

# ANGULAR WORKSHOP

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# Agenda

- What are Frameworks?
- What is Angular?
- Angular Versions
- Why Angular?
- Where does Angular fit?
- Angular CLI
- TypeScript
- Angular Building Blocks
- Setting up Dev Environment
- Components
- Decorators
- Modules
- Data Binding
- Directives
- Pipes
- Component Interaction
- Services
- Routing
- Observables
- Forms
- Server Communication

# What are Frameworks?

- Software Library
  - Collection of functions
  - Has well-defined interface
  - Reuse of behavior
  - Modular
- Software Framework
  - Provides
    - generic functionality
    - you the ability to customize the functionality according to your app needs
    - reusable environment
    - broad generic structure for your app

# What are Frameworks?

- Library vs Framework
  - Library
    - Your code is in charge
    - Calls into the library when necessary
  - Framework
    - Framework is in charge
    - Calls into your code when needed
- Hollywood Principle
  - Do not call us, we will call you
- Inversion of Control

# What is Angular?

- Developed in 2009 by Misko Hevery
- Currently maintained by Google
- Framework for building front-end JavaScript applications
- Angular apps
  - Can run on desktop and mobile devices
  - Are generally SPAs
- Open-source, TypeScript-based framework
- 'A' of MEAN stack

# Angular Versions

- AngularJS (v1.x)
  - Aims to simplify the development and testing of web apps
  - Worked on the concept of scope and controllers
  - Initial release, v0.9.0 – Oct 2010
  - Latest release, v1.7.5
- Angular 2
  - Added component as a key building block
  - Complete re-write of AngularJS, no backward compatibility
  - Released in Sep 2016

# Angular Versions

- Angular 4
  - Apps are smaller & faster
  - AOT compilation, Angular Universal - SSR
  - Backward compatible with Angular 2
  - Released in Mar 2017
- Angular 5
  - Smaller, faster and easier to use
  - Build optimizer, compiler improvements
  - New HttpClient, pipes, router lifecycle events
  - Released in Nov 2017

# Angular Versions

- Angular 6
  - Synchronized major versions – Framework, Material and CLI
  - CLI – New commands
    - ng update
      - Can be used to update Angular framework packages to newer version
    - ng add
      - Can be used to add new capabilities to your Angular app
  - CLI has support for
    - workspaces containing multiple projects, such as multiple applications or libraries
    - creating and building libraries
  - Angular Elements
    - Angular components packaged as custom elements, a web standard for defining new HTML elements in a framework-agnostic way
  - Angular Material + CDK –
    - New tree component for displaying hierarchical data is now available
  - Tree Shaking Providers help to reduce app size
  - Angular has been updated to use v6 of RxJS
  - Released in May 2018



# Angular Versions

- Angular 7
  - Synchronized major versions – Framework, Material and CLI
  - CLI prompts added to common commands
  - Bundle Budgets - make sure your app size is under control
  - CDK includes following features
    - Virtual Scrolling
    - Drag & Drop
  - Dependency updates
    - TypeScript 3.1
    - RxJS 6.3
    - Node 10
  - Released in Oct 2018

# Why Angular?

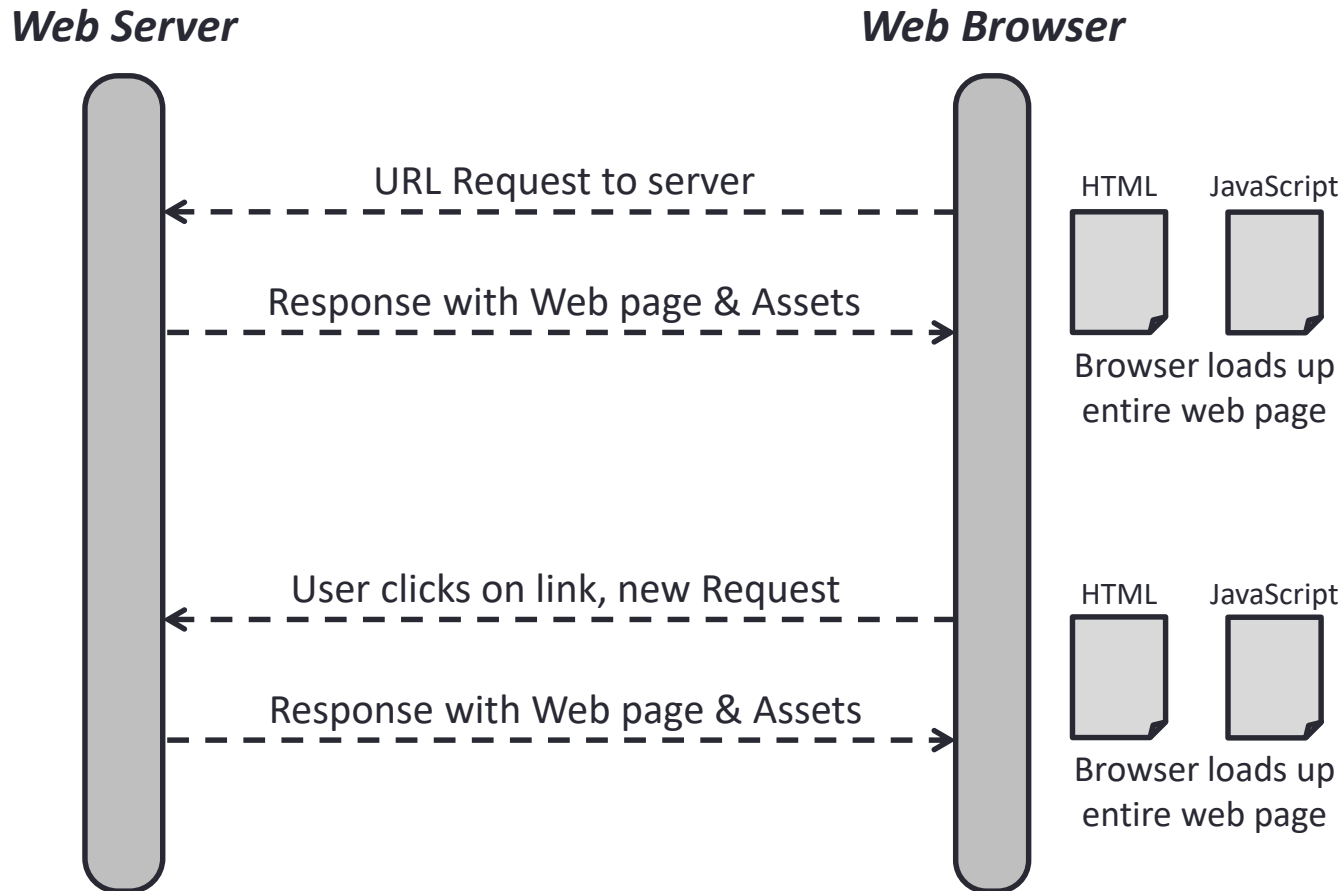
- Single Page Apps (SPA)
  - Better user experience
  - Reduced full page reloads
  - Better overall performance
  - Less network bandwidth
- Proven software patterns and practices
  - Model View Controller (MVC)
  - Model View ViewModel (MVVM)
  - Dependency Injection (DI)
- Declarative programming
  - Better readability, concise code
  - Better developer productivity
  - Faster development

# Why Angular?

- Component based
  - Reusable
- Structures app code
  - Modular, Maintainable, Scalable
- Cross platform, mobile support
  - Target multiple browsers, platforms & devices
- Decouples DOM manipulation from app logic
  - Testable, TDD
- Move app code forward in the stack
  - Reduces server load, reduces cost
  - Crowd sourcing of computational power

