**TypeScript**

* TypeScript is a Superset of JavaScript-> A language building up on JavaScript by adding new features + Advantages to JavaScript.
* Browser can’t directly execute TypeScript
* TypeScript is a tool which compiles TypeScript code into JavaScript code.
* TypeScript will check error during the compilation process, that’s why compile time error will not generated directly on browser
* TypeScript is a powerful, open-source programming language. It is built on JavaScript by adding static type definition, making it a superset of JavaScript.
* TypeScript enhances the development experience by enabling developers to catch errors in early stage through the type checking and it facilitates the development of large-scale applications with improved code quality and maintainability.

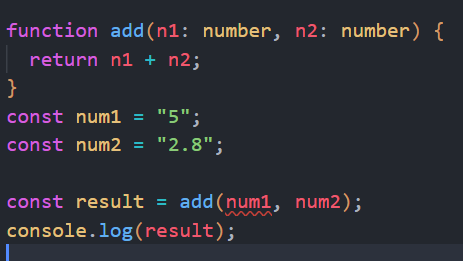
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* **Key Features of TypeScript:**

1. **Static Typing:**

* TypeScript’s type system helps catch errors at compile time, reducing runtime errors and improving code reliability.



1. **Better Code Readability and Maintainability:**

* Type definition and interface make the code more understandable and easier to maintain.

1. **Adding Non-JavaScript Features like interface or Generics**
2. **It also gives Meta-programming Feature like Decorators**
3. **Rich configuration Options.**

* **Data Types:**

1. **Number:**

* All numbers, no differentiation between integers or float
* 1, 5.3, -10

1. **String:**

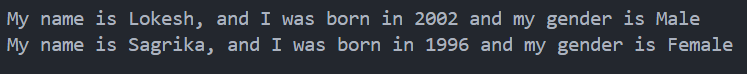
* All text values

1. **Boolean:**

* Just these two, no “truthy” or “falsy” values
* True or false

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1. **Object:**

* Any JavaScript object, more specific types are possible
* {age:30}

1. **Array:**

* Any JavaScript array, with more specific types declaration
* [1,2,3]

1. **Tuple:**

* Tuple is fixed length array
* [number, string] = [1, “Lokesh”]

1. **Enum:**

* Automatically enumerated global constant identifiers
* enum {New, Old}
* It gives us numerated index which starting at 0

1. **any:**

* Any can used to assign any type of value in variables
* It is not type safe
* We should avoid use of any in TypeScript
* const variable: any [] = [1, true, “Lokesh”]
* **JavaScript vs TypeScript:**

|  |  |
| --- | --- |
| **TypeScript** | **JavaScript** |
| 1. TypeScript is a superset of JavaScript | 1. JavaScript is a subset of TypeScript |
| 1. Ts provide static typing checking | 1. Js provide dynamically typed |
| 1. Syntax is similar to JS with additional features | 1. Standard JavaScript syntax |
| 1. Stronger typing can help identify errors | 1. May require more debugging and testing |
| 1. Adding non-js feature like interface or generics | 1. Interface or generics are not present in js. |
| 1. In TS Error will identify during compilation phase | 1. In JS error will identify during runtime phase |

* **Type Assignment & type inference:**

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* If we assign variable with value at a time of declaration, then no need to explicitly mention **type** for that variable.
* If we only declare variables without initializing value and we want to initialize value later then we should mention **type** for that variable.
* **Type Inference:**
* Type inference allows the compiler to automatically determine data types of variables, functions return type, Object types and Array types based on the context in which they are used.
* TypeScript uses inference extensively to provide type safety while still maintaining the flexibility of JavaScript.
* **Type Assignment:**
* In Type Assignment we need to explicitly defined type of variable
* So typescript compiler can easily understand what type of data is present in that variable.
* **Objects:**
* An **object** in typescript is an instance that contains a set of key-value pairs.
* These pairs can hold various data types, including scalar values, functions, or even arrays of other objects.
* Typescript object refers to any value that isn’t primitive. This is different from the empty object type **{}**, and also different from the global type Object.

