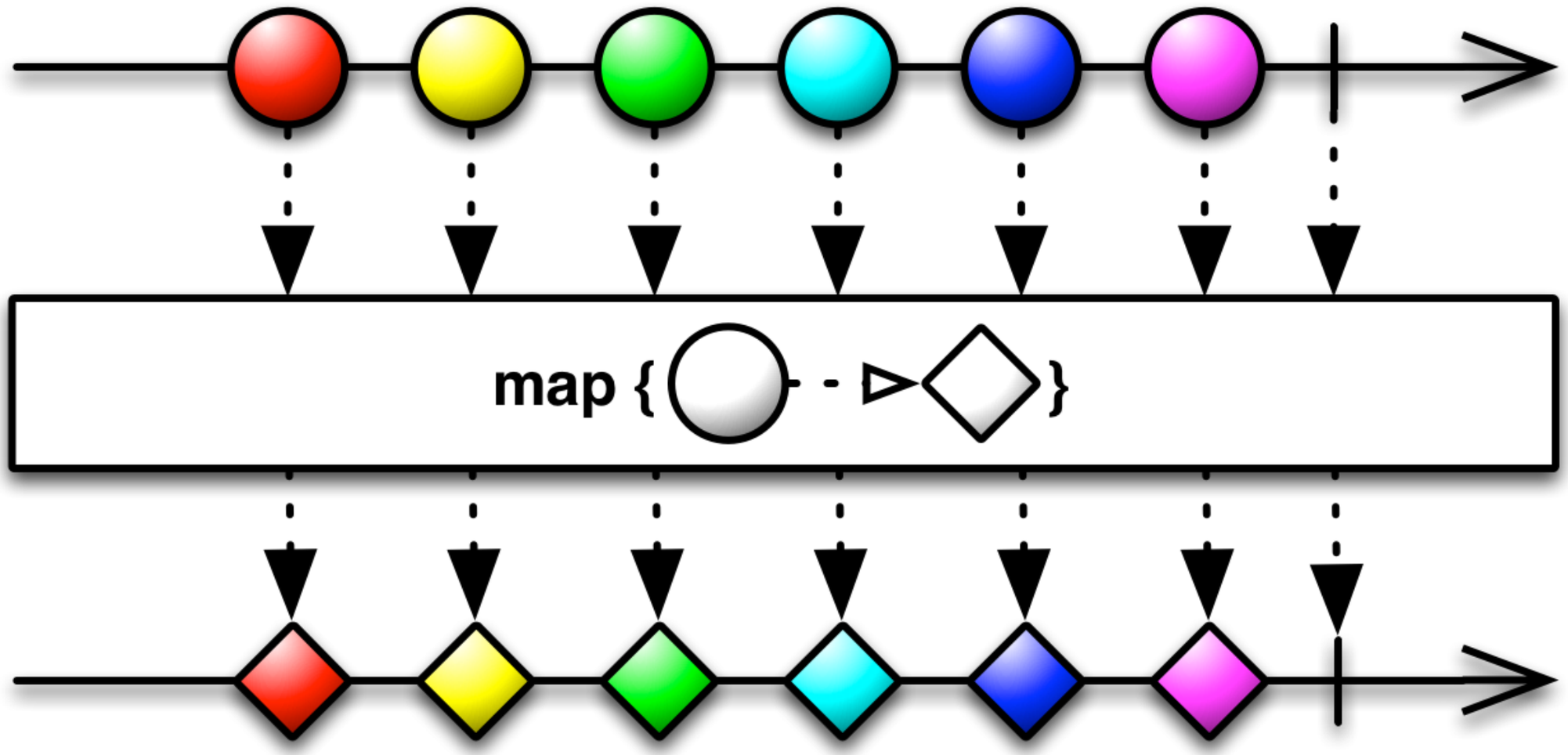
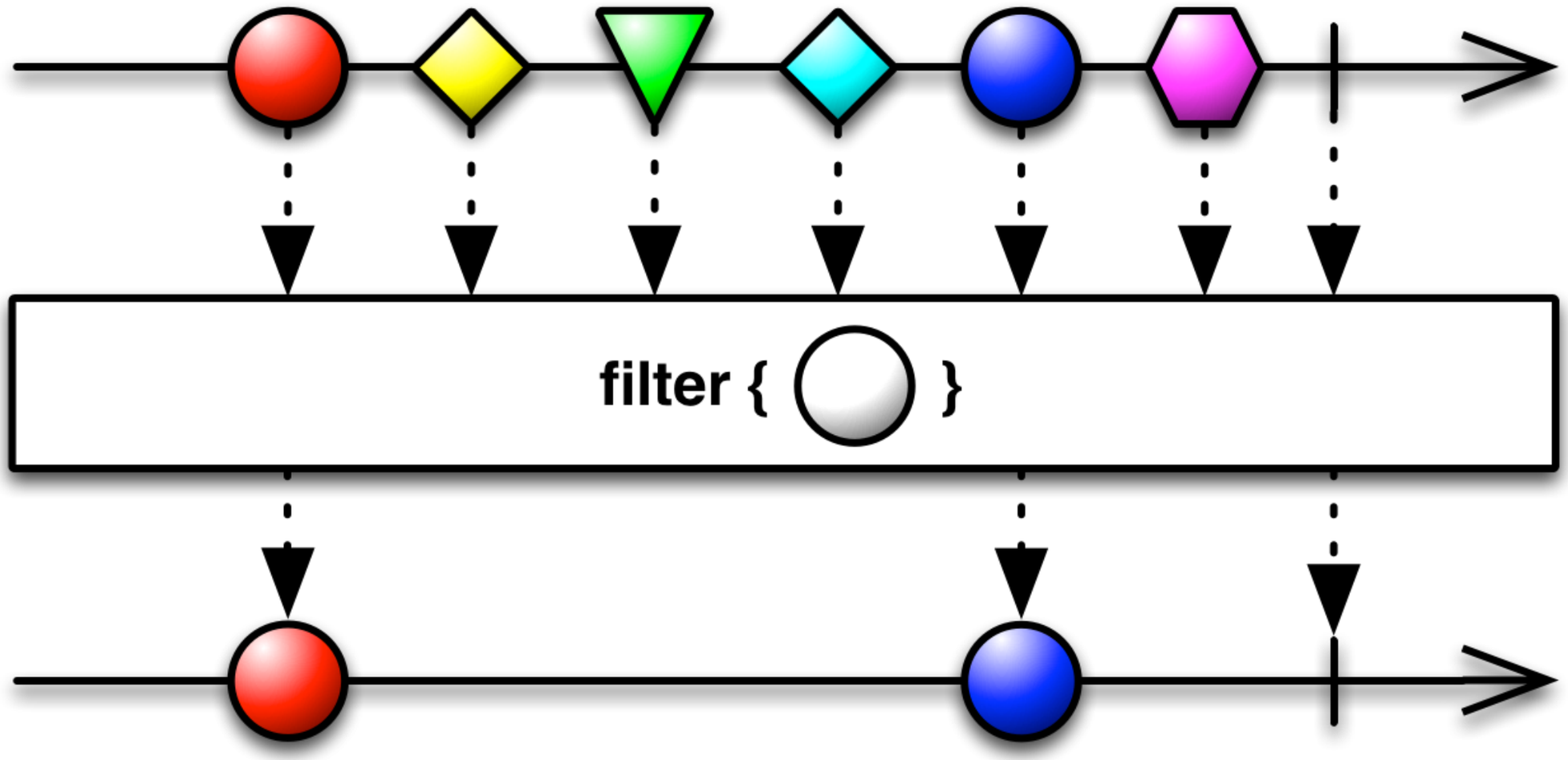
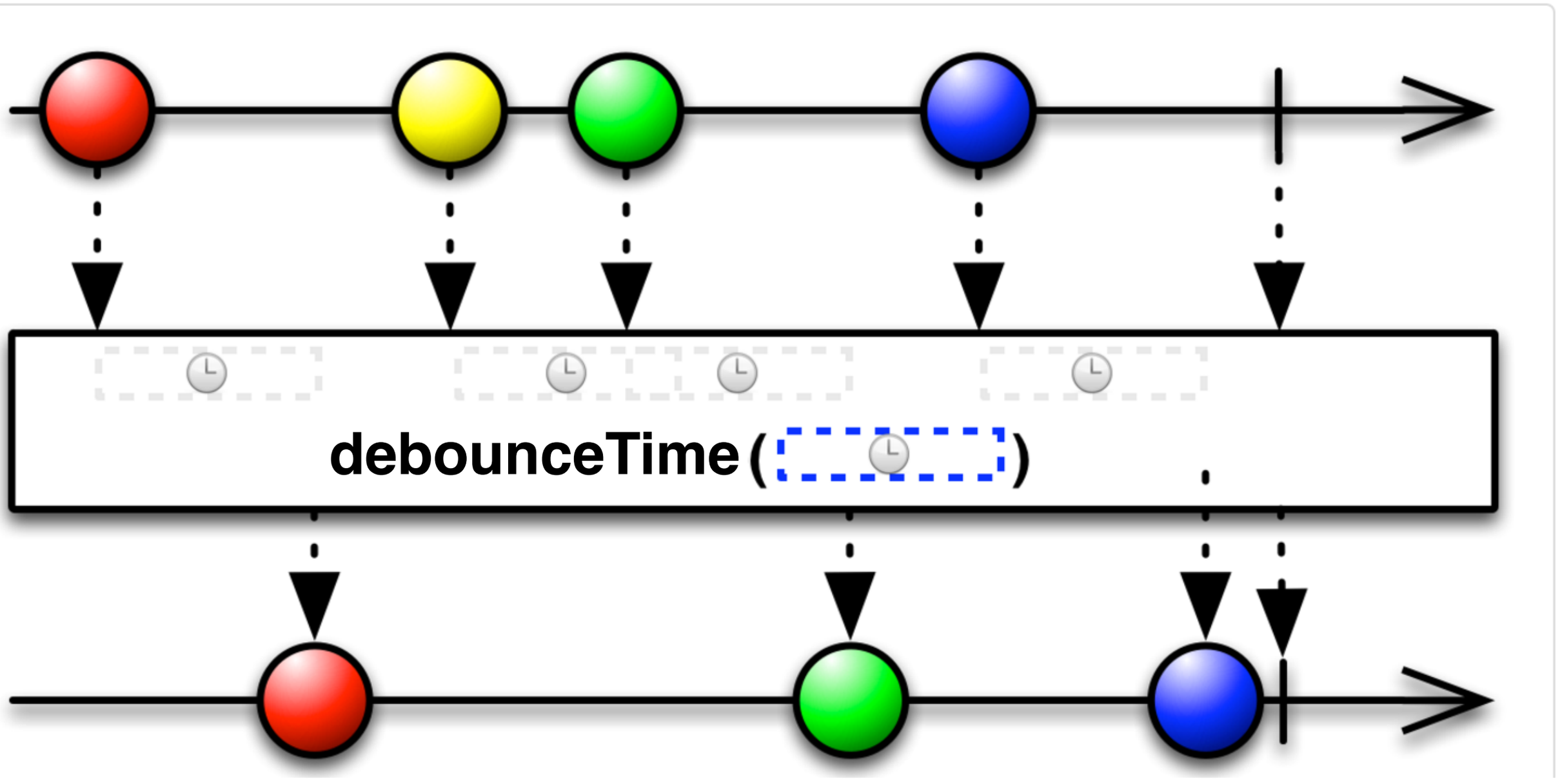
map



filter



debounceTime



Importing RxJS operators

- **RxJS 5**: Importing from rxjs/add/operator patches `Observable.prototype`

```
import 'rxjs/add/operator/debounceTime';

this.searchInput.valueChanges
      .debounceTime(500)
      .subscribe(stock => this.getStockQuoteFromServer(stock));
```

