TypeScript

Course Overview

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TypeScript

Course Objectives & Program

TypeScript

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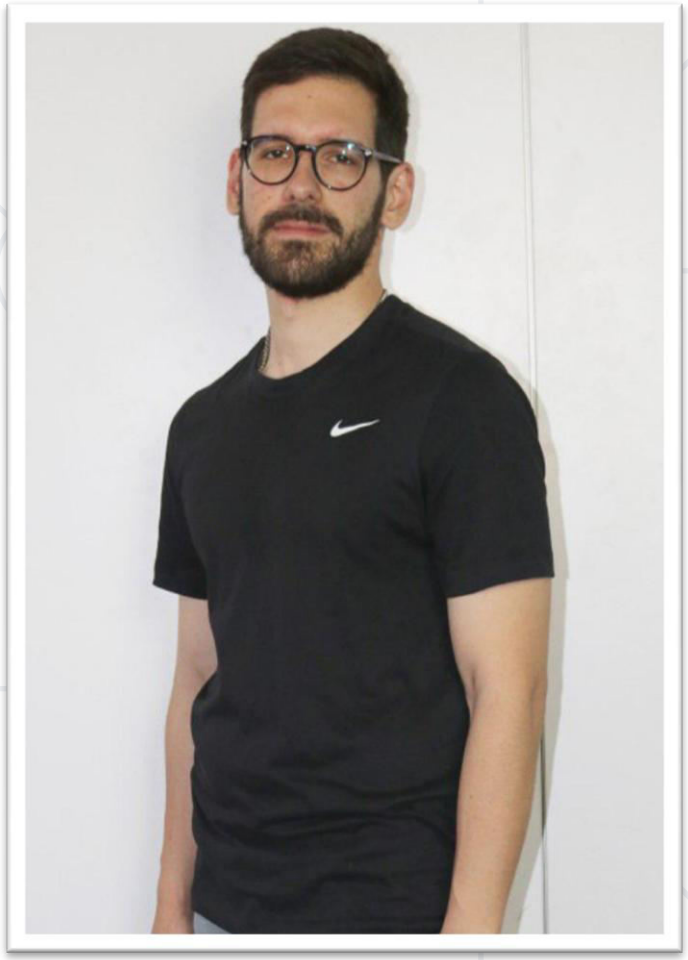
1. **Type System**
2. **Generics**
3. **Object Oriented Programming** (Class Based Objects)
4. **Namespaces and modules**
5. **Decorators**
6. **Workshop**

Trainers and Team

Ilia Idakiev

SoftUni Foundation

- Software developer-entrepreneur
- Google Developer Expert
- Co-organizer of Angular Sofia and SofiaJS / BeerJS
- Lecturer at Sofia University (FMI)
  - "Advanced JavaScript" course



Course Objectives

Course Details and Schedule

Targets of the Course

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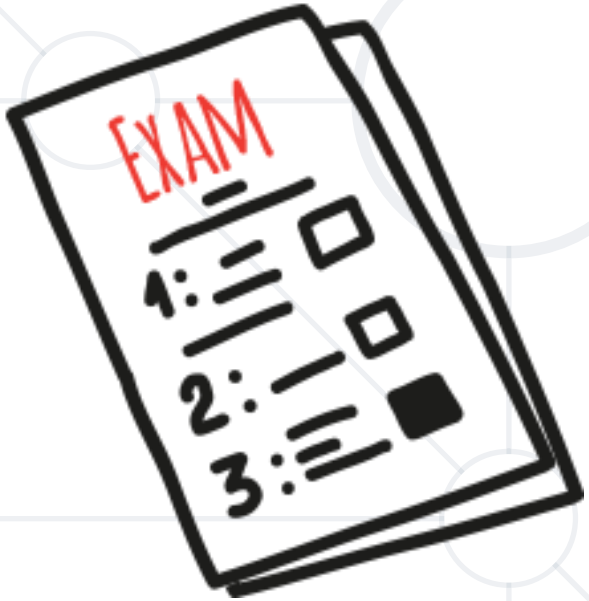
- Introduction to the TypeScript programming language
- Covers: **Type System**, **Generics**, **Object Oriented Programming**, **Namespaces and modules** and **Decorators**

