

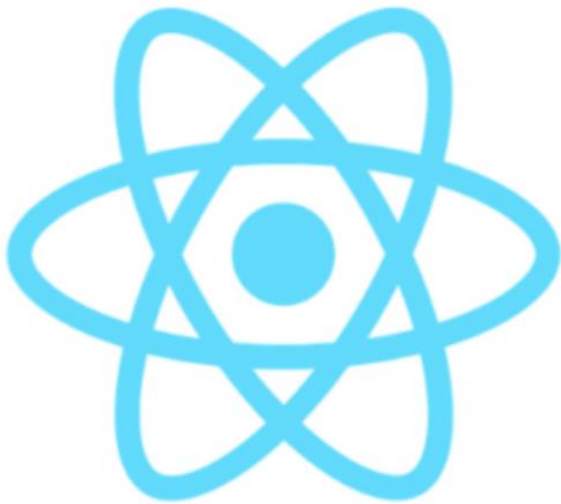


Full-stack Application Development

TypeScript

Where to Find The Code and Materials?

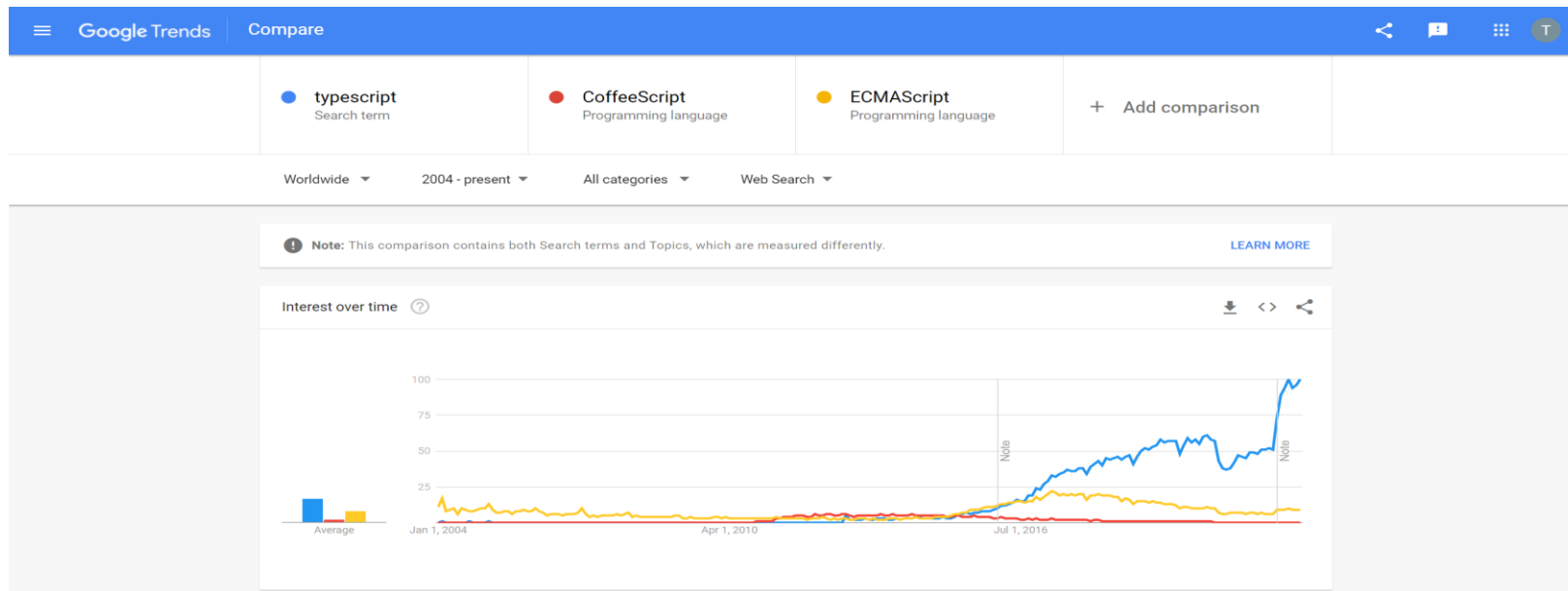
<https://github.com/iproduct/react-typescript-academy-2022>



