

Typescript

Overview.

- **Open source language, developed by Microsoft (2010-12).**
 - *Anders Hejlsberg*, the creator of C# and Turbo Pascal
- **Based on ECMAScript 4 and 6.**
- **A superset of Javascript.**
- **We still write JS, but augmented by the class-based OOP of ES6, and the structural type system of ES4.**
- **TS is compiled to regular JS and runs in any browser, any host, and OS,**
- **“... and one thing TS got right: local type inference”** Bernard Eich
- **“What impressed me the most is what TS doesn't do; it does not output type checking into your JS code”** Nicholas C Zakas .
- **TS is a a language for application-scale JavaScript development**

File Extensions.

- **.ts - source file extension.**
- **.d.ts - declaration files.**
- **Declaration source files:**
 - **Provide type definitions, separate from the source code.**
 - Analogous to header files in C/C++..
 - **Also used to describe the exported virtual TypeScript types of a third-party JavaScript library, allowing TS developers to consume it.**
 - **Tooling - Gives type safety, intellisense and compile errors.**

Types

- **Primitive Types:**
 - number – represents integers. Floats, doubles
 - booleans
 - string – single or double quote
 - null
 - undefined
- **Object Types:**
 - Class, module, interface and literal types.
 - Supports typed arrays.
- **The Any type:**
 - All types are subtypes of a single top type called the Any type.
 - Represents any JavaScript value with no constraints.

Type Annotations.

- (Optional) static typing.
- Lightweight way to record the intended contract of a variable or function.
- Applied using a post-fix syntax.
 - e.g. `let me : string = “Diarmuid O; Connor”`
- Typed Array:
 `let myNums: number[] = [1, 2, 3, 5];`
- Can also apply to function signature:

```
function add(a: number, b: number) {  
    return a + b;  
}
```

Classes

- **Support for ECMAScript 6 alike classes.**
- **public or private member accessibility.**
- **Parameter property declarations via constructor.**
- **Supports single-parent inheritance.**
- **Derived classes make use of super calls to parent.**

```
class Animal {  
    constructor(public name) { }  
    move(meters) {  
        alert(this.name + " moved " + meters + "m.");  
    }  
}  
  
class Snake extends Animal {  
    move() {  
        alert("Slithering...");  
        super.move(5);  
    }  
}  
  
class Horse extends Animal {  
    move() {  
        alert("Galloping...");  
        super.move(45);  
    }  
}
```

Interfaces.

- **Designed for development tooling support only.**
- **No output when compiled to JavaScript.**
- **Open for extension (may declare across multiple files).**
- **Supports implementing multiple interfaces.**

```
interface Drivable {
    start(): void;
    drive(distance: number): void;
    getPosition(): number;
}

class Car implements Drivable {
    private isRunning: bool = false;
    private distanceFromStart: number;

    public start(): void {
        this.isRunning = true;
    }
    public drive(distance: number): void {
        if (this.isRunning) {
            this.distanceFromStart += distance;
        }
    }
    public getPosition(): number {
        return this.distanceFromStart;
    }
}
```

Interface Data Types.

- An interface data type tells the TypeScript compiler about property names an object can have and their corresponding value types. Therefore, interface is a type and is an abstract type since it is composed of primitive types.

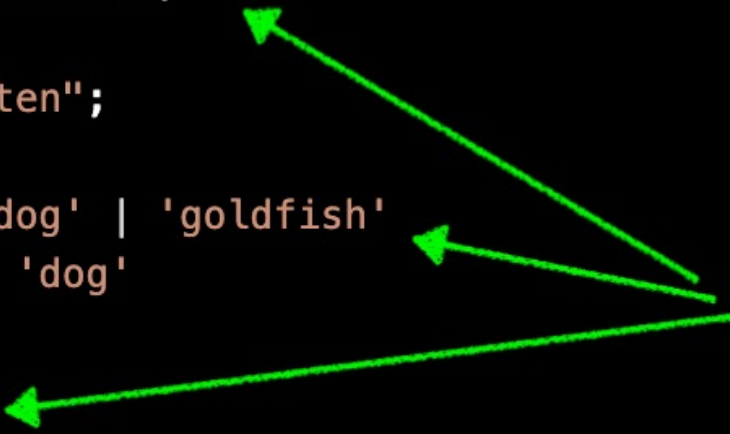
```
interface Person {  
    first: string;  
    last: string;  
}
```

```
const me: Person = {  
    first: "diarmuid",  
    last: "o connor",  
};
```


Type Aliases.

- Type aliases create a new name for a type. Type aliases are sometimes similar to interfaces, but can name primitives, unions, tuples, and any other types.

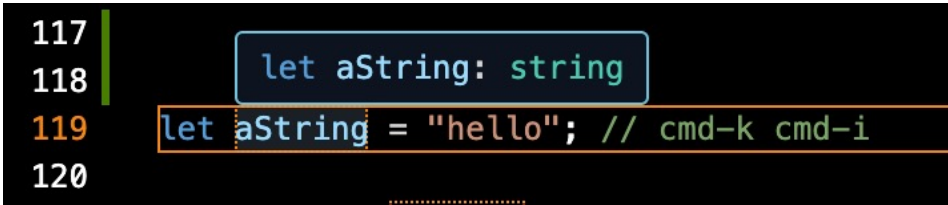
```
11  type alphaNumeric = string | number;
12  let num : alphaNumeric = 10;
13  const str : alphaNumeric = "ten";
14
15  type PetCategory = 'cat' | 'dog' | 'goldfish'
16  let petXType : PetCategory = 'dog'
17
18  type Point = {
19      x: number;
20      y: number;
21  };
22
23  let pt : Point = {x: 10, y: 20};
24
```



Type Inference.


- **TS compiler can infer the types of variables based on their values.**

```
117 |  
118 |  
119 | let aString = "hello"; // cmd-k cmd-i  
120 |
```



- **Inferencing increases developer productivity.**

```
128 const friends: Person[] = [  
129   { first: "bob", last: "sullivan" },  
130   { first: "kyle", last: "dwyer" },  
131   { first: "jane", last: "smith" },  
132 ];  
133 const sFriends = friends.filter((friend) => friend.last.startsWith("s"));  
134
```



Functions.

- Declaring the types in a function's signature.

```
4 function addNumbers(a: number, b: number): number {  
5     return a + b;  
6 }
```

- Compiler can often infer the return type.

```
8  
9 TS i function addtoNumberArray(nums: number[], inc: number): number[]  
10 export function addtoNumberArray(nums: number[], inc: number) { You, 8 n  
11     const newNums = nums.map((num) => num + inc);  
12     return newNums;  
13 }
```

Higher Order Functions (HOF).

- Declaring the callback's type in a HOF.

callback : (param1: type, param2: type, ...) => type

```
4 export function printToConsole(  
5   text: string,  
6   callback: (s: string) => string  
7 ): void {  
8   const response = callback(text);  
9   console.log(response);  
10 }
```

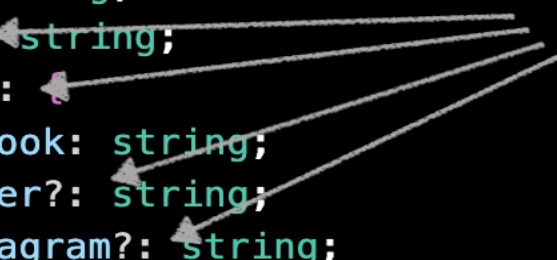
```
12 export function arrayMutate(  
13   numbers: number[],  
14   mutate: (num: number) => number  
15 ): number[] {  
16   return numbers.map(mutate);  
17 }
```

- This function signature syntax can be used in type aliases to improve code readability and type safety

Optionals. (?)

- Optional object properties are properties that can hold a value or be undefined.

```
4  interface User {  
5      id: string;  
6      name: string;  
7      email?: string;  
8      social?:  
9          facebook: string;  
10         twitter?: string;  
11         instagram?: string;  
12     };  
13     status : boolean  
14 }
```



- May also be used with function parameters.
 - An optional parameter cannot precede a required one.
 - Must accommodate undefined case in body – otherwise compiler errors may arise.

Union types & Type Literals

- **Union types** are used when a value can be more than a single type, e.g.
type Size = string | number
let glassSz : Size = 'medium'
let bottleSz: Size = 2. // litre
type Role = Student | Lecturer | Manager
- **Literal types** - three sets of literal types available in TS: strings, numbers, and booleans; by using literal types you can allow an exact value which a string, number, or boolean must have.
e.g. type DegreeNomination = 'BSc' | 'BEng' | 'BA' | 'BBs'

Generics

- *A major part of software engineering is building components that not only have well-defined and consistent APIs, but are also reusable, i.e. can be used for multiple data types.*
- *Generics allow creating 'type variables' which can be used to create classes, functions & type aliases that don't need to explicitly define the data types that they use.*

```
29 // T is a type variable - it's assigned a Type on invocation
30 // element and num are parameters that are assigned values on invocation
31 function process<T>( element: T, num: number) {
32     // process T
33 }
34
35 process<Person>( personX, 5)
36 process<Box>( boxY, 12)
37
```

Utility Types

- TypeScript provides several utility types to facilitate common type transformations.
- These utilities are available globally.