**Syntax:**let Name\_of\_object = {

object\_property : value,

}

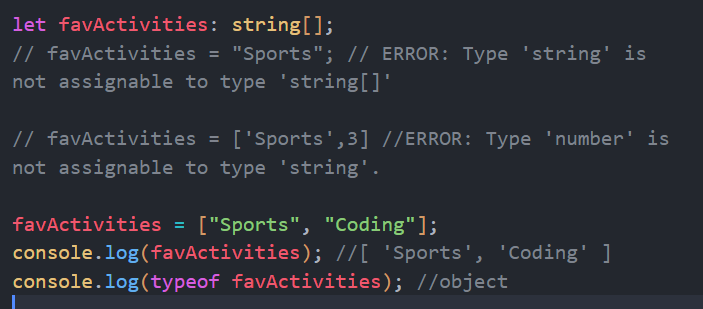
* Eg:  
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* We can explicitly mention type of field while declaring object with object property or we can directly declare object than TypeScript automatically like this.

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* TypeScript detect property in compile time which is not exist in object
* **Array:**
* An array is a user defined data type.
* An array is a homogeneous collection of similar types of elements that have a contiguous memory location, and which can store multiple values of different data types.
* We can explicitly mention type of array and this array can only store that type of values.



* If we want to multiple type of array then we can use **any** of simply mention that types.

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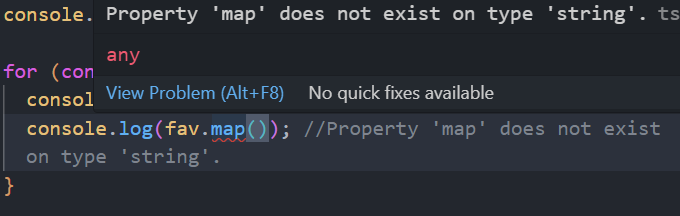
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* If we iterate over an array element than TypeScript help us by suggesting supported method on that element

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If we use another method which is not supported for this elements, then it will throw error on compile time.



* We can use array for code optimization and for randomly access elements.
* **Tuples:**
* As we know array consists of values of homogeneous (same) types but sometimes when we need to store a collection of different types value in a single variable, then we will go with **Tuples.**
* Tuples may be one or more than one type of data.
* Eg:

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* Tuples have a **fixed size,** and we cannot store element more than its size.
* Also, we can store value of **fixed type,** we cannot store number in string place.
* Even we cannot assign empty array to tuple variable.
* **Enum:**
* TypeScript **Enum Type** is not natively supported by JavaScript, but it’s a notable feature of the TypeScript Programming Language.
* In general, enumeration shortly called **enum.**
* Enums allow us to create a set of named constant, Making it easier for us by being self-explanatory while declaring a set of predefined value, by default enum variables has value form **0**.

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Eg:

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* While Enums are constant by default that’s why we cannot reassign value to enum variables after declaring it.
* Enum is user defined type that’s why we can access enum variable using **(.)** operator.
* **Any:**
* **any** type is a dynamic type that can represent values of any data type.
* It allows for flexible typing but sacrifice type safety, as it lacks compile-time checking
* We can avoid use of any in TypeScript because it affect big feature of TypeScript which is **type safety.**

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* **Union Type:**
* The TypeScript union has the ability to combine one or two different types of data.
* It is the most powerful way to express a variable with multiple types.
* Use **pipe (‘|’)** symbol to combine two or more data types to achieve union type.

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Eg:

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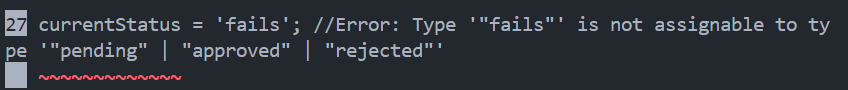
* **Literal Types:**
* The string literal type was added in TypeScript version 1.8.
* String literal types work well with union types and type aliases in practice. These properties can be combined to give strings enum-like functionality.
* The string literal type allows you to specify a set of possible string values for a variable, only those string values can be assigned to a variable.
* TypeScript throws a compile-time error if we tries to assign a value to the variable that isn’t defined by the string literal type
* Syntax:

**Let** variableName : **‘stringLiteral’;**

* Eg:

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* **Alias type:**
* Type alias give a type a new name.
* They are similar to interfaces in that they can be used to name primitives and any other kinds that you’d have to define by hand otherwise.
* Aliasing doesn’t create a new type, instead , it gives that type a new name.