Practical Exam

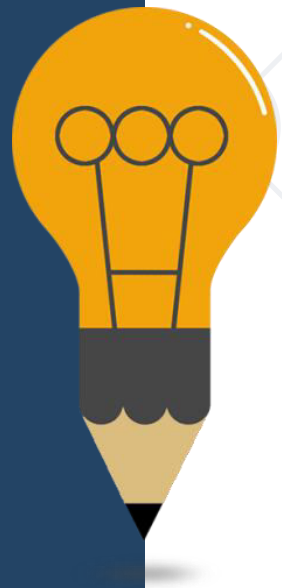
- Structure: **3 problems** for **4 hours**
- Problems description:
  - **OOP**
  - **Generics**
  - **Decorators**

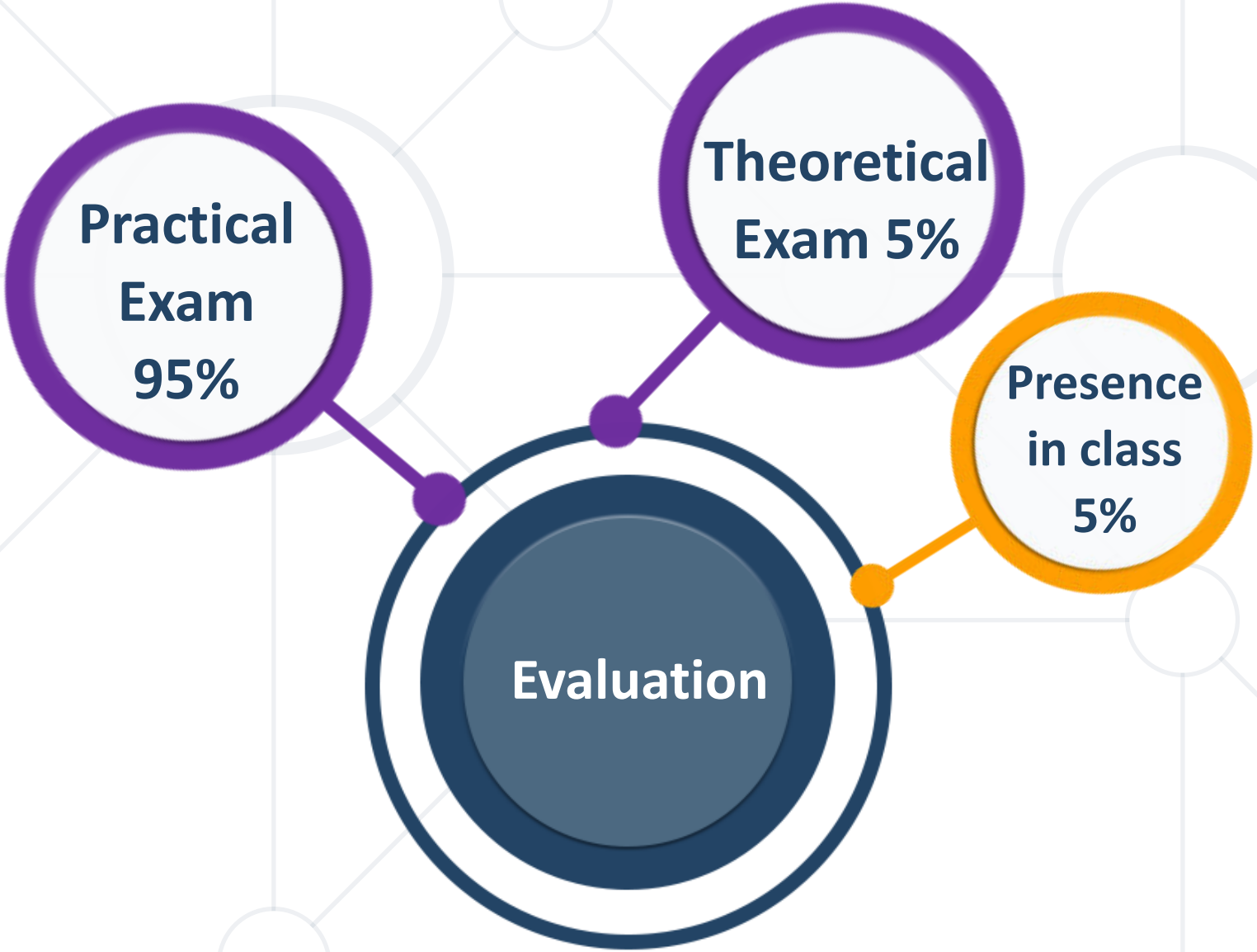


Theoretical Exam

- 20 questions for 30 minutes
  - Multiple-choice with 1 correct answer
  - English
- Automated quiz system
- Available online the day before the practical exam
  - You can submit your answers just one time

Scoring System for the Course





Course Organization

Evaluation Criteria

- **Mandatory**
  - **Practical exam** - 95%
  - **Theoretical exam** - 5%
- Bonuses:
  - Presence in class – 5% bonus (onsite students only)

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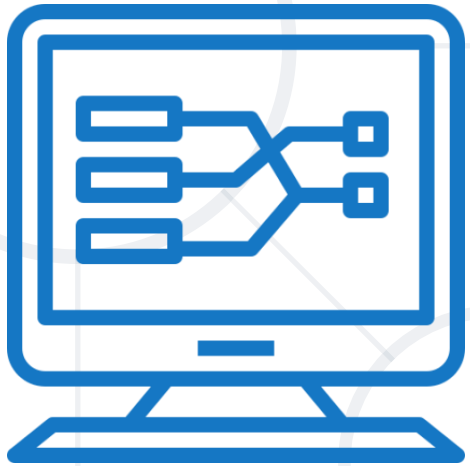
TypeScript Type System

Basic and Advanced data types



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Introduction to TypeScript

TypeScript and JavaScript

- TypeScript is a **superset** of JavaScript
- Created by Microsoft Corporation
- All JavaScript code is **valid** in TypeScript too
- TypeScript **compiles to** JavaScript

TypeScript vs JavaScript

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- TypeScript

```
class Person {
  private firstName: string;
  constructor(f: string) {
    this.firstName = f;
  }
  greeting() {
    return `${this.firstName} `
  }
}
```

- JavaScript

```
"use strict";
class Person {
  constructor(f) {
    this.firstName = f;
  }
  greeting() {
    return  `${this.firstName} `;
  }
}
```

Install TypeScript to Visual Studio Code

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- Install **TypeScript** with **npm**

```
npm install -g typescript (latest stable build)
```

- Test if **TypeScript** is **installed properly**

```
tsc --version //Should return a message 'Version
3.x.x'.
```

- Create the **tsconfig.json** file

```
tsc --init – This command will create a new
tsconfig.json file
```

tsconfig.json

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- In the tsconfig.json file, please **remove the comments** from the following:

```
{
  "compilerOptions" : {
      "target": "esnext",   //ECMAScript target version
      "module": "esnext",   //module code generation
      "sourceMap": true,    //Generates corresponding .map file
      "strict": true,       //strict type-checking options
      "outDir": "out",      //redirect output to the directory.
    }
}
```

Basic Data Types

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- **String** - used to represent **textual** data

```
let str: string = `hello`;
str = 'singleQuotes' ; //valid
str = "doubleQuotes" ; //valid
str = 11; //invalid
```

- **Number** - a numeric data type

```
let decimal: number = 11; //valid
let hex: number = 7E3; //valid
let binary: number = 11111100011 //valid
let float: number = 3.14 //valid
decimal = `hello`; //invalid
```