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**, to generate it run: **tsc --init**
- 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** -> **.eslintrc.js**:
<https://palantir.github.io/tslint/rules/>
- Developing simple TS project – **Login Demo**

typescript-eslint configuration: **.eslintrc.cjs**

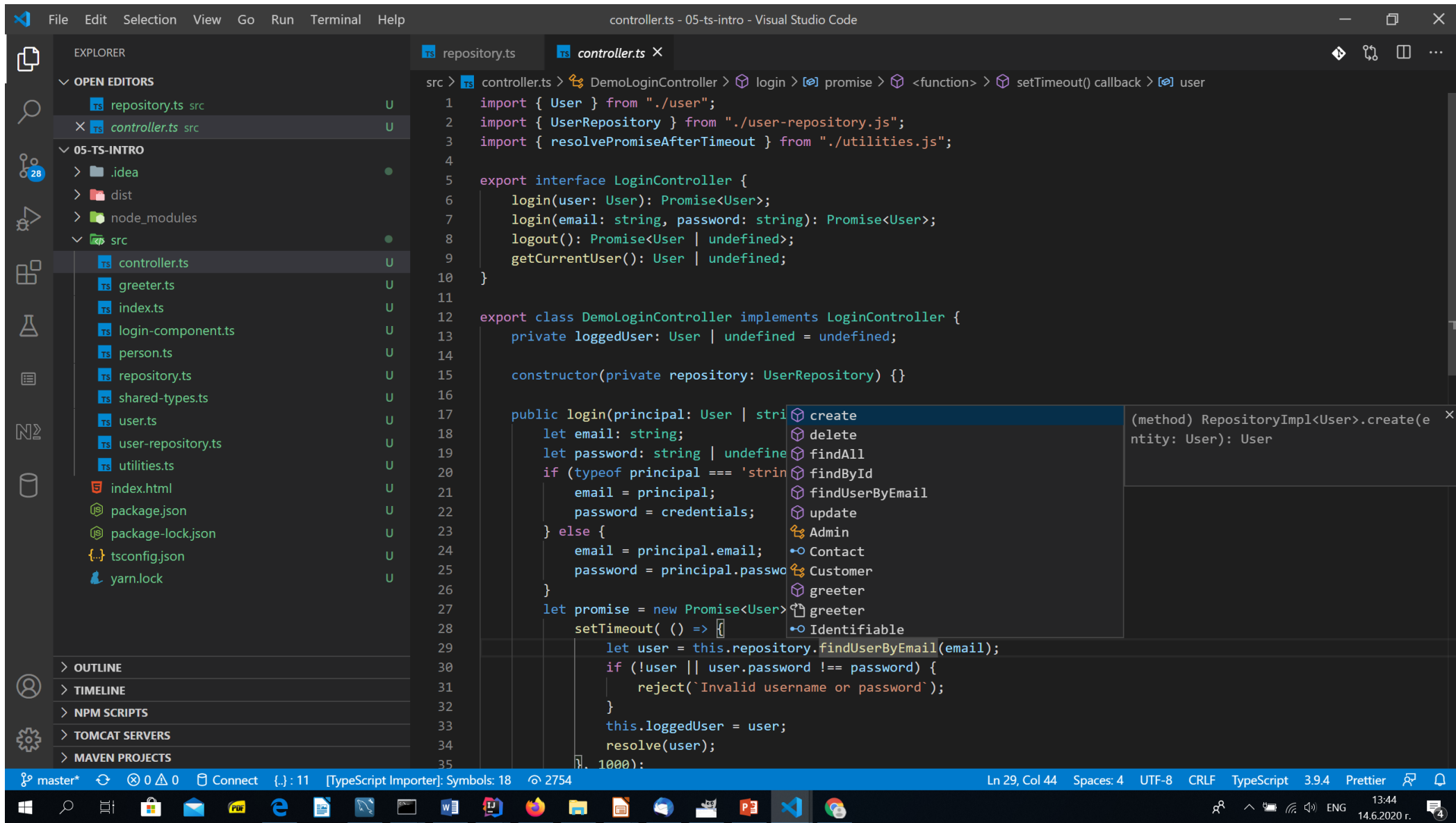
- *npm install --save-dev @typescript-eslint/parser @typescript-eslint/eslint-plugin eslint typescript*
- *yarn add --dev @typescript-eslint/parser @typescript-eslint/eslint-plugin eslint typescript*