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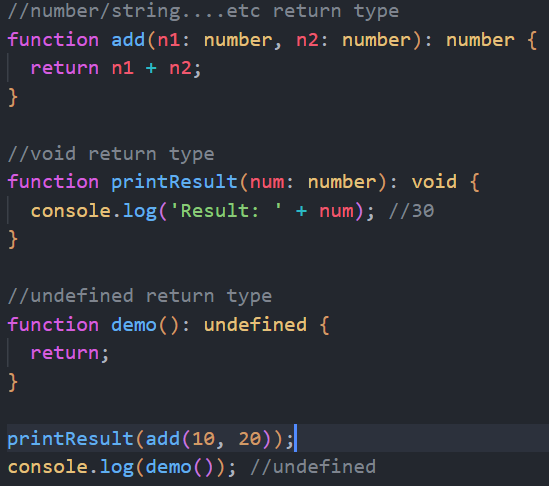
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* String literals as type alias.

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* **Function Return Type:**
* TypeScript support function with return types where JavaScript does not support functions with return type

Eg:  


* There are 3 major return type
  + Number, string, Boolean …. etc.
  + Void return type: if we want to print something than we use void
  + Undefined return type: if we want to return nothing or undefined value then we use this
* If we want to return nothing or undefined value, we can also use void
* **Function as a Type:**

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* **Callback Function:**
* Callback function mean passing a function as a arguments to another function.

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* **Unknown Type:**
* In TypeScript any value can assign to unknown, but without a type assertion, unknown can’t be assigned to anything.
* **Unknown** type is used to make our code type-safe, when we deal with unknown type.
* it looks like **any** type but it is different, **any** is fully flexible and not type safe while **unknown** if partially flexible and type safe.
* If we declare two variables one with **unknown** and other with **string/number** type and store string in **unknown type** variable and then try to assign **unknown type** variable in **string** type variable then it will throw error

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* Unknown type variable can only be assigned to another unknown type variable or a variable of type **any,** unknown type is displayed as **undefined.**
* **Never type:**
* When we are certain that a particular situation will never happen, we use the never type.
* Eg: suppose we construct a function that never returns or always throws an exception then we can use the **never** type on than function.
* Neve is a new type in TypeScript that denotes values that will never be encountered.

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This function doesn’t return anything.

* **null** value cannot be assigned to **never type.**
* We are not able to store any value in **never type** variables.

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* **NOTE:**

1. To run TypeScript file in watch mode use following syntax

**tsc filename.ts -w**

**or**

**tsc filename.ts –watch**

1. To compile entire project at one time
   1. **tsc --init 🡪**it will create **tsconfig.json** file for configuration.
   2. **tsc** or **tsc –w**
2. To exclude any file from compilation when we compiling entire project for that we make changes in **tsconfig.json** file
   1. Open **tsconfig.json**  file

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1. Also there is **include** property in that file which indicate all file which mention in **include** property only compile that files remaining file is not compiled
2. If we want to set folder path for compiled file then enable following property in **tsconfig.json** file

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* **Intersection Type:**
* An intersection type is a type that merges several kinds into one.
* This allows you to combine many types to create a single type with all of the properties that you require.
* An object of this type will have members from all of the types given.
* The ‘**&**’ operator is used to create the intersection type.

