IN4MATX 133: User Interface Software

Lecture:
Components in Angular

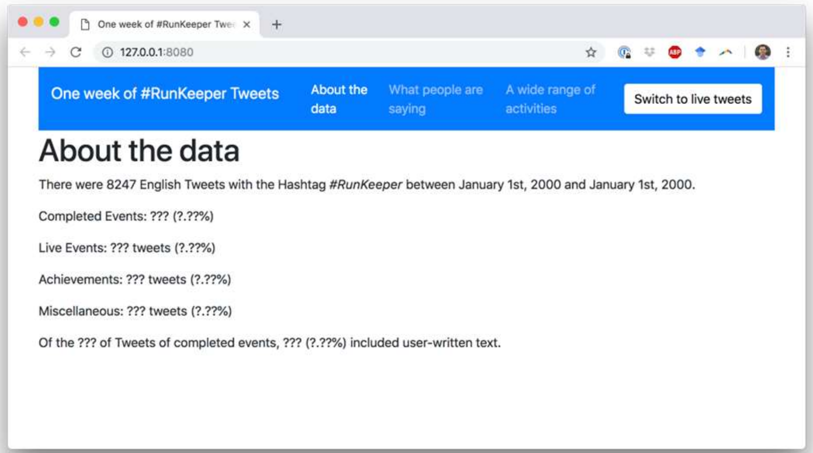
Goals for this lecture

By the end of this lecture, you should be able to…

- Explain a Model-View-Controller Architecture
  and how Angular implements the architecture
- Describe the role of an Angular component
- Implement an Angular component which follows the MVC architecture

A “small” client interface

- 3 pages
- No interactivity between pages
- Data is dynamic,
  but UI is fairly static
- A lot of computation behind each page, but each page was very self-contained


One week of #RunKeeper Twe
127.0.0.1:8080
One week of #RunKeeper Tweets
About the data
What people are saying
A wide range of activities
Switch to live tweets

About the data

There were 8247 English Tweets with the Hashtag *#RunKeeper* between January 1st, 2000 and January 1st, 2000.

Completed Events: ??? (?.??%)

Live Events: ??? tweets (?.??%)

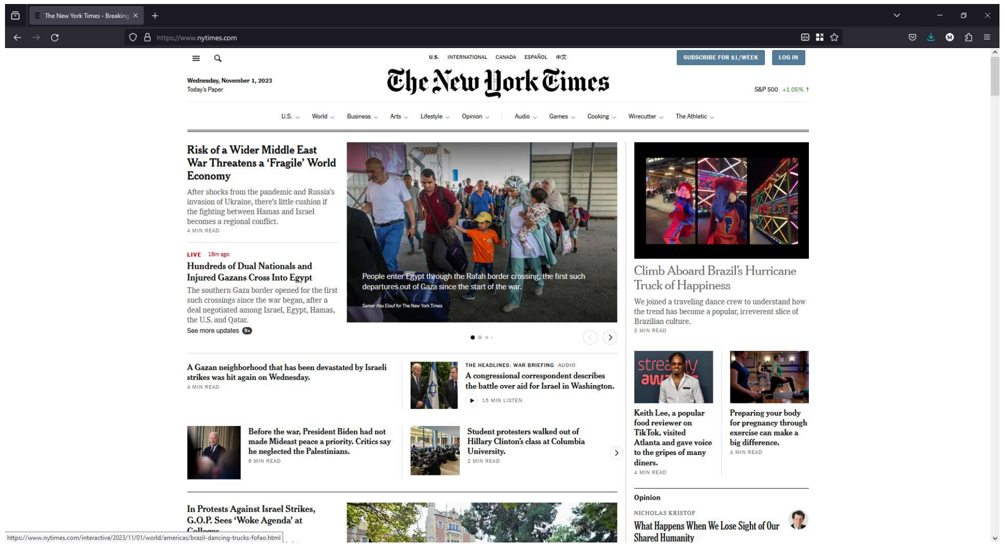
Achievements: ??? tweets (?.??%)

Miscellaneous: ??? tweets (?.??%)

Of the ??? of Tweets of completed events, ??? (?.??%) included user-written text.

A “large” client interface

- Hundreds of pages and ways to navigate between pages
- Repeated UI components (news updates)
- Different content, links, etc. displayed for each person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Wednesday, November 1, 2023
Today's Paper

Risk of a Wider Middle East War Threatens a ‘Fragile’ World Economy
After shocks from the pandemic and Russia’s invasion of Ukraine, there’s little cushion if the fighting between Hamas and Israel becomes a regional conflict.
4 MIN READ

LIVE 18m ago
Hundreds of Dual Nationals and Injured Gazans Cross Into Egypt
The southern Gaza border opened for the first such crossings since the war began, after a deal negotiated among Israel, Egypt, Hamas, the U.S. and Qatar.

People enter Egypt through the Rafah border crossing, the first such departures out of Gaza since the start of the war.
Samar Abu Elouf for The New York Times

Climb Aboard Brazil’s Hurricane Truck of Happiness
We joined a traveling dance crew to understand how the trend has become a popular, irreverent slice of Brazilian culture.
3 MIN READ

A Gazan neighborhood that has been devastated by Israeli strikes was hit again on Wednesday.
4 MIN READ

THE HEADLINES: WAR BRIEFING AUDIO
A congressional correspondent describes the battle over aid for Israel in Washington.
15 MIN LISTEN

Before the war, President Biden had not made Mideast peace a priority. Critics say he neglected the Palestinians.
6 MIN READ

Student protesters walked out of Hillary Clinton’s class at Columbia University.
2 MIN READ

Keith Lee, a popular food reviewer on TikTok, visited Atlanta and gave voice to the gripes of many diners.
4 MIN READ

Preparing your body for pregnancy through exercise can make a big difference.
4 MIN READ

In Protests Against Israel Strikes, G.O.P. Sees ‘Woke Agenda’ at Colleges

Opinion
NICHOLAS KRISTOF
What Happens When We Lose Sight of Our Shared Humanity

https://www.nytimes.com/interactive/2023/11/01/world/americas/brazil-dancing-trucks-fofao.html

How do we develop large client applications?

Frameworks for large clients

- Add structure and organization
- Make UI components reusable
- Support modularity
    - Import packages, UIs, etc. when needed

Frameworks for large clients

- Angular
- React
- Vue.js

- All support the same overall goal

Angular

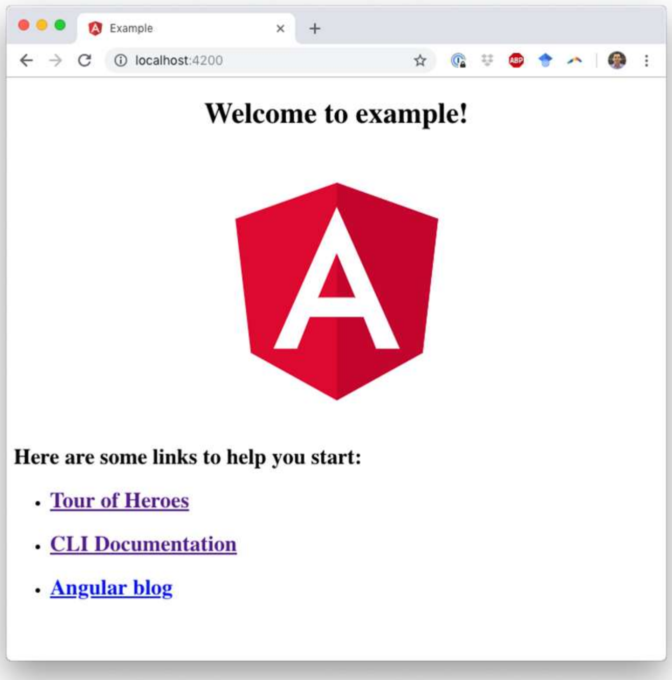
- First released in 2009
- Uses TypeScript, HTML, and CSS
- Does not dictate what framework is used server-side
- Last major release was version 16 in May 2023

Angular != AngularJS

- Major rewrite in 2016
  - Move to TypeScript from JavaScript
  - Not backwards-compatible
- Makes searching StackOverflow a bit of a pain
  - But the syntax maps over reasonably okay

Angular installation

- `npm install -g @angular/cli`
- Create a new app with name `example`
  - `ng new example`
- Run app
  - `cd example`
  - `ng serve (--open)`
  - (Runs on localhost:4200 by default)



Welcome to example!

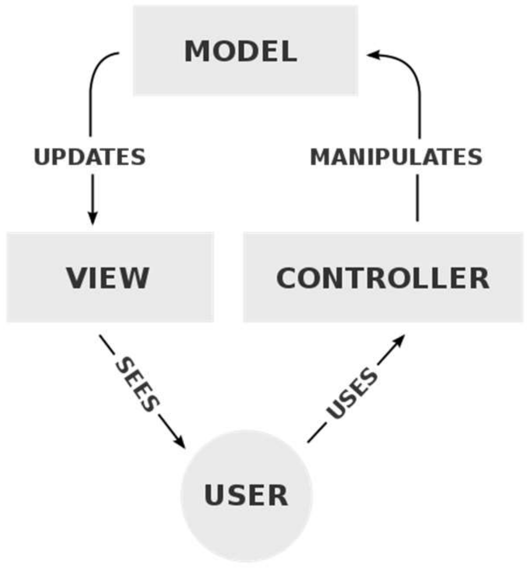
Here are some links to help you start:

- Tour of Heroes
- CLI Documentation
- Angular blog

Angular architecture

Model-View-Controller

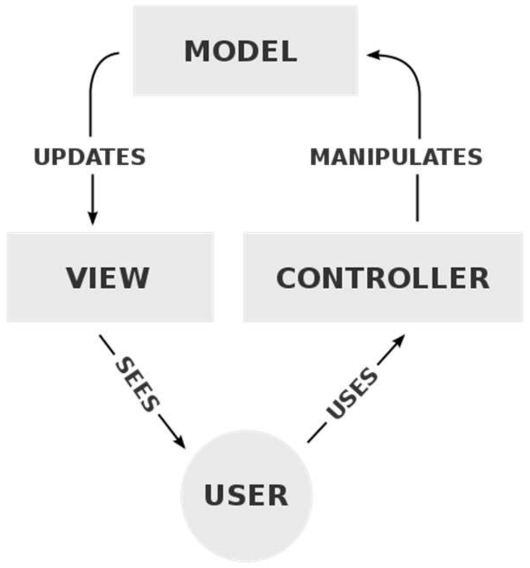
- Approach for structuring the code behind interfaces
- Model: the data behind an app
- View: the visual interface of an app
- Controller: the interaction with an app



https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

Model-View-Controller

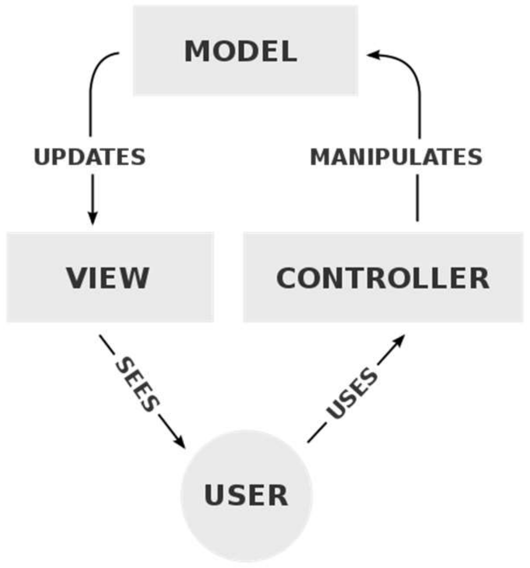
- Model: the data behind an app
  - Notifies views when it changes
  - Enables views to query the model for data
  - Allows the controller to manipulate data in the model



https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

Model-View-Controller

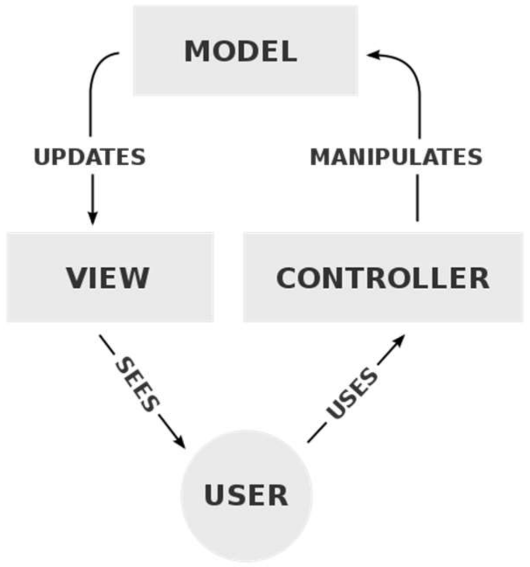
- View: the visual interface of an app
    - Renders the contents of the model
    - Specifies how the model data should be presented
    - When the model changes, the view must update it's presentation
    - "Push" approach: the view waits for change notifications (live updating feed)
    - "Pull" approach: the view must ask when it wants new data (pull to refresh)
    - Forwards input to the controller



https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

Model-View-Controller

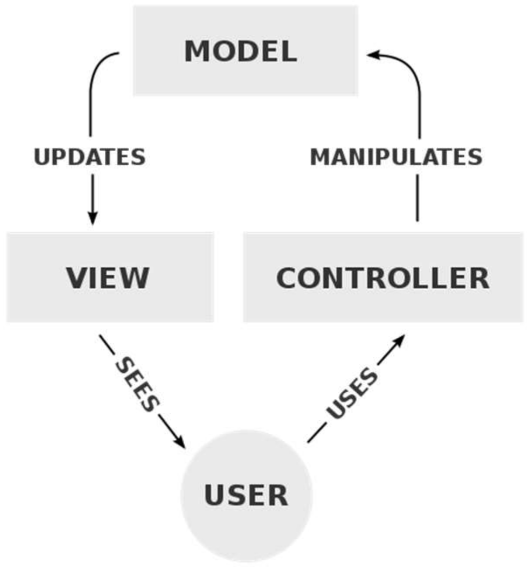
- Controller: the interaction with an app
  - Interprets user input and maps them to actions
  - Tells the model what actions to perform
  - Tells the view if page should be rendered differently



https://en.wikipedia.org/wiki/Model%E2%80%93view%E2%80%93controller

Model-View-Controller

- Model: JavaScript for loading, parsing, and manipulating data
- View: HTML and CSS to specify layout
- Controller: event handlers for buttons and inputs in JQuery



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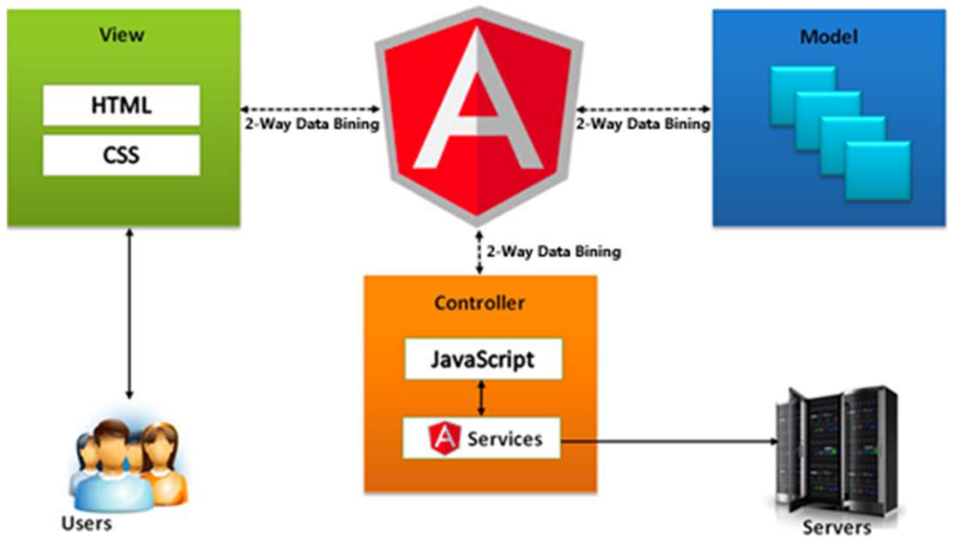
MVC in Angular

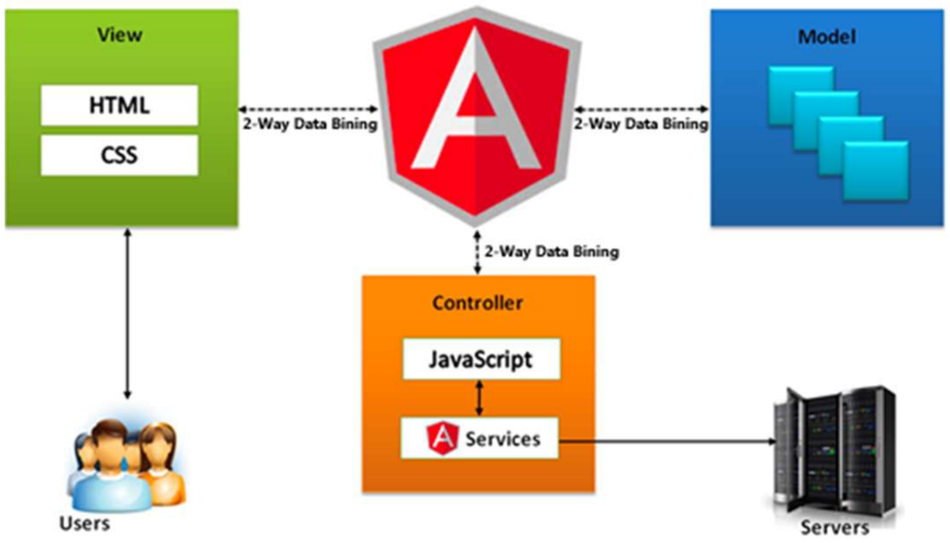
- View: HTML and CS
- Model & Controller: TypeScript
- Angular functionality serves as the glue between the three



https://codeburst.io/angularjs-4-101-6675076784aa

MVC in Angular

- **Binding**: key term
  - Variables in a view can be *bound* to variables and functions in a model or controller
  - When a variable in the *model* changes, any references to it in the *view* will also change ("push" model)
  - When a view receives input from a user, it passes it to controller bound for that input



https://codeburst.io/angularjs-4-101-6675076784aa

Following MVC in Angular

Angular components

- A component is an interface element
    - Usually larger than “a button”, but smaller than “a page”
    - Usually one which repeats across the interface

Angular components

- Component terms
  - template*:* the HTML file representing the view
  - style: the CSS file(s) which indicate how the component should be styled
  - selector: a CSS selector that Angular will use to all instances with this component

Angular components

- Defines the model, view, and controller for any interface element
- Make a new component: `ng generate component hello`
- Each component makes a folder consisting of four files:
  - `hello.component.css` (view)
  - `hello.component.html` (view)
  - `hello.component.spec.ts` (for automated testing; we'll mostly ignore)
  - `hello.component.ts` (model and controller)

Angular components

- Every app has at least one component
- “Root” component
  - By default, in `app.component.(html/css/ts/spec.ts)`
  - The “main” page in your app, essentially

Root template

app.component.html

```
<div style="text-align:center">
  <h1>
    Welcome to {{ title }}!
  </h1>
  <img width="300" alt="Angular Logo" src="data:image/...”>
</div>
<h2>Here are some links to help you start: </h2>
<ul>
  <li>
    <h2><a target="_blank" rel="noopener" href="https://angular.io/tutorial">Tour of Heroes</a></h2>
  </li>
  <li>
    <h2><a target="_blank" rel="noopener" href="https://github.com/angular/angular-cli/wiki">CLI
Documentation</a></h2>
  </li>
  <li>
    <h2><a target="_blank" rel="noopener" href="https://blog.angular.io/">Angular blog</a></h2>
  </li>
</ul>

<router-outlet></router-outlet>
```

Root template

app.component.html

- Looks like any other HTML page
- Only difference: page can support data binding

Root template

app.component.html

```
<div style="text-align:center">
  <h1>
    Welcome to {{ title }}!
  </h1>
  <img width="300" alt="Angular Logo" src="data:image/...">
</div>
<h2>Here are some links to help you start: </h2>
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  </li>
  <li>
    <h2><a target="_blank" rel="noopener" href="https://blog.angular.io/">Angular blog</a></h2>
  </li>
</ul>

<router-outlet></router-outlet>
```

⬅ Binds text to the variable `title`

Root component

app.component.ts

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

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

Import Angular component library

Designates class as a component

Replace all occurrences of `app-root` with this

Designate template

Designate style(s)

All code for the component

Root component and template

app.component.html

```html
<div style="text-align:center">
  <h1>
    Welcome to {{ title }}!
  </h1>
  <img width="300" alt="Angular Logo" src="data:image/...">
</div>
<h2>Here are some links to help you start: </h2>
<ul>
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  </li>
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  </li>
  <li>
    <h2><a target="_blank" rel="noopener"
href="https://blog.angular.io/">Angular blog</a></h2>
  </li>
</ul>

<router-outlet></router-outlet>
```

Bound to

app.component.ts

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

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

Four types of binding

- Interpolation: {{ }}
- Property: []
- Event: ( )
- Two-way: [( )]

https://angular.io/guide/template-syntax

Interpolation binding {{ }}

- “Weave calculated strings into the text between HTML element tags and within attribute assignments”

```
<h3>
  {{title}}
  <img src="{{heroImageUrl}}" style="height:30px">
</h3>
```

- Can also be used to calculate values

```
<!-- "The sum of 1 + 1 is 2" -->
<p>The sum of 1 + 1 is {{1 + 1}}</p>
```

https://angular.io/guide/template-syntax

Property binding [ ]

- “Set an element property to a component property value”

```
<img [src]="heroImageUrl">
```

https://angular.io/guide/template-syntax

Event binding ( )

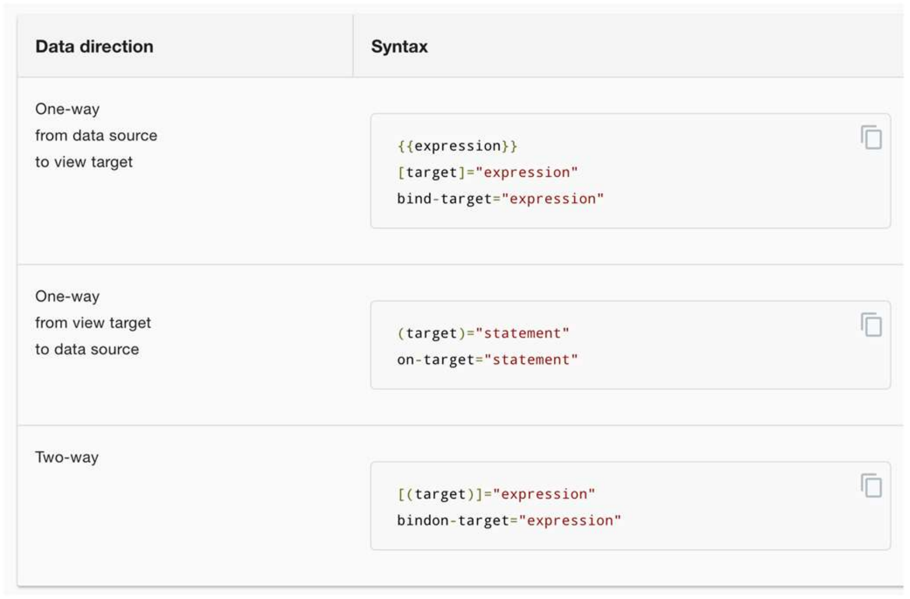
- “Listen for certain events such as keystrokes, mouse movements, clicks, and touches”

```
<!--When clicked, will run the onSave() function in
component.ts file-->
<button (click)=“onSave()">Save</button>
```

https://angular.io/guide/template-syntax

One-way binding

- Interpolation, property, and event are all one-way, or *read-only* binding
- For interpolation {{ }} and property [ ], binding goes from data source (.ts) to view target (.html)
- For event ( ), binding goes from view target (.html) to data source (.ts)



Data direction	Syntax
One-way from data source to view target	`{{expression}}` `[target]="expression"` `bind-target="expression"`
One-way from view target to data source	`(target)="statement"` `on-target="statement"`
Two-way	`[(target)]="expression"` `bindon-target="expression"`

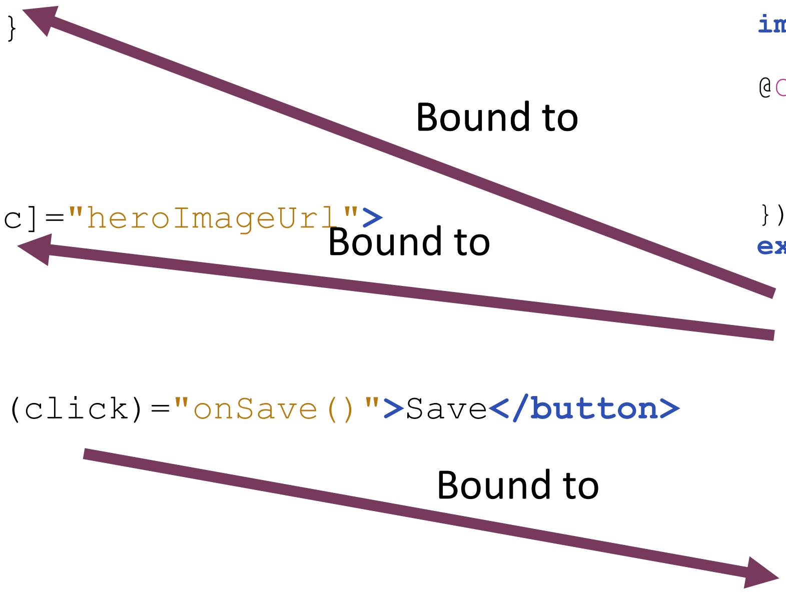
https://angular.io/guide/template-syntax

One-way binding

```
{{title}}


<img [src]="heroImageUrl">


<button (click)="onSave()">Save</button>
```



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

@Component({
  selector: 'app-hello',
  templateUrl: './hello.component.html',
  styleUrls: ['./hello.component.css']
})
export class HelloComponent implements OnInit {
  title = 'example';
  heroImageUrl = 'hero.jpg';

  constructor() { }

  ngOnInit() {
  }

  onSave() {
    console.log('File saved!');
  }

}
```

https://angular.io/guide/template-syntax

Two-way binding [( )]

- “You often want to both display a data property and update that property when the user makes changes”
- Most common use: binding to user-generated input
- ngModel directive enables two-way binding to input fields

```
<!--enteredText variable contains inputted text-->
<!--textChanged() is called after every keystroke-->
<input [(ngModel)]="enteredText" (change)="textChanged()">
```

https://angular.io/guide/template-syntax

Binding

```
<!--enteredText variable contains inputted text-->
<!--textChanged() is called after every keystroke-->
<input [(ngModel)]="enteredText" (change)="textChanged()">

<!--When clicked, will run the onSave() function in component.ts
file-->
<button (click)="onSave()">Save</button>

<h3>
  <!--will display the title-->
  {{title}}
  <!--will display the image at heroImageUrl-->
  <img [src]="heroImageUrl">
</h3>
```

Directives

*ngIf

- Render a tag if condition is true

```
<p *ngIf="isHalloween">
  Spooky!
</p>
```

- Can use ternary operator

```
<div [style.display]="isSpecial ? 'block' : 'none'">Show
with style</div>
```

Directives

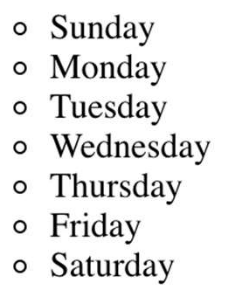
*ngFor

- Repeat an item multiple times

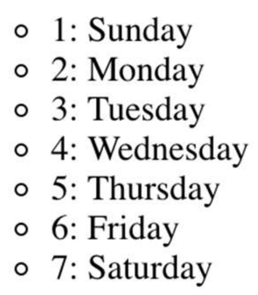
```
<ul>
  <li *ngFor="let day of days">
    {{day}}
  </li>
</ul>
```

- Can optionally specify index

```
<ul>
  <li *ngFor="let day of days; let i=index">
    {{i+1}}: {{day}}
  </li>
</ul>
```



```
◦ Sunday
◦ Monday
◦ Tuesday
◦ Wednesday
◦ Thursday
◦ Friday
◦ Saturday
```



```
◦ 1: Sunday
◦ 2: Monday
◦ 3: Tuesday
◦ 4: Wednesday
◦ 5: Thursday
◦ 6: Friday
◦ 7: Saturday
```

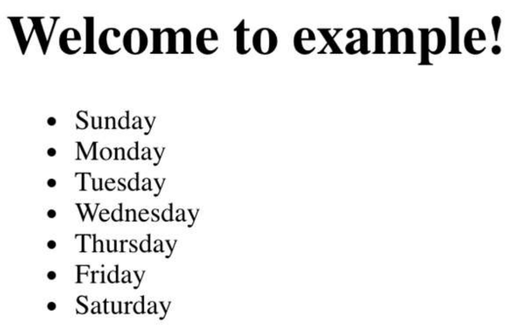
```
//In
component.ts
  days =
["Sunday",
"Monday",
"Tuesday",
"Wednesday",
"Thursday",
"Friday",
"Saturday"];
```

Using components

- Components can import other components
  - Follow the selector defined in the component's `.ts` file
- In app.component.html:

```
<div>
  <h1>
    Welcome to {{ title }}!
  </h1>
  <app-day></app-day>
</div>

<router-outlet></router-outlet>
```



Welcome to example!

- Sunday
- Monday
- Tuesday
- Wednesday
- Thursday
- Friday
- Saturday

Using components

- Components can specify inputs

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

@Component({
  selector: 'app-day',
  templateUrl: './day.component.html',
  styleUrls: ['./day.component.css']
})
export class DayComponent {
  @Input() today:string;

  days = ["Sunday", "Monday",
"Tuesday", "Wednesday", "Thursday",
"Friday", "Saturday"];

  constructor() { }
}
```

Input

```
<ul>
  <li *ngFor="let day of days">
    {{day}}
    <strong *ngIf="day == today">Today!</strong>
  </li>
</ul>
```

Input referenced in .html

Using components

- Inputs are then passed:
  - As properties if they're dynamic
  - Like any other attribute if they're static

```
<div>
  <h1>
    Welcome to {{ title }}!
  </h1>
  <app-day [today]="dayOfWeek"></app-day>
</div>
```

Sets `day` property
to `dayOfWeek` variable

```
<div>
  <h1>
    Welcome to {{ title }}!
  </h1>
  <app-day today="Friday"></app-day>
</div>
```

Sets `day` property
static value `Friday`

Using components

- Can also specify output properties

```
@Output('myClick') clicks = new EventEmitter<string>();
```

- When adding component, can specify an event to trigger when `clicks()` is called

```
<app-button (myClick)="clickMessage">click with myClick</app-button>
```

- The event will be triggered in the parent component

```
clickMessage() {
  console.log("clicked!");
}
```

onInit() vs Constructor

- Most components have both a constructor and an onInit() function
- Better to put any setup code in onInit() which occurs later

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

@Component({
  selector: 'app-hello',
  templateUrl: './hello.component.html',
  styleUrls: ['./hello.component.css']
})
export class HelloComponent implements OnInit {

  constructor() { }

  ngOnInit() {
  }
}
```

https://stackoverflow.com/questions/35763730/difference-between-constructor-and-ngoninit

Summary

- Angular is made up of components, which are UI elements which each follow a Model-View-Controller framework
  - `.html` and `.css` file define the view
  - `.ts` defines the model and controller
- Data moves between model and view through binding
  - Components can pass data by binding `Input`s and `Output`s
- Components can include other components
  - `*ngIf` and `*ngFor` help determine whether and how many components to create

Goals for this lecture

By the end of this lecture, you should be able to…

- Explain a Model-View-Controller Architecture and how Angular implements the architecture
- Describe the role of an Angular component
- Implement an Angular component which follows the MVC architecture