- .eslintrc.cjs:

/ eslint-disable no-undef */*

```
module.exports = {  
  extends: ['eslint:recommended', 'plugin:@typescript-eslint/recommended'],  
  parser: '@typescript-eslint/parser',  
  plugins: ['@typescript-eslint'],  
  root: true,  
  rules: {  
    '@typescript-eslint/no-non-null-assertion': 'off',  
  }  
};
```

Visual Studio Code



Visual Studio Code

```
10 export default class UserView extends Component<Props> {  
    2 references  
11     render() {  
12         return (  
13             |  
14         );  
15     }  
16  
    0 references  
17     private getYearJoined(user: User) {  
18         return _.padStart(user.dateJoined.format('yyyy'), 6);  
19     }  
20  
    0 references  
21     private getDisplayName(user: User) {
```










VS Code: Popular Angular/TS Plugins I

- **TSLint** - linter for the TypeScript language, help fixing error in TS code. Must have when working with TS -> merged with **ESLint**.
- **ESLint** - linter for the ECMAScript and TypeScript languages, help fixing error in TS code. TSLint announced that it will merge with ESLint:
<https://github.com/typescript-eslint/tslint-to-eslint-config>
- **ES7 React/Redux/GraphQL/React-Native snippets** - This extension provides you JavaScript and React/Redux snippets in ES7 with Babel plugin features for VS Code. **Supported languages:** JavaScript (.js), JavaScript React (.jsx), TypeScript (.ts), TypeScript React (.tsx)
- **JavaScript (ES6) code snippets** – This extension contains code snippets for JavaScript in ES6 syntax for Vs Code editor – supports both JavaScript and TypeScript.
- **Typescript React code snippets** – code snippets for React with Typescript.
- **React + Typescript Code Snippets** – opinionated code snippets for React with Typescript










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 III

	Auto Import 1.5.3 Automatically finds, parses and provides code actions and code completion for all available imports. Works with Typescript and TSX steoates	959K ⭐ 4.5
★ 	Beautify 1.5.0 Beautify code in place for VS Code HookyQR	4.9M ⭐ 4.5
★ 	Docker 0.8.2 Makes it easy to create, manage, and debug containerized applications. Microsoft	4.7M ⭐ 4.5
	Document This 0.7.1 Automatically generates detailed JSDoc comments in TypeScript and JavaScript files. Joel Day	685K ⭐ 3.5
	ES7 React/Redux/GraphQL/React-Native snippets 2.8.0 Simple extensions for React, Redux and GraphQL in JS/TS with ES7 syntax dsznajder	1.5M ⭐ 4.5
★ 	ESLint 1.9.1 Integrates ESLint JavaScript into VS Code. Dirk Baeumer	9.5M ⭐ 4.5
★ 	Git History 0.6.5 View git log, file history, compare branches or commits Don Jayamanne	2.5M ⭐ 4.5
★ 	GitLens — Git supercharged 10.2.2 Supercharge the Git capabilities built into Visual Studio Code — Visualize code authorship at a glance via Git blame annotations and code lens, seamlessly navigate and ex... Eric Amodio	5.4M ⭐ 5
	JavaScript (ES6) code snippets 1.8.0 Code snippets for JavaScript in ES6 syntax charalampos karypidis	3.5M ⭐ 5