Basic Data Types

- **Boolean** - only **true** and **false** values
  - Functions or expressions that return true or false values may also be assigned to Boolean data type

```
let isBool: boolean = true;
isBool = 5 < 2; //valid
let numbers = [1, 2, 3, 4];
isBool = numbers.includes(100)
//valid
isBool = 11; //invalid
```

Basic Data Types

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- **Array** - use any valid data type (String, Boolean, Number) and postfix []

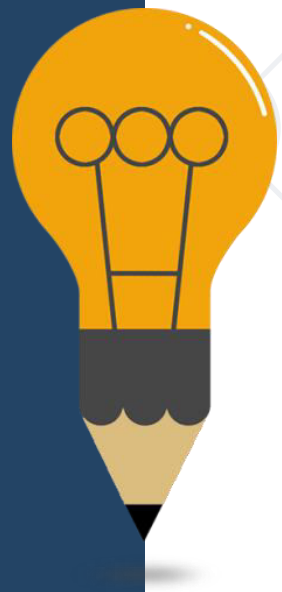
```
let arrayOfStr: string[];
arrayOfStr.push(`Hello`); //valid
arrayOfStr.push(`World`); //valid
arrayOfStr.push(11); //invalid
```

- **Tuple** - array with fixed number of elements whose types are known

```
let tuple:[string, number];
tuple = [`Hello`, 11]; //valid
tuple = [11, `Hello`]; //invalid
```

Basic Data Types

- **Enum** - Gives sets of numeric values more readable names
  - By default each enum starts at 0



```
enum DaysOfTheWeek {
    Monday,  //0
    Tuesday, //1
    …
};
let day: DaysOfTheWeek;
day = DaysOfTheWeek.Monday;
console.log(day); //0
if (day === DaysOfTheWeek.Monday) {
    console.log(`I hope you all had a great weekend!`);
} //It will print the message
```

Basic Data Types

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- **Any** - takes any and all values. It`s a way to escape the strong types

```
let example: any = `hello`;
example = true; //valid
example = 11 ; //valid
```

- **Void** - mainly used in functions that return no value

```
function greet(message: string): void {
    console.log(message);
}
```

Optional data types

- The **optional** data types are marked with **?**
  - Required parameters **cannot** follow optional ones

```
function optionalParams(name: string, mail?: string) {
      //some logic
} //valid

function optionalParams(name?: string, mail: string) {
      //some logic
} //invalid
```

Return data types

- The **return data types** are marked with **:** after the braces in function declaration
  - The **return value type** should match the **return type**

```
function greet (name: string): string {
    return name;
}

console.log(greet('Hello'));
```

Advanced Data Types

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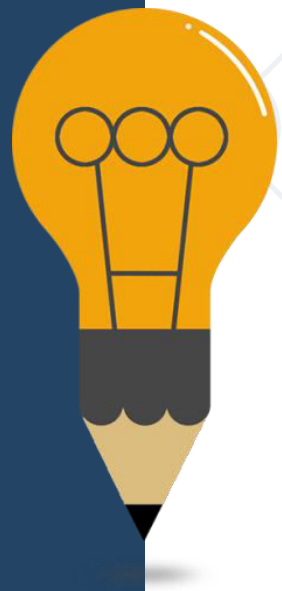
- **Union type** - combine multiple types in one type

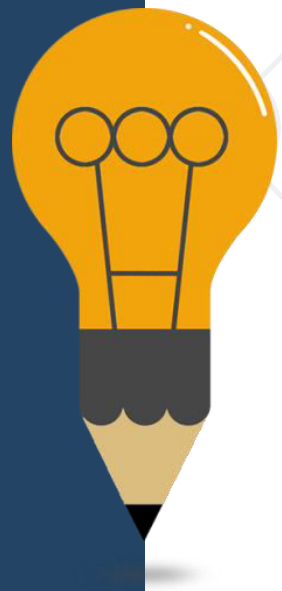


```
function greet(message: string | string[]) {
    if (typeof message === "string") {
        return message;
    }
    return message.join(' ');
}
let greeting = 'Hello world';
let greetingArray = ['Dear', 'Sir/Madam'];

console.log(greet(greetingArray)); //Dear Sir/Madam
```

