

# Novelties in ES6+. Introduction to TypeScript. Building and Deploying TypeScript Project

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# Agenda I

1. Novelties in ES6+
2. TypeScript Hello World
3. Configuring, building and deploying TypeScript project – node package manager (**npm**), package.json, tsconfig.json, **@types** and npm packages, TypeScript compiler options.
4. Linting TypeScript code – **tslint.json**
5. Module resolution. Configuring **System.js** module loader.
6. Introduction to TypeScript – functions, interfaces, classes and constructors.
7. Common types: Boolean, Number, String, Array, Enum, Any, Void. Duck typing.

# Agenda II

7. Declaring contracts using Interfaces – properties and optional properties, function types, class types, array types, hybrid types, extension of interfaces.
8. Classes – constructors, public/private properties, get and set accessors, static and instance sides.
9. Functions and function types – optional default and rest parameters, function lambdas and use of this, overloads.
10. Using Enums.
11. Modules in TypeScript – namespaces and modules (former internal and external modules), using import and export

# Agenda III

- 12. Interoperability with external JS libraries – ambient type declarations and ambient modules, typings, @types.
- 13. Generic type parameters – writing generic functions and classes, generic constructors, bounded generics.
- 14. Advanced types. Symbols. Declaration merging. Decorators. Using mixins in TypeScript.
- 15. Production grade integration with build tools – **npm**, **webpack**.

# Where is The Code?

**TypeScript Application Programming**  
code is available @GitHub:

<https://github.com/iproduct/Course-Multimedia-FMI>

# EcmaScript 6 – ES 2015, Harmony

[<https://github.com/lukehoban/es6features>]

A lot of new features:

- arrows
- classes
- enhanced object literals
- template strings
- destructuring
- default + rest + spread
- let + const
- iterators + for..of
- Generators
- unicode
- Modules + module loaders
- map + set + weakmap + weakset
- proxies
- symbols
- subclassable built-ins
- Promises
- math + number + string + array + object APIs
- binary and octal literals
- reflect api
- tail calls

# ES6 Classes [<http://es6-features.org/>]

```
class Shape {  
  constructor (id, x, y) {  
    this.id = id  
    this.move(x, y)  
  }  
  move (x, y) {  
    this.x = x  
    this.y = y  
  }  
}
```

```
class Rectangle extends Shape {  
  constructor (id, x, y, width, height)  
  {  
    super(id, x, y)  
    this.width = width  
    this.height = height  
  }  
}  
  
class Circle extends Shape {  
  constructor (id, x, y, radius) {  
    super(id, x, y)  
    this.radius = radius  
  }  
}
```



# Block Scope Vars: let [<http://es6-features.org/>]

```
for (let i = 0; i < a.length; i++) {  
  let x = a[i]  
  ...  
}
```

```
for (let i = 0; i < b.length; i++) {  
  let y = b[i]  
  ...  
}
```

```
const callbacks = []  
for (let i = 0; i <= 2; i++) {  
  callbacks[i] =  
    function () { return i * 2 }  
}
```

```
callbacks[0]() === 0  
callbacks[1]() === 2  
callbacks[2]() === 4
```



# ES6 Arrow Functions and this

- ECMAScript 6:

```
this.nums.forEach((v) => {  
  if (v % 5 === 0)  
    this.fives.push(v)  
})
```

- ECMAScript 5:

```
var self = this;  
this.nums.forEach(function (v) {  
  if (v % 5 === 0)  
    self.fives.push(v);  
});
```

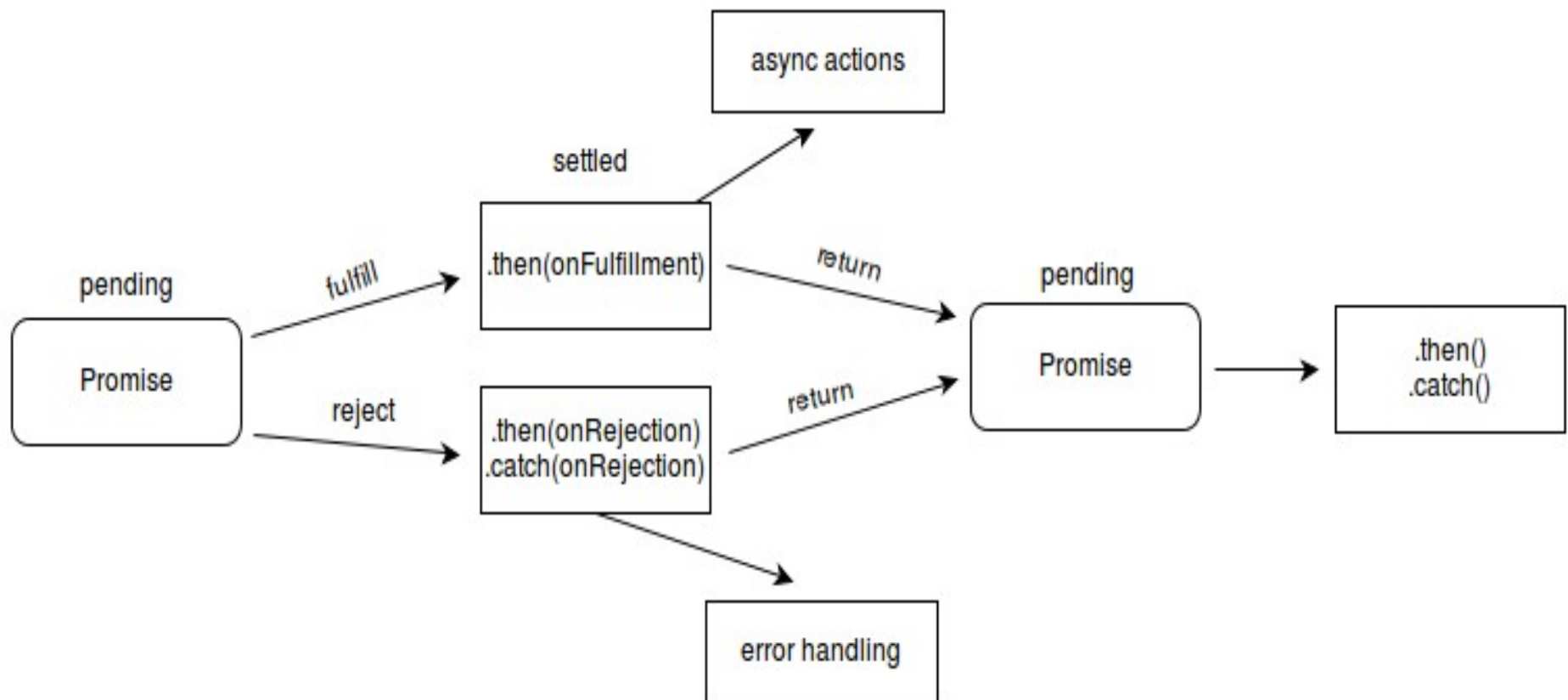
# Array and Object Destructuring

```
let persons = [  
  { name: 'Michael Harrison',  
    parents: {  
      mother: 'Melinda Harrison',  
      father: 'Simon Harrison',  
    }, age: 35},  
  { name: 'Robert Moore',  
    parents: {  
      mother: 'Sheila Moore',  
      father: 'John Moore',  
    }, age: 25}];  
  
for (let {name: n, parents: { father: f }, age } of persons) {  
  console.log(`Name: ${n}, Father: ${f}, age: ${age}`);  
}
```

