

Introduction to Angular Modules and Shadow DOM

CS569 – Web Application Development II

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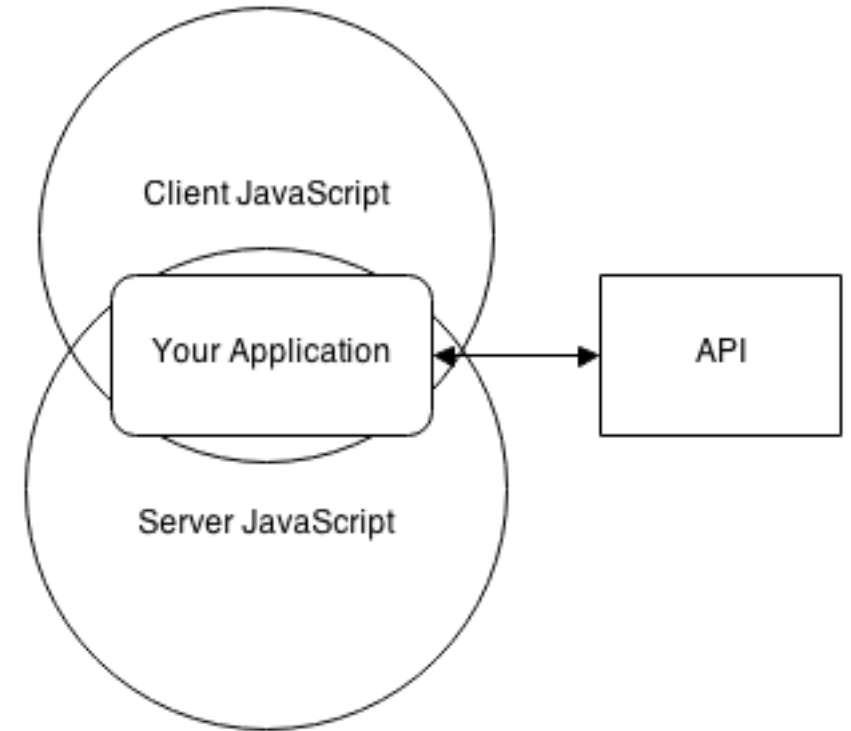


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Isomorphic JavaScript

In web development, an isomorphic application is one whose code can run both in the **server** and the **client**.

In SPA applications, the first request made by the web browser is processed by the server while subsequent requests are processed by the client.



Why Isomorphic?

One language that runs on the client & server

SEO-friendly

Google can now crawl JavaScript applications on websites. As of May 23rd, 2014, Google bot executes JavaScript.

Speed

Faster to render HTML content, directly in the browser. Better overall user experience.

Easier code maintenance

Single Page Application - SPA

A single-page application (SPA) is a web application that fits on a single web page with the goal of providing a user experience similar to that of a desktop application.

In an SPA, either all necessary code – HTML, JavaScript, and CSS – is retrieved with a single page load, or the appropriate resources are dynamically loaded and added to the page as necessary, usually in response to user actions.

The page does not reload at any point in the process, nor does control transfer to another page, although the location hash or the HTML5 History API can be used to provide the perception and navigability of separate logical pages in the application.

Interaction with the single page application often involves dynamic communication with the web server behind the scenes.

Angular

Angular is a framework that will provide us flexibility and power when building our apps (One framework for mobile & desktop).

- Takes advantage of ES6

- Web components

- Framework for all types of apps

- Speed improvements



Do I have to use TypeScript?

No, you don't have to use TypeScript to use Angular, but you probably should.

- Angular does have an ES5 API.

- Angular is written in TypeScript.

We're going to use TypeScript in this course because it's great and it makes working with Angular easier. But again it is not required.

Build Your Environment

Angular CLI will install and setup the environment for us:

Setup TypeScript and all Typings (using **typescript** and **typings**)

Watch all TS files and ES6 files and convert them to JS (ES5) so all browsers will understand (**tsc -w**)

Bundle all modules and create the bundle.js (using **Webpack**)

Create a NodeJS web server when in Dev mode (using **light-server**)

Push the refreshed code to browser every time you change your code (using **browser-sync**)

Run all above simultaneously (using **concurrently**)

Angular CLI

You can have an Angular app up and running like this:

```
npm install -g @angular/cli
ng help
ng new new-app
ng new new-app -d [--dry-run] // no files will be created
ng new new-app --skip-install // create files but do not run: npm install
ng new new-app -S [--skip-tests] // do not generate "spec.ts" test files
ng serve [--host 0.0.0.0 --port 4201] // [-o] to open the browser
```

ng new

The Angular CLI makes it easy to create an application that already works, right out of the box.

ng generate

Generate components, routes, services and pipes with a simple command.

ng serve

Easily put your application in production (Bundler is ready)

Angular Packages

Since Angular is very modular framework, these are going to be pulled in as separate modules.