Let's Install Some VSCode Plugins IV

	JSON to TS 1.7.5 Convert JSON object to typescript interfaces MariusAlchimavicius	190K ⭐ 4.5
	Latest TypeScript and Javascript Grammar 0.0.53 This is development branch of VSCode JS/TS colorization. Please file any issues you find against https://github.com/Microsoft/TypeScript-TmLanguage/issues Microsoft	292K ⭐ 3.5
	Material Icon Theme 4.1.0 Material Design Icons for Visual Studio Code Philipp Kief	4.4M ⭐ 5
	Move TS - Move TypeScript files and update relative imports 1.12.0 extension for moving typescript files and folders and updating relative imports in your workspace stringham	291K ⭐ 4.5
	Node Exec 0.5.1 Execute the current file or your selected code with node.js. Miramac	194K ⭐ 5
★ 	npm Intellisense 1.3.0 Visual Studio Code plugin that autocompletes npm modules in import statements Christian Kohler	2.1M ⭐ 4.5
	Nx Console 12.0.0 Nx Console for Visual Studio Code nrwl	437K ⭐ 3.5
	Paste JSON as Code 12.0.46 Copy JSON, paste as Go, TypeScript, C#, C++ and more. quicktype	500K ⭐ 4.5
	Peacock 3.7.2 Subtly change the workspace color of your workspace. Ideal when you have multiple VS Code instances and you want to quickly identify which is which. John Papa	754K ⭐ 4.5

Let's Install Some VSCode Plugins V

	React + Typescript Code Snippets 2.1.0 Code snippets for react in typescript weffe	1K
	refactorix 0.3.6 TypeScript refactoring tools for Visual Studio Code Christian Oetterli	110K ★ 5
	Simple React Snippets 1.2.2 Dead simple React snippets you will actually use Burke Holland	511K ★ 5
	TSLint 1.2.3 TSLint support for Visual Studio Code Microsoft	1.9M ★ 3
	TypeScript Hero 3.0.0 Additional toolings for typescript Christoph Bühler	593K ★ 3.5
	TypeScript Importer 2.0.1 Automatically searches for TypeScript definitions in workspace files and provides all known symbols as completion item to allow code completion. pmneo	276K ★ 4.5
	Typescript React code snippets 1.3.1 Code snippets for react in typescript infeng	98K ★ 4.5
	Typescript React/Redux Snippets 0.2.0 Typescript React Snippets Alexander Botteram	15K
	TypeScript Toolbox 0.5.0 Add and Optimize Imports, Generate Getters / Setters and Constructors DSKWRK	143K ★ 3.5

