Q

Can JavaScript be made less rubbish?

JS strict mode

Errors are generated for

- any assignment to:
  - a non-writable property,
  - a getter-only property,
  - a non-existing property,
  - a non-existing variable,
  - a non-existing object.
- any deletion of variable, function or undeletable property (e.g. delete Object.prototype;)
- usage of forbidden words (eval, arguments, implements, interface, let, package, private, protected, public, static, yield)
- duplication of parameters (e.g. f(p,p));
- usage of with operator

The "use strict" directive is only recognized at the **beginning** of a script or a function.
In a function it has local scope.

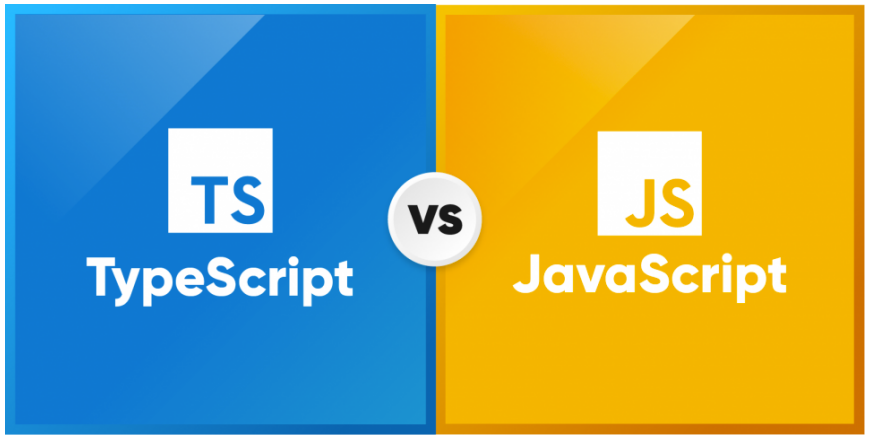
see https://www.w3schools.com/js/js_strict.asp

Polyfilling and transpiling

- Polyfiling is one of the methodologies that can be used as a sort of backward compatibility measurement.
- “A polyfill, or polyfiller, is a piece of code (or plugin) that provides the technology that you, the developer, expect the browser to provide natively. (Remy Sharp).”

- a “Transpiler” is a tool that transforms code with newer syntax into older code equivalents. This process is called “Transpiling”.

Making life easier with Typescript



See also https://www.typescriptlang.org/docs/handbook/

(Some slides adapted from LifeMichael.com)

TypeScript

- The TypeScript programming language was developed by Microsoft. It is an open source programming language.
- The code we write in TypeScript is compiled into JavaScript (transpiled)
- TypeScript gives us the capabilities, which are required to develop large scale applications using JavaScript.

TypeScript

- TypeScript is a superset of JavaScript. It includes the entire JavaScript programming language together with additional capabilities.
- TypeScript allows us to use JavaScript as if it was a strictly type programming language.
  - TypeScript allows us to specify the type of the variables.
  - TypeScript allows us to define classes and interfaces.

TypeScript

- In general, nearly every code we can write in JavaScript can be included in code we write in TypeScript.
- Compiling TypeScript into JavaScript we get a clean simple ES3 compliant code we can run in any web browser