The main packages are:

- `@angular/core`

- `@angular/common`

- `@angular/compiler`

- `@angular/platform-browser`

- `@angular/platform-browser-dynamic`

Other optional packages we'll use:

- `@angular/router`

- `@angular/http`

- `@angular/forms`

Angular Dependencies

We want to use all new ES6 features that aren't yet supported by browsers. This is why we need transpilers, loaders, polyfills, and shims.

These dependencies help provide some functionality for Angular that make our apps better.

core-js: Adds es6 features to browsers that don't have them

zone.js: Creates execution context around my app. Helps with change detection and showing errors. Provides stack traces.

rxjs: (ReactiveX) Libraries that help create asynchronous data streams. Gives us Observables, the preferred way of handling async events in Angular (Promises in AngularJS).

Environment Setup - Structure

The directory structure for your app will look like this:

```
| - src/  
    | - index.html  
    | - main.ts // bootstrap our app  
    | - app/  
        | - app.component.ts // main app component  
        | - app.module.ts // main app module  
| - package.json  
| - tsconfig.json  
| - angular.json
```

Getting started

Getting started with Angular requires **three major files**:

`main.ts`: This is where we bootstrap our app. *This is similar to using ng-app in AngularJS.*

`app.module.ts`: The top level module for our app. The module defines a certain section of our site.

`app.component.ts`: The main component that encompasses our entire app.

The reason we separate bootstrapping out into its own file is that we could bootstrap a number of different ways. We're going to bootstrap our app for the browser, but it could be done for mobile, universal, and more.

Bootstrapping the App

To bootstrap an Angular application in the JIT mode, you pass a module to `bootstrapModule` in `main.ts`.

```
import { platformBrowserDynamic } from '@angular/platform-browser-dynamic';  
import { AppModule } from './app.module';  
  
platformBrowserDynamic().bootstrapModule(AppModule);
```

`main.ts`

This will compile `AppModule` into a module factory and then use the factory to instantiate the module

1. Define dependent modules (Eager loading)
2. Define components our module consist of (Create instance)
3. Define services (Create instance)

What is a Module?

A module is a simple class/object. But this class is decorated with `@NgModule()` factory decorator, where we pass metadata/object to it to describe this module and have Angular controls it.

```
@NgModule({  
  imports: [ .. ],  
  declarations: [ .. ],  
  providers: [ .. ],  
  bootstrap: [ .. ] })  
class AppModule {}
```

NgModules

NgModules are distribution of Angular components and pipes.

In many ways they are similar to ES6 modules, in that they have declarations, imports, and exports.

Modules can be loaded **eagerly** when the application starts or in a **lazy** way from the router when we need them.

Modules

@NgModule is the decorator that gives us an Angular module.

A module is the way that we can bundle sections (components) of our applications into a singular focused package.

A module can include many parts including other modules (**imports**), components and/or directives (**declarations**), and services used to access data (**providers**).

Every component belongs to a NgModule.

Each module should represent a feature in our application.

Modules

To define a Module we pass the following Metadata to the factory decorator:

imports: Other **modules** (native or custom built) that are parts of our application. (HttpClientModule, FormModule, RouteModule, BrowserModule). All these modules and their functionalities will be available to the app.

declarations: These are any **components** or **directives** or **pipes** that you want access to in your application.

providers: Configure dependency injection. These are **services** and used as a singular place to access and manipulate certain data. Services declared here share the same instance between all application unless they are declared in each component, then a new instance of the service will be initialized.

bootstrap

app.module.ts

Destructuring



```
import { NgModule } from '@angular/core';
import { BrowserModule } from '@angular/platform-browser';

import { AppComponent } from './app.component';
import { userAPI } from './services/app.userAPI';

@NgModule({
  imports: [ BrowserModule ],
  declarations: [ AppComponent ],
  providers: [ userAPI ],
  bootstrap: [ AppComponent ] })

export class AppModule {}
```

Bootstrap

The bootstrap property defines the components that are instantiated when a module is bootstrapped.