Importing RxJS operators

- **RxJS 5**: Importing from rxjs/add/operator patches `Observable.prototype`

```
import 'rxjs/add/operator/debounceTime';

this.searchInput.valueChanges
      .debounceTime(500)
      .subscribe(stock => this.getStockQuoteFromServer(stock));
```

- **RxJS 6**: Pipeable operators are pure functions and are tree-shakeable

```
import { debounceTime } from 'rxjs/operators';

this.searchInput.valueChanges
      .pipe(debounceTime(500))
      .subscribe(stock => this.getStockQuoteFromServer(stock));
}
```

Let’s have a beer

```
let beers = [
    {name: "Stella", country: "Belgium", price: 9.50},
    {name: "Sam Adams", country: "USA", price: 8.50},
    {name: "Bud Light", country: "USA", price: 6.50},
    {name: "Brooklyn Lager", country: "USA", price: 8.00},
    {name: "Sapporo", country: "Japan", price: 7.50}
];
```

Observable Beer

No streaming yet

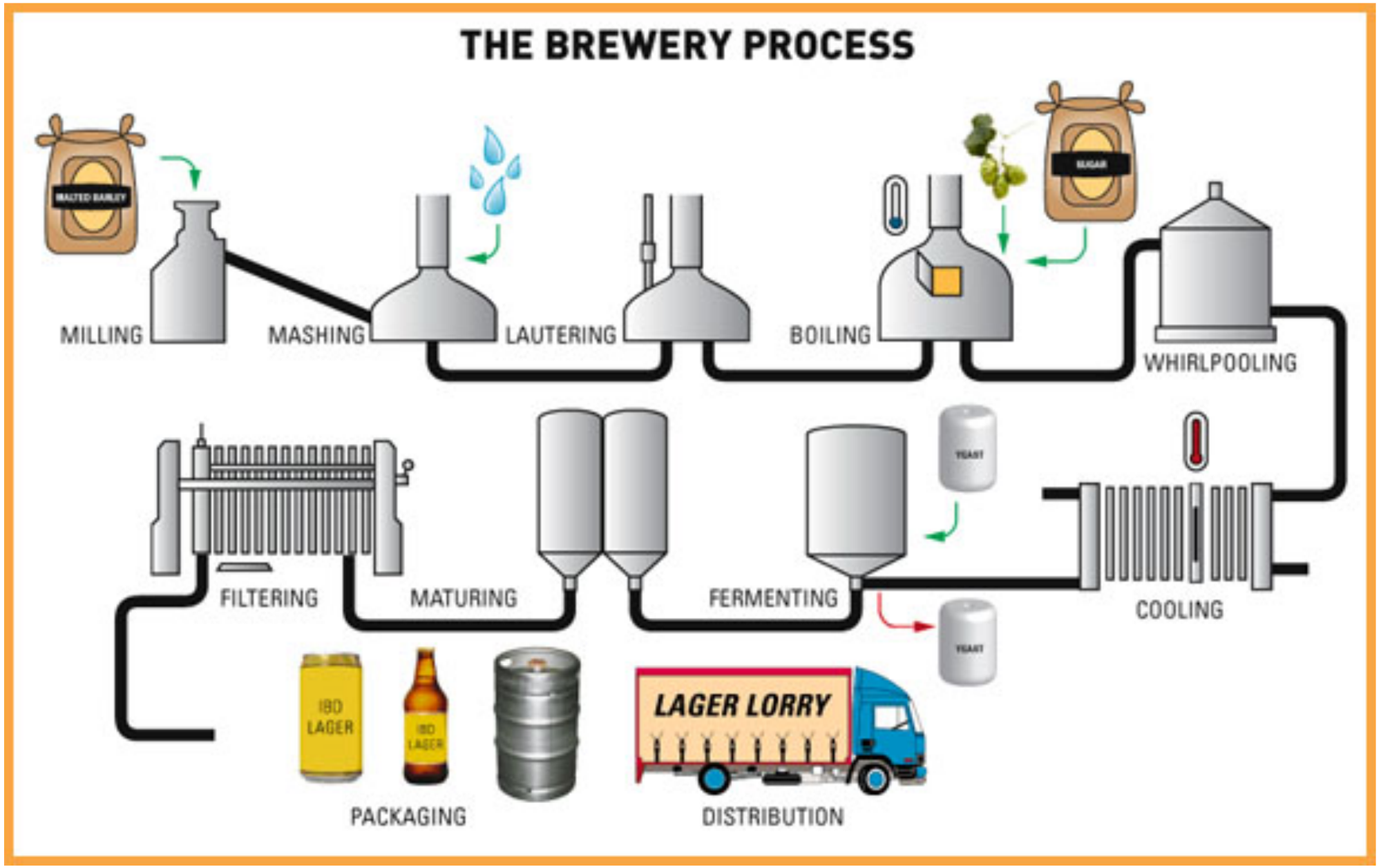
Streaming begins

```
const { from } = rxjs;
const { filter, map } = rxjs.operators;

observableBeers$ = from(beers)
    .pipe(
       filter(beer => beer.price < 8),
       map(beer => beer.name + ": $" + beer.price)
     );

observableBeers$
    .subscribe(
        beer => console.log(beer),
        err  => console.error(err),
        ()   => console.log("Streaming is over")
    );
```

Demo
from() + filter + map()

https://codepen.io/yfain/pen/OZmgmM?editors=1012

RX: the data moves across your algorithm



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Operator

Operator

Operator

Operator

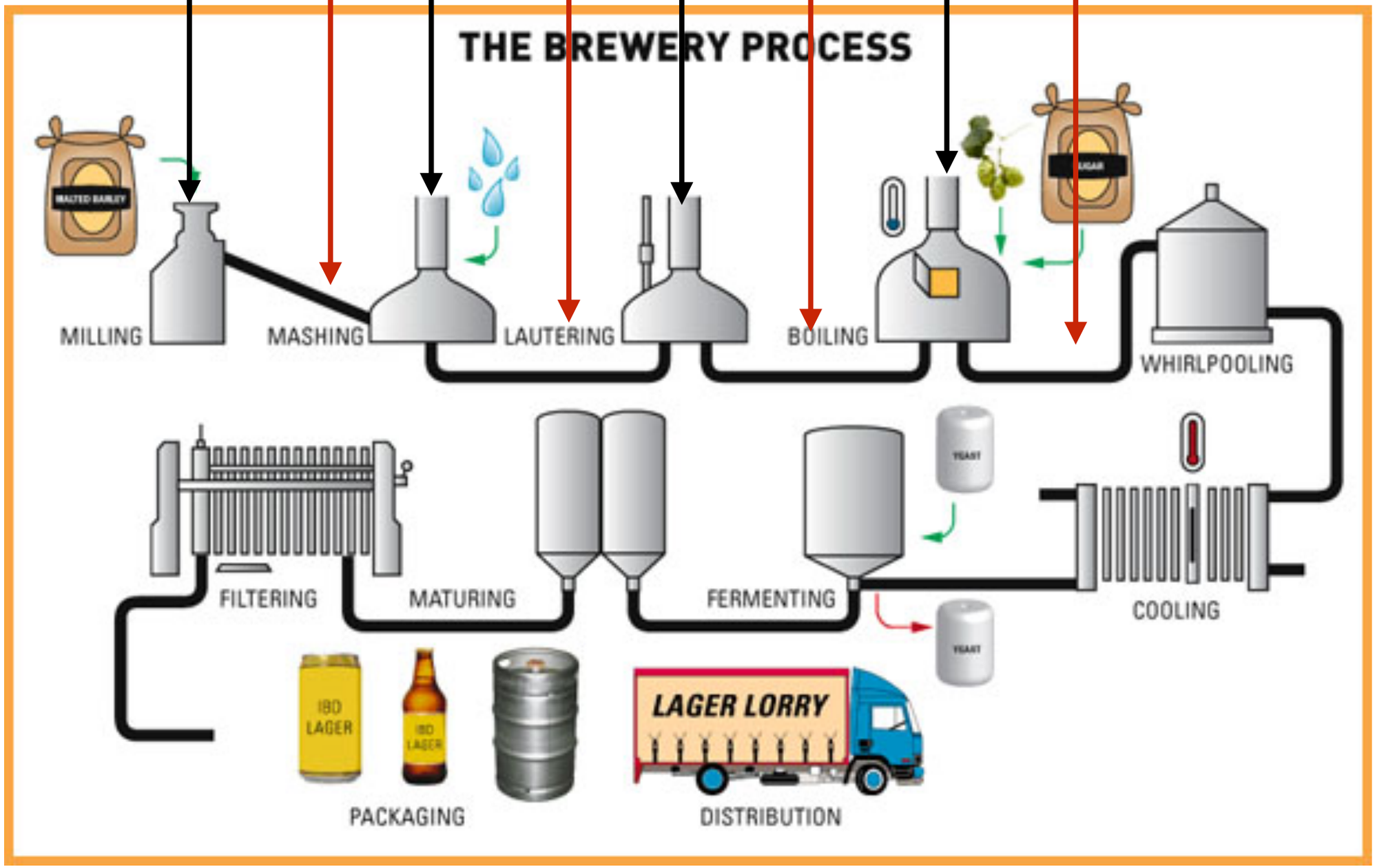
Observable

Observable

Observable

Observable

Observable



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Error-handling operators

- `error()` is invoked by the Observable on the Observer.
- `catchError()` - intercepts the error in the subscriber before the observer gets it. Replaces RxJS 5 `catch()`.
- `retry(n)` - retry immediately up to n times
- `retryWhen(fn)` - retries as prescribed by the argument function