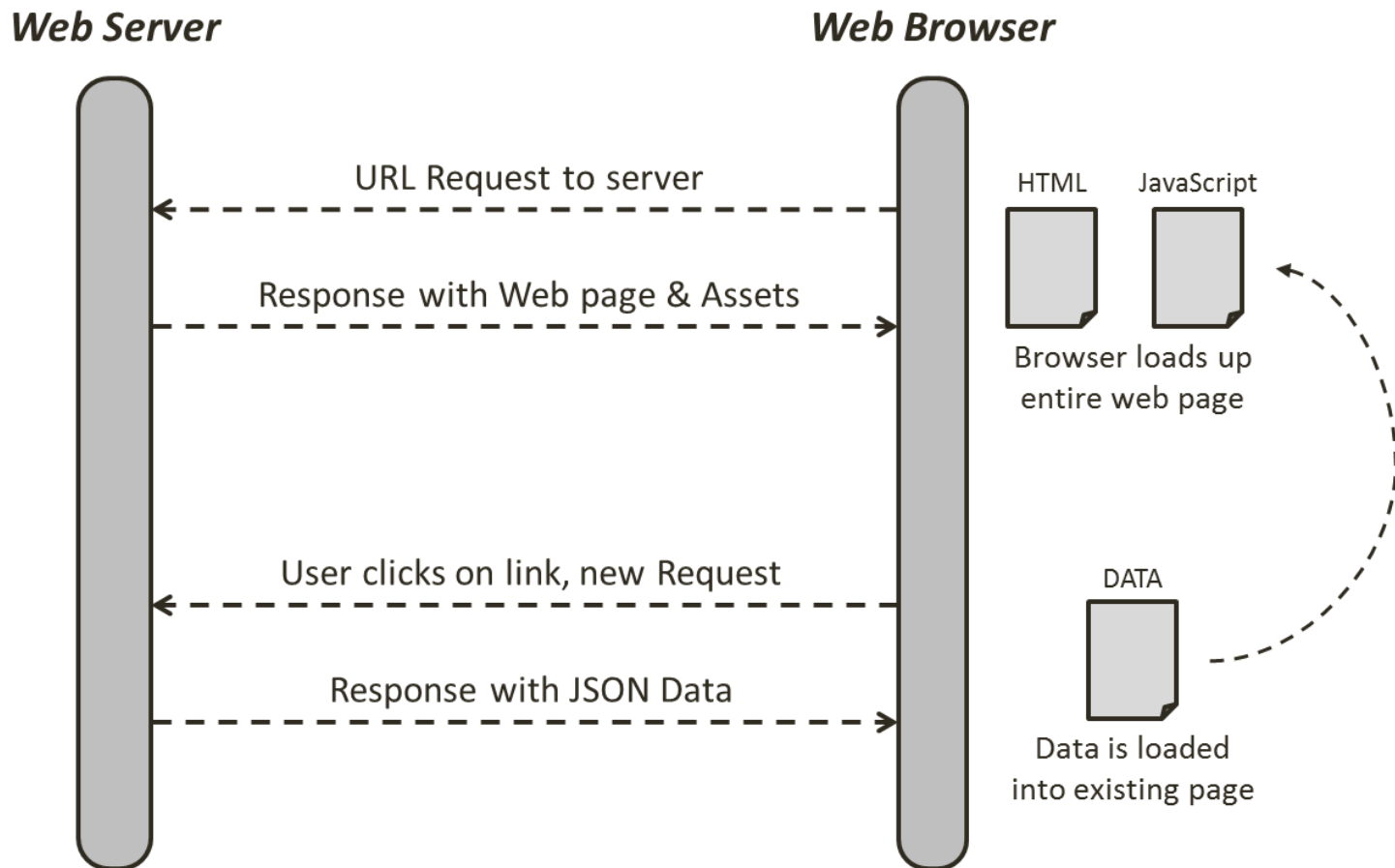
# Traditional Web App

## Request & Response

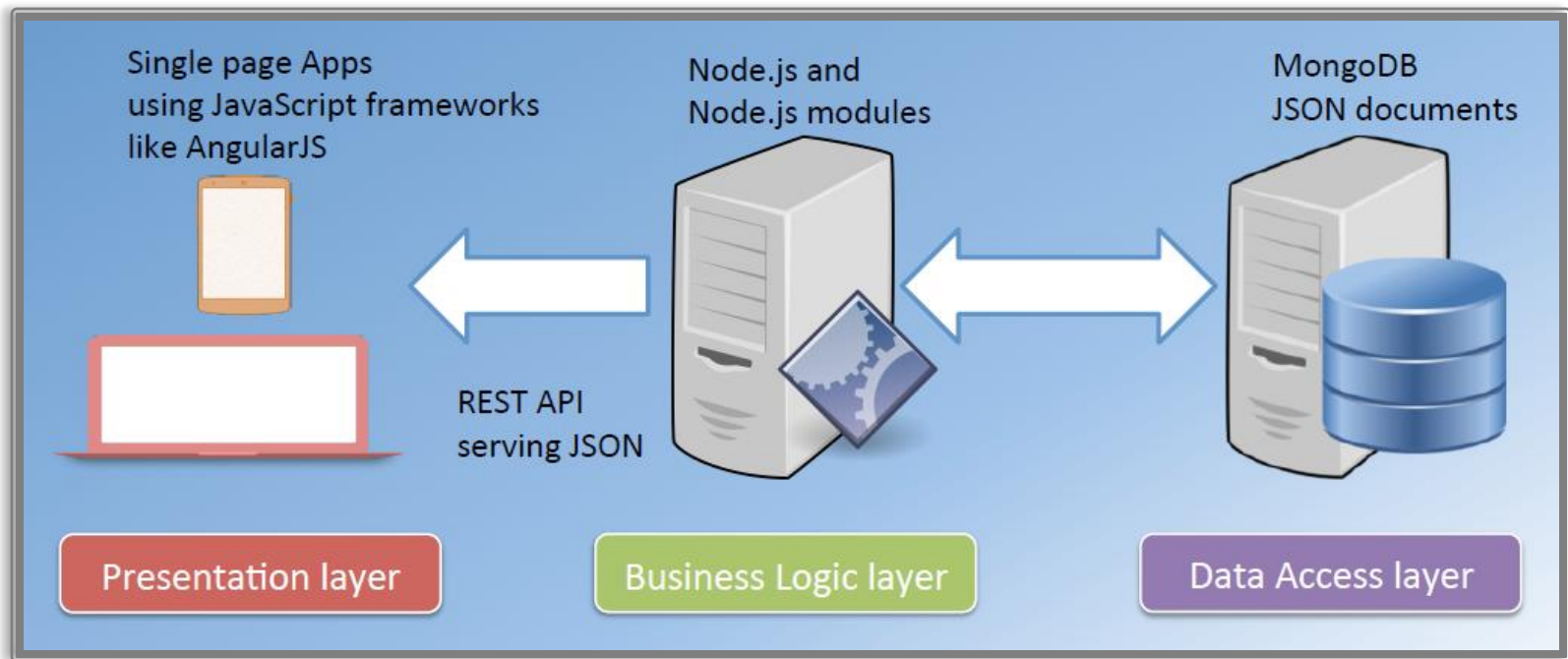


# Angular App

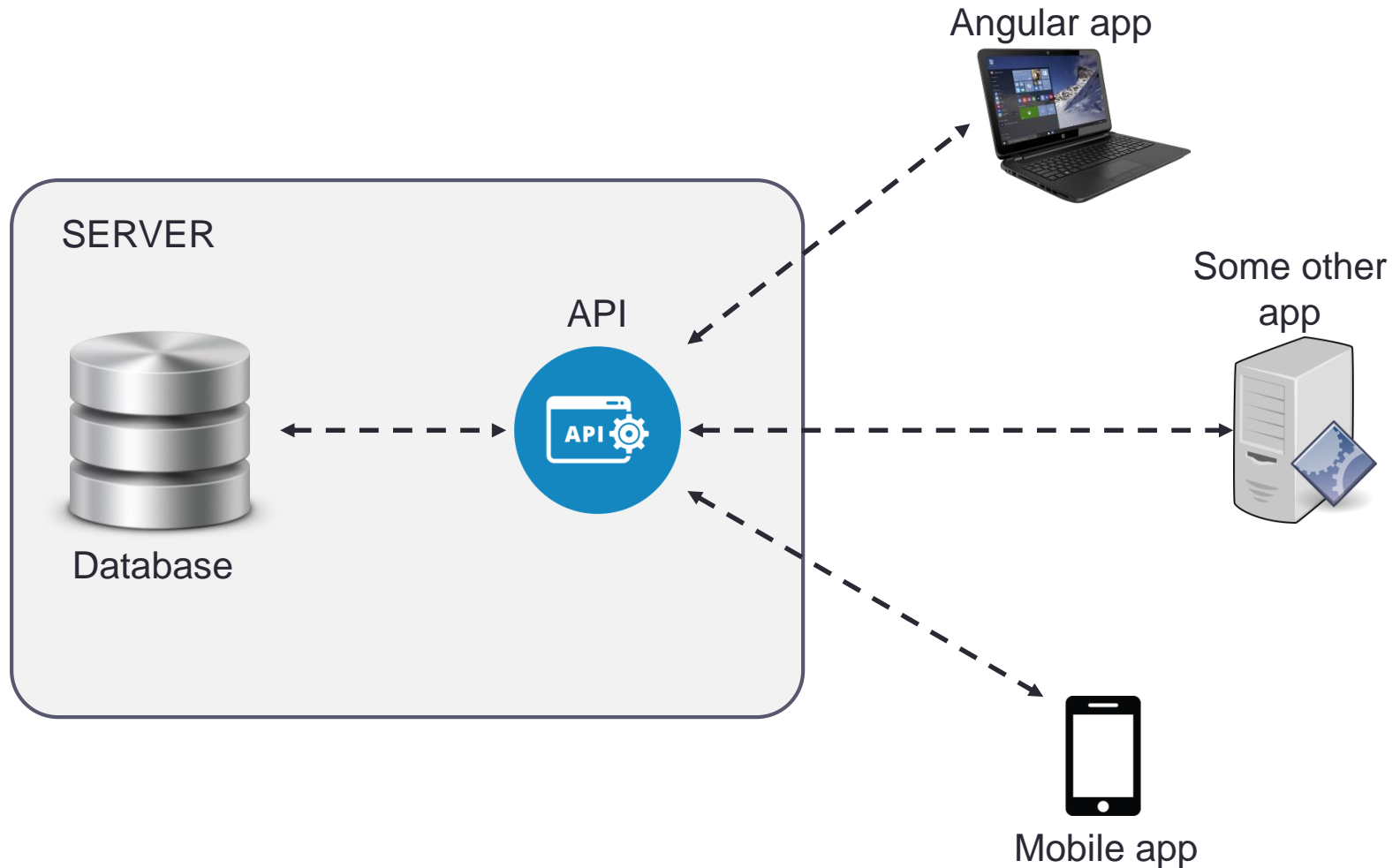
## Request & Response



# Where does Angular fit?



# Where does Angular fit?



# Angular CLI

- Toolset that makes creating, managing and building Angular apps very simple
- Great tool for big Angular projects
  - Website: <https://cli.angular.io>
  - Wiki: <https://github.com/angular/angular-cli/wiki>
- Requires Node.js
  - <https://nodejs.org>

```
> npm install -g @angular/cli  
> ng new my-first-app  
> cd my-first-app  
> ng serve
```



# TypeScript

- Superset of JavaScript
  - Any valid JavaScript code is also valid TypeScript code
- Offers more features over vanilla JavaScript
  - Types, Classes, Interfaces, Modules, etc.
- TypeScript does not run in the browser, it is compiled to JavaScript (by CLI)
- Chosen as main language by Angular
- By far most documentation & example-base uses TypeScript
- Why TypeScript?
  - Strong Typing
    - reduces compile-time errors, provides IDE support
  - Next Gen JS Features
    - Modules, Classes, Import, Export, ...
  - Missing JS Features
    - Interfaces, Generics, ...

# TypeScript

- Strong typing
  - More predictable and easier to debug
- Object-oriented features
  - Classes, Interfaces, Modules, Properties, Generics, etc.
- Compile-time errors
- Great tooling
  - Intelli-sense
- Installing TypeScript