Angular creates a component factory for each of the bootstrap components. And then, at runtime, it'll use the factories to instantiate the components.

You can pass as many bootstrap components as you want. You will end up with several independent components trees, When running change detection Angular will run change detection for each tree separately.

Application

An Angular Application is nothing more than a **tree of Components**.

One of the great things about Components is that they're **composable**. This means that we can build up larger Components from smaller ones. The Application is simply a Component that renders other Components.

Because Components are structured in a parent/child tree, when each Component renders, **it recursively renders its children Components**.

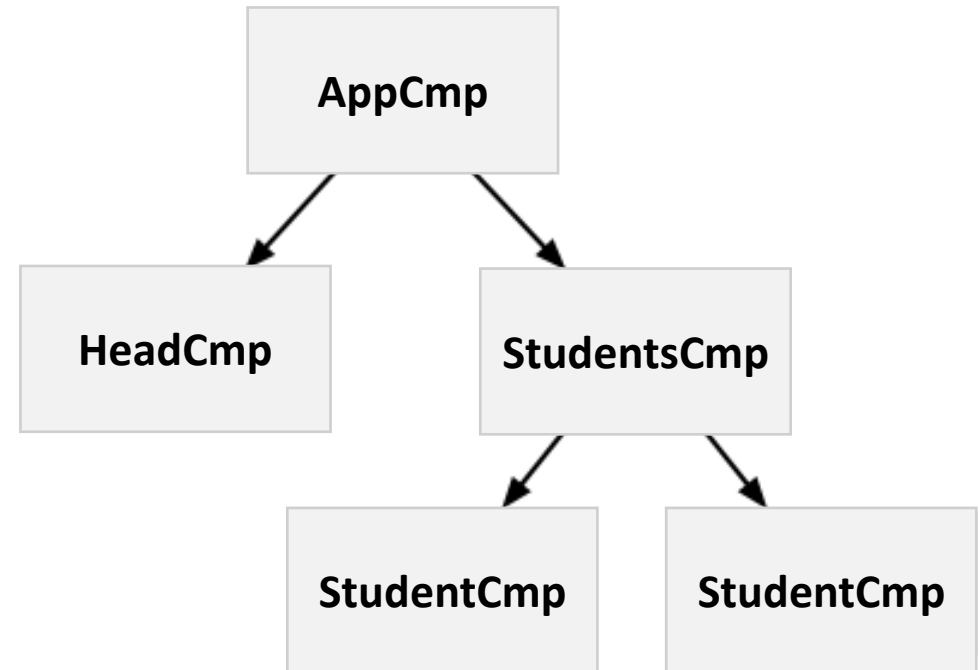
What are Components?

In our Angular apps, we write HTML markup that becomes our interactive application, but the browser understands only limited built-ins markup tags like `<select>` or `<form>` or `<video>` all have functionality defined by the browser.

What if we want to teach the browser **new tags**? What if we wanted to have a `<weather>` tag that shows the weather? Or what if we wanted to have a `<login>` tag that creates a login panel?

Components

To build an Angular application you define a set of components, for every UI element, screen, and route. An application will always have root components that contain all other components.



What is a Component?

A component is a simple class/object. But this class is decorated with `@Component()` factory decorator, where we pass metadata/object to it to describe this component and have Angular controls it.

```
@Component({  
    selector: '',  
    template: ''})  
class AppComponent {}
```

A component represents one element in Angular Application, this element has a tag name (selector), and has view/template and state/object. The template is what being rendered to the DOM by Angular.

Types of Components

1. Presentational

- Dumb components
- Stateless
- Inputs/Outputs for communication

2. Container

- Smart components
- Keep track of the application state
- Responds to updates to children