Advanced Data Types

- **Intersection types** - combine multiple types in one type



```
interface Person { fullName: string | string[]; }
interface Contact { email: string; }
function showContact(contactPerson: Person & Contact) {
    return contactPerson;
}
let contactPerson: Person & Contact = {
    fullName: 'Svetoslav Dimitrov',
    email: 'test@test.com'
}
console.log(showContact(contactPerson));
```

Problem: Mathematical operations

- Write a **TypeScript function** that makes **simple mathematical operations** over an array of numbers
  - It will receive two parameters: **array of numbers and operation**
    - The operations might be: **addition**, **multiplication** **or finding the largest number**

Solution: Mathematical operations

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```
function solve(arrOfNums: number[], operation: string): number {
    let result: number = 0;
    const addition = () => result = arrOfNums.reduce((a, b) => a + b, 0);
    const multiplication = () => result = arrOfNums.reduce((a, b) =
> a * b, 1);
    const largestNumber = () => result = Math.max(...arrOfNums);
    const actions = {
        'Addition': addition,
        'Multiplication': multiplication,
        'Largest number': largestNumber
    }
    actions[operation]();
    return result;
}
```

Live Exercises

Summary

- TypeScript presents strong typing to your JavaScript code
  - `let`, `const` and `var` are used to declare variables
  - There are basic (Number, String, Boolean, etc.) and more advanced data types like union or intersection
- Functions can:
  - Take optional and required parameters and return result

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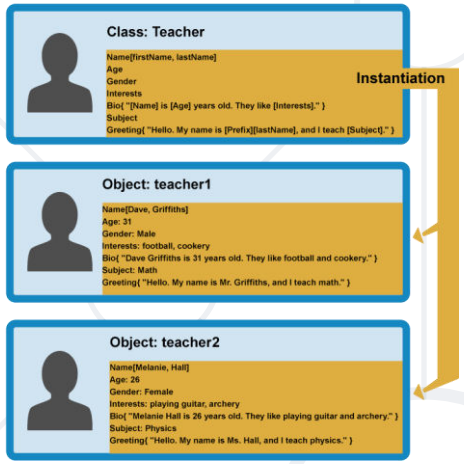
TypeScript OOP

Classes, inheritance, abstraction



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TypeScript Classes

Definition

- **Classes** in TypeScript can contain:
  - **Data**, defined by its **properties**
  - Who can use the data - **access modifiers**
  - Some **actions** by using **methods**
- **One class** may have **many heirs** – **inheritance**
- **Abstract classes** cannot be instantiated directly. They are the **ancestor** class which starts the **inheritance chain**

Overview

```
class Dog {
    private name: string;
    private age: number;

    constructor(n: string, a: number) {
        this.name = n;
        this.age = a;
    }

    bark() {
        return `${this.name} woofed friendly`;
    }
}

let tommy = new Dog('Tommy', 6);

console.log(tommy); //Dog { name: 'Tommy', age: 6 }
console.log(tommy.bark()); //Tommy woofed friendly
```

Class initialization

Class properties

Class constructor

Class method

Breakdown: Properties

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- The **properties** in TypeScript are used to **store data**
  - They are defined **before** the constructor in the **body** of the class
  - The **data is passed** to them **afterwards**

```
class ContactList {
    private name: string;
    private email: string;
    private phone: number;
}
```

Property declarations

Breakdown: Constructor

- The **constructor** is used to give properties **values**
  - Each **class** can have only **one constructor**
  - The constructor creates **new object** with the defined properties