  - `npm install -g typescript`
- Transpile TS to JS
  - `tsc some-program.ts`

# TypeScript

- Declaring variables
  - var
  - const
  - let
- Types
  - number
  - string
  - boolean
  - any
- Type Assertions
  - `<string>message`
  - `message as string`
- Arrow Functions
  - `let log = (message) => console.log(message);`

# TypeScript

- Interfaces

```
interface Point {  
    x: number,  
    y: number  
}
```

- Classes

```
class Point {  
    x: number;  
    y: number;  
  
    draw() {  
        console.log('x = ' + this.x + ', y = ' + this.y);  
    }  
}
```

# TypeScript

- Constructors
  - Optional parameters
- Access Modifiers
  - public (default)
  - private
  - protected
- Access Modifiers in Constructor Parameters
- Properties
  - Getter
    - `get X() { return this.x; }`
  - Setter
    - `set X(value) { this.x = value; }`
- Modules
  - export
  - import

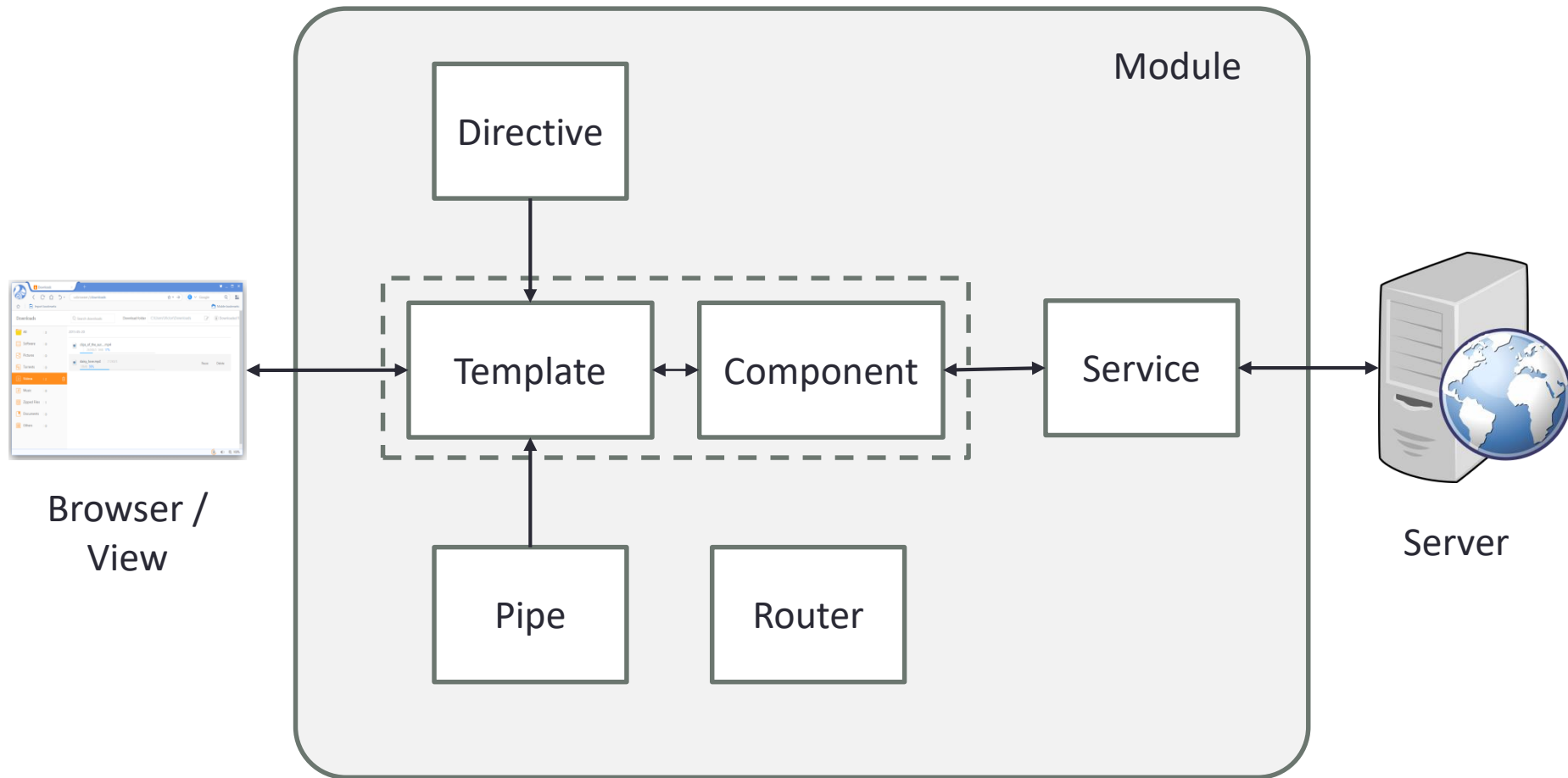
# Setting up Angular App

- Add Bootstrap to the project
  - `npm install --save bootstrap`
- Add reference to bootstrap.css
  - `.angular-cli.json`
    - In “styles” array, add a reference to “bootstrap.min.css”
    - For e.g., `"../node_modules/bootstrap/dist/css/bootstrap.css"`
- How does an Angular app gets started?
  - `index.html` – Served by the server
  - `main.ts` – First file that gets executed
  - `app.module.ts` – Main loads this module
  - `app.component.ts`
    - Root component of the app
    - App module loads this component at the startup

# Angular Building Blocks

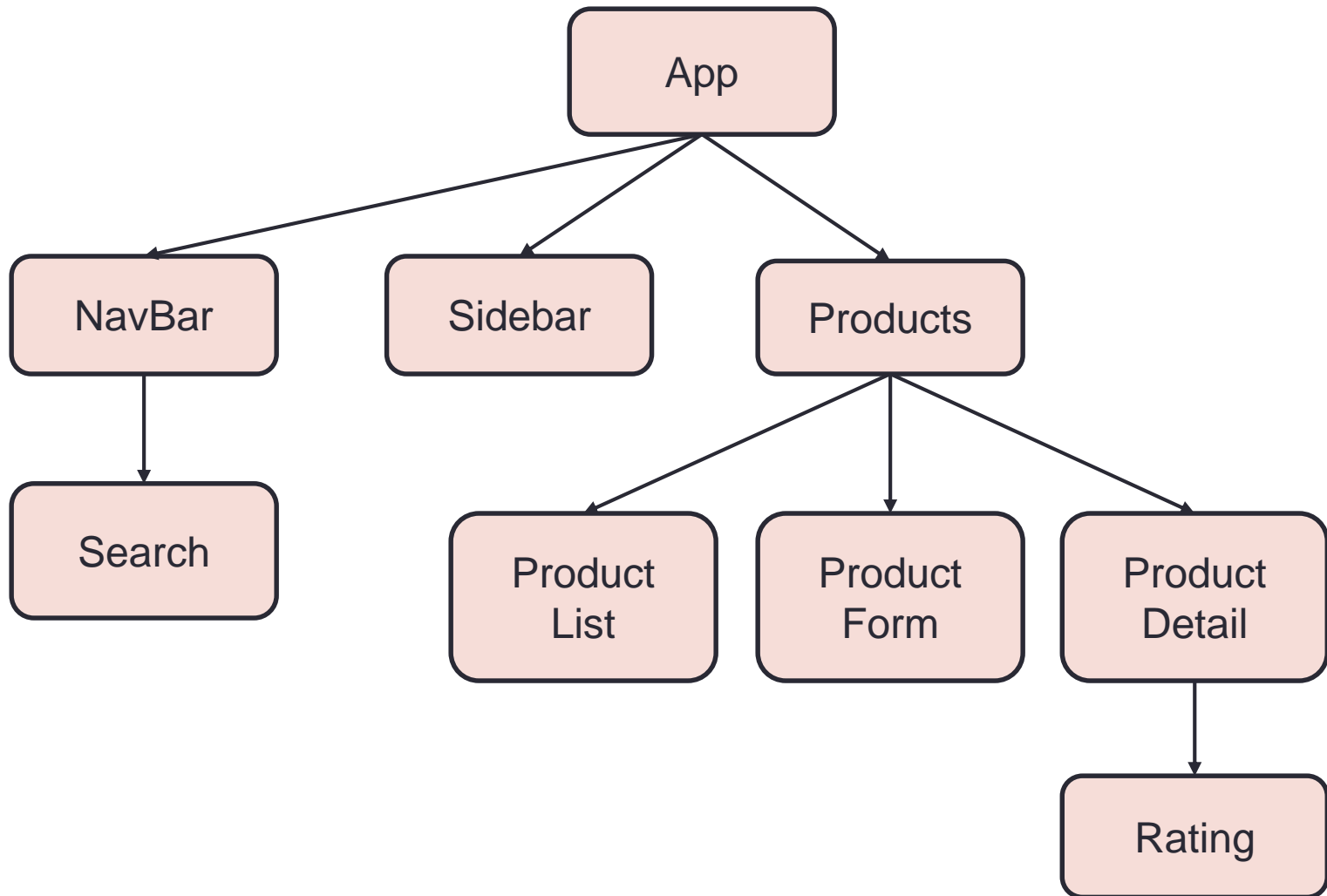
- Components
  - Encapsulates the template, data and the behavior of a view
  - Completely decoupled from DOM
- Directives
  - To modify DOM elements and/or extend their behavior
  - Built-in or custom
- Pipes
  - Takes in data as input and transforms it to a desired output
- Services
  - Encapsulates any non UI logic
    - Http calls, logging, business logic, etc
  - Any logic not related to a view is delegated to a service
- Routers
  - Responsible for navigation from one view to another
- Modules
  - A block of highly related classes

# Angular Building Blocks





# Components



# Components

- Key feature of Angular
- Encapsulate the template, data and the behavior of a view
- Allows you to break a complex web page into smaller, manageable & reusable parts
- Plain TypeScript class
- App component
  - Root component
  - Holds our entire application
  - Other components are added to App component
- A Component has its own
  - Template – HTML markup
  - Style – CSS styles
  - Business logic (data and behavior) – TypeScript code
- Promotes
  - Reusability
  - Maintainability
  - Testability

# Decorators

- Extends the behavior of a class / function without explicitly modifying it
- Attaches metadata to classes

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

@Component({
  selector: 'app-server',
  templateUrl: 'server.component.html'
})
export class ServerComponent {
}
```

# Modules

- Organizes an app into cohesive blocks of functionality
- A class decorated with @NgModule metadata
- Every Angular app has at least one module class, the **root** module

```
@NgModule({
  imports: [module1, module2, ...],
  declarations: [
    component(s), directive(s), pipe(s), ...
  ],
  providers: [service1, service2, ...],
  bootstrap: [AppComponent]
})
export class AppModule{ }
```

# Exercise

- Creating a new component
  - Create a new file, for e.g., products.component.ts
  - Create a class – ProductsComponent
- Understanding Decorator
  - Add decorator - @Component()
  - import { Component } from '@angular/core';
  - Provide metadata within @Component decorator
    - selector, templateUrl
- Understanding AppModule
  - Register ProductsComponent within 'declarations' array
  - Import ProductsComponent into AppModule
- Using a component
  - Use the selector <app-products></app-products> within app component template

# Exercise

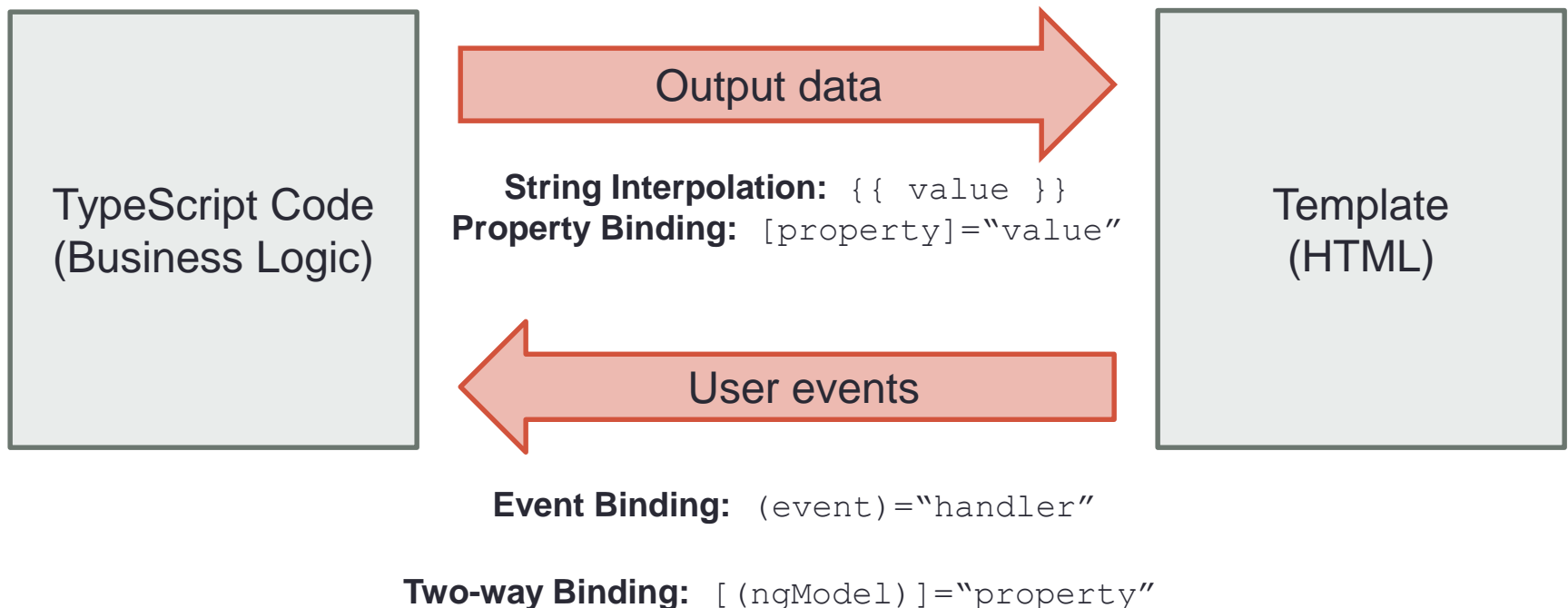
- Creating a component with CLI
  - ng generate component products
  - ng g c products

# Component Templates & Styles

- Templates
  - templateUrl property – external template file
  - template property – inline template
- Styles
  - styleUrls property – external stylesheet file(s)
  - styles property – inline styles

# Data Binding

- Communication between the TypeScript code and the HTML template





# Data Binding

- String Interpolation
  - {{ }}
- Property Binding
  - []
- Event Binding
  - ()
  - \$event – Passing event data
- Two-way Data Binding
  - [(ngModel)]
  - Note: FormsModule should be imported in AppModule (imports[] array) to use ngModel

# Directives

- Instructions in the DOM
- Components are directives with template
- Can be built-in or custom
- Built-in directives
  - Structural directives
    - Have a leading \*
    - Alter layout by adding, removing, and replacing elements in DOM
    - E.g. \*ngIf, \*ngFor
  - Attribute directives
    - Look like a normal HTML attribute
    - Modifies the behavior of an existing element by setting its display value property and responding to change events
    - E.g. ngStyle, ngClass

# Pipes

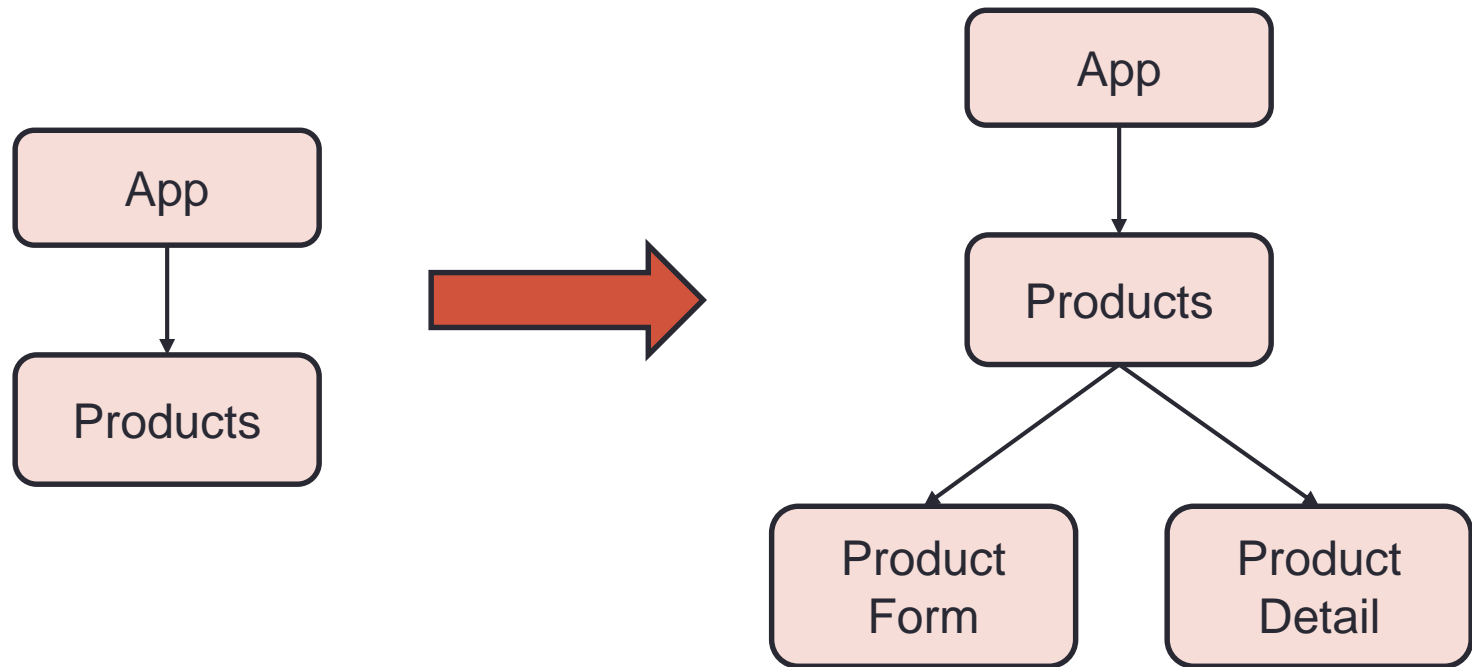
- Transform output, do not modify the underlying data
- Format the value of an expression for display
- Built-in pipes
  - uppercase
  - date
- Using pipes
- Parameterizing pipes
- Chaining multiple pipes

# Pipes

- Creating custom pipes
  - Create a class
  - Implement PipeTransform interface (`@angular/core`)
  - Implement `transform()` method
- Parameterizing a custom pipe

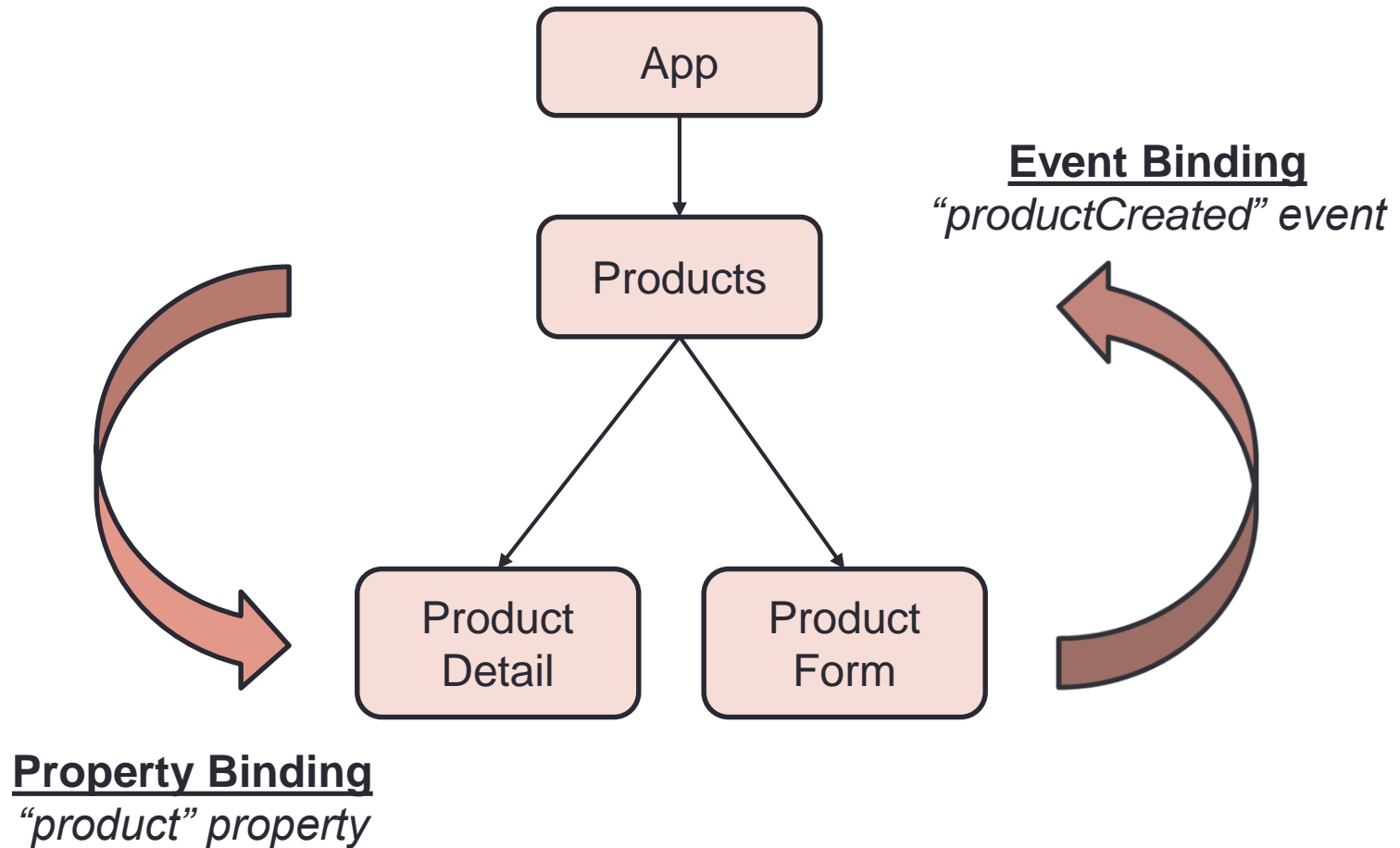
# Component Interaction

- Splitting app into multiple components



# Component Interaction

- Overview



# Component Interaction

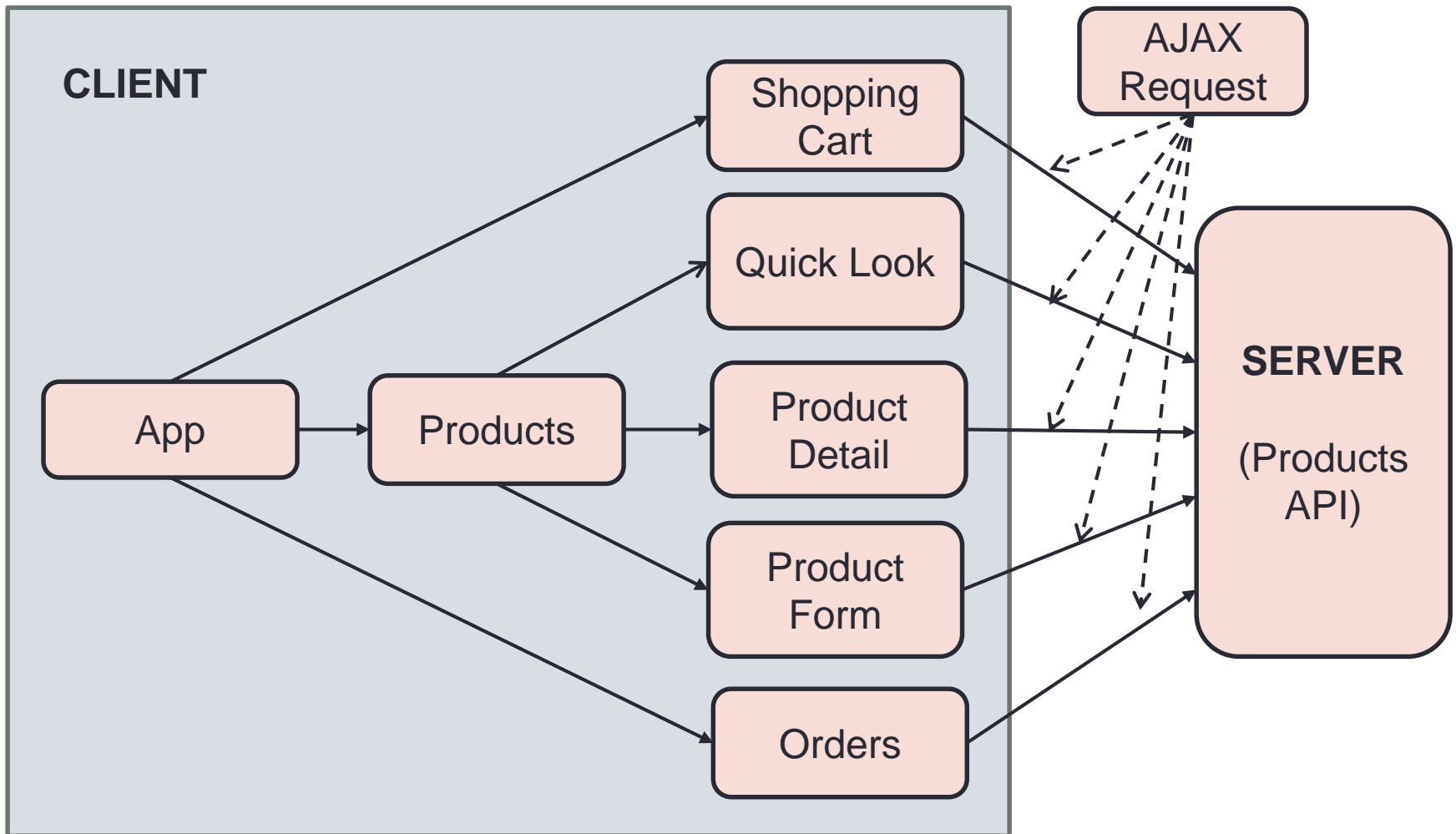
- Binding to Custom Properties
  - Pass data from parent to child component
    - @Input() decorator
- Binding to Custom Events
  - Emitting event from child component
    - @Output() decorator
    - EventEmitter<T>
    - eventEmitterObj.emit()

# View Encapsulation

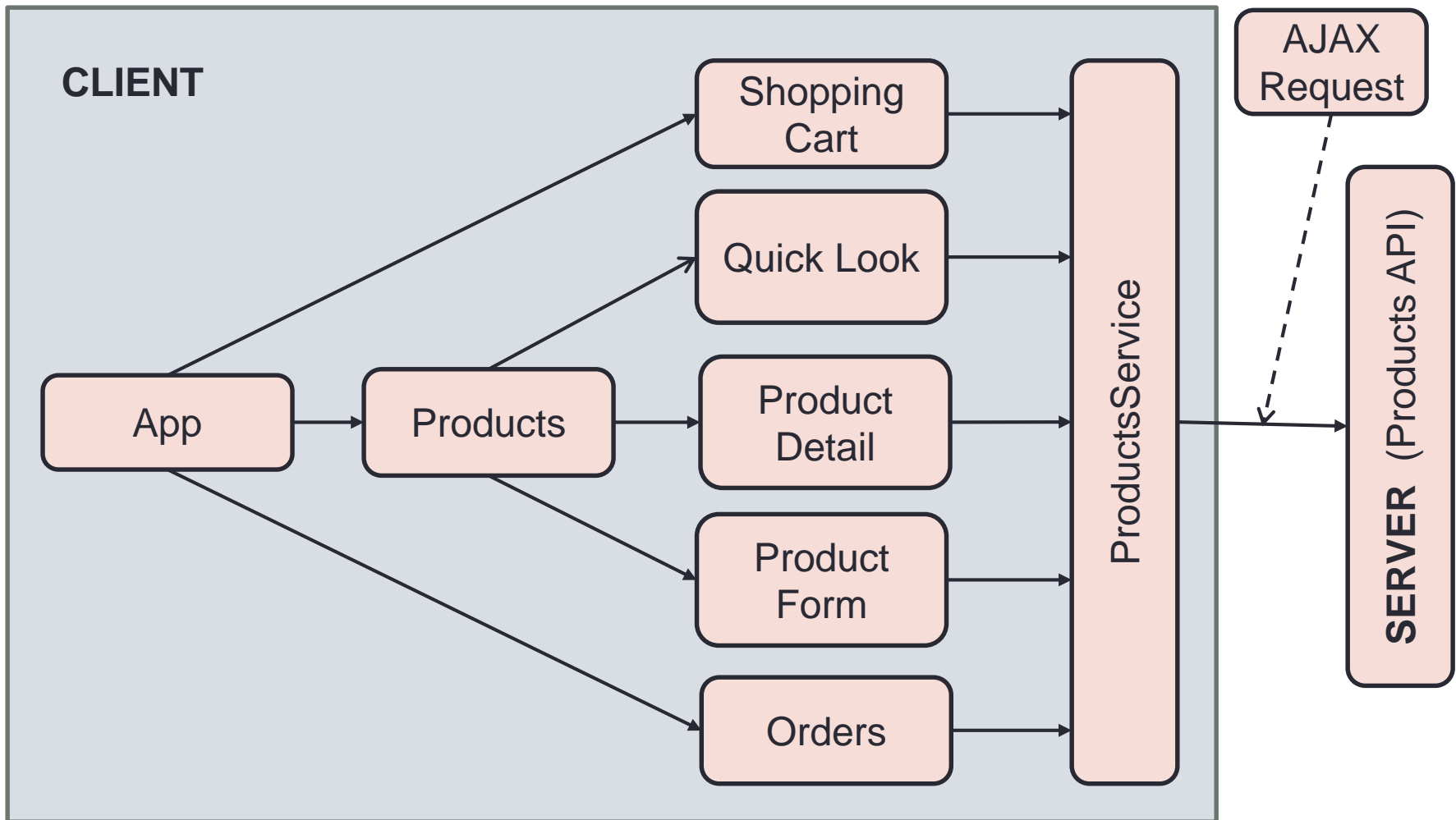
- Understanding View Encapsulation
- @Component()
  - encapsulation: ViewEncapsulation.None
- ViewEncapsulation
  - Emulated – default
  - Native
  - None



# Services



# Services



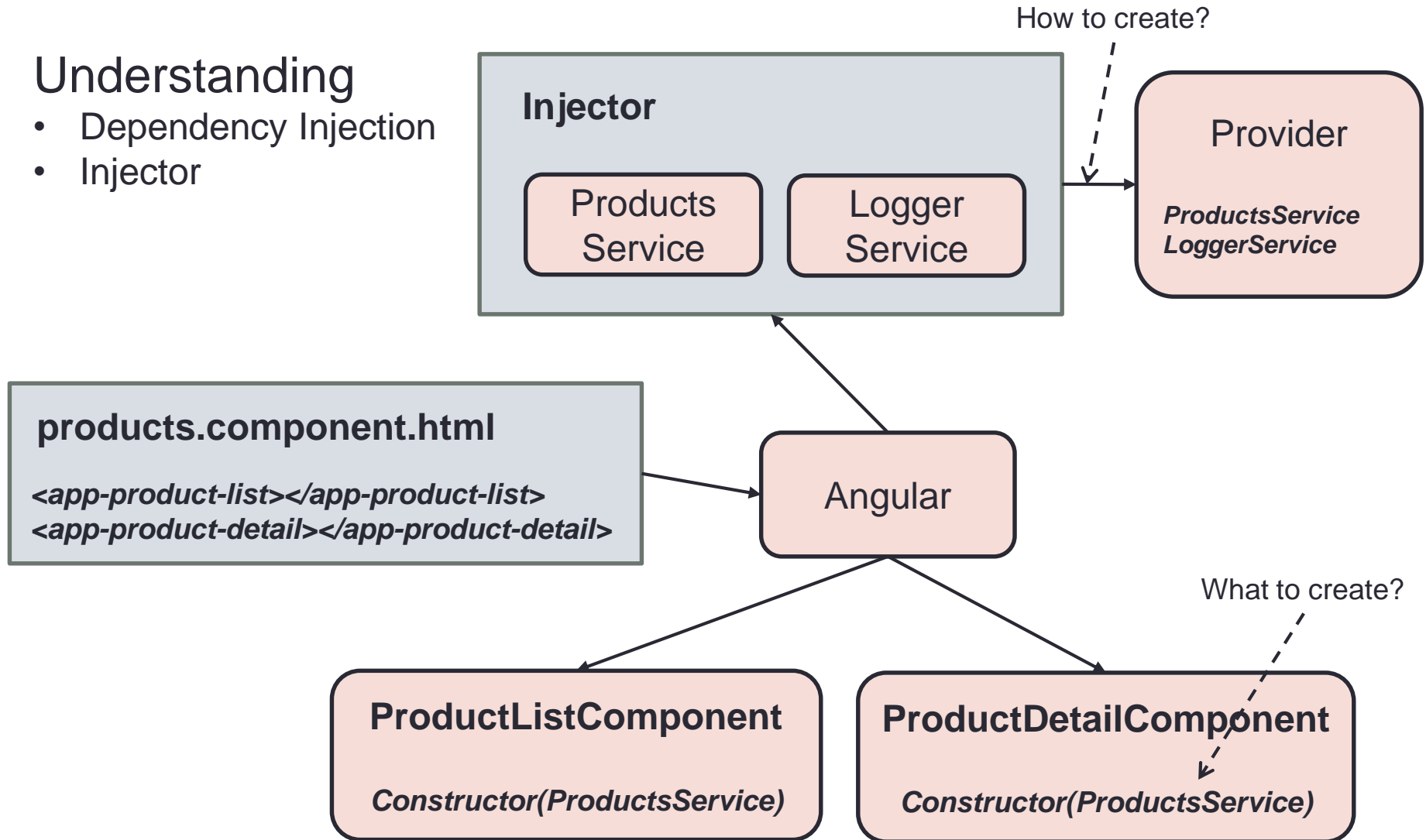
# Services

- A class with a narrow, well-defined purpose
  - For e.g.
    - Logging service
    - Data service
    - Tax calculator
    - App configuration
    - Message bus
- Acts as a central repository/business unit
- Creating a service
- Injecting a service into a component
  - Constructor
  - Providers
    - Component level
    - Module level
- Injecting a service into another service
  - @Injectable()

# Services

## Understanding

- Dependency Injection
- Injector



# Services

- Controlling the creation of instances of a Service

**AppModule**

Same instance of Service is available ***Application wide***

**AppComponent**

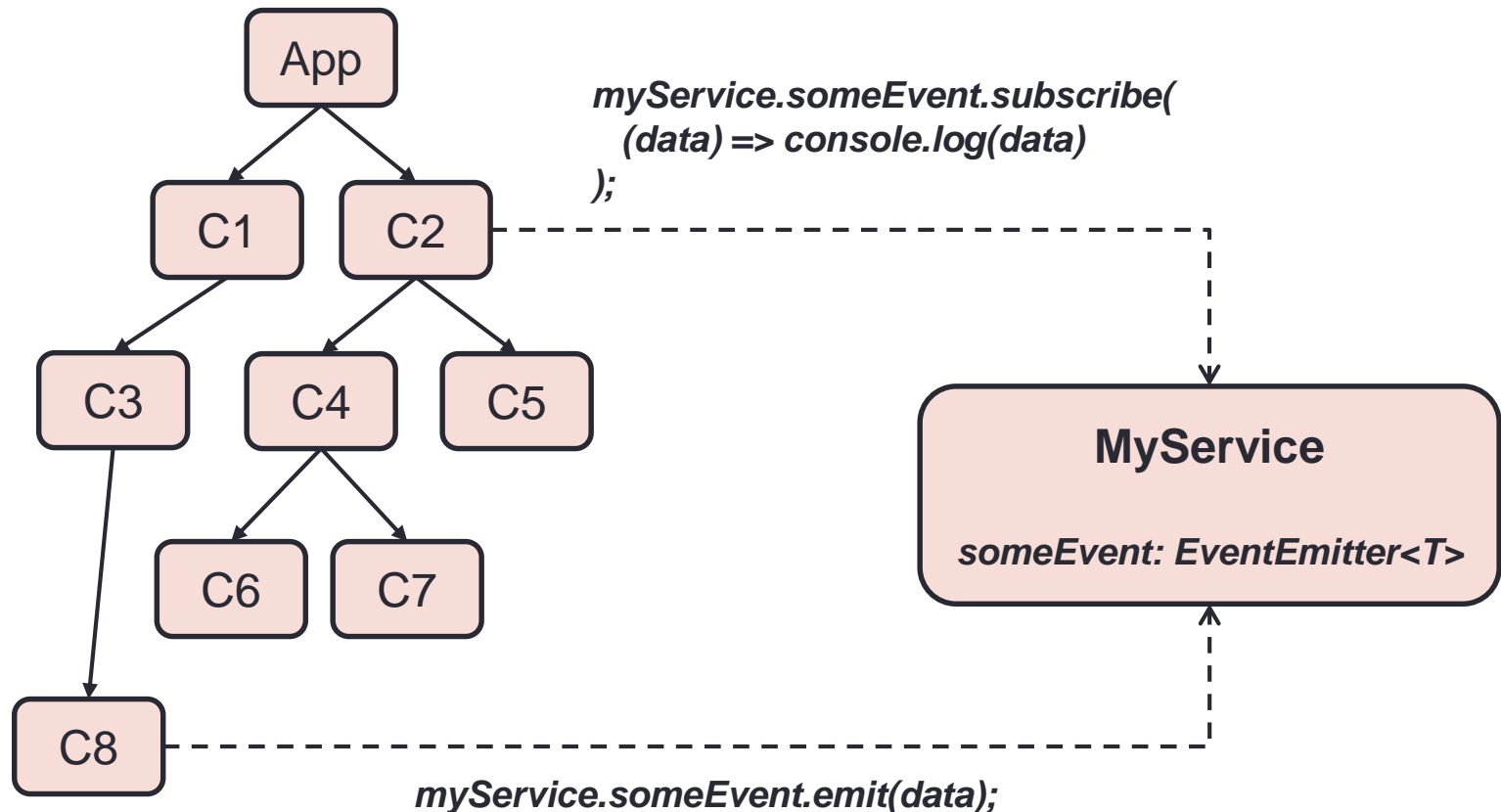
Same instance of Service is available for ***all Components*** (but not for other services)

**Any other  
Component**

Same instance of Service is available for ***the Component*** and ***all its child Components***

# Services

- Cross component communication using a service
  - In the service, expose an event object of type ***EventEmitter***
  - From the source component, invoke ***emit()*** method, pass necessary data as an argument
  - From the destination component subscribe to the service's event object using ***subscribe()*** method, pass callback function as an argument



# Routing

- Setting up routes (@angular/router module)
  - Routes
    - Define a constant appRoutes of type Routes
  - RouterModule.forRoot()
    - Register the routes with RouterModule.forRoot()
    - Include this in imports array of app module
- Loading Routes
  - <router-outlet> directive
- Navigating with Router Links
  - routerLink directive
- Styling active links
  - routerLinkActive="active"
  - [routerLinkActiveOptions]="{exact: true}"
- Navigating Programmatically
  - Import Router from @angular/router
  - Inject Router within the constructor
  - Router.navigate(['/products'])

# Routing

- Passing Parameters to Routes
  - [routerLink] = “['/servers', 10]”
- Fetching Route Parameters
  - ActivatedRoute.snapshot.params['id']
  - ActivatedRoute.params.subscribe()
- Passing Query Parameters
  - [queryParams] = “{allowEdit: true}”
- Retrieving Query Parameters
  - ActivatedRoute.snapshot.queryParams[]
  - ActivatedRoute.queryParams.subscribe()
- Setting up Child Routes
- Redirecting and Wildcard Routes
- Outsourcing the Route Configuration



# Observables

- Used to handle asynchronous tasks / operations
- Can be thought of as a data source
  - E.g. User input event, Http requests
- Object we import from a third-party package – rxjs
- Follows Observable pattern
  - Observable
  - Stream – timeline
    - Multiple events/data packages emitted by the observable, depending on the data source
  - Observer – your code
    - 3 ways of handling data packages
      - Handle Data
      - Handle Error
      - Handle Completion

# Observables

- Observable – rxjs/Observable
  - Observable.interval()
  - Observable.create()
    - Observer - rxjs/Observer
    - Observer.next()
    - Observer.error()
    - Observer.complete()
  - Observable.subscribe() – returns Subscription (rxjs/Subscription)
- Subject
  - Subject.next()
  - Subject.subscribe()
- <http://reactivex.io/rxjs/>

# Forms

- Angular helps
  - To get form values entered by the user
  - To check if the form is valid
  - To conditionally change the way the form is displayed
- Two Approaches
  - Template-Driven Forms
    - Angular infers the form object from the DOM (Template)
    - Good for simple forms
    - Simple validation
    - Easier to create
    - Less code
  - Reactive Forms
    - Form is created programmatically and synchronized with the DOM
    - Good for complex forms
    - More control over validation logic
    - Unit testable

# Forms

- Template-Driven Forms
  - Make sure that FormsModule is imported within the app module
  - Creating the form
    - `<form>` tag need not have these attributes:
      - action
      - method
  - Registering the controls
    - Include “ngModel” directive
    - Include “name” attribute
  - Submitting the form
    - Include ngSubmit event
    - `<form (ngSubmit)="onSubmit(f)" #f="ngForm">`
  - Understanding form state
  - Accessing the form with @ViewChild
    - `@ViewChild('f') productForm: NgForm;`
  - User Input Validation
    - Directives
      - required, email, minlength, maxlength, pattern
    - Form State
      - pristine / dirty, touched / untouched, valid / invalid
    - CSS
      - ng-pristine / ng-dirty, ng-touched / ng-untouched, ng-valid / ng-invalid

# Forms

- Template-Driven Forms

- Using Form State

- Disable submit button

