

The new Angular

The king is dead, long live the king!



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Introduction

welcome to the jungle

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1. Your teacher
2. Course structure
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6. The chain
7. Gamebook - the beginning

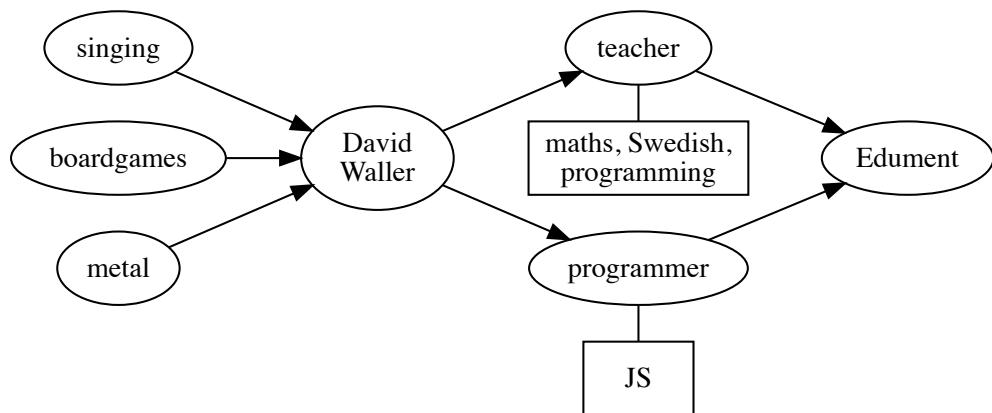
1-1. Your teacher

Let's start with the most important - **me!**

1-1-1

So, who am I?

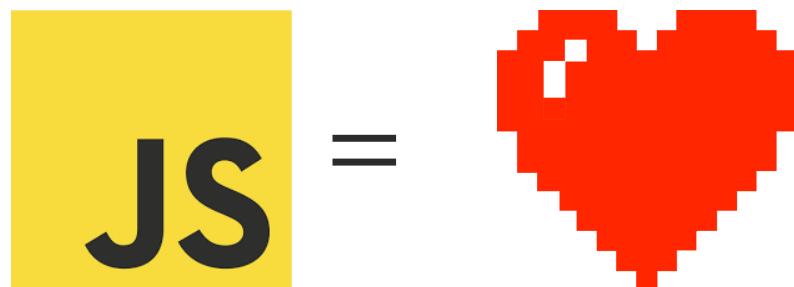
1-1-2



- david.waller@edument.se
- [@krawaller](https://twitter.com/krawaller)

Don't be a stranger!

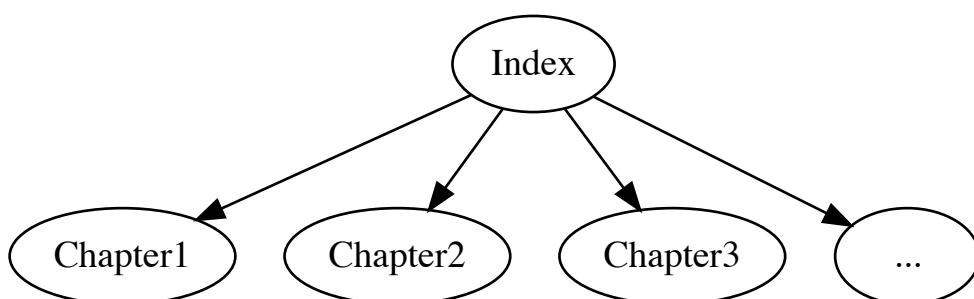
But, **fair warning** - I spend my days singing this gospel:



1-2. Course structure

How we'll go about things

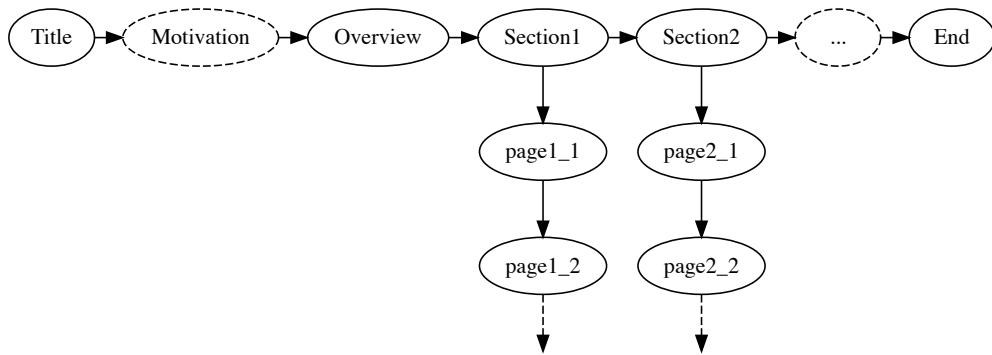
The course is divided into several **chapters**, where you're currently in the first.



We access the chapters from an **index**, giving you a **birds-eye view** of the entire contents.

Each **chapter** has many **sections**:

1-2-2



In the **printed material** (or PDF) and in the **presentation top-right corner**,
the slides are numbered **X-Y-Z** where...

1-2-3

- X is the number of the current **chapter**
- Y is the number of the section **section** within that chapter
- Z is the number of the **slide** within that section

Some sections are **exercises**, where you'll get to internalise what we've
been talking about through a **practical task**.

1-2-4

These are all **tied together** in that it is one single app that you will keep
tinkering with.

Quite a bit of material live in the **Appendices**. You should take a look
what's there, and we'll **dive down when we need to or feel like it!**

1-2-5

1-3. Manifesto

what we want to achieve

Obviously, first and foremost, this course aims to **teach you about**
Angular.

1-3-1

As with all our courses we strive **not to focus just on the API**, but mainly to provide a deep understanding for the subject.

1-3-2

In this case, the **Angular way of thinking!**

Also, in the case of Angular, a **detailed-oriented focus** would be **extra unfortunate** as things are still **changing around quite frequently**.

1-3-3

1-4. The name Angular

Nya gamla Ullevi

So - **Angular!**

1-4-1

First lesson for the day: this is a **completely new framework**.

It is rebuilt from the ground up but **borrows ideas from its predecessor**, AngularJS (or Angular 1).

Angular v1 still lives on, and will be developed in parallel with Angular v2+.

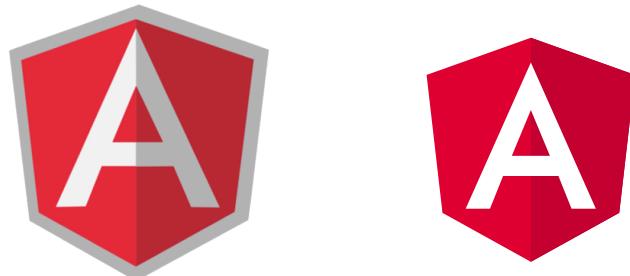
1-4-2

Really, the new Angular could (should?) have been **called something completely different**.



So - can you **spot the difference** between these two?

1-4-3



Obviously;

1-4-4

- The first is the logo for **AngularJS**
- The second represents **Angular**

Some more comparisons:

1-4-5

	Angular v1	Angular v2+
Official name	AngularJS	Angular
Homepage	http://angularjs.org	http://angular.io
NPM package	angular	@angular
Git repo	angular/angular.js	angular/angular
version (jan 2018)	1.6.8	5.1.3

 ...isn't this **hugely confusing?**

1-4-6

 Yes. Yes, it is.

1-4-7

 And since **development continues on Angular1** - what happens when they need a **new major version**?

1-4-8

1-4-9

Because of this confusion, many opted to **refer to the new framework as Angular 2**, even though that is not the official name.

1-4-10

But that doesn't work anymore, since **Angular "2" is now version 5**.

...and, to put a cherry on the cake, there **never was a version 3**.

1-4-11

But, jokes aside - Angular is a **well thought-through framework** using **cutting-edge technologies** while still leaning on experience from AngularJS.

1-4-12

As such is it **well worth getting to know**. So, let's do just that!

1-5. Hello World

hello yourself!

There's really a **whole lot to learn** before we *can* say hello to the world, but - let's cheat!

1-5-1

We'll jump **straight into the deep** and see what a **Hello World** demo would look like!

1-5-2

So, there was a **lot of things in that code that we didn't understand** at all.

1-5-3

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

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

But **main.ts** seems to be mainly **bootstrapping** stuff.

And **app.ts** didn't really look *that* bad!

1-5-4

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

If we pretend that weird @ sign wasn't there, this looks **almost decipherable**!

And of course, throughout this course, we will **decipher all of what you just saw**.

1-5-5

But now you **have an idea what we're dealing with**!

1-6. The chain

From source to seeing

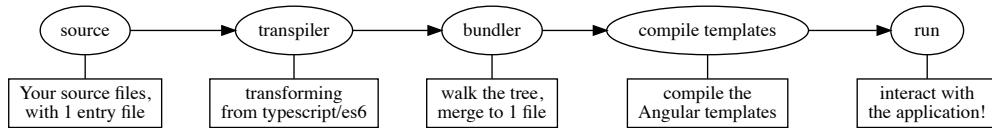
In our sheltered demo setup it is a bit **hard to get a feel for the setup chain**, since all of that takes place behind the curtain.

1-6-1

Let's peek, at least squintingly, at **what that looks like** before we move on!

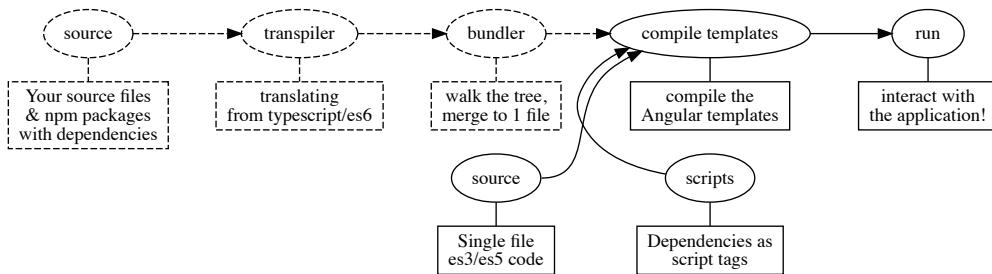
Here is an overview of **what needs to happen** before the user can interact with your Angular app:

1-6-2



(Although it is possible, but not advisable, to **cheat**)

1-6-3

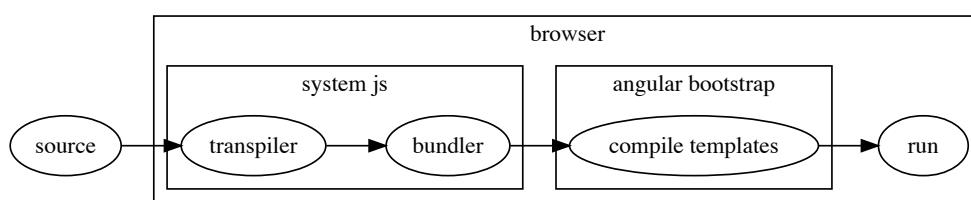


So, if we don't cheat, **how do we make all this happen?** Let's look at a few **different setups**.

1-6-4

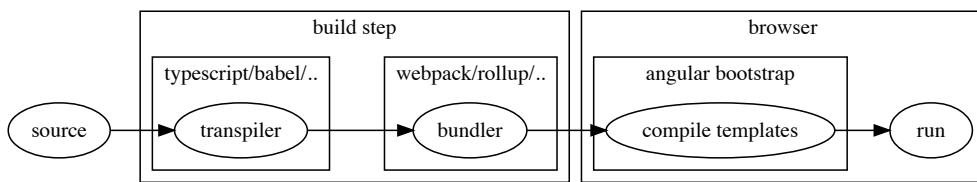
Here's the **Quickstart setup**:

1-6-5



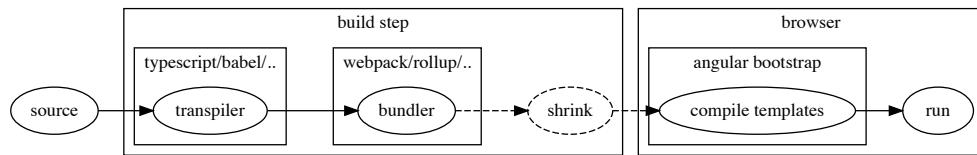
Everything happens in the **client's browser**.

A more typical approach is to have a **build step**, where we do stuff **on the developer's computer**. Here's a **common setup**:



Transpiling and bundling are often done at the same time.

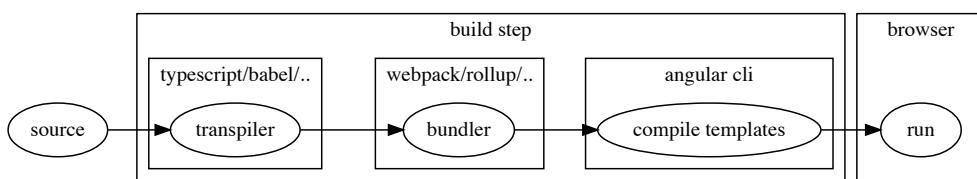
An advantage of a build step is that it lets us **shrink the code**:



This is primarily done through 3 different means:

- Minification Remove whitespace, rename variables etc. This also obfuscates!
- Compression Using gzip or similar to pack the file
- Tree shaking Identifying and eliminating unused code from the package

We can increase performance by **moving the template compiling to the build step**:



But, we're getting ahead of ourselves!

1-7. Gamebook - the beginning

left or right, block or strike?

Even though we **really** don't know what's going on yet, let's have a quick first exercise!

1-7-1

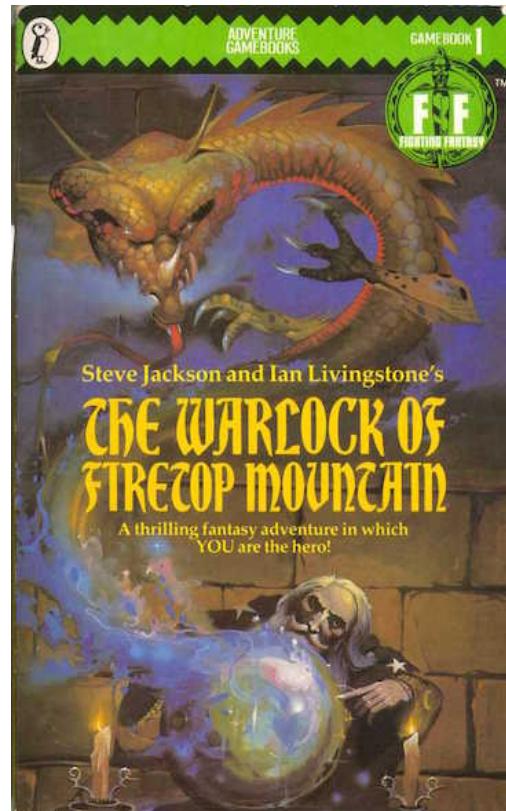
This will mean **using techniques and tools** we haven't explained yet, but, 1-7-2
humour us and follow along anyway! :)

We'll now **walk through the instructions together** so you know what to do. 1-7-3

But remember that you have these **same exact** slides in the provided material, so refer to that while you're working!

So! Does anyone **recognizes** this book cover?

1-7-4



This is the first of the legendary Fighting Fantasy gamebooks! They work something like this: 1-7-5

A dark hallway extends into the unknown. You can just make out the outline of a door to your left.

- to try the door, go to page 43
- to fumble down the hallway, go to page 231

Throughout this course we will learn **Angular** by hacking away at **our own gamebook app!**

1-7-6

Now, with the [Hello World](#) demo fresh on our retinas, we'll start by just making a **static example page**.

Your illustrious teacher will provide you with a **starter kit**, which you should **download** to your computer and **open in your editor**.

1-7-7

Then, moving forward, **every iteration** of the app will have its own **folder** inside the starter kit.

Before we can do anything we must **download the dependencies**. You must...

1-7-8

- **open a node terminal** (there's one in VSC!)
- **navigate to the exercises**
- **copy the `_seed` folder**
- **navigate into the copy**
- **type `npm install`**

In this folder you'll find a bunch of files, most of which you don't need to touch.

1-7-9

For now we only need to talk about...

- a** `src/app.ts`
- b** `src/module.ts`
- c** `main.ts`

- a** The **app.ts** file defines and exports a single component.

1-7-10

On this small scale you could say that **this is the application!**

The **only part you need to care about now** is the **template**, which contains what should be rendered to the screen.

You should **change this template** so that it shows a **single page** from a **gamebook**.

1-7-11

It **won't have any functionality** yet, just a static rendering.

The template should contain:

- An **adventure title** that never changes
- A **scene title**
- An **image** (link it in using an `img` element with a `src` attribute)
- A **text** describing the scene
- A list of **options** (that won't be clickable yet, just make them pure text)

The exciting Quest

1-7-12

A dark hallway



The corridor extends into eternity in front of you. A few meters down a heavy oak door is set in the left wall.

- Open the door
- Walk down the corridor
- Turn back

To prevent the image from being **too large**, add a quick styling to the Component metadata:

```
styles: ['img {max-width: 250px; max-height: 200px;}']
```

1-7-13

b The `module.ts` will...

1-7-14

- Create a **root module**
- Import the **needed dependencies**
- Import the **component** from `app.ts`

You **don't have to change anything** here unless you want to add more components.

c Finally, `main.ts` is the **bootstrapping file** It will

1-7-15

- import the app module
- bootstrap it

You **don't have to change anything** here.

After you've **finished the template** it is time to **bundle up!**

1-7-16

For these exercises we'll be using **webpack**.

To bundle up your app, you must type...

1-7-17

```
npm run build
```

...inside the project folder.

This will **create `dist/bundle.js`**, which **`dist/index.html` is already wired to use**.

Now you can **view `dist/index.html`** in your browser and **see your app in action!**

1-7-18

This is **best done over a web server**. The easiest way is likely to **do this from inside your editor** if it has that functionality.

Now that we've had a taste of creating an Angular app, we'll rewind to the actual beginning and lay out the tools and theories we need to actually understand what we just did.

1-7-19

Dependencies

What makes Angular tick

Taking a detour before getting into Angular for real, we will now tour the **dependencies of the framework!**

Sections in this chapter:

1. CoreJS
2. TypeScript
3. ZoneJS
4. Reflect metadata
5. RxJS
6. SystemJS

2-1. CoreJS

ES3 -> ES5

CoreJS is a node module that **provides polyfills for ES5** (and some more advanced features).

2-1-1

This means we can **write code in ES5**, but be sure that **ES3 browsers can run it**.

As you can see, it is a **very popular** solution:

2-1-2

93,595 downloads in the last day

1,718,600 downloads in the last week

6,895,965 downloads in the last month

CoreJS is **not actually a dependency** of Angular, but as your app is likely to end up as ES5 code (after having been chewed by TypeScript), CoreJS is an **easy way to increase browser coverage**.

2-1-3

A **normal usage** of CoreJS is to pull it in via NPM, and then **reference the shim file** in your main index.html file:

2-1-4

```
<script src="../node_modules/core-js/client/shim.min.js"></script>
```

Note that since **no code transpiling** is taking place, **only polyfilling is possible**.

2-1-5

2-2. TypeScript

Waiter, there are types in my JavaScript!

TypeScript is **language** that **compiles to JavaScript**.

2-2-1

Unlike other such languages like for example [CoffeeScript](#), it is a **superset of JavaScript**. This is important since it means that **regular JavaScript is valid TypeScript**.

So what does TypeScript add? Many things!

2-2-2

Most importantly **types**, as the name suggests.

We can add type annotations to variables, parameters and functions:

2-2-3

```
let name: string = 'foo';

function isAllowedIn(age: number): boolean {
  return age >= 18;
}
```

Now, if some other code **violates these annotations**, TypeScript would **flag this as a problem**. (During compilation, or even earlier, if your editor is TypeScript-aware.)

However, the **real power of TypeScript** is that it does **static analysis** of your code. So if we later typed this...

2-2-4

```
let willHaveFun = isAllowedIn(16);
```

...and hovered above `willHaveFun`, a TypeScript-aware editor would **tell you that this is a boolean!**

In other words, **this example code...**

2-2-5

```
let name: string = 'foo';
```

...was **unnecessarily complex**, as **this would be enough**:

```
let name = 'foo';
```

TypeScript sees from the assignment that `name` is a **string**, and will treat it as such.

In other words - simply by activating TypeScript we get a lot of power, even if we don't use any type annotations!

2-2-6

TypeScript isn't strictly a dependency of Angular.

2-2-7

Yes, Angular is written in TypeScript, but that code has already been transpiled to regular JavaScript.

But since we will use TypeScript in our Angular code, TypeScript should be a devDependency of our project.

2-2-8

Exactly how we use it depends on the build setup, or if we're using SystemJS.

Q So... we don't have to use TypeScript. But what will we use it for?

2-2-9

A The following:

2-2-10

- as an ES6 transpiler
- a few type annotations for dependency injections (more on that later)
- for decorating classes as we saw earlier
- class property initialisation which isn't possible in regular JS (yet)

In other words, our code will mostly be normal ES6, so don't be too scared! :)

2-2-11

In an optional part of the exercises we'll also be using TypeScript interfaces.

2-2-12

They are very powerful, but we'll just use them to define object shapes. Kind of a data type!

It looks like this; in the interface definition we specify the expected properties for our object shape:

```
interface User {  
  name: string,  
  age: number  
}
```

2-2-13

Now we can use the interface as a type...

2-2-14

```
let me: User = { name: "David", age: 37 };
```

...and TypeScript will ensure compliance:

```
let you: User = { name: "Bob" }; // angry red squiggly line
```

Note that interfaces are purely a development artifact, there'll be no trace of them in the generated JS code.

2-2-15

Which means there's no performance or bloat penalty to using them, but we gain in code clarity and bug prevention!

There is a lot more to say about TypeScript that is outside the scope of the usage in Angular. In fact, we have a [whole course just about TypeScript!](#)

2-2-16

2-3. ZoneJS

perimeter alarms

[ZoneJS](#) is an implementation of *zones* for JavaScript. A zone is...

2-3-1

an execution context that persists across async tasks

Q Wat?!

2-3-2

A Ok, ok. Imagine this simple app...

2-3-3

5 bottles of beer on the wall

Buy more

...where clicking the button increases the count by 1.

AddSkills Umeå, 8 jan 2018

© Edument 2018

Here's an implementation using React:

2-3-4

```
let Clicker = React.createClass({
  getInitialState: ()=> ({count:3}),
  more() {
    this.setState({count:this.state.count+1})
  },
  render() {
    return <div>
      <p>{this.state.count} bottles of beer on the wall</p>
      <button onClick={this.more}>Buy more</button>
    </div>
  }
})
```

The interesting part is the **statement that is executed when we click the button:**

2-3-5

```
this.setState({count:this.state.count+1})
```

The **only way to change the state in React is to call `setState`.**

This also means that React **only needs to update the UI when `setState` has been called**, since that is the only time things can change!

2-3-6

Here's the **same app in Angular**:

2-3-7

```
@Component({
  selector: 'clicker',
  template:
    <p>{{count}} bottles of beer on the wall</p>
    <button (click)="more()">Buy more</button>
  )
class Clicker {
  count = 3
  more() {
    this.count++
  }
}
```

When the button is clicked, we **simply mutate an instance property directly**:

2-3-8

```
this.count++
```



But.. if there's no `setState` equivalent to piggyback on, **how does Angular know when to update the UI?**

2-3-9



Angular cheats by **patching every function that can cause a change**.
Because there are only a finite set of times when this can happen, most importantly:

2-3-10

- DOM events
- Timeouts and intervals
- AJAX requests return

AngularJS did the patching by forcing developers to use **Angular variants** of things:

2-3-11

- `ng-click` instead of regular `click` event
- `$timeout` service instead of regular `setTimeout`
- `$http` service instead of regular `XMLHttpRequest`

These special Angular variants would **call their native equivalents**, but also **wrap the UI updating**.

2-3-12

In Angular, we **patch the native methods directly** instead.

2-3-13

Except, it is actually **ZoneJS** who does the patching for us!



Ok, so **ZoneJS** tells us when to look for changes, but - what's the point?

2-3-14



Only this: by hooking our UI update mechanics into all points where stuff can happen, we can **allow devs to mutate state directly...**

2-3-15

```
this.count++
```

...instead of **forcing them through a function**:

```
this.setState({count:this.state.count+1})
```

We use `zone.js` either by referencing it in the html file...

2-3-16

```
<script src=".../node_modules/zone.js/dist/zone.js"></script>
```

...or **importing** it in our app root:

```
import `zone.js`
```

2-4. Reflect metadata

the story behind the story

Reflect Metadata is...

2-4-1

- a proposal for a new **Reflect** global object
- a sample implementation of that feature

The **Reflect** object houses functionality that allows you to **read / write metadata** to / from data structures.

2-4-2

Now, the **decorating** itself and the weird `@` syntax that it uses is **not part of Reflect**. **Reflect** is merely a **convenient tool** to use in that process.

2-4-3

Decorators are a separate proposal, as well as a competing implementation by TypeScript.

2-4-4

Suffice to say that the situation is a bit of a mess.

For our use case all you need to know about Reflect is that **Angular relies on it being available**, and so we must make sure that it is by **referencing it** in our html file...

2-4-5

```
<script src="../node_modules/reflect-metadata/Reflect.js"></script>
```

...or **import** it into our codebase:

```
import 'reflect-metadata'
```

In the future, when the native Reflect object stabilises, the plan is to do **without Reflect metadata**. But, we're not quite there yet.

2-4-6

2-5. RxJS

Everything is a stream

Like ZoneJS, RxJS is a **PeerDependency**, which again means that it is up to you to **make sure it is available**.

2-5-1

However, unlike ZoneJS, you **don't have to bring it into your project**.

2-5-2

Just make sure it **sits in node_modules**, and **Angular will reference it** under the hood as needed.

So what does it do? RxJS is a **stream library**. What are those? They are frequently described as

2-5-3

promises on steroids

In other words, they are a **tool for working with asynchronicity!**

Here are some **example streams**:

2-5-4

This was fun! Here's a **few more**:

2-5-5

To give you a sense of the **size of RxJS** - remember the **super simple clicker example** from when we talked about zones?

2-5-6

5 bottles of beer on the wall

Buy more

Here's an **implementation written with CycleJS**:

2-5-7

```
function Clicker({DOM}){
  const click$ = DOM.select('button').events('click')
  const count$ = click$.mapTo(1).startWith(3).scan(
    (acc, seed)=>(acc|0)+seed
  )
  return {
    DOM: count$.map(count=> div([
      div([count+ ' bottles of beer on the wall']),
      button(['Buy more'])
    ]))
  };
}
```

CycleJS is a very different beast that is **solely based on streams** which makes for a **very different programming experience**, as you just saw!