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 II

- 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 (=>) 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;  
        };  
        ...  
    }  
}
```

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

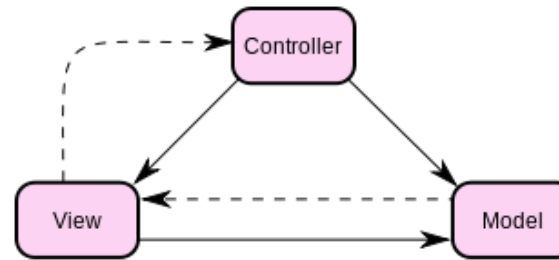
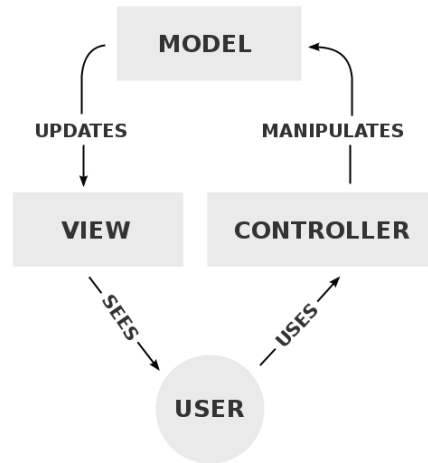
Exercise: Users Login Demo

<https://github.com/iproduct/fullstack-typescript-react/tree/master/05-ts-intro>

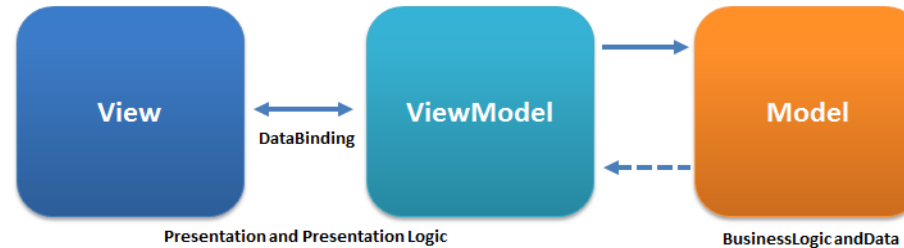


MVC Comes in Different Flavors

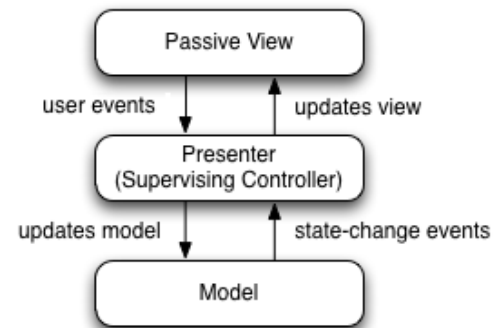
- MVC



- MVVM



- MVP



Using JavaScript Libraries in TypeScript: JQuery I

```
import { LoginController } from './controller';  
import '../node_modules/jquery/dist/jquery.js';
```

```
export class LoginComponent {  
  private messagesElement: JQuery;  
  constructor(private jqElementSelector: string, private loginController: LoginController) {  
  
    const keyboardEventHandler = (event: JQuery.Event) => {  
      if (event.keyCode === 13) {  
        loginEventHandler();  
      }  
    };  
  
    const loginEventHandler: any = () => {  
      this.loginController.login(usernameInputElem.val() as string, passwordInputElem.val() as string)  
        .then(() => {  
          this.showCurrentUser();  
        }).catch(err => {  
          this.showError(err);  
        });  
      return false;  
    };  
  }  
}
```

(- continues -)

Using JavaScript Libraries in TypeScript: JQuery II

```
const formElem = $("<form class='form-inline' role='form'>").addClass('form-inline');
const usernameInputElem: JQuery<HTMLElement> =
    $("<input id='username' type='email' placeholder='email'>")
    .addClass('form-control').bind('keypress', keyboardEventHandler);
const passwordInputElem: JQuery<HTMLElement> =
    $("<input id='password' type='password' ", keyboardEventHandler);
const loginButtonElem: JQuery<HTMLElement> =
    $('<button>Login</buttton>').addClass('btn btn-primary')
    .click(loginEventHandler);

// build the login form
formElem.append(usernameInputElem);
formElem.append(passwordInputElem);
formElem.append(loginButtonElem);
this.messagesElement = $('<div id="message" class="well well-lg">');
$(jqElementSelector).append(formElem).append(this.messagesElement);

this.showCurrentUser();
}

public showCurrentUser(): void {
    const user = this.loginController.getCurrentUser();
    this.messagesElement.html(user ? `Welcome ${user.salutation}` : `No user is logged in.`);
}
```

Webpack Builder & Bundler Tool

webpack - Mozilla Firefox

File Edit View History Bookmarks Tools Help

we X Home Media Lib AdWc AdWc M [ANS] P How t P Mar 2 P Green ex HTML ex Web ex Softw Monit 25 Goog T CALL P Open BIA Flying FX Impro Graph f > + v

https://webpack.js.org

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bundle your scripts

MODULES WITH DEPENDENCIES

STATIC ASSETS

10:08 PM 4/1/2018

Creating New Project: NPM + WebPack + React