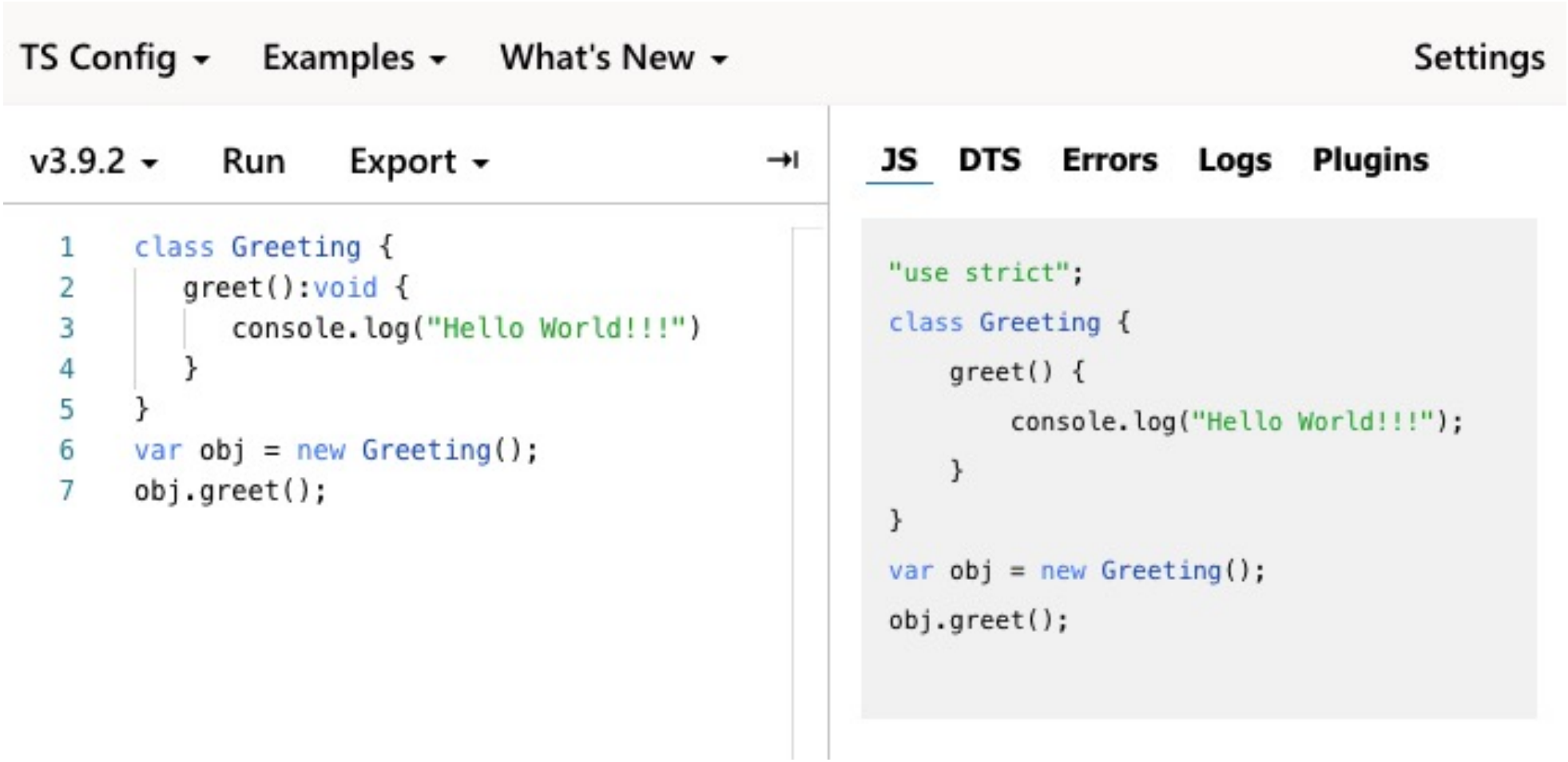
TypeScript

- Installing the official transpiler

https://www.w3schools.com/typescript/typescript_getstarted.php

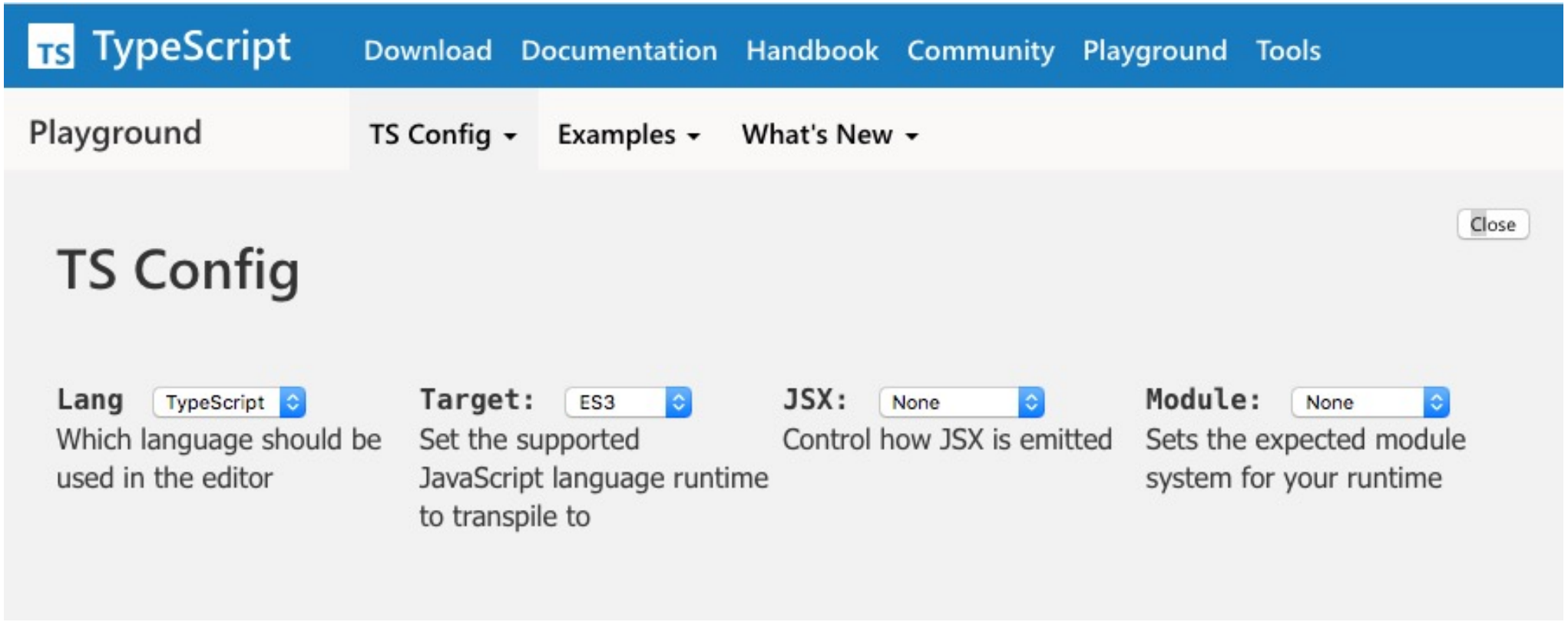
The TypeScript playground