# ES6 Promises [<http://es6-features.org/>]

```
function msgAfterTimeout (msg, who, timeout) {  
  return new Promise((resolve, reject) => {  
    setTimeout(() => resolve(`${msg} Hello ${who}!`), timeout)  
  })  
}  
  
msgAfterTimeout("", "Foo", 1000).then((msg) => {  
  console.log(`done after 1000ms:${msg}`);  
  return msgAfterTimeout(msg, "Bar", 2000);  
}).then((msg) => {  
  console.log(`done after 3000ms:${msg}`)  
})
```

# ES6 Promises



Source:

[https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global\\_Objects/Promise](https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Promise)

# Combining ES6 Promises

```
function fetchAsync (url, timeout, onData, onError) { ... }
fetchPromised = (url, timeout) => {
  return new Promise((resolve, reject) => {
    fetchAsync(url, timeout, resolve, reject)
  })
}
Promise.all([
  fetchPromised("http://backend/foo.txt", 500),
  fetchPromised("http://backend/bar.txt", 500)
]).then( (data) => {
  let [ foo, bar ] = data
  console.log(` success: foo=${foo} bar=${bar}`)
}).catch( (err) => {
  console.log(` error: ${err}`)
})
```

# Combining ES6 Promises

```
function fetchAsync (url, timeout, onData, onError) { ... }
fetchPromised = (url, timeout) => {
  return new Promise((resolve, reject) => {
    fetchAsync(url, timeout, resolve, reject)
  })
}
Promise.all([
  fetchPromised("http://backend/foo.txt", 500),
  fetchPromised("http://backend/bar.txt", 500)
]).then( (data) => {
  let [ foo, bar ] = data
  console.log(` success: foo=${foo} bar=${bar}`)
}, (err) => {
  console.log(` error: ${err}`)
})
```

# Async – Await – Try – Catch

```
async function init() {  
  try {  
    const userResult = await fetch("user.json");  
    const user = await userResult.json();  
    const gitResp = await fetch(  
      `http://api.github.com/users/${user.name}`);  
    const githubUser = await gitResp.json();  
    const img = document.createElement("img");  
    img.src = githubUser.avatar_url;  
    document.body.appendChild(img);  
    await new Promise((resolve, reject) => setTimeout(resolve, 6000));  
    img.remove();  
    console.log("Demo finished.");  
  } catch (err) {  
    console.log(err);  
  }  
}
```



# JavaScript Module Systems - CommonJS

- math.js:

```
exports.add = function() {  
    var sum = 0, i = 0, args = arguments, len = args.length;  
    while (i < len) {  
        sum += args[i++];  
    }  
    return sum;  
};
```

- increment.js:

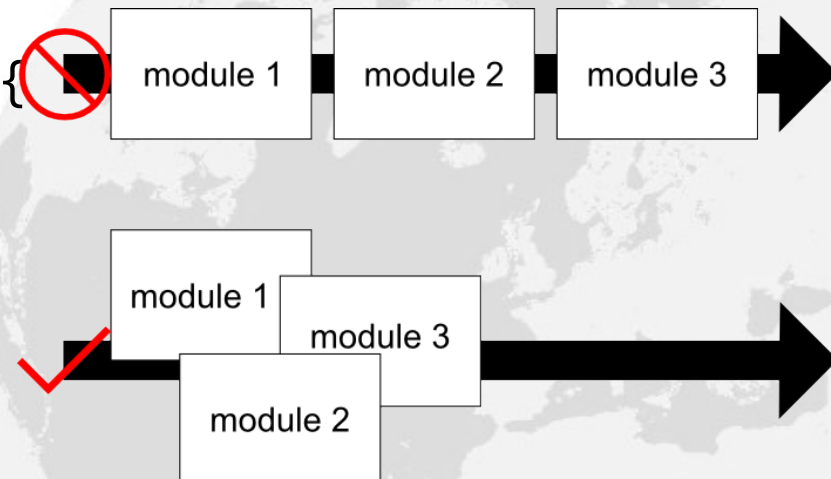
```
var add = require('./math').add;  
exports.increment = function(val) {  
    return add(val, 1);  
};
```

# JavaScript Module Systems – AMD I

```
//Calling define with module ID, dependency array, and factory  
//function
```

```
define('myModule', ['dep1', 'dep2'], function (dep1, dep2) {  
    //Define the module value by returning a value.  
    return function () {};  
});
```

```
define(["alpha"], function (alpha) {  
    return {  
        verb: function(){  
            return alpha.verb() + 2;  
        }  
    };  
});
```



# JavaScript Module Systems - AMD II

- Asynchronous module definition (AMD) – API for defining code modules and their dependencies, loading them asynchronously, on demand (lazy), dependencies managed, client-side

```
define("alpha", ["require", "exports", "beta"],
    function(require, exports, beta) {
        exports.verb = function() {
            return beta.verb();
            //OR
            return require("beta").verb();
        }
    });

define(function (require) {
    require(['a', 'b'], function (a, b) { //use modules a and b
    });
});
```