Failover with catchError()

```
function getData(): Observable {…} // data source 1

function getCachedData(): Observable {…} // data source 2

function getDataFromAnotherService(): Observable {…} // data source 3


getData()
  .pipe(
    .catchError(err => {

        if (err.status === 500){
            console.error("Switching to streaming cached beer data");
            return getCachedData();

        } else{
            console.error("Switching to another beer service");
            return getDataFromAnotherService();
        }

 }),
 map(beer => beer.name + ", " + beer.country)
)
.subscribe(
     beer => console.log("Subscriber got " + beer)
);
```

Failover

See it in CodePen: https://codepen.io/yfain/pen/OZgpZx?editors=1011

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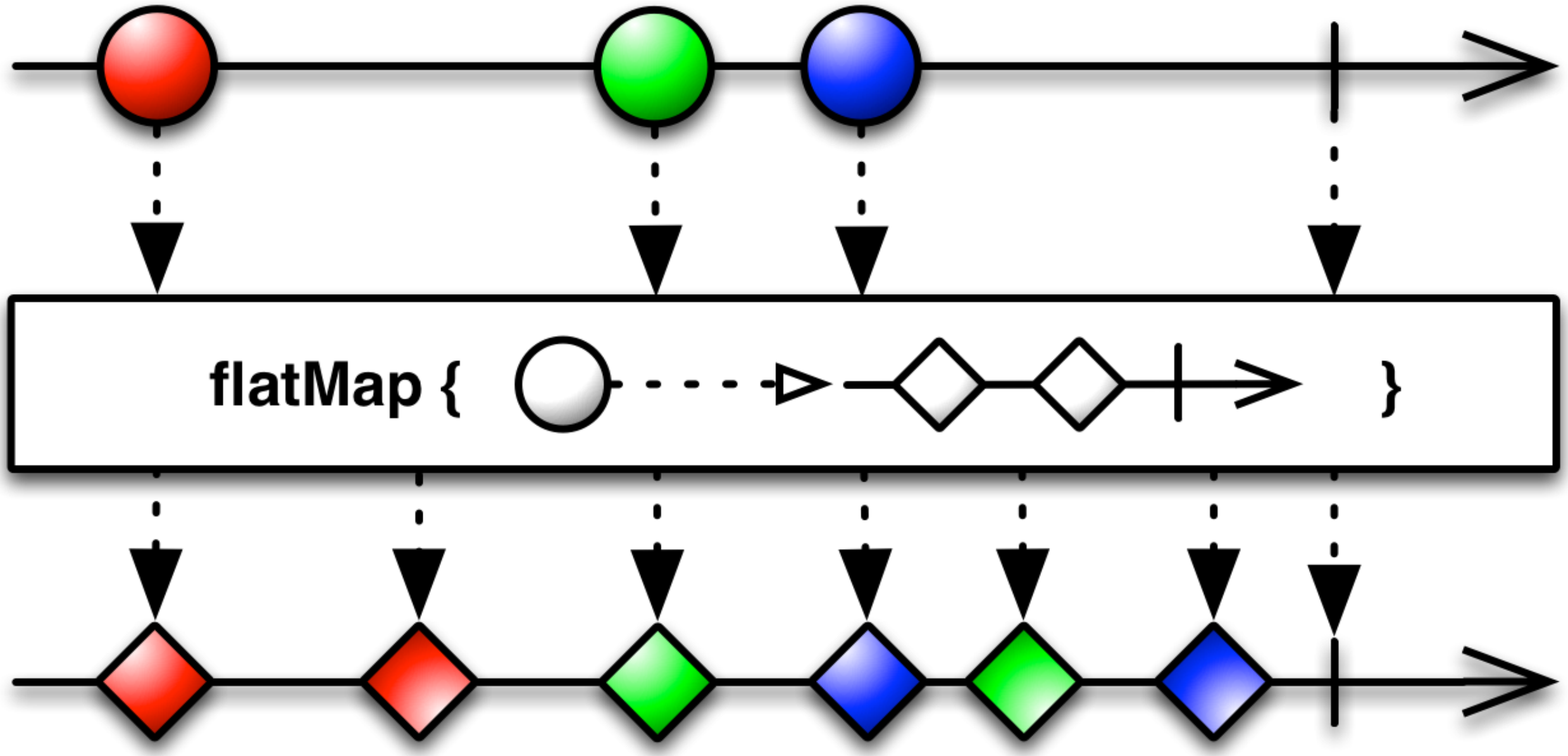
flatMap



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Operator flatMap

- Handles every value emitted by an observable as another observable

- Auto-subscribes to the internal observable and unwraps it

```
function getDrinks() {

    let beers = from([
        {name: "Stella", country: "Belgium", price: 9.50},
        {name: "Sam Adams", country: "USA", price: 8.50},
        {name: "Bud Light", country: "USA", price: 6.50}
    ]);

    let softDrinks = from([
        {name: "Coca Cola", country: "USA", price: 1.50},
        {name: "Fanta", country: "USA", price: 1.50},
        {name: "Lemonade", country: "France", price: 2.50}
    ]);

    return Observable.create( observer => {
            observer.next(beers);         // pushing the beer pallet (observable)
            observer.next(softDrinks);    // pushing the soft drinks pallet (observable)
        }
    );
}

getDrinks()
    .pipe(
     .flatMap(drinks => drinks)           // unloading drinks from pallets
    )
    .subscribe(
       drink => console.log("Subscriber got " + drink.name + ": " + drink.price )
    );
```

See it in CodePen: https://codepen.io/yfain/pen/MGopzx?editors=1011

The side-effect operator tap()

- Can perform a side effect for every emitted value
- Returns an observable that is identical to the source
- Replaces the deprecated `do()` operator

```
myObservable$
  .pipe(
    tap(beer => console.log(`Before: ${beer}`)),
    map(beer => `${beer.name}, ${beer.country}`),
    tap(beer => console.log(`After: ${beer}`))
  )
  .subscribe(...);
```

Observables in Angular

- Router
- Reactive Forms
- Handling HTTP responses
- AsyncPipe

Observables in Forms

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FormControl

- `valueChanges` - the value of the form control changes

```
this.searchInput.valueChanges.subscribe(…);
```

- `statusChanges` - status of the form control (valid/invalid)

```
this.password.statusChanges.subscribe(…);
```

Observable Events

```
@Component({
    selector: "app",
    template: `
      <h2>Observable events demo</h2>
      <input type="text" placeholder="Enter stock" [formControl]="searchInput">
    `
})
class AppComponent implements OnInit {

    searchInput: FormControl;

    constructor(){
        this.searchInput = new FormControl('');
    }

    ngOnInit(){
        this.searchInput.valueChanges
           pipe(
            debounceTime(500)
           )
           .subscribe(stock => this.getStockQuoteFromServer(stock));
    }

    getStockQuoteFromServer(stock) {

        console.log(`The price of ${stock} is ${100*Math.random().toFixed(4)}`);
    }
}
```

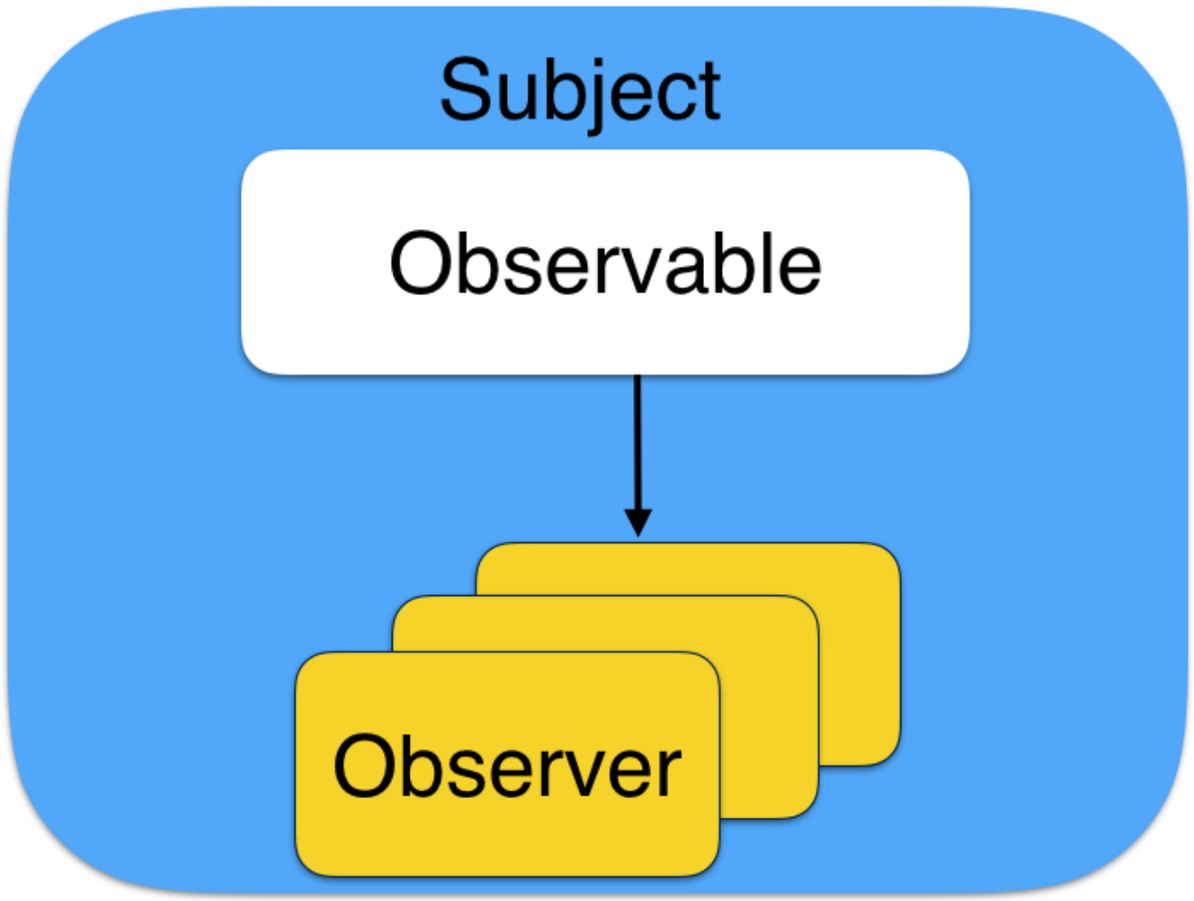
Observable

Walkthrough 6.1

- Open the directory **unit6/observables** in your IDE
- npm i
- This app subscribes to observable events from the `FormControl` Review the code in the directory **formcontrol**.
- ng serve formcontrol -o
- Open the browser console
- Enter any stock symbol to see the generated price on the console
- Because of `debounceTime(),` the `FormControl`'s observable emits when the interval between entering characters is more than 500 milliseconds