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* By intersection multiple type in single type, we can access all properties of all types by assigning only single type to that variable.
* If we do not mention any filed from all types then it will throw error.
* Intersection and union type almost work same but with some difference which is when we declare intersection type with **&** then we need to compulsory used all properties in that object of all types. But when we declare union type then we don’t need to compulsory mention all the field/Properties of all types.

|  |  |
| --- | --- |
| **Intersection type** | **Union type** |
|  |  |
| This will throw the error **& , and** | This is not throwing error **‘|’ , or** |

* **Type Guards:**
* Type Guards are TypeScript features that allow developers to narrow down the type of a variable within a conditional block.
* They are particularly useful when dealing with union types or when the types of variables cannot be determined by TypeScript’s static analysis alone.
* Type Guard provides a way to ensure type safety at runtime, thereby preventing potential errors.
* There are several type of Type Guard:  
  **1. typeOf():**

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* + it can be used to check the type of a variable using the **typeOf** operator.

**2. instanceof:**

- This **instanceof** operator checks if an object is an instance of a particular class or constructor function.

**3. in:**

**-** it is used to check given property present in the object or not

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**4. Discriminated Union type:**

- It is also called ‘tagged union type’ or ‘algebraic data types’.

- it is a type that can represents a value that can be one of several different type, with a tag indicating the type of the value.

* **Type Casting:**
* In TypeScript type casting happen by two ways

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1. **as:**
   * A straightforward way to cast a variable is using the **as** keyword, which will directly change the type of the given variables.
   * **as** is used to set return type of variable
2. **<>:**
   * Itworks the same as casting with **as.**

* **Index type Properties:**
* It is a feature that allow us to create object more flexible regarding the property they might hold.
* We can also set types on object properties/keys
* Then we cannot create property of other type like if we create property with number type then we cannot create property of string type in that variable

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* **Function Overloading:**
* Function overloading is the process in which one method could be used multiple times with same name and different parameter types or return types.
* Function name and number of parameters in overloaded functions should be same.

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* **Optional Chaining(?.):**
  + The optional chaining is an error-proof way to access nested object properties, even if an intermediate property doesn’t exist.
  + It is similar to **chaining ‘.’** Except that it does not report the error, instead it returns a value which is **undefined**.
  + It also works with a function call when we try to make a call to a method which may not exist.
  + When we want to check a value of the property which is deep inside a tree-like structure, we often must perform check whether intermediate nodes exist.

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* + It is also work on method, it checks method exists or not if exist then it execute that method or return undefined.

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* **Nullish Value:**
  + Nullish value are **null** and **undefined** only it is not contain other falsy value like **0,’ ’, NaN.**
  + It is fix that error

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* **Access Modifiers:**
* Access modifiers is used to protect data/variable for accessing outside the class
* It set accessibility on that variable or functions.
  + 1. **Private:**
       - If we declare variable with private modifier than this variable/method is only accessible in that class



* + 1. **Public:**
       - By default, all TypeScript object/variables/function are public.
       - We don’t need to mention **public** modifier on that variables/function
       - We can access public variable from anywhere in program after its declaration



* + 1. **Protected:**
       - Protected field/function only accessible in inherited classes and its own class



* + 1. **Readonly:**
       - Readonly property is used to set field/method to readonly.
       - We cannot be able to modify the value of that variable after declaring
       - To make field/property/method readonly, **readonly** keyword is used.

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* **NOTE:**
  + By adding modifier in constructor parameters then we don’t need to explicitly be defined that property in field

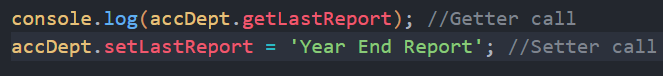
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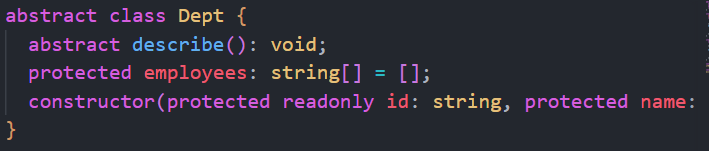
* **Getter and Setter:**
  + Getter and setter is used get value and set value

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* **Abstract Class Syntax:**
* Abstract classes are mainly for inheritance where other classes may derive from them.
* We cannot be able to create an instance of an abstract class.
* An abstract class typically include one or more abstract method or property declarations.
* The class which extends the abstract class must define all the abstract methods.
* To declare abstract method or property the class should be abstract.
* We can also add regular method in abstract class.