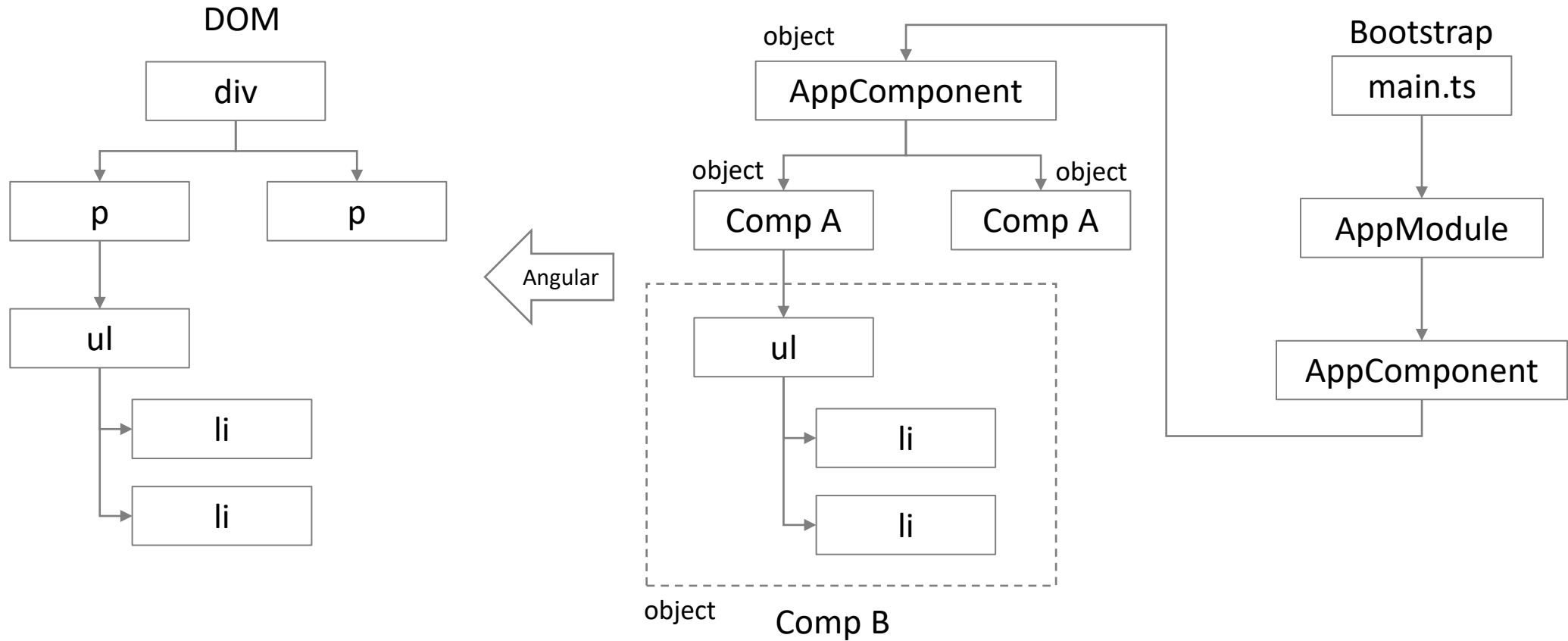
3. Layout

- Layout of the page
- Parent to any inner components, but data is not shared
- Does not need to update