Multi-casting with Subject

Rx.Subject is both an observable and observer




```
const mySubject = new Subject();
...
subscription1 = mySubject.subscribe(...);
subscription2 = mySubject.subscribe(...);
...
mySubject.next(123); // each subscriber gets 123
```

BehaviorSubject

- Includes an observable and observer(s)
- Remembers the last emitted value
- Every new subscriber gets the initial or last emitted value
- The last emitted value could represent your app state

Revisit the mediator service example from unit 4

HttpClient and Observables

```
@Component({
    selector: 'http-client',
    template: `<h1>All Products</h1>
  <ul>
    <li *ngFor="let product of products">
       {{product.title}}
    </li>
  </ul>
  `})
class AppComponent implements OnInit{

  products: Array = [];

  constructor(private http: HttpClient) {}

  ngOnInit() {
    this.http.get<Product[]>('/products')
        .subscribe(
           data => {
              this.products=data;
          },
          err =>
             console.log("Can't get products. Error code: %s, URL: %s ",
                                                    err.status, err.url),
           () => console.log('Product(s) are retrieved')
       );
  }
}
```

Observer

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Async pipe

Auto-subscribes/unsubscribes and unwraps the `Observable` in the component's template

```
@Component({
  selector: 'http-client',
  template: `<h1>All Products</h1>
  <ul>
    <li *ngFor="let product of products$ | async">
       {{product.title}}
    </li>
  </ul>
   {{errorMessage}}
  `})
class AppComponent implements OnInit{

  products$: Observable<Product[]>;
  errorMessage: string;

  constructor(private http: HttpClient) {}

  ngOnInit() {
    this.products$ = this.http.get<Product[]>('/products')
      .pipe(
        catchError( err => {
                this.errorMessage =`Can't get product details from ${err.url},
                                    error ${err.status} `;
                return Observable.empty();
                });
      )
  }
}
```

```
export interface Product {
   id: number;
   title: string;
   price: number
}
```

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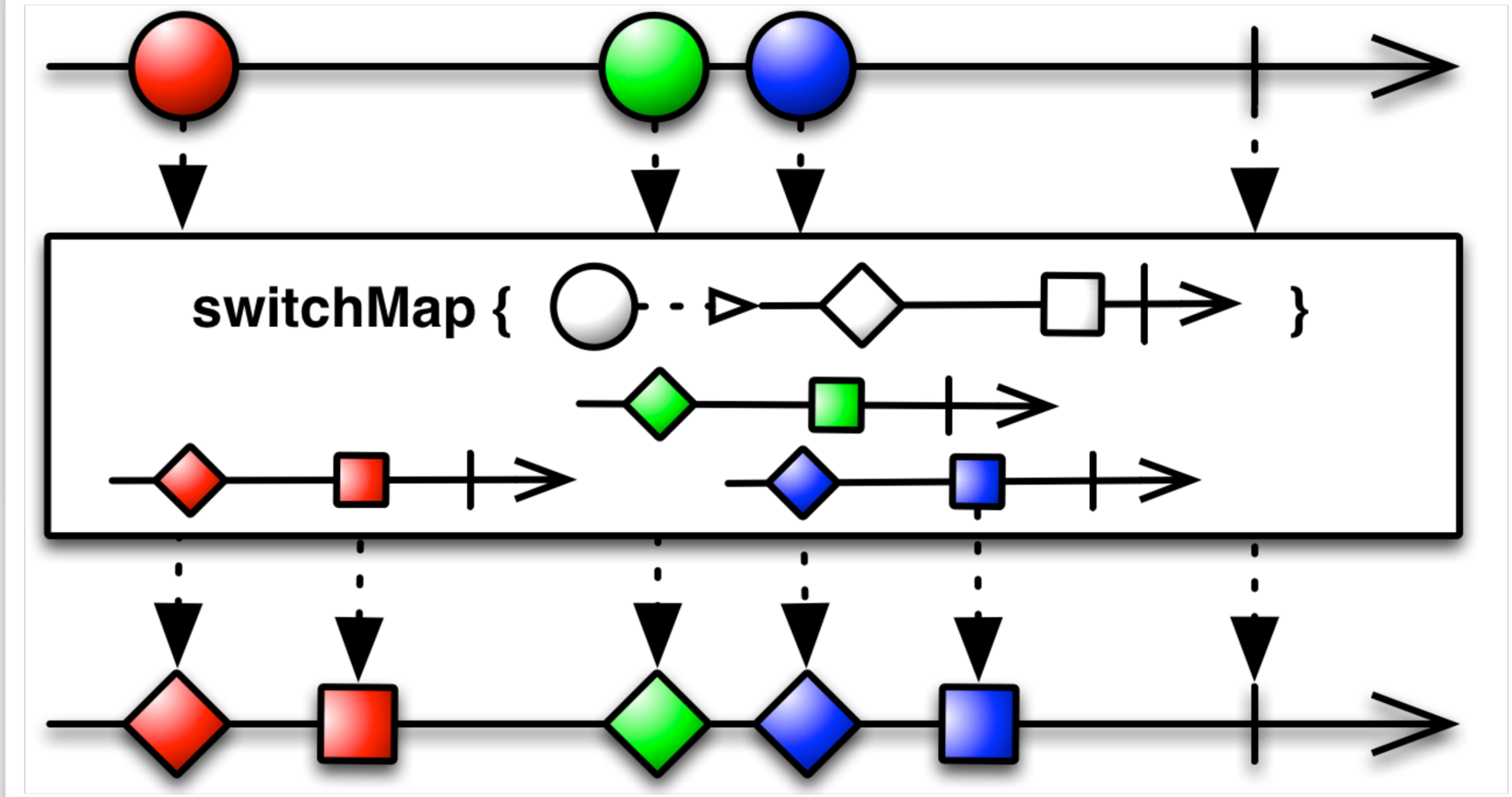
The switchMap operator



http://reactivex.io/documentation/operators/images/switchMap.png

Killing HTTP requests with switchMap

```
@Component({
  selector: "app-root",
  template: `
    <h2>Observable weather</h2>
    <input type="text" placeholder="Enter city" [formControl]="searchInput">
    <h3>{{temperature}}</h3>
  `
})
export class AppComponent {
  private baseWeatherURL: string= 'http://api.openweathermap.org/data/2.5/weather?q=';
  private urlSuffix: string = “&units=imperial&appid=12345"; // use the real appid

  searchInput: FormControl = new FormControl();
  temperature: string;

  constructor(private http: HttpClient){

    this.searchInput.valueChanges
      .pipe(
      switchMap(city => this.getWeather(city))
      )
      .subscribe(
        res => {
          this.temperature =
            `Current temperature is  ${res['main'].temp}F, ` +
            `humidity: ${res['main'].humidity}%`;
        },
        err => console.log(`Can't get weather. Error code: %s, URL: %s`, err.message, err.url)
      );
  }

  getWeather(city: string): Observable<Array<string>> {
    return this.http.get(this.baseWeatherURL + city + this.urlSuffix)
      .pipe(catchError( err => {
        if (err.status ===404){
          console.log(`City ${city} not found`) ;
          return Observable.empty()}    // empty observable
      }));
  }
}
```

Outer Obs.

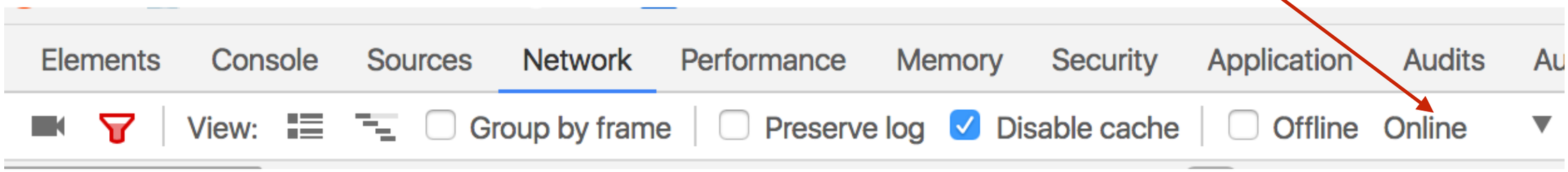
Inner Obs.

Walkthrough 6.2 (start)

- ng serve weather -o
- Open the Network tab in Chrome Dev Tools
- Enter the name of a city and the app renders the weather
- The Network tab shows multiple HTTP requests/responses as you type
- Open the Console tab - if the city was not found, the 404 error was handled by `catch()`

Walkthrough 6.2 (end)

- Open Developer Tools in the Network tabs and emulate slow connection by changing the Online mode to Slow 3G



- Start typing the name of the city

- Note how the app sends several HTTP requests and all of them were cancelled except the last one.

