Learn With

Knowledge to Boost Your Career

Introduction To TypeScript

WWW.LEARN-WITH.COM

Part of the DotComIt Brain Trust

Learn With
Introduction to TypeScript

By Jeffry Houser

http://www.learn-with.com

http://www.jeffryhouser.com

https://www.dot-com-it.com

Contents

Introduction to TypeScript

TypeScript is a strongly typed language which can be used to build web applications. It come with a special compiler that converts the strongly typed language into JavaScript so it can run in a traditional browser. Since TypeScript is strongly typed, it can offer better tooling around it than can be done with simple JavaScript. Angular 2 and above were built in TypeScript and I use it heavily in my Angular 4 books. This article is intended to give you an introduction to TypeScript.

Setup the Project

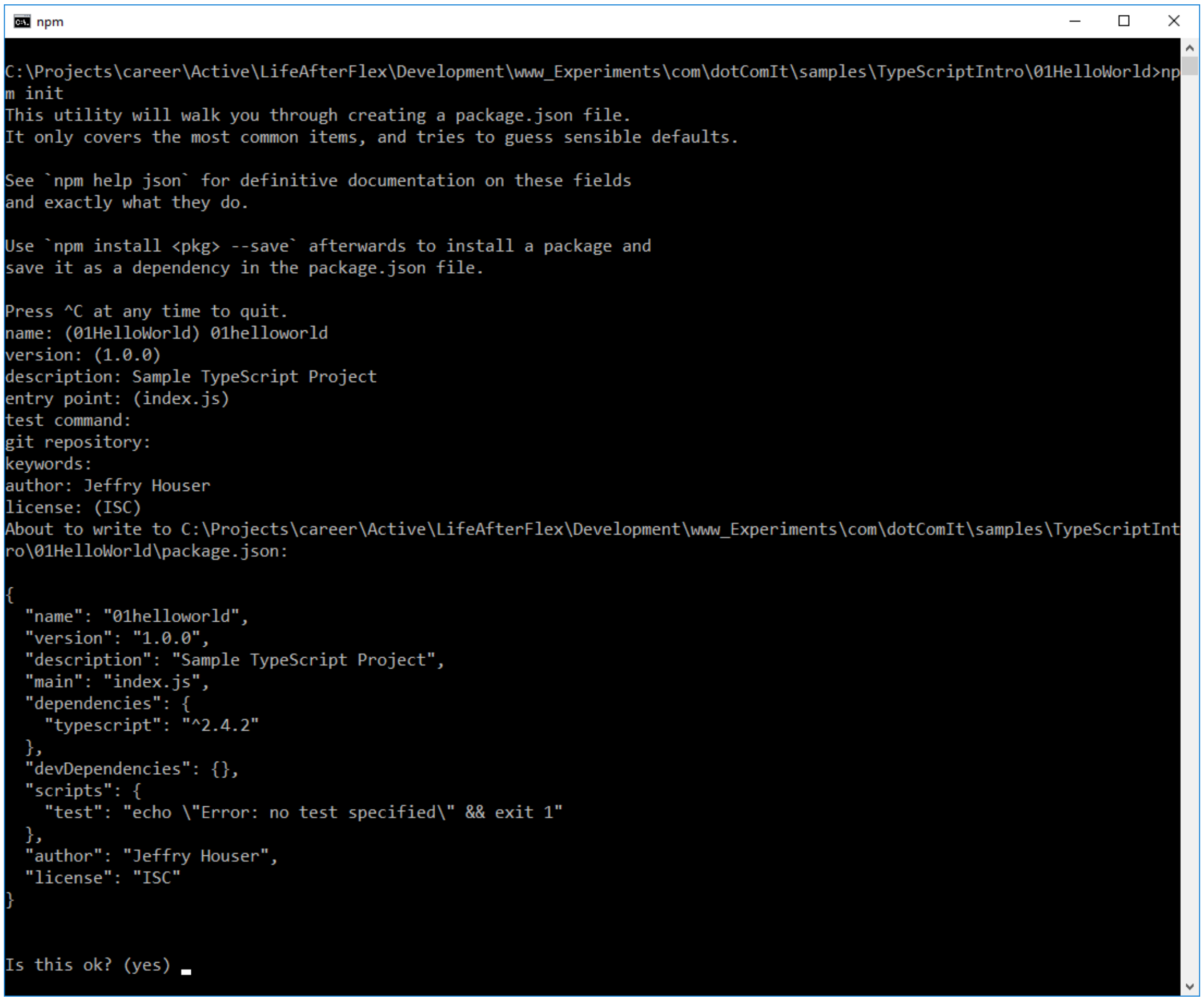
This section will show you how to setup and compile a TypeScript project from scratch

Install Dependencies

The first step to creating a TypeScript application is to install the compiler. I'm going to use the Node compiler. First, you'll need to set up the node project. Run this command:

```
npm init
```

And follow the instructions. You'll see something like this:



```
C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\01HelloWorld>np
m init
This utility will walk you through creating a package.json file.
It only covers the most common items, and tries to guess sensible defaults.

See `npm help json` for definitive documentation on these fields
and exactly what they do.

Use `npm install <pkg> --save` afterwards to install a package and
save it as a dependency in the package.json file.

Press ^C at any time to quit.
name: (01HelloWorld) 01helloworld
version: (1.0.0)
description: Sample TypeScript Project
entry point: (index.js)
test command:
git repository:
keywords:
author: Jeffry Houser
license: (ISC)
About to write to C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptInt
ro\01HelloWorld\package.json:

{
  "name": "01helloworld",
  "version": "1.0.0",
  "description": "Sample TypeScript Project",
  "main": "index.js",
  "dependencies": {
    "typescript": "^2.4.2"
  },
  "devDependencies": {},
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "Jeffry Houser",
  "license": "ISC"
}


Is this ok? (yes)
```

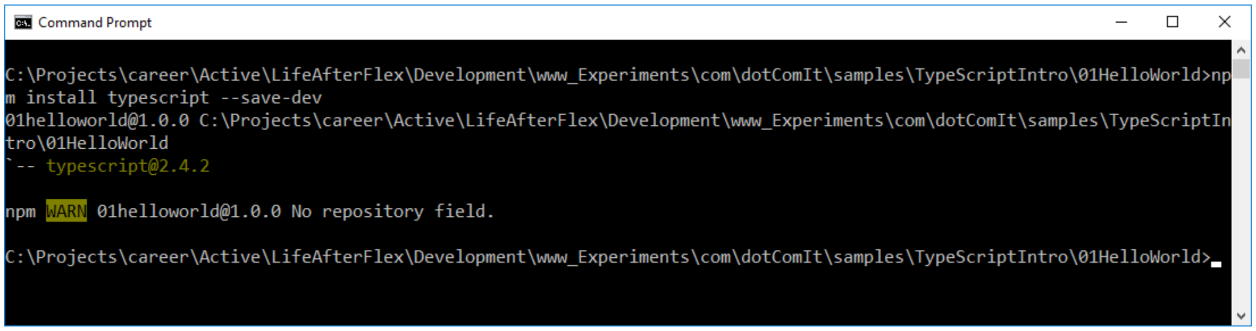
This will create a package.json file that will look something like this:

```
{
  "name": "01helloworld",
  "version": "1.0.0",
  "description": "Sample TypeScript Project",
  "main": "index.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "Jeffry Houser",
  "license": "ISC"
}
```

Now install the TypeScript compiler:

```
npm install -g typescript
```

You'll see this:



```
C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\01HelloWorld>np
m install typescript --save-dev
01helloworld@1.0.0 C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIn
tro\01HelloWorld
`-- typescript@2.4.2

npm WARN 01helloworld@1.0.0 No repository field.

C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\01HelloWorld>
```

You're ready to write your first TypeScript.