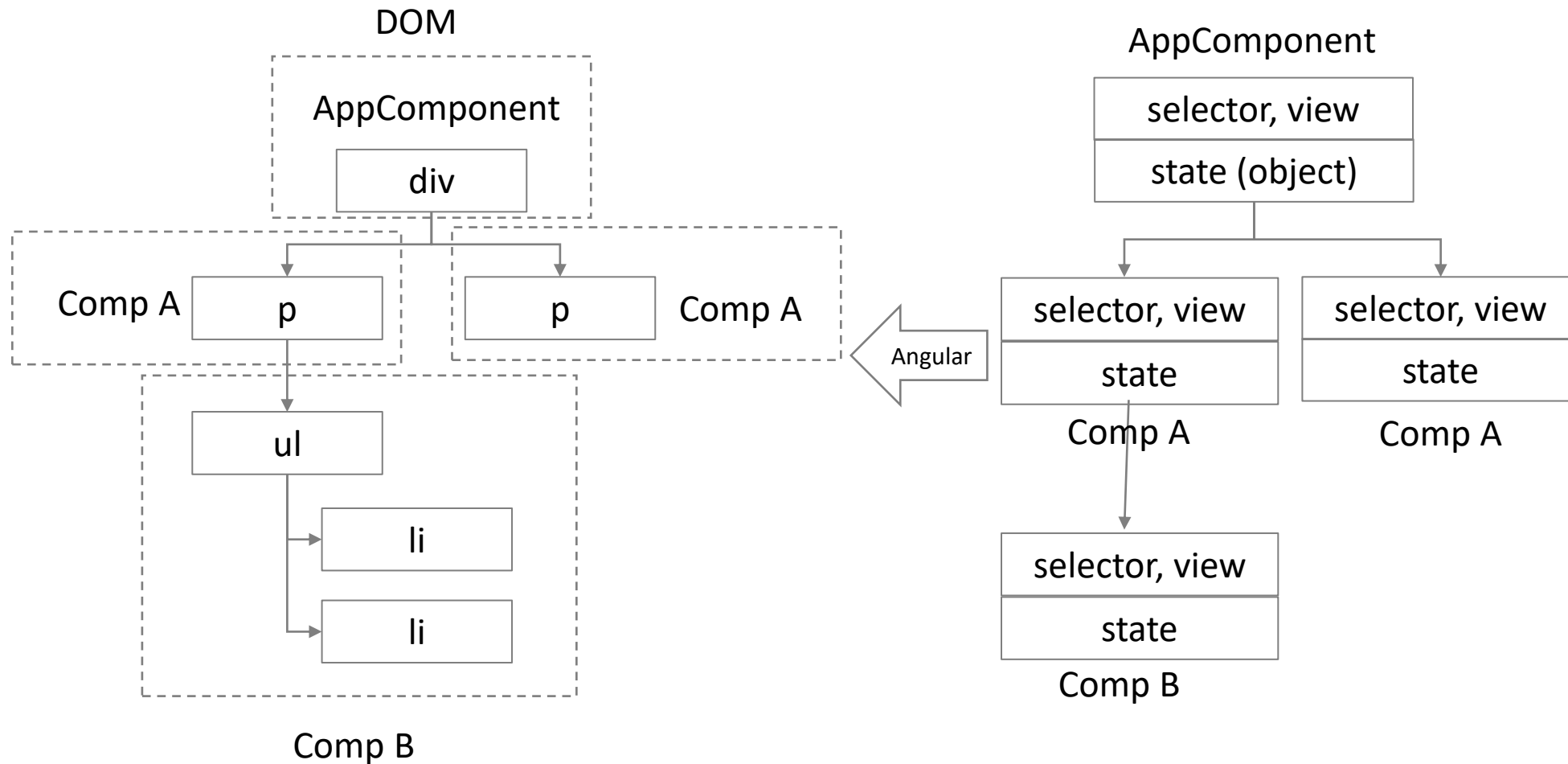
Types of States

- **Server state** REST APIs
- **Application state** Router/URLs, NgRx
- **Page-specific state** Component State, Services

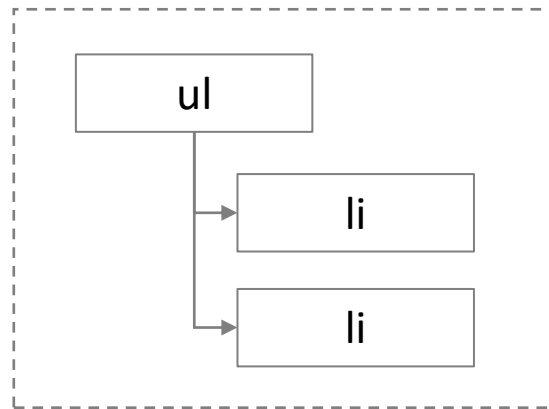
Angular Page vs HTML Page



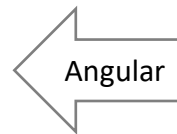
Components vs HTML Tags



DOM (template) and Component State



DOM

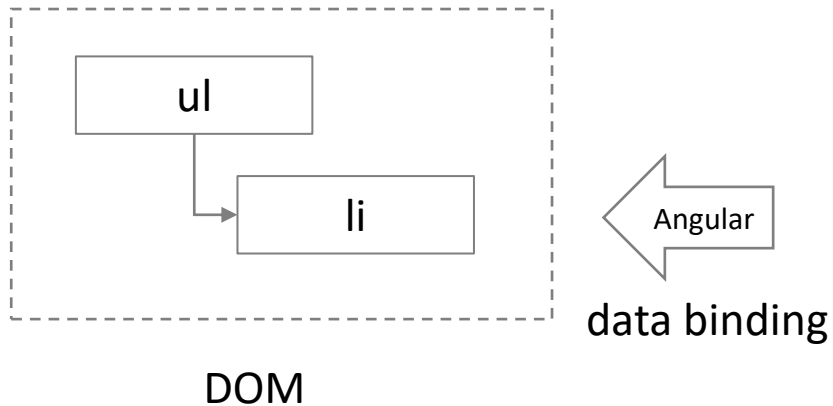


```
@Component({  
  selector: 'compB',  
  template: `<ul>  
    <li></li>  
    <li></li>  
  </ul>`})
```

```
class ComponentB {}
```