Observables in the Router

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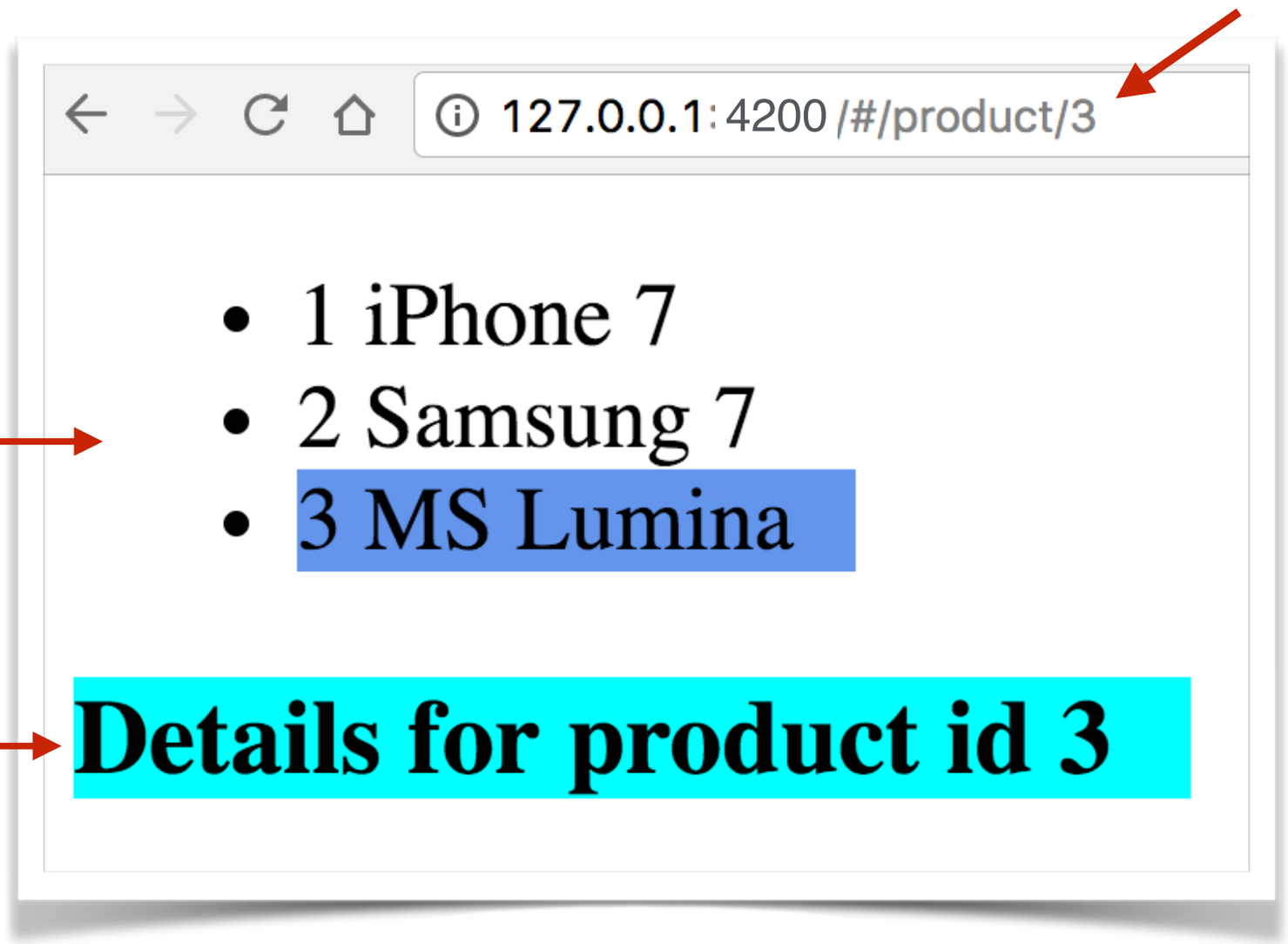
ActivatedRoute (fragment)

```
export declare class ActivatedRoute {
    /** An observable of the URL segments matched by this route */
    url: Observable<UrlSegment[]>;
    /** An observable of the matrix parameters scoped to this route */
    params: Observable<Params>;
    /** An observable of the query parameters shared by all the routes */
    queryParams: Observable<Params>;
    /** An observable of the URL fragment shared by all the routes */
    fragment: Observable<string>;
    /** An observable of the static and resolved data of this route. */
    data: Observable<Data>;
    /** The outlet name of the route. It's a constant */
    readonly paramMap: Observable<ParamMap>;
    readonly queryParamMap: Observable<ParamMap>;
    toString(): string;
    ...
}
```

Receiving params in ActivatedRoute

- Inject `ActivatedRoute` into a component to receive the route params
- Use `ActivatedRoute.snapshot` to get params **once**
- Use `ActivatedRoute.paramMap.subscribe()` for receiving **changing** params over time

Master-Detail with Router



Parent component

<router-outlet>

```
const routes: Routes = [
    {path: 'productDetail/:id', component: ProductDetailComponent}
];
…

class AppComponent {
  …
    constructor(private _router: Router){}

    onSelect(prod: Product): void {
         this._router.navigate(["/productDetail", prod.id]);
    }
}
```

```
export class ProductDetailComponent {

  productID: string;

  constructor(private route: ActivatedRoute) {

    this.route.paramMap
      .subscribe(params => this.productID = params.get('id'));
  }
}
```

Demo

- ng serve master-detail -o
- Click on the item in the list (master), and the detail component will reflect the change

What have we learned

- An observable emits data over time
- An observer contains code to handle data
- RxJS has lots of pipeable operators that can transform observable data en route
- Angular offers observable streams in Forms, Router, `HttpClient`
- The `switchMap` operator allows an app to abandon unwanted HTTP responses

Angular Development with TypeScript

Unit 7: Component lifecycle and change detection

In this unit

- Change detection
- Component lifecycle

Change Detection

Change Detection (CD)

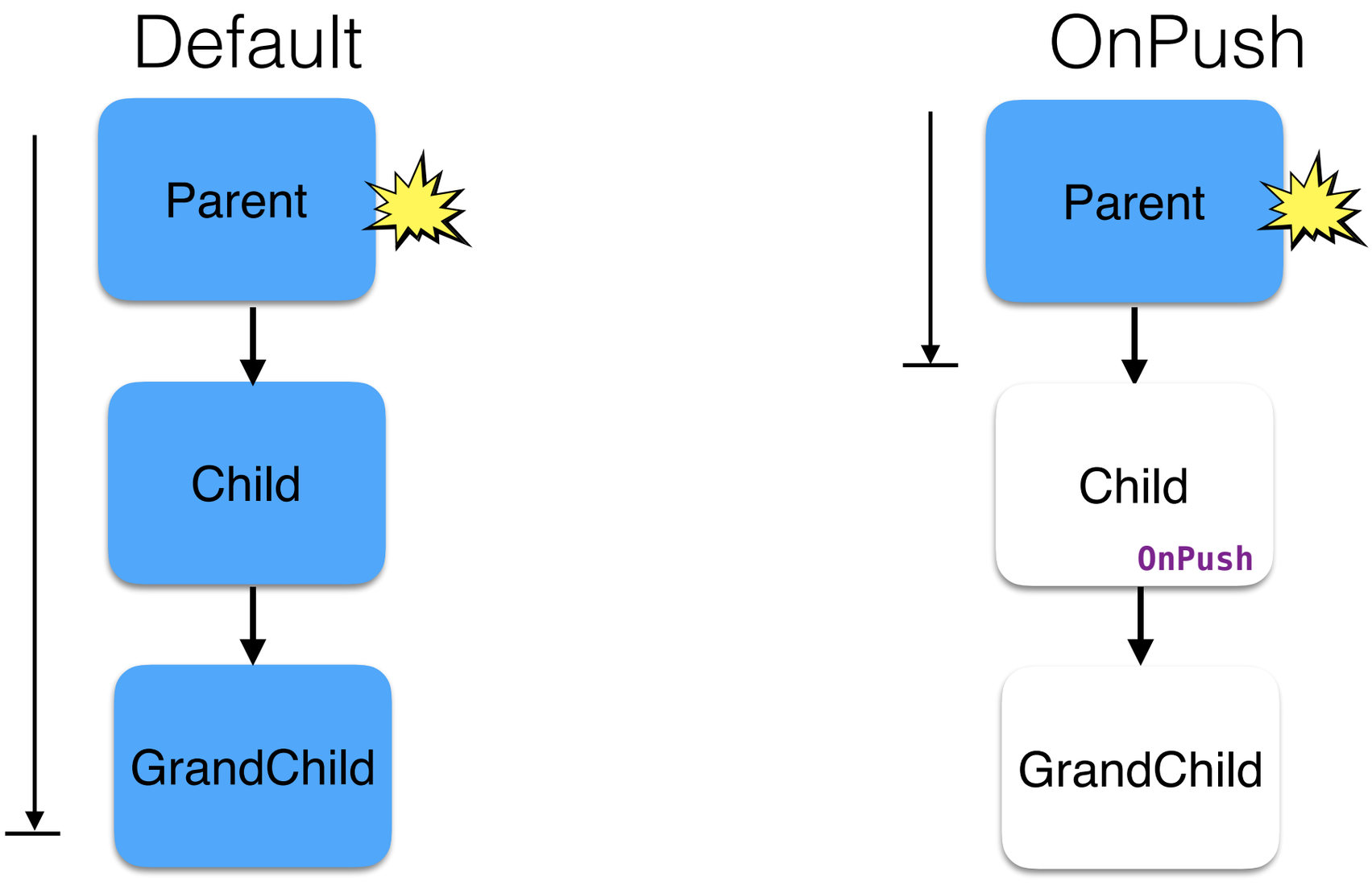
- CD is about updating the view whenever the underlying model changes

- The CD mechanism patches asynchronous browser's actions:
  - `addEventListener()`
  - `setTimeout()`, `setInterval()`
  - HTTP and WebSocket requests