https://www.typescriptlang.org/play/

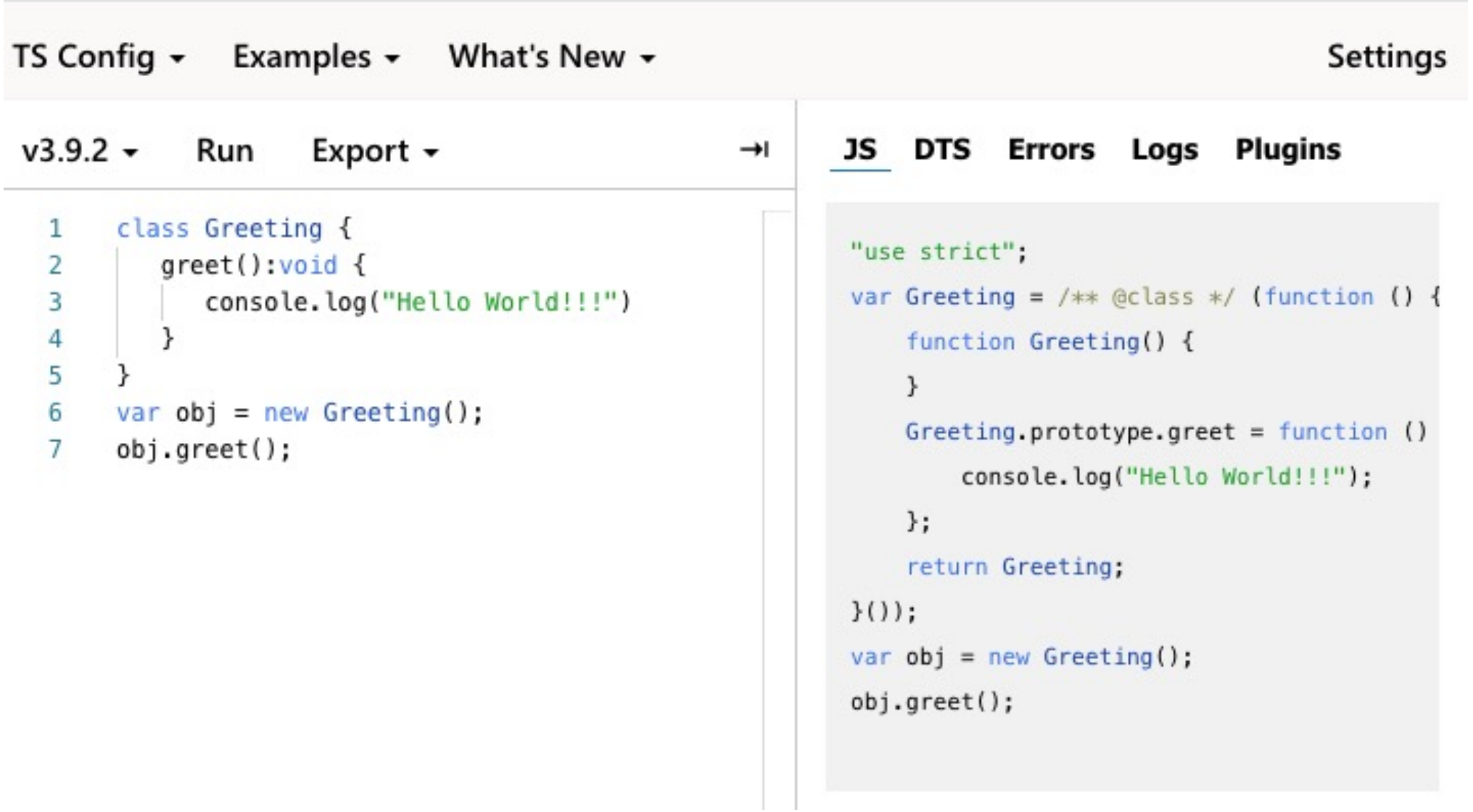


EcmaScript 2017

Configuring TypeScript playground

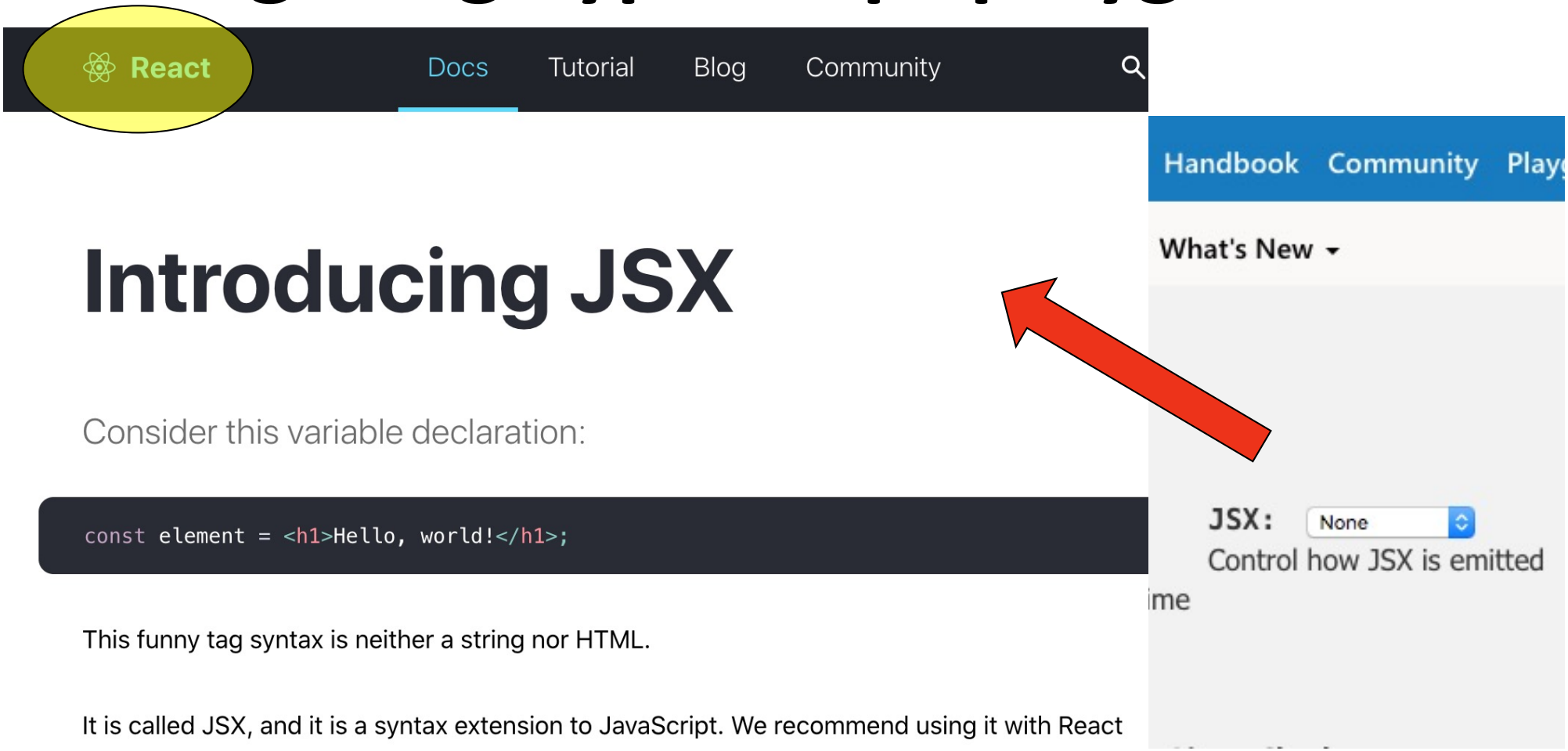


Configuring TypeScript playground



ES 3

Configuring TypeScript playground