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* **Interface:**
* An interface in TypeScript defines the structure or skeleton of an object.
* It enforce a specific syntax on classes, specifying the types of data an object must have.
* Essentially, an interface acts as a contract that describes the shape of an object.
* In interface we cannot implement or initialize any field or method

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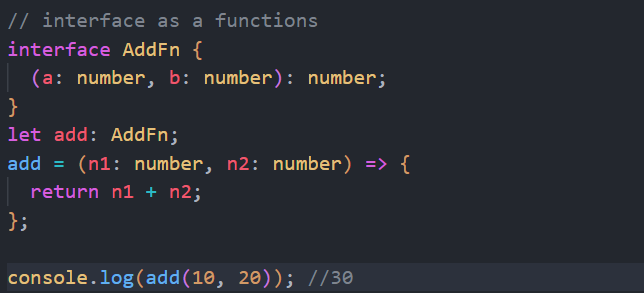
* **Eg:**

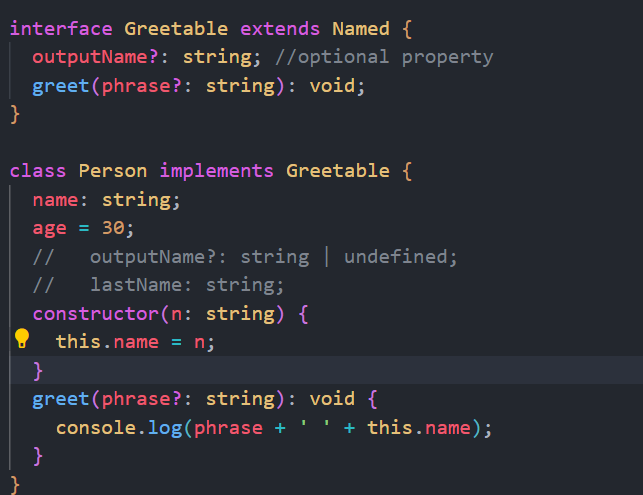
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* **Difference Between type and interface.**

|  |  |
| --- | --- |
| **Type** | **Interface** |
| It is a collection of data types. | It is a form of syntax. |
| Types are more flexible. | Interface is less flexible when compared to typescript types. |
| It uses the ‘**type’** keyword for creating new type. | It uses the **‘interface’** keyword for declaring an interface |
| It supports the creation of new name for a type. | It provides a way to define the entities. |
| Two types having same name raise an exception. | Two interfaces having same name get merged. |
| It does not have implementation purpose | It has an implementation purpose. |
| we cannot implement it using classes | We can implement it using classes |
|  |  |

* Interface is mainly used to describe the structure of objects. While types aliases can be used for a wider range of types including primitives, unions, intersections, and tuples in addition to object shapes.
* **Interface as a functions:  
  **
* **Optional Properties and parameter:**
  + You can add optional property/method in interface.
  + So if we don’t want to use that property/method in implementation we can avoid it
  + It will not throw any error if we did not define that property

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outputName and phrase are optional property and parameter

* **Generics:** [🖇**️**](https://www.freecodecamp.org/news/how-typescript-generics-work/)
* Generics in TypeScript enable writing code that can work with a variety of data types while maintaining **type safety.**
* They allow the creation of reusable components, functions, and data structures without sacrificing type checking.
* Generics are represented by type parameters, which act as placeholders for types. These parameters are specified within angle brackets (**<>**) and can be used throughout the code to define types of variables, function parameters, return types, and more.

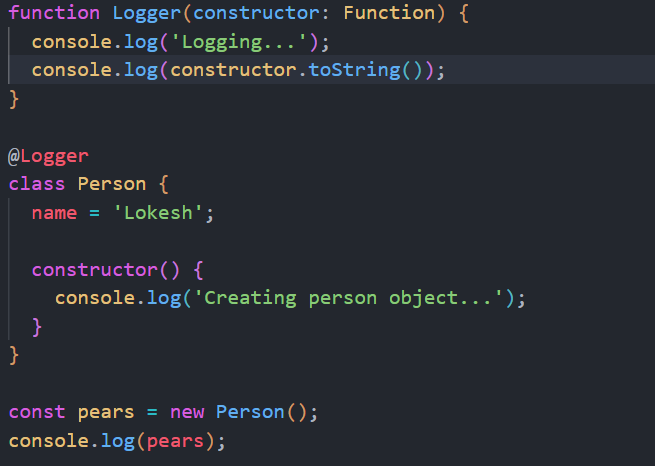


* To set a constraint on generics type we use **extends** keyword



Then we can only set type of given type in this case object type

* **Decorators:**
* A Decorator is a special kind of declaration that can be attached to a **class declaration, method, accessor, property** or **parameter.**
* Decorators are the language-specific feature used to modify and transform the classes and their members at the time of their declarations.
* Decorators are simple functions defined using the **@** symbol before their names.
* Decorators use the form **@**expression, where **expression** must evaluate to a function that will be called at runtime with information about the decorated declaration.
* Decorators’ compulsory received arguments which is **constructor function.**
* Decorators can execute before the class will execute
* Decorator can execute when the class is define

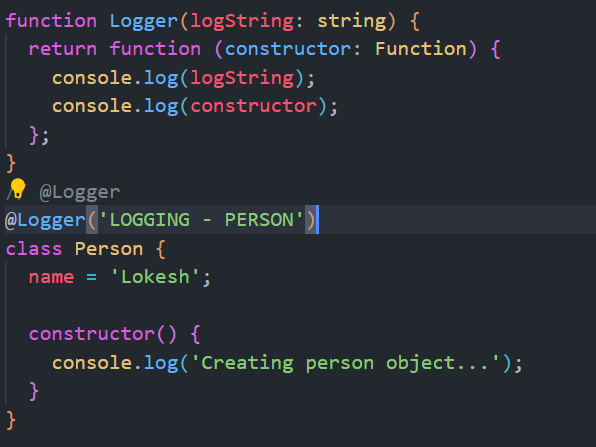


**O/P:**

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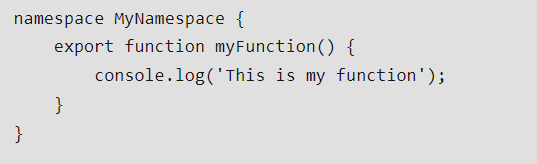
* To pass a custom parameter to decorators we used the following syntax.

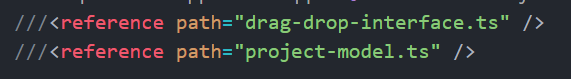
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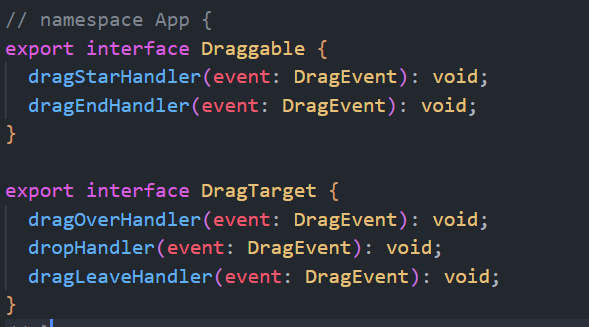
* Decorators provide a way to add both annotation and a meta-programming syntax for class decorations and members.
* **Namespaces and File Bundling:**
* In TypeScript, a namespace is a way to organize code into logical groups and avoid naming collisions between identifiers.
* Namespaces provide a way to group related code into a single namespace or module so that we can manage, reuse and maintain our code easily. w
* Namespaces provide a way to create modular code by breaking up a large codebase into smaller, more manageable pieces.
* Use **namespace** code syntax to group code.

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* To import file in project we use following syntax:  
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Where **///** are not comment it’s a special syntax for **import** files.

* **Import and export file using ES Module**
  + Remove all namespaces and export functions directly



* + Then import like this