- CD is implemented in the library **zone.js**

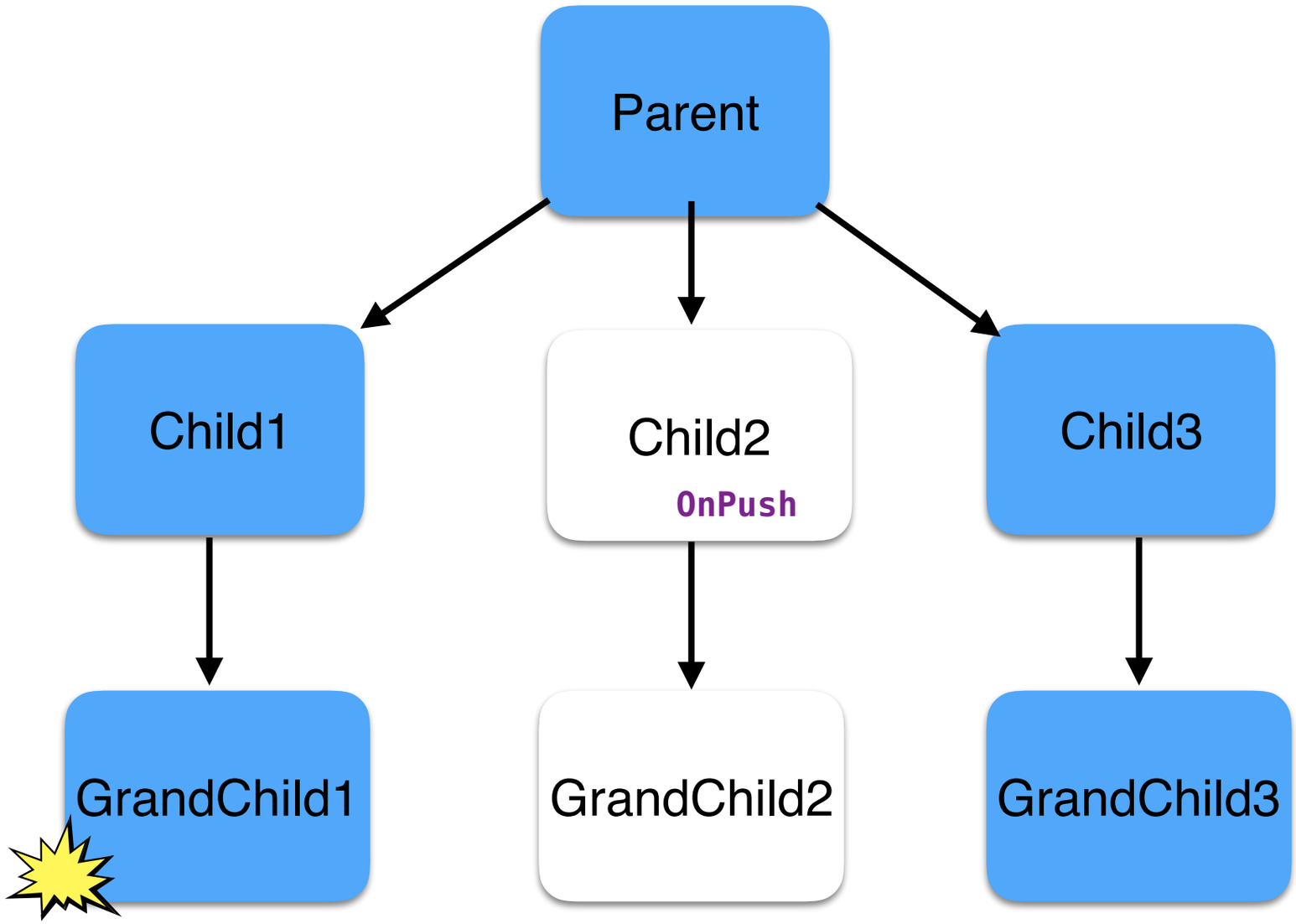
CD strategies: Default vs OnPush

`changeDetection: ChangeDetectionStrategy.OnPush`



With **`OnPush`** strategy the Zone won't check a component unless the reference of the value bound to its `@Input` properties change.

CD strategies: default vs OnPush



A change in the GrandChild1 will start the change detection pass in all blue components.

Prod vs Dev Mode

- In dev mode:
  - Change detector runs twice
  - Additional debug info is included in the compiled code
  - Additional warnings may be printed on the console

- Enable prod mode before bootstrapping the app:

```
import {enableProdMode} from '@angular/core';
…
enableProdMode();

platformBrowserDynamic().bootstrapModule(AppModule);
```

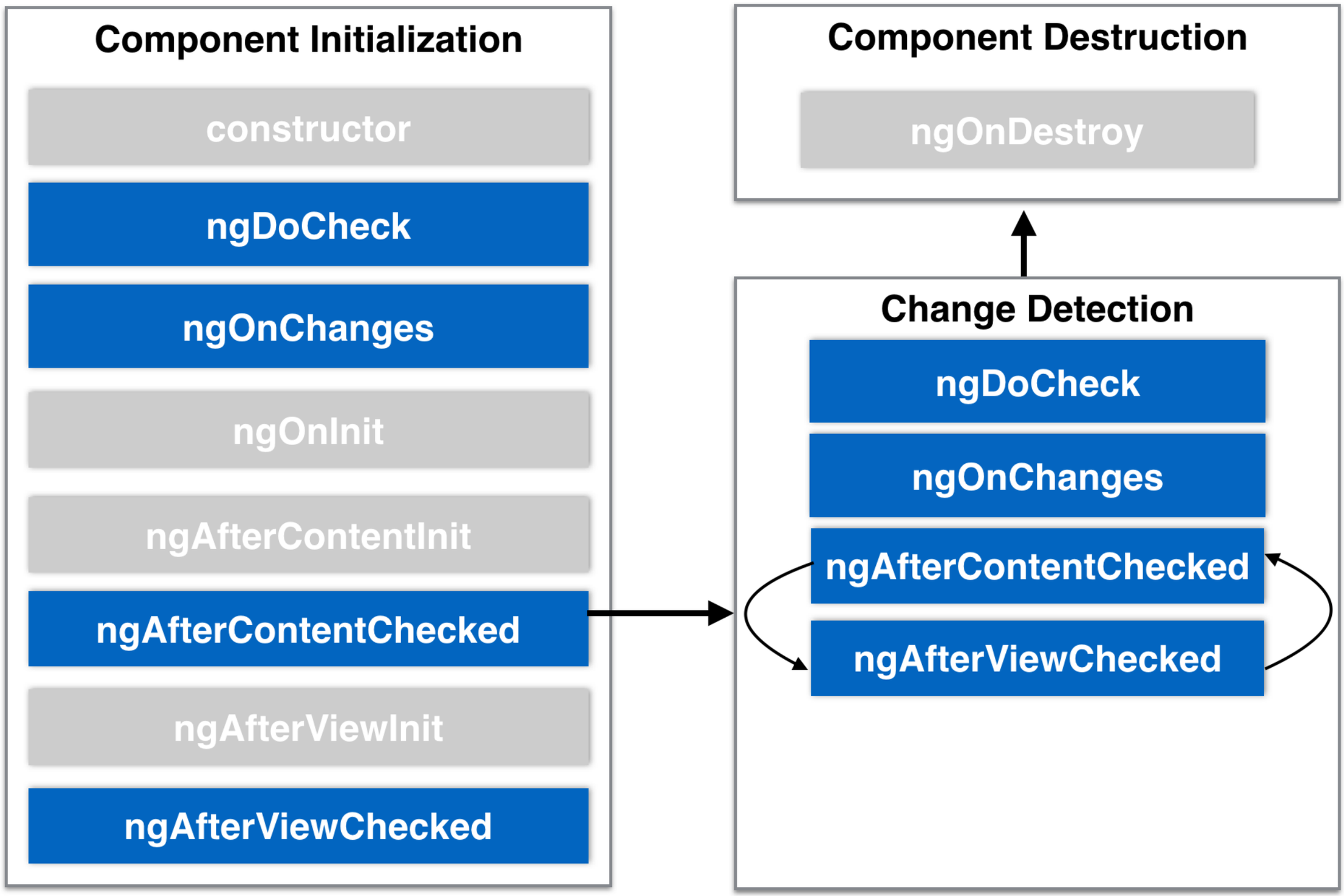
Component Lifecycle

Documentation: https://angular.io/docs/ts/latest/guide/lifecycle-hooks.html

Component's Lifecycle

- Component gets created and initialized
- Change-detection mechanism starts monitoring the component
- You can intercept component lifecycle's key moments by implementing lifecycle hook interfaces
- Angular calls the hooks only if you implemented them
- Component gets destroyed

Component lifecycle hooks



Implementing lifecycle hooks

`OnInit, OnChanges, AfterViewInit, AfterViewChecked etc.`

```
@Component({
  selector: 'my-component',
  template: '…'
})
class MyComponent implements OnInit, OnChanges {

…

ngOnInit() {
    console.log(`In ngOnInit`);
  }

 ngOnChanges() {
    console.log(`In ngOnChanges`);
  }


}
```

ngOnInit()

- By the time `ngOnInit()` is called, component properties are initialized
- `ngOnInit()` is often used for fetching data.
- Place the code that uses component's properties in `ngOnInit()`.

```
@Input() productId: number;

constructor(private productService: ProductService) {}

ngOnInit(){
  this.product = this.productService.getProductById(this.productId);
}
```

ngOnChanges() in child intercept input properties changes

Parent

```
@Component({
  selector: 'app',
  styles: ['.parent {background: lightblue}'],
  template: `
   <div class="parent">
  <h2>Parent</h2>
  <div>Greeting: <input type="text" [(ngModel)]="myGreeting"></div>
  <div>User name: <input type="text" [(ngModel)]="myUser.name"></div>

  <child [greeting]="myGreeting" [user]="myUser"></child>
</div>

  `
})
class AppComponent {
  myGreeting = 'Hello';
  myUser: {name: string} = {name: 'John'};
}
```

ngOnChanges() in child intercept input properties changes

Parent

```
@Component({
  selector: 'app',
  styles: ['.parent {background: lightblue}'],
  template: `
   <div class="parent">
  <h2>Parent</h2>
  <div>Greeting: <input type="text" [(ngModel)]="myGreeting"></div>
  <div>User name: <input type="text" [(ngModel)]="myUser.name"></div>

  <child [greeting]="myGreeting" [user]="myUser"></child>
</div>

  `
})
class AppComponent {
  myGreeting = 'Hello';
  myUser: {name: string} = {name: 'John'};
}
```

Child

```
@Component({
  selector: 'child',
  styles: ['.child{background: lightgreen}'],
  template: `
     <div class="child">
      <h2>Child</h2>
      <div>Greeting: {{greeting}}</div>
      <div>User name: {{user.name}}</div>
    </div>
  `
})
class ChildComponent implements OnChanges {
  @Input() greeting: string;
  @Input() user: {name: string};

  ngOnChanges(changes: {[key: string]: SimpleChange}) {
    console.log(JSON.stringify(changes, null, 2));
  }
}
```

Mutable vs Immutable

- JavaScript primitives are immutable

```
let greeting = "Hello";   // allocates an address in memory for greeting
greeting = "Hello Mary”;  // allocates another address in memory
```

- JavaScript objects are mutable

```
let user = {name: "John"}; // allocates an address for the var user
user.name = "Mary";        // the address of the var user remains the same
```

Walkthrough 7.1

- Open the project **unit7/lifecycle**
- Review the code in the directory comp-lifecycle. In the `ChildComponent` note the the argument of `ngOnChanges()`
- ng serve lifecycle -o
- In the Dev Tools console, note the params received by `ngOnChanges()`
- Change the value in the field **Greeting** - `ngOnChanges()` is invoked (`greeting` is immutable)
- Change the value in the field **User name** - `ngOnChanges()` is **not** invoked (`user` is mutable)