```
mkdir my-project
cd my-project
npm init
npm install --save-dev webpack webpack-cli webpack-dev-server
touch index.html src/index.js webpack.config.js
npm install --save react react-dom
npm install --save-dev @types/react @types/react-dom
npm install --save-dev typescript ts-loader source-map-loader
// OR npm install typescript awesome-typescript-loader --save-dev
npm install css-loader style-loader css-to-string-loader --save-dev
npm install file-loader url-loader html-loader clean-webpack-plugin --save-dev
npm install extract-text-webpack-plugin html-webpack-plugin --save-dev
npm i --save-dev eslint @typescript-eslint/parser @typescript-eslint/eslint-plugin eslint-plugin-react
```

In package.json:

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

Minimal tsconfig.json

```
{
  "compilerOptions": {
    "outDir": "./dist/",
    "sourceMap": true,
    "noImplicitAny": true,
    "strictNullChecks": true,
    "module": "ESNext",
    "moduleResolution": "node",
    "target": "ES6",
    "jsx": "react",
    "allowSyntheticDefaultImports": true,
  },
  "include": [ "src/**/*" // *** The files TypeScript should type check *** ],
  "exclude": ["node_modules", "build"] // *** The files to not type check ***
}
```

- For more complete TS config see:

<https://www.sitepoint.com/react-with-typescript-best-practices/>

React Component File: /src/components/Hello.tsx

```
import * as React from 'react';
```

```
export interface HelloProps {  
  compiler: string;  
  framework: string;  
}
```

// 'HelloProps' describes the shape of props. State is never set so we use the '{}' type.

```
export class Hello extends React.Component<HelloProps, {}> {  
  render() {  
    return (  
      <h1>  
        Hello from {this.props.compiler} and {this.props.framework}!  
      </h1>  
    );  
  }  
}
```

React Main File: /src/index.tsx

```
import * as React from "react";
import * as ReactDOM from "react-dom";

import { Hello } from "../components/Hello";

ReactDOM.render(
  <Hello compiler="TypeScript" framework="React" />,
  document.getElementById("demo")
);
```


Simple webpack.config.js I

```
const path = require('path');
const HtmlWebpackPlugin = require('html-webpack-plugin');
const { CleanWebpackPlugin } = require('clean-webpack-plugin');
module.exports = {
  mode: 'development',
  entry: {
    app: './src/index.tsx',
  },
  devtool: 'inline-source-map',
  devServer: {
    contentBase: './dist',
    compress: true,
    hot: true,
    port: 9000
  },
  plugins: [
    new CleanWebpackPlugin({ cleanStaleWebpackAssets: false }),
    new HtmlWebpackPlugin({
      template: path.join(__dirname, 'index.html'),
      title: 'Hello React',
    }),
  ],
};
```

Simple webpack.config.js II

```
output: {
  filename: '[name].bundle.js',
  path: path.resolve(__dirname, 'dist'),
},
resolve: {
  extensions: ['.wasm', '.ts', '.tsx', '.mjs', '.js', '.json'],
},

module: {
  rules: [
    {
      test: /\.ts(x?)$/,
      exclude: /node_modules/,
      use: [
        {
          loader: "awesome-typescript-loader"
        }
      ]
    }
  ]
},
```

Simple webpack.config.js III

```
// optimization
optimization: {
  splitChunks: {
    cacheGroups: {
      default: false,
      vendors: false,
      // vendor chunk
      vendor: {
        // sync + async chunks
        chunks: 'all',
        // import file path containing node_modules
        test: /node_modules/
      }
    }
  }
};
```

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

- [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 → **SplitChunksPlugin**

Resources

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

Thank's for Your Attention!



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