Variable typing

We define the type of the variables:

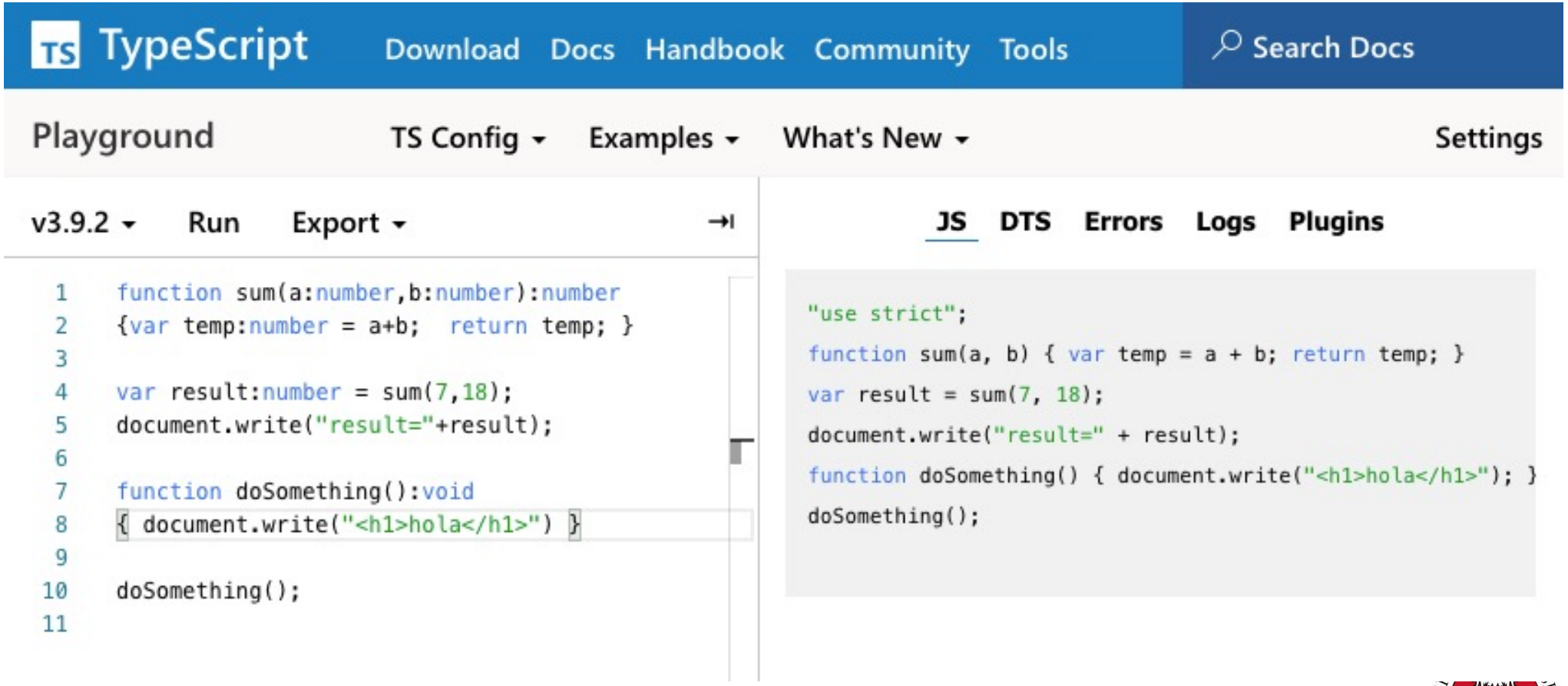
name:type

```
var id:number = 221255;
var aname:string = "Dorothea";
var tall:boolean = true;
var names:string[] = ['pippo','pluto','minnie'];
```