2-5-8

But, the details of this are a **story for another time**.

However, in CycleJS you can **choose which stream library to use**.

2-5-9

Here's a **size comparison** for CycleJS clicker apps between **rxjs** and another lib called **xstream**:

Implementation	Code size	Bundle size
rxjs	518	941031
xstream	521	270980

As you noticed, **rxjs is a beast**. And as streams aren't central to Angular, there's been some **criticism** that rxjs needlessly **bloats the size of Angular apps**.

2-5-10

But there are also those who appreciated the opportunity to use the presence of RxJS in Angular as an excuse to learn streams by finding a use in their apps for it!

2-5-11

2-6. SystemJS

on-demand loader

SystemJS is a

2-6-1

universal dynamic module loader - loads ES6 modules, AMD, CommonJS and global scripts in the browser and NodeJS

This means that if your code is modularised into files using any of those formats, SystemJS will let you **run that code in the browser**.

2-6-2

If your code is using **modern features** that need to be dumbed down for the browser, SystemJS will **need a transpiler**.

2-6-3

There are therefore plugins to use **Babel**, **Traceur** or **TypeScript**.

You use SystemJS by **including it as a script tag** in your html file:

2-6-4

```
<script src="node_modules/systemjs/dist/system.src.js"></script>
```

This will create the **System** global object.

You will then likely need to do some **configuring**, for example giving the path to the **node_modules** directory.

2-6-5

```
System.config(myConfigObj);
```

This is traditionally done in a **separate config file**:

```
<script src="systemjs.config.js"></script>
```

Now you can **start your application** by importing the module containing the starting point:

2-6-6

```
System.import('app.js');
```

Since SystemJS will be loading the non-starting files on the fly as they are needed, it **works best if you load your html file with a web server**.

2-6-7

Otherwise you risk being hampered by disallowed cross origin HTTP requests.

So in essence, SystemJS is a way to do **transpiling and bundling in the browser**.

2-6-8

This is useful for **quick prototyping and experimenting** as it means we don't need webpack/browserify or something similar, but for **production it is recommended that you serve a precompiled bundle**.

Q What then is the **connection to Angular**?

2-6-9

A None at all! Except that they use SystemJS for their official [Quickstart](#)

2-6-10

This is likely also the reason that it **keeps popping up in 3rd party articles related to Angular**.

Components 101

The building blocks

Sections in this chapter:

1. Component basics
2. Component styling
3. Reading model values
4. Template expressions
5. Built-in directives
6. Gamebook - dynamism

3-1. Component basics

The primary building block

Unlike its predecessor AngularJS, **Angular is component centric**.

3-1-1

The vast majority of your code is likely to be **made up by components**.

Much of what was housed in controllers in AngularJS has **moved into components** in Angular.

3-1-2

So, let's **learn about components!**

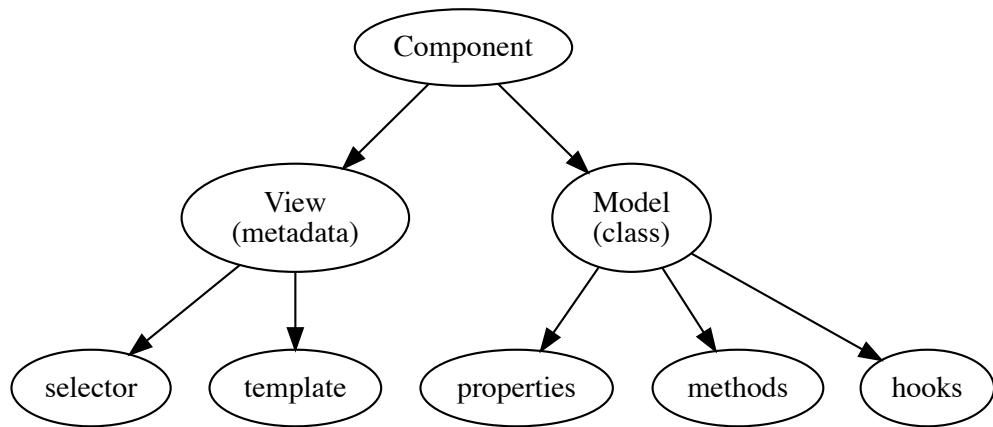
In Angular, components are made up by **two parts**:

3-1-8

- A **model**, represented by a **class**, to hold **values, methods and lifecycle hooks**.
- A **view**, represented as **decorated metadata** on the class, to hold **template** and related things.

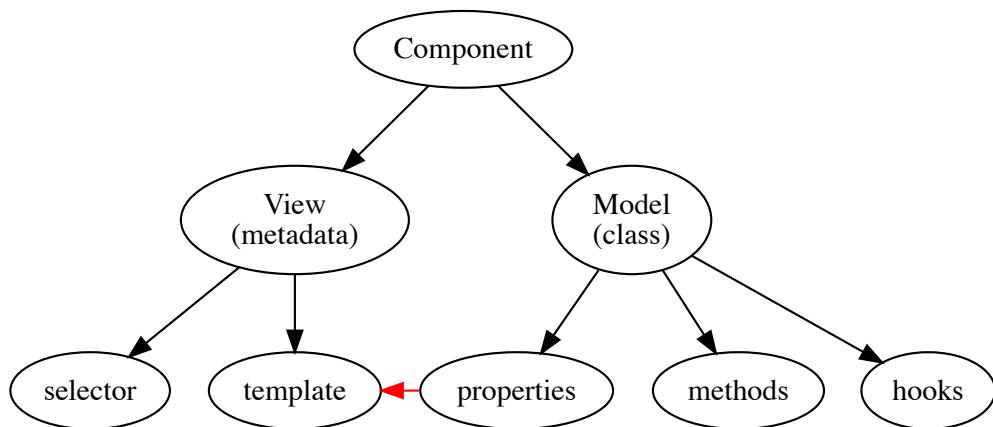
This can be translated to the following **structure map**:

3-1-4



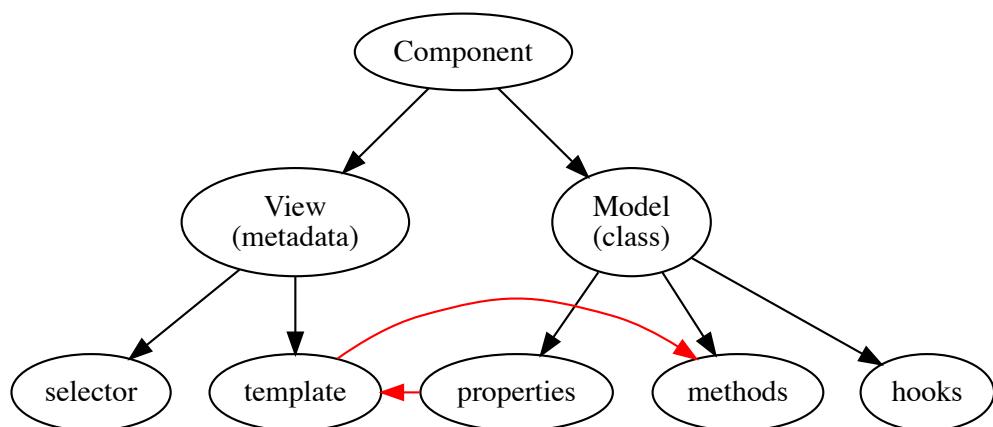
In the **template** we can **read values from the model**:

3-1-5



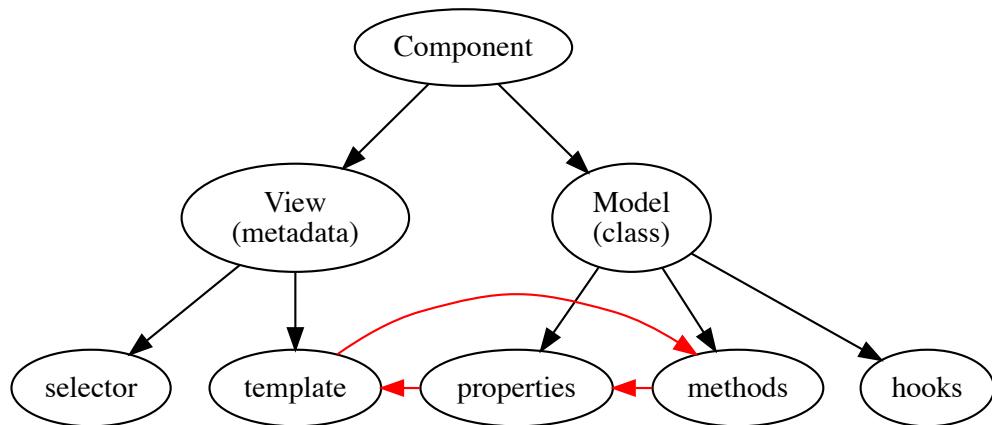
Also we can use **model methods** as **event handlers** in the template...

3-1-6



...which causes the values to change and to be read again.

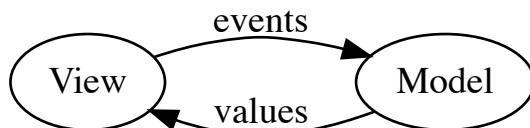
3-1-7



Thus we get a **uni-directional dataflow** on a component scale.

We can boil the cycle down to this:

3-1-8



Understanding this cycle is **absolutely central** in learning about components!

3-2. Component styling

putting on the makeup

As you've already seen flash by, the **Component** metadata can have a **styles** property:

3-2-1

```
styles ['h1 {text-decoration: none;}']
```

It should contain an **array of CSS strings** that will be applied.

As with the templates (which we just might have forgotten to mention!), we can also **refer to external files**:

3-2-2

```
styleUrls: ['app/css/usersection.css']
```



But, wait a minute. If we're just throwing **regular CSS** at the component, then **how is it scoped?**

3-2-3

Won't these styles just **apply to everything?**



Excellent question! As usual, **it depends.** :)

3-2-4

Specifically, it depends on our selected level of **view encapsulation!**

Angular offers **two approaches** for rendering components:

3-2-5

- as **regular HTML** (meaning no encapsulation)
- as **Shadow DOM** (meaning full encapsulation)

Shadow DOM, as an elevator pitch, is a way to have **tiny contained documents** within the larger document.



...you mean like **iframes**?

3-2-6



No, yuck!

3-2-7

Well, ok, yes. Sort of. But with **controlled ways to interact with the context.**

We control encapsulation through the **encapsulation** metadata property. It has **three possible values:**

3-2-8

Native	Assume native shadow DOM support in the browser (which few have)
Emulated	Use an Angular-included emulation of shadow DOM . This is the default
None	Render component as regular HTML

There are **constants for the modes** on the core-provided **ViewEncapsulation** object, so configuration looks like this:

3-2-9

```
@Component({  
  encapsulation: ViewEncapsulation.None,  
  ...  
})
```

The shadow DOM has some **useful pseudo selectors**:

3-2-10

- **:host** matching the **containing element**
- **:host-context()** which lets us **test the host context**

Likely you'll only use **:host**.

And likely you're fine with the **Emulated default**, so for normal development you **won't have to care at all!**

3-2-11

The **only things to remember** are that...

- you can **style the containing element with **:host****
- **styles are scoped to the component** (by default)

3-3. Reading model values

and he went hither

Let's get this show going by looking at how the **view reads values from the model!**

3-3-1



The template can read values from the model by using **interpolation**. Anything **within double braces** is evaluated as a **model property**:

3-3-2

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

See also the [Hello someone](#) demo.



But **what if the value isn't static?** Let's say we **change our model** to update 'world' to 'WORLD' after 1 second:

3-3-3

```
class AppComponent {  
  name = 'world'  
  constructor(){  
    setTimeout(()=> this.name='WORLD',1000)  
  }  
}
```

To handle this, **what do we need to do?**



Nothing! This is the **zone** thing that we mentioned earlier. Zone enables Angular to **check all bindings at every point in time when something might have changed**, and update references accordingly.

3-3-4

See for yourself in the [Hello Changing](#) demo.

Interpolation **isn't just for text nodes** - sometimes we want **model values in element properties** too:

3-3-5

```
@Component({  
  selector: 'app',  
  template: `<input placeholder="{{helpText}}">`  
})  
export class AppComponent {  
  helpText = "Enter your name..."  
}
```

Side note - remember our earlier look at the **difference between a property and an attribute!**

3-3-6

- an **attribute** is an attribute on the HTML element
- a **property** is a property on the resulting DOM node.

Since we are writing HTML code you'd **think we're dealing with attribute**, but as **Angular deals exclusively with properties** (well, almost) we will use that word instead.

3-3-7

Back to interpolation - those **double brackets** in a string really aren't pretty:

3-3-8

```
<input placeholder="{{helpText}}">
```

But there is an **alternative syntax for properties** which is more explicit, namely the **bind-** prefix:

```
<input bind-placeholder="helpText">
```

These two lines are **completely equivalent**.

The bind- prefix is prettier but still **rather verbose**:

3-3-9

```
<input bind-placeholder="helpText">
```

...so quickly the **bracket shorthand** became popular:

```
<input [placeholder]="helpText">
```

This is still **equivalent to the previous versions**.

See the **different syntaxes side by side** in the [Property](#) demo.

3-3-10

And note again that the bind- and bracket syntaxes are **just for attributes**. Inside a **text node** there is no choice, we must use **double braces**.

3-4. Template expressions

uncovering the lie

We've now seen how to **reference model properties** in the view:

3-4-1

```
@Component({
  selector: 'app',
  template: '<p>Hello {{name}}</p>'
})
export class AppComponent {
  name = "Batman"
}
```

But we are actually **not limited to referencing properties!**

3-4-2

The code inside the interpolation/binding is called a **template expression**, and it is evaluated much like JavaScript:

```
You finished {{place === 1 ? 'FIRST!!' : 'in ' + place + ' place'}}
```

But **not exactly** like JavaScript expressions. Here are **some important limitations**:

3-4-3

- we **can't do side effects**, only pure expressions
- we can **only reference model properties and methods**, global variables are out of reach

There are also **some additions** when compared to JavaScript:

3-4-4

- a The **pipe operator**
- b The **safe navigation operator**

Let's briefly touch on these!

- a The **pipe operator** is familiar to AngularJS developers as a **convenient way to call functions** inside templates:

3-4-5

```
userName |UpperCase
```

We'll dig deeper into pipes later!

- b The safe navigation operator is recognisable from many other languages, for example [CoffeeScript](#). It allows us to dig into objects without erroring if some step is undefined:

```
user.address?.street
```

Note that this is **in contrast with AngularJS**, where **object navigating was inherently safe** in their version of the template expressions.

Even though the **template expressions are powerful**, you should **strive to keep them as simple as possible**.

More complex logic should be done in the model.

3-5. Built-in directives

Not made to order

Although the **subject of conversation is Components**, we still **need to talk about Directives**. And actually, **Components are a sub-group of Directives**.

A directive, in the broad term, simply means **something we put in the HTML that has special meaning**. It **directs the browser** in how it should behave.

Like with AngularJS, a big part of learning the framework means **learning what is already there!**

We'll know **explore what's already there in Angular**, but first a **word of warning**: The demos we'll see will **include concepts we've yet to explore**! Don't let those get you down, we'll cover them soon enough.

So! In the case of **Angular** and directives, we get **five of them** to use in everyday templating. There are **three structural directives...**

3-5-3

- a ngFor
- b ngIf
- c ngSwitch

...and **two helpers**:

- d ngClass
- e ngStyle

a First **ngFor**, which as the name implies is a helper for **rendering lists**:

3-5-4

```
<div *ngFor="let msg of messages">{{ msg }}</div>
```

This will **repeat the div for every item in the messages array**.

Noticed the scary ***** character prefixing **ngFor**? That is a **shorthand**, which expands to this:

3-5-5

```
<ng-template ngFor let-msg [ngForOf]="messages">
  <div>{{ msg }}</div>
</ng-template>
```

All **structural directives**, who **change the HTML structure**, uses the **same *** **syntax**.

You can see **both variants** of the for loop in the [Forloop demo](#).

3-5-6

b Equally mandatory as **ngFor** is the **ngIf** directive, which lets you **optionally display something** given the truthiness of an expression.

3-5-7

```
<p *ngIf="flag">I only show when flag is true!</p>
```

See this live in the [If demo](#).

What if we have an **if-else** situation? There are two approaches;

3-5-8

- Simply use two **ngIf** with inverted clauses as in the [IfElse](#) demo.
- Pick a connected **ng-template** as in the [IfElseTemplate](#) demo.

c Then **ngSwitch**, which of course **emulates a switch statement** in the template.

3-5-9

But! We're actually **not going to go into detail**, as **ngSwitch** is **rarely useful**.

Such logic often **belongs in the model**, a subject we'll come back to.

3-5-10

If you're curious anyway, **check out the [Switch](#) demo**.

d Now **ngClass** which can **dynamically set a single style**...

3-5-11

```
<div [class.someClass]="someCondition"></div>
```

...or **many** (keys are classes, values are conditions) :

```
<div [ngClass]="someObject"></div>
```

Try it in the [Class Single](#) and [Class Many](#) demos.

e Finally **ngStyle**! Much like with **ngSwitch** we **advise against using this directive** for normal usage.

3-5-12

If you want to dynamically **alter the style for an element** - which is what it lets you do - it is **better to add/remove a CSS class** with **ngClass**.

There are however **two good reasons** for using **ngStyle**:

3-5-13

- The **styles depend on state** (think x- and y coordinates in a game)
- We're doing full-blown **CSS in JS**

But, if you are curious, **check the [Style Single](#) and [Style Many](#) demos**.

3-5-14

In this course we'll be focusing mostly on Components, but there's definitely **more to say on directives**.

3-5-15

See the Appendix for more details!

3-6. Gamebook - dynamism

hello someone

Let's revisit our Gamebook project! To start off,

3-6-1

1. **copy the folder for the first version,**
2. **paste it right next to the first version, and**
3. **give it the name `FF02-dynamic`.**

A static gamebook won't get us very far. Let's make it **show dynamic data** instead!

3-6-2

Here's the **plan** - we need to:

- a package the scene data somewhere
- b make the component fetch data
- c make the template read data from that prop

- a Having the **scene data hard-coded in the component** won't get us very far.

3-6-3

Let's **create a new file `data.ts`** for the data to live in!

The data file should **export a single object** containing our data. But let's look ahead - we're going to need more than one scene.

3-6-4

Therefore we should make the data file **contain a full adventure!**

The **adventure object** could look something like this:

3-6-5

```
export const myAdventure = {
  title: 'A strange adventure',
  scenes: {
    someScene: { ...scene data goes here... }
    // later there'll be more scenes here
  }
}
```

Note that we chose to **store scenes in an object** as opposed to an array. If we chose an array instead, a link to scene 7 would break if we later insert a new scene at position 4, leading to a more brittle structure.

3-6-6

The **scene object** needs to contain...

3-6-7

- **title**
- **img url**
- **text**
- **options array** (a list of strings, for now)

Only **make one single scene** for now, containing what is **currently in the template**.

b Now we adapt the component in `app.ts`:

3-6-8

- Import the **adventure** into the file
- Add an **adventure prop** to the component
- Initialise that prop to the imported adventure data
- Add a **scene** property to the component
- Initialise that prop to the only scene in `this.adventure`

c Having done that, **adapt the template to read the data from the `scene` prop** instead! It will end up containing a **bunch of interpolations** referencing `scene.title`, etc.

3-6-9

It should also show `adventure.title` up top!

Now, the template is an **actual template**, capable of rendering any scene we throw at it.

Bundle your code as before (node build nameoffolder in the root), open index.html and **make sure things still work!**

3-6-10

There'll be **no visible difference** from the previous version, we've just done some **preparation work** for what is to come.

Challenge: If you have time over, let's employ some **TypeScript power!**

3-6-11

If you take on this challenge there will be **further TypeScript challenges** building on this one in the following exercises.

The plan is to make use of **TypeScript interfaces** to get code completion for adventure and scene data!

3-6-12

- a Create a new file to house the interfaces
- b Export an interface describing the scene object
- c Export an interface describing the adventure object
- d Make the data file use the adventure interface

a In a big project you would likely have **one interface per file**, but we can put them all in a single file.

3-6-13

Create a file for this purpose called `interfaces.ts`!

b In that file we first export the **Scene interface**.

3-6-14

```
export interface Scene {  
    // definition in here  
}
```

It should **specify all four properties** that a scene can contain. In the definition the **keys are properties** and the **values are types**!

To say that a property is an **array of something**, as we need to do with the options, put a **pair of brackets at the end of the type**:

3-6-15

```
options: string[]
```

- c Now also add an **Adventure** interface to the same file, describing the two adventure properties!

3-6-16

```
export interface Adventures {  
  // definition in here  
}
```

The definition of the **scenes** prop (or pages or whatever you've decided to call it) is a bit special since it is an object with **any number of keys where each value is a scene!** This has the following special syntax:

3-6-17

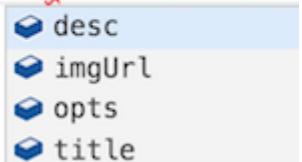
```
scenes: {  
  [index: string]: Scene  
}
```

- d Now, in `data.ts`, add a type annotation to the exported object saying that it is of type `Adventure`!

3-6-18

Not that we really need it yet, but we now have **code completion for our data!**

3-6-19

```
export class AppComponent {  
  adventure = strangeJourney;  
  scene = this.adventure.scenes['corridor'];  
}  


The image shows a code completion dropdown for the 'scene' property. The dropdown is a light gray box with a list of four items: 'desc' (with a clipboard icon), 'imgUrl' (with a camera icon), 'opts' (with a gear icon), and 'title' (with a document icon). The 'desc' item is highlighted with a blue background.


```

Components 102

Much wants more

Sections in this chapter:

1. Gamebook - state
2. Catching View events
3. Lifecycle hooks
4. Politics
5. Debugging Angular apps
6. Gamebook - page turning

4-1. Gamebook - state

storing position

Before we get started on advanced component API:s, let's do a little 4-1-1
exercise prelude!

As before; 4-1-2

1. **copy the folder of the previous version,**
2. **paste it right next to that version, and**
3. **give it the name **FF03-state**.**

So! The plan is to **introduce gameState** to our model, which should **store the progress** the player makes.

4-1-3

Here's the plan:

- a Design the shape of the GameState data
- b Add a `startState` prop to the adventure data
- c Add a `gameState` prop to the component
- d Turn scene into a computed property

a We begin by figuring out what the **state of a game session** looks like.

4-1-4

It really only needs to track **one single thing**, namely the **key of the current page!**

But as the future might bring more stuff, let's put that into an **object** so we can add more things later!

4-1-5

So our state looks something like this:

```
{  
  atScene: 'corridor'  
}
```

If you're following along with the TypeScript stuff we should of course **create an interface** for this object, called `GameState` or something similar.

4-1-6

b It makes sense for the **starting state** to be **part of the adventure data**.

4-1-7

After all, only the author of the adventure knows **which page to start at** (and how much gold to begin with, etc).

Therefore, **add a new `startState` prop to adventure** in `data.ts`, containing an initial game state object with `atScene` pointing to the first page of the adventure.

4-1-8

Of course we only have one page right now, so use that as starting page!

If you have an **Adventure** interface that must now be updated to allow a **startState** prop of type GameState.

4-1-9

c Now, add a **gameState** property (or another name of your choosing) to our component class in `app.ts`, and initialise it to the start state according to the adventure.

4-1-10

```
gameState = this.adventure.startState;
```

d Finally, let's turn our attention to the **scene** prop.

4-1-11

Right now we manually point it to the scene object inside the adventure:

```
scene = this.adventure.scenes['corridor'];
```

But this doesn't make sense anymore, since the **current scene can be computed** by looking at `gameState` and `adventure`!

4-1-12

We might even risk introducing **out-of-sync bugs** if `gameState` and `scene` don't agree!

We should therefore turn **scene** into a **computed property**.

4-1-13

Make `scene` a getter by using the **get** keyword and turning it into a method, which **returns the correct scene** by reading from `gameState` and `adventure`.

For an **example** how that is done, see the [Computed Property](#) demo.

4-1-14

Now our small refactoring is done! Rebuild, and if it all fits together it will again work just like before.

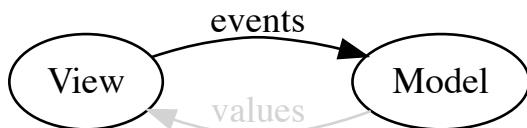
4-1-15

4-2. Catching View events

What's up?

Now we take a look at **the other half of the cycle!**

4-2-1



Here is a super simple event catching example:

4-2-2

```
@Component({
  selector: 'app',
  template: `
    <button on-click="flag = !flag">Toggle!</button>
    <p>Flag? {{flag}}</p>
  `
})
export class AppComponent {
  flag = false
}
```

Take a closer look at the event handler:

4-2-3

```
<button on-click="flag = !flag">Toggle!</button>
```

The **on-click** attribute will be **executed as code** when the event happens.

Note that **on-click** is **not a native DOM event handler**. That would have been called **onclick**.

But we really **shouldn't mutate values in the view** so let us **call a method instead**:

4-2-4

```
@Component({
  selector: 'app',
  template: `
    <button on-click="toggle()">Toggle!</button>
    <p>Flag? {{flag}}</p>
  `
})
export class AppComponent {
  flag = false
  toggle() {
    this.flag = !this.flag;
  }
}
```

Remember that we are **not attaching a function but writing code that will run** when the event happens. So don't write this...

4-2-5

```
<button on-click="toggle">Toggle!</button>
```

...since you likely mean this:

```
<button on-click="toggle()">Toggle!</button>
```

Similar to how `[attr]` is a shortcut for `bind-attr`, we can use **(event)** instead of **on-event**:

4-2-6

```
<button (click)="toggle()">Toggle!</button>
```

In case we are interested in event data, like if we catch a keyup event from an `input` element, Angular **automatically creates an \$event variable** containing the DOM event object:

4-2-7

```
@Component({
  selector: 'app',
  template: `
    <input (keyup)="myName = $event.target.value">
    <p>Who am I? {{myName}}</p>
  `
})
export class AppComponent {
  myName: string
}
```

See this in the [Catch event variable](#) demo

As noted before we prefer to have **value mutations in the model**, so we should **pass the event to the model instead**:

4-2-8

```
<input (keyup)="setName($event.target.value)">
<p>Who am I? {{myName}}</p>
```

```
class AppComponent {
  myName: string
  setName(txt) {
    this.myName = txt;
  }
}
```

Much like the **template expressions** are *sort of* JavaScript, so are the **template statements** that we use as event handlers. Most importantly, they also can **only reach values and methods on the model**.

4-2-9

There are **more details** in the [Template statement](#) sections of the official docs.