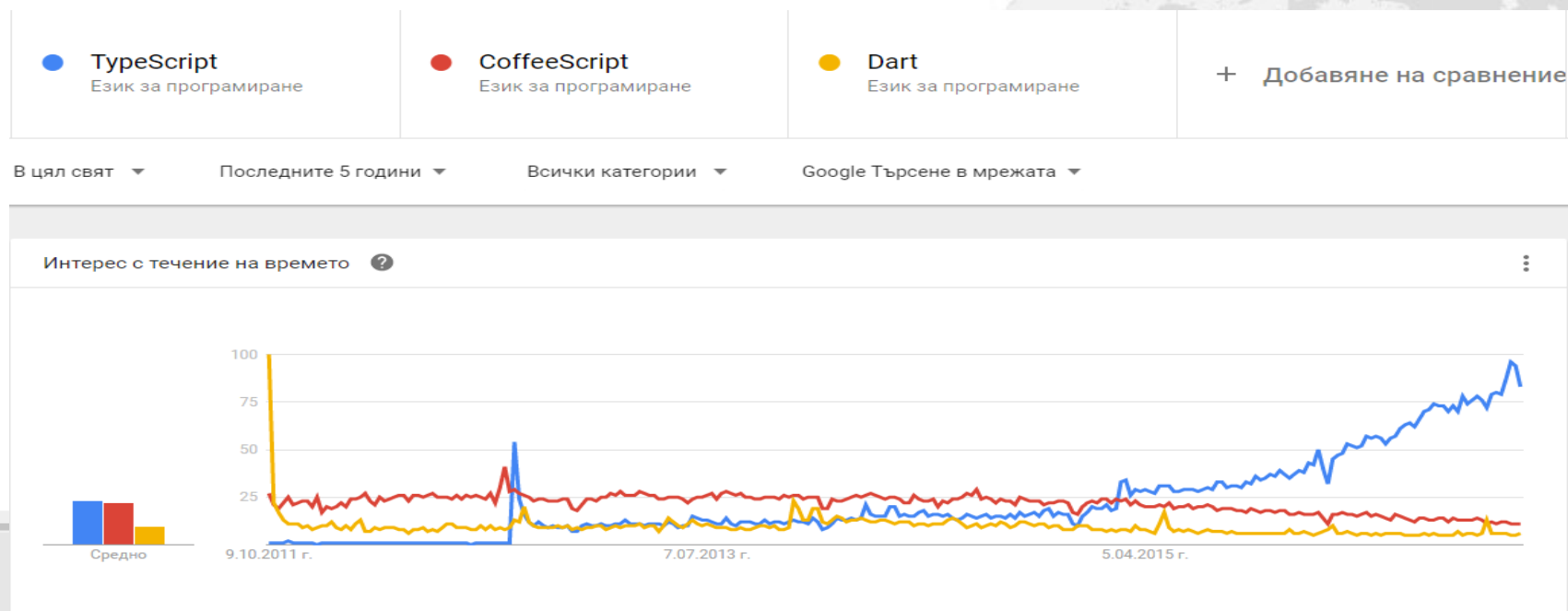
# JavaScript Module Systems – ES6

- `// lib/math.js`  
`export function sum (x, y) { return x + y }`  
`export var pi = 3.141593`
- `// someApp.js`  
`import * as math from "./lib/math"`  
`console.log("2 $\pi$  = " + math.sum(math.pi, math.pi))`
- `// otherApp.js`  
`import { sum, pi } from "./lib/math"`  
`console.log("2 $\pi$  = " + sum(pi, pi))`
- `// default export from hello.js and import`  
`export default () => ( <div>Hello from React!</div> );`  
`import Hello from "./hello";`

# TypeScript

[<http://www.typescriptlang.org/>]

- Typescript → since October 2012, Anders Hejlsberg (lead architect of C# and creator of Delphi and Turbo Pascal)
- Targets large scale client-side and mobile applications by compile time type checking + @Decorators -> Microsoft, Google
- TypeScript is strictly superset of JavaScript, so any JS is valid TS



Source: Google Trends comparison

# TypeScript Hello World I

- Installing Typescript: **npm install -g typescript**
- Create new directory: **md 02-ts-demo-lab**
- Create a new TS project using npm: **npm init**
- Write a simple TS function – file **greeter.ts** :

```
function greeter(person: string) {  
    return 'Hello, ' + person + ' from Typescript!';  
}  
  
const user = 'TypeScript User';  
document.body.innerHTML = greeter(user);
```

# TypeScript Hello World II

- Compile TypeScript to JavaScript (ES5): **tsc greeter.ts**

- Include script in **index.html** :

```
<html>
<head>
  <title>ES6 Simple Demo 01</title>
</head>
<body>
  <script src="greeter.js"></script>
</body>
</html>
```

- And open it in web browser – thats all :)
- If you make changes - use watch flag: **tsc -w greeter.ts**



# Configuring, Building and Deploying TypeScript Project

- Node package manager (**npm**) configuraton – **package.json**
- TypeScript configuration – **tsconfig.json**
- Configuring System.js module loader – **systemjs.config.js**
- Using external JS librarries – **@types** and npm packages
- TypeScript compiler options:  
<http://www.typescriptlang.org/docs/handbook/compiler-options.html>
- Linting TypeScript code – **tslint.json**:  
<https://palantir.github.io/tslint/rules/>
- Developing simple TS project – **Login Demo**

# Visual Studio Code

The screenshot displays the Visual Studio Code interface. The top menu bar includes File, Edit, Selection, View, Go, and Help. The left sidebar shows the Extensions view with a search bar and a list of installed and available extensions. The main editor area displays the details for the 'Angular v2 TypeScript Snippets' extension by johnpapa. The extension is highlighted in blue. Below the extension details, there are tabs for Details, Contributions, Changelog, and Dependencies. The main content area shows the extension's title, version, and a description. At the bottom, there is a terminal window showing the command prompt output.

login-controller.ts | Extension: Angular v2 TypeScript Snippets x | user-repository.ts | index.ts