Create your first TypeScript File

Create a file named **hello.ts**:

```
function echo(message) {
    return message;
}
document.body.innerHTML = echo("Hello World");
```

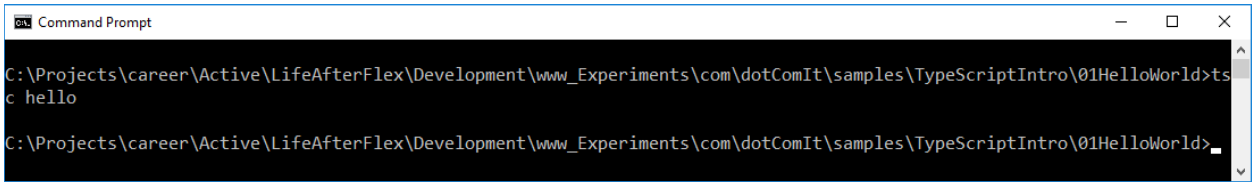
The purpose of this code is to echo a Hello Word message. The function accepts a string, and returns it. The **innerHTML** of the **document**'s **body** tag is set to the results of the function call.

This file would be valid JavaScript, but it works fine since TypeScript is a Superset of JavaScript. We can use JavaScript inside of TypeScript easily. We'll improve on this throughout the article as we introduce more TypeScript specific concepts.

You can compile this file by running this command line:

```
tsc hello
```

You'll see something like this:



```
C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\01HelloWorld>tsc hello

C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\01HelloWorld>
```

You aren't given a lot of feedback, but if you check the directory, you'll see a hello.js file:

```
function echo(message) {
    return message;
}
document.body.innerHTML = echo("Hello World");
```

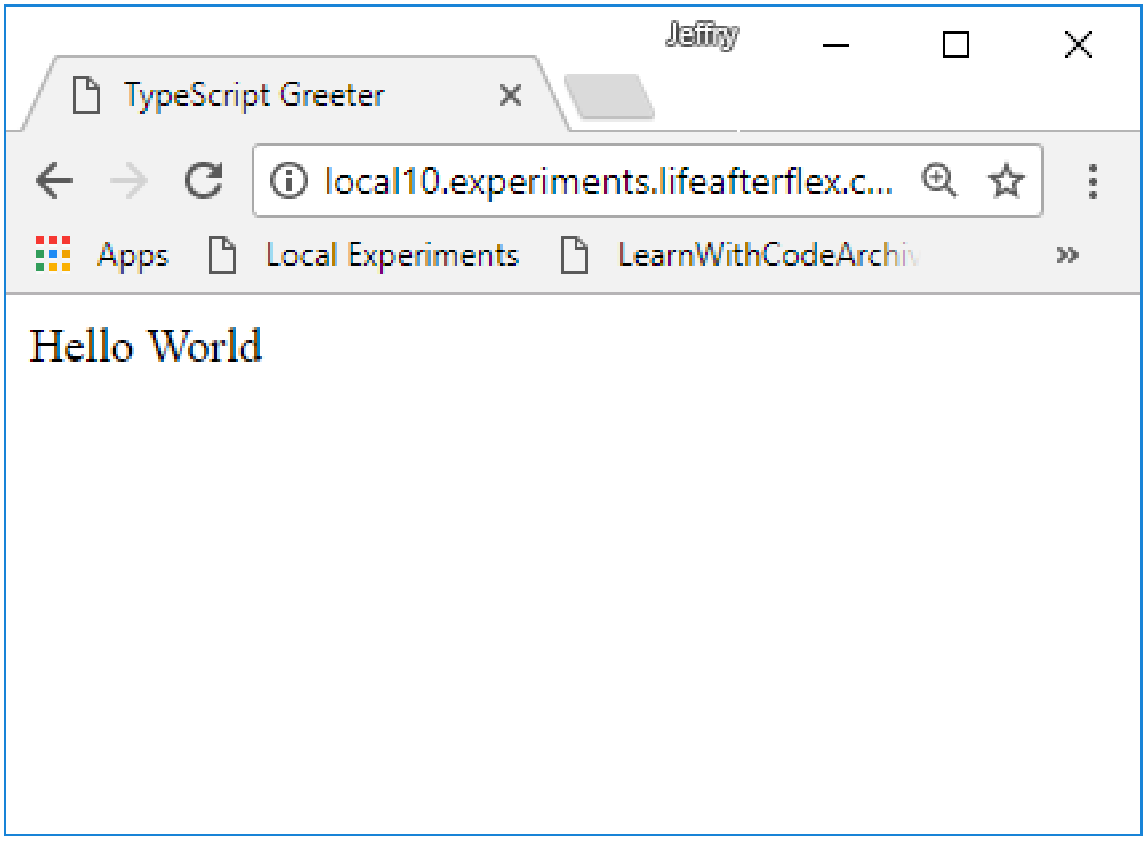
There isn't a lot of difference between the original file and the compiled file, that is because our main TypeScript file is primarily JavaScript.

Test the Application in your Browser

Now it is time to test the application in a browser. Create a page named **Index.html**:

```
<html>
<head><title>TypeScript Greeter</title></head>
<body>
<script src="hello.js"></script>
</body>
</html>
```

This index file loads the **hello.js** file, which will cause the **document.body.innerHTML** assignment to be called, which will run function and return the results:



Hello World

Congratulations! You've created your first TypeScript application.

Creating Variables

An important part of programming is the ability to create variables. Let's turn our "Hello World" Variable into a variable. First, we'll do it the Javascript way and then we'll modify it with some TypeScript.

Create a Variable

This is the original demo from the previous section:

```
function echo(message) {
    return message;
}
document.body.innerHTML = echo("Hello World");
```