Function typing

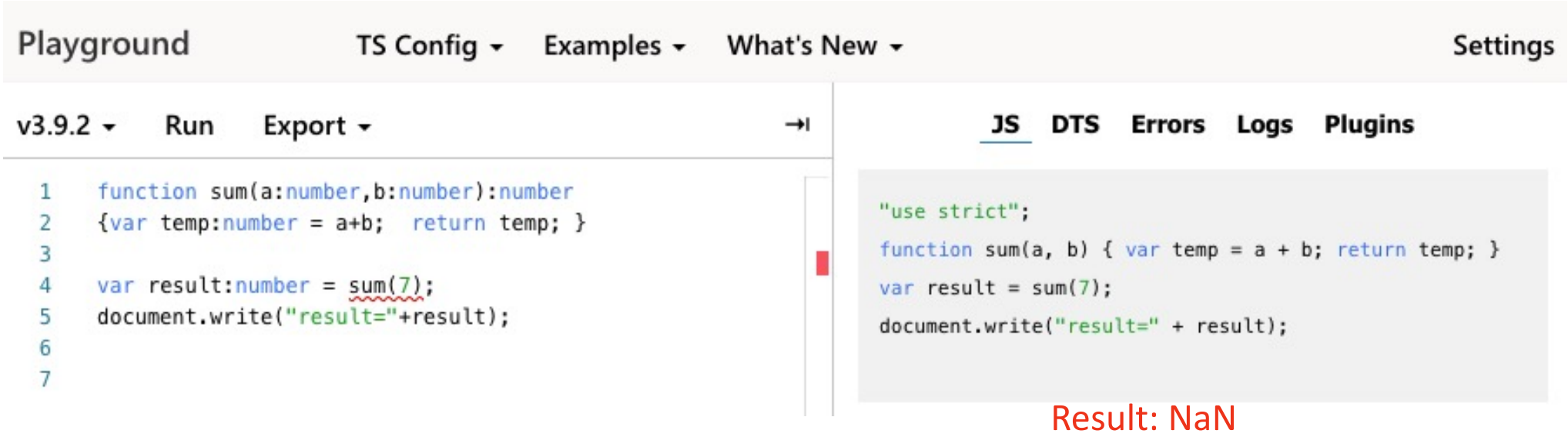
We define the type of the variables:

name:type



Number of params

- Unlike JavaScript, when calling a function passing over arguments the number of arguments must match the number of the parameters, otherwise then we get a compilation error.



Result: NaN

Optional params

- Adding the question mark to the name of a parameter will turn that parameter into an optional one.
- The optional parameters should be after any other required one. They should be the last ones.

```
function sum(a:number,b:number,c?:number):number
{
var total = 0;
if(c!==undefined) { total += c; }
total += (a+b); return total;
}

var temp = sum(7,8);
document.write("temp="+temp);
```

Default params

- When defining a function we can specify default values for any of its parameters. Doing so, if an argument is not passed over to the parameter then the default value we specified will be set instead.