Search Extensions in Marketplace

**Add jsdoc comments** 0.0.8  
Adds jsdoc @param and @return tags for s...  
stevenc1

**Angular 2 TypeScript Test Snippets** 0.7.3  
Angular 2 TypeScript test snippets (updated...  
Marinho Brandao

**Angular 2, 4 and upcoming latest TypeScript**  
Angular 2, 4 and upcoming latest Typescript...  
Balram Chavan

**Angular v2 TypeScript Snippets** 2.0.3  
Angular with TypeScript snippets. This exten...  
johnpapa

**Autolinting for Javascript** 1.3.0  
Automatically activate the correct Javascript...  
t-sauer

**Debugger for Chrome** 2.7.1  
Debug your JavaScript code in the Chrome ...  
Microsoft

**Document This** 0.4.3  
Automatically generates detailed JSDoc co...  
Joel Day

**ESLint** 1.2.8  
Integrates ESLint into VS Code.  
Dirk Baeumer

**exports autocomplete** 0.4.6  
autocompletes javascript module exports fr...  
capaj

**File Peek** 1.0.1

**Angular v2 TypeScript Snippets** johnpapa.Angular2  
johnpapa | 365100 | ★★★★★ | License  
Angular with TypeScript snippets. This extension supports Angular v2 or greater.  
Disable Uninstall

**Details** Contributions Changelog Dependencies

## Angular TypeScript Snippets for VS Code

**Now Updated for Angular 2.4 release**

This extension for Visual Studio Code adds snippets for Angular for TypeScript and HTML.

villain.component.ts - angular-event-view-cli

1: cmd.exe

PROBLEMS OUTPUT DEBUG CONSOLE **TERMINAL**

Microsoft Windows [Version 6.1.7601]  
Copyright (c) 2009 Microsoft Corporation. All rights reserved.  
Copyright (c) 2009 Microsoft Corporation. All rights reserved.  
Copyright (c) 2009 Microsoft Corporation. All rights reserved.

C:\CourseAngular2\git\course-angular2\ts-demo-03-lab>

master\* [TypeScript Importer]: Symbols: 15 321

Start [Taskbar icons] 11:57 PM 3/25/2017










# VS Code: Popular Angular/TS Plugins

- **TSLint** - linter for the TypeScript language, help fixing error in TS code. Must have when working with TS.
- **Angular Language Service** - This extension provides a rich editing experience for Angular templates, both inline and external templates.
- **Angular v5 TypeScript Snippets**
- **Angular 5 and TypeScript/HTML VS Code Snippets**
- **Angular + snippets - TypeScript, Html, NGRX, ...**
- **Angular Files** - allows quickly scaffold angular 2 file templates in VS Code project.

# VS Code: Popular Angular/TS Plugins II

- **TypeScript Hero** - Sorts and organizes your imports according to convention and removes imports that are unused (Ctrl+Alt+o on Win/Linux or Ctrl+Opt+o on MacOS).
- **Path Intellisense** - VSCode has a very good auto import capability, but sometime you still need to import some files manually, and this extension helps a lot in these cases.
- **TypeScript Importer** - Automatically searches for TypeScript definitions in workspace files and provides all known symbols as completion item to allow code completion.
- **Debugger for Chrome** - allows to debug using chrome and add your breakpoints in VSCode.

# Let's Install Some VSCode Plugins I










INSTALLED			43
	<b>Add Angular Files</b> 2.0.1 Add Angular files including snippets to your Visual Studio Code project Sebastian Baar	22K ⭐4	⚙️
	<b>Angular 2 TypeScript Emmet</b> 2.0.3 Support zen-coding syntax for Angular 2 typescript files. jakethashi	145K ⭐3	⚙️
	<b>Angular 5 and TypeScript/HTML VS Code Snippets</b> 1.0.19 VS Code snippets for Angular (v2 or higher) and TypeScript/HTML Dan Wahlin	288K ⭐5	⚙️
	<b>Angular 5 Snippets - TypeScript, Html, Angular Material, ngRx, RxJS &amp; Flex Layout</b> 5.2.23 172 Angular Snippets (TypeScript, Html, Angular Material, Flex Layout, ngRx, RxJS, PWA & Testing) Updated for v5.2.5 Mikael Morlund	2.1M ⭐5	⚙️
	<b>Angular Essentials</b> 0.3.2 Essential extensions for Angular developers John Papa	93K ⭐4.5	⚙️
	<b>Angular Extension Pack</b> 1.0.2 Popular Visual Studio Code extensions for Angular Development Will 保哥	82K ⭐4.5	⚙️
	<b>Angular Files</b> 1.4.0 Quickly scaffold angular file templates Alexander Ivanichev	70K ⭐4.5	⚙️
	<b>Angular Follow Selector</b> 1.1.1 Enables clicking on Angular selectors in your HTML files and being redirected to their component definition, as well as th... Sander Ledegen	4K ⭐5	⚙️
	<b>Angular Language Service</b> 0.1.9 Editor services for Angular templates	506K ⭐4.5	⚙️