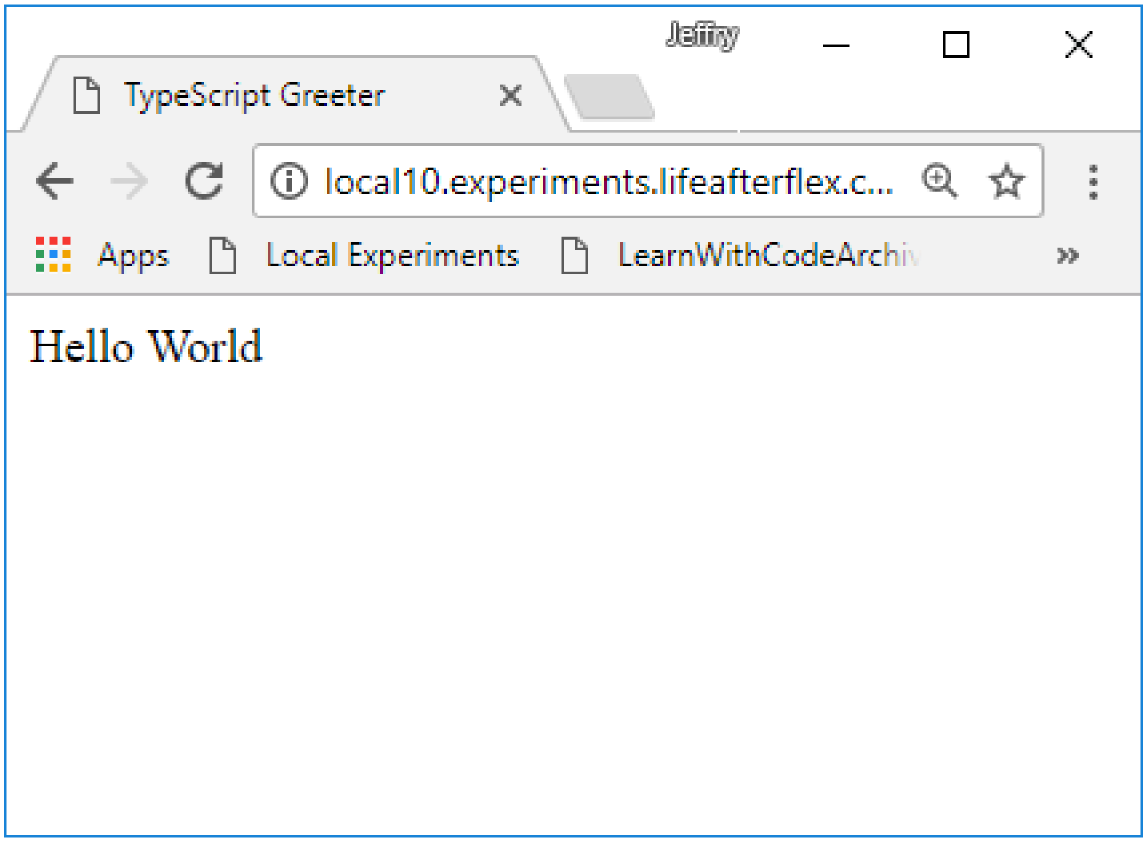
We can easily add a variable in here. First, create the variable, named **message**:

```
var message ="Hello World"
```

The **var** keyword is the normal way to create a variable in JavaScript. Now, modify the **echo()** call to pass the variable instead of the string:

```
document.body.innerHTML = echo(message);
```

Recompile the code and it will work just as the previous sample:



Hello World

So far so good.

Define the Variable with Let instead of Var

TypeScript includes a secondary way to create a variable, using the **let** keyword instead of the **var** keyword:

```
let message ="Hello World";
```

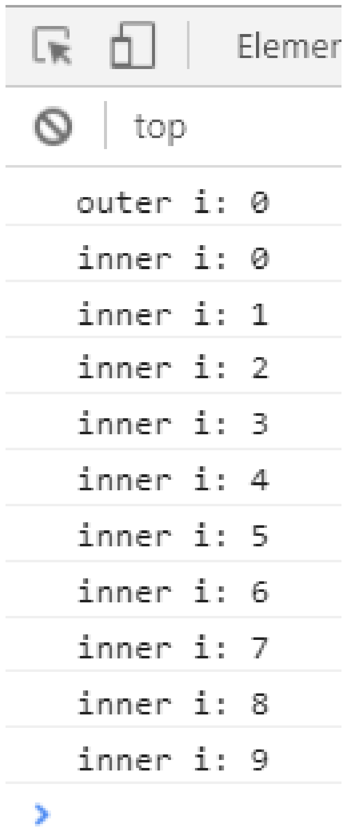
This simple replaces the **var** command with the **let** command. Recompile and you'll see the same results. **Let** is part of the ECMAScript 6 standard, but for maximum browser compatibility, you probably want to stick to ECMAScript 5 or lower compatibility.

The reason to use the let command instead of **var** is because the two scope differently. When you use **var** the new variable is created as part of the function block. If the variable is not part of the function block it is added to the global scope of the page. This is why it is considered a best practice for a lot of code to be included in an IIFE. This can cause unexpected results in some cases, such as when you access loop counters inside nested for loops, or have one function embedded in another. The **let** keyword always scopes at the block level, so each for loop would be considered its' own block.

Consider this code:

```
function scopedemovar(){
    for(var i = 0; i <10; i++){
        console.log('outer i: ' + i);
        for(var i = 0; i <10; i++){
            console.log('inner i: ' + i);
        }
    }
}
scopedemovar();
```

This might be considered nonstandard code. Both loops use the same counter variable, and the counter variable is defined twice. However, the code is perfectly valid. What would you expect the output to be? Try it and run it:



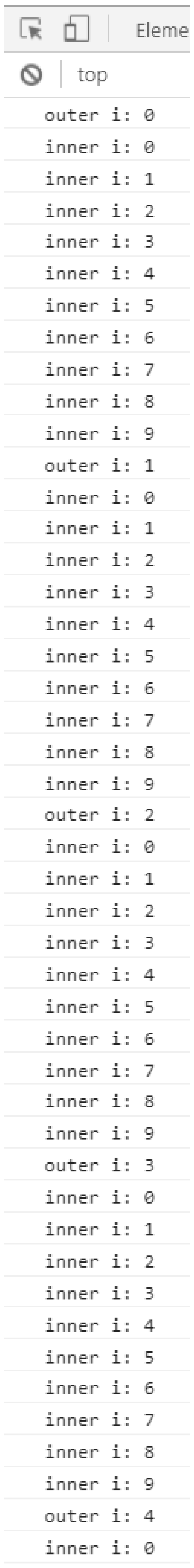
```
outer i: 0
inner i: 0
inner i: 1
inner i: 2
inner i: 3
inner i: 4
inner i: 5
inner i: 6
inner i: 7
inner i: 8
inner i: 9
```

You may expect the outer loop to loop 10 times, but it only loops once. That is because the inner loop changes the value of the counter variable and the stop condition triggers the second time the outer loop tries to run.

Change the **var** to **let**:

```
function scopedemolet(){
    for(let i = 0; i <10; i++){
        console.log('outer i: ' + i);
        for(let i = 0; i <10; i++){
            console.log('inner i: ' + i);
        }
    }
}
```

Now, each **i** variable is scoped to its own for block and they do not interfere with each other:



```
outer i: 0
inner i: 0
inner i: 1
inner i: 2
inner i: 3
inner i: 4
inner i: 5
inner i: 6
inner i: 7
inner i: 8
inner i: 9
outer i: 1
inner i: 0
inner i: 1
inner i: 2
inner i: 3
inner i: 4
inner i: 5
inner i: 6
inner i: 7
inner i: 8
inner i: 9
outer i: 2
inner i: 0
inner i: 1
inner i: 2
inner i: 3
inner i: 4
inner i: 5
inner i: 6
inner i: 7
inner i: 8
inner i: 9
outer i: 3
inner i: 0
inner i: 1
inner i: 2
inner i: 3
inner i: 4
inner i: 5
inner i: 6
inner i: 7
inner i: 8
inner i: 9
outer i: 4
inner i: 0
```

I cut off the full output since it was very long, but you can run the code to see that both the inner and outer loop both execute a full 10 times using **let** to define the variable instead of **var**.