<compB></compB>

Data Binding



```
@Component({  
  selector: 'compB',  
  template: `<ul>  
    <li> {{ message }} </li>  
  </ul>`})  
  
class ComponentB {  
  message = 'Hello there!';  
}
```

- You change the state (message property)
- Angular reflects the change to the view
- Angular renders the view to real DOM (one way data binding)
- Notice that changing the DOM won't affect your app state (message property)

Creating a new Component

We can build our component from scratch but it's easier to use Angular CLI

```
ng generate component myComponent  
ng g c myComponent
```

Notice the changes in `module.ts`

```
ng g c --flat myComponent
```

--flat No new folder

```
ng g c --inline-template myComponent  
ng g c -t myComponent
```

-t No Template file (inline)

```
ng g c --inline-style myComponent  
ng g c -s myComponent
```

-s No Style file (inline)

```
ng g c --flat -s -t myComponent --skip-tests
```

app.component.ts

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

@Component({
  selector: 'my-app',
  template: ` <div class="big">
                    <h1>Welcome to CS569!</h1>
                </div>
            `,
  styles: [`.big { font-size: 20px; }`]
})

export class AppComponent {}
```


Template

A component must have a template, which describes how the component will be rendered on the page.

You can define the template:

inline using **template** property

externally using **templateUrl** property

In addition to the template, a component can define styles using:

styles property

styleUrls property

By default the styles are encapsulated.

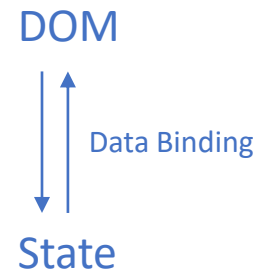
Template Binding

We can pass data from our component class to our template very easily and bind them together by defining a property and access it with string interpolation syntax in our template:

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

```
@Component({  
  selector: 'my-app',  
  template: ` {{ message }} `,  
})
```

```
export class AppComponent {  
  message = 'Hello there!';  
}
```



A Simple Component

Here's another simple Component that renders our name property:

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

@Component({
  selector: 'my-component',
  template: '<div>Hello my name is {{name}}</div>'
})


export class MyComponent {
  public name;
  constructor() {
    this.name = 'Saad'
  }
}
```

When we use `<my-component>` in our app, this component will be created, its constructor will be called, and then rendered.

Adding CSS to your component


```
@Component({  
  selector: 'app-comp',  
  template: `<p class="red">Red Paragraph</p>`,  
  styles: ['p { border: 1px solid black }', 'p.red { color: red; }']  
})
```

```
<style>  
  p [_ngcontent-yvn-3]{ border: 1px solid black }  
  p.red[_ngcontent-yvn-3] { color: red; }  
</style>
```



```
@Component({  
  selector: 'app-comp',  
  template: `<p class="red">Red Paragraph</p>`,  
  styleUrls: ['./user.component.css'],  
})
```

```
p { border: 1px solid black }  
p.red { color: red; }
```



user.component.css

The Shadow DOM

Shadow DOM refers to the ability of the browser to include a subtree of DOM elements into the rendering of a document, but not into the main document DOM tree.

The Shadow DOM is simply saying that **some part of the page, has its own DOM within it**. Styles and scripting can be **scoped** within that element so what runs in it only executes in that boundary.

The scoped subtree is called a **shadow tree**.

The element it's attached to is its **shadow host**.

Not all elements can
host a shadow tree v1
*Like <input> <textarea>
..etc*

DOM Composition

By using Shadow DOM, we have hidden the presentation details of the component from the document. The presentation details are encapsulated in the Shadow DOM.

View Encapsulation

The 3 states of view encapsulation in Angular are:

None: All elements/styles are leaked - no Shadow DOM at all.

Emulated: Tries to emulate Shadow DOM to give us the feel that we are scoping our styles. This is not a real Shadow DOM but a strategy that works in all browsers.

ShadowDom: This is the real deal as shadow DOM is completely enabled. Not supported by older browsers.

```
@Component({  
  template: '<p class="box"></p>',  
  styles: [`.box { height: 100px; width: 100px; } `],  
  // encapsulation: ViewEncapsulation.ShadowDom  
  // encapsulation: ViewEncapsulation.None  
  // encapsulation: ViewEncapsulation.Emulated is default  
})
```