What have we learned

- Lifecycle hooks methods are invoked at specific moments of the component life span

- The code for initial data fetch is typically placed in `ngOnInit()`

- Change detection is the controlled by zone.js and is performed automatically

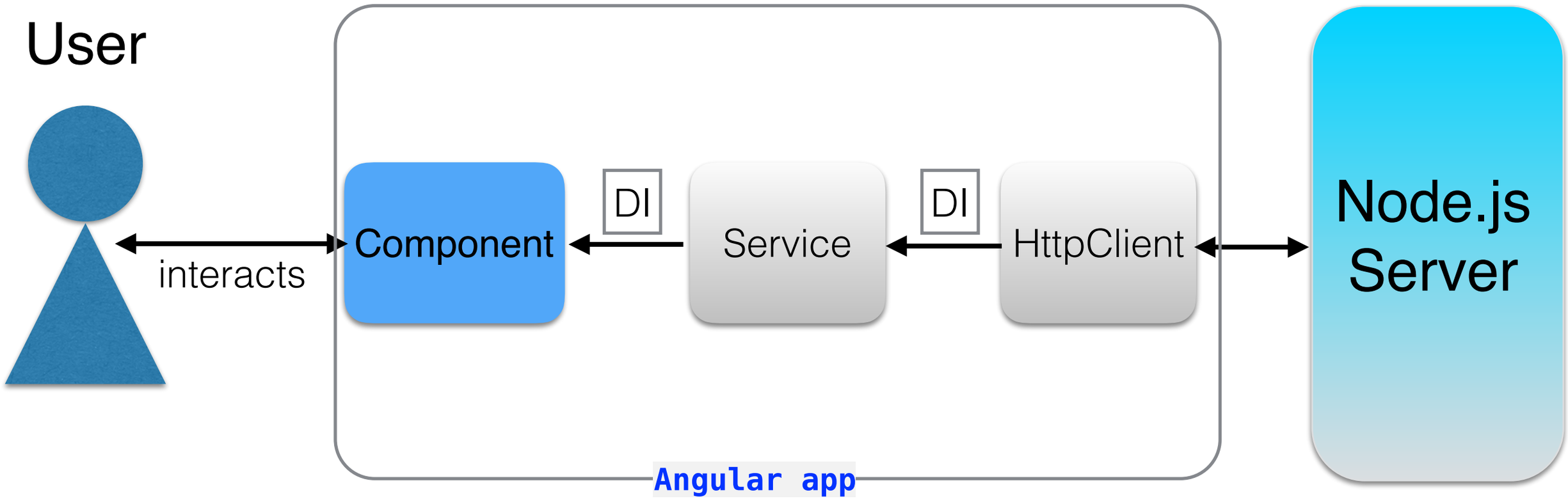
Angular Development with TypeScript

Unit 9: Communicating with a web server using HTTP

In this unit

- Creating a simple HTTP server with Node.js
- Working with the Angular HttpClient object
- Deploying apps on Node server with Angular CLI
- Bundling the auction and deploying it on the Node.js server

Let's develop an app



NodeJS can be replaced with Java, .Net, or other technology.

Angular and Node.js

Angular app

```
data: Observable<Product[]>;

constructor(httpClient: HttpClient) {
    this.data = httpClient
                    .get<Product[]>('/products');
  }
```

Node.js server

```
app.get('/products', (req, res) =>
        res.send('Got a request for products'
);
```

The server

Node.js

package.json (server)

```
{
  "name": "node-servers",
  "description": "Node and Express samples",
  "private": true,
  "scripts": {
    "devRest": "node build/rest-server.js",
    "devRestAngular": "node build/rest-server-angular.js"
  },
  "dependencies": {
    "express": "^4.16.4"
  },
  "devDependencies": {
    "@types/express": "^4.16.0",
    "@types/node": "^10.12.0",
    "typescript": "^3.1.3"
  }
}
```

tsconfig.json for the server

```
{
  "compilerOptions": {
    "module": "commonjs",
    "outDir": "build",
    "target": "es6"
  },
  "exclude": [
    "node_modules"
  ]
}
```

```
import * as http from 'http';
```

becomes

```
var http = require('http');
```

Creating a RESTful API to the server

rest-server.ts

```
import * as express from "express";

const app = express();

class Product {
    constructor(public id: number, public title: string, public price: number){}
}

const products = [
    new Product(0, "First Product", 24.99),
    new Product(1, "Second Product", 64.99),
    new Product(2, "Third Product", 74.99) ];

function getProducts(): Product[] {
    return products;
}

app.get('/', (req, res) => {
    res.send('The URL for products is http://localhost:8000/api/products');
});

app.get('/api/products', (req, res) => {
    res.json(getProducts());
});

function getProductById(productId: number): Product {
    return products.find(p => p.id === productId);
}

app.get('/api/products/:id', (req, res) => {
    res.json(getProductById(parseInt(req.params.id)));
});

const server = app.listen(8000, "localhost", () => {
    const {address, port} = server.address();
    console.log(`Listening on ${address}:${port}`);
});
```

Walkthrough 9.1

1. In your IDE open dir **unit9/server**

2. npm i

3. Compile the code into the directory **build**:
   tsc

4. node build/rest-server

5. Open your browser at **http://localhost:8000/api/products**
   You'll see 3 products in JSON format.

6. Change the URL to **http://localhost:8000/api/products/1**
   You'll see the JSON data for the second product

Angular client

Working with HttpClient

Angular HttpClient

- Offers API for all standard HTTP methods,
  e.g. `get()`, `post()`, `put()`, `delete()`, `request()`

- All these methods return `Observable`

- Interceptors - the code that's invoked on each HTTP request or response

- Supports progress events for request uploads and response downloads

Using HttpClient

Import `HttpClientModule` in `@NgModule` and inject an `HttpClient` object into the constructor of a service (or component)

```
import {HttpClientModule}
              from ‘@angular/common/http’;
…
@NgModule({
    imports:      [ BrowserModule,
                    HttpClientModule],
    declarations: [ AppComponent],
    bootstrap:    [ AppComponent ]
})
class AppModule { }
```

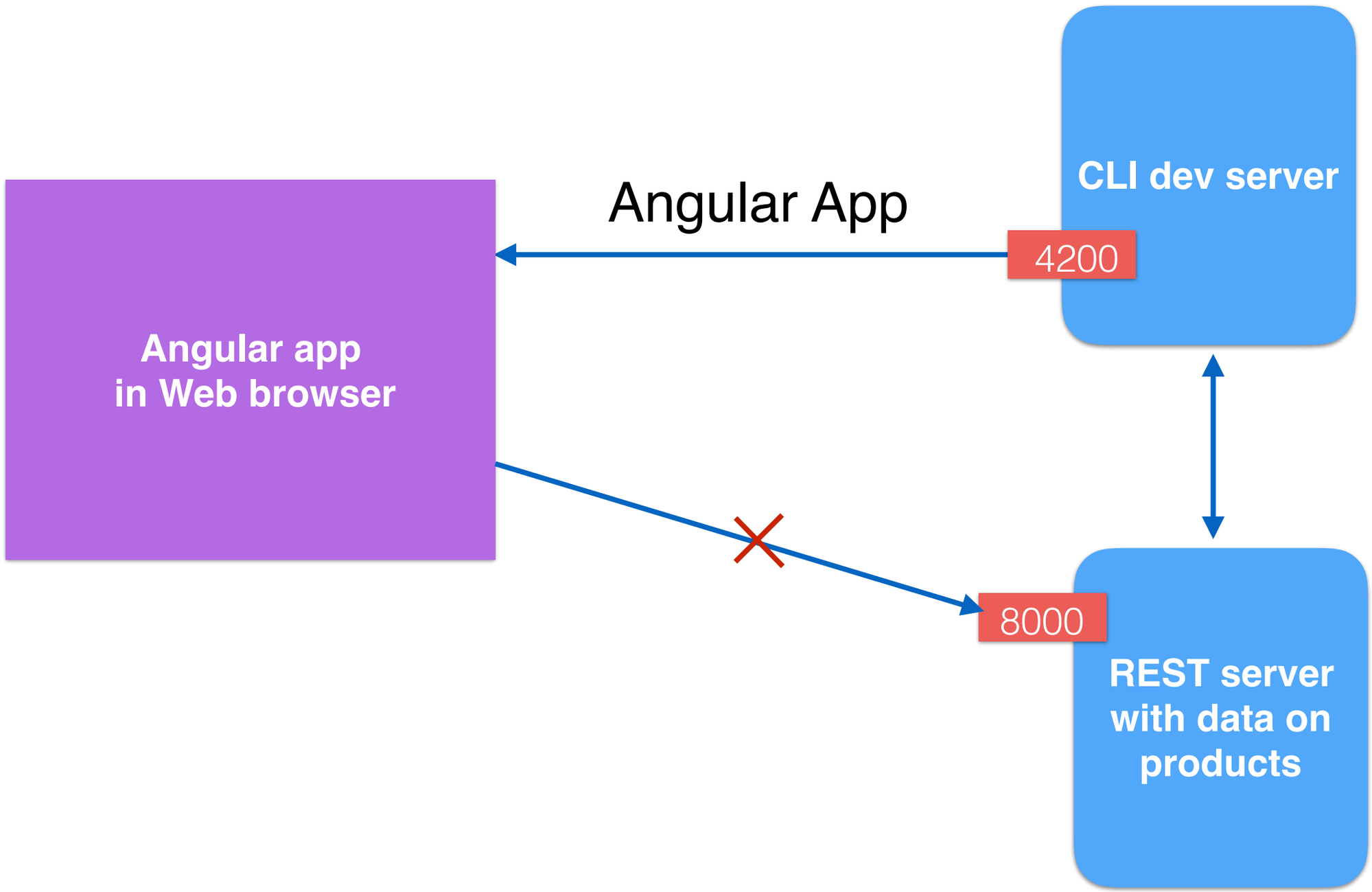
```
import {HttpClient} from ‘@angular/common/http';
...
class ProductService {

 constructor(private httpClient: HttpClient){}

 getProducts(){
  this.httpClient.get<Product[]>(‘/api/products’)
      .subscribe(...);
 }
}
```