Playground TS Config Examples What's New Settings

v3.9.2 Run Export

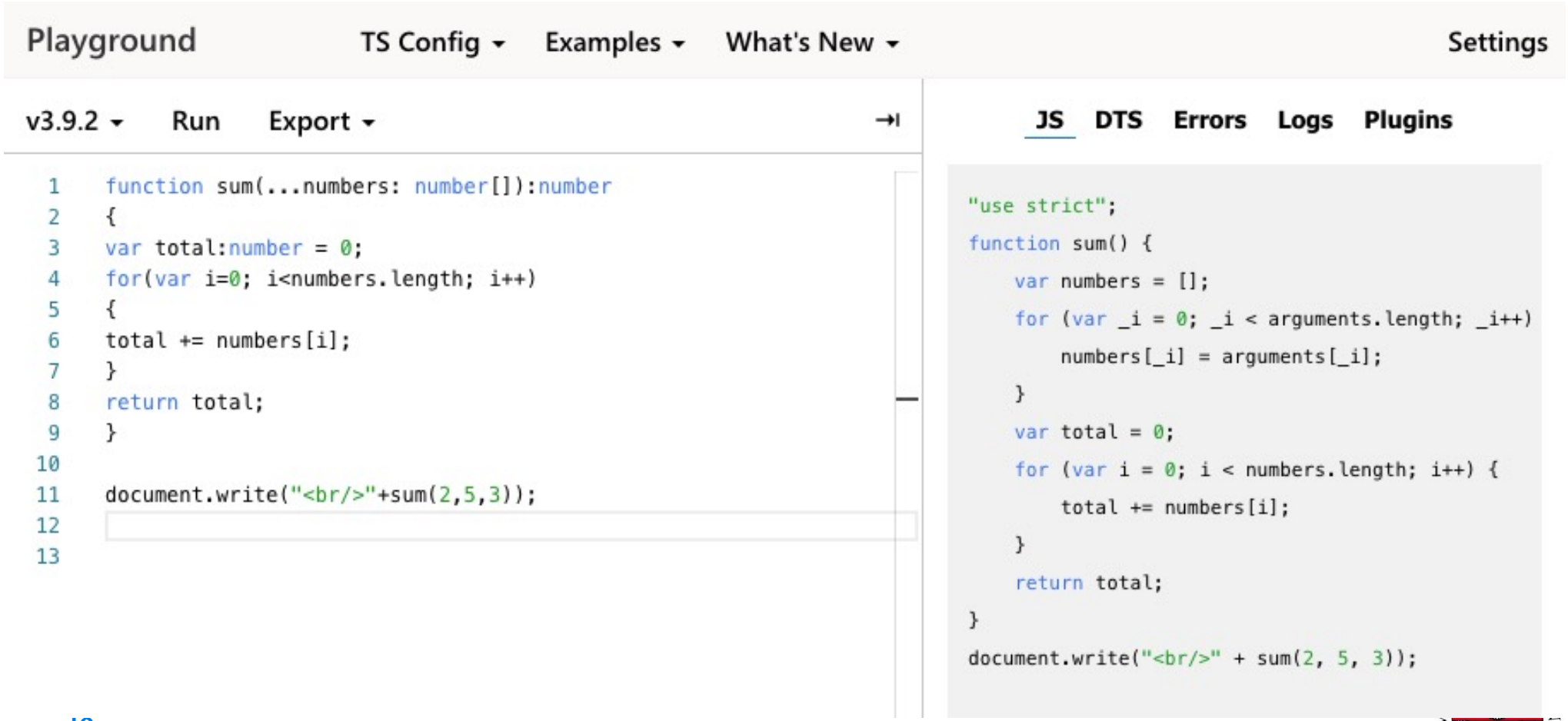
```
1  function dosomething(a:number,b:number,step:number=((b-a)%5)) {
2    var i=a;
3    while(a<=b) {
4     document.write("<br/>"+a);  a+=step;
5    }
6  }
7
8  dosomething(1,20);
9
```

JS DTS Errors Logs Plugins

```
"use strict";
function dosomething(a, b, step) {
    if (step === void 0) { step = ((b - a) % 5); }
    var i = a;
    while (a <= b) {
        document.write("<br/>" + a);
        a += step;
    }
}
dosomething(1, 20);
```


Rest params

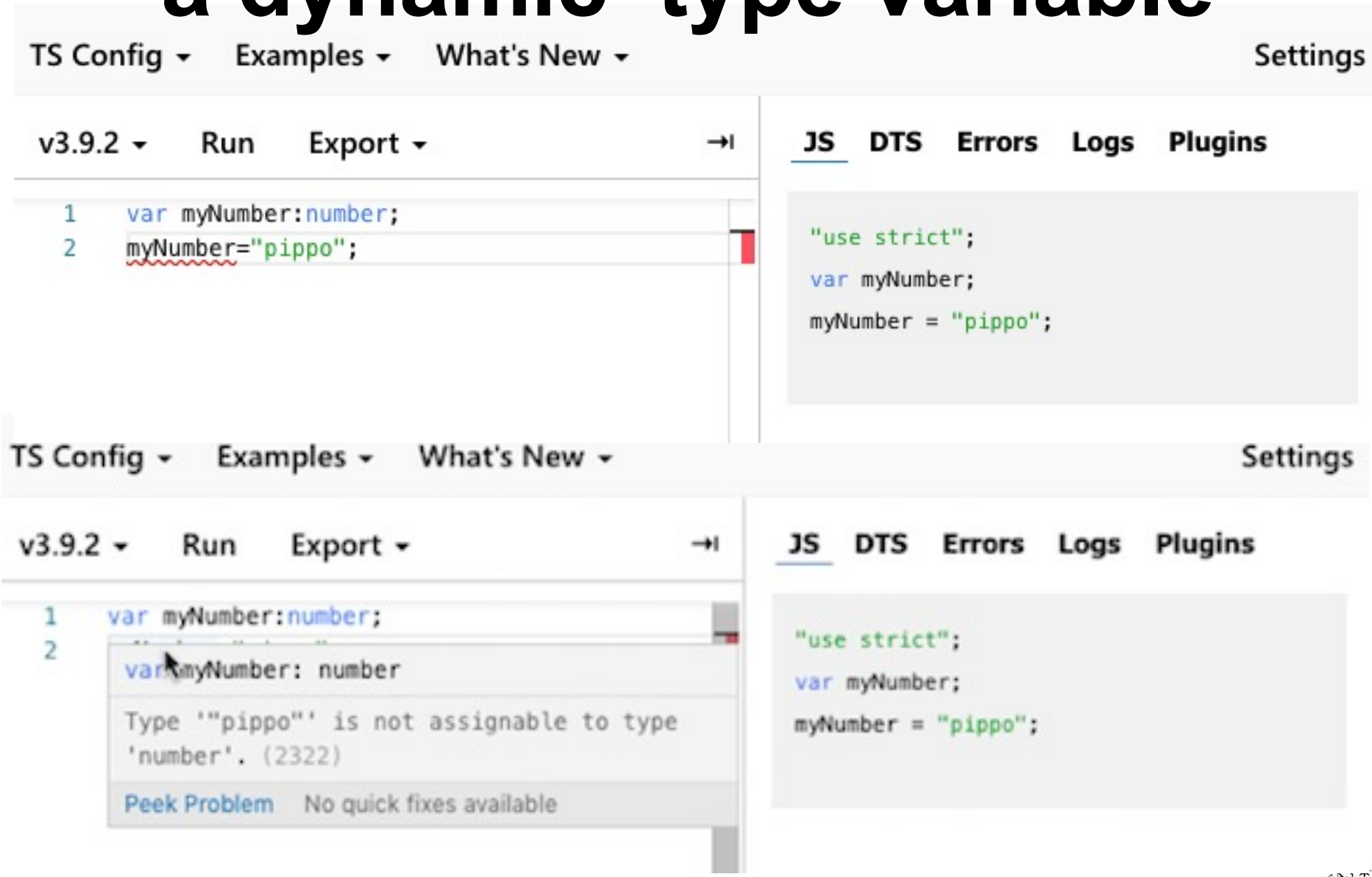
- We can define a function with an arbitrary number of params (like the "main" in Java).