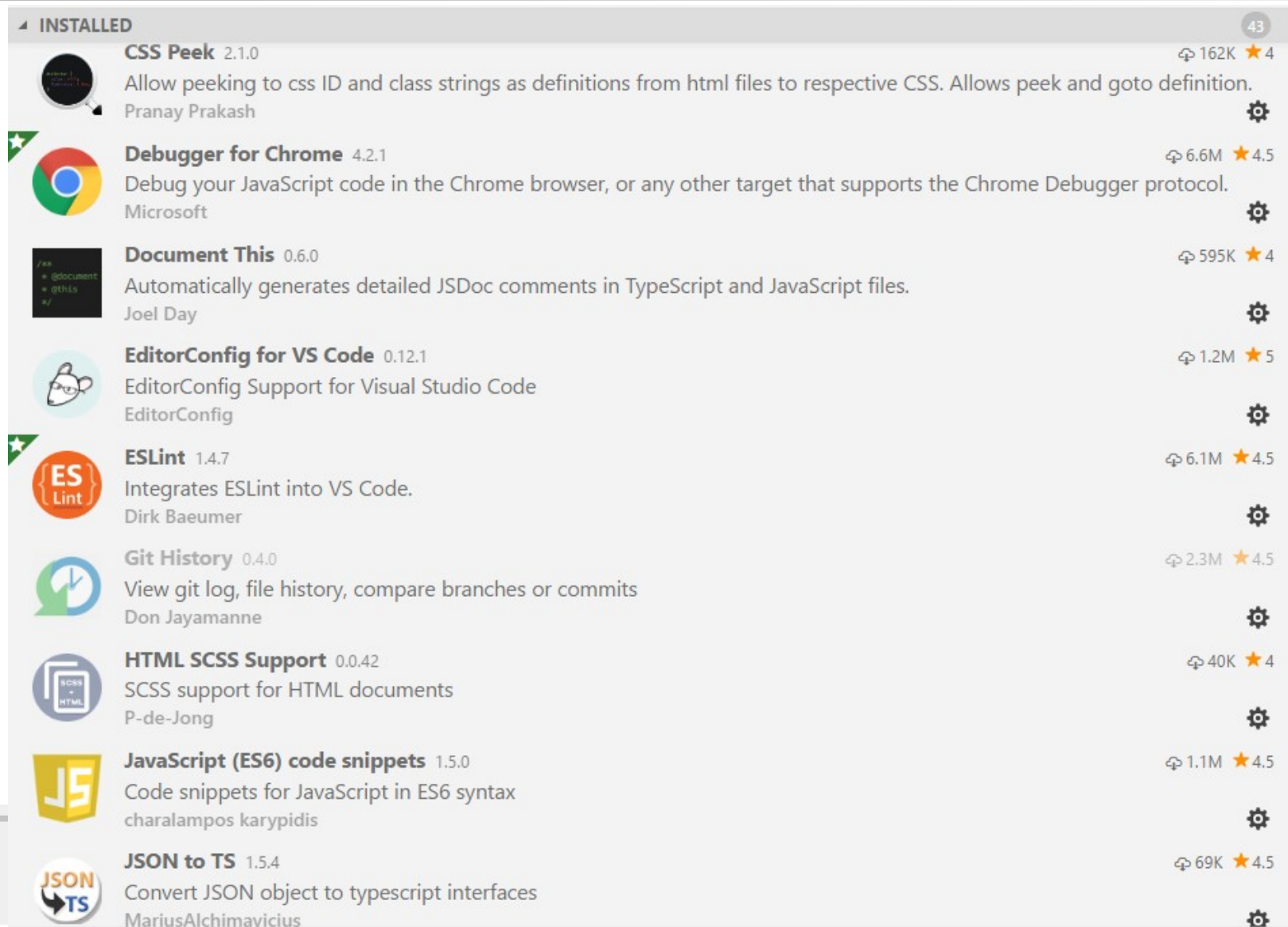
# Let's Install Some VSCode Plugins II

43

INSTALLED

	<b>Angular Material 2, Flex layout 1, Covalent 1 &amp; Material icon snippets</b> 0.13.0 Providers snippets Angular Material 2, Angular Flex layout 1, Teradata Covalent 1 & Material icons 1Ton Technologies	43K ★ 5
	<b>Angular Productivity Pack</b> 1.7.1 A collection of Angular extensions to boost productivity DevBoosts	14K ★ 5
	<b>Angular UI Bootstrap Snippets</b> 4.0.9 Angular UI Bootstrap Snippets for VS Code (HTML and JS) HerrHerrmann	64K ★ 5
	<b>Angular v5 Snippets</b> 2.14.0 Angular v5 snippets by John Papa John Papa	2.4M ★ 5
	<b>angular2-inline</b> 0.0.17 Visual Studio Code language extension for javascript/typescript files that use Angular2. Nate Wallace	124K ★ 4.5
	<b>angular2-switcher</b> 0.1.6 Easily navigate to component's files in angular2 project. infinity1207	103K ★ 5
	<b>Auto Rename Tag</b> 0.0.15 Auto rename paired HTML/XML tag Jun Han	541K ★ 4.5
	<b>Beautify</b> 1.3.0 Beautify code in place for VS Code HookyQR	2.3M ★ 4.5
	<b>Better Comments</b> 1.2.1 Improve your code commenting by annotating with alert, informational, TODOs, and more! Ammar Bad	82K ★ 5