```
class ContactList {
    //property declarations
    constructor(n: string, e: string, p: number) {
        this.name = n;
        this.email = e;
        this.phone = p;
    }
}
```

Breakdown: Methods

- The **methods** are used to define functionalities
  - Each **class** can have **lots of methods**
  - Generally speaking, each **method** should do **one thing** only

```
class ContactList {
    //property declarations
    //constructor
  call() {
    return `Calling Mr. ${this.name}`
  }
  showContact() {
    return `Name: ${this.name} Email: ${this.email} Number: ${this.phone}`
  }
}
```

Methods

Access modifiers

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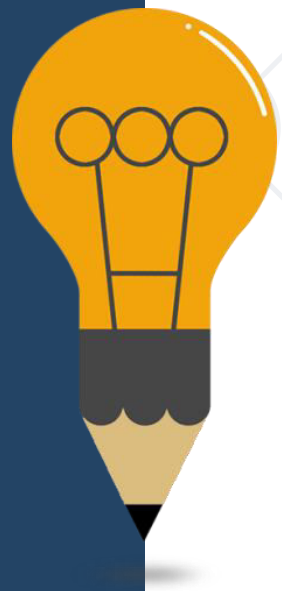
- Unlike JavaScript, TypeScript has **access modifiers**
- Used to **define** who can **use** the class elements
- **Types** of access modifiers:
  - Public
  - Private
  - Readonly
  - Protected



Public

- By **default** each element is defined **as public**
- Gives **access** to the element
- Not only **properties** may be public, but **constructors** as well

```
class Zoo {
    public type: string;
    public name: string;

    public constructor(t: string, n: string) {
        this.type = t;
        this.name = n;
    }
}
```

Private

- Element marked as **private** cannot be accessed **outside** the declaration

```
class Zoo {
    private type: string;
    private name: string;

    constructor(t: string, n: string) {
        this.type = t;
        this.name = n;
    }
}
let animal = new Zoo('bear', 'Martha');
console.log(animal.name); //Error: name is private.
```

Readonly

- **Readonly** protects the value from being **modified**
- No unexpected data mutation

```
class Zoo {
    readonly name: string;

    constructor(n: string) {
        this.name = n;
    }
}
let animal = new Zoo('Martha');
animal.name = 'Thomas'; //Error: name is read-only.
```

Protected

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- Element marked as **protected** can be accessed **only** within the **declaration class** and **the subclasses**

```
class Zoo {
    protected name: string;
    constructor(n: string) { this.name = n; }
}
class Bear extends Zoo {
    private color: string;
    constructor (name, c: string) {
        super(name);
        this.color = c;
    }
}
let martha = new Bear('Martha', 'Brown');
```

Inheritance

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- Used to **extend** existing classes to **new ones**
- To do so we use the **extend** key word
- The "basic" class is often called **superclass** and the extended - **subclasses**
- To inherit the superclass's **constructor** to the subclass we use the keyword **super**

Example of inheritance

```
class Company {
    public name: string;
    constructor(n: string) { this.name = n; }
}
class Department extends Company {
    private depName: string;
    constructor(name, dN) {
        super(name);
        this.depName = dN;
    }
}
class Employee extends Department {
     //Some code logic
}
```

Class Department inherits the Company class

Class Employee inherits the Department class

Inheritance

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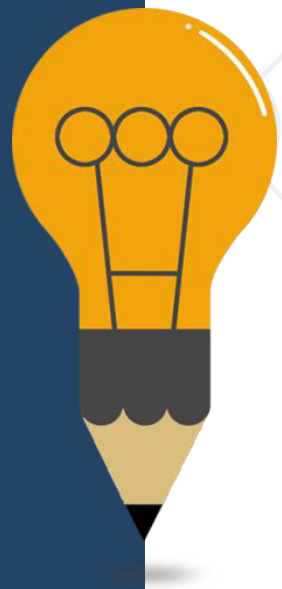
- Not only **properties** might be inherited, but **methods** as well.