Server endpoint

Explicit subscription to HttpClient

```
@Component({
  selector: 'app-root',
  template: `<h1>All Products</h1>
  <ul>
    <li *ngFor="let product of products">
       {{product.title}} {{product.price}}
    </li>
  </ul>
  {{error}}
  `})
export class AppComponent implements OnInit, OnDestroy{

  products: Product[] = [];
  theDataSource: Observable<Product[]>;
  productSubscription: Subscription;
  error:string;

  constructor(private httpClient: HttpClient) {
    this.theDataSource = this.httpClient.get<Product[]>('/api/products');
  }

  ngOnInit(){
    this.productSubscription = this.theDataSource
      .subscribe(
        data => {
            this.products=data;
        },
        err =>
          this.error = `Can't get products. Got ${err.status} from ${err.url}`
    );
  }

  ngOnDestroy(){
    this.productSubscription.unsubscribe();
  }
}
```

Configuring a proxy for dev mode



Same origin error

- In dev mode you can continue running the dev server for the client on port 4200 with **ng serve**
- But our REST server runs on port 8000
- If the client will do `httpClient.get('http://localhost:8000/api/products')`, it'll get this:

```
XMLHttpRequest cannot load http://localhost:8000/api/products. No 'Access-Control-Allow-Origin' header is present on the requested resource. Origin 'http://localhost:4200' is therefore not allowed access.
```

Due to the **same-origin policy** we can configure a proxy on the client or add the header **Access-Control-Allow-Origin**: * on the server

Configuring proxy for Angular client

proxy-conf.json

```
{
  "/api": {
    "target": "http://localhost:8000",
    "secure": false
  }
}
```

The REST server runs here

Angular client: `http.get('/api/products');`

goes to 4200 and gets redirected

```
ng serve restclient --proxy-config proxy-conf.json
```

Walkthrough 9.2

1. Keep the Node server from walkthrough 1 running on port 8000

2. In your IDE, open the directory **unit9/client** and run npm i

3. Review the code in the dir **app/restclient**

4. ng serve restclient -o

5. Browser's console shows 404 for localhost:4200/api/products because the server that runs on port 4200 doesn't have the endpoint /api/products.

6. Stop the dev server that runs on **port 4200** (Ctrl-C)

7. Review the content of the file **proxy-conf.json**

8. Start the client with proxy
   ng serve restclient --proxy-config proxy-conf.json -o

9. The browser renders three products received from our rest server

Subscribing to HttpClient with async pipe

```
@Component({
  selector: 'app-root',
  template: `<h1>All Products</h1>
  <ul>
    <li *ngFor="let product of products$ | async">
      {{product.title }} {{product.price}}
    </li>
  </ul>
  {{error}}
  `})
export class AppComponentAsync{

  products$: Observable<Product[]>;
  error:string;
  constructor(private httpClient: HttpClient) {
    this.products$ = this.httpClient.get<Product[]>('/api/products')
      .catchError( err => {
          this.error = `Can't get products. Got ${err.status} from ${err.url}`;
          return EMPTY;    // empty observable
      });
  }
}
```

2

1

Best practice

To run, modify restclient/app.module.ts to boot the AppComponentAsync:

bootstrap: [AppComponentAsync]

Best practice

Encapsulate all communications with the server
in an Angular service

Service

```
@Injectable()
export class ProductService{

  constructor( private http: HttpClient){}

  getProductByID(productID: string): Observable<Product[]>{
    return this.http.get<Product[]>(`api/products/${productID}`);
  }
}
```

Service

```
@Injectable()
export class ProductService{

  constructor( private http: HttpClient){}

  getProductByID(productID: string): Observable<Product[]>{
    return this.http.get<Product[]>(`api/products/${productID}`);
  }
}
```

Component

```
export class AppComponent {

products$: Observable<Product[]>;  // subscribe with async pipe in the template

  constructor(private productService: ProductService) {}

  getProductByID(formValue){
    this.products$ = this.productService.getProductByID(formValue.productID);
  }
}
```

Deploying Angular apps on the server with npm scripts

Serving Angular app from the Node server

- From the Node's perspective, Angular client's code is "static resources"
- Use Node's `path.join()`:

```
const app = express();

app.use('/', express.static(path.join(__dirname, 'public')));
```

server: rest-server-angular.ts

```
let express = require("express");

let path = require("path");
let compression = require("compression");

const app = express();
app.use(compression()); // serve gzipped files

app.use('/', express.static(path.join(__dirname, 'public')));

class Product {
    constructor(
        public id: number,
        public title: string,
        public price: number){}
}

const products = [
    new Product(0, "First Product", 24.99),
    new Product(1, "Second Product", 64.99),
    new Product(2, "Third Product", 74.99)
];

function getProducts(): Product[] {
    return products;
}

app.get('/api/products', (req, res) => {
    res.json(getProducts());
});

function getProductById(productId: number): Product {
    return products.find(p => p.id === productId);
}

app.get('/api/products/:id', (req, res) => {
    res.json(getProductById(parseInt(req.params.id)));
});

const server = app.listen(8000, "localhost", () => {
    const {address, port} = server.address();
    console.log('Listening on %s %s', address, port);
});
```

Angular app will be deployed here

all products

product by id

JiT vs AoT compilation

- **Just-in-Time** compilation: your app includes Angular's compiler and is dynamically compiled in the browser.

- **Ahead-of-Time** compilation: Angular components and templates are precompiled into JS with the **ngc** compiler.

- The AoT-compiled apps don't include the Angular compiler

AOT doesn't always make smaller bundles, but they load faster in the browser.

ng build for dev

the output goes into the **dist** dir

- ng build

```
136B Jan 29 12:46 data
5.3K Jan 29 12:46 favicon.ico
609B Jan 29 12:46 index.html
5.7K Jan 29 12:46 inline.bundle.js
5.8K Jan 29 12:46 inline.bundle.js.map
9.0K Jan 29 12:46 main.bundle.js
6.2K Jan 29 12:46 main.bundle.js.map
212K Jan 29 12:46 polyfills.bundle.js
259K Jan 29 12:46 polyfills.bundle.js.map
 11K Jan 29 12:46 styles.bundle.js
 15K Jan 29 12:46 styles.bundle.js.map
2.4M Jan 29 12:46 vendor.bundle.js
2.9M Jan 29 12:46 vendor.bundle.js.map
```

ng build for dev and prod

the output goes into the **dist** dir

- ng build

```
136B Jan 29 12:46 data
5.3K Jan 29 12:46 favicon.ico
609B Jan 29 12:46 index.html
5.7K Jan 29 12:46 inline.bundle.js
5.8K Jan 29 12:46 inline.bundle.js.map
9.0K Jan 29 12:46 main.bundle.js
6.2K Jan 29 12:46 main.bundle.js.map
212K Jan 29 12:46 polyfills.bundle.js
259K Jan 29 12:46 polyfills.bundle.js.map
 11K Jan 29 12:46 styles.bundle.js
 15K Jan 29 12:46 styles.bundle.js.map
2.4M Jan 29 12:46 vendor.bundle.js
2.9M Jan 29 12:46 vendor.bundle.js.map
```

- ng build --prod

performs AoT by default

```
3.2K Jan 29 12:51 3rdpartylicenses.txt
136B Jan 29 12:51 data
5.3K Jan 29 12:51 favicon.ico
589B Jan 29 12:51 index.html
1.4K Jan 29 12:51 inline.d483d84aa7d8440978f5.bundle.js
175K Jan 29 12:51 main.8522776bac4edaecdaad.bundle.js
 64K Jan 29 12:51 polyfills.47853ebf6acf9efe05b4.bundle.js
 79B Jan 29 12:51 styles.9c0ad738f18adc3d19ed.bundle.css
```

Demo: ng build

1. Go to Terminal window in the directory unit9/client. After running each of the following commands check the content of the **dist** dir

2. ng build ← JIT, not optimized

3. ng build --prod ← AoT, optimized

Adding custom npm scripts

```
"scripts": {

  "build": "ng build -prod --app restclient",
  "postbuild": "npm run deploy",
  "predeploy": "rimraf ../server/build/public
                && mkdirp ../server/build/public",

  "deploy": "copyfiles -f dist/** ../server/build/public"
}
```

post- runs after

pre- runs before

static resources

Include these devDependencies in package.json

Walkthrough 9.3

1. In the Terminal window go to dir unit9/**client**

2. Review the scripts section in package.json

3. npm run build *<- It'll run build, postbuild, predeploy, and deploy.*

4. Switch to the server project and review the content of **server/build/public.** The Angular app was bundled and deployed there

5. Stop the server if running

6. Start the server with deployed Angular client:
   node build/rest-server-angular

7. Open your browser at localhost:8000. The Angular app shows three products.

HTTP interceptors

@yfain

Why intercepting?

- For pre- and post-processing of all HTTP requests and responses, e.g. adding certain headers
- For implementing cross-cutting concerns, e.g. logging, global error handling, authentication

The original HttpRequest is immutable, but you can clone it and update the clone

@yfain

Intercepting HTTP requests

```
@Injectable()
export class MyInterceptor implements HttpInterceptor {

  constructor (private auth: MyAuthService) {}

  intercept(req: HttpRequest<any>, next: HttpHandler): Observable<HttpEvent<any>> {

    const modifiedRequest =
        req.clone({ req.headers.set('Authorization', this.auth.getToken()) });

    return next.handle(modifiedRequest);
  }
}
```

```
@NgModule({
  ...
  providers: [[ { provide: HTTP_INTERCEPTORS, useClass: MyInterceptor, multi: true } ]],
})
```

@yfain

Intercepting HTTP responses

- `next.handle()` returns an observable of `HttpEvent`'s
- Use RxJS operators to handle the response
- No need to subscribe as the original `HttpClient` has a subscriber

```
@Injectable()
export class MyInterceptor implements HttpInterceptor {
   ...
    return next.handle(modifiedRequest).pipe(
          tap(event = > {
            if (event instanceOf HttpResponse) {
              // clone and change event here if need be
                console.log (event);
            }
            return event;
           });
}
```

@yfain

Demo: interceptors

An interceptor for logging errors

1. Start the server
node build/rest-server-angular-post-errors

2. Start the client
ng serve interceptor --proxy-config proxy-conf.json

3. Go to localhost:4200 in your browser

4. Open the browser's console and start adding products. The server with throw random errors that will be logged by the interceptor.

Demo

- **Progress events**
  ng serve progressevents

What have we learned

- HTTP requests are treated as observable data streams
- How to create a simple Web server with NodeJS
- How to build and deploy an Angular app on the server
- How to automate your build process with npm scripts
- What are interceptors and progress events

Thank you for attending my workshop!

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