4-3. Lifecycle hooks

the lifespan milestones

We won't be using them in our project or go into too much detail, but we'd be amiss if we didn't mention the **lifecycle hooks**.

4-3-1

These are magical method names that will be **invoked at certain points** in the lifecycle of a directive.

For example, **ngOnInit** is called after the first render, and **ngOnDestroy** when it leaves the DOM.

4-3-2

You can see the [full list of methods](#) in the official docs, together with a demo component that shows off them all.

4-4. Politics

let's talk about the elephant

Let's zoom out for a while and **discuss what we've just learned**. All of those directives can be called a **DSL for templating**, and **most templating solutions have corresponding solutions**.

4-4-1

The reason is simple - we're **working in HTML** which **isn't a logical language**, but since we **need logic** in our template we **have to add it** somehow.

4-4-2

This is in stark **contrast** to React, which **expresses the templates in JavaScript**. If you need a **loop** in a React component, you'll use a **regular JavaScript loop**:

```
var Chores = function(props){  
  var renderedChores = props.chores.map(function(chore,n){  
    return <li key={n}>{chore}</li>;  
  });  
  return (  
    <div>  
      <h4>My chores:</h4>  
      <ul>{renderedChores}</ul>  
    </div>  
  );  
}
```

But! Since we need to **output HTML** in the end, React instead has a **DSL for expressing nested data in JS**, namely the weird xml syntax you saw inside the return statement.

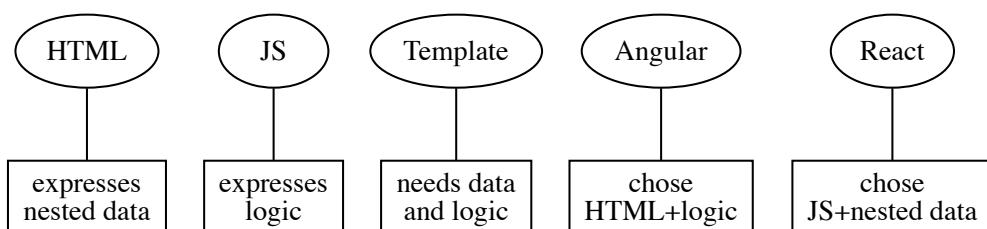
```
return (  
  <div>  
    <h4>My chores:</h4>  
    <ul>{renderedChores}</ul>  
  </div>  
>);
```

Because here's the **foundational problem** - we...

- **express UI:s as nested data**
- **perform logic to define the UI**

...so we need **both logic and nested data at the same time**.

It all **boils down to this**:



4-5. Debugging Angular apps

bug hunting tools & tricks

When debugging Angular apps, **regular JS debugging tricks** still apply to a large extent.

4-5-1

And the king of those is; make sure that you **know the browser dev tools!**

We'll walk through **three tips** for debugging Angular apps:

4-5-2

- a Augury
- b Bound JSON output
- c Logger services

- a **Angular Augury** is a **Chrome dev tools extension** for Angular debugging, serving much the same purpose as Ng-Inspector and Batarang for AngularJS.

4-5-3



Here's an in-action **screenshot** of what Augury looks like:

4-5-4

Properties Injector Graph

AppComponent **(View Source)** (\$a in Console)

Change Detection: Default

State

submitted: ...

input: Object

nativeElement: null

As you can see, Augury shows us

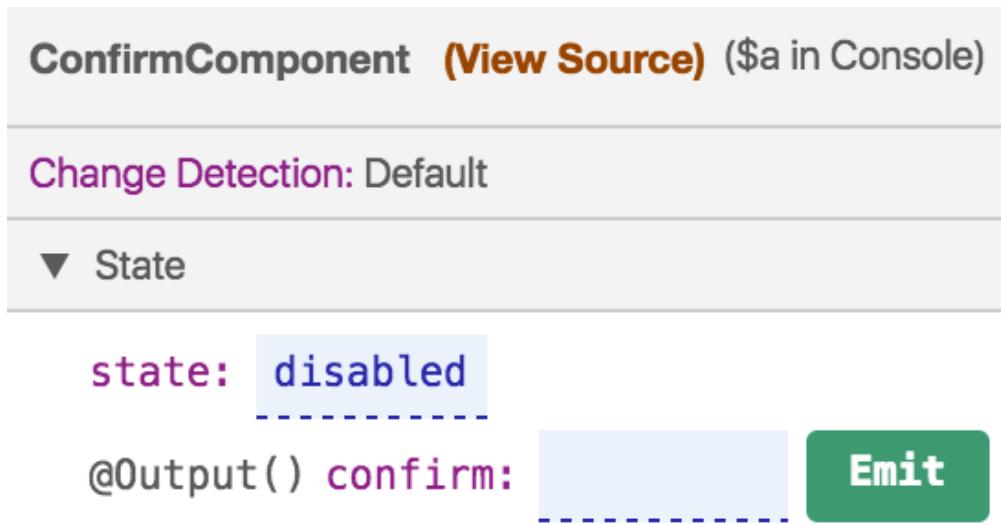
4-5-5

- The **component tree**
- Component **state**

It also gives us powerful tooling around **dependency graphs** and **route overviews**.

For components with **Outputs**, Augury lets you **trigger outputs** for easy experimenting:

4-5-6



ConfirmComponent (View Source) (\$a in Console)

Change Detection: Default

▼ State

state: disabled

@Output() confirm: **Emit**

Augury also has a **bunch of other features** that makes it well worth getting to know.

4-5-7

Of course, given the fickle nature of Angular, Augury is in **heavy development**.

Also, note that **Augury requires a web server** to function! It **won't work over the file:// protocol**.

4-5-8

b Now for a neat trick to **debug component state**!

4-5-9

Take our gamebook project for example, which now has gameState:

```
gameState: GameState = {  
  atScene: this.adventure.startsAt  
}
```

Imagine how later on it will become **much more complex**:

4-5-10

```
gameState: GameState = {  
  atScene: this.adventure.startsAt,  
  gold: 5,  
  inventory: ['sword', 'shield'],  
  hp: 12,  
  xp: 3  
}
```

It is quite common for apps to be **driven by a central state** like this, and for that state to **change frequently**.

4-5-11

Debugging will then often mean to **check the contents of that state**. How do we easily do that?

A **naïve way** to debug this would be to sprinkle...

4-5-12

```
console.log(this.gameState);
```

...in various places. This works ok, but quickly becomes **cumbersome**.

Now for the trick: by **adding this line to the template**:

4-5-13

```
<pre>{{gameState | json}}</pre>
```

...we get a **see the state live** directly in the view!

The corridor extends into eternity in front of the left wall.

- Open the door
- Walk down the corridor
- Turn back

```
{  
  "atScene": "corridor"  
}
```

Try this out in the [JSON debug](#) demo!

4-5-14

AngularJS developers will recognise this, as the **exact same thing was possible in AngularJS!**

- c** While debugging an app, you inevitably start **sprinkling console.log calls here and there.**

4-5-15

And, equally inevitably, **forget to remove some of them before production...**

To mitigate that, and to allow for more powerful logging features, it is common practice to instead use a **Logger** service.

4-5-16

In its simplest form this just **implements a log method:**

```
export class Logger {  
  log(msg: any) { console.log(msg); }  
}
```

You would then inject this into your component or whatnot...

4-5-17

```
constructor(private logger: Logger){}
```

...and use the logging where needed:

```
someComplexMethod() {  
  let result = /* complex calculation */  
  this.logger.log(result)  
}
```

Using a **Loggerservice** in this way means that you...

4-5-18

- can ship a "mute" **Logger** in production instead of removing log statements
- hook in **other functionality** such as **writing logs to files**, etc

4-6. Gamebook - page turning

Actual interaction

As before;

4-6-1

1. **copy the folder of the previous version,**
2. **paste it right next to that version, and**
3. **give it the name FF04-interaction.**

The time has finally come to **implement page turning!** Here's the plan;

4-6-2

- a Add more scenes to the adventure data
- b Turn the **option** data into **objects** with links
- c Make **option clicking** update game state

- a To turn between pages we **need more than one page**, so **add a few more** to the adventure in the `data.ts` file!

4-6-3

```
const adventure = {  
  title: 'A strange adventure',  
  startState: {atScene: 'house'},  
  scenes: {  
    house: { ... },  
    road: { ... },  
    ambush: { ... },  
    ...  
  }  
}
```

- b We must also **turn the option strings into objects**, since they need to contain both

4-6-4

- the **text** to show
- which **scene to move to**

So for each link, turn them into objects and **add the key to the target scene!**

Again, if you're using **TypeScript interfaces** you must **update** those.

4-6-5

To avoid the **Scene** interface growing too complex you could **add a new Option interface**, and adapt Scene to use that for the options!

- c Finally the time has come to **make the options clickable!**

4-6-6

- add a **changeScene** method to the component that **expects an option object** and **updates gameState** accordingly
- use that method as **clickhandler for options** with `(click)`. If you are typescripting, the clickhandler parameter type should be an **Option**!

Since we've already wired **scene** to read from **gameState** in the previous exercise, we're all done! Reward yourself by trying out your fully playable adventure.

4-6-7

Although a humble beginning, you now have all the needed parts to make a full game book!

...ignoring the likely wishes for more functionality such as health points, inventory etc...

4-6-8

Now that we have state that we manipulate, don't forget to use the debug tactics you've learned about!

4-6-9

Challenge: If you sailed through all of that, how about implementing an automatic reset for game-ending scenes with no options?

4-6-10

And perhaps also adding some dramatic background-color to the end-game scenes while we're at it?

How would we go about all this? Well, we need to show a restart link when the scene has no options.

4-6-11

For our **model**, this means we can:

- add a **gameOver** getter that returns true if there are no options in the scene
- add a **resetGame** method that sets **gameState** to **startState** from **adventure**

And in our **view**:

4-6-12

- add a **reset** option **** that
 - only show if **gameOver** is true
 - calls **resetGame** when clicked
- wrap the whole template in a **div**
- add a dynamic **dead** class to the **div** using **[class.dead] = "gameOver"**
- add a style for the **.dead** class

If you've followed along, it is very likely that you now have a bug where nothing happens when we click **reset**. What is going on?!

4-6-13

Here's a **clue**: use the `<pre>` debug trick to show **adventure.startState** on the screen. That object should of course never change, but, does it, perhaps? Why, and how do we prevent it?

4-6-14

Eventually we probably also want to have dead ends that doesn't mean that the player died but that he **finished the adventure successfully**. How would we **distinguish between wins and losses**?

4-6-15

We leave that as a challenge challenge for you to ponder after the course! :)

Composition

Combining components

Sections in this chapter:

1. Child components
2. Passing data
3. Receiving data
4. Passing elements
5. A composition case study
6. Gamebook - composition

5-1. Child components

Spawning children

So, finally - how do we **render one component from another** in Angular?

5-1-1

The answer has **two parts**:

- make sure the **child component is visible to the parent** from an NgModule perspective
- include **markup in the parent template that matches the child selector**

Component selectors are mostly **element types**:

5-1-2

```
@Component({  
  selector: 'myCustomComp',  
  template: '...'  
})
```

To use this component, our **markup must contain**:

```
<myCustomComp></myCustomComp>
```

But technically we can use **any CSS selector**, including targetting attributes like the built-in directives:

```
@Component({  
  selector: '[myCustomComp]',  
  template: '...'  
})
```

```
<div myCustomComp></div>
```

But, as stated, **element types are the most common**.

5-1-3

Which incidentally means that **usage of Angular components is identical to Web Components**.

This **opens some interesting possibilities**, but we **won't explore that further in this course**.

It is also **identical** to the relation between the **root component and the main index page**! Our root components have **all used this selector**:

```
@Component({  
  selector: 'app',  
  template: '...'  
})
```

...and in the main `index.html` files you find this:

```
<app>loading...</app>
```

Again, composition works in the **exact same way**.

5-1-5

See it in action in the [Composition](#) demo, or the [Composition Scoped](#) which uses components from different NgModules.

Btw, did you notice the **style definition in the root** in the demo?

5-1-7

```
:host /deep/ span {  
  border: 1px solid black; padding: 3px;  
}
```

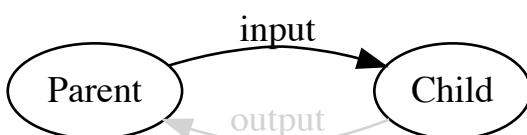
As you might guess, the **/deep/ selector** means we **dig into the encapsulation of our children** to be able to style them too.

5-2. Passing data

pouring down

Time to start exploring **parent-child communication**, and specifically, how **parents give input to their children!**

5-2-1



The syntax is actually rather ingenious - with an **@Input** decorator we can mark a property as an input:

5-2-2

```
class Child {  
  @Input() someProp  
  aPrivateProp  
}
```

After having done so, the **someProp** property can be **bound to in the parent template**:

5-2-3

```
<child [someProp]="myVariable"></child>
```

We can also **alias the property name** if we for some reason want to have the input named differently:

5-2-4

```
class Child {  
  @Input('aliasedProp') someProp  
}
```

```
<child [aliasedProp]="myVariable"></child>
```

And as the **bound property is a normal class property**, we can also **use a setter**:

5-2-5

```
class Child {  
  aPrivateProp: string  
  @Input() set exposedProp(fromMum){  
    this.aPrivateProp = fromMum  
  }  
}
```

It looks exactly the **same as before** from the outside:

```
<child [exposedProp]="cleanYourRoom"></child>
```

You can see **all three variants** in action in the [Child input demo](#).

5-2-6

If we **tried to bind to aPrivateProp** which hasn't been exposed via @Input, or a non-existent property, **Angular would throw an error**:

5-2-7

```
✖ ▶ Unhandled Promise rejection: Template parse errors: zone.js:344  
  Can't bind to 'nonExistingInput' since it isn't a known property of  
  'child'. ("  
    <input [(ngModel)]="input1"> <input [(ngModel)]="input2">  
    <hr>  
    <child [ERROR ->][nonExistingInput]="input1" [alias]="input2"></child>  
  "): AppComponent@3:11 : Zone: <root> : Task: Promise.then : Value: Error:
```

Notice how it **points out the offending input** with an [ERROR->] marker.

Interestingly, this is the **exact same error** we'd see for ngModel if we **forgot the FormsModule**!

5-2-8

```
✖ ▶ Unhandled Promise rejection: Template parse errors: zone.js:344  
  Can't bind to 'ngModel' since it isn't a known property of 'input'. ("  
    <input [ERROR ->][(ngModel)]="input1">
```

That makes sense since native `input` elements have no `ngModel` prop.

5-2-9

But it also reveals some interesting facts:

- directives can have inputs too
- we have already been using inputs without knowing it!

For example, we use `ngIf` by feeding it an expression:

5-2-10

```
<div *ngIf="someFlag">  
  shown only if `someFlag` is truthy!  
</div>
```

Obviously `ngIf` uses `[ngIf]` as selector, but if what we saw earlier is true, it must also define `ngIf` as an input!

And sure enough, in the [source code](#) we see this:

5-2-11

```
@Directive({selector: '[ngIf]'}  
export class NgIf {  
  private _hasView: boolean = false;  
  constructor(...) {}  
  @Input()  
  set ngIf(condition: any) {  
    ...  
  }  
}
```

So the **old AngularJS cliché still holds true**;

5-2-12

Angular is built with Angular

Like in AngularJS, Angular defines a **central infrastructure**, and then uses that both to **create built-in helpers** and **allow developer-made building blocks**.

Btw, wanna know how to **easily find the source code** for some part of Angular? Easy:

- Go to the [official API docs](#)
- Type in the name of the part in the search field
- Click to get to the dedicated page
- Find the source link in the bottom-right corner

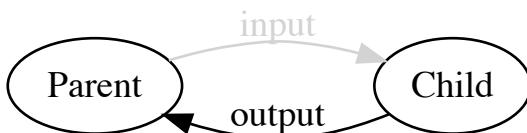
5-2-13

5-3. Receiving data

here you go

Time to explore the other side of parenthood - **children output!**

5-3-1



Q Let me guess - we **mark child properties with an @Output decorator?**

5-3-2

A You've got it! :)

5-3-3

But still, there's **far more to the story...**

Because if we were just to **expose a regular property...**

5-3-4

```
class Child {  
  @Output() someProp = 'foo'  
}
```

...how would we **connect to that in the parent?**

A naïve approach could be a **simple two-way data binding** through simply **binding to a prop in the parent**:

5-3-5

```
<child (someProp)='parentProp'></child>
```

But this would fall apart quickly. What if I **don't want to store the value** but simply **act when something happens?**

And **how would I know when the value changes?**

We've actually **already seen output from a parent perspective** when we learned about **event handling!**

5-3-6

There we were taught that for outputs we **don't use template expressions but template statements!**

```
<child (someProp)='catchOutput($event);'></child>
```

We also saw that in this statement we can access **\$event** which contains the message from the child.

This makes sense - now I have **code that triggers upon receiving the message**, and I can **do what I want**.

5-3-7

And as you've already figured out, there's **no difference to child component output** and **outputs from input elements**.

Because the **inputs are clad with the ngModel directive**, who apparently are using **@Outputs** under the hood.

5-3-8

Again,

Angular is built with Angular



So, can you guess what **@Outputs** look like in children?

5-3-9

You've already seen the answer, **way back in the beginning of the course...**



Now we finally get to see the main reason why Angular needs RxJS - you see, **outputs are implemented through streams!**

5-3-10

Thinking about it this makes a whole lot of sense - **streams are an asynchronous chain of events**, which is **exactly what child outputs are too!**

5-3-11

In Angular this means that **output properties are EventEmitters**, which are streams that emit events of a given type:

5-3-12

```
@Output() whine = new EventEmitter<string>()
```

Using this the **child will emit events** to the parent:

```
this.whine.emit(this.msg);
```

See this in action in the [Child output](#) demo.

And, speaking on **ngModel** - if we were to peek at that source, **what could we expect?**

5-3-13

- it should have an **@Input named ngModel**
- it should have an **@Output named ngModelChange** (because of what the banana box syntax actually means)
- it is likely **very complex** :P

And indeed, if we [go look](#), that is **exactly what we find!**

5-3-14

Speaking of **streams** - we should also add that you **can use them more heavily in your own code** too.

5-3-15

For an example, check out the [Submitname with Streams](#) demo!

5-4. Passing elements

Here you go, my child

When we looked at **composition**, we noted how parents and children communicate.

5-4-1

But there is a scenario we haven't covered yet - what happens when we **pass elements to a child**?

```
<child>
  <p>What will happen to me?</p>
</child>
```

Unless the child actively captures those elements, **they will just disappear**.

5-4-2

However the child **can capture the elements** by including this in its template:

```
<ng-content></ng-content>
```

See this in action in the [Passing elements](#) demo.

The child can also **split the elements up** and show them in **different places** using the **select** attribute on **ng-content**:

5-4-3

```
<ng-content select='header'></ng-content>
<ng-content select='footer'></ng-content>
```

See this in action in the [Passing split elements](#) demo.

5-5. A composition case study

Building a sharable component

In an Angular application **components are your primary building block**. It therefore stands to reason that you should **consider each component API carefully**:

5-5-1

- what **@Inputs** does it need?
- what **@Outputs** does it provide?

To wrap our brains around this, let's do a **small case study** where we implement a stand-alone UI component meant to be integrated into other apps.

5-5-2

We'll be making a **confirmation button**!

It is meant to be used as a **confirmation button in a form**:

5-5-3



Gnork

Submit

Submitted name: John Doe

But of course it is not just a regular button: when the **user clicks the button** it should **allow confirmation and cancel**:

5-5-4



Gnork

Cancel

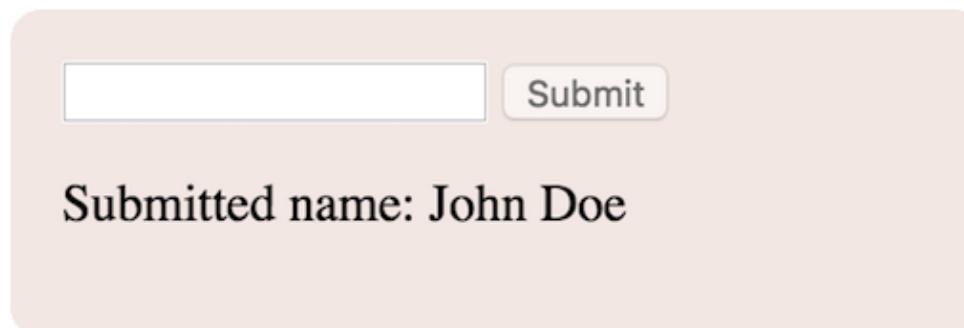
Confirm

Submitted name: John Doe

Only if the **user chooses confirm** should the **parent be notified**, otherwise it just **reverts to the previous standby mode**.

Additionally we should **allow the parent to disable the button** if whatever data we're confirming is invalid, for instance if the field is empty:

5-5-5



Submit

Submitted name: John Doe

So let's consider the API for this! We'll need...

5-5-6

- an **@Output** to emit confirmations to
- an **@Input** for whether or not we're disabled

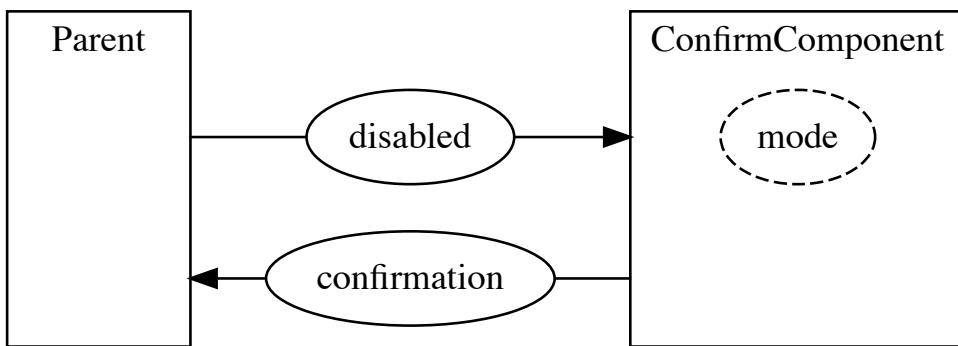
Internally we'll also need to track our current **mode**, which can be

5-5-7

- **standby** - showing submit button
- **disabled** - button should be greyed out
- **confirm** - showing confirm and cancel

So the map for the component would be something like this:

5-5-8



With our three modes in mind, we could implement the template like so:

5-5-9

```
<span *ngIf="mode !== 'confirm'">
  <button (click)="maybe()" [disabled]="mode === 'disabled'">
    Submit
  </button>
</span>
<span *ngIf="mode === 'confirm'">
  <button (click)="changedmymind()">Cancel</button>
  <button (click)="yesimsure()">Confirm</button>
</span>
```

And here's the **model to match** that:

5-5-10

```
class ConfirmComponent {  
  mode: 'standby' | 'disabled' | 'confirm' = 'standby'  
  @Output() confirm = new EventEmitter<void>()  
  @Input() set disabled(bool: boolean){  
    this.mode = bool ? 'disabled' : 'standby'  
  }  
  maybe() { this.mode = 'confirm' }  
  changedmymind() { this.mode = 'standby' }  
  yesimsure() { this.confirm.emit(); this.mode = 'standby' }  
}
```

Note how we're **not explicitly tracking disabled**, instead that **input is a setter** which manipulates mode accordingly:

5-5-11

```
@Input() set disabled(bool: boolean){  
  this.mode = bool ? 'disabled' : 'standby'  
}
```

This pattern is **somewhat common** - an input doesn't have to be something we store, but can be used as a signal from the outside world.

You can try the component out in the [Confirm](#) demo.

5-5-12

And again, the point of this little case study was to **highlight the component perspective**. Think of your app in terms of components, and think carefully about how they interact.

There is an **alternative solution** using a **lifecycle hook** instead of a getter here: [Confirm-Hook](#)

5-5-13

5-6. Gamebook - composition

Matryoshka time

As before;

5-6-1

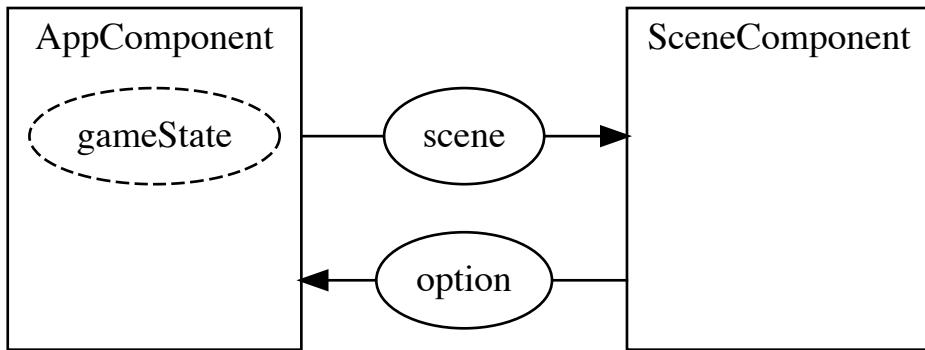
1. **copy the folder of the previous version,**
2. **paste it right next to that version, and**
3. **give it the name **FF05-components**.**

Let's clean up our code a bit by using the **component composition** techniques we just learned about!

5-6-2

Specifically, we're going to **abstract out a **SceneComponent**** from the **AppComponent**:

5-6-3



SceneComponent is given a **scene** object to render as input, and will **output option objects** when they are clicked.

In other words, we need to...

5-6-4

- a Create a new **scene.ts** file for SceneComponent
- b Update **AppComponent** to use the new component
- c Update the **NgModule** in **main.ts** to expose the new component

- a Since **scene.ts** will contain much of what is now in **app.ts**, let's make a copy of **app.ts** and call it **scene.ts**!

5-6-5

In **scene.ts** we then need to...

5-6-6

- Change the selector to something else
- Change the component name to SceneComponent
- Remove game status, that will reside in AppComponent.
- Remove the adventure import, we don't need that
- Change **scene** to be an **@Input**
- Make the clickhandler an **@Output**
- Change the handler to emit clicked option objects
- Remove the adventure title from the template

b Back in `app.ts` we must..

5-6-7

- Change the template to **use the scene element**
- But still show the **adventure title** above the scene
- Feed the scene element **the current scene**
- **Connect the scene element output to the click handler**

If you took on the **reset option challenge** in the earlier exercise, we **need gameOver state in both** `AppComponent` and `SceneComponent`, and probably a **new Output from scene** for the reset clicking.

5-6-8

Alternatively, have the reset button in the `AppComponent` template instead, separate from the scene options.

c Finally, for `SceneComponent` to be available in the `AppComponent` template, we must **add it to the Declarations array** of our module in `module.ts`.

5-6-9

Now, after all that work, **bundle and fire up the new version**.

5-6-10

And if everything went according to plan, **things will work exactly as before!**

Dependency injection

Providing the ingredients

Sections in this chapter:

1. Dependency VS input
2. Injection explained
3. Dependencies in AngularJS
4. Dependencies in Angular
5. Providing dependencies
6. Non-class dependencies
7. Services
8. Gamebook - dependencies

6-1. Dependency VS input

What do we actually mean?

Take a look at this **hypothetical** function:

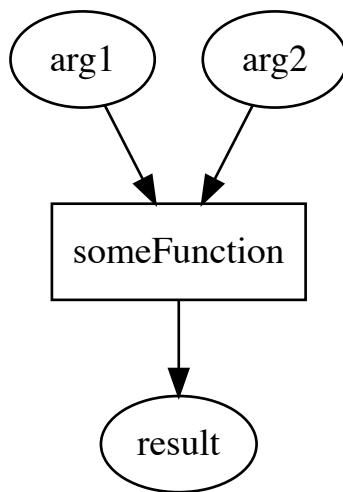
6-1-1

```
import complexLib from 'complexLib'

function someFunction(arg1,arg2){
  /*
    Somehow calculate `result` using `arg1`,
    `arg2` and methods on `complexLib`
  */
  return result;
}
```

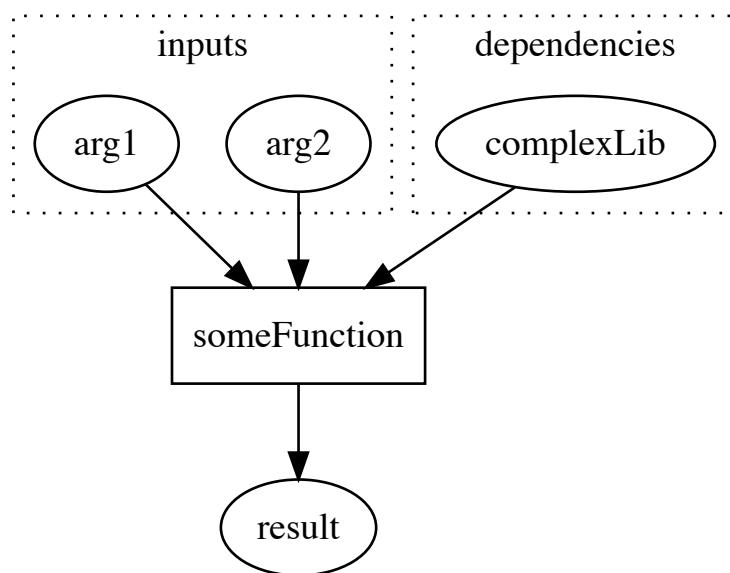
If we were to graph `someFunction`, it might look like this:

6-1-2



But although that **maps the full signature**, it doesn't capture the **dependency on `complexLib`**. Here's the **complete truth**:

6-1-3



As `someFunction` is currently implemented there is a **big problem with testability**, since we **cannot control the dependencies**.

6-1-4

Ideally we would just want to test that `someFunction` **calls the correct methods on `complexLib`**, given the values of the inputs.

6-1-5

```
let complexLib = myMock // someFunction won't use this! :(  
  
let result = someFunction(testval1,testval2)  
  
assert.equal(result,expectedResult)  
assert.equal(myMock.usedMethod.firstCall,expectedArgs)
```

But, how do we **make `someFunction` use `myMock`?**

Let's use this simple example to explore **4 options to handle the dependency:**

6-1-6

- a in the signature
- b in a prop
- c in the context
- d with a constructor

- a We could simply **change the signature** from this...

6-1-7

```
someFunction(arg1, arg2)
```

...to this:

```
someFunction(arg1, arg2, complexLib)
```

Now that the **`complexLib` implementation is passed in**, we can easily **use a mock:**

6-1-8

```
let result = someFunction(testval1, testval2, myMock)  
  
assert.equal(result,expectedResult)  
assert.equal(myMock.usedMethod.firstCall,expectedArgs)
```

This works, and is probably the **easiest solution**. Now `someFunction` is **easily testable and not tied to a specific `complexLib` implementation**. Loose coupling!

6-1-9

The downside is that we have **mixed inputs with dependencies** in the signature, which isn't super intuitive.

6-1-10

But `someFunction` is a **function**, and they only have **one natural point of entry**
- the parameters!

b We could **attach them as props on the function**:

6-1-11

```
import complexLib from 'complexLib'

function someFunction(arg1,arg2){
  /*
    Somehow calculate `result` using `arg1`, `arg2`
    and methods on `someFunction.complexLib`
  */
  return result;
}
someFunction.complexLib = complexLib
```

Now we would **test it like thus**:

6-1-12

```
let oldImplementation = someFunction.complexLib
someFunction.complexLib = myMock

let result = someFunction(testval1, testval2)

assert.equal(result,expectedResult)
assert.equal(myMock.usedMethod.firstCall,expectedArgs)

someFunction.complexLib = oldImplementation
```

It works, but it is **not very convenient**.

c Or we could **use the context**:

6-1-13

```
function someFunction(arg1,arg2){
  /*
    Somehow calculate `result` using `arg1`, `arg2`
    and methods on `this.complexLib`
  */
  return result;
}
```

Now you would have to call **someFunction** like thus:

6-1-14

```
import complexLib from 'complexLib'  
let result = someFunction.call({complexLib}, arg1, arg2)
```

Not much better!

We can improve the situation by **defaulting to a private reference**:

6-1-15

```
import complexLib from 'complexLib'  
  
function someFunction(arg1,arg2){  
    /*  
        Somehow calculate `result` using `arg1`, `arg2`  
        and methods on `this.complexLib || complexLib`  
    */  
    return result;  
}
```

Now a **normal call is normal again**:

6-1-16

```
let result = someFunction(arg1, arg2)
```

...while **testing is still possible**:

```
let result = someFunction.call({complexLib:myMock}, arg1, arg2)
```

- d** A final example - we could **provide someFunction from a constructor** to which we pass in the dependency:

6-1-17

```
function getSomeFunc(dep){  
    return someFunc(arg1,arg){  
        // calc result using `dep`  
        return result;  
    }  
}
```

Normal usage will now look like this:

6-1-18

```
let someFunc = getSomeFunc(complexLib);
let result = someFunc(arg1, arg2);
```

...while we test like so:

```
let someFunc = getSomeFunc(myMock);
let result = someFunc(arg1, arg2);
```

All of these setups sort of work, but all have downsides. The important thing is to...

6-1-19

- understand the difference between input and dependency
- not have a tight coupling to dependencies in your implementation

6-2. Injection explained

needles aren't that scary

Now we will take a look at **dependency injection** as a concept!

6-2-1

In essence, the **idea** is that if we can

6-2-2

- a separate dependencies from inputs, and
- b explain what dependencies we need, then
- c the dependencies are injected automatically!

- a Borrowing from an earlier example, imagine a system where **all functions have the following syntax:**

6-2-3

```
everyFunction(...args, dependencies)
```

In other words, the **last argument is an object with dependencies**.

6-2-4

Thus we have **achieved separation** between dependencies and inputs.
AddSkills Umea, 8 jan 2018

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b

Now also imagine that every function somehow specifies what dependencies it needs, perhaps with a **definition object** on the function:

6-2-5

```
someFunction.neededDeps = {  
  lib: 'dependencyID',  
  anotherLib: 'anotherDependencyID'  
}
```

Which would mean that **someFunction** expects to be called thusly:

6-2-6

```
someFunction(arg1,arg2,arg3,{  
  lib: instanceOfLib,  
  anotherLib: instanceOfAnotherLib  
})
```

c

Finally, imagine that we **abstract out the dependency** providing to a helper function:

6-2-7

```
callWithDeps(someFunction,arg1,arg2,arg3)
```

It is now up to **callWithDeps** to call **someFunction** with the needed dependencies!

6-2-8

Internally, **callWithDeps** would

1. **look at the `neededDeps` prop** of the provided function.
2. **use the `dependencyID`s to procure dep instances** from some kind of **repository**
3. **call the function with the deps**

Of course this assumes that the **dependencies have been registered in the repository** with the corresponding ID:s.

6-2-9

Q

Ok, so we abstract out the dependency providing. Fine. **What is the point?**

6-2-10

- It makes usage **convenient** (if done right)
- We can **manipulate the repo** in a testing scenario to **provide mocks**
- The **repository becomes a recipe for the app**
- It makes **static analysis** of the app easier, enabling things like **dependency graphs**.

Also, in our example we played around with **dependencies for function calls**.

6-2-12

But in our Angular code we declare **dependencies for instantiation**, which makes more sense to leave to the system. Subsequent usage of the instance isn't affected.

A final note: **dependency injection (DI)**, and **inversion of control (IoC)** which DI is an example of, are **design patterns** with **exact definitions** that we haven't religiously adhered to in our explanations.

6-2-13

6-3. Dependencies in AngularJS

Writing a wishlist yesterday

Already back in **AngularJS** we had **dependency injection**.

6-3-1

In order to understand the new Angular implementation we will first **explore AngularJS's solution!**

AngularJS used a very simple system: the **constructor function parameters** were used as **dependency ID:s**.

6-3-2

So when AngularJS needs to **call this constructor**:

6-3-3

```
function myConstructor(someDepName, anotherDepName){  
  // doing stuff  
}
```

...it would **look in the repository** for dependencies named **someDepName** and **anotherDepName**.

So if you had previously **registered resources**...

6-3-4

```
module.service('myService', definition)  
module.value('someConst', 42)
```

...then your constructor could simply **name these resources**:

6-3-5

```
function myConstructor(myService, someConst){  
  // doing stuff  
}
```

...and they **would be provided to you**.

There was also a bunch of **built-in resources** that you could name:

6-3-6

```
['$scope', '$rootScope', '$http', ...]
```

The \$ character signifies that this is built-in and not user defined.

Q Wait. So the parameters are resource ID:s. I get a **reference to the function**. But how do I **derive the parameter names** from that? There is no `func.params` thing, is there?

6-3-7

A No, **there isn't**, and I'm glad you asked!

6-3-8

So, the black magic they're using is a **weirdness with string casting** in JavaScript.

For example, if we try to **cast an object to a string**...

6-3-9

```
myObj.toString()
```

...we get this **completely useless output**:

```
"[object Object]"
```

But, if we **cast a function to a string**...

6-3-10

```
myFunc.toString()
```

...we get the **source code as a string**!

```
"function myFunc(anArg, anotherArg, aThirdArg){ ... }"
```

So attacking that string with some **regex magic**...

6-3-11

```
myFunc.toString().match(/^[^]*\((.*?)\)\)[1].split(/, */)
```

...we get a **list of parameter names**!

```
['anArg', 'anotherArg', 'aThirdArg']
```

This is **what AngularJS does under the hood**.

Zooming out: the dependency injection in AngularJS was **widely appreciated**. But it was also **criticised**:

6-3-12

- The **reliance on parameter spelling is brittle**
- More advanced provider **gymnastics** was hard

Both these issues were **addressed in the new Angular version**!

6-4. Dependencies in Angular

Writing a wishlist today

Recall the **someFunction** example, where we

6-4-1

- highlighted the importance to **distinguish between inputs and dependencies**
- showed that this is **difficult to do for functions** since they only have one entry point
- said that **dependencies often end up in the signature** for this reason

In Angular, **all application parts** - whether actual Components or Directives or whatnot - **are classes...**

6-4-2

```
class SomeApplicationPart {  
  constructor(){ ... }  
  someProp = initialVal  
  someMethod(){ ... }  
}
```

...which, in contrast to regular function, means we have **many potential entry point!**

The **inputs** (and **outputs**) in an Angular component are **decorated properties...**

6-4-3

```
class SomeApplicationPart {  
  constructor(){ ... }  
  @Input someProp = initialVal // <--- input!  
  @Output() anotherProp = new Emitter<someType>() // <--- output!  
  someMethod(){ ... }  
}
```

...while **dependencies** have a very natural home in the **constructor signature!**

6-4-4

```
class SomeApplicationPart {  
  constructor(dep1, dep2){ ... } // <--- our dependencies  
  @Input someProp = initialVal  
  @Output() anotherProp = new Emitter<someType>()  
  someMethod(){ ... }  
}
```

Let's now dig into exactly **how** they are listed!

First off, the **dependency ID:s are not just pure strings** as in Angular1.

6-4-5

We now call them **tokens**, and most often they are the **class we want an instance from**.

In an **ES6 version** (that is, non-TypeScript) we **add the token as metadata** using a **decorator**:

```
class SomeApplicationPart {  
  constructor(  
    @Inject(Dep1Class) dep1,  
    @Inject(Dep2Class) dep2  
  ){ ... }  
}
```

In a **TypeScript version** we just do **regular type annotation**:

```
class SomeApplicationPart {  
  constructor(dep1: Dep1Class, dep2: Dep2Class) {...}  
}
```

The **token** and **type** are one and the same!

Even React lovers grudgingly admit that this syntax is **supremely elegant!**

If you want the dependencies to **become props on the instance**, typescript has the **public** keyword

```
class SomeApplicationPart {  
  constructor(dep1: Dep1Class, public dep2: Dep2Class) {...}  
}  
  
instance.dep1 // undefined  
instance.dep2 // Dep2Class instance
```

We can also use **private**, and then they're **not available in the template**.

6-5. Providing dependencies

the delivery service

So now we know how dependencies are specified.

6-5-1

Time to see how they are provided!

As you might have guessed, the vehicle for this is **NgModule**.

6-5-2

Every module can list resources for dependency injection in their **providers** metadata property.

```
@NgModule({  
  providers: [provider1, provider2, ...]  
})
```

A provider is an **object** that...

6-5-3

- **mentions a dependency token** and
- **explains how to get it**

The **most common configuration** looks like this:

6-5-4

```
{ provide: SomeClass, useClass: SomeClass }
```

Note that...

- the **provide** prop contains the **token**, and
- the **useClass** prop mentions the **class to be instantiated**.

Because **using the wanted class as a token is so common**, Angular lets you use this:

6-5-5

```
SomeClass
```

...as a shorthand for this:

```
{ provide: SomeClass, useClass: SomeClass }
```

- a** Declaring the class to be injected
- b** Providing the dependency in NgModule
- c** Use it as **construction parameter** in a component.

Let's see all this in action!

- a** Here's the super useful **class we want to inject**:

```
class Dependency {
  foo = 'bar'
}
```

An instance would get a prop `foo` with the value 'bar'.

- b** To make **Dependency available** we register it in an NgModule:

```
@NgModule({
  imports:      [ BrowserModule ],
  declarations: [ AppComponent ],
  bootstrap:   [ AppComponent ],
  providers:    [ Dependency ] // [ {provides: Dependency, useClass: Dependency} ]
})
class AppModule {}
```

- c** Now we can **inject it into a component**:

```
@Component({
  selector: 'app',
  template: `Value from dependency: {{dep.foo}}`,
})
export class AppComponent {
  constructor(public dep: Dependency) {}
}
```

You can [see this in action](#) in the [Class Dependency](#) demo!

Note that **providers aren't limited by lines of sight**. Unless you take specific measures, **all providers are visible in all modules**.

This is by design; normally you want all components to **share a single instance** of your service.

This means that when you want to **test your components** (or directives or other part), we **use test-specific providers**.

6-5-11

Unlike in AngularJS, the **built-in injectables** are **not automatically available**! You have to manually **import the module** they live in.

6-5-12

For example, the **http service** is provided by the **HttpModule**, which must be **imported by your module**.

The **robust and flexible dependency injection** is one of Angular's **main advantage over other frameworks** such as React, which lacks an equivalent system.

6-5-13

So it might **seem abstract and hard**, but **take the time to get to know it** as it will be well worth the effort!

6-5-14

6-6. Non-class dependencies

not as classy anymore

Q We just saw the elegant solution to **providing class instances** by using the **token as the type** for the parameter.

6-6-1

But, what if we want to provide, say a **constant**?

A For this you would provide **useValue** instead of **useClass**:

```
{provide: MyToken, useValue: 42}
```

6-6-2

But you already noticed the bigger problem - **what should MyToken be?**

We could imagine making a **dummy class**:

6-6-3

```
class MyToken {}
```

And **use that as type** in the component:

```
constructor(val: MyToken)
```

Or we could just use a **string constant**:

6-6-4

```
const MyToken = 'SOME_UNIQUE_STRING'
```

But there are **two problems** with these solutions:

6-6-5

- a There's a **type mismatch**. We claim `val` is a `MyToken`, but it is a number!
- b **Dummy classes are inelegant and magic strings dangerous.**

a We solve the **type mismatch** by using the **Inject** decorator we saw earlier for the non-typescript version:

6-6-6

```
constructor(@Inject(MyToken) val: number) {}
```

Now the **token is supplied as metadata**, and we have a **true type annotation**.

6-6-7

Not as sleek as when the token was the type, but for good reason - the **token isn't the type here!**

b Regarding tokens for non-class dependencies, Angular has an **InjectionToken** creator for this purpose:

6-6-8

```
const MyToken = InjectionToken('someDescriptiveString');

// Typed version
const MyToken = InjectionToken<SomeType>('someDescriptiveString');
```

Previously there was an **OpaqueToken**, but that has been deprecated and replaced by **InjectionToken**.

6-6-9

If you need more control, there's also a **useFactory** option where you supply a function, and the **returned value is provided**.

6-6-10

```
{provide: MyToken, useFactory: ()=> 42}
```

Try it in the [Constant Dependency](#) demo!

For when you need **other dependencies injected into the factory** you need to **list the tokens in the deps prop**.

6-6-11

```
{
  provide: MyToken,
  useFactory: (someDep)=> someDep.doSomething(),
  deps: [SomeDepToken]
}
```

See this in action in the [Dependency Factory](#) demo!

A final note: don't hesitate to **use dependency injection for constants!**

6-6-12

It might **seem like overkill**, but the...

- **fine-grained control** and
- **code predictability**

..that you gain is hard to beat!

6-7. Services

where are they?

Let's take a brief moment to discuss the word **Service**.

6-7-1

In AngularJS they meant something specific - it was a type of building block that we explicitly defined on our modules, alongside controllers and directives and the rest.

Yet so far we've seen **no mention of them in the new Angular!**

That is simply because we **don't need the concept**. Angular lets us **provide whatever values we want** through registering providers in our modules.

6-7-2

Where those values come from is **completely up to us**.

Still, the term **Service** has carried over to Angular, even though it has **no technical meaning**.

6-7-3

It simply means a **class available for injection**.

As with AngularJS, there are a whole slew of **built-in "services"**.

6-7-4

And just like with directives, a big part of **learning Angular** means **learning what is already there and when to use it**.

If your **dependency has dependencies**, we need to **mark it with the Injectable decorator** to let Angular know that this class also needs to be part of the dependency graph.

6-7-5

```
@Injectable()  
export default class Dependency {  
  constructor(public foo:Dependency2){}  
}
```

Although **dependencies with dependencies** might seem a special case, make note;

6-7-6

- This is actually where **DI really shines**, as managing this manually is hard
- It **isn't that uncommon**. For example, your custom service might use the `http` service.

6-8. Gamebook - dependencies

Lethal injection

You know the drill;

6-8-1

1. **copy the folder of the previous version,**
2. **paste it right next to that version, and**
3. **give it the name **FF06-dependencies**.**

So! If **dependency injection** is as cool as they say, we'd better **use it in our gamebook app!**

6-8-2

To try our hand at this, we're going to implement a **StateHandler** service!

This service will contain:

6-8-3

- a **private gameState variable**
- a **listeners array** of callbacks to be notified when gameState changes
- a **.listen(cb)** method for adding a callback.
- an **.update(newState)** method for updating gameState

Components interested in game state can then call **.listen** on the service, passing in a callback that likely stores a local copy:

6-8-4

```
this.stateHandler.listen(state => {
  this.gameState = state
});
```

And if they feel cocky they can **update gameState**. Perhaps using a cool **object spread**:

6-8-5

```
this.stateHandler.update({...this.gameState, propToUpdate: newValue});
```

Note that if they are **listening**, this will cause the component to update!

Here's the plan for implementing the service;

6-8-6

- a add a **statehandler.ts** file with the service
- b expose the service in **NgModule**
- c use it in **AppComponent**

a Here's a skeleton for **statehandler.ts**:

6-8-7

```
class StateHandler {  
  private listeners: Function[]          // all interested callbacks  
  private gameState: GameState           // current state  
  listen(cb: Function) { ... }           // add listener  
  update(newState: GameState) { ... }    // update state  
}
```

Some clues regarding how to fill it out:

6-8-8

- The **listeners** should be **initiated to an empty array**
- The **gameState** should be **initiated the adventure startstate**
- the **listen** method should **add the given callback, and invoke it immediately**
- the **update** method should **replace gameState with the new one**

b With the **stateHandler** created, we must **add it to the providers array** in the root **NgModule**:

6-8-9

```
providers: [ StateHandler ]
```

We'll use the **normal shorthand** where the class is also the token.

c Time to **update **AppComponent**!** We must

6-8-10

- **add stateHandler as a dependency**
- **use the load method** when initialising game state
- **use the save method** inside the link handler

Build, reload, and see if all still works like before!

6-8-11

Challenge: If you have time left over, let's **clean up a code smell!**

6-8-12

Right now we're **importing the adventure** data in `app.ts` to use it inside `AppComponent`, and in `statehandler.ts` to initiate game state in the `StateHandler` service.

We should inject the adventure to those places instead!

This will likely involve an **InjectionToken** defined in a separate file, that you refer to in the `NgModules` providers array as well as in the `AppComponent`.

6-8-13

If you need, peek again at the [Inject non-class](#) demo.

Challenge: And here's a neat one - why not **make stateHandler load and save to localStorage?**

6-8-14

In other words - when you go to the next page, and **reload**, your **state should be saved!**

Two lines of code that **might come in handy** for this:

6-8-15

```
JSON.parse( localStorage.getItem(SAVEKEY) || "{}" ) // loading
```

...and...

```
localStorage.setItem( SAVEKEY, JSON.stringify(state) );
```

...where `SAVEKEY` is some unique string identifier.

Forms

we all love them

Sections in this chapter:

1. Two-way data binding
2. Forms
3. Validation
4. Reactive forms
5. Template referencing
6. Gamebook - extras

7-1. Two-way data binding

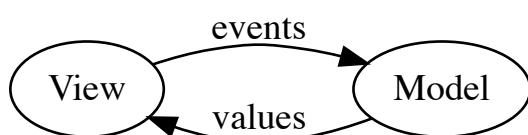
Going both ways at once

Before we can even begin to get into forms, we need to talk about **two-way data binding**. In essence, making a **form element synced to a model value**.

7-1-1

Previously we went **full circle** in the communication:

7-1-2



But there is a **common special case** that warrants extra mention - what if an element in the UI wants to **both display and mutate** a value?

7-1-3

Here is the simplest possible example:

7-1-4

```
<input [value]="name" (input)="name = $event.target.value">
```

The `input` element both **reads and writes to the `name` model variable**.

This means that if `name` was changed by someone else, the element would update!

7-1-5

```
<p>
  Edit name:
  <input [value]="name" (input)="name = $event.target.value">
</p>
<button (click)="name = 'Batman'">put on costume</button>
<p>I'm {{name}}</p>
```

```
class AppComponent {
  name = 'Bruce'
}
```

We just did two-way binding on a **text field**...

7-1-6

```
<input type="text"
  [value]="val" (input)="val = $event.target.value">
```

...but it works equally well on **other input types**, for instance a **check box**:

```
<input type="checkbox"
  [checked]="val" (change)="val = $event.target.checked">
```

If we compare them...

7-1-7

```
<input type="text"
  [value]="val" (input)="val = $event.target.value">
<input type="checkbox"
  [checked]="val" (change)="val = $event.target.checked">
```

...we see that **3 things differ** depending on input type:

- The **property name** to bind to
- The **event name** to listen to
- The **value location** in the event object

To help abstract away these differences, Angular comes with a **prebuilt** **ngModel** directive. Our previous examples...

7-1-8

```
<input type="text"
  [value]="val" (input)="val = $event.target.value">
<input type="checkbox"
  [checked]="val" (change)="val = $event.target.checked">
```

...would become this:

```
<input type="text"
  [ngModel]="val" (ngModelChange)="val = $event">
<input type="checkbox"
  [ngModel]="val" (ngModelChange)="val = $event">
```

Looking at the new code in detail...

7-1-9

```
<input type="text"
  [ngModel]="val" (ngModelChange)="val = $event">
<input type="checkbox"
  [ngModel]="val" (ngModelChange)="val = $event">
```

...we see that **ngModel** dealt with the 3 differences like this:

- The **property** is exposed as **ngModel**
- The **event** is exposed as **ngModelChange**
- The **event object** becomes the **value**

Q Wait - sometimes there are **many different events** we could bind to, like on a text field.

7-1-10

How does ngModel decide the exact event?

A Good question! It always go for the **real-time approach**.

7-1-11

Q And, the **homogenisation** offered by **ngModel** seems like a **very small win**. What's the big deal?

7-1-12

We're all web developers, we know what events and properties to bind to!

A Again a good question! The win would indeed be small, if not for the fact that **this exact pattern...** 7-1-13

```
<input [ngModel]="val" (ngModelChange)="val = $event">
```

...can be expressed with the **bindon-** syntax:

```
<input bindon-ngModel="val">
```

...and the **bindon-** syntax... 7-1-14

```
<input bindon-ngModel="val">
```

...has a **shorthand!**

```
<input [(ngModel)]="val">
```

This is lovingly called the **banana box syntax**.

So just to come full circle, our **two previous examples...** 7-1-15

```
<input type="text"
      [value]="val" (input)="val = $event.target.value">
<input type="checkbox"
      [checked]="val" (change)="val = $event.target.checked">
```

...would become this:

```
<input type="text" [(ngModel)]="val">
<input type="checkbox" [(ngModel)]="val">
```

To use **ngModel** you must have **imported FormsModule** into your app module. 7-1-16

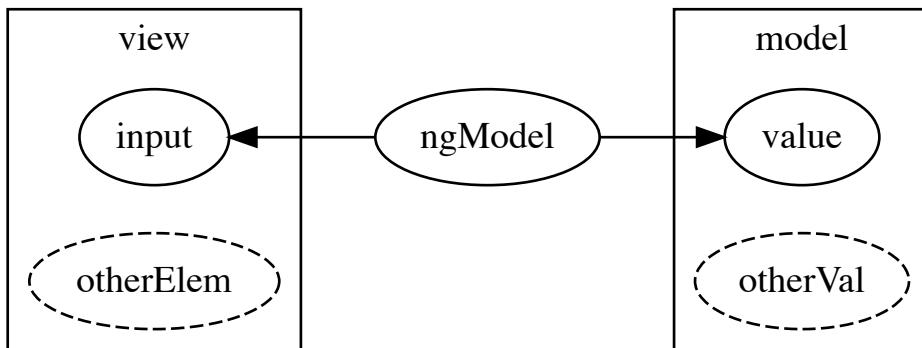
```
import { FormsModule } from '@angular/forms';

@NgModule({
  imports: [ BrowserModule, FormsModule ],
  // ...and the rest
})
class AppModule {}
```



Would it be fair to say that **ngModel** could have been called **ngModelValue**, since it connects one value in the model to an input?

7-1-18



Yes!!

7-1-19

(...although it **also does more things**, as we'll see later on when we talk about **forms...**)

7-2. Forms

fill in the blanks

There are **two different takes** on forms in Angular:

7-2-1

- **Template-driven forms** where the definitions are in the template. Similar to AngularJS, and likely the most common way of doing it.
- **Reactive forms** (sometimes called model-driven) where the definition is in the class. More testable, scales better, but also more verbose.

We'll **focus primarily on template-driven forms**, although with a quick look at reactive forms later on.



Looking at the [Forms section in the official docs](#), or the index of any Angular book, there seems to be a **whole lot to say about forms**.

7-2-2

Yet you only offer one measly section, how come?

A

Mainly because we're staying true to our manifesto - we want to explain the way of thinking, but not lose too much time on details.

7-2-3

With forms you need to grokk the basic setup, which we're walking through here, after which it is easy enough to fill in the details.

Also, we actually have **three sections**, as we'll be looking at validation and reactive forms separately. :)

7-2-4

So, now we're going to **dig into template-driven forms!** Specifically, we'll talk about:

7-2-5

- a the **ngForm** directive
- b hooking up inputs
- c aggregated info
- d generated classes

a

The **ngForm** directive is at the heart of it all. Angular will **automatically create it on form elements**.

7-2-6

In other words, if we snoop at the [source code](#), we should see **form** used as **selector!**

The **ngForm** directive contains a **whole lot of functionality** related to the form. Commonly you'll want to **hook into this within the form**, which is why it is a common practice to **set a reference to it**:

7-2-7

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

b

To make inputs part of the **ngForm** aggregation, we must:

7-2-8

- use the **ngModel** directive, even if not bound to anything
- give it a **name**, as in regular HTML

```
<input name="lastName" ngModel>
```

- c Now, through `ngModel`, we can access aggregated info for the whole form and do things like checking overall validity...

7-2-9

```
<input type="submit" [disabled]="!f.form.valid" value="Submit">
```

...or accessing individual values:

```
<button (click)="checkName(f.value.lastName)">
```

- d Also, much like in AngularJS, there are lots of **auto-generated CSS classes** to make life easier:

7-2-10

- `ng-pristine` and `ng-dirty`
- `ng-untouched` and `ng-touched`
- `ng-valid` and `ng-invalid`

These are applied to the **form element** as well as **individual form controls**.

See it all in action in the [Form](#) demo!

7-2-11

7-3. Validation

Attaching the polygraph

Now for some **words on validation!** Specifically we'll discuss

7-3-1

- a disabling native validation
- b mimicking HTML5 validation
- c checking validity
- d writing custom validation

- a Modern browsers all have **native validation behaviour**, tying in to the HTML5 validation attributes. So if an **input** looks like this...

7-3-2

```
<input required>
```

...and the input is **empty**, the browser would **somewhat hint that it is currently invalid**.

But in a web app you likely **want control over that yourself!** Fortunately HTML5 has an **attribute to opt out** - just attach **novalidate** on the form:

7-3-3

```
<form #f="ngForm" novalidate>
```

- b As you might have guessed, the **FormsModule** includes **directives for all HTML5 validation arguments**;

7-3-4

- required
- minlength
- maxlength
- pattern

In other words, **simply use the attributes as you normally would**, and they will be picked up by Angular.

7-3-5

- c And, as we already spoiled in the previous section, you can **access aggregated validation** through **ngForm**, checking...

7-3-6

- **validity of individual elements or**
- **the form as a whole.**

- d Of course, still true to the...

7-3-7

Angular is built with Angular

...adage, the **API that these directives were implemented with is available to you**.

Which means we can build **custom validation!**

Custom validators are simply **directives** that **implement this validate method**:

7-3-8

```
validate(ctrl: FormControl){  
  // return null if valid, otherwise { [category]: {valid: false} }  
}
```

To make Angular understand that the directive is a validator, we must
dance this dance:

7-3-9

```
@Directive({  
  selector: '[myattribute][ngModel]',  
  providers: [  
    {  
      provide: NG_VALIDATORS,  
      useExisting: forwardRef(() => MyClassName),  
      multi: true  
    }  
  ]  
)  
class MyClassName { ... }
```

This is **likely to change**, perhaps by introducing a new `@Validator` decorator.

You can see an example of this in the [Custom validation](#) demo.

7-3-10

7-4. Reactive forms

let the model do the driving

See:

7-4-1

- [Reactive form](#) demo
- [Reactive validation](#) demo

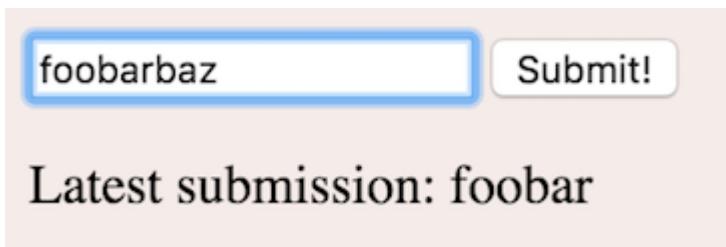
7-5. Template referencing

strings attached

Consider a simple app where we have

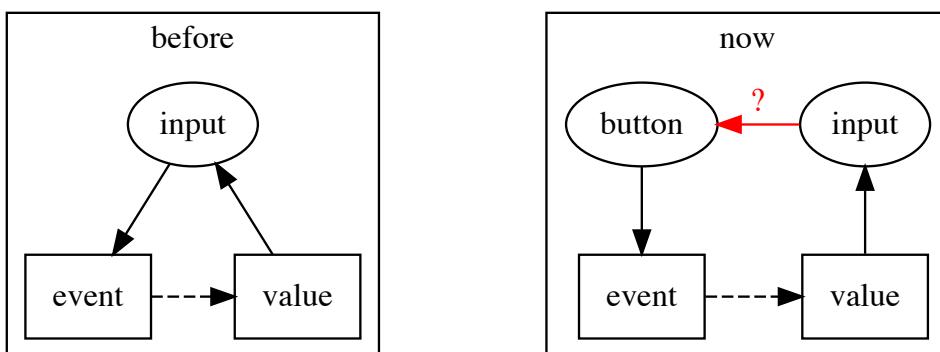
7-5-1

- the latest submitted name
- an input field where you can type a new name
- a button which submits the input content



This is a (slightly) **more difficult problem** than just doing a two-way data binding. Back then the **change listener and value belong to the same element**.

7-5-2



But now they are on **different elements**!

We solve it in the [Submit binding](#) demo by **tracking the field content**:

7-5-3

```
<input [(ngModel)]="fieldValue">
<button (click)="submitName()">Submit!</button>
<p>Latest submission: {{submission}}</p>
```

...and **use that for submission** on clicks:

```
submitName() {
  this.submission = this.fieldValue;
}
```

You could however argue that this is somewhat **unclean**, as **fieldValue** isn't really part of our model.

7-5-4

Still, we must have **access to the field contents**. Is there perhaps a way to **reference** the field to query its value?

Indeed there is, and they're called **refs**! Add it like this:

7-5-5

```
<input ref-field>
```

...and we can **use that reference in siblings or children in the template**:

```
<button (click)="submitName(field.value)">click!</button>
```

Much like with **bind-** and **on-**, there is a **shorthand for the **ref-** prefix**...

7-5-6

```
<input ref-field>
```

...that uses the **# character instead**:

```
<input #field>
```

Try this out in the [Submit Reference](#) demo.

We can also **reach references from the model** by using the **@ViewChild** decorator:

7-5-7

```
class AppComponent {
  fetchedValue: string
  @ViewChild('field') input: ElementRef
  submitName() {
    this.fetchedValue = this.input.nativeElement.value;
  }
}
```

Now we **don't have to pass the reference from the template**, which feels a bit cleaner. Try this out in the [Submit ViewChild](#) demo.

We should also note that **@ViewChild** can find node by other means than references, the API is very flexible.

7-5-8

7-6. Gamebook - extras

i want more

As per usual;

7-6-1

1. **copy the folder of the previous version,**
2. **paste it right next to that version, and**
3. **give it the name FF07-moremoremore.**

The smart thing would be to **leave well enough alone**, but that wouldn't be any fun.

7-6-2

Instead, let's find an excuse to **cram a form into our app somewhere!** How about allowing the player to **name his character** and have the **name be used in the adventure?**

It could look **something like this:**

7-6-3

John Doe Playing as: John Doe

A strange journey

The journey begins



You wake up in a strange room, with no recollection on how you got here. The only thing you remember is your name - John Doe. An opening leads out into whatever house this is.

- Stay in the room
- Walk through the opening



Ideally we would want to **display the form when the game starts**, but that would require a bunch of other changes.

7-6-4

So let's go with simply **always showing the form up top**, as in the previous screenshot.

Here's the plan:

7-6-5

- a add **name** to **gameState**
- b create a **NameForm** component
- c hook up **NameForm** to **AppComponent**
- d make **SceneComponent** receive **gameState**
- e put name placeholders in adventure data
- f make a playername pipe
- g have **SceneComponent** use the pipe
- h wire everything up

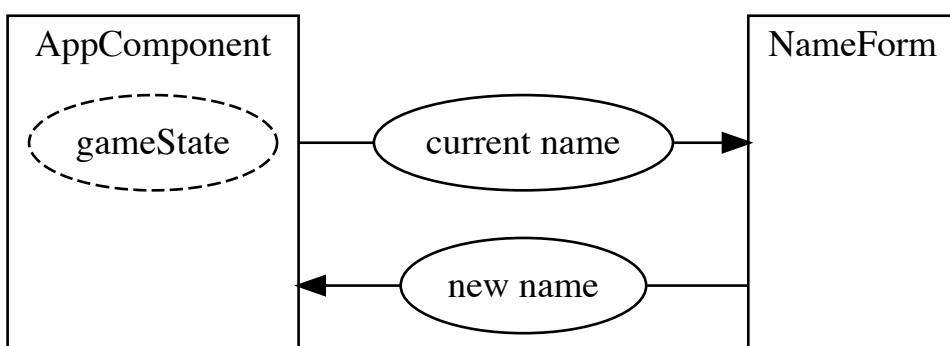
- a First we must change **gameState** to also contain the name. This means...

7-6-6

- make the **default state** contain a **name** in the **StateHandler** **load** method
- update the **TypeScript interface** if you're using those

- b Now for the tough part - creating a **NameForm** component!

7-6-7



It will

- receive the **current name** as **input**
- **output the new name** on form submission

In other words, the **NameForm** class should look something like this:

7-6-8

```
class NameForm {  
  @Input() currentName: string  
  @Output() newName = new EventEmitter<string>()  
  onSubmit(plrname: string){  
    this.newName.emit(plrname)  
  }  
}
```

The **NameForm** template is of course the complicated part, but you can steal pretty much **everything** from the **Form** demo!

7-6-9

As in the demo you should have **some simple validation**, like a minimum (and maybe maximum) character count.

c Now let's use **NameForm** in **AppComponent**! This means...

7-6-10

- adding **NameForm** to the template
- passing in the current name
- creating a **newName** method that updates **gameState** (and remember to save!)
- hook up **newName** to **NameForm** output

d Since the **SceneComponent** will need the player name, we might as well pass it all of **gameState**.

7-6-11

Normally we'd be **wary to share too much**, but it stands to reason that **future state** such as inventory, health, etc, would **also be shown in the scene view**.

e Time to update the adventure data to use the name! Add a **PLAYERNAME** placeholder to relevant positions in the texts.

7-6-12

f Now we need to **create a pipe to exchange the placeholder**!

7-6-13

If you haven't already, look at the **Pipe** section in the **Appendix Various** chapter, and also the **Pipe** demo.

Our pipe should take a block of text and **replace **PLAYERNAME** with the current name**.

7-6-14

How do we get hold of playername? Why, by using the **StateHandler** service of course!

Note that to force our pipe to be applied whenever something changes, we **must set it to be impure** (see the last part of the **Pipe** section).

7-6-15

- g With that done we must use the pipe in the **SceneComponent** template where we display the scene text:

```
 {{currentScene.desc | plrname}}
```

- h Finally we must wire things up by updating our **NgModule** to expose the **NameForm** and the new pipe.

7-6-16

That was a long treck, but now you should have a **fully functioning personalised adventure**, increasing the immersion a thousand times! :)

7-6-17

Postludium

♪♪ *Tiiime tooo saay goodbyyye* ♪♪

Sections in this chapter:

1. What's next?

8-1. What's next?

Where to go from here

So, now that you're about to be **thrown out into the cold**, let's talk about where to go from here for continued Angular support!

8-1-1

We've already bounced around in the [official docs](#).

8-1-2

They **aren't complete** and sometimes they **lag behind**, but they should still be your number one resource.

We'd like to **highlight** some different sections:

8-1-3

- The [API reference](#) is probably the most important part
- The [guides](#) and [advanced](#) sections together make up what amounts to an **explanatory book**.
- Also, don't miss the official [cheat sheet](#) which you should (regularly) print and have lying next to you as you code!

For **third party blogs**, we'd like to mention two sites:

8-1-4

- The [Thoughtram Blog](#)
- The [Angular University](#)

Regarding **books** you'd think there wouldn't be any ready yet, but there is one! And it is actually **up to date** (for a little while longer...)!

8-1-5

We're talking about [Manning Publication's book Angular 2 development with TypeScript](#).

Despite obviously being **written in parallel with Angular development**, it is actually **pretty good**.

8-1-6

At the time of writing it is still in **early access**, meaning you can **only buy pdf**. But **all content is finished**, and the expected release is in november.

Beyond that, of course, there's **no quick fix** for learning the framework.

8-1-7

Except for **taking an Angular class**, but you just did that. :)

So what remains is to **try it out** and get lots of **hands-on experience**.

And in that endeavour we **wish you the best of luck!**

8-1-8

Thank you for participating, see you down the road! :)

Appendix: Web stuff

Laying out the tools

This appendix chapter gathers a **bunch of different good-to-knows** regarding the web in general and JavaScript in particular, that might benefit you while working with Angular.

Sections in this chapter:

1. The JavaScript language
2. The web as a platform
3. Node and NPM
4. CSS Selectors
5. Object references
6. Attributes vs Properties
7. Functional programming
8. Statements vs Expressions

9-1. The JavaScript language

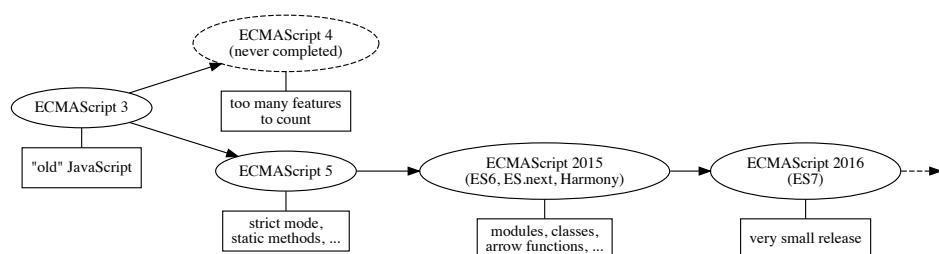
lingua franca of the web

So - **JavaScript!** Let's kick things off with a **chopper view of the language**.

9-1-1

First, here is an overview of the **different JavaScript versions**:

9-1-2



We will be using the **very latest features**, which we will walk through later.

...as well as some **more** stuff beyond the borders of JavaScript, but that comes later too!

9-1-3

Since we **can't trust all browsers to know the latest JS**, we must **convert our code**. We do this either by...

9-1-4

- a polyfilling
- b transpiling

- a** Polyfilling means **adding a homebrew version** of a method if a native one isn't available. This **can be done programmatically**, like this:

```
Array.isArray = Array.isArray || function(a){  
  return '' + a !== a && {}.toString.call(a) == '[object Array]';  
};
```

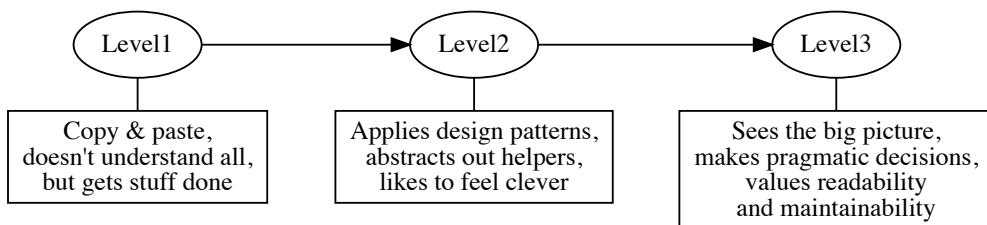
9-1-5

- b** But **syntax changes** requires a **transpilation step** that must be done **prior to running the code**. We **cannot do this programmatically**.

9-1-6

Speaking of JavaScript's character - are you familiar with the **3 levels of programming**?

9-1-7



- Q** They were interesting, but **what do they have to do with JavaScript?**

9-1-8

- A** JavaScript's flexible nature **encourages and empowers level 2 behaviour**.

9-1-9

So **take care**, and remember:

With great power comes great responsibility

Wielding of that power requires you to **have a grasp** JS's quirks, of which there are many.

9-1-10

These ones are **especially important**:

- **Loose typing** and **truthiness**
- The **implicit `this`** parameter
- **Lexical scoping**
- **closures**

A very **good** resources for these quirks is [JavaScript Garden](#).

9-1-11

For more **general JS references** we recommend [MDN](#) (and **not W3Schools**).

9-2. The web as a platform

this or this or this or

Zooming out from JS, we also need to realise a few things regarding **the web as a platform**.

9-2-1

By that we mean building applications with **JavaScript, HTML and CSS**.

Something that is often **overwhelming to newcomers** is that there is an **abundance of choices** to make, for many different aspects;

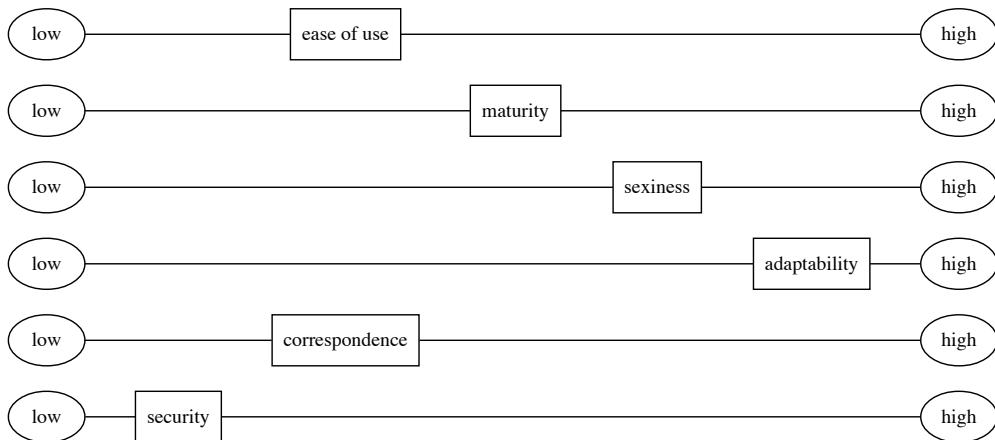
9-2-2

- **what framework** to use
- **what build chain** to use
- **which JS language flavour** to use
- **what CSS preprocessor** to use
- **what style rules** to enforce
- **how to enforce** those rules

...and many more.

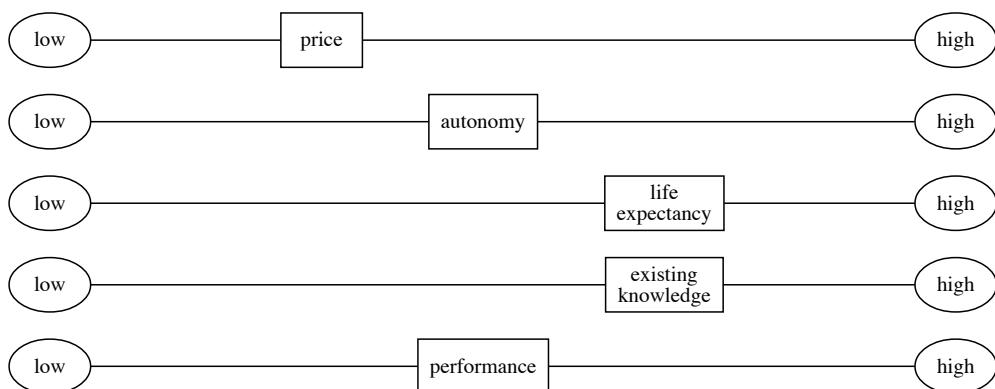
And for each of those choices, you must consider;

9-2-3



...and also:

9-2-4



...and likely a few more that we've forgotten.

Regarding the choice of framework, the most important aspect is perhaps that of complexity:

9-2-5



The one we've chosen here, Angular, is of medium- to heavy weight.

9-2-6

Which means that it offers us all we need, but still leaves some room to make choices!

Observe that there is **no right or wrong** in the complexity choice.

9-2-7

The important thing is to be aware of where on the scale you are, and understand the consequences of that.

9-3. Node and NPM

workbench and pantry

In the course we'll rely heavily on

9-3-1

- a the JavaScript runtime Node and
- b the package manager npm

...so let's touch briefly on both!

a **Node** is mostly associated with **running JavaScript on the server**, but in actuality it is a **JavaScript runtime that can be run anywhere**. Some differences versus the in-browser runtime is that

9-3-2

- Node has **no DOM**
- Node can **read and write files**
- Node has **its own module system**

There are **two ways to execute JS** with Node. We can enter the **REPL** by typing `node` in a node terminal...

9-3-3

```
Davids-MacBook-Pro-2:mc2 davidwaller$ node
> 0.1 + 0.2
0.30000000000000004
> |
```

...or we can **execute JavaScript files** by typing `node myfile.js` which executes the JS code in `myfile.js`.

9-3-4

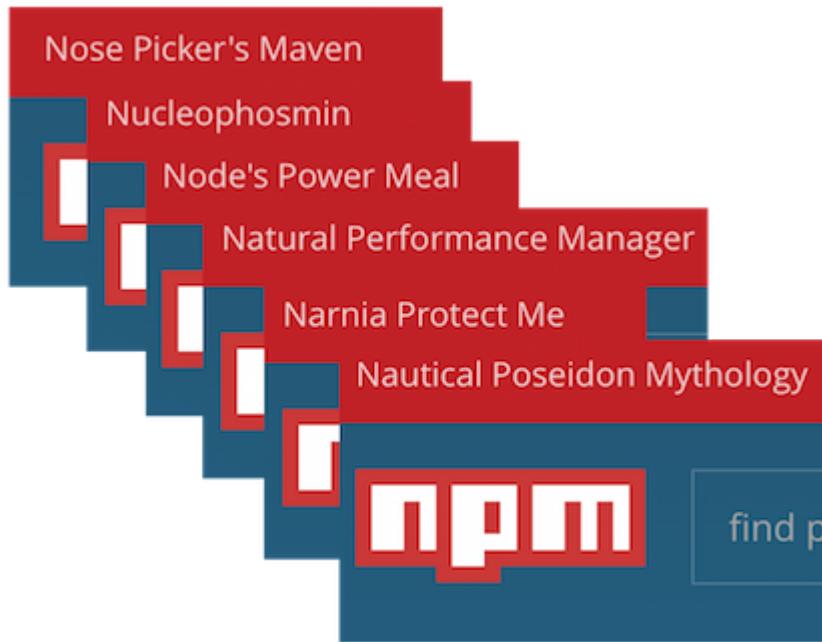
This of course is the **most common usage** of Node.

JS developers frequently use Node to **run code as part of their build chain**.

- b) However, Node is also used for running **npm**, through which we can download packages from the online repository at <https://www.npmjs.com/>.

9-3-5

Allegedly npm is an acronym for Node Package Manager, but npm themselves deny that through consistently using lower-case characters, and through the top-left corner of their homepage:



We download packages by

9-3-7

- turning our own code into a package through adding a **package.json** file
- listing the packages we depend on in that file
- typing **npm install** to download all listed dependencies to **node_modules**
- using those modules in our code!

By having **package.json** as part of the project, but excluding **node_modules**, we get a small code repository which can still be easily inflated with dependencies.

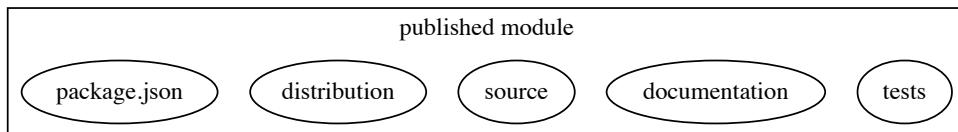
9-3-8

And we can still be sure that everyone has the same dependcies.

(...at least if we're careful...)

A downloaded published module will normally look like this:

9-3-9



The package.json file will specify where in the source the entry point is.

So! Node's module system that we mentioned earlier lets us

9-3-10

- import stuff from other files by using require
- export stuff from files by assigning to module.exports

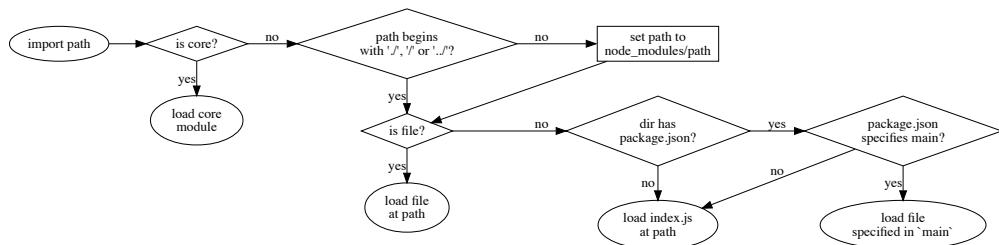
But now for the beautiful part - we can also require packages from node_modules!

9-3-11

Thus Node and npm together solve both the code modularisation problem along with 3rd party code import problem.

Here's the full truth about how we require stuff:

9-3-12



The important part is to realise that there is no magic involved, and that Node provides us with a convenient way to load...

9-3-13

- core modules (like fs, http, etc)
- 3rd party code (like angular)
- own local modules (like ./src/mycomponent)

9-4. CSS Selectors

You know of them, but do you know them?

When we say **CSS**, we are actually talking about **two different syntaxes**:

9-4-1

```
div > h1:first-child {  
  background-color: #CCC;  
  font-style: italic;  
}
```

- The line preceding the brackets is a **selector**
- The stuff inside the brackets are **style rules** which will be applied to all nodes matching the selector

They are used for two **very different things**:

9-4-2

- **Selectors** allow you to **reference a set of DOM nodes**
- With **style rules** you **describe what the nodes look like**

The **DOM** has its own API for selecting nodes, but it is **really limited and verbose**.

9-4-3

Therefore **jQuery imported CSS selectors to JS**:

```
jQuery('div > h1:first-child').doSomethingWithTheseNodes();
```

This turned out to be a **really good idea**, and the biggest reason behind why **jQuery is now used by half of the internet**.

9-4-4

Because this was such a good idea, it has now been made into a **native DOM method**:

9-4-5

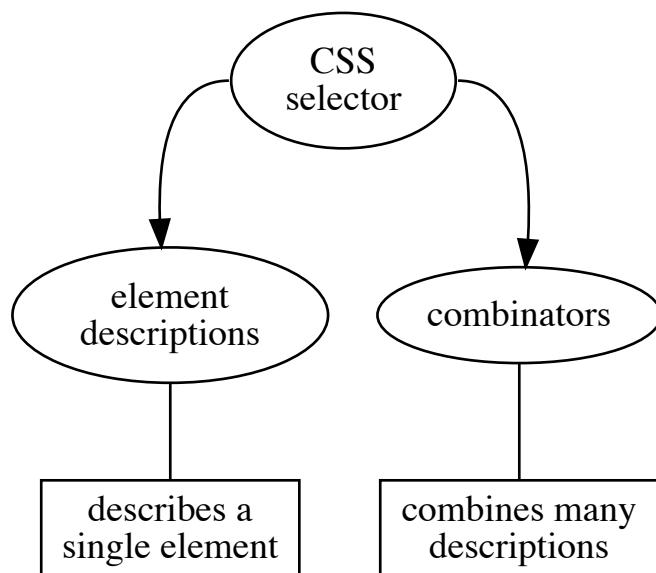
```
document.querySelectorAll('h1:first-child').doSomething();
```

There is also a **document.querySelector** variant that **always returns just 1 node** (or none).

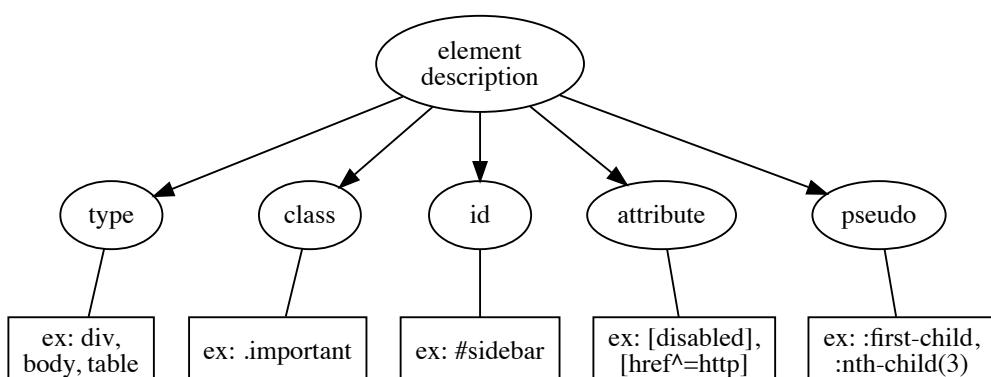
And, as we will soon see, **CSS selectors are also used in Angular!**

9-4-6

All this make for a very good reason to brush up on your **CSS selector knowledge**, so let's do that now!



Starting with **element descriptions**, they describe elements in **one or more of five different ways**:



These **can be combined** however you see fit. Here is an (exaggerated) example using all of them:

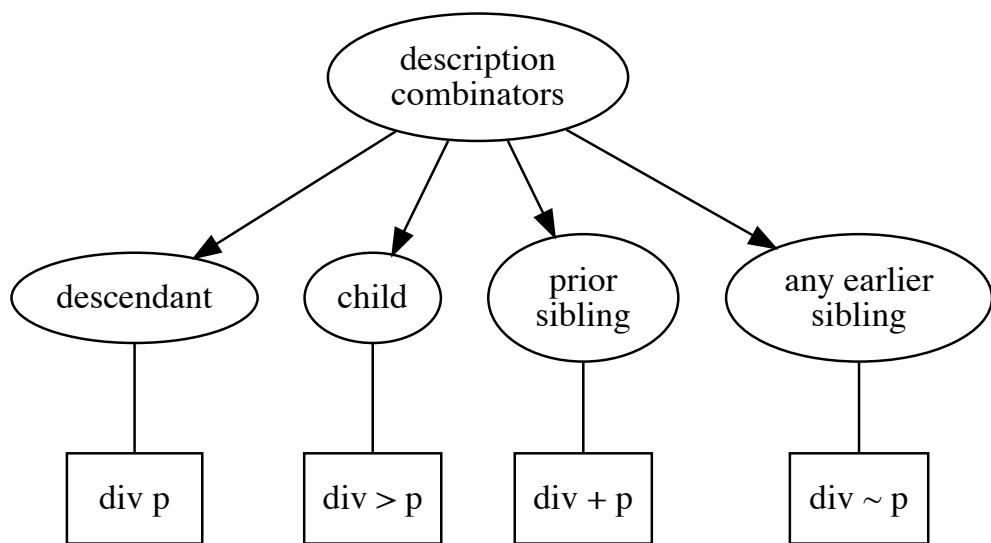
```
button[disabled]#deletemsg.big:first-child
```

This would match all

- nodes of **type** buttons
- that has a disabled **attribute**
- and **id** is **deletemsg**
- and **class** attribute contains 'big'
- and it is the **first child** of its parent

Now for the **combinators**! There are **4 different different ways** that descriptions can be combined.

9-4-10



We'll now look closer at one at a time!

9-4-11

- a descendant combinator
- b child combinator
- c sibling combinator
- d adjacent sibling combinator

- a The perhaps most common one is the **descendant combinator**. By having **two descriptions with a space between...**

9-4-12

```
div p
```

9-4-13

```
div p
```

...we match all elements that

- **match the last description**
- **have an ancestor matching the first description**. This can be **any number of generations** up the tree.

It is unfortunate that the descendant combinator doesn't have a non-space symbol, something like this:

9-4-14

```
div _ p
```

Whitespace elsewhere in CSS doesn't have meaning, but here it suddenly does. To help with this, think of descendant combinator as invisible symbols!

(b)

9-4-15

```
div > p
```

The **child combinator** is very similar to descendant selector, but here the first selector must match the **parent** and not just any ancestor.

Thus the child combinator is **smaller in scope** than the descendant combinator.

9-4-16

(c)

9-4-17

```
div ~ p
```

The **sibling combinator** is similar to the descendant combinator, but **works horizontally** instead.

9-4-18

```
div ~ p
```

This means it matches elements that...

- **match the last description**
- have an **older sibling that matches the first description**

(d)

9-4-19

```
div + p
```

Finally the **adjacent sibling combinator** works in the exact same way, but requires the **neighbouring older sibling to match the first description**.

The two sibling combinators are not often used, but they are **good at what they do**.

9-4-20

Solving that problem with other means would require **brittle workarounds**, something you often see from web developers who don't know about them.

9-5. Object references

Any strings attached?

In JavaScript, **objects (and therefore also arrays) are references**.

9-5-1

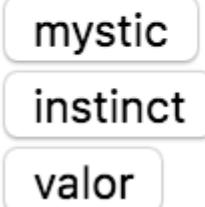
This means that...

- passing around references is **dangerous**
- you must be **careful with mutation**
- know if APIs **copy or mutate**

As a **cautionary tale**, have a look at this app:

9-5-2

Team mystic is the best!



Clicking a team **gives it a point**, and the headline shows the **current leader**.

However, in an early version, a **bug caused the buttons to change order when the leader changed**.

9-5-3

This was **not the intened behaviour**.



Can you spot the cause of the bug?

9-5-4

```
class PokemonGoComponent {  
  votes = {mystic: 0, instinct: 0, valor: 0}  
  list = Object.keys(this.votes).sort()  
  get best() {  
    return this.list.sort(  
      (a,b)=> this.votes[a] < this.votes[b] ? 1 : -1  
    )[0] // best is 1st element in sorted list  
  }  
  vote(team) {  
    this.votes[team]++  
  }  
}
```



The offence is in the **best** getter:

9-5-5

```
get best() {  
  return this.list.sort(  
    (a,b)=> this.votes[a] < this.votes[b] ? 1 : -1  
  )[0] // best is 1st element in sorted list  
}
```

The **.sort** method **mutates** `this.list`, which means that the **buttons would change order!**

9-5-6

The problem was fixed by first **copying** the array using the **non-mutating slice method**:

```
get best() {  
  return this.list.slice().sort(  
    (a,b)=> this.votes[a] < this.votes[b] ? 1 : -1  
  )[0] // best is 1st element in sorted list  
}
```

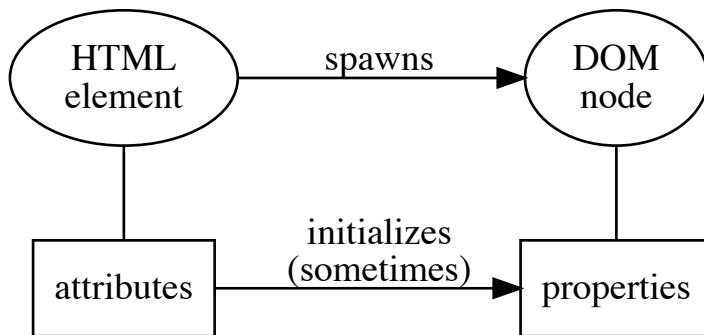
9-6. Attributes vs Properties

You say potato

HTML elements have **attributes** but DOM nodes have **properties**.

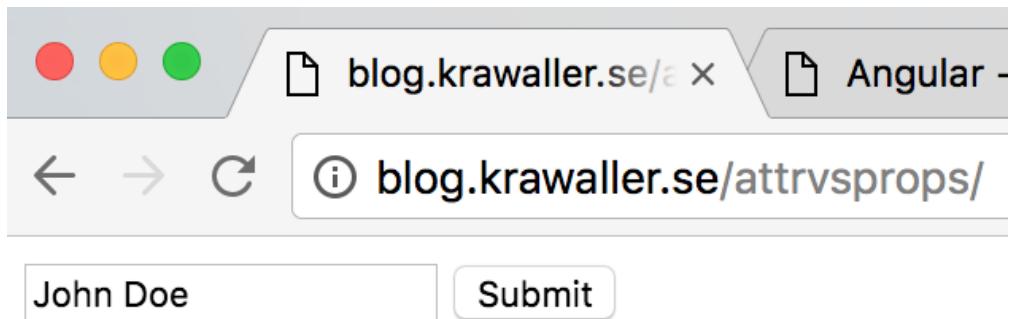
9-6-1

Usually, but not always, the former initializes the latter:



We will now showcase the difference using this simple page:

9-6-2



It is published at <http://blog.krawaller.se/attrvsprops/>.

If you **view source** you'll see this:

9-6-3

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8"/>
  </head>
  <body>
    <input value="John Doe"> <button>Submit</button>
  </body>
</html>
```

Note that the **input** has the initial value "**John Doe**".

In the console we can get a reference to the input field node like this:

9-6-4

```
var field = document.querySelector("input");
```

Using that reference we can **confirm the value of the value attribute**:

9-6-5

```
field.getAttribute("value") // "John Doe";
```

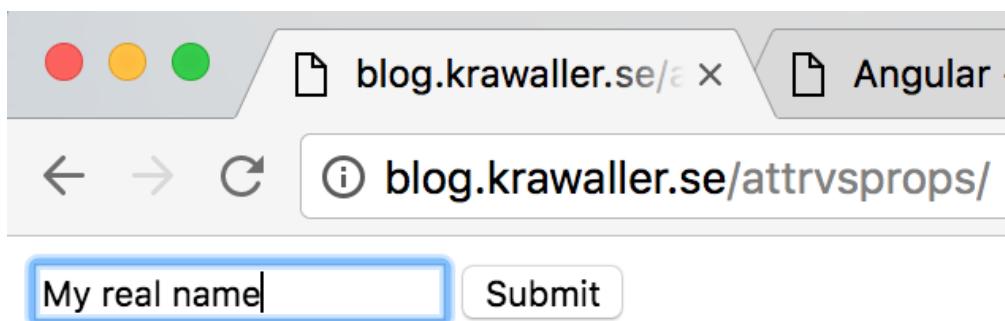
And we can also **read the value property**:

9-6-6

```
field.value // "John Doe";
```

Now **type in the field** to say something else:

9-6-7



If we **query the attribute again**, we see that it is still John Doe:

9-6-8

```
field.getAttribute("value") // "John Doe";
```

But the **property is updated**:

9-6-9

```
field.value // "My real name";
```

This reflects the fact that **attributes are characteristics of the original HTML elements**, while **properties belong to the live DOM nodes**.

9-6-10

To wit:

9-6-11

- HTML elements have attributes, and DOM nodes have properties.
- Attributes often initialize properties (but not always)
- Attributes never change, but properties can change.



Ok, this is all very interesting, but **what does this have to do with Angular?**

9-6-12



Nothing directly, except it is **even easier to mix things up in Angular** because of its use of templates.

9-6-13

Take this **Angular template bit**:

9-6-14

```
<button [disabled]="someFlag">
```

- Here `disabled` is given the value of `someFlag`.
- Whenever `someFlag` changes, so will `disabled`.

In essence: when writing Angular templates it **looks like we're dealing with attributes**.

9-6-15

But we are **actually dealing with properties** (with some exceptions).

9-7. Functional programming

Jumping down the rabbit hole

JavaScript is a **functional language**, which Angular makes good use of.

9-7-1

We'll now **walk through a quick example** to make sure we **understand the power of this paradigm!**

So - since **functions are first class citizens**, we can **send them around just like any value**.

9-7-2

Which also means that a **function can take, and/or return, other functions!** Such a function is called a **higher order function**.

As a contrived **example**, say we have this function:

9-7-3

```
var spam = function(){
  console.log("SPAM!");
}
```

And then we have this **higher order function**:

9-7-4

```
function repeater(func,times){
  for(var i = 0; i < times; i = i + 1){
    func();
  }
}
```

If we **invoke repeater** like this:

9-7-5

```
repeater(spam,3);
```

We would **see this in the console**:

```
"SPAM! "
"SPAM! "
"SPAM! "
```

To show we can also **return new functions**, take a look at this beauty:

9-7-6

```
function multiplier(func,times){
  return function(){
    for(var i = 0; i < times; i = i + 1){
      func();
    }
  };
}
```

Did you see the difference? **multiplier** doesn't execute the parameter function, but **returns a new function!**

9-7-7

```
var tripleSpam = multiplier(spam,3);
```

If we **execute the returned function** we get the triple spam:

```
tripleSpam(); // SPAM! SPAM! SPAM!
```

Functional programming is a **really powerful tool**, and something that is likely to **get you hooked once you have learned it**. We warmly encourage you to explore the subject!

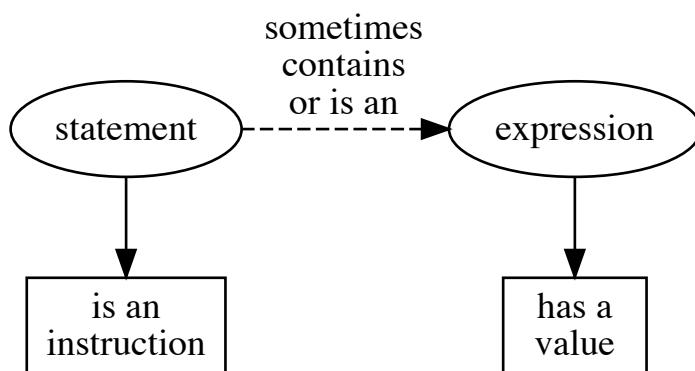
9-7-8

9-8. Statements vs Expressions

I say tomato

The code we write is made up by **statements** and **expressions**. So what is the difference?

9-8-1



For example, consider this line of code:

9-8-2

```
var cost = quantity * price;
```

- The line is a **statement**, declaring a variable and assigning a value
- It **contains an expression** `quantity * price`, and whatever that evaluates to will be assigned to `cost`.
- Does the whole expression have a value? Yes, but it happens to be `undefined`. So, not really.

The fact that **assignment forms part of a valid expression** in JavaScript is why this code isn't a syntax error:

9-8-3

```
if (count = 12) {  
  output("That's right, a dozen means 12!");  
}
```

Then there are things in JS which aren't expressions but could be. This is a syntax error:

9-8-4

```
var suffix = switch (quoty % 10) {  
  case 1: 'st'  
  case 2: 'nd'  
  case 3: 'rd'  
  default: 'th'  
}
```

Instead we have to do this:

9-8-5

```
var suffix;  
  
switch (quoty % 10) {  
  case 1: suffix = 'st'; break;  
  case 2: suffix = 'nd'; break;  
  case 3: suffix = 'rd'; break;  
  default: suffix = 'th'; break;  
}
```

Granted, it is probably because JS has fall-through that switches aren't expressions (which is considered a flaw too).

Perhaps weirdly, **any expression is a valid statement**. (It's an "expression statement".) Consider this line:

9-8-6

```
2+3;
```

It will be evaluated to 5, but nothing uses that value and there are no side effects. On the Chrome Console you can see the 5.

A famous example of clever usage of this is the strict mode opt-in "magical string":

```
"use strict";
```

Sometimes JavaScript even taunts us with the statement/expression distinction. There's both a **function statement** and a **function expression**:

```
function luke() {           // function statement
}

var leia = function() { }; // function expression
```

Function statements *require* the function name, which gets installed in the current scope. Function expressions do no such thing.

Have you thought about the fact that { } gets used for two completely different things in JavaScript?

```
{
  console.log("This is a block!");
}

var however = {
  here: "these braces denote",
  an: "object literal!"
};
```

How does JavaScript know when it's supposed to be one or the other? Well, that's also a statement/expression distinction. See the recurring theme here?



Ok, got it, there are **many nuances** to the difference between statements and expressions.

9-8-9

But isn't this just **theoretical academics with no practical value**?



No! Don't dismiss this!

9-8-10

Understanding the difference will give you a **better understanding** of, and **perspective** on, your code!

Also, as we will see soon enough, the **distinction comes into play in Angular**.

Appendix: ES2015

The new shinies

In this appendix chapter we will more fully **explore the new features in ES2015!**

Sections in this chapter:

1. Versatile object definitions
2. Destructuring and rest
3. Versatile function definitions
4. Spreads
5. Modules
6. Classes
7. Decorators
8. Miscellaneous
9. Trying it out

10-1. Versatile object definitions

defining objects like a boss

In ES2015 we got five small but nice features for **defining objects in a smoother way**:

10-1-1

- a dynamic keys
- b automatic same-key-value
- c method shorthand
- d getters
- e setters

a

If we wanted to create an **object with a dynamic key** we had to go about it in a roundabout way before:

10-1-2

```
var obj = {};
var obj[dynamicKey] = someValue;
```

Now, instead, we can use the **dynamic key syntax** by wrapping it in brackets:

10-1-3

```
var obj = {[dynamicKey]: someValue};
```

b

Also, if our value is in a **variable with the same name as the intended key**, like here:

10-1-4

```
var person = {
  name: name,
  age: age
};
```

...ES2015 introduces a **shorthand syntax**:

10-1-5

```
var person = {name, age};
```

c

And if we define an **object with a method**:

10-1-6

```
var obj = {
  method: function(arg1,arg2){
    // do advanced stuff
  }
};
```

...ES2015 lets us be less verbose by using the **method shorthand syntax**:

10-1-7

```
var obj = {
  method(arg1,arg2){
    // do advanced stuff
  }
};
```

This can also be **combined with the dynamic key syntax**:

10-1-8

```
var obj = {
  [methodName](arg1,arg2){
    // do advanced stuff
  }
};
```

- (d) Finally, ES2015 also introduced **getters and setters**.

10-1-9

Let's look at **getters** first. They are very useful for dealing with **computed properties**.

Say we're working with **user objects** like this:

10-1-10

```
var user = {
  firstName: "John",
  lastName: "Doe"
};
```

Now we want to implement a **computed property `fullName`**.

Here's an **ES3 solution** doing it as a **method**:

10-1-11

```
var user = {
  firstName: "John",
  lastName: "Doe",
  fullName: function(){
    return this.firstName + ' ' + this.lastName;
  }
}

user.fullName(); // John Doe
```

By using an **ES2015 getter** we can access the computed property normally instead:

```
var user = {
  firstName: "John",
  lastName: "Doe",
  get fullName() {
    return this.firstName + ' ' + this.lastName;
  }
}

user.fullName; // John Doe, without invocation!
```

Cf. [uniform access principle](#).

You can **see all three syntaxes** in an Angular context in the [Getter](#) demo!

10-1-18

e A **setter** let's you **act upon prop mutation**, for example **logging**...

10-1-14

```
var user = {
  set userName(str) {
    log(this._userName + " changed name to " + str);
    this._userName = str;
  }
}

user.userName = "Steve"; // Bob changed name to Steve
```

...or **validation**:

10-1-15

```
var user = {
  set userName(str) {
    if (str.match(/[a-z]/)){
      throw "Name can only contain lowercase letters!";
    }
    this._userName = str;
  }
}

user.userName = "Bob the 1 and only"; // Name can only contain..
```

Q Did you note that we used a **different property name** inside the setter? The setter was for `userName`, but inside it we instead set `_userName`.

10-1-16

Why do you think that is?

A

If we mutated the same property inside the setter then that would trigger the setter to be called, which would mutate the property, which would trigger the setter, etc. We would end up in an **infinite loop**.

10-1-17

10-2. Destructuring and rest

cherry-picking the raisins from the cookie

Destructuring is a way to pick values from nested structures without having to do the manual digging.

10-2-1

Let's say we have an **array of contenders**, each represented by an object.

10-2-2

```
let contenders = [
  {name: "David", age: 37},
  {name: "Carl", age: 38}
  /* and a few others */
];
```

They are **sorted by position** so the first contender won, etc.

If we wanted the **name of the winner** we would do something like this in ES5:

```
let winnersName = contenders[0].name;
```

With **destructuring**, we can instead do this:

```
let [{name: winnersName}] = contenders;
```

Or, combined with the **same-key-value shorthand**:

```
let [{name}] = contenders;
```

Destructuring also allows us to use the powerful **rest** element which can lump up many array elements into one, making for some very succinct code:

10-2-5

```
let [winner, ...losers] = contenders;
```

Note that the rest element **has to be the last one in the array**, so this wouldn't work:

10-2-6

```
let [...others, superloser] = contenders; // syntax error
```

Q Wait.. Theoretically, the rest could be placed *anywhere*, as long as there's just one. The parser should still be able to figure out what's what!

10-2-7

Right?

A True. But that would require lookahead, which is **complex and more taxing**. And so the choice was made to only allow the rest element in the last position.

10-2-8

10-3. Versatile function definitions

defining function like a boss

ES2015 provides several neat features for defining functions:

10-3-1

- a** default parameter values
- b** rest parameters
- c** destructuring parameters
- d** arrow functions

a Default parameter values exist in many languages, and was popularised in JS through [CoffeeScript](#).

10-3-2

The idea is to handle optional parameters in a smoother way.

Creating a **function with an optional parameter** in ES3 meant we had to do a sometimes tedious dance of initialization:

10-3-3

```
function makePerson(name, age) {  
  var age = age || 'unknown';  
  // do complex stuff  
}
```

This may or may not do what you want. (Hint: is 0 a reasonable value for age?)

With **default parameter values** we can instead do this:

10-3-4

```
function makePerson(name, age = 'unknown') {  
  // do complex stuff  
}
```

b The second new feature, **rest parameters**, is a way of capturing multiple arguments into a single variable like a rest element in a destructuring.

10-3-5

This can often save us from having to do awkward stuff with the not-quite-an-array `arguments` object.

Imagine a `competition` function that is called with all contenders one by one:

10-3-6

```
function competition() {  
  var contenders = Array.prototype.slice.call(arguments);  
  var winner = contenders[0];  
  var losers = contenders.slice(1);  
  // do something with winner and losers  
}
```

Using rest parameters, this function simply becomes:

10-3-7

```
function competition(winner, ...losers) {  
  // do something with winner and losers  
}
```

Note that the rest parameter **has to be the last parameter**, just like the rest element, and for the same reason.

10-3-8

c

Remember destructuring? We can use that in signatures:

10-3-9

```
function introduce({name, age}) {
  console.log(name, "is", age, "years old");
}
var me = {name: "David", age: 37};
introduce(me); // David is 37 years old
```

d

Finally - know how **defining anonymous functions** in JS is rather verbose?

10-3-10

```
var mcboatify = function(arg) {
  return "Boaty Mc" + arg + "Face";
};
```

With **arrow functions** things feel less heavy:

10-3-11

```
var mcboatify = (arg) => {
  return "Boaty Mc" + arg + "Face";
};
```

They can become smaller still - if we have **exactly one parameter**, we can **omit the parenthesis** in the signature:

10-3-12

```
var mcboatify = arg => {
  return "Boaty Mc" + arg + "Face";
};
```

Finally, if you **just want to return an expression**, we can **skip brackets** and the **return keyword**:

10-3-13

```
var mcboatify = arg => "Boaty Mc" + arg + "Face";
```

Now the function body consists of a single expression, which will be implicitly returned.

Note however that if you want to use the **single expression form with an object literal**, we have to **wrap it in parenthesis** to distinguish it from a regular function block:

10-3-14

```
var createUser = (name,age)=> ({name,age})
```

Arrow functions are not only less heavy to write, they are also lighter for the interpreter since they **don't get an implicit context parameter**.

10-3-15

Which means that if you refer to **this** inside an arrow function, it is the **same this as on the outside**.

10-3-16

```
var me = this;
setTimeout(() => {
  console.log(this === me); // true
}, 10)
setTimeout(function(){
  console.log(this === me); // false
}, 10)
```

As a final note; arrow functions can beautifully describe the flow for **nested higher order callbacks**. Remember the **multiplier** example from the functional programming section?

10-3-17

```
function multiplier(func,times){
  return function(){
    for(var i = 0; i < times; i = i + 1){
      func();
    }
  };
}
```

With arrow functions, that becomes:

10-3-18

```
var multiplier = (func,times)=> ()=> {
  for(var i = 0; i < times; i = i + 1){
    func();
  }
}
```

10-4. Spreads

the dark side of rests

You have already seen how we use **rest** element/parameter to capture several array elements into a single variable:

```
var [winner, ...losers] = competitors;
```

Now imagine **the opposite scenario** - we have the **winner** and **losers** variables, and want to define **competitors**. In ES3 this is done like this:

```
var competitors = [winner].concat(losers);
```

ES2015 gives us a new options - **spreads!** It looks exactly like rest, but we use it on the *right side* instead (or when we *call* a function as opposed to when we define it):

```
var competitors = [winner, ...losers];
```

We say that we *spread* the contents of the expression into the outer array.

Spreads gives us a less verbose way to **copy an object and add properties to it**, which is otherwise done like this:

```
var augmentedObj = Object.assign({}, oldObj, newProps);
```

With spreads we can instead do this:

```
var augmentedObj = {...oldObj, ...newProps};
```

Note that while spreads and rests *with arrays* are in the spec for ES2015, **object spread is still a Stage 3 proposal** (November 2017).

It is **expected to be accepted into an upcoming release** of the language, and is already supported by Babel and the like.

10-5. Modules

getting into the import/export business

As we saw earlier, **Node gave us modules** through the `require` and `module.exports` globals it provides.

10-5-1

But with ES2015, we got **native modules** for the very first time!

While **Node modules** followed the **CommonJS module standard**, what was implemented in the language follows **another syntax**, named **ES modules**.

10-5-2

But the **concepts are the same**. While you would do this in **CommonJS**...

```
// file1.js
module.exports = { .. };

//file2.js
var lib = require("./file1.js");
```

...you would do this with **ES modules**:

```
// file1.js
export const lib = { .. };

//file2.js
import lib from './file1.js'
```

We have to **name our exports** here, otherwise things are pretty similar.

There are **other differences too**, so for the full scope you should **check the MDN docs** for **import** and **export**

10-5-4

Note that even though this is now **part of the language**, there are **no browsers that implement the functionality yet**.

10-5-5

This is mainly because it **wouldn't be practical** - we'd get a **gazillion http requests for small files**.

And since we **likely have a build step anyway** to do minification and transpiling and similar, you can easily **bundle your code into a single file**, too.

10-5-6

But, with the advent of HTTP2, **who knows what the future will hold!**

10-6. Classes

Waiter, there are classes in my JS!

Before ES2015, JavaScript used to famously **lack classes**.

10-6-1

This was **not an oversight**. Consider what **classes are normally used for**:

- **resusing functionality** and
- **setting up hierarchies**

In JavaScript this is addressed by

10-6-2

- **simply grabbing methods** and/or **mixing objects**
- **prototypal "inheritance"**, which should really be called delegation

This means that **classes didn't really serve a purpose**. Yet they were **still frequently used**, through the weird, bolted-on **new** syntax which **makes functions behave like constructors**:

10-6-3

```
var user = new User("David", 1979);
```

But to really make this **behave like normal classes...**

10-6-4

```
var lucas = new Dog("Lucas");
lucas instanceof Dog; // true
lucas instanceof Animal; // true
lucas.bark(); // Lucas goes woof!
```

...then lots of **jumping through hoops** had to be done:

10-6-5

```
Dog.prototype = new Animal();
Dog.prototype.constructor = Animal;
Dog.prototype.bark = function() {
  console.log(this.name, "goes woof!");
}
```

To facilitate "class" use in JavaScript, ES2015 introduced the **class** syntax:

10-6-6

```
class Dog extends Animal {
  bark() {
    console.log(this.name, "goes woof!");
  }
}
```

Note how **method shorthands** are available in class declarations too!

But it is important to note that this does **not mean that JavaScript has actual classes**.

10-6-7

Under the hood the same weird prototype and constructor dance happens.

Still, since the **syntax hides the mismatch**, it can be a **convenient way to package functionality**. And Angular makes heavy use of this construct, so let's check out some details! Specifically:

10-6-8

- a constructor
- b methods
- c properties

a First off, what **used to go in the fake constructor...**

10-6-9

```
function Animal(name) {
  this.name = name;
}
```

...is now placed in a literal **constructor** method in the class declaration:

10-6-10

```
class Animal {  
  constructor(name) {  
    this.name = name;  
  }  
}
```

If you want **the inherited constructor to be invoked too**, you must **do so yourself** with the new **super** keyword:

10-6-11

```
class Dog extends Animal {  
  constructor(name) {  
    super(name);  
    this.nickname = name + 'y boy';  
  }  
}
```

b And you've **already seen methods**:

10-6-12

```
class Dog extends Animal {  
  constructor() { ... }  
  bark() {  
    console.log(this.name, "goes woof!");  
  }  
}
```

Similar to object methods, **this** (normally) **points to the instance**.

c Finally, as you saw, **properties are normally initialised in the constructor**:

10-6-13

```
class Animal {  
  constructor(name) {  
    this.name = name;  
  }  
}
```

...but when we use **TypeScript** we can also initialise properties directly on the class declaration:

```
class Dog {  
  numberOfLegs = 4;  
}
```

This is likely to become a part of **JavaScript** syntax too.

So, to recap:

10-6-15

- classes are just a **light syntactic sugar** introduced in **ES2015**
- we normally **don't need them in JavaScript**
- but they are a **convenient way to bundle related functionality**
- which **Angular makes heavy use of!**

10-7. Decorators

dewhatnow?

The situation around decorators is rather confusing;

10-7-1

- There is a **proposal** to add it as a language feature
- There is a slightly different **implementation in TypeScript**
- There is the parallel idea in **Reflect**
- There is **disagreement** on whether decorators are a good idea at all
- There is (was?) something called **annotations** that is sort of the same... yet not

Focusing on the **TypeScript implementation**, decorators are a way of decorating a class...

10-7-2

- **declaration**
- **property**
- **getter or setter**
- **method**
- **method parameter**

As a simple example, imagine that we have a **debounce** function that throttles other functions:

10-7-3

```
function debounce(fn) {  
  // ... create a throttled version of `fn`...  
  return throttledFn;  
}
```

And then we have a class with a **method that is very expensive** to call:

10-7-4

```
class myClass {  
  myExpensiveMethod: function() {  
    // lots of heavy lifting here  
  }  
}
```

Without decorators we would do this:

10-7-5

```
class myClass {  
  myExpensiveMethod: debounce(function() {  
    // lots of heavy lifting here  
  })  
}
```

With decorators, instead, we use the @ syntax:

10-7-6

```
class myClass {  
  @debounce  
  myExpensiveMethod: function() {  
    // lots of heavy lifting here  
  }  
}
```

The **end result is the same thing**.

We can also have **decorators that take additional arguments**. For instance debounce could accept a **minimum number of milliseconds**:

10-7-7

```
class myClass {  
  @debounce(300)  
  myExpensiveMethod: function() {  
    // lots of heavy lifting here  
  }  
}
```

In other words, **decorators are just a light syntax sugar**.

10-7-8

But since an Angular app consists mainly of **classes with core functionality sprinkled in**, then **decorators make a lot of sense**.

This is what a **Hello-World component looks like without them**:

10-7-9

```
AppComponent = Component({
  selector: 'my-app',
  template: '<h1>My First Angular App</h1>'
}).Class({
  constructor: function() {},
  // other model-specific stuff
});
```

And here it is in **using decorators** (through TypeScript):

10-7-10

```
@Component({
  selector: 'my-app',
  template: '<h1>My First Angular App</h1>'
})
class AppComponent {
  // other model-specific stuff
}
```

If you want to **dig deeper into decorators**, check out...

10-7-11

- The [decorator section](#) of the TypeScript handbook
- This [concise and clear explanation](#) with examples and interactive links

10-8. Miscellaneous

odds and ends

There's three more things worth mentioning:

10-8-1

- a** declaring variables with **let**
- b** declaring variables with **const**
- c** **template strings**

a Variables in JavaScript have **functional scope**.

10-8-2

Even if you declare them inside an **if-block** in the middle of a function, the variable is still **visible throughout the entire function**.

So when you write this...

10-8-3

```
function myFunc(arg,lib){  
  if (arg === 42){  
    var ret = lib.method() + 7;  
    return ret;  
  }  
  // do sth else  
}
```

...this is what (conceptually) happens:

10-8-4

```
function myFunc(arg,lib){  
  var ret;  
  if (arg === 42){  
    ret = lib.method() + 7;  
    return ret;  
  }  
  // do sth else  
}
```

In other words, the **declaration is hoisted to the top**.

This is generally considered a **design mistake**, and can give rise to **weird bugs**.

10-8-5

ES6 therefore introduces **let** as an alternative to **var** for declaring variables, and the **only difference** is that **let has block scope**.

b In most languages there's a way to **define constants**, meaning a **variable that cannot change**.

10-8-6

This is **missing from JavaScript**.

A common "hack" is to **name constants in all capitals**:

10-8-7

```
var SOME_CONST = 42;
```

But this has **no technical significance**, it is just a hint.

ES6 therefore introduces **const** as another alternative to **var**, and the **only difference** is that you **cannot reassign** the value.

10-8-8

```
const answer = 42;
answer = 43; // throws an error
```

c Finally, **template strings!**

10-8-9

```
let userTempl = `
  First name: ${user.fname}
  Last name: ${user.lname}
`;
```

As you saw, template strings...

10-8-10

- are **defined inside two backticks**
- can **contain linebreaks**
- allow **interpolation inside \${}**

There's also a **semi-secret way to invoke functions with templates**.

10-8-11

Here's an example from [Choo](#):

```
html`  
  <main class="app">  
    Count: ${state.counter.count}  
    <button onclick={() => send('counter:increment')}>+</button>  
  </main>`
```

The **html** function is invoked with the templates and interpolated values.

10-9. Trying it out

Toe into the water

As a light-weight exercise during the upcoming break, let's try some of the ES6 stuff out!

10-9-1

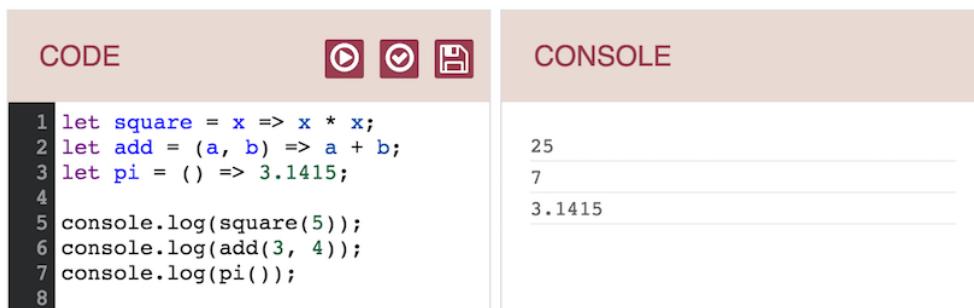
We'll do this in two different parts:

10-9-2

- a writing and running ES6 code
- b checking how it translates to ES5

- a An easy way to run ES6 code is by using es6fiddle.net. Write ES6 code in the left column, and see the output to the right.

10-9-3



The screenshot shows a split-screen interface. The left side is labeled 'CODE' and contains the following ES6 code:

```
1 let square = x => x * x;
2 let add = (a, b) => a + b;
3 let pi = () => 3.1415;
4
5 console.log(square(5));
6 console.log(add(3, 4));
7 console.log(pi());
```

The right side is labeled 'CONSOLE' and shows the output of the code:

```
25
7
3.1415
```

Through a dropdown you can access a number of ready-made examples which are a good starting point for experimenting.

10-9-4

If you have a modern version of Chrome you can also run ES2015 code in the console!

10-9-5



The screenshot shows the Chrome DevTools Console tab. The tab bar includes 'Elements', 'Console' (which is selected), and 'Sources'. Below the tab bar are controls for clearing the log, selecting the log level (top), and a 'Preserve log' checkbox. The console output shows the execution of an array map operation:

```
> [1,2,3].map(e => e*3)
< [3, 6, 9]
> |
```

- b To see the ES5 equivalent, we'll use babeljs.io/repl. The right column here shows ES5 translation instead of output.

10-9-6

```
1 const add = (a, b) => a + b;
2 let nums = [5, 4];
3 console.log(add(...nums));|
```

```
1 "use strict";
2
3 var add = function add(a, b) {
4   return a + b;
5 }
6 var nums = [5, 4];
7 console.log(add.apply(undefined, nums));
```

A good way to get started is to **copy the ES6fiddle examples** and **see what they translate to!**

10-9-7

Appendix: NgModules

fitting the pieces together

Sections in this chapter:

1. Introducing NgModule
2. Module scoping
3. Module motivation
4. Root module
5. AoT vs JIT

11-1. Introducing NgModule

or package or barrel or glob or

When AngularJS came out, there was **no native module solution** for JavaScript.

11-1-1

AngularJS therefore **included a module system as part of the framework**.

Initially this was seen as a **big advantage** of AngularJS.

11-1-2

But **after ES6 introduced native modules**, having to work with the AngularJS modules **felt stale and limited**.

That's just **one of many examples** of how time ran away from AngularJS.

11-1-8

Which is also the motivation behind the new Angular: **keep the good ideas but take advantage of modern features**.

So in Angular we expected to **use native modules**, and not having to deal with a parallel homebrew solution.

11-1-4

And, indeed, **this was the case...**

...until one of the last release candidates, which introduced **NgModules**.

11-1-5

Now, suddenly, we would **modularise our code using ES6 modules** as usual, but that code was in turn **split into NgModules**.

And, of course, this is **exactly the kind of thing we wanted to get away from!**

11-1-6

Unsurprisingly this addition was **heavily critisized**, both for **coming so late** and for being a

11-1-7

solution in search of a problem

Q But, so, **why did they do it?**

11-1-8

A Many reasons! However, before we delve into that we'll first take a look at **how NgModules work!**

11-1-9

11-2. Module scoping

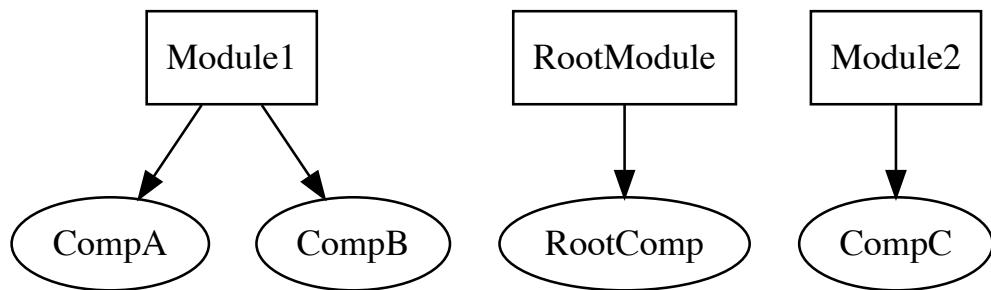
lines of sight

An **NgModule**, similar to modules in AngularJS, is mainly a **scoped container for application parts**.

11-2-1

Let's say we have these **three NgModules**:

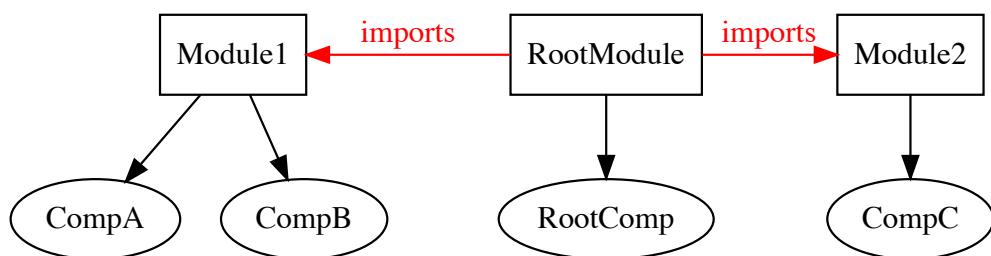
11-2-2



- **Module1** defines CompA and CompB
- **Module2** defines CompC
- **RootModule** defines RootComp

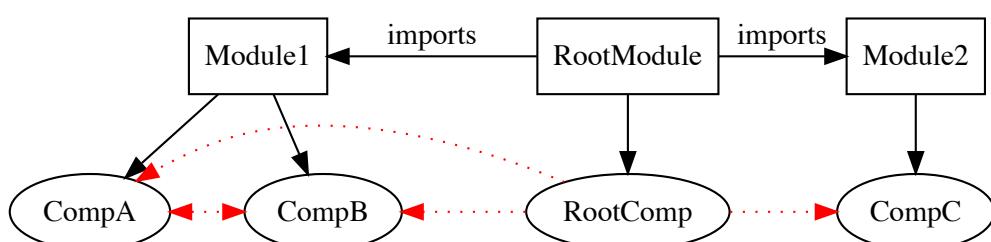
Now, if **RootModule** imports the other two:

11-2-3



...then the **lines of sight** will be:

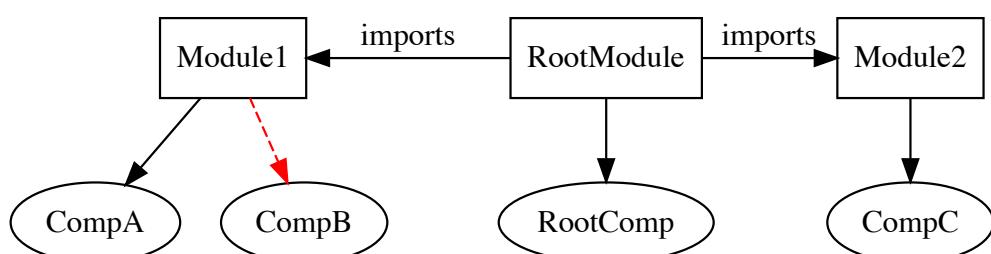
11-2-4



- **RootComp** can use everything
- **CompA** and **CompB** can use each other
- **CompC** can't use any other component

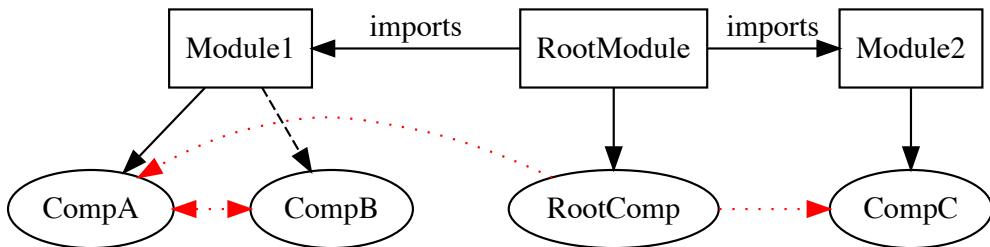
But if **CompB** isn't exported:

11-2-5



...then the **lines of sight** become:

11-2-6



- **RootComp** can use **CompA** and **CompC**
- **CompA** and **CompB** can use each other
- **CompC** can't use any other component

Here's the code for **Module1** in the final version of the example:

11-2-7

```
@NgModule({  
  exports: [ CompA ],  
  declarations: [ CompA, CompB ]  
})  
class Module1 {}
```

Note how **only CompA is exported**.

And for completion, here's **Module2**:

11-2-8

```
@NgModule({  
  exports: [ CompC ],  
  declarations: [ CompC ]  
})  
class Module2 {}
```

...and **RootModule**:

11-2-9

```
@NgModule({  
  imports: [ Module1, Module2 ],  
  declarations: [ RootComp ],  
  bootstrap: [ RootComp ]  
})  
class RootModule {}
```

We could summarize the sight rules like this -

11-2-10

A component can see:

- all other components defined in the same module
- all exported components in imported modules

Although we've just talked about components, the **same thing applies to Directives and Pipes.**

11-2-11

Q Wait - what's the point of defining but not exporting something?

11-2-12

A Likely what you're not exporting is an **implementation detail of something you ARE exporting.**

11-2-13

In our example, **CompB** is probably used by **CompA**, but wouldn't make sense to use on its own or anywhere else.

Q Also - what if we are creating a 3rd party **library of components**? Won't it be a **headache for the root module to export all components?**

11-2-14

A It would be, if not for the fact that we can **export modules**. So the **root module** of such a library would **look like this**:

```
@NgModule({
  imports: [ Module1, Module2, Module3, ... ],
  exports: [ Module1, Module2, Module3, ... ]
})
class RootModule {}
```

Q And, why are **modules classes** anyway? Would we **ever write something inside the class declaration** for an **NgModule**?

11-2-16

A No, we never would. They likely went with that just to have a **consistent look with how other application parts are defined**, that is, **class declarations with decorated metadata**.

11-2-17

11-3. Module motivation

Digging into the why

Before **NgModules** were added to Angular, **components could declare dependencies**:

```
@Component({  
  directives: [ComponentB],  
  template: '...'  
})  
class ComponentA {...}
```

Now **ComponentA** could use **ComponentB** in its template.

With the introduction of **NgModule**, **this API was deprecated**. Now all **components must belong to an NgModule**, and **only NgModule scope allows access**.

11-3-1

11-3-2

11-3-3

11-3-4

11-3-5

11-3-6

Q This seems **more cumbersome** in every way. Why did they make this change?

A There are **many different reasons**.

And note that since **they knew there would be backlash**, they likely thought this through more than once.

Let's go over **three of the reasons** behind **NgModule**:

- a** a tool for you to **modularise your codebase**
- b** **scope** **selectors** to lessen risk of clash
- c** allow easier **static dependency analysis** when the templates are compiled

a NgModules are an **Angular-specific way to organise your code**, often in a thematic way.

For example, a forum app might consist of a **ThreadModule**, a **FrontpageModule** and an **AdminModule**, which are then all brought in by a root **AppModule**.

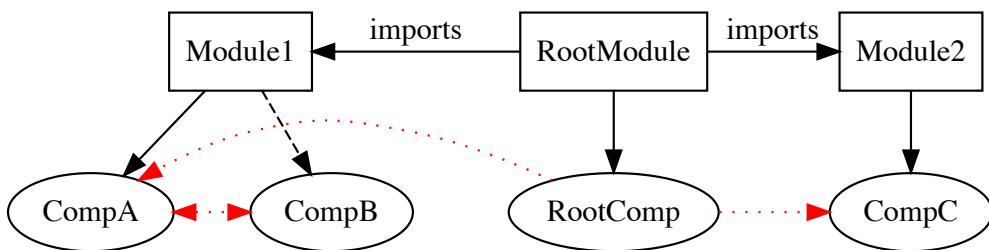
11-3-7

b Also, **NgModules** reduce risk of selector clashes. If two components have the same selector, that works fine as long as you cannot see both of them.

11-3-8

Q Returning to the scoping example - what components could safely have the same selector?

11-3-9



A Only **CompB** and **CompC**, since no module sees both of them.

11-3-10

c The third and final reason: **NgModules** make static analysis easier, especially for AoT compilation.

11-3-11

More information [here](#).

Q The first reason seems really weak, and the second seems periferal. Is it fair to say that the third reason is the most important one?

11-3-12

A Yes, absolutely. It might seem not to matter for small / simple apps, but as soon as you

11-3-13

- scale up or do
- advanced bootstrapping or
- lazy loading,

...it becomes really important.

So, really, the Angular team deserves credit for making a necessary but tough decision that they knew would cause lots of backlash, and would only be understood by a minority.

11-3-14

11-4. Root module

Where it all begins

So, **Angular applications** are made up by **one or more NgModule:s**. 11-4-1

Of these, exactly 1 is a **root module**. Let's find out what those are!

As the name suggests, the root module is **the root of the application**. 11-4-2

More precisely, it's **the NgModule we bootstrap from**:

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

Usually this module is **called AppModule**, although the name has no technical meaning.

For a module to be boostrappable it must **say which component to bootstrap from**, so that's another trait of a root module. This is done in the **bootstrap** property: 11-4-3

```
@NgModule({
  imports:      [ BrowserModule ],
  declarations: [ AppComponent ],
  bootstrap:   [ AppComponent ] // <--- bootstrap comp!
})
class AppModule {}
```

The root module is also responsible for **importing global dependencies**. 11-4-4
If we're running in the browser we need **BrowserModule**, so that's another root module giveaway:

```
@NgModule({
  imports:      [ BrowserModule ], // <--- global browser stuff
  declarations: [ AppComponent ],
  bootstrap:   [ AppComponent ]
})
class AppModule {}
```

One the small scale of the demos and exercises in this course there really is no need for more modules beyond the root module, so we will simply let that one import and declare everything.

11-4-5

But in a larger app the scoping becomes important, and at that point you have to plan out what the **RootModule** should provide for the rest.

11-4-6

11-5. AoT vs JIT

Prebaked vs Made to order

We've already mentioned the **two options for template compilation** a few times:

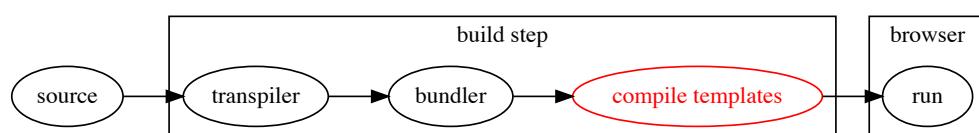
11-5-1

AoT **Compile Ahead of Time** in a build step

JiT **Compile Just in Time** in the browser

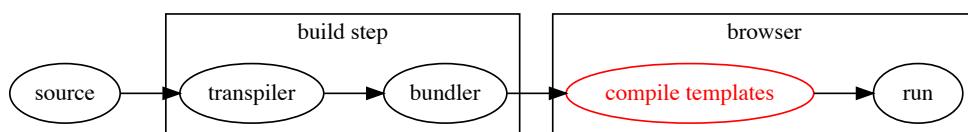
To revisit the infrastructure chain, we either do this (AoT):

11-5-2



...or this (JiT):

11-5-3



The **advantage of build-step compilation** is that we get a **smaller package**

11-5-4

The price for that advantage is **added build complexity**.

We'll now take a look at what the two approaches look like in practice!

AddSkills Umeå, 8 jan 2018

11-5-5

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We have **already been doing** JIT in previous examples:

11-5-6

```
import AppModule from './main.ts';
platformBrowserDynamic().bootstrapModule(AppModule);
```

Inside the **bootstrapModule** code, the **template compilation** is taken care of.

Look again at our JIT setup:

11-5-7

```
import AppModule from './main.ts';
platformBrowserDynamic().bootstrapModule(AppModule);
```

In AoT, that would become the following:

```
import AppModuleNgFactory from './main.ngfactory';
platformBrowser().bootstrapModuleFactory(AppModuleNgFactory);
```

The **main.ngfactory** file is created by the **ngc** command line tool, which lives in the **@angular/compiler-cli** package.

11-5-8

See more details in the [official Ahead-of-Time compilation guide!](#)

Appendix: Directives

From molecules to atoms

This appendix chapter takes a **closer look at directives** - what kinds are there, and **how do we make our own?**

Sections in this chapter:

1. Node manipulation
2. Server safety
3. Consorting with the host
4. Case study - host
5. Structure directives

12-1. Node manipulation

regaining control

So - directives! We've seen that there are **three different kinds**:

12-1-1

- **Components** who have their own template
- **Structure directives** who also change the HTML structure
- regular **Directives** who just manipulate the element they're attached to

Most of the **built-in directives** we've been using, except for the *-prefixed `ngIf` and `ngFor`, belong to the latter **category**.

12-1-2

Let's now talk about **custom directives** in that category, starting with: **what's the point?**

A big **reason for using a framework** is to not having to deal with the **DOM**. And indeed, with Angular, you don't have to.

12-1-3

But **sometimes you need to!** How, then, do we **take back control** from Angular?

A **common scenario** is that we want to use **some other library** that needs DOM access. For instance, we might have a **jQuery plugin** that we want to attach to an element.

12-1-4

So, how do we go about getting a **reference to an element**?

The key is the **built-in dependency** called **ElementRef**. If we define our **@Directive**'s class constructor like this...

```
constructor(public myElement: ElementRef){}
```

...we can access that reference elsewhere:

```
someClickHandler(){
  // do stuff with this.myElement.nativeElement
}
```

Alternatively, if it is a one-off mutation, **do it straight in the constructor**:

```
constructor(public myElement: ElementRef){
  this.myElement.nativeElement.doSomethingUseful();
}
```

Note that this is **safe if we're in a directive**, while a **component should use a lifecycle hook** to ensure we have been rendered.

12-1-5

For an example that **uses this technique to wrap a jQuery plugin**, check out the [Element manipulation](#) demo.

12-1-6

Or - another common example - **setting autofocus to an element** which you can see in the [Autofocus](#) demo.

12-1-7

12-2. Server safety

Cut the cord to the DOM

The **autofocus** demo we saw earlier was implemented like this:

12-2-1

```
class Focus {  
  constructor(public elRef: ElementRef) {}  
  ngOnInit() {  
    this.elRef.nativeElement.focus()  
  }  
}
```

There is **one big drawback** with that code; what happens if we attempt to render this app on the server?

12-2-2

There **won't be a DOM node**, so presumably things will go boom.

The solution is to **communicate intent** of node manipulation instead of actually performing it.

12-2-3

That way, **if we're on the server**, those **intents** can simply be ignored.

We accomplish this by using the **Renderer** as proxy:

12-2-4

```
class Focus {  
  constructor(public rndr: Renderer, public elRef: ElementRef) {}  
  ngOnInit() {  
    this.rndr.invokeElementMethod(  
      this.elRef.nativeElement, 'focus', []  
    );  
  }  
}
```



Wait - why is this:

12-2-5

```
this.rndr.invokeElementMethod(  
  this.elRef.nativeElement, 'focus', []  
)
```

...so much better than this?

```
this.elRef.nativeElement.focus()
```



Since the **Renderer** is injected, we can have a **special server version** which simply **doesn't do anything** in **invokeElementMethod**.

12-2-6

```
this.elRef.nativeElement.focus()
```

...we would have to make **mock elements** to prevent errors, which would be **much more complicated**.

12-3. Consorting with the host

let me count the ways

We're now going to look at **three ways to interact with the host element**:

- a Referencing the element
- b Listening to events
- c Binding to properties

- a First off, by **asking for an ElementRef in the constructor** we can get a reference to the host element:

```
class {
  constructor(private el: ElementRef){}
  /* rest of the code can access `this.el` */
}
```

On `this.el` we find the **nativeElement** property which points to the actual DOM node.

- b So just saw how we can use **ElementRef** to **access the parent node to which the directive is attached**.

Theoretically, that's all we need to do whatever we want, including **attaching eventhandlers**.

Here's what that could look like when **using the reference**:

12-3-5

```
class {
  constructor(private el: ElementRef){}
  handleClick() { /* do something */ }
  ngOnInit() {
    this.el.nativeElement.addEventListener(
      'click', this.handleClick
    )
  }
}
```

...but reverting to the **regular DOM API** like this feels very **primitive**!

Angular therefore offers a shorthand through the **HostListener** decorator:

12-3-6

```
class {
  @HostListener('click') handleClick() { /* do something */ }
}
```

C Similarly, using the ref to **control host properties** would be convoluted:

12-3-7

```
class {
  constructor(private el: ElementRef){}
  active: boolean
  updateHost() {
    let method = this.active ? 'add' : 'remove';
    this.el.nativeElement.classList[method]('highlighted')
  }
  /* and some code to update `active` */
}
```

Therefore there is a powerful shorthand to **bind to host properties**:

12-3-8

```
class {
  @HostBinding('class.highlighted') active: boolean
  /* and some code to update `active` */
}
```

Much slicker, and again, note how **no reference is needed**!

12-4. Case study - host

Putting the host to the test

To internalise what we just walked through, lets **convert a component to use these APIs!**

12-4-1

Here's the **template**:

12-4-2

```
<div [class.highlighted]="flag" (click)="toggle">  
  someKindOfContent  
</div>
```

When **flag** is true the **highlighted** class is set.

Here's the **component** with the **event handler** and **state**:

12-4-3

```
class {  
  flag: boolean = false  
  toggle(){  
    this.flag = !this.flag;  
  }  
}
```

The **entire definition** (almost):

12-4-4

```
@Component({  
  template: `<div [class.highlighted]="flag" (click)="toggle">  
    someKindOfContent  
</div>`,  
  styles: ['.highlight {background-color: red;}']  
)  
class {  
  flag: boolean = false  
  toggle(){  
    this.flag = !this.flag;  
  }  
}
```

In essence; **clicking the component toggles the **highlighted** class.**

12-4-5

Now imagine that we have **many components** behave in the same way. Let's therefore **move the behaviour to a directive!**

We want to be able to use it like thus:

12-4-6

```
<div highlighttoggle>someKindOfContent</div>
```

That means we need **something like this**:

12-4-7

```
@Directive({ selector: '[highlighttoggle]' })
class {}
```

Our directive must **house the flag state** and **have a method to toggle it**:

12-4-8

```
@Directive({ selector: '[highlighttoggle]' })
class {
  flag: boolean = false
  toggle(){
    this.flag = !this.flag
  }
}
```

We make the method run whenever the host is clicked by adding the **HostListener** decorator:

12-4-9

```
@Directive({ selector: '[highlighttoggle]' })
class {
  flag: boolean = false
  @HostListener('click') toggle(){
    this.flag = !this.flag
  }
}
```

And finally bind the flag to the host class using **HostBinding**:

12-4-10

```
@Directive({ selector: '[highlighttoggle]' })
class {
  @HostBinding('class.highlighted') flag: boolean = false
  @HostListener('click') toggle(){
    this.flag = !this.flag
  }
}
```

Try this out in the [Highlighter Directive demo!](#)

12-5. Structure directives

Redrawing the map

Structure directives are a common label applied to directives that **change the template** of the elements they are attached to.

12-5-1

You've already seen **ngFor** and **ngIf**, two **built-in structure directives**.

12-5-2

Let's consider **what we would need** to implement such a directive!

12-5-3

- a we need the original template
- b we need the host container

(a) For example, in the case of **ngFor**, we must have a **reference to the host template** in order to be able to **repeat it once per item** in the list.

12-5-4

We achieve this through injecting a **TemplateRef** from `@angular/core`:

```
constructor(private templateRef: TemplateRef<any>)
```

(b) We also need a way to **communicate to the host view container** what we have decided that the content should be.

12-5-6

Again using **ngFor** as an example, when we have repeated the template once per item we need **somewhere to pass them off to**!

This is the role fulfilled by the **ViewContainerRef**, also injected from `@angular/core`:

12-5-7

```
constructor(private viewContainer: ViewContainerRef)
```

Now that we have the pieces, let's use them to **implement an `unless` directive!**

12-5-8

It should function as a **direct inverse to `ngIf`...**

```
<div *unless="flag">...</div>
```

...and **only show the content if the expression is false.**

Remember, the ***** is just a shorthand for the full template syntax:

12-5-9

```
<template unless="flag">
  <div>...</div>
</template>
```

Let's get started by **creating a Directive definition!**

12-5-10

```
@Directive({})
class UnlessDirective {}
```

We want our directive to be **applied to all elements with an `unless` attribute**, so we set up the corresponding **selector**:

12-5-11

```
@Directive({ selector: '[unless]' })
class UnlessDirective {}
```

Since we know we need the **template** and the **host view**, let's **inject both in the constructor**:

12-5-12

```
@Directive({ selector: '[unless]' })
class UnlessDirective {
  constructor(
    private templateRef: TemplateRef<any>,
    private viewContainer: ViewContainerRef
  ) { }
}
```

We also need to register the **unless** property as an input:

12-5-13

```
@Directive({ selector: '[unless]' })
class UnlessDirective {
  constructor( ... ) { }
  @Input() set unless(condition: boolean) {}
}
```

And, depending on the truthiness of the condition, we either want to display the template or simply display nothing:

12-5-14

```
@Input() set unless(condition: boolean) {
  if (!condition)
    // show the template as per normal
  else
    // show nothing!
}
```

We accomplish this through the **.createEmbeddedView** and **.clear** methods of **viewContainer**:

12-5-15

```
@Input() set unless(condition: boolean) {
  if (!condition)
    this.viewContainer.createEmbeddedView(this.templateRef);
  else
    this.viewContainer.clear();
}
```

Here's the **full code**:

12-5-16

```
@Directive({ selector: '[unless]' })
class UnlessDirective {
  constructor(
    private templateRef: TemplateRef<any>,
    private viewContainer: ViewContainerRef
  ) { }
  @Input() set unless(condition: boolean) {
    if (!condition)
      this.viewContainer.createEmbeddedView(this.templateRef);
    else
      this.viewContainer.clear();
  }
}
```

See this in action in the [Unless Directive demo!](#)

Appendix: various NG

Give me more, give me more

This appendix chapter collects **various specific API:s** in the Angular framework.

Sections in this chapter:

1. Pipes
2. Routing
3. Animations
4. Testing Angular

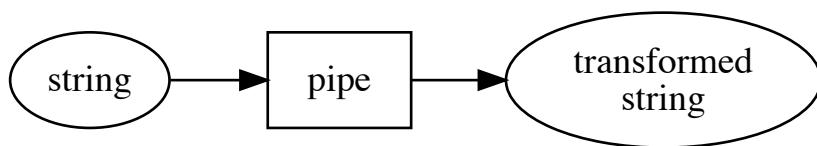
13-1. Pipes

a.k.a. filters

Pipes are primarily a way to **transform strings**, although they can also be used on other values.

13-1-1

In other words, a regular **pure function**!



AngularJS called them **filters**, but this was a bit **confusing** since

13-1-2

- they **didn't necessarily filter** anything
- there was a **filter named filter** :)

Angular has the **same special syntax** for pipes as AngularJS:

13-1-3

```
<p>The party is planned to be at {{partyDate | formatDate}}</p>
```

The bracket contents is **equivalent** to:

```
formatDate(partyDate)
```

When you want **arguments**, list them after **colons**:

13-1-4

```
The party is at {{partyDate | formatDate : 'dd/mm'}}
```

Now the brackets translate to:

```
formatDate(partyDate, 'dd/mm')
```

Q But, as we said, **pipes are just functions**. Was it really **necessary to invent this new syntax**?

13-1-5

A Perhaps not, but there are **two good reasons** for it!

13-1-6

First off, here we **know that formatDate is a Pipe**:

```
{{partyDate | formatDate : 'dd/mm'}}
```

While here it could be **any function** in the same scope:

```
formatDate(partyDate, 'dd/mm')
```

Secondly, we can **have many pipes**:

13-1-7

```
{{partyDate | formatDate : 'dd/mm' | frameWithNotes}}
```

which we have to **write in reverse order** in regular code:

```
frameWithNotes( formatDate(partyDate, 'dd/mm') )
```

To see a pipe in action and how they are registered, check out the [Pipe demo!](#)

13-1-8

There are of course a number of built-in pipes, such as **DatePipe**, **UpperCasePipe** and **CurrencyPipe** among others.

13-1-9

Note that you must import the NgModules they reside in to be able to use them!

The built-in **Async** pipe deserves a **special mention**, as it can be a **huge code saver** in the right circumstances.

13-1-10

Check it out in the [Async Pipe](#) demo.

Notable **omissions** among the built-in pipes are equivalents to **filter** and **orderBy** from AngularJS.

13-1-11

Find out exactly why they were omitted in the [Filter omission explanation](#) in the official docs.

A final note: by default pipes are **pure**, meaning they are **only applied when a change to the input is detected**.

13-1-12

But sometimes you might need the pipe to **always be applied on every rerender**. If so, set pure to false:

```
@Pipe({  
  name: 'myPipe',  
  pure: false  
})
```

13-2. Routing

Finding the way

Before we say anything, a word of warning - the **Angular router** has **received many makeovers**, so make sure any online material is up to date, otherwise you risk being severely confused.

13-2-1

Also, there are whispers that the great reception of the **recent overhaul of the React Router** might cause even further changes, so, **don't get too attached to the API!**

13-2-2

Partly because of this we **won't dig too deep into the router in this course**, but we still want you to **get a sense for how it is working**.

13-2-3

So now we'll **walk through the basic functionality** which **covers the vast majority of use cases**.

Here's **what we'll cover**:

13-2-4

- a routes definition
- b installing the routes
- c select strategy
- d providing an outlet
- e navigating
- f parameters

a Here's a **simple routes definition example**:

13-2-5

```
const routes = [
  {path: '/', component: HomeComponent},
  {path: 'product/:tool', component: ProductComponent}
]
```

As you can see we are **connecting paths to components**.

The syntax might **seem verbose**, but the reason for having an array of objects is to accommodate **lots of other functionality** - child routes, extra settings, data, etc.

13-2-6

- b** We make our app use the routes by importing the result of feeding routes to a **RouterModule** method:

```
@NgModule({  
  imports: [ BrowserModule, RouterModule.forRoot(routes) ],  
  ...  
})
```

Now we're navigating from the root, but we could also use routes from a child component.

- c** When we make a SPA, by definition, we don't want the browser to reload between pages. Yet we still want the user to be able to use browser controls!

We must therefore employ some kind of strategy that marries internal navigation with the browser address bar.

There are primarily three ways to handle navigation in a SPA:

pushState Makes the URL look "real"
hash navigation Using the trailing #something part of the URL
in memory Means browser controls won't work
Of course there are lots more details that we're skipping over here.

We select strategy by registering the corresponding provider in the route-providing module:

```
@NgModule({  
  imports: [ BrowserModule, RouterModule.forRoot(routes) ],  
  providers: [  
    {provide: LocationStrategy, useClass: HashLocationStrategy}  
  ],  
  ...  
})
```

The router will then handle navigation accordingly.

d

Obviously we must also **render the matched component somewhere!**
The Router does this through the **ng-output** directive, meaning the **root component template** can look something like this:

```
<h1>My amazing app</h1>
<router-outlet></router-outlet>
<footer>© Edument 2016 → end of time</footer>
```

Effectively functioning as a **master template!**

13-2-11

e

There are **two ways to navigate;**

13-2-12

- either **programmatically** or through
- **normal anchor elements.**

To **navigate programmatically** we **inject the router** and call its **navigate** method:

13-2-13

```
class MyComponent {
  constructor(private router: Router){}
  someEventHandler(){
    this.router.navigate([someUrl, scndPartOfUrl]);
  }
}
```

Like earlier, the seemingly **verbose syntax** is there to accomodate a **complex API!**

We can also **navigate by anchor elements**, but that entails using the **routerLink** directive instead of the normal **href** attribute:

13-2-14

```
<a [routerLink]="/heroes/batman">Batman</a>
```

The directive also contains ways to **add CSS classes to active links**, etc.

f

Finally, a word about **parameters**! Maybe you spotted them in the routes example earlier?

13-2-15

```
const routes = [
  {path: '', component: HomeComponent},
  {path: 'product/:tool', component: ProductComponent}
]
```

As in so many other routing solutions, **parameters are defined by colon prefixes**.

We access the current parameters by injecting the **ActivatedRoute** service:

13-2-16

```
class UserComponent {
  userId: string
  constructor(route: ActivatedRoute){
    this.userId = route.snapshot.params['user']
  }
}
```

We covered a lot of ground, but left many details unsaid. Still, what you saw is the gist of the gist.

13-2-17

Try it out in the [Router](#) demo, or [read more](#) in the [Router section](#) of the official docs.

13-3. Animations

marquees and blinks?

In **AngularJS**, animations were done through **framework-generated CSS classes** to which you would hook up **CSS transitions or keyframes**.

13-3-1

Angular, however, gives you a **completely different setup** where you get **full programmatic control!**

It builds on the foundation of [Web Animations](#), a new API for controlling animations from JS.

13-3-2

Since this is **still experimental**, we need a [polyfill](#) to make it work.

```
<script src="web-animations.min.js"></script>
```

There are two parts to animations; we **tag the elements we want to animate** using the animation-specific `@animName` syntax, **binding that to an expression**:

```
<div [@mode] = "styleMode">
```

Then we add a **corresponding animation definition** within the **animations array** of the metadata:

```
animations: [
  trigger('mode', [
    state('day', style(objWithStyles)),
    state('night', style(anotherObjWithStyles)),
    transition('* => *', animate('100ms ease-in')),
  ])
],
```

From that we can deduce that...

13-3-5

- we have **one trigger per `@animName`**
- the **possible values of the bound expression** translate to **different animation states**
- we **control how to transition between states**

Regarding **transitions**: in the example we used the **wildcard * syntax**...

13-3-6

```
transition('* => *', animate('100ms ease-in'))
```

...but we can be **more specific**:

```
transition('day => night', animate('100ms ease-in')),
transition('night => day', animate('300ms ease-out')),
```

Of course, it wouldn't be called animations if we didn't have the ability to define **keyframes**.

13-3-8

That is, **intermediate states** and not just the target state.

This is done by **passing keyframes to the `animate` method** instead of just a string:

```
transition('* => day', animate(300, keyframes([
  style({ backgroundColor: '#F57171', offset: 0.5}),
  style({ backgroundColor: '#DCEDF2', color: 'black', offset: 1 })
]))
```

Try this in the [Animation Keyframes](#) demo.

By the way, **where all the helper methods comes from?** Surprisingly, `@angular/core`!

```
import {
  Component, trigger, state, style, transition, animate
} from '@angular/core';
```

The API is **even more powerful** than we've showed here - see the [official guide](#) for more details.

13-3-10

Speaking of power - remember that **most animation needs** can be fulfilled with **dynamic classes and regular CSS**.

13-3-11

Normally we **don't need the animation API**.

But if you want to...

13-3-12

- **animate entering / leaving elements** (by using the magical "**void**" target state)
- have **dynamic props** in the animation

...then the **animate API is your friend!**

13-4. Testing Angular

TDD, BDD, FFS

We'll walk you through the basic flow for **unit testing Angular components**.

13-4-1

If you are not familiar with **unit tests** and **integration tests**, or testing at all, **now is the time to raise your hand and ask! :)**

Commonly people use **Jasmine** to write assertions in their Angular tests.

13-4-2

We have however strived to **focus solely on the Angular-specific parts**, so we won't go into detail on how to write assertions.

At the heart of Angular testing are the **testing utilities**:

13-4-3

```
import {  
  ComponentFixture, // interface for test components  
  TestBed // set up mock modules with custom dependencies  
} from '@angular/core/testing';  
import {  
  By // helper for querying template output  
} from '@angular/platform-browser';  
import {  
  DebugElement // interface for queried element  
} from '@angular/core';
```

We'll now work through a **common testing flow**:

13-4-4

- a **unit test setup**
- b **test module creation**
- c **create component instance**
- d **test template output**
- e **manipulate the instance**

a We start off our test by **creating variables** to hold...

13-4-5

- the **component fixture**
- the **component itself**

```
let fixture: ComponentFixture<MyComponent>;
let comp: MyComponent;
```

b Next we **spin up a testing module**:

13-4-6

```
TestBed.configureTestingModule({
  declarations: [ MyComponent ]
});
```

Here we would also put **mock providers**.

c We can now use the module to **instantiate the component**...

13-4-7

```
fixture = TestBed.createComponent(MyComponent);
```

...and **access the instance**:

13-4-8

```
comp = fixture.componentInstance;
```

With access to the instance we can **manipulate properties** and **call methods**, and do whatever assertions we want!

d If we want to **test the template output**, we'd use the **By** helper:

13-4-9

```
let elem:DebugElement = fixture.debugElement.query(
  By.css('.twain') // `By` can query through lots of means
);
```

We can now **do assertions on elem.nativeElement**.

e

To test the component we **manipulate the instance**. However, you have to **manually trigger the change cycle** after you manipulate something:

13-4-10

```
comp.someMethod();
fixture.detectChanges();
```

Now you can do your assertions.

Instead, if we want to, we can **configure the test module to detect changes automatically**:

13-4-11

```
TestBed.configureTestingModule({
  declarations: [ MyComponent ],
  providers: [
    { provide: ComponentFixtureAutoDetect, useValue: true }
  ]
})
```

...and that's pretty much **how you unit test Angular!**

13-4-12

We need to know about Jasmine (for writing assertions) and Karma (for running the tests) too, but that's a **story for another time**.

A final word regarding **E2E-tests** - the primary tool is **Protractor**. Yes, the **same as for AngularJS!**

13-4-13

However the **current support is flaky**, which is no surprise given how quickly Angular has changed.

External links

- 10-1-7 method shorthand syntax: https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Functions/Method_definitions
- 10-1-12 uniform access principle: https://en.wikipedia.org/wiki/Uniform_access_principle
- 10-2-1 Destructuring: https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Operators/Destructuring_assignment
- 10-5-4 export: <https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Statements/export>
- 10-5-4 import: <https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Statements/import>
- 10-7-1 annotations: <http://blog.thoughtram.io/angular/2015/05/03/the-difference-between-annotations-and-decorators.html>
- 10-7-1 disagreement: <https://github.com/wycats/javascript-decorators/issues/48>
- 10-7-1 implementation in TypeScript: <https://www.typescriptlang.org/docs/handbook/decorators.html>
- 10-7-1 proposal: <http://tc39.github.io/proposal-decorators/>
- 10-7-11 concise and clear explanation: <https://github.com/arolson101/typescript-decorators>
- 10-7-11 decorator section: <https://www.typescriptlang.org/docs/handbook/decorators.html>
- 10-8-11 Choo: <https://github.com/yoshuawuyts/choo>
- 10-9-3 es6fiddle.net: <http://es6fiddle.net/>
- 10-9-6 babeljs.io/repl: <https://babeljs.io/repl>
- 1-4-5 @angular: <https://www.npmjs.com/package/@angular/core>
- 1-4-5 angular: <https://www.npmjs.com/package/angular>
- 1-4-5 angular/angular: <https://github.com/angular/angular>
- 1-4-5 angular/angular.js: <https://github.com/angular/angular.js>
- 11-3-11 here: <https://github.com/angular/angular/issues/10552#issuecomment-241556913>
- 11-5-8 official Ahead-of-Time compilation guide: <https://angular.io/guide/aot-compiler>
- 13-1-11 Filter omission explanation: <https://angular.io/docs/ts/latest/guide/pipes.html#!#no-filter-pipe>
- 13-2-17 Router section: <https://angular.io/docs/ts/latest/guide/router.html>
- 13-3-2 Web Animations: <https://developer.mozilla.org/en-US/docs/Web/API/Animation>
- 13-3-2 polyfill: <https://www.npmjs.com/package/web-animations-js>
- 13-3-11 official guide: <https://angular.io/docs/ts/latest/guide/animations.html>
- 13-4-2 Jasmine: <http://jasmine.github.io/>
- 13-4-13 Protractor: <https://github.com/angular/protractor>
- 2-1-1 CoreJS: <https://www.npmjs.com/package/core-js>
- 2-2-1 CoffeeScript: <http://coffeescript.org>
- 2-2-1 TypeScript: <http://typescriptlang.org>
- 2-2-16 whole course just about TypeScript:
<https://edument.se/education/categories/webdevelopment/typescript>
- 2-3-1 ZoneJS: <https://github.com/angular/zone.js>
- 2-4-1 Reflect Metadata: <https://www.npmjs.com/package/reflect-metadata>
- 2-6-1 SystemJS: <https://github.com/systemjs/systemjs>
- 2-6-10 Quickstart: <https://angular.io/docs/ts/latest/quickstart.html>
- 3-2-5 Shadow DOM: https://developer.mozilla.org/en-US/docs/Web/Web_Components/Shadow_DOM
- 3-4-6 CoffeeScript: [http://coffeescript.org/](http://coffeescript.org)
- 4-2-9 Template statement: <https://angular.io/docs/ts/latest/guide/template-syntax.html#!#template-statements>
- 4-3-2 full list of methods: <https://angular.io/docs/ts/latest/guide/lifecycle-hooks.html>
- 4-5-3 Angular Augury: <https://augury.angular.io/>

5-1-4 Web Components: https://developer.mozilla.org/en-US/docs/Web/Web_Components

5-2-11 source code:

https://github.com/angular/angular/blob/2.0.2/modules/%40angular/common/src/directives/ng_if.ts#L9-L51

5-2-13 official API docs: <https://angular.io/docs/ts/latest/api/>

5-3-14 go look:

https://github.com/angular/angular/blob/2.0.2/modules/%40angular/forms/src/directives/ng_model.ts#L108

7-2-2 Forms section in the official docs: <https://angular.io/docs/ts/latest/guide/forms.html>

7-2-6 source code:

https://github.com/angular/angular/blob/2.0.2/modules/%40angular/forms/src/directives/ng_form.ts#L62

8-1-2 official docs: <https://angular.io/docs/ts/latest/>

8-1-3 API reference: <https://angular.io/docs/ts/latest/api/>

8-1-3 advanced: <https://angular.io/docs/ts/latest/guide/ngmodule.html>

8-1-3 cheat sheet: <https://angular.io/cheatsheet>

8-1-3 guides: <https://angular.io/docs/ts/latest/guide/>

8-1-4 Angular University: <http://blog.angular-university.io/>

8-1-4 Thoughtram Blog: <http://blog.thoughtram.io/>

8-1-5 Angular 2 development with TypeScript: <https://www.manning.com/books/angular-2-development-with-typescript>

8-1-5 Manning Publication: <https://www.manning.com/>

9-1-11 JavaScript Garden: <http://bonsaiden.github.io/JavaScript-Garden/>

9-1-11 MDN: <https://developer.mozilla.org/en-US/>

9-3-2 Node: <https://nodejs.org/en/>