- ```
<button type="submit" [disabled]="!f.valid">Save</button>
```

- Include CSS classes to provide better user feedback & experience

- ```
input.ng-invalid.ng-touched {  
  border: 1px solid red;  
}
```

- Display validation messages

- ```
<span class="help-block" *ngIf="!productName.valid && productName.touched">  
  Product name is required.  
</span>
```

- Using ngModel with one-way and two-way binding

- [ngModel]="productName"
      - [(ngModel)]="productName"

- Grouping Form Controls

- ngModelGroup="address"
      - #addr="ngModelGroup"

- Using Form Data

- productForm.value

- Resetting Forms

- productForm.reset()

# Forms

- Reactive Forms
  - More control over form structure and behavior
  - Easier to unit test
  - The form is created programmatically
    - `signupForm: FormGroup`
    - `FormGroup` is imported from `'@angular/forms'`
  - AppModule
    - Import `ReactiveFormsModule` from `'@angular/forms'`
    - Add `ReactiveFormsModule` to `'imports'` array within `@NgModule` decorator
  - Creating a form in code
    - Preferably use `'ngOnInit()'` to create the form

```
this.signupForm = new FormGroup({  
  'username': new FormControl('default-value', validator),  
  'email': new FormControl('default-value', validator)  
});
```

# Forms

- Reactive Forms
  - Linking HTML and Form
    - Use 'formGroup' directive to link `<form>` and form object
      - `<form [formGroup]="signupForm">`
    - Use 'formControlName' directive to link form control and form object's property
      - `<input type="text" id="username" formControlName="username">`
  - Submitting the form
    - Use 'ngSubmit' event
      - `<form [formGroup]="signupForm" (ngSubmit)="onSubmit()">`
  - Adding Validation
    - Pass validator(s) as second parameter to FormControl object

```
this.signupForm = new FormGroup({  
  'username': new FormControl(null, Validators.required),  
  'email': new FormControl(null, [ Validators.required, Validators.email ])  
});
```
    - Import Validators from '@angular/forms'

# Forms

- Reactive Forms

- Getting access to controls

- formObj.get('control-name')

- E.g.

- ```
<span *ngIf="!signupForm.get('email').valid" class="help-block">
```

- Email is required.

- ```
</span>
```

- Showing Specific Validation Errors

- ```
<div class="help-block"
```

- ```
  *ngIf="email.touched && email.invalid">
```

- ```
    <div *ngIf="email.errors.required">
```

- Email is required.

- ```
    </div>
```

- ```
    <div *ngIf="email.errors.email">
```

- Email is not valid.

- ```
    </div>
```

- ```
</div>
```



# Forms

- Reactive Forms

- Implementing Custom Validators

- validate(c: AbstractControl): ValidationErrors|null***

- AbstractControl, ValidationErrors – '@angular/forms'

- Asynchronous Validators

- validate(c: AbstractControl):***

- Promise<ValidationErrors|null>|Observable<ValidationErrors|null>***

- Showing a loader image

- `<div *ngIf="name.pending">`

- `Checking for uniqueness...`

- `</div>`

# Forms

- Reactive Forms
  - Validating the Form Upon Submit
    - Component

```
this.form.setErrors({
  invalidCustomer: true
});
```
    - Template

```
<div class="alert alert-danger" *ngIf="form.errors">
  Customer data is invalid!
</div>
```

# Forms

- Reactive Forms

- Nested FormGroup

```
this.form = new FormGroup({  
  name: new FormControl("", Validators.required),  
  contact: new FormGroup({  
    phone: new FormControl("", Validators.required),  
    email: new FormControl("", Validators.required)  
  }),  
  city: new FormControl("", Validators.required)  
});
```

- Template

```
<div formGroupName="contact">  
  <div class="form-group">  
    <label for="customerPhone">Phone</label>  
    <input type="text" class="form-control"  
      id="customerPhone" name="customerPhone" formControlName="phone">  
  </div>  
  <div class="form-group">  
    <label for="customerEmail">Email</label>  
    <input type="text" class="form-control"  
      id="customerEmail" name="customerEmail" formControlName="email">  
  </div>  
</div>
```

# Forms

- Reactive Forms
  - Create Forms using FormBuilder

```
export class CustomerFormComponent {  
  form: FormGroup;  
  
  constructor(private fb: FormBuilder) {  
    this.form = this.fb.group({  
      name: ['', Validators.required],  
      contact: this.fb.group({  
        phone: ['', Validators.required],  
        email: ['', Validators.required]  
      }),  
      city: ['', Validators.required]  
    });  
  }  
}
```

# Server Communication

- Http – '@angular/http'
  - Performs http requests using XMLHttpRequest
- Getting Data
  - App Module
    - Import 'HttpModule' from '@angular/http'
    - Add 'HttpModule' to 'imports' array
  - Constructor
    - Inject 'Http' instance in the constructor
    - Import 'Http' from '@angular/http'
  - Get data
    - Use Http.get('url') method to create the get request
    - Http.get() returns Observable<Response>
    - Use subscribe() method of the Observable
    - responseObj.json() with actually return the data
- Creating Data
  - Http.post('url', newObject)
  - The Response object contains the newly created object

# Server Communication

- Updating Data
  - `Http.put('url' + id, updatedObject)`
  - `Http.patch('url' + id, updatedObject)`
  - The Response object contains the updated object
- Deleting Data
  - `Http.delete('url' + id)`
- OnInit Interface
  - Constructor should be lightweight and should not perform expensive operations
  - Do not call Http services in the constructor of the component
  - Use `OnInit.ngOnInit()` method for initialization

# Server Communication

- Separation of Concerns
  - Single responsibility
  - Do not include http service calls in the component
- Handling Errors
  - Unexpected errors
    - Server is offline
    - Network is down
    - Unhandled exceptions
  - Expected errors
    - Not found error (HTTP error code 404)
    - Bad request error (HTTP error code 400)

# Server Communication

- The Catch operator

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

```
return this.http.get('api-url')  
  .catch( (error: Response) => console.log(error.message) );
```

- Throw application errors

```
import { Observable } from 'rxjs/Observable';  
import 'rxjs/add/observable/throw';
```

```
return this.http.get('api-url')  
  .catch( (error: Response) => {  
    return Observable.throw(new AppError(error));  
  })
```



# Server Communication

- Global Error Handling

- Create a class – `AppErrorHandler` – that implements `ErrorHandler` from `'@angular/core'`
- Implement `'handleError()'` method in this class
- In the app module, register `'AppErrorHandler'` in `'providers'` array

```
providers: [  
  { provide: ErrorHandler, useClass: AppErrorHandler }  
]
```

- The Map Operator

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

```
return this.http.get('api-url')  
  .map( response => response.json() );
```

# Server Communication

- Observables vs Promises

- Observables

- Lazy
    - Can be converted into promises using toPromise() operator
    - Handle multiple values over time
    - Cancellable

- Promises

- Eager
    - Do not have operators like in Observables
    - Called only once and will return a single value
    - Not cancellable

# Q & A

- Thank you!