Add Typing to Variables

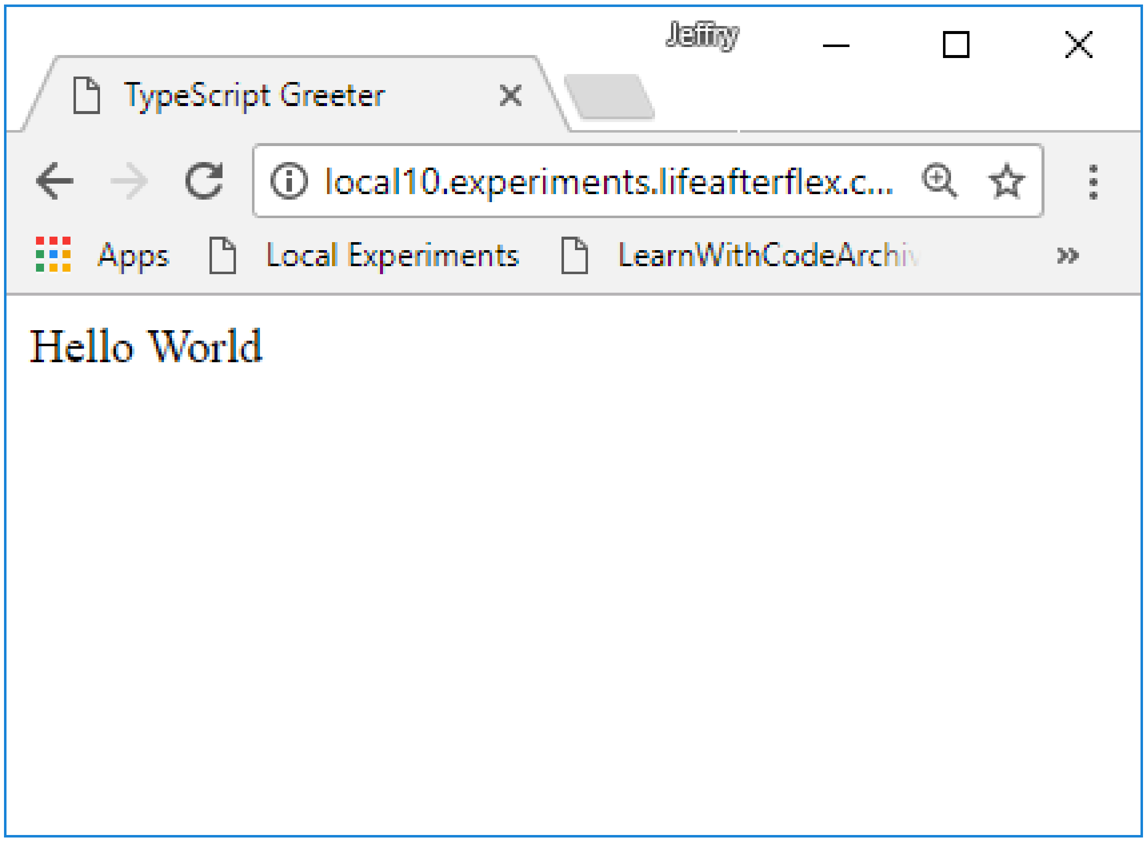
An important decision for using TypeScript is to make variables statically typed instead of dynamically typed. We can add a type to the variable definition, like this:

```
let message : string ="Hello World";
```

We can change the function definition too:

```
function echo(message:string ):string {
    return message;
}
```

The function now includes a typed argument and an explicit return type. When we send in the **message** variable the compiler checks to make sure that we are sending in a string. Recompile the code and run it. You'll see no differences in the output:



Hello World

Open up the JavaScript file created by the TypeScript compiler for a bit of a surprise:

```
function echo(message) {
    return message;
}
var message = "Hello World";
document.body.innerHTML = echo(message);
```

All your type statements were stripped out. That is because these types are part of TypeScript, but not JavaScript. They allow for compile time checking of values, but do not change the underlying language or how things run in the browser. This is an important distinction to remember as you learn TypeScript. The language is all about improved tooling and compile time validation; not about a new language in the browser.

A List of Types

TypeScript offers you these types:

- **Boolean**: A Boolean value holds two states, either true of false.
- **Number**: A Number represents any numerical value.
- **String**: A string represents any textual, alphanumeric data.
- **Array**: An array is a collection of multiple types. We'll discuss Array's in more detail in the next section.
- **Tuple**: A Tuple is an array with a fixed number of elements. Since they have a fixed number of elements, they may be more memory efficient. You might use this for a list of states in the US, as one example.
- **Enum**: An Enum type is like a numerical array, but allows you to provide descriptive names to each number value. We'll cover Enum's in more detail in a later section.
- **Any**: The any type means that this variable can contain any type. This is how we are used to dealing with values in JavaScript. Generally, I try to avoid using this, however it can be useful in certain situations such as dynamic function arguments or an array that contains mixed type values.
- **Void**: The void type is the opposite of any. It represents the absence of a type. You wouldn't use this for the value of a variable, but may use it as the return type of a function.
- **Your Class Here**: You can create your own custom class if you need to. We'll show you more in this later.

Use a Constant

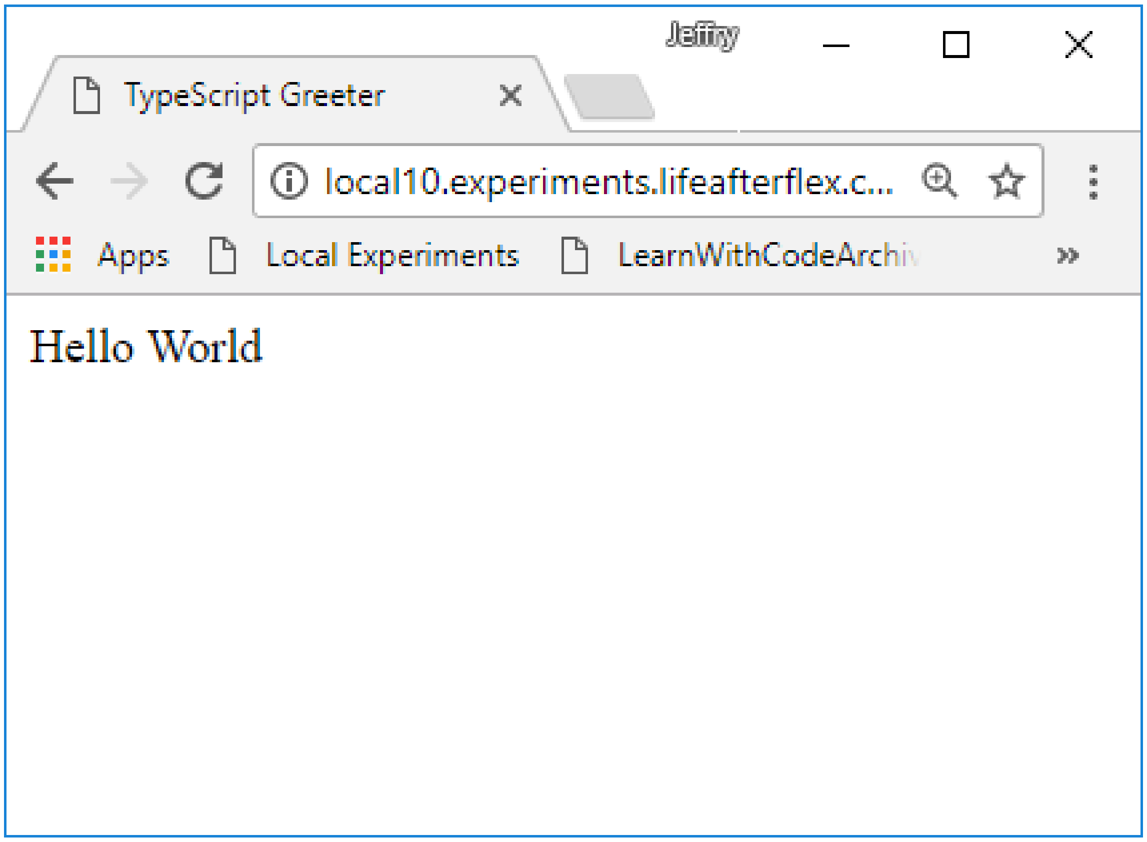
TypeScript supports the use of constants. A constant is like a variable that will never change. JavaScript does not have any native support for constants. This is easy to setup. Instead of using the **let** keyword you can use the **const** keyword. Let's change how our hello world is created:

```
const messageIntro = "Hello"
let messageSubject : string ="World";
```