TypeScript

- When starting from standard JavaScript, you might get some errors due to the differences between JavaScript and TypeScript.
- For instance, you get an error if you treat a variable in our code as if it was a dynamic type variable (as in JavaScript).
- Unlike other programming languages, when getting error messages from the TypeScript compiler it will still try to execute the code.

treating a variable as if it was a dynamic type variable



Dynamic type variables

We can create a variable with a dynamic type if we specify its type to be `any`.

```
var temp:any = 3;
temp = 'a';
temp = [23,5,23];
temp = true;
temp = new Object();
```


Classes

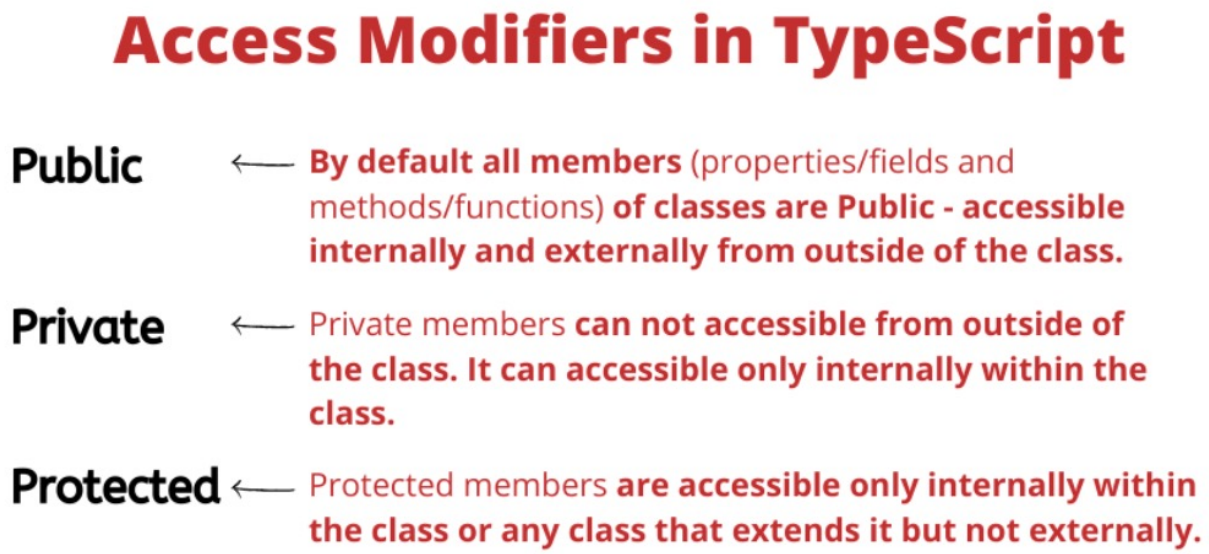
```
class Car {
   //field
   engine:string;

   //constructor
   constructor(engine:string) {
      this.engine = engine
   }

   //function
   disp():void {
      console.log("Engine is   :   "+this.engine)
   }
}
```

Constructor

- When we define a new class it automatically has a constructor, the default one.
- We can define a new constructor. When doing so, the default one will be deleted.
- There is no constructor polymorfism.
- When we define a new constructor we can specify each one of its parameters with an access modifier and by doing so indirectly define those parameters as instance variables

Access modifiers

- The available access modifiers are `private`, `public` and `protected`. The `public` access modifier is the default one. If we don't specify an access modifier then it is `public`.



