JavaScript Frameworks

Outline

- Node.js
- Angular

Node.js

1. Node.js is a JavaScript runtime built on **Chrome's V8 JavaScript engine**.

   https://v8.dev/

1. Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient.
2. Node.js allows the creation of Web servers and networking tools using JavaScript and a collection of "modules" that handle various core functionality.
3. Modules handle file system I/O, networking (DNS, HTTP, TCP, TLS/SSL, or UDP), binary data (buffers), cryptography functions, data streams and other core functions.

Basic functionality

HTTP

- To use the HTTP server and client one must **require('http').**
- The HTTP interfaces in Node.js are designed to support many features of the protocol which have been traditionally difficult to use. In particular, large, possibly chunk-encoded, messages. The interface is careful to never buffer entire requests or responses--the user is able to stream data.

http.createServer([requestListener])

- Returns a new instance of http.Server.
- The requestListener is a function which is automatically added to the 'request' event.

http.request(options[, callback])

- Node.js maintains several connections per server to make HTTP requests. This function allows one to transparently issue requests.
- options can be an object or a string. If options is a string, it is automatically parsed with url.parse().

http.get(options[, callback])

- Since most requests are GET requests without bodies, Node.js provides this convenience method. The only difference between this method and http.request() is that it sets the method to GET and calls req.end() automatically.

Basic functionality

File System

- File I/O is provided by simple wrappers around standard POSIX functions. To use this module do **require('fs')**. All the methods have asynchronous and synchronous forms..

fs.readFile(file[, options], callback)

- Asynchronously reads the entire contents of a file.
- The callback is passed two arguments (err, data), where data is the contents of the file.
- If no encoding is specified, then the raw buffer is returned.

fs.readFileSync(file[, options])

- Synchronous version of fs.readFile. Returns the contents of the file.
- If the encoding option is specified then this function returns a string. Otherwise it returns a buffer.

.

Basic functionality

Buffer

- Prior to the introduction of TypedArray in ECMAScript 2015 (ES6), the JavaScript language had no mechanism for reading or manipulating streams of binary data. The Buffer class was introduced as part of the Node.js API to make it possible to interact with octet streams in the context of things like TCP streams and file system operations.
- The Buffer class is a **global** within Node.js, making it unlikely that one would need to ever use require('buffer').

Buffers and Character Encodings

- Buffers are commonly used to represent sequences of encoded characters such as UTF8, UCS2, Base64 or even Hex-encoded data. It is possible to convert back and forth between Buffers and ordinary JavaScript string objects by using an explicit encoding method.

Example usage – Buffer Class

buffer.js:

```
const { Buffer } = require('buffer’);
const buf = Buffer.from('hello world', 'utf8’);
console.log(buf.toString('hex'));
// Prints: 68656c6c6f20776f726c64
console.log(buf.toString('base64'));
// Prints: aGVsbG8gd29ybGQ=
console.log(Buffer.from('fhqwhgads', 'utf8'));
// Prints: <Buffer 66 68 71 77 68 67 61 64 73>
console.log(Buffer.from('fhqwhgads', 'utf16le'));
// Prints: <Buffer 66 00 68 00 71 00 77 00 68 00 67 00 61 00 64 00 73 00>
```

Example usage – ‘fs’Read File

fs-readFile.js:

```
var fs = require('fs');
fs.readFile('./intro.txt', 'utf-8', function (err, data) {
  if (err) throw err;
  console.log(data);
});
```

intro.txt:

```
JsApp.US is a hosting platform for node.js  applications.
It is setup to be a platform to coddle to quick, weekend hack like projects.
```

Run command (may have to add ‘sudo’):

$ node fs-readFile.js

```
ubuntu@ip-172-31-12-48:~/nodejs$ nodejs fs-readFile.js
CSCI571 focuses on the phenomenon known as the World Wide Web (WWW or Web).
It's focus is to present many of the core technologies that the Web is based upon.
```

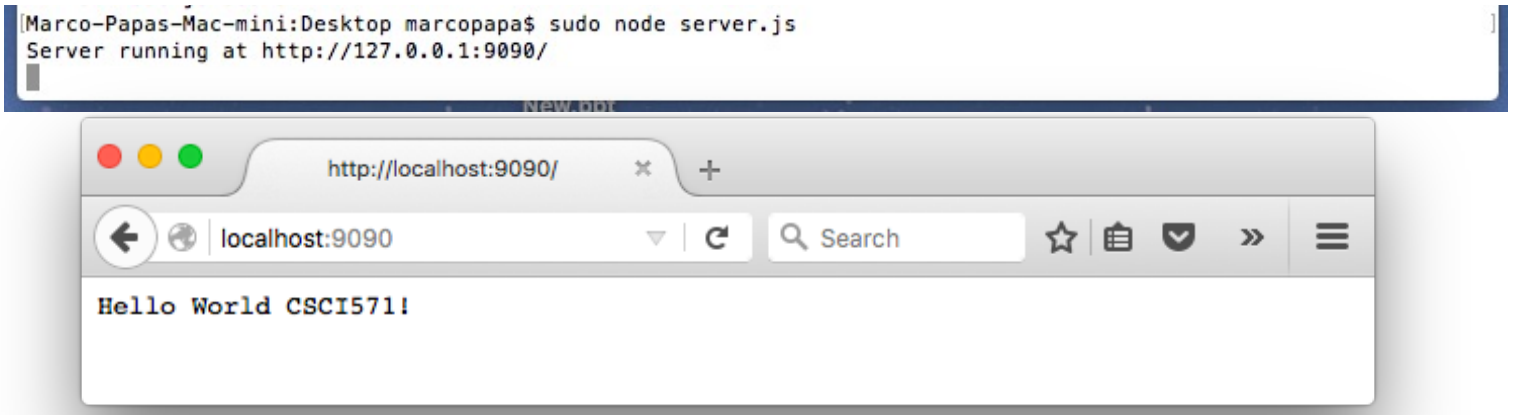
Example usage – ‘http’ Run Web Server

server.js:

```
const http = require('http');
http.createServer(function (req, res) {
  res.writeHead(200, { 'Content-Type': 'text/plain' });
  res.end('Hello World CSCI571!\n');
}).listen(9090, '127.0.0.1', function () {
  console.log(`Server running at http://localhost:9090/`);}););
```

Run command:

$ sudo node server.js



Node.js Modules

- **npm**: package manager for JavaScript.
  The **npm** command-line tool is bundled with Node.js. If you have it installed, then you already have **npm** too. (see https://www.npmjs.com)
- **nodemon**: monitor script for use during development of a Node.js app. Will watch files in the directory in which nodemon was started. If any files change, it will restart your node app. (see https://nodemon.io)
- **jshint**: a static analysis tool to detect errors and potential problems in JavaScript code and to enforce your team's coding conventions. (see http://jshint.com)

Node.js Modules (cont'd)

- **express**: a fast, minimalist web framework. It provides small, robust tooling for HTTP servers, making it a great solution for single page applications, web sites, hybrids, or public HTTP APIs. (see https://expressjs.com)
- **fastify**: a Node.js web framework (see https://fastify.dev)
- **hono**: ***[炎] means flame 🔥 in Japanese*** - is a small, simple, and ultrafast web framework for the Edges. It works on any JavaScript runtime: Cloudflare Workers, Fastly Compute, Deno, Bun, Vercel, Netlify, AWS Lambda, Lambda@Edge, and Node.js. Most popular. (see https://hono.dev)
- **ElysiaJS**: Elysia is an ergonomic web framework for building backend servers for Bun with JavaScript or TypeScript. (see https://elysiajs.com)

Node.js Modules (cont'd)