This creates a constant named **messageIntro** and gives it the value of "Hello". Then we have our **messageSubject**, with the value of "World". Put them together when we make the call:

```
document.body.innerHTML = echo(messageIntro + " " + messageSubject);
```

Our code operates identically even though the implementation is different:



Hello World

The JavaScript code behind this looks like this:

```
function echo(message) {
    return message;
}
var messageIntro = "Hello";
var messageSubject = "World";
document.body.innerHTML = echo(messageIntro + " " + messageSubject);
```

Both **const** and **let** transpile to **var** statements in the final code. The use of these new constructs is primarily to help with tooling and to catch possible errors during compile time instead of by testing code in a browser.

Enums

Enums are a data type I have not come across in most other languages, but they are inspired by C#. An enum is a way to give friendly names to numerical values. They are like an array with indexes, but more specific. I can envision using something like this with a view stack style component and using an enum to handle which view is currently displayed. Or, I might use it with an event class instance to determine what type of event occurred. Or it could be used to determine what color style to apply to certain text.

Create a Number based Enum

I'm going to start by creating a simple sample with a number based enum:

```
enum MyNumbers {
    First,
    Second,
    Third
}
```

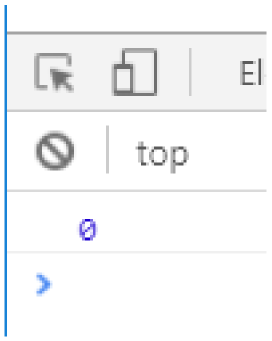
The **MyNumbers** enum contains four values each one representing a number. Since enums are sort of like arrays, the **First** item is at the 0 index, the second item will have the value of 1, and so on. We can use **MyNumbers** like it is own variable type:

```
let myNum :MyNumbers = MyNumbers.First;
```

Output this value.

```
console.log(myNum);
```

What do you think you'll get? Since it is the value of **MyNumbers.First** and that is the first element of the zero-based index, you'll get number 0:



```
0
```

A benefit of enums is that we can control the number scheme:

```
enum MyNumbers {
    First = 1,
    Second,
    Third
}
```

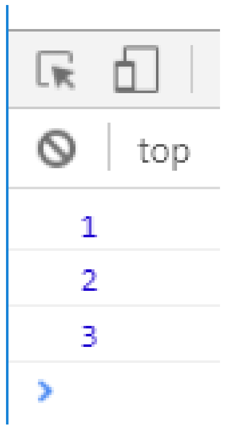
We specified the **First** item is equal to the number 1. Turn each element into a variable:

```
let myNum1 :MyNumbers = MyNumbers.First;
let myNum2 :MyNumbers = MyNumbers.Second;
let myNum3 :MyNumbers = MyNumbers.Third;
```

Then output them:

```
console.log(myNum1);
console.log(myNum2);
console.log(myNum3);
```

You'll see:



```
1
2
3
```

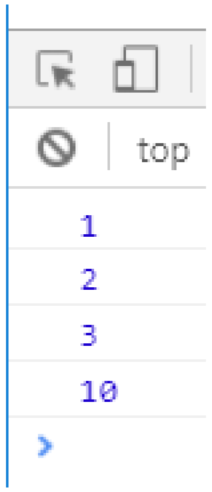
Now our text numbers match up with the actual text index. We can control the numbers even if they aren't in sequential order. Add a new entry to the **MyNumbers** enum:

```
enum MyNumbers {
    First = 1,
    Second,
    Third,
    Ten = 10,
}
```

This is number 10, skipping four through 9. Grab it as a variable and output it:

```
let myNum10 :MyNumbers = MyNumbers.Ten;
console.log(myNum10);
```

Combined with our other outputs, you'll see something like this:



```
1
2
3
10
```

Enums provide a lot of flexibility.

Creating a String based Enum

It is interesting that Enum's can be used to represent textual values too. Look at this:

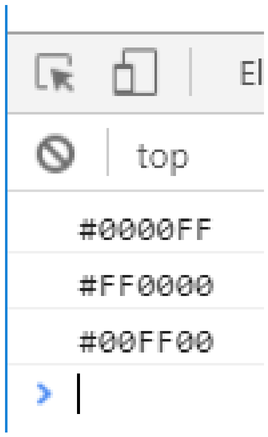
```
enum MyColors {
    Blue = "#0000FF",
    Red = "#FF0000",
    Green = "#00FF00",
};
```

The value of the color name represents the hex value of the actual color. I recently could have used something similar when dynamically applying colors to the header of a site based on which section the user was viewing. Get the individual colors, and output them:

```
let myColor1 :MyColors = MyColors.Blue;
let myColor2 :MyColors = MyColors.Red;
let myColor3 :MyColors = MyColors.Green;

console.log(myColor1);
console.log(myColor2);
console.log(myColor3);
```

You'll see something like this:



```
#0000FF
#FF0000
#00FF00
```

Enums are an interesting data type, caught somewhere between an array and a class.

Loops and Arrays

This section will show you how to create an array and loop over it. We'll create an array of strings, and then loop over them with our echo function to welcome multiple people in our HTML page.

Create an Array

The first step is to create an array. You can use this syntax:

```
let personArray : string[] = ["Jeffry", "Tom", "John"];
```

This creates a variable just like other variables we had seen. The key differentiator is that after the variable type, I added square brackets. This is what tells the compiler we are creating an array of strings. You can define arrays with any of the native types, such as numbers or Boolean, or with your own custom types.

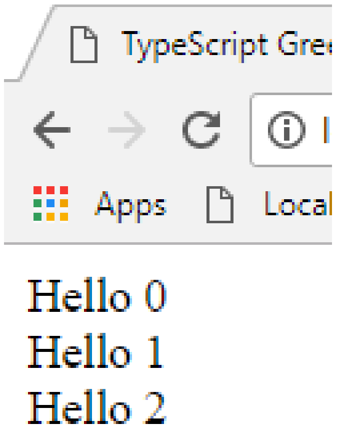
For-in Loop

The very first time I wanted to loop over an array, I used a for-in loop, like this:

```
let bodyString : string = "";
for (let person in personArray){
    bodyString += echo(messageIntro + " " + person + "<br/>");
}
document.body.innerHTML = bodyString ;
```

I had used for-in loops in other languages, such as ActionScript so this was my natural impulse.