Instance vars and methods

- The variables are usually declared before the constructor. Each variable definition includes three parts. The optional access modifier, the identifier and the type annotation.
- The methods are declared without using the function keyword. We can precede the function name with an access modifier and we can append the function declaration with the type of its returned value.

Instance vars and methods

```
class Rectangle
{
    private width:number;
    private height:number;
    constructor(width:number,height:number)
    {
        this.width = width;
        this.height = height;
    }

    protected area():number
    {
        return this.width*this.height;
    }

}
```

Static vars and methods

- We can define static variables and static methods by adding the `static` keyword. Accessing `static` variables and methods is done using the name of the class.

Static vars and methods

```
class FinanceUtils
{
    public static VAT = 0.18;
    public static calculateVAT(sum:number):number
    {
        return FinanceUtils.VAT*sum;
    }
}

var price:number = 1020;
document.write("<br/>"+FinanceUtils.calculateVAT(price));
```

Class inheritance

```
class Shape {
   Area:number

   constructor(a:number) {
      this.Area = a
   }
}

class Circle extends Shape {
   disp():void {
      console.log("Area of the circle:  "+this.Area)
   }
}

var obj = new Circle(223);
obj.disp()
```

Type assertion

- *Type assertions* are a way to tell the compiler "trust me, I know what I'm doing." A type assertion is like a type cast in other languages, but performs no special checking. It has no runtime impact, and is used purely by the compiler.

```
class Person {
  id:number;
  name:string;
}

class Student extends Person
{
  average:number;
}

var a:Person = new Student();
var b:Student = <Student>a;
```

Generics

function identity<T>(arg: T): T { return arg; }

Usages:

explicit form:

let output = identity<string>("myString"); // ^ = let output: string

implicit form:

let output = identity("myString"); // ^ = let output: string

see https://www.typescriptlang.org/docs/handbook/generics.html

Other class related issues

- TypeScript doesn't support multiple inheritance.
- super()

The super call must supply all parameters for base class.
The constructor is not inherited.

- Classes implement interfaces

```
class Student implements Iprintable {…}
```


The next big thing: interfaces

- We can use Interfaces as data type definition
- They fully disappear in JavaScript!

Playground TS Config Examples What's New Settings

v3.9.2 Run Export

```
1   interface IPerson {
2       firstName:string,
3       lastName:string,
4       sayHi: ()=>string
5   }
6
7   var customer:IPerson = {
8       firstName:"Tom",
9       lastName:"Hanks",
10      sayHi: ():string =>{return "Hi there"}
11  }
12
13  console.log("Customer Object ")
14  console.log(customer.firstName)
15  console.log(customer.lastName)
16  console.log(customer.sayHi())
```

JS DTS Errors Logs Plugins

```
"use strict";
var customer = {
    firstName: "Tom",
    lastName: "Hanks",
    sayHi: function () { return "Hi there"; }
};
console.log("Customer Object ");
console.log(customer.firstName);
console.log(customer.lastName);
console.log(customer.sayHi());
```

interfaces multiple inheritance

```
interface IParent1 {
    v1:number
}

interface IParent2 {
    v2:number
}

interface Child extends IParent1, IParent2 { }
var Iobj:Child = { v1:12, v2:23}
console.log("value 1: "+this.v1+" value 2: "+this.v2)
```

duck inheritance

```
class Vehicle {
    public run(): void { console.log('Vehicle.run'); }
}

class Task {
    public run(): void { console.log('Task.run'); }
}

function runTask(t: Task) {
    t.run();
}

runTask(new Task());
runTask(new Vehicle());
```


Duck Typing

- Duck typing in computer programming is an application of the duck test—"If it walks like a duck and it quacks like a duck, then it must be a duck"—to determine if an object can be used for a particular purpose. With normal typing, suitability is determined by an object's type.

Duck-Typing is **a method/rule used to check the type compatibility for more complex variable types**. TypeScript uses the duck-typing method to compare one object with other objects by checking that both objects have the same type matching names or not.

avoiding duck inheritance - 1

```
class Vehicle {
    private x: string="A";
    public run(): void { console.log('Vehicle.run'); }
}

class Task {
    private x: string="A";
    public run(): void { console.log('Task.run'); }
}

function runTask(t: Task) {
    t.run();
}

runTask(new Task());
runTask(new Vehicle()); // Will be a compile time error
```

Argument of type 'Vehicle' is not assignable to parameter of type 'Task'.
Types have separate declarations of a private property 'x'.(2345)

avoiding duck inheritance - 2

```
class Vehicle {
    private x: string="A";
    public run(): void { console.log('Vehicle.run'); }
}

class Task {
    private s: string="A";
    public run(): void { console.log('Task.run'); }
}

function runTask(t: Task) {
    t.run();
}

runTask(new Task());
runTask(new Vehicle()); // Will be a compile time error
```

Argument of type 'Vehicle' is not assignable to parameter of type 'Task'.
Property 's' is missing in type 'Vehicle' but required in type 'Task'.(2345)

References for TypeScript

- http://www.typescriptlang.org
- https://www.tutorialspoint.com/typescript/index.htm