# Let's Install Some VSCode Plugins III

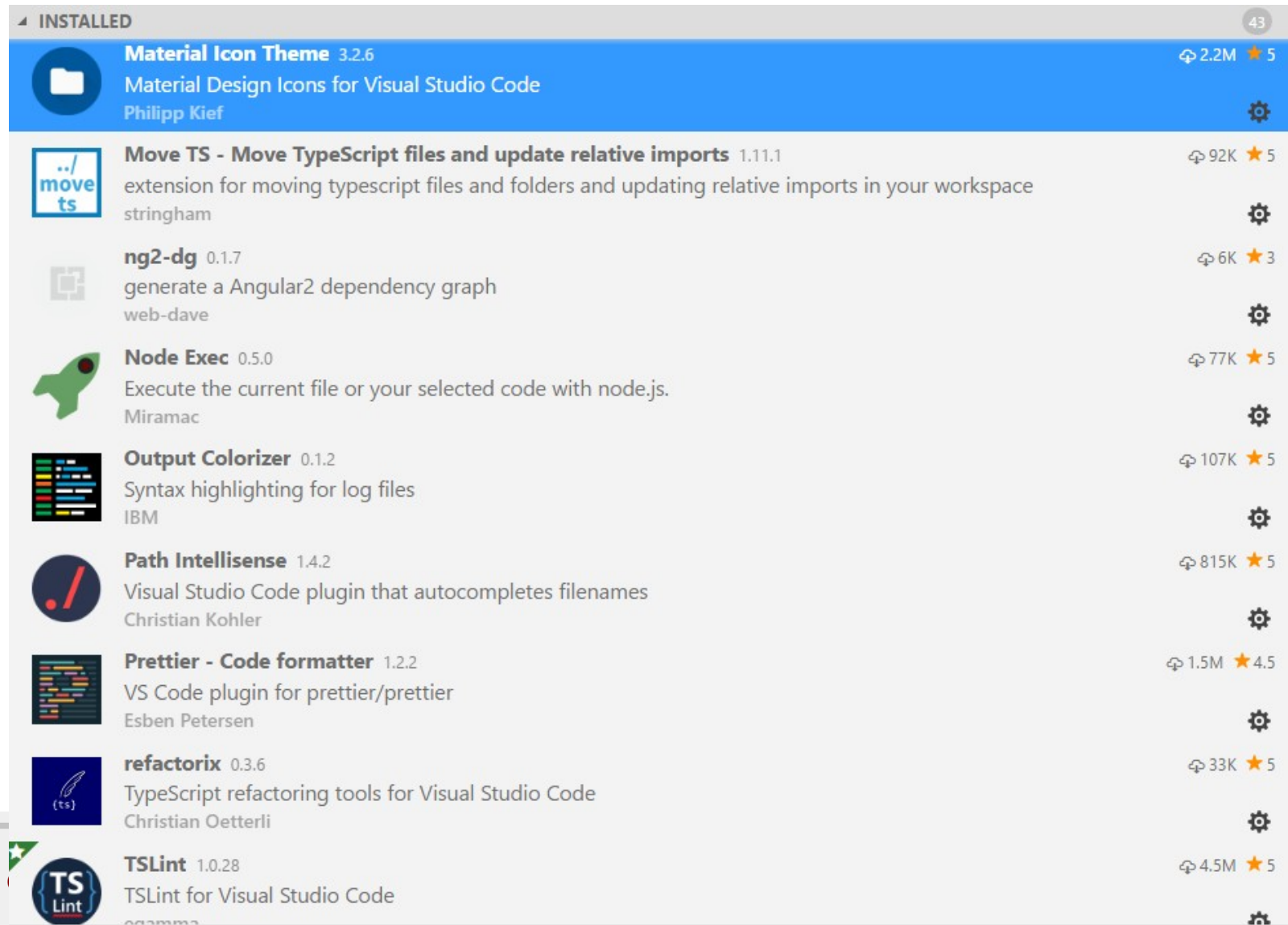


A screenshot of the VS Code Extensions view, specifically the 'INSTALLED' tab. The list shows various plugins installed on the system, including CSS Peek, Debugger for Chrome, Document This, EditorConfig for VS Code, ESLint, Git History, HTML SCSS Support, JavaScript (ES6) code snippets, and JSON to TS. Each entry includes a plugin icon, name, version, description, publisher, download count, rating, and a settings gear icon.

Plugin Name	Version	Description	Publisher	Downloads	Rating
CSS Peek	2.1.0	Allow peeking to css ID and class strings as definitions from html files to respective CSS. Allows peek and goto definition.	Pranay Prakash	162K	4
Debugger for Chrome	4.2.1	Debug your JavaScript code in the Chrome browser, or any other target that supports the Chrome Debugger protocol.	Microsoft	6.6M	4.5
Document This	0.6.0	Automatically generates detailed JSDoc comments in TypeScript and JavaScript files.	Joel Day	595K	4
EditorConfig for VS Code	0.12.1	EditorConfig Support for Visual Studio Code	EditorConfig	1.2M	5
ESLint	1.4.7	Integrates ESLint into VS Code.	Dirk Baeumer	6.1M	4.5
Git History	0.4.0	View git log, file history, compare branches or commits	Don Jayamanne	2.3M	4.5
HTML SCSS Support	0.0.42	SCSS support for HTML documents	P-de-Jong	40K	4
JavaScript (ES6) code snippets	1.5.0	Code snippets for JavaScript in ES6 syntax	charalampos karypidis	1.1M	4.5
JSON to TS	1.5.4	Convert JSON object to typescript interfaces	MariusAlchimavicius	69K	4.5



# Let's Install Some VSCode Plugins IV








A screenshot of the Visual Studio Code Extensions view, specifically the 'INSTALLED' tab. The list shows various plugins installed on the system, including Material Icon Theme, Move TS, ng2-dg, Node Exec, Output Colorizer, Path Intellisense, Prettier, refactorix, and TSLint. Each entry includes an icon, the plugin name, version, description, and download statistics.

Plugin Name	Version	Description	Downloads	Rating
Material Icon Theme	3.2.6	Material Design Icons for Visual Studio Code	2.2M	5
Move TS - Move TypeScript files and update relative imports	1.11.1	extension for moving typescript files and folders and updating relative imports in your workspace	92K	5
ng2-dg	0.1.7	generate a Angular2 dependency graph	6K	3
Node Exec	0.5.0	Execute the current file or your selected code with node.js.	77K	5
Output Colorizer	0.1.2	Syntax highlighting for log files	107K	5
Path Intellisense	1.4.2	Visual Studio Code plugin that autocompletes filenames	815K	5
Prettier - Code formatter	1.2.2	VS Code plugin for prettier/prettier	1.5M	4.5
refactorix	0.3.6	TypeScript refactoring tools for Visual Studio Code	33K	5
TSLint	1.0.28	TSLint for Visual Studio Code	4.5M	5

# Let's Install Some VSCode Plugins V

43 INSTALLED

-  **TypeScript Hero** 2.3.1  
Additional tooling for the typescript language  
Christoph Bühler  
569K ⭐ 4
-  **TypeScript Importer** 1.2.14  
Automatically searches for TypeScript definitions in workspace files and provides all known symbols as completion item to..  
pmneo  
91K ⭐ 4.5
-  **TypeScript Toolbox** 0.4.2  
Add and Optimize Imports, Generate Getters / Setters and Constructors  
DSKWRK  
109K ⭐ 4
-  **VSCode simpler Icons with Angular** 1.5.2  
A fork from vscode-great-icons. With fewer different icons and some angular icons. Mainly created for personal use.  
davidbabel  
69K ⭐ 5
-  **vscode-icons** 7.22.0  
Icons for Visual Studio Code  
Roberto Huertas  
6M ⭐ 5

# Introduction to TypeScript I

- Functions, interfaces, classes and constructors.
- Common types – Boolean, Number, String, Array, Tuple, Enum, Any, Void, Null, Undefined.
- --strictNullChecks flag
- Type assertions: `let length: number = (<string> data).length;`  
`let length: number = (data as string).length;`
- **Duck typing** = structural similarity based typing
- Declaring variables – **let**, **const** and **var**. Scopes, variable capturing, Immediately Invoked Function Expressions (IIFE), closures and **let**.

# Declaring Contracts using Interfaces I

```
export interface User {  
    id: number;  
    firstName: string;  
    lastName: string;  
    email: string;  
    password: string;  
    contact?: Contact; ← Optional properties  
    roles: Role[];  
    getSalutation(): string; ← Required methods  
}
```

# Declaring Contracts using Interfaces II

```
import { User } from './users';
export interface UserRepository {
  addUser(user: User): void;
  editUser(user: User): void;
  ...
  findAllUsers(): User[];
}
export class DemoUserRepository implements UserRepository {
  private users = new Map<number, User>();
  public addUser(user: User): void {
    if (this.findUserByEmail(user.email)) {
      throw `User with email ${user.email} exists.`;
    }
    user.id = this.getNextId();
    this.users.set(user.id, user);
  }
  ...
}
```

# Declaring Contracts using Interfaces III

- Properties, optional properties and readonly properties:

```
interface UserRepository {  
    readonly size: number;  
    addUser: (user: User) => void;  
}
```

- Function types:

```
interface RoleFinder {  
    (user: User) : Role[];  
}
```

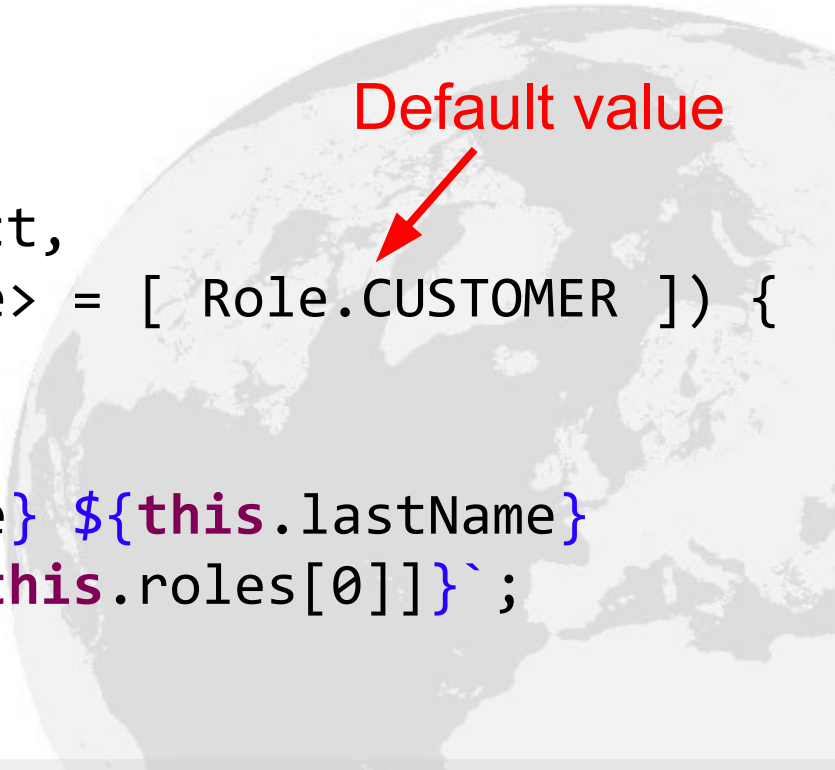
- Array (indexable) types. Dictionary pattern:

```
interface EmailUserMap {  
    [key: string]: User;  
}
```




# Class Types

```
export class Customer implements User {  
    public id: number; // set automatically by repository  
    constructor(public firstName: string,  
        public lastName: string,  
        public email: string,  
        public password: string,  
        public contacts?: Contact,  
        public roles: Array<Role> = [ Role.CUSTOMER ]) {  
    }  
    public get salutation() {  
        return `${this.firstName} ${this.lastName}  
            in role ${Role[this.roles[0]]}`;  
    }  
}
```



Default value





# Extension of Interfaces. Hybrid Types.

```
export interface Person {  
    id: number;  
    firstName: string;  
    lastName: string;  
    email: string;  
    contact?: Contact;  
}
```

```
export interface User extends Person{  
    password: string;  
    roles: Role[];  
    getSalutation(): string;  
}
```

# Classes

- Constructors, constructor arguments as properties
- Public/private/protected properties
- Get and set accessors

```
export interface User extends Person{  
    password: string;  
    roles: Role[];  
    readonly salutation: string;  
} ...  
public get salutation() {  
    return `${this.firstName} ${this.lastName}`;  
}
```

- Static and instance sides of a class. Abstract classes

# Functions and Function Types

- Optional, default and **rest (...)** parameters

```
export class Person {  
    public restNames: string[];  
    constructor(public firstName: string, ...restNames: string[]) {  
        this.restNames = restNames;  
    }  
    public get salutation() {  
        let salutation = this.firstName;  
        for (let name of this.restNames) {  
            salutation += ' ' + name;  
        }  
        return salutation;  
    }  
}  
console.log(new Person('Ivan', 'Donchev', 'Petrov').salutation);
```

# Function Lambdas ( $\Rightarrow$ ) and Use of **this**

```
export class LoginComponent {  
  constructor(private jqElem: string, private loginC: LoginController){  
    const keyboardEventHandler = (event: JQueryKeyEventObject) => {  
      if (event.keyCode === 13) {  
        loginEventHandler();  
      }  
    };  
  
    const loginEventHandler = () => {  
      this.loginC.login(usernameInput.val(), passwordInput.val())  
        .then(() => {  
          this.showCurrentUser();  
        }).catch(err => {  
          this.showError(err);  
        });  
      return false;  
    };  
    ...  
  }  
}
```

# Using Lambdas

```
const usernameInputElem =  
  $("<input id='username' type='email'>")  
    .addClass('form-control')  
    .bind('keypress', keyboardEventHandler);
```

# Type Guards & Method Overloading

```
export class DemoLoginController implements LoginController {  
    public login(email: string, password: string): Promise<User>;  
    public login(user: User): Promise<User>;  
    public login(principal: User | string, credentials?: string)  
        : Promise<User> {  
        let email: string, password: string;  
        if (typeof principal === 'string') {  
            email = principal;  
            password = credentials;  
        } else {  
            email = principal.email;  
            password = principal.password;  
        }  
        let promise = new Promise<User>( (resolve, reject) => { ... });  
        return promise;  
    }  
}
```



# Using Enums

- Defining enumeration:

```
enum Role {  
    ADMIN = 1, CUSTOMER  
}
```

- In generated code an enum is compiled into an object that stores both forward (name -> value) and reverse (value -> name) mappings.
- Getting enumerated name by value:

```
public get salutation() {  
    return `${this.name} in role ${Role[this.roles[0]]}`;  
}
```

# JavaScript Module Systems – ES6

- `// lib/math.js`  
`export function sum (x, y) { return x + y }`  
`export var pi = 3.141593`
- `// someApp.js`  
`import * as math from "lib/math"`  
`console.log("2 $\pi$  = " + math.sum(math.pi, math.pi))`
- `// otherApp.js`  
`import { sum, pi } from "lib/math"`  
`console.log("2 $\pi$  = " + sum(pi, pi))`