```
class Vehicle {
    public color: string;
    constructor(c: string) { this.color = c; }
    showColor() { return `The car is ${this.color}`; }
}
class PassengerCar extends Vehicle {
    public model: string;
    constructor(color, m: string) {
        super(color);
        this.model = m;
    }
    details() {
        return `${super.showColor()} and is ${this.model}`
    }
}
```

Accessors

- In order to use accessors your compiler output should be set to **ES6** or higher
- **Get** and **Set**
  - Get method comes when you want to **access** any class property
  - Set method comes when you want to **change** any class property



Example of accessors

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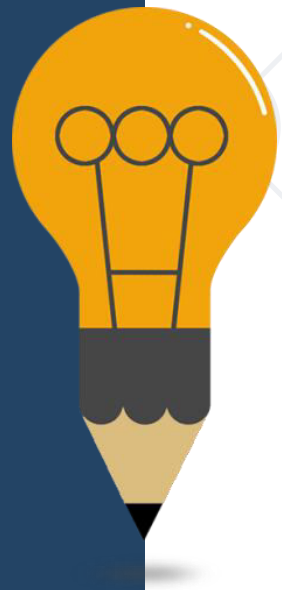
```
const fullNameMaxLength = 10;

class Employee {
    private _fullName: string;

    get fullName(): string {
        return this._fullName;
    }

    set fullName(newName: string) {
        if (newName && newName.length > fullNameMaxLength) {
            throw new Error("fullName has a max length of " + fullNameMaxLength);
        }

        this._fullName = newName;
    }
}
```

Abstract class

- Defined by keyword **abstract**
- They are **superclasses** but **cannot** be **instantiated directly**
- Methods inside abstract classes and marked as such **do not contain implementations** but **must be** implemented **in derived classes**



Example of abstract class

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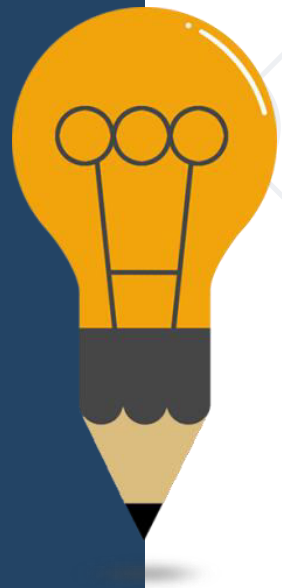
```
abstract class Department {
    public depName: string;
    constructor(n: string) { this.depName = n; }
    abstract sayHello(): void;
}
class Engineering extends Department {
    public employee: string;
    constructor (depName: string, e:string) {
        super(depName)
        this.employee = e;
    }
    sayHello() {
        return `${this.employee} of ${this.depName} department says hi!`;
    }
}
let dep = new Department('Test') //Cannot create instance of abstract class
```

Static properties

- Defined by keyword **static**
- The **property** belongs to the class itself, so it **cannot be accessed** outside of the class
- We can only access the properties directly **by referencing** the class itself



Example of abstract class

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```
class Manufacturing {
    public maker: string;
    public model: string;
    public static vehiclesCount = 0;

    constructor(maker: string, model: string, ) {
        this.maker = maker;
        this.model = model;
    }
    createVehicle() {
        Manufacturing.vehiclesCount++;
        return `Created cars: ${Manufacturing.vehiclesCount} of
        ${this.maker} ${this.model}`;
    }
}
```

Live Exercises

Summary

- Classes in TypeScript consist of
  - Properties
  - Constructor
  - Methods
- You can restrict or allow access to properties by using access modifiers
- Using get and set methods