Let's look at the results:

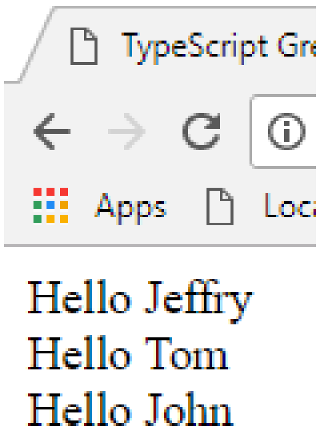


```
Hello 0
Hello 1
Hello 2
```

Instead of outputting the data in the array, it outputted the index. The proper way to use a for-in loop in TypeScript would be like this:

```
for (let person in personArray){
    bodyString += echo(messageIntro + " " + personArray[person] + "<br/>");
}
```

This isn't much different than a generic for loop that uses a counter, although the syntax is a bit nicer:



```
Hello Jeffry
Hello Tom
Hello John
```

All version of ECMAScript after 2015 support for-in loops the same way that TypeScript does. This is supported by most browsers and in fact that generated JS Code uses for-in loops:

```
for (var person in personArray) {
    bodyString += echo(messageIntro + " " + person + "<br/>");
}
```

But, this result wasn't quite what I was after. Thankfully TypeScript includes another option, the for-of loop.

For-of Loop

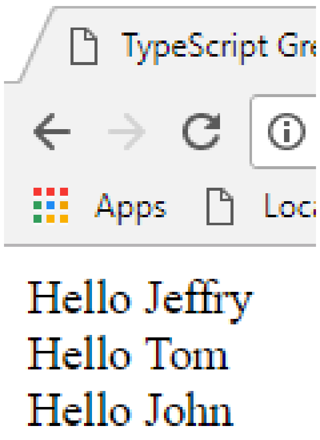
A for-of loop makes one syntactical difference than a for-in loop. Instead of using the keyword **in**, it uses the keyword **of**:

```
for (let person of personArray){
    bodyString += echo(messageIntro + " " + person + "<br/>");
}
```

This type of loop the loop counter, **person**, will match the value of the **personArray** instead of the index. After the compilation, this is turned into a for loop with an explicit counter:

```
for (var _i = 0, personArray_1 = personArray; _i < personArray_1.length; _i++)
{
    var person = personArray_1[_i];
    bodyString += echo(messageIntro + " " + person + "<br/>");
}
```

Compile this code and load it in the browser to see the expected results:



```
Hello Jeffry
Hello Tom
Hello John
```

Looping in TypeScript is not much different than looping in other languages.

Creating Your First Class

As with many languages, TypeScript allows you to create your own classes. A class is like your own data type with data and functions to process that data.

Create your First Class

Create your class stub:

```
class Echo {
}
```

This creates a class named **Echo**. The purpose of this class is to create and store our welcome message. Let's start by creating some properties on the class:

```
static readonly messageIntro : string = "Hello"
subject : string;
private message : string;
```

The **subject** is a relatively normal variable. It is a string that contains the subject of our welcome message. The **message** variable is similar, but has the private distinguisher. This means that the message variable is private to the local message. It will contain the final message once it is put together, but is only accessible inside the class, not from code accessing an instance of the class.

The **messageIntro** is a bit different. We are not able to define constants inside of a TypeScript class, so instead I used the **readonly** keyword. This means the value will not be changeable, like a constant. I also define the messageIntro as a static property, which means it exists on the class and not on an instance of the class. A big difference between constants and readonly properties is that readonly properties can be set in the constructor of an instance of a class.

Every class needs a constructor, so create one:

```
constructor(subject : string){
    this.subject = subject;
}
```

The constructor will be called automatically when we create a new instance of the class with the new keyword. This constructor accepts one argument, the **subject**. The code just saves the **subject** argument into the **subject** variable.

Now, add a **createMessage()** function:

```
createMessage():void{
    this.message = Echo.messageIntro + " " + this.subject + "<br/>";
}
```

This concatenates the read only **messageIntro** variable with the **subject.** It puts a space in between and a HTML line break at the end. We had similar code in previous samples, but not encapsulated into a class function. The return type of this function is void, meaning nothing is returned.

We'll add one final function to our class:

```
echo():string{
        return this.message;
}
```

This function returns the complete message. The message value could be blank if the **createMessage()** function as not called yet, however this will still work.

Now, create an instance of the **Echo** class:

```
var echoInstance : Echo = new Echo('World')
```

This uses the new keyword to create the new instance. You may have seen this in other languages.

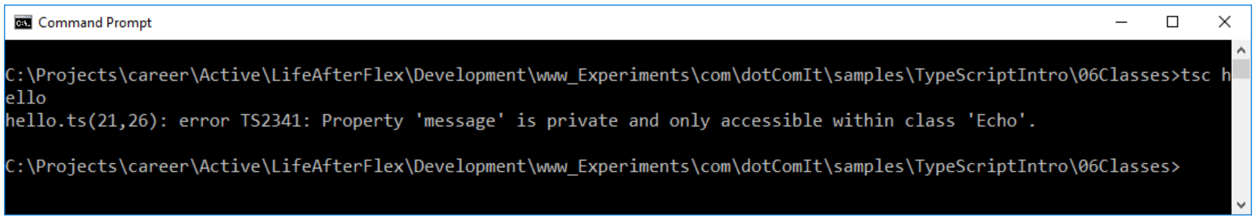
You can output the **subject** for testing purposes:

```
console.log(echoInstance.subject);
```

You can also try to output the **message**:

```
console.log(echoInstance.message);
```

Since the **message** is a private variable, you'll see a compile error:



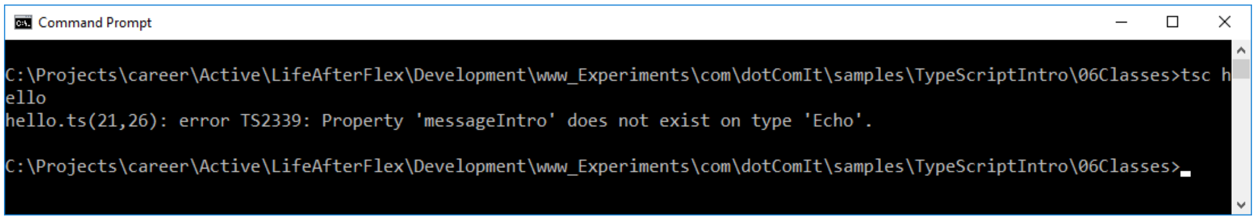
```
C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\06Classes>tsc h
ello
hello.ts(21,26): error TS2341: Property 'message' is private and only accessible within class 'Echo'.

C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\06Classes>
```

By the same token, we can access the **messageIntro** static value:

```
console.log(echoInstance.messageIntro);
console.log(Echo.messageIntro);
```

Can you guess which line works before trying to compile the code? The second one is the proper way to access static variables. The first one will throw an error:



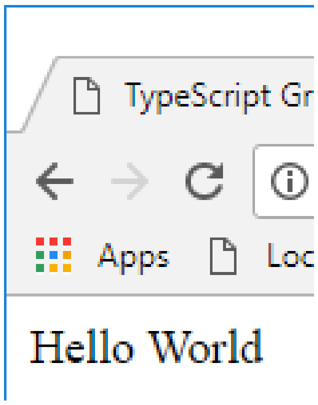
```
C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\06Classes>tsc h
ello
hello.ts(21,26): error TS2339: Property 'messageIntro' does not exist on type 'Echo'.

C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\06Classes>
```

Our final code is to output the value to the screen:

```
document.body.innerHTML = echoInstance.echo();
```

Compile the code—you should see no errors—and load it in a browser:



Hello World

In a non-sample application, I might try to make my classes more discrete. Since this one adds a line break at the end of the message, it is conflating data processing and display code, something which is undesirable in real world applications.

Review the generated code

This is the generated code:

```
var Echo = (function () {
    function Echo(subject) {
        this.subject = subject;
    }
    Echo.prototype.createMessage = function () {
        this.message = Echo.messageIntro + " " + this.subject + "<br/>";
    };
    Echo.prototype.echo = function () {
        return this.message;
    };
    Echo.messageIntro = "Hello";
    return Echo;
}());
var echoInstance = new Echo('World');
echoInstance.createMessage();
document.body.innerHTML = echoInstance.echo();
```

The **Echo** class is created using an immediately invoked function expression. The **static** class property. **MessageIntro,** is created as an instance variable inside the class—remember that JavaScript doesn't have the concept of **readonly** or **static** properties. The **subject** and **message** variables are not defined since they do not have default values. They'll be created on the class when they are needed. For the **subject** that is inside the constructor, and for the **message** that is inside the **createMessage()** function.

Although beyond the scope of this tutorial, inheritance is supported with TypeScript, so one class can inherit from another.

Interfaces

This section will talk about interfaces. It is not going to talk about User interfaces, but rather object-oriented interfaces. An interface is a definition of properties and methods that must be supported by a class which implements this interface. You can think of an interface as the contract between a class instance and a method argument or variable. If they both match the interface they are interchangeable.

Create the Interface

For this sample, we're going to create a **name** interface. This interface will represent the name of a person and will contain a first name and last name. It will have an optional middle initial and also a method to retrieve the name.

Here is the interface:

```
interface name {
    firstName: string;
    middleInitial? : string;
    lastName: string;
    getName() : string;
}
```

The interface is set up similar to a class or enum. It uses the keyword interface, and the name of the interface—in this case **name**. The **firstName** and **lastName** properties are as normal properties on an object. The **middleInitial** is an optional property, and that is distinguished by a question mark. Finally, a single method is defined by the interface, **getName()**. This will be used to return the name. The interface does not contain an implementation, just a definition of the method. That means different classes which extend the interface can have different implementations.

Rework the Echo Class

Let's rework the **Echo** class to use the interface instead of strings. First create the method stub with the instance variables:

```
class Echo {
    static readonly messageIntro : string = "Hello"
    subjectArray : name[];
    private message : string;
}
```

The main change here is that the **subject** string was replaced with a **subjectArray** of **name** types. The constructor:

```
constructor(subjects : name[]){
    this.subjectArray = subjects;
}
```

The constructor now accepts an array of name instead of a single string.

The **createMessage()** function now loops over the array:

```
createMessage():void{
    this.message = '';
    for (let person of this.subjectArray){
        this.message += Echo.messageIntro + " " + person.getName() + "<br/>";
    }
}
```

Inside the loop, the interface's **getName()** function is used to add an element to the output.

Finally, the **echo()** function:

```
echo():string{
        return this.message;
}
```

The **echo()** function has not changed, it just returns the object instance variable, **message**.

Implement the Interface with a Class

I'm going to create two classes which implement our **name** interface contract. One will be for a **Person** and another for a **Pet**. First, the **Person** class:

```
class Person implements name {
   firstName: string;
   middleInitial : string;
   lastName: string;
   getName(): string {
     return this.firstName + ' ' + this.middleInitial + ' ' + this.lastName;
   }
}
```

The **Person** class is defined with the class keyword followed by the name of the class. Then comes the **implements** keyword followed by the name of the interface. If you wanted you could list multiple interfaces here, each separated by a comma.

The **firstName**, **middleInitial**, and **lastName** are created properties on the object, not much different than how they were with the **interface** definition. The **getName()** method includes a definition. It concatenates the **firstName**, **middleInitial**, And **lastName**, returning a single string.

Now, let's create another class that implements name. This one is called **Pet:**

```
class Pet implements name {
    firstName: string;
    lastName: string;
    type : string;
    getName(): string {
        return this.firstName + ' ' + this.lastName + ", " + this.type;
    }
}
```

This includes the **firstName** and **lastName** defined as variables on the class object. A new property is named **type**, this will represent the type of pet we have. A class can implement properties or methods not included in an interface. The **middleInitial** is left out, which is okay because that is marked as an optional property in the interface—and my pets don't have middle initials. The **getName()** method puts together the **firstName** and **lastName**, but appends the type to the end.

Create a name Array

We have an interface and two classes that extend it. Let's put all together. Start by creating a names array:

```
let nameArray : name[] = [];
```

Now create a new **Person** instance. This one represents me:

```
let jeffryInstance : Person = new Person();
jeffryInstance.firstName = "Jeffry";
jeffryInstance.middleInitial = "A";
jeffryInstance.lastName = "Houser";
nameArray.push(jeffryInstance);
```

The new **jeffryInstance** of the **Person** class is added to the **nameArray**.

Create two pets:

```
let hercInstance : Pet = new Pet();
hercInstance.firstName = "Hercules";
hercInstance.lastName = "Houser";
hercInstance.type = "Dog";
nameArray.push(hercInstance);

let zeusInstance : Pet = new Pet();
zeusInstance.firstName = "Isadora";
zeusInstance.lastName = "Houser";
zeusInstance.type = "Dragon";
nameArray.push(zeusInstance);
```

One is for my pet dog, Hercules, and the other is for my pet dragon, Isadora. Both are added to the same **nameArray** value without issue even though they have different types. The implementation of the interfaces tells the compiler that the **nameArray** can accept both Pet and Person instances.

Now, create an instance of the **Echo** class:

```
let echoInstance : Echo = new Echo(nameArray);
```

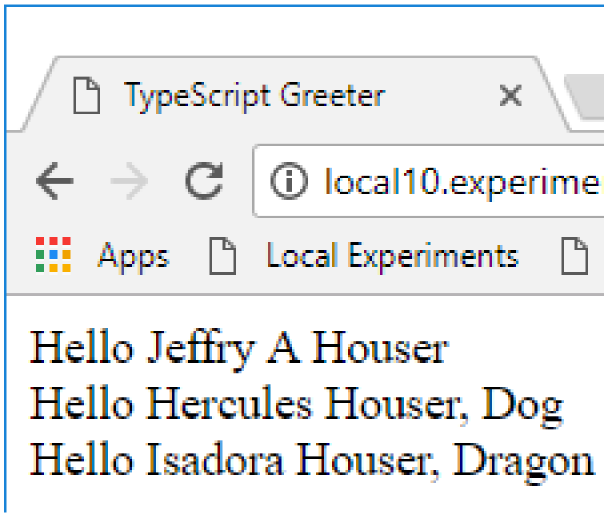
Create the **message**:

```
echoInstance.createMessage();
```

And output the **message**:

```
document.body.innerHTML = echoInstance.echo();
```

Recompile the app and load it in a browser:



```
Hello Jeffry A Houser
Hello Hercules Houser, Dog
Hello Isadora Houser, Dragon
```

It works as expected.