# Modules in TypeScript

- **Namespaces** and **modules** – former internal and external modules – prefer **namespace X { ... }** instead **module X { ... }**
- ES6 modules (preferred) – using **export** and **import**:

```
export interface Person {...}
export interface User extends Person {...}
export interface Contact {...}
export enum Role { ADMIN, CUSTOMER }
export class Customer implements User {...}
import {User} from './users';
import {resolvePromiseAfterTimeout} from './utilities';
import $ from 'jquery';
import * as repository from './user-repository'; //default import
import './my-module.js'; //import a module for side-effects only
let module = await import('/modules/my-module.js'); // dynamic
```

# Interoperability with External JS Libraries

- Ambient type declarations and ambient modules (**\*.d.ts**) – **typings, @types** – Example **node.d.ts** (simplified):

```
declare module "url" {  
    export interface Url {  
        protocol?: string;  
        hostname?: string;  
        pathname?: string;  
    }  
    export function parse(urlStr: string, parseQueryString?,  
        slashesDenoteHost?): Url;  
}  
/// <reference path="node.d.ts"/>  
import * as URL from "url";  
let myUrl = URL.parse("https://github.com/iproduct");
```

# Generic Type Parameters I

- Writing generic functions, interfaces and classes – Examples:

```
interface Repository {  
    findById<T>(id: number): T;  
    findAll<T>(): Array<T>;  
}
```

//OR

```
interface Repository<T> {  
    findById: (id: number) => T;  
    findAll(): Array<T>;  
}
```

# Generic Type Parameters II

```
export class RepositoryImpl<T> implements Repository<T> {  
    private data = new Map<number, T>();  
    public findById(id: number): T {  
        return this.data.get(id);  
    }  
    public findAll(): T[] {  
        let results: T[] = [];  
        this.data.forEach(item => results.push(item));  
        return results;  
    }  
}
```

- Bounded generics
- Generic constructors



# Advanced TypeScript Topics

- Advanced types
- Type Guards and Differentiating Types
- Type Aliases
- Symbols
- Declaration merging
- Decorators
- Using mixins in TypeScript

# Webpack Builder & Bundler Tool

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https://webpack.js.org

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## bundle your scripts

MODULES WITH DEPENDENCIES

STATIC ASSETS

Windows Taskbar: File Explorer, Edge, Mail, Firefox, Chrome, VS Code, etc.

System Tray: 10:08 PM 4/1/2018

# Creating New Project: NPM + WebPack

[<https://angular.io/guide/webpack>]

```
mkdir my-project
cd my-project
npm init
npm install webpack webpack-dev-server --save-dev
touch index.html src/index.js webpack.config.js
npm install awesome-typescript-loader angular-router-loader
  angular2-template-loader --save-dev
npm install css-loader style-loader css-to-string-loader --save-dev
npm install file-loader url-loader html-loader --save-dev
npm install extract-text-webpack-plugin html-webpack-plugin --save-dev
```

In package.json:

```
"scripts": {
  "start": "webpack-dev-server --inline --hot",
  "watch": "webpack --watch",
  "build": "webpack -p"
},
```

# Simple webpack.config.js I

```
const path = require('path');
```

```
module.exports = {  
  context: path.resolve(__dirname, 'src'),  
  entry: './index.js',  
  output: {  
    path: path.resolve(__dirname, 'dist'),  
    filename: 'bundle.js'  
  },  
  ...  
}
```

## Simple webpack.config.js II

```
module: {  
  rules: [{  
    test: /\.ts$/,  
    loaders: ['awesome-typescript-loader',  
      'angular-router-loader', 'angular2-template-loader']  
  }, {  
    test: /\.html$/,  
    loader: 'html-loader'  
  }, ...  
  {  
    test: /\.css$/,  
    include: helpers.root('src', 'app'),  
    loader: ['css-to-string-loader', 'css-loader']  
  }]  
}  
...
```

# Webpack Loaders and Plugins

- Loaders are **transformations** (functions running in node.js) that are applied on a resource file of your app
- You can use loaders to load **ES6/7** or **TypeScript**
- Loaders can be chained in a pipeline to the resource. The final loader is expected to return **JavaScript**
- Loaders can be **synchronous** or **asynchronous**
- Loaders accept **query parameters** – loader configuration
- Loaders can be **bound to extensions / RegExps**
- Loaders can be published / installed through **npm**
- **Plugins** – more universal than loaders, provide **more features**



# Webpack Loaders

[<https://webpack.js.org/loaders/>]

- **Ts-loader, awesome-typescript-loader** - TypeScript => ES 5 or 6
- **babel-loader** - turns ES6 code into vanilla ES5 using Babel
- **file-loader** - emits the file into the output folder and returns the url
- **url-loader** - like file loader, but returns Data Url if file size <= limit
- **extract-loader** - prepares HTML and CSS modules to be extracted into separate files (alt. to ExtractTextWebpackPlugin)
- **html-loader** - exports HTML as string, requiring static resources
- **style-loader** - adds exports of a module as style to DOM
- **css-loader** - loads css file resolving imports and returns css code
- **sass-loader** - loads and compiles a SASS/SCSS file
- **postcss-loader** - loads and transforms a CSS file using PostCSS
- **raw-loader** - lets you import files as a string

# Webpack Main Plugins

- **ExtractTextWebpackPlugin** - extracts CSS from your bundles into a separate file (e.g. app.bundle.css) → **mini-css-extract-plugin**
- **CompressionWebpackPlugin** - prepare compressed versions of assets to serve them with Content-Encoding
- **I18nWebpackPlugin** - adds i18n support to your bundles
- **HtmlWebpackPlugin** - simplifies creation of HTML files (index.html) to serve your bundles
- **ProvidePlugin** - automatically loads modules, whenever used
- **UglifyJsPlugin** – tree transformer and compressor which reduces the code size by applying various optimizations
- ~~**CommonsChunkPlugin**~~ - generates chunks of common modules shared between entry points and splits them to separate bundles

# Resources

- Official Webpack repo @ GitHub:  
<https://github.com/webpack/webpack>
- Webpack: An Introduction (Angular website):  
<https://v5.angular.io/guide/webpack>
- TypeScript Quick start –  
<http://www.typescriptlang.org/docs/tutorial.html>
- TypeScript Handbook –  
<http://www.typescriptlang.org/docs/handbook/basic-types.html>



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# Thanks for Your Attention!

## Questions?