TypeScript Introduction

What are we going to cover?

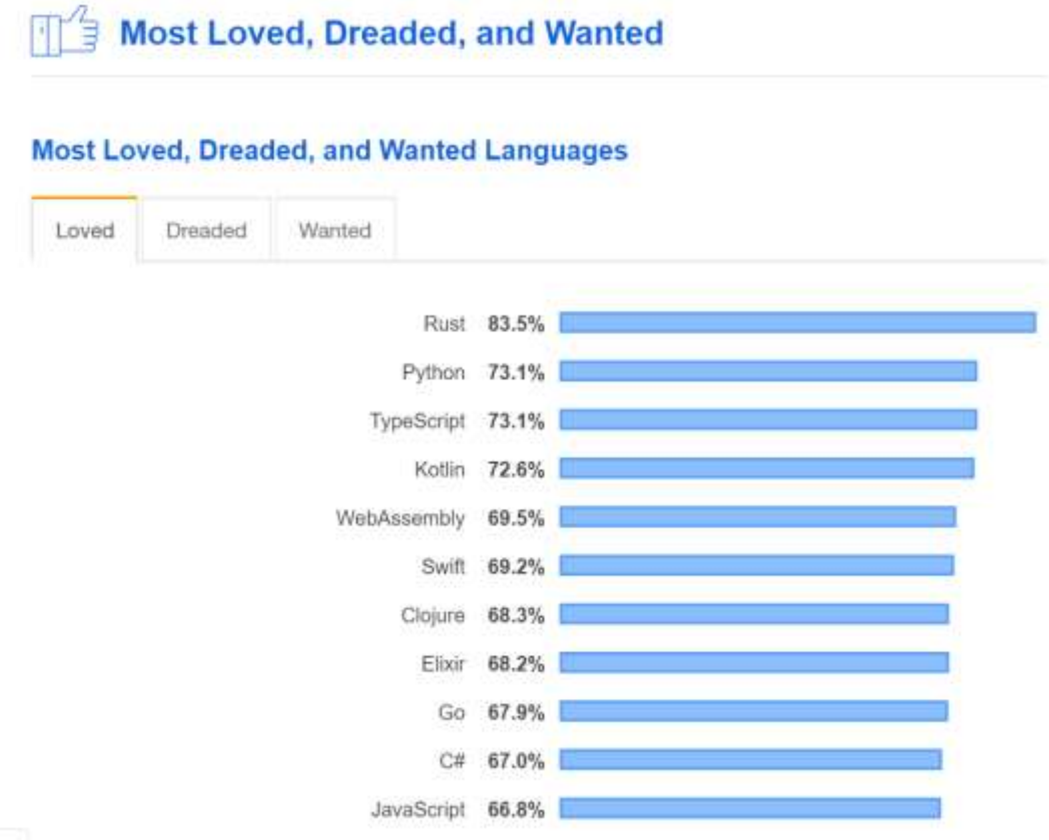
What is TypeScript?

Why use TypeScript instead of ECMAScript.

Understand the main TypeScript language constructs:

- Type inference
- Classes
- Structural typing
- Type definitions

Stackoverflow 2019 Developer Survey Results



Most Loved, Dreaded, and Wanted

Most Loved, Dreaded, and Wanted Languages

What is TypeScript?

TypeScript is a typed superset of ECMAScript 2015.

- Created at Microsoft by Anders Hejlsberg.

TypeScript is open source with an Apache 2 license.

Almost all valid JavaScript is also valid TypeScript.

Browsers don’t understand the TypeScript language.

- You need to transpile it to ECMAScript first

Many open source projects use TypeScript

Deno
- A secure runtime for JavaScript and TypeScript

Angular
- Build with the TypeScript language
- Strongly encourages application developers to do the same

RxJS
- Build with the TypeScript language

MobX
- Build with the TypeScript language

Ionic
- Build with the TypeScript language
- Encourages application developers to do the same

Installing TypeScript

The command-line compiler is a Node.js package.

- Use **npm install typescript --save-dev**
- Execute the **tsc** command to run the compiler

Many plugins for various editors

- Visual Studio 2013/2015/2017
- Visual Studio Code
- Sublime Text
- Atom
- WebStorm

Configuring the TypeScript compiler

Either use command line parameters with **tsc**.

- Easy and quick to do
- Harder to share configuration between tools like **tslint**

Alternatively create a **tsconfig.json** configuration file.

- Create one reusable configuration with **tsc --init**
- The TypeScript compiler uses it no matter how it was called

tsconfig.json

```
{
    "compilerOptions": {
        "module": "system",
        "noImplicitAny": true,
        "outFile": "../../built/local/tsc.js",
        "sourceMap": true
    },
    "include": [
        "src/**/*"
    ],
    "exclude": [
        "node_modules"
    ]
}
```

TypeScript is superset of ECMAScript

Almost all valid JavaScript is also valid TypeScript.

- With a few exceptions due to type inference

TypeScript adds optional static typing.

TypeScript supports almost all ECMAScript 2015/2016 features.

- And some features further in the future

The TypeScript compiler compiles down to ECMAScript 3, 5, 2015, 2016, 2017 or ESNEXT.

ECMAScript that causes errors in TypeScript

```
const person = {
    age: 25
};

// error TS2339: Property ‘name' does not exist on type '{ age: number; }'.
person.name = ‘John’;


const element = document.getElementById('name');
// error TS2339: Property 'value' does not exist on type 'HTMLElement'.
console.log(element.value);
```

Converted to valid TypeScript

```
const person: any = {
   age: 25
};
person.name = ‘John’;

const element =
   document.getElementById('name’) as HTMLInputElement;
console.log(element.value);
```

Basic Types

TypeScript supports all ECMAScript types.

- Boolean, number, string, object, array, null and undefined

And adds support for a number of extra types:

- Tuple
- Enum
- Any
- Void
- Unkown
- Never

Type inference

TypeScript tries to determine variable type based on usage.

With the any type you can declare variables to be dynamic and type less.

Type inference

```
// data is a number
// Same as let data: number = 42;
let data = 42;


function subtract(x, y) {
    return x - y;
}


// difference is inferred to be a number
// because of the - operator
let difference = subtract(1, 2);


function add(x: number, y: number) {
    return x + y;
}
// sum  is inferred to be a number because of adding two numbers
let sum = add(1, 2);
```

Fat arrow functions

Shorthand notation to define functions.

- Syntactically very similar to C# lambda expressions

Preserve the same reference of this as the outer function.

- Done using an ECMAScript closure

Classes

TypeScript **classes** are very similar to standard ECMAScript 2015 classes.

- Constructor, inheritance, super etc.

TypeScript does add **private** and **readonly** modifiers but these only apply to TypeScript.

- Still publicly accessible in the generated JavaScript
- Use getter and setter to prevent that

Classes

```
class Cat {
    name: string;

    constructor(name: string) {
        this.name = name;
    }

    sleep() {
        console.log(this.name, 'is sleeping');
    }
}

const zorro = new Cat('Zorro');
zorro.sleep();
```

Parameter properties

```
class Cat {
    constructor(private readonly name: string) {
    }

    sleep() {
        console.log(this.name, 'is sleeping');
    }
}

const zorro = new Cat('Zorro');
zorro.sleep();
```

Inheritance

Classes can be derived from other classes.

- Only single inheritance is possible

Mixins can be used for the same purpose

Inheritance

```
class Animal {
    constructor(private name: string) {
    }
}


class Cat extends Animal {
    constructor(name: string) {
        super(name);
    }
}
```

Interfaces

TypeScript **interfaces** can be used to describe the shape of objects.

- Do not contain any actual code

These interfaces are only used at **compile time** by TypeScript.

- No JavaScript is generated for them

Interface names do not start with an I!

Interfaces

```
interface CatLike {
    sleep()
}

class Cat implements CatLike {
    constructor(private readonly name: string) {}

    sleep() {
       console.log(this.name, 'is sleeping');
    }
}
const zorro: CatLike = new Cat('Zorro');
zorro.sleep();
```

Type Alias

A **type alias** is another powerful way to define types

- Originally just a new name for an existing type

The **preferred approach** these days

- Can do almost anything an interface can and much more

The **typeof** operator can be used to derive types

Type Alias

```
type CatLike = {
  sleep(): void
};

class Cat implements CatLike {
  constructor(private readonly name: string) {}

  sleep() {
    console.log(this.name, "is sleeping");
  }
}
```

Typeof operator

```
const person = {
  firstName: "Maurice",
  lastName: "de Beijer"
};

type Person = typeof person;

function print(p: Person) {
  console.log(p.firstName, p.lastName);
}
```

Structural typing

The TypeScript compiler actually uses **structural typing**.

The compiler checks if the required type shapes match.

- Interfaces are just a named type descriptions

You can also describe the expected shape inline if you prefer.

- Interfaces and classes make a type more reusable then inlining

Structural typing

```
// Be like a CatLike interface
function beforeDinner(cat: CatLike) { cat.sleep(); }

// Be like a Cat
function eatDinner(cat: Cat) { cat.sleep(); }

// Have a sleep() function
function afterDinner(cat: {sleep()}) { cat.sleep(); }

const zorro = new Cat('Zorro');

beforeDinner(zorro);
eatDinner(zorro)
afterDinner(zorro);
```

Generics

Generic classes and functions are more flexible in their usage.

- Create types that depend on other types

You can add **constraints** to generics as needed.

Generics

```
class Cat {
    constructor(public name : string) {}
}

class Fish {}

class PetShop <T extends {name : string}> {
    sell(pet : T) {
        console.log('Selling', pet.name);
    }
}
const shop = new PetShop();
shop.sell(new Cat('Zorro'));
// error TS2345: Argument of type 'Fish' is not
assignable to parameter of type '{ name: string; }'.
Property 'name' is missing in type 'Fish'.
shop.sell(new Fish());
```

Working with existing libraries

Use **type definitions** with the public interface.

- Provides compile time checking for jQuery, AngularJS etc.

DefinitelyTyped is the main repository.

- https://github.com/borisyankov/DefinitelyTyped

Create a new type definition using **dts-gen**

- Or use the **--allowJs** to have the TypeScript compiler parse ECMAScript

Conclusion

TypeScript is a superset of ECMAScript 2015.

- Adds type annotations and checking
- And much more

Easy to get started with.

- Most valid JavaScript is also valid TypeScript
- Just rename your files and use the tsc compiler

Using TypeScript can reduce the number of potential bugs.

- Type inference and checking warns for possible errors

Makes writing large JavaScript applications a lot easier and safer.