Modules

When writing a real-world application, it does not make sense to include all the code in a single file. TypeScript supports that by allowing you to expand different functionality into modules.

Create Interface Module

The first thing we're going to do is create a module for the name interface. I put this in a file named **IFile.ts**:

```
export interface name {
    firstName: string;
    middleInitial? : string;
    lastName: string;
    getName() : string;
};
```

This looks exactly like the Interface created in the previous exception with the one addition of the **export** keyword. Export tells the compiler that this class is available for use inside other classes.

Create Class Modules

Now create the person class:

```
export class Person implements name {
  firstName: string;
  middleInitial : string;
  lastName: string;
  getName() : string {
      return this.firstName + ' ' + this.middleInitial + ' ' + this.lastName;
  }
}
```

This also puts the **export** keyword in front of the class definition. If you try this you'll notice an immediate error. The **name** is not defined. To define it we'll need to add an **import** statement:

```
import {name} from "./IName";
```

The import statement tells you that the **name** entity is imported from the **IName** file and can be used within this class. The path I used, './IName', tells us that the files are in the same directory, however we can use a more elaborate package setup, and most likely you will do that for main applications.

We can create the **Pets.ts** module in the same manner:

```
import {name} from "./IName";

export class Pet implements name {
    firstName: string;
    lastName: string;
    type : string;
    getName()  : string {
        return this.firstName + ' ' + this.lastName + ", " + this.type;
    }
}
```

This code mirrors the **Person** module, with the primary changes being the use of the **export** keyword before the class definition and the import of the **name** interface.

The **Echo** class needs a similar rework:

```
import {name} from "./IName";

export class Echo {
  static readonly messageIntro : string = "Hello"
  subjectArray : name[];
  private message : string;
  constructor(subjects : name[]){
      this.subjectArray = subjects;
  }
  createMessage():void{
      this.message = '';
      for (let person of this.subjectArray){
        this.message += Echo.messageIntro + " " + person.getName() + "<br/>";
      }
  }
  echo():string{
      return this.message;
  }
}
```

The functionality remains unchanged. Like the previous classes it uses an **export** statement to make the class available elsewhere, and an **import** statement to make use of the **name** interface.

Rework Main Application

With all the classes stored in separate files, our primary app has become a lot simpler. First, import all the classes:

```
import {name} from "./IName";
import {Person} from "./Person";
import {Pet} from "./Pet";
import {Echo} from "./Echo";
```

Then, create the **nameArray**:

```
let nameArray : name[] = [];
```

Now, populate the **nameArray**:

```
let jeffryInstance : Person = new Person();
jeffryInstance.firstName = "Jeffry";
jeffryInstance.middleInitial = "A";
jeffryInstance.lastName = "Houser";
nameArray.push(jeffryInstance);
```

```
let hercInstance : Pet = new Pet();
hercInstance.firstName = "Hercules";
hercInstance.lastName = "Houser";
hercInstance.type = "Dog";
nameArray.push(hercInstance);

let zeusInstance : Pet = new Pet();
zeusInstance.firstName = "Isadora";
zeusInstance.lastName = "Houser";
zeusInstance.type = "Dragon";
nameArray.push(zeusInstance);
```

Create an instance of the **Echo** class:

```
let echoInstance : Echo = new Echo(nameArray);
```

Call the **createMessage()** function:

```
echoInstance.createMessage();
```

Finally, output the results:

```
document.body.innerHTML = echoInstance.echo();
```

The changes to the main file consisted of removing the class and interface definitions and replacing them with imports.

Setup Module Loader

The **import** statement is not a native JavaScript statement and does not have an easy parallel. To make code like this work in the browser we'll need to use a module loader. There are a few different types of module loaders such as RequireJS or SystemJS. Many people use code tools like Browserify or WebPack to encapsulate away the complexity.

For the purposes of this sample, I'm going to use RequireJS. Open up the **index.html** file and add this script statement:

```
<script data-main="requireconfig"
      src="//cdnjs.cloudflare.com/ajax/libs/require.js/2.3.4/require.min.js">
</script>
```

This loads the RequireJS library from a remote CDN. Note that I have completely removed the script tag that loads the **hello.js** file.

The script tag also has a different attribute named **data-main** with a value of "requireconfig". This property tells Require that whenever it has completed loading it should look for the **requireconfig.js** file. Create that file next:

```
requirejs.config({
    baseUrl: '',
    paths: {
        app: ''
    }
});
```

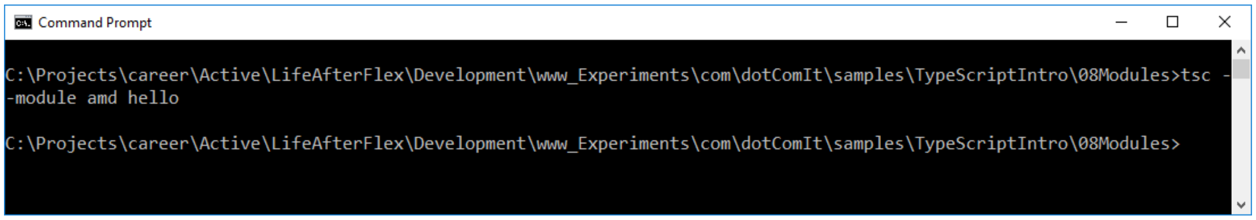
This sets up the **baseUrl** and the paths to the app. Since all our code is in the main dev directory, I set these values to blank. Now, tell RequireJS to load our main application file:

```
requirejs(['hello']);
```

Since there are a few different methods of creating modules, we have to tell our TypeScript compiler which one to use. We want it to use the **amd** approach. When you compile your application add the module flag and specify **amd**. Use this at the command line:

```
tsc -module amd hello
```

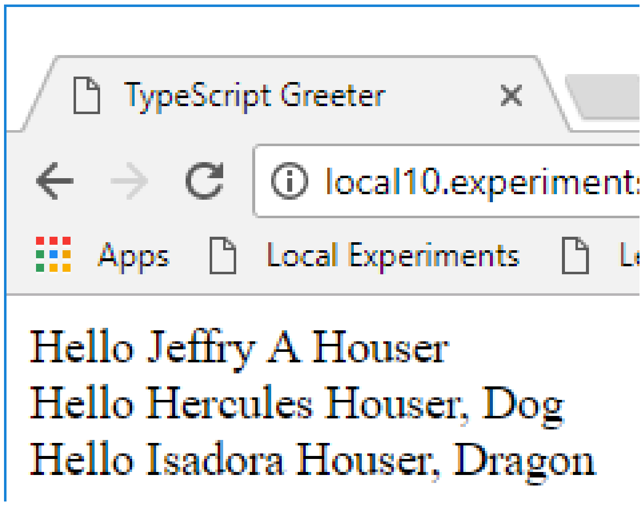
You'll see this:



```
C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\08Modules>tsc -
-module amd hello

C:\Projects\career\Active\LifeAfterFlex\Development\www_Experiments\com\dotComIt\samples\TypeScriptIntro\08Modules>
```

The response is as boring as expected. Now load the app in the browser:



```
Hello Jeffry A Houser
Hello Hercules Houser, Dog
Hello Isadora Houser, Dragon
```

Congratulations; you've created a TypeScript application with multiple classes and interfaces!

Final Thoughts

This series should have given you all the information you need to know to start using TypeScript in your applications. Check out our book on Angular 4 which uses TypeScript heavily.