- **socket.io**: a Node.js real-time framework server. It enables real-time bidirectional event-based communication. (see https://socket.io/docs/)
- **cors**: a Node.js package for providing a Connect/Express middleware that can be used to enable CORS with various options. (see https://github.com/expressjs/cors)
- **body-parser**: body-parser extracts the entire body portion of an incoming request stream and exposes it on req.body as something easier to interface with. (see https://github.com/expressjs/body-parser)
- ~~**request**: simplified HTTP request client. Supports HTTPS. (see https://www.npmjs.com/package/request~~) Deprecated

Node.js Modules (cont'd)

- **xml2js**: a simple XML to JavaScript object converter. (see https://www.npmjs.com/package/xml2js)
- **async**: a utility module which provides straight-forward, powerful functions for working with asynchronous JavaScript. (see https://caolan.github.io/async/)
- **q**: a library for promises. A promise is an object that represents the return value or the thrown exception that the function may eventually provide. (see https://github.com/kriskowal/q)
- **underscore**: a JavaScript library that provides a whole set of useful functional programming helpers without extending any built-in objects. (see http://underscorejs.org)
- **socket.io**: a Node.js real-time framework server. It enables real-time bidirectional event-based communication. (see https://socket.io/docs/)
- **minimist**: a module used to parse command line arguments. (see https://www.npmjs.com/package/minimistx)

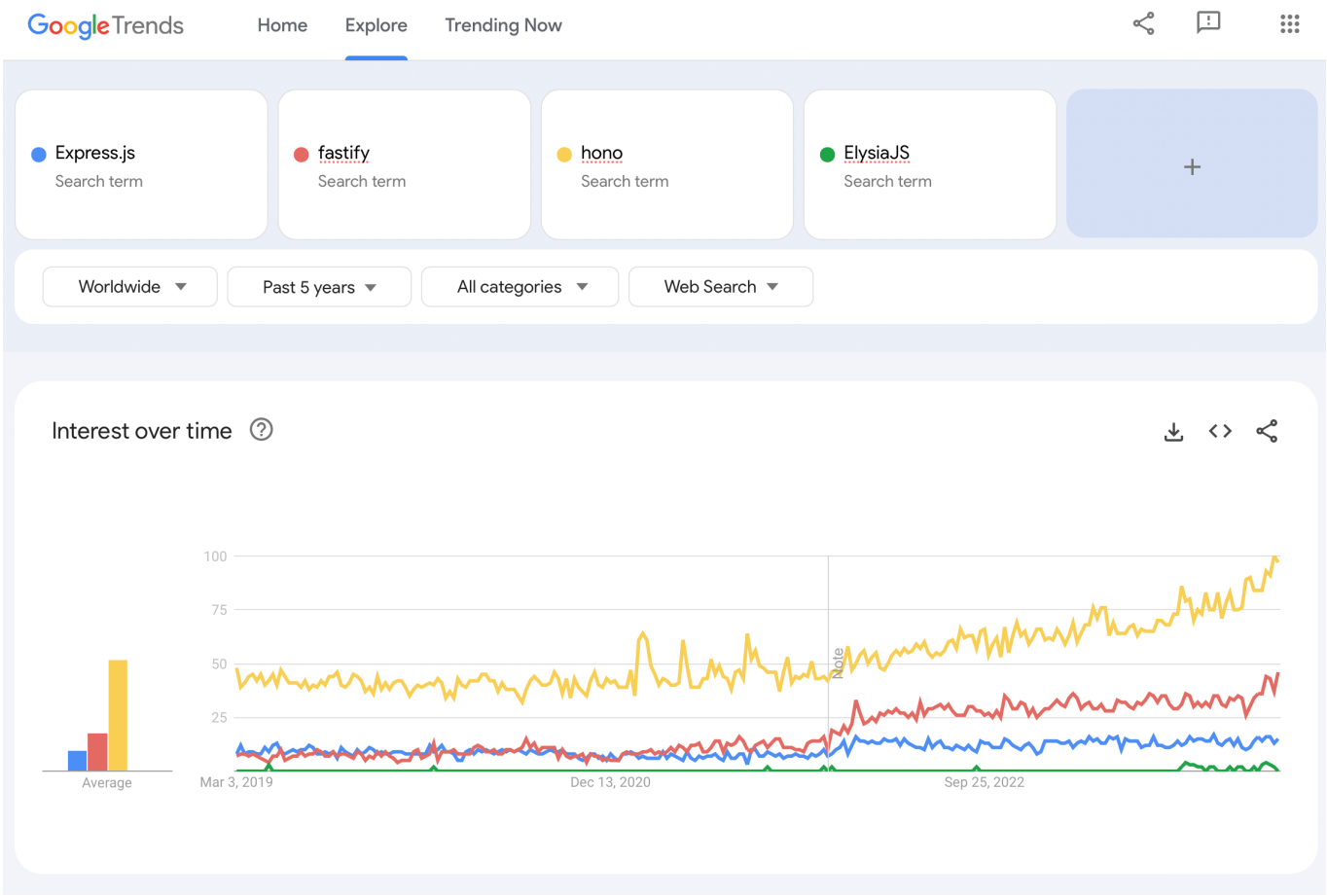
Node.js Modules (cont'd)

- **mocha**: a simple, flexible, fun JavaScript test framework for Node.js and the browser. (see https://mochajs.org)
- **http-server**: a simple, zero-configuration command-line http server. Powerful enough for production usage, but it's simple and hackable enough to be used for testing, local development, and learning. (see https://github.com/indexzero/http-server)
- **mongodb**: the official MongoDB driver for Node.js. It provides a high-level API on top of mongodb-core that is meant for end users. (see https://www.mongodb.com/docs/drivers/node/current/)
- **mongoose**: a MongoDB object modeling tool designed to work in an asynchronous environment. (see http://mongoosejs.com)

Node.js Modules (cont'd)

- **node-fetch**: a light-weight module that brings window.fetch to Node.js. Server version of client-side window.fetch compatible API (see https://www.npmjs.com/package/node-fetch)
- **axios**: a promise-based HTTP client for the browser and node.js. Make XMLHttpRequests from the browser. Make http requests from node.js. Supports the Promise API. (see https://www.npmjs.com/package/axios)
- **Hapi**: a powerful and robust framework that is used for developing APIs. It was first introduced by Eran Hammer 2011 at Walmart while trying to handle the traffic on black Friday.. (see https://hapi.dev/)
- **passport**: a unique authentication module for Node.js devs. Hundreds of authentication methods to choose from, starting from internal ones, all the way up to external ones like Google, Facebook, and others. (see https://github.com/jaredhanson/passport)

Node.js Web Frameworks Popularity



express Module Example

```
var express = require('express');
var app = express();

//respond with "hello world" when a GET request is made
to the homepage
app.get('/', function (req, res) {
  res.send('Hello World')
});

//server listening on port 3000
app.listen(3000);
```

cors Module Example

```
var express = require('express');
var cors = require('cors');
var app = express();

app.use(cors());

app.get('/products/:id', function (req, res, next) {
  res.json({msg: 'This is CORS-
enabled for all origins!'})
});

app.listen(80, function () {
  console.log('CORS-
enabled web server listening on port 80')
});
```

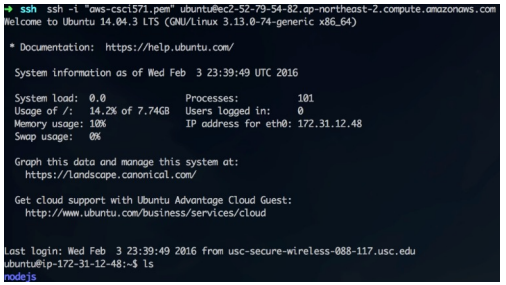
xml2js Module Example

```
var parseString = require('xml2js').parseString;
var xml = "<root>Hello xml2js!</root>”;

//”result” is the result of parsing xml
parseString(xml, function (err, result) {
    console.dir(result);
});
```

Node.js on AWS

- Create Ubuntu Micro EC32 instance
- ssh to the AWS ubuntu server
- Download node.js using ‘wget’
- Execute the binaries, make, and install:

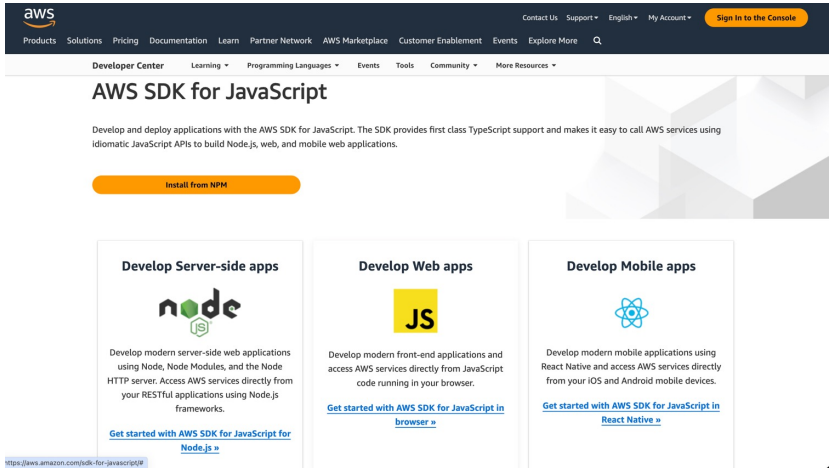
./configure && make && sudo make install



- Alternatively, use **AWS Elastic Beanstalk** and select the Node.js Preconfigured Platform when creating Environment
- See supported platforms, Node.js 18 & 20:
  https://docs.aws.amazon.com/elasticbeanstalk/latest/platforms/platforms-supported.html#platforms-supported.nodejs
- **nginx** Proxy server
- Supports static file mappings and **gzip** compression
- See slides on D2L Brightspace. Also see:
  https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/nodejs-dynamodb-tutorial.html
  https://docs.aws.amazon.com/elasticbeanstalk/latest/dg/create_deploy_nodejs.container.html

Node.js on AWS (cont'd)

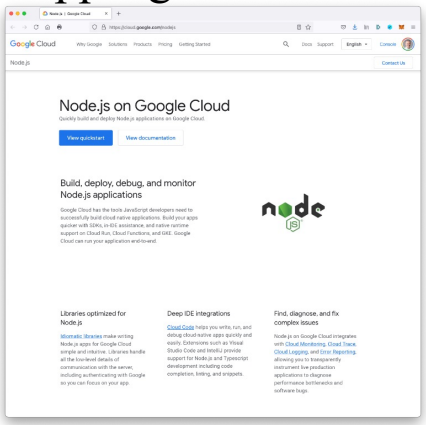
- AWS SDK for JavaScript in Node.js
- Provides JavaScript objects for AWS services including Amazon S3, Amazon EC2, DynamoDB, Amazon Elastic Beanstalk and many more.
- Single, downloadable package includes the AWS JavaScript Library and documentation
- See: https://aws.amazon.com/sdk-for-javascript/



Node.js on Google Cloud

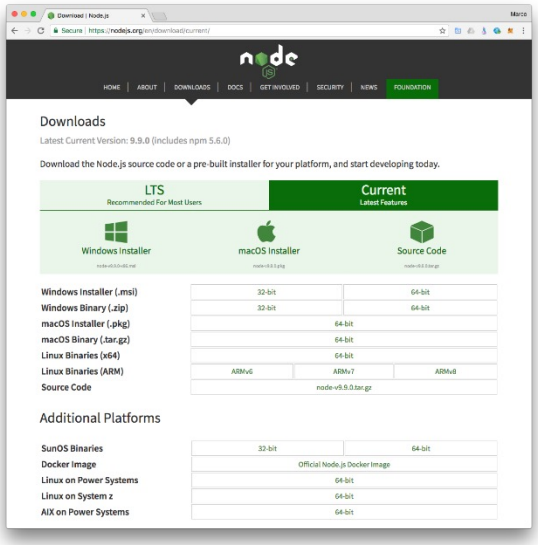
- Node.js app deployed using Google App Engine Managed VMs
- Scales to serve millions of requests
- Supports structures and binary data, authentication, logging, events
- See: https://cloud.google.com/nodejs
- See slides on D2L Brightspace.
- Node.js supported versions:

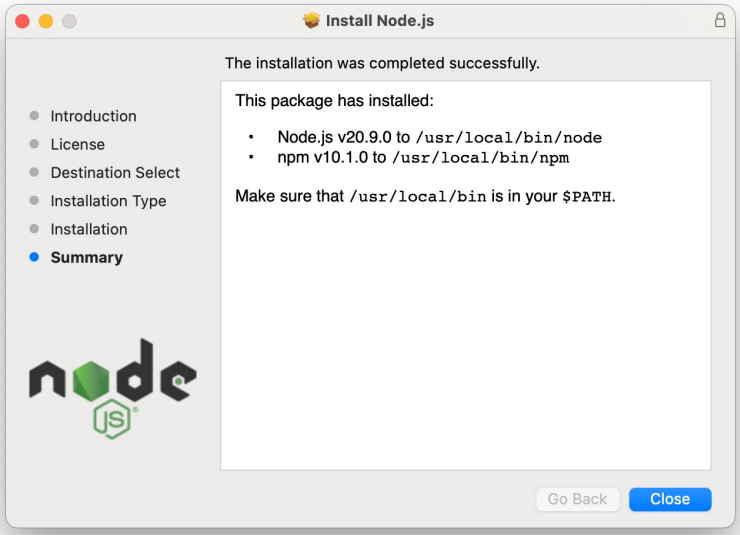
  https://cloud.google.com/appengine/docs/standard/lifecycle/support-schedule#nodejs



Node.js on macOS and Windows

- Download macOS (64bit) and Windows package at https://nodejs.org/en/
- Learn Node.js on you local MacBook or Windows PC
- Latest versions are 20.11.1 Long Term Support (LTS) and 21.7.0 Current





Related URLs

- **Node.js website:** https://nodejs.org/
- **Node.js on Github:** https://github.com/nodejs/node
- **NPM:** https://www.npmjs.com/
- **Learn Node.js in terminal:** https://github.com/workshopper/learnyounode
- **Tools:** http://gruntjs.com/

Introduction

- AngularJS is a complete JavaScript-based open-source front-end web application framework.
- It is mainly maintained by Google and some community of individuals.
- It provides a framework for client-side model–view–controller (MVC) and model–view–viewmodel (MVVM) architectures.
- AngularJS is the frontend part of the **MEAN stack**, consisting of **M**ongoDB database, **E**xpress.js web application server framework, **A**ngular.js itself, and **N**ode.js runtime environment.

Angular.js

Why AngularJS?

- HTML is great for declaring static documents, but it falters when we try to use it for declaring **dynamic views** in web-applications. AngularJS lets you extend HTML vocabulary for your application. The resulting environment is extraordinarily expressive, readable, and quick to develop.

Alternatives

- Other frameworks deal with HTML's shortcomings by either abstracting away HTML, CSS, and/or JavaScript or by providing an imperative way for manipulating the DOM. Neither of these address the root problem that HTML was not designed for **dynamic views**.

Extensibility

- AngularJS is a toolset for building the framework most suited to your application development. It is fully extensible and works well with other libraries. Every feature can be modified or replaced to suit your unique development workflow and feature needs. Read on to find out how.

Basic functionality

Control of the app

Data Binding

- Data-binding is an automatic way of **updating the view** whenever the **model changes**, as well as **updating the model** whenever the **view changes**. This is awesome because it eliminates DOM manipulation from the list of things you have to worry about.

Controller

- Controllers are the behavior behind the DOM elements. AngularJS lets you express the behavior in a clean readable form without the usual boilerplate of updating the DOM, registering callbacks or watching model changes.

Plain JavaScript

- Unlike other frameworks, there is no need to inherit from proprietary types in order to wrap the model in accessors methods. Angular models are plain old JavaScript objects. This makes your code easy to test, maintain, reuse, and again free from boilerplate.

Basic functionality (cont'd)

Wire up a Backend

Deep Linking

- A deep link reflects where the user is in the app, this is useful so users can bookmark and email links to locations within apps. Round trip apps get this automatically, but AJAX apps by their nature do not. AngularJS combines the benefits of deep link with desktop app-like behavior.

Form Validation

- **Client-side form validation** is an important part of great user experience. AngularJS lets you declare the validation rules of the form without having to write JavaScript code. Write less code, go have beer sooner.

Server Communication

- AngularJS provides built-in services on top of XHR (**X**ML**H**ttp**R**equest) as well as various other backends using third party libraries. Promises further simplify your code by handling asynchronous return of data. (Alternative to jQuery's .ajax(), fetch(), etc.)

Basic functionality (cont'd)

Create Components

Directives

- Directives is a unique and powerful feature available only in Angular. Directives let you invent new HTML syntax, specific to your application.

Reusable Components

- We use directives to create reusable components. A component allows you to hide complex DOM structure, CSS, and behavior. This lets you focus either on what the application does or how the application looks separately.

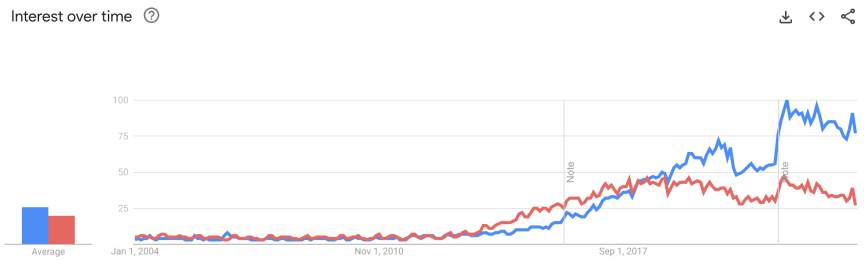
Localization

- An important part of serious apps is localization. Angular's locale aware filters and stemming directives give you building blocks to make your application available in all locales.

Companies that Use Angular JS

There are approximately 12,000 other sites out of 1 million tested in May 2017 that use Angular JS

React and Angular on Google Trends:
https://trends.google.com/trends/explore?date=all&q=React,Angular&hl=en-US



Goals

AngularJS de-emphasizes explicit DOM manipulation with the goal of improving testability and performance.

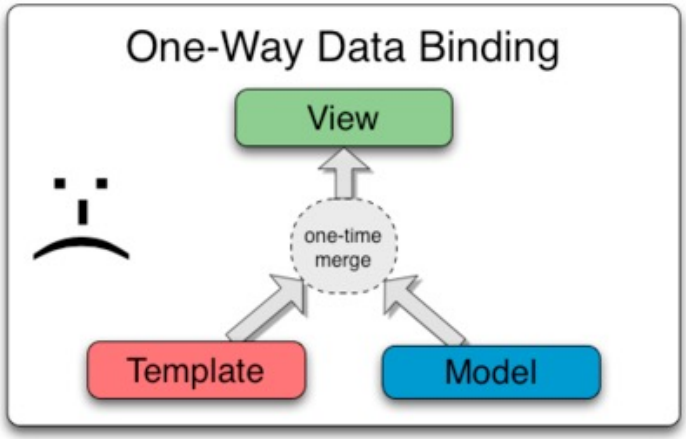
- Design goals are
  - It decouples DOM manipulation from application logic
  - It decouple the client side of an application from the server side.
  - It provides structure for building an application
    - Designing the UI
    - Writing the business logic
    - Testing

Goals (cont'd)

- Angular JS framework adapts and extends traditional HTML.
- It supports dynamic content through two-way data-binding.
- Two-way data-binding allows for the automatic synchronization of models and views.
- The tasks in angular bootstrapper occur in 3 phases
  - Creation of a new Injector
  - Compilation of the directives that decorate the DOM
  - Linking of all directives to scope

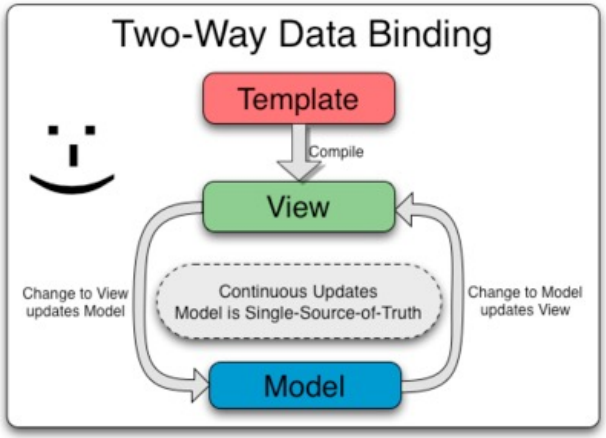
Data Binding

Classical



Any changes that the user makes to the view are not reflected in the model

Angular



The view is just a projection of the model. So there is automatic refresh of the data between view and model

AngularJS Directives

- AngularJS directives allows to specify custom reusable HTML-like elements and attributes.
- Some of the Angular Directives are
  - ng-app
  - ng-controller
  - ng-bind
  - ng-model
  - ng-class
  - ng-repeat

AngularJS Directives (Cont'd)

- **ng-app**
  - Declares the root element of an AngularJS application.
- **ng-controller**
  - Specifies a JavaScript controller class that evaluates HTML expressions.
- **ng-bind**
  - Sets the text of a DOM element to the value of an expression.
- **ng-model**
  - Similar to ng-bind, but establishes a two-way data binding between the view and the scope.
- **ng-repeat**
  - Instantiate an element once per item from a collection.

Code Snippet – AngularJS Instantiation

```
<script>
var app = angular.module("myApp", []);
app.controller("myController", function($scope,$http) {
   //  $scope holds your model (metadata) for your application
   $scope.topic = "CSCI 571";
});
</script>

<body ng-app="myApp" ng-controller="myController">
</body>
```

- An AngularJS module defines an application.
- The module is a container for controllers
- Controllers always belong to a module.

AngularJS Data Binding - Example

```
<div ng-app="formExample" ng-controller="ExampleController">
  <form class="form container simple-form">
    <div class="form-group">
    <label>Name :</label> <input class="form-control" type="text" ng-model="user.name" />
    </div>
    <div class="form-group">
    <label>E-mail:</label> <input class="form-control" type="email" ng-model="user.email" /><br />
    </div>
    <div class="form-group">
    <label>School:</label> <input class="form-control" type="text" ng-model="user.school" /><br />
    </div>
    <div class="form-group">
    <label>Level:</label>
      <select class="form-control" ng-model="user.level">
        <option value=""></option>
        <option value="G">Graduate</option>
        <option value="UG">Under Graduate</option>
        <option value="PhD">Doctoral</option>
      </select><br />
    </div>
    <input class="btn btn-default" type="button" ng-click="reset()" value="Reset" />
    <input class="btn btn-primary" type="submit" ng-click="update(user)" value="Save" />
  </form>
  <br/>
  <div class="container">
    <pre>user = {{user | json}}</pre>
    <pre>master = {{master | json}}</pre>
  </div>
</div>
```

```
angular.module('formExample', [])
  .controller('ExampleController', ['$scope', function($scope) {
    $scope.master = {};

    $scope.update = function(user) {
      $scope.master = angular.copy(user);
    };

    $scope.reset = function() {
      $scope.user = angular.copy($scope.master);
    };

    $scope.reset();
  }])
```

A simple example which shows how AngularJS process two-way data binding using **ng-model**.

http://csci571.com/examples/Angular/binding/index.html

AngularJS Repeat with data from static array

```
<div class="row">
    <div class="col-md-6 col-sm-12">
        <h3>Loading Data from Array</h3>
        <h4>Web Tech Producer</h4>
        <table class="table table-striped">
            <tr>
                <th>#</th>
                <th>Name</th>
                <th>Office Hours</th>
                <th>Location</th>
            </tr>
            <tr ng-repeat="x in producers track by $index">
                <td>{{$index + 1}}</td>
                <td>{{x.Name}}</td>
                <td>{{x.Office}}</td>
                <td>{{x.Location}}</td>
            </tr>
        </table>
    </div>
```

```
var app = angular.module("data", []);
app.controller("data", function ($scope, $http) {
    $scope.producers = [
        {
            Name: "Producer 1",
            Office: "10-11 AM",
            Location: "Leavey Library (LVL) 201"
        },
        {
            Name: "Producer 2",
            Office: "9-10 AM",
            Location: "Leavey Library (LVL) 202"
        },
        {
            Name: "Producer 3",
            Office: "4-5 PM",
            Location: "Leavey Library (LVL) 203"
        },
        {
            Name: "Producer 4",
            Office: "2-3 PM",
            Location: "Leavey Library (LVL) 204"
        },
        {
            Name: "Producer 5",
            Office: "5-6 PM",
            Location: "Leavey Library (LVL) 201"
        },
        {
            Name: "Producer 6",
            Office: "10-11 AM",
            Location: "Leavey Library (LVL) 209"
        },
        {
            Name: "Producer 7",
            Office: "10-11 AM",
            Location: "Leavey Library (LVL) 202"
        }
    ];

});
```

ng-repeat works like a for loop and replicates the template to the number of rows in the model

http://csci571.com/examples/Angular/populating_data/index.html

AngularJS Repeat from http request

```
<table class="table table-responsive table-striped" ng-app="myapp" ng-
controller="myapp">
  <tr>
    <th>Name</th>
    <th>City</th>
    <th>Country</th>
  </tr>
  <tr ng-repeat="x in rows">
    <td>{{x.Name}}</td>
    <td>{{x.City}}</td>
    <td>{{x.Country}}</td>
  </tr>
</table>
```

```
angular.module('myapp', [])
 .controller('myapp', function($scope, $http) {
   $scope.rows = {};

  $http.get("http://www.w3schools.com/angular/customers.php").then(functi
on(response){
    $scope.rows = response.data.records;
  });
});
```

$http holds the xml http request handler in Angular.

Name	City	Country
Alfreds Futterkiste	Berlin	Germany
Ana Trujillo Emparedados y helados	México D.F.	Mexico
Antonio Moreno Taquería	México D.F.	Mexico
Around the Horn	London	UK
B's Beverages	London	UK
Berglunds snabbköp	Luleå	Sweden
Blauer See Delikatessen	Mannheim	Germany

http://csci571.com/examples/Angular/populating_data/index.html

AngularJS Sort and Search

```
<table class="table table-responsive table-striped" ng-app="myapp" ng-controller="myapp">
  <tr>
    <th>Name</th>
    <th>City</th>
    <th>Country
      <input type="text" class="form-control pull-right" style="width:40%;" placeholder="Search" ng-
model="search" />
    </th>
  </tr>
  <tr ng-repeat="x in rows| orderBy:Name | filter: search">
    <td>{{x.Name}}</td>
    <td>{{x.City}}</td>
    <td>{{x.Country}}</td>
  </tr>
</table>
```

```
angular.module('myapp', [])
 .controller('myapp', function($scope, $http) {
   $scope.rows = {};

  $http.get("http://www.w3schools.com/angular/customers.php").then(functi
on(response){
    $scope.rows = response.data.records;
  });
});
```

orderBy: sort the Column ascending
orderBy:<column>:<reverse>
<column> - the column you want to sort
<reverse> - true-descending, false-ascending

Filter: search the rows in the model
Filter:<searchstring> e.x. filter: search
Or
Filter:<column_based_search> e.x.
filter:{<column>:search}

Name	City	Country
Alfreds Futterkiste	Berlin	Germany
Ana Trujillo Emparedados y helados	México D.F.	Mexico
Antonio Moreno Taquería	México D.F.	Mexico
Around the Horn	London	UK
B's Beverages	London	UK
Berglunds snabbköp	Luleå	Sweden
Blauer See Delikatessen	Mannheim	Germany

http://csci571.com/examples/Angular/sort_and_search/index.html

AngularJS External UI Components

```
<table class="table table-responsive table-striped" ng-app="myapp" ng-controller="myapp">
  <tr>
    <th>Name</th>
    <th>City</th>
    <th>Country
      <input type="text" class="form-control pull-right" style="width:40%;" placeholder="Search" ng-
model="search" />
    </th>
  </tr>
  <tr dir-paginate="x in rows| orderBy:Name:false | filter: search| itemsperpage: 10" pagination-
id="example">
    <td>{{x.Name}}</td>
    <td>{{x.City}}</td>
    <td>{{x.Country}}</td>
  </tr>
</table>
<dir-pagination-controls max-size="10" boundary-links="true" direction-links="true" max-size="10"
pagination-id="example"></dir-pagination-controls>
```

External components need to be added to the angular application.
angular.module('myapp', [<external_components>])

```
angular.module('myapp', ['angularUtils.directives.dirPagination'])
 .controller('myapp', function($scope, $http) {
   $scope.rows = {};

  $http.get("http://www.w3schools.com/angular/customers.php").then(function(response){
    $scope.rows = response.data.records;
  });
});
```

http://csci571.com/examples/Angular/external_plugins/index.html

AngularJS Remove and Insert DOM Element

```
<div ng-app="myApp">
    <div ng-controller="AppCtrl">
        <input type="checkbox" ng-click="toggleShowDiv()"/>
        <label for="showDiv">Toggle DIV</label>
        <div id="my-div" ng-if="showDiv">New Div</div>
    </div>

</div>
```

Using ***ng-if*** to insert/remove the dom.

```
angular.module('myApp', ['ngAnimate'])
    .controller('AppCtrl', function ($scope) {
  $scope.showDiv = false;

  $scope.toggleShowDiv = function(){
    console.log('fired');
    $scope.showDiv = !$scope.showDiv;
  }
});
```

http://csci571.com/examples/Angular/manipulate_dom/index.html

About Angular 2+

- AngularJS is the name for all AngularJS version 1.x.
- Angular 2+ stands for the Angular 2 and later, including Angular 2,4,5,6,7 and 8.
- Angular 2+ is a ground-up rewrite.
- AngularJS 1.7 was released on July 1, 2018, and it enters a 3 years long-term support. It is “retired” now.
- There are few upgrade possibilities of AngularJS to Angular 2+ and in most cases the only suitable possible option is to rewrite the application in Angular 2+.
- Starting with Angular 2, a major release is **published every 6 months**. There are some improvements between each version.
- The “active” Angular version is **Angular 17.3** and was released in March 11, 2024. https://angular.io/guide/releases
- The “LTS” release is Angular version 16.0.0.

Differences between versions

	AngularJS	Angular 2+
Architecture	Based on MVC	Based on service/component
Javascript vs TypeScript	Uses JavaScript	Uses TypeScript (a superset of JavaScript) and RxJS (A reactive programming library for JavaScript).
Component-based UI		Can split application features into various components and call required UI, which increases reusability and flexibility
Mobile Support		Native Script or Ionic
SEO (Search Engine Optimization) Friendly	Difficult to develop search engine friendly Single Page Applications	Possible to build Single Page Applications SEO friendly by rendering plain HTML at the server side. It released Angular Universal.

Features of Angular 4

- **Smaller and Faster**
- **View engine with less code**
  - The view engine is introduced in Angular 4 where the produced code of components can be reduced up to 60%. The bundles are reduced to thousands of KBs.
- **Improved *ngIf directive**
  - A new “else” statement is added
- **Animation**
  - Animations are pulled from the Angular core and set in their own package
- **TypeScript 2.1 and 2.2 Compatibility**
- **Source Maps for Templates**
  - Now whenever there's an error caused by something in one of the templates, source maps are created which provide a meaningful context concerning the original template.

Features of Angular 6

- **ng update**
  - Using **ng update** to update your Angular app from Angular 2, 4 or 5.
- **ng add**
  - Using **ng add** to add new dependencies and invoke an installation script.
- **Angular Material + CDK Components**
- **CLI Workspaces**
  - CLI projects will now use angular.json for build and project configuration.
- **Animations Performance Improvements**
- **RxJS v6**

Features of Angular 7

- **Application Performance**
  - Optimize polyfills.ts
- **Angular Material & the CDK**
  - Virtual Scrolling
  - Drag and Drop
- **Partner Launches**
  - NativeScript: A single project that builds for both web and installed mobile with NativeScript
  - StackBlitz 2.0 supports multipane editing and the Angular Language Service
- **Dependency Updates**
  - Typescript 3.1
  - RxJS 6.3
  - Node 10

Features of Angular 8

- **Requires TypeScript 3.4**
  - Required. You will need to upgrade.
- **Ivy support**
  - New compiler / runtime for Angular
- **Bazel support**
  - Build tool developed and built by Google.
  - Build back-end and front-end with same tool
- **Router**
  - Lazy-loading with import() syntax
- **Location**
  - Location services to help migrating from AngularJS

Features of Angular 9

- **Requires TypeScript 3.7**
  - You will need to upgrade.
- **Ivy support**
  - Angular compiles by Ivy by default
- **APIs**
  - Lots on new removed and deprecated APIs
- **Migration**
  - CLI handles many migrations automatically

Features of Angular 10

- **Requires TypeScript 3.9**
  - You will need to upgrade.
- **Deprecations**
  - @angular/core (may be removed in v12)
  - IE 9, 10 and IE Mobile (removed in v11)
- **Ivy**
  - Heavily promoted as default rendering engine
  - See: https://angular.io/guide/ivy
- **Migration**
  - Automated migration from version 9

Features of Angular 12

- **Requires TypeScript 4.2.3 to 4.2.x**
  - You will need to upgrade.
- **Angular CDK and Angular Material**
  - Use the new SASS module system
- **Angular Tooling**
  - Uses Webpack 5 to build applications
- **See**
  - https://angular.io/guide/updating-to-version-12

Features of Angular 14

- **Requires newer TypeScript**
  - You will need to upgrade.
  - https://update.angular.io/
- **Strictly Typed Reactive Forms**
- **ComponentFactory and ngModuleFactory cleanup**
- **Lots of deprecations**
  - https://angular.io/guide/deprecations
- **Upgrade from AngularJS**
  - https://angular.io/guide/upgrade

Features of Angular 16

- **Requires newer TypeScript**
  - You will need to upgrade.
  - https://update.angular.io/ (15 to 16)
- **Angular Signals developer preview**
- **Faster builds with the esbuild developer preview**
- **Standalone component migration and scaffoldin**
- **Angular v16 requires node.js version v16 or v18**
- **Angular v16 requires TypeScript version 4.9 or later**
- **Lots of deprecations**
  - https://angular.io/guide/deprecations
- **Upgrade from AngularJS**
  - https://angular.io/guide/upgrade

RxJS

- Reactive programming is an asynchronous programming paradigm concerned with data streams and the propagation of change (Wikipedia)
- RxJS is a library for reactive programming. (RxJS Docs)
- Angular2+ use RxJS for asynchronous operation. (Angular RxJS)
- RxJS uses **Observables** for asynchronous or callback-based code.
  - Converting existing code for async operations into observables
  - Iterating through the values in a stream
  - Mapping values to different types
  - Filtering streams
  - Composing multiple streams
- See example “Repeat from http request”

Angular 2+ Data Binding Component Example

```html
<div>
  <form class="form container simple-form">
    <div class="form-group">
      <label>Name:</label> <input class="form-control" type="text" [(ngModel)]="user.name" name="name" />
    </div>
    <div class="form-group">
      <label>E-mail:</label> <input class="form-control" type="email" [(ngModel)]="user.email" name="email" /><br />
    </div>
    <div class="form-group">
      <label>School:</label> <input class="form-control" type="text" [(ngModel)]="user.school" name="school" /><br />
    </div>
    <div class="form-group">
      <label>Level:</label>
      <select class="form-control" [(ngModel)]="user.level" name="level">
        <option value=""></option>
        <option value="G">Graduate</option>
        <option value="UG">Under Graduate</option>
        <option value="PhD">Doctoral</option>
      </select><br />
    </div>
    <input class="btn btn-default" type="button" (click)="reset()" value="Reset" />
    <input class="btn btn-primary" type="submit" (click)="update()" value="Save" />
  </form>
  <br />
  <div class="container">
    <pre>user = {{user | json}}</pre>
    <pre>master = {{master | json}}</pre>
  </div>
</div>
```

form.component.html

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

@Component({
  selector: 'app-form',
  templateUrl: './form.component.html',
  styleUrls: ['./form.component.css']
})
export class FormComponent implements OnInit {
  user = {};
  master = {};

  constructor() { }

  ngOnInit() {
  }

  update() {
    this.master = Object.assign({}, this.user);
  }

  reset() {
    this.user = Object.assign({}, this.master);
  }

}
```

form.component.ts

http://csci571.com/examples/Angular/binding_angular2_and_4/index.html

Angular 2+ Repeat with data from static array

```html
<div class="row">
  <div class="col-md-6 col-sm-12">
    <h3>Loading Data from Array</h3>
    <h4>Web Tech Producer</h4>
    <table class="table table-striped">
      <tr>
        <th>#</th>
        <th>Name</th>
        <th>Office Hours</th>
        <th>Locaton</th>
      </tr>
      <tr *ngFor="let x of producers; index as i; trackBy: trackByFn">
        <td>{{i + 1}}</td>
        <td>{{x.Name}}</td>
        <td>{{x.Office}}</td>
        <td>{{x.Location}}</td>
      </tr>
    </table>
  </div>
</div>
```

staff.component.html

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

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

  producers = [
    {
      Name: 'Producer 1',
      Office: '10-11 AM',
      Location: 'Leavey Library (LVL) 201'
    },
    {
      Name: 'Producer 2',
      Office: '9-10 AM',
      Location: 'Leavey Library (LVL) 202'
    },
    {
      Name: 'Producer 3',
      Office: '4-5 PM',
      Location: 'Leavey Library (LVL) 203'
    },
    {
      Name: 'Producer 4',
      Office: '2-3 PM',
      Location: 'Leavey Library (LVL) 204'
    },
    {
      Name: 'Producer 5',
      Office: '5-6 PM',
      Location: 'Leavey Library (LVL) 201'
    },
    {
      Name: 'Producer 6',
      Office: '10-11 AM',
      Location: 'Leavey Library (LVL) 209'
    },
    {
      Name: 'Producer 7',
      Office: '10-11 AM',
      Location: 'Leavey Library (LVL) 202'
    }
  ];

  constructor() { }

  ngOnInit() {
  }

  trackByFn(index, item) {
    return index;
  }
}
```

staff.component.ts

http://csci571.com/examples/Angular/populating_data_static_angular_2_and_4/index.html

Angular 2+ Repeat from http request

```html
<table class="table table-responsive table-striped">
  <tr>
    <th>Name</th>
    <th>Email</th>
    <th>Phone</th>
    <th>Website</th>
  </tr>
  <tr *ngFor="let x of rows">
    <td>{{x.name}}</td>
    <td>{{x.email}}</td>
    <td>{{x.phone}}</td>
    <td>{{x.website}}</td>
  </tr>
</table>
```

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

@Injectable()
export class DataService {

  constructor(private http: Http) { }

  getCustomer() {
    return this.http.get('http://jsonplaceholder.typicode.com/users');
  }

}
```

```typescript
import { DataService } from './../../services/data.service';
import { Component, OnInit } from '@angular/core';

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

  rows = [];

  constructor(private dataService: DataService) {
    dataService.getCustomer().subscribe(response => {
      this.rows = response.json();
    });
  }

  ngOnInit() {
  }

}
```

Using **observable** subscription to handle asynchronized http request

http://csci571.com/examples/Angular/populating_data_external_angular_2_and_4/index.html

Angular 2+ External UI Components

```
<table class="table table-responsive table-striped">
  <tr>
    <th>Name</th>
    <th>Email</th>
    <th>Phone</th>
    <th>Website</th>
  </tr>
  <tr *ngFor="let x of rows | paginate: { itemsPerPage: 5, currentPage: p }">
    <td>{{x.name}}</td>
    <td>{{x.email}}</td>
    <td>{{x.phone}}</td>
    <td>{{x.website}}</td>
  </tr>
</table>

<pagination-controls (pageChange)="p = $event"></pagination-controls>
```

```
import { DataService } from './services/data.service';
import { BrowserModule } from '@angular/platform-browser';
import { NgModule } from '@angular/core';
import { HttpModule } from '@angular/http';
import { NgxPaginationModule } from 'ngx-pagination';

import { AppComponent } from './app.component';
import { PaginationComponent } from './components/pagination/pagination.component';

@NgModule({
  declarations: [
    AppComponent,
    PaginationComponent
  ],
  imports: [
    BrowserModule,
    HttpModule,
    NgxPaginationModule
  ],
  providers: [DataService],
  bootstrap: [AppComponent]
})
export class AppModule { }
```

```
import { DataService } from './../../services/data.service';
import { Component, OnInit } from '@angular/core';

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

  p: number = 1;
  rows = [];

  constructor(private dataService: DataService) {
    dataService.getCustomer().subscribe(response => {
      this.rows = response.json();
    });
  }

  ngOnInit() {
  }

}
```

http://csci571.com/examples/Angular/external_plugins_angular_2_and_4/index.html

Angular 2+ Remove and Insert DOM Element

```
<div>
    <div>
        <input type="checkbox" (click)="toggleShowDiv()"/>
        <label for="showDiv">Toggle DIV</label>
        <div id="my-div" *ngIf="showDiv">New Div</div>
    </div>

</div>
```

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

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

  showDiv = false;

  constructor() { }

  ngOnInit() {
  }

  toggleShowDiv() {
    console.log('fired');
    this.showDiv = !this.showDiv;
  }

}
```

http://csci571.com/examples/Angular/manipulate_dom_angular_2_and_4/index.html

Angular 2+ Sort and Search

- Angular 2+ doesn't support *FilterPipe* or *OrderByPipe* mainly because they are expensive operations and they have often been abused in AngularJS apps.
- To learn more about why FilterPipe and OrderByPipe are not supported and what the alternatives are, see this page:

https://angular.io/guide/pipes#appendix-no-filterpipe-or-orderbypipe.

Angular Bootstrap : ng-bootstrap

- “Angularized” Bootstrap widgets
- Built such a way that the only external dependency is the Bootstrap CSS
- Hence, no external JS is needed to run ng-bootstrap
- See: https://ng-bootstrap.github.io/#/home

// installation for Angular CLI (recommended)

```
ng add @ng-bootstrap/ng-bootstrap
```

ng-bootstrap Dependencies

The only two required dependencies are Angular and Bootstrap CSS. The supported versions are:

ng-bootstrap	Angular	Bootstrap CSS	Popper
	Show older versions		
10.x.x	^12.0.0	4.5.0	
11.x.x	^13.0.0	4.6.0	
12.x.x	^13.0.0	5.0.0	^2.10.2
13.x.x	^14.1.0	5.2.0	^2.10.2
14.x.x	^15.0.0	5.2.3	^2.11.6
15.x.x	^16.0.0	5.2.3	^2.11.6
16.x.x	^17.0.0	5.3.2	^2.11.8

ng-bootstrap – Node.js Dependencies

On Google Cloud only recent version are supported, especially Bootstrap 5.

Node	Angular	ng-bootstrap	Bootstrap CSS
Node.js 18	15.0.0	14.x.x	5.2.3
Node.js 18	16.0.0	15.x.x	5.2.3
Node.js 20	17.0.0	16.x.x	5.3.2

ng-bootstrap Components

Components

Accordion

Alert

Buttons

Carousel

Collapse

Datepicker

Dropdown

Modal

Nav

Pagination

Popover

Progressbar

Rating

Table

Timepicker

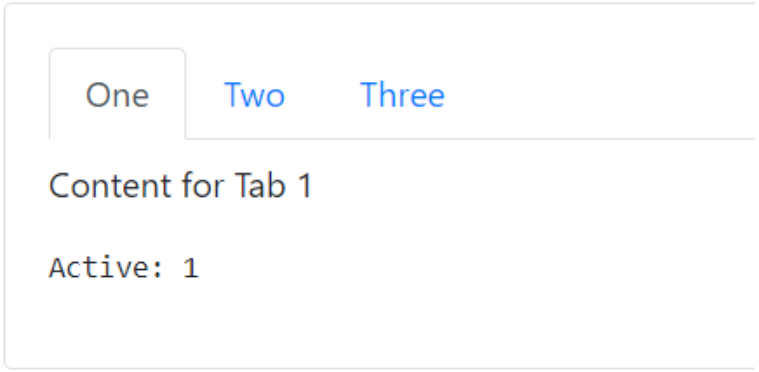
Toast

Tooltip

Typeahead

ng-bootstrap Example : Nav

```
<ul ngbNav #nav="ngbNav" [(activeId)]="active" class="nav-tabs">
  <li [ngbNavItem]="1">
    <a ngbNavLink>One</a>
    <ng-template ngbNavContent>
      <p>Content For Tab 1</p>
    </ng-template>
  </li>
  <li [ngbNavItem]="2">
    <a ngbNavLink>Two</a>
    <ng-template ngbNavContent>
      <p>Content For Tab 2</p>
    </ng-template>
  </li>
  <li [ngbNavItem]="3">
    <a ngbNavLink>Three</a>
    <ng-template ngbNavContent>
      <p>Content For Tab 3</p>
    </ng-template>
  </li>
</ul>
<div [ngbNavOutlet]="nav" class="mt-2"></div>
<pre>Active: {{ active }}</pre>
```



https://stackblitz.com/run?file=app/nav-basic.ts

ng-bootstrap Example : Progress Bar

progressbar-striped.html progressbar-striped.ts

```
<p><ngb-progressbar type="success" [value]="25" [striped]="true"></ngb-progressbar></p>
<p><ngb-progressbar type="info" [value]="50" [striped]="true"></ngb-progressbar></p>
<p><ngb-progressbar type="warning" [value]="75" [striped]="true"></ngb-progressbar></p>
<p><ngb-progressbar type="danger" [value]="100" [striped]="true"></ngb-progressbar></p>
```

ng-bootstrap Example : Table

```
<table class="table table-striped">
  <thead>
  <tr>
    <th scope="col">#</th>
    <th scope="col">Country</th>
    <th scope="col">Area</th>
    <th scope="col">Population</th>
  </tr>
  </thead>
  <tbody>
  <tr *ngFor="let country of countries; index as i">
    <th scope="row">{{ i + 1 }}</th>
    <td>
      <img [src]="'https://upload.wikimedia.org/wikipedia/commons/' + country.flag"
      class="mr-2" style="width: 20px">
      {{ country.name }}
    </td>
    <td>{{ country.area | number }}</td>
    <td>{{ country.population | number }}</td>
  </tr>
  </tbody>
</table>
```

#	Country	Area	Population
1	Russia	17,075,200	146,989,754
2	Canada	9,976,140	36,624,199
3	United States	9,629,091	324,459,463
4	China	9,596,960	1,409,517,397

ng-bootstrap Example : Alert

Closable Alert

```
<p *ngFor="let alert of alerts">
  <ngb-alert [type]="alert.type" (closed)="close(alert)">{{ alert.message }}</ngb-alert>
</p>
<p>
  <button type="button" class="btn btn-primary" (click)="reset()">Reset</button>
</p>
```

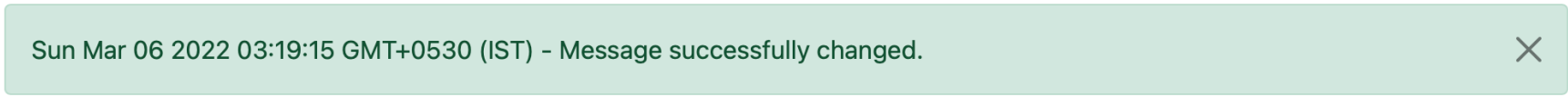

```
@Component({
  selector: 'ngbd-alert-closeable',
  templateUrl: './alert-closeable.html'
})
export class NgbdAlertCloseable {

  alerts: Alert[];

  constructor() {
    this.reset();
  }

  close(alert: Alert) {
    this.alerts.splice(this.alerts.indexOf(alert), 1);
  }

  reset() {
    this.alerts = Array.from(ALERTS);
  }
}
```

ng-bootstrap Example : Self Closing Alert

```
<ngb-alert #selfClosingAlert *ngIf="successMessage" type="success" (closed)="successMessage = ''">{{
successMessage }}
</ngb-alert>
<p>
  <button class="btn btn-primary" (click)="changeSuccessMessage()">Change message</button>
</p>
```

```
export class NgbdAlertSelfclosing implements OnInit {
  private _success = new Subject<string>();

  staticAlertClosed = false;
  successMessage = '';

  @ViewChild('staticAlert', {static: false}) staticAlert: NgbAlert;
  @ViewChild('selfClosingAlert', {static: false}) selfClosingAlert: NgbAlert;

  ngOnInit(): void {
    setTimeout(() => this.staticAlert.close(), 20000);

    this._success.subscribe(message => this.successMessage = message);
    this._success.pipe(debounceTime(5000)).subscribe(() => {
      if (this.selfClosingAlert) {
        this.selfClosingAlert.close();
      }
    });
  }

  public changeSuccessMessage() { this._success.next(`${new Date()} - Message successfully changed.`);
  }
}
```

This shows self-closing success message that disappears after 5 seconds



Angular HttpClient

- HttpClient is Angular's mechanism for communicating with a remote server over HTTP.
- See: https://angular.io/guide/understanding-communicating-with-http
- Make HttpClient available everywhere in the application in two steps.
  STEP – 1: Add it to the root AppModule by importing it:

src/app/app.module.ts (HttpClientModule import)

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

Next, still in the `AppModule`, add `HttpClientModule` to the `imports` array:

src/app/app.module.ts (imports array excerpt)

```
@NgModule({
  imports: [
    HttpClientModule,
  ],
})
```

Angular HttpClient (cont'd)

- **STEP - 2:** HttpClient Inject

- HttpClient methods are get(),delete(), patch(), post(), put() etc.
  - Inject HttpClient using constructor into our component or service. HttpClient is imported from @angular/common/http library as following.
  - Find constructor to inject HttpClient
  - Ready to call HttpClient methods using http instance.

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

```
constructor(private http: HttpClient) {
}
```

```
getWriterWithFavBooks(): Observable<any> {
        return this.http.get(this.writerUrl);
}
```

TypeScript

- Open-source programming language developed and maintained by Microsoft
- Syntactical superset of JavaScript
- Developed by **Anders Hejlsberg**, C# Architect and creator of Turbo Pascal
- First made public in October **2012** (version 0.8)
- Built-in support for TypeScript in Visual Studio 2013+
- Latest version is **TypeScript 5.3**
- TypeScript program can seamlessly consume JavaScript
- TypeScript compiler written in TypeScript
- See: http://www.typescriptlang.org/

TypeScript Features

- Extensions to ECMAScript 5th Ed.
  - Type annotations and compile-time type checking
  - Type inference
  - Type erasure
  - Interfaces
  - Enumerated type
  - Mixin
  - Generic
  - Namespaces
  - Tuple
  - Await
- Backported features from ECMAScript 2015
  - Classes
  - Modules
  - Arrow syntax for anonymous functions
  - Optional and default parameters

TypeScript and Angular

- Angular IDE by Codemix, optimized for Angular 2+
- Commercial product from Genuitec
  https://www.genuitec.com/products/angular-ide/
- TypeScript validation and debugging
- Angular HTML Template Intelligence
  - Validation
  - Detection of misdefined element tags
  - HTML elements auto-complete
  - TypeScript expressions auto-complete
- Angular-CLI Integration
- Angular Source Navigation
- TypeScript Debugging
- Live Preview
- **Free Trial (for 30 days)** download for 64-bit versions of Windows, macOS and Linux at: https://www.genuitec.com/products/angular-ide/download/

Example usage & Related URLs

Examples

- **Hello World:** https://angularjs.org/#the-basics
- **Todo List:** https://angularjs.org/#add-some-control
- **Advanced Single Page App:** https://angularjs.org/#wire-up-a-backend

Related URLs

- **Angular.js website:** https://angularjs.org
- **Angular.js on Github:** https://github.com/angular/angular.js
- **Tutorial:** https://docs.angularjs.org/tutorial
- **Angular.js Course**
  http://campus.codeschool.com/courses/shaping-up-with-angular-js/level/1/section/1/creating-a-store-module
- **Angular 2+:** https://angular.io/
- **Angular 2+ docs**: https://angular.io/docs
- **Angular 2+ IDEs, Tools, Libraries, UI Components**: https://angular.io/resources

Angular Examples URLs

- **Best Examples of Websites and Applications built with Angular:** https://clockwise.software/blog/best-angular-applications/
- **Tour of Heroes App :** https://stackblitz.com/edit/angular-tour-of-heroes-example
- **Ng For Example :** https://stackblitz.com/edit/angular-10-ngfor-example
- **Angular Forms and Property Binding :** https://stackblitz.com/edit/angular-disable-form-field-on-select-value
- **Angular Pipes :** https://stackblitz.com/edit/angular-simple-examples