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TypeScript Generics

Interfaces, Generic Functions and Classes

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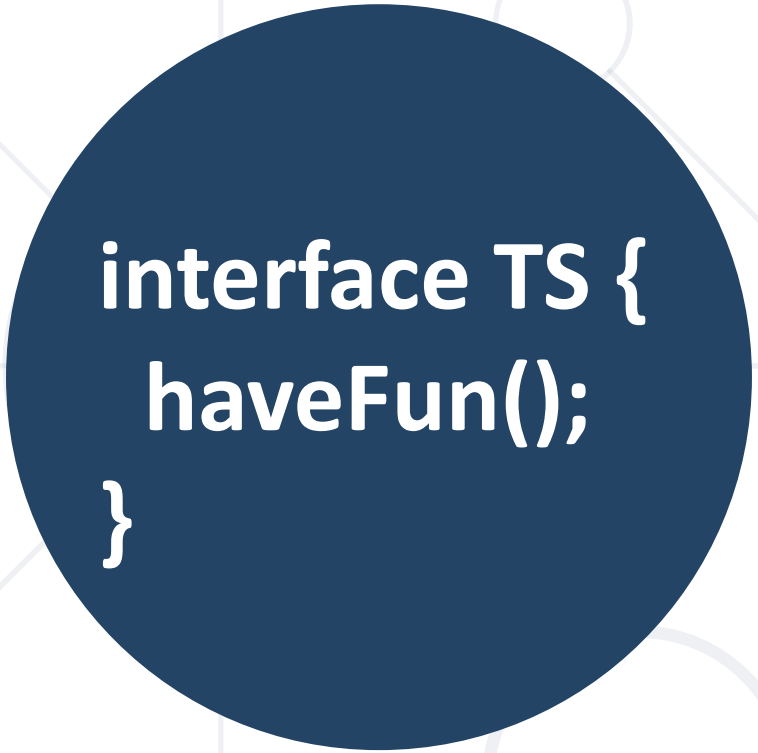

Interfaces

Definition

- Defined by using keyword **interface**
- Often called **duck typing** or **structural typing**
- We can define **properties**, **methods** and **events** also called **members** of the interface
- The interface **contains** only **the declaration** of its members
- Helps to **standardize the structure** of the deriving classes

Example: Basic interface

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```
interface Person {
    fullName: string,
    email: string,
}

let thomas: Person = {
    fullName: 'Thomas Doe',
    email: 'thomas@test.test',
}

console.log(thomas.fullName) //Thomas Doe
```

Interface declaration

Declare a variable with the interface as type in order to follow the structure

Describe function types

- Interfaces in TypeScript can also describe function types
  - They are constructed in the following way:

```
interface Name {
   (paramOne: type, paramTwo: type,...paramN: type): type;
}
```

    - Where in the parantheses we put the **parameters** we want to pass to the function with their **types**, splitted by comma.
    - On the right side is the **return type** of the function

Example: Describe function types

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```
interface Calculator {
    (numOne: number, numTwo: number, operation: string): number;
}

let calc: Calculator = function (a: number, b: number, operation:
 string): number {
    let result: number = 0;
    const addition = () =>  result = a + b; ;
    const parser = {
        'addition': addition,
    }
    parser[operation]();
    return result;
}
```

Implemented by classes

- Interfaces can be implemented by classes using the keyword **implement**
- A class that implements an interface **must have** all the properties defined in the interface
  - Describes the **public** side of the class

```
interface Person { ... }

class Teacher implements Person { ... }
```

Example: Implemented by class

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```
interface ClockLayout {
    hour: number;
    minute: number;
    showTime(h: number, m: number): string;
}

class Clock implements ClockLayout {
    public hour;
    public minute;
    constructor(h: number, m: number) {
        this.hour = h;
        this.minute = m;
    }
    showTime() {
        return `Current time: ${this.hour}:${this.minute}`;
    }
}
```

Extending interfaces

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- Interfaces can extend **classes** and other **interfaces**
  - Extending **classes**
    - The extended interface **inherits** all of the members of the class including **private** and **protected** members
    - The interface **does not inherit** the **implementations** of the members (e.g. method implementations)
  - Extending other **interfaces**
    - Creates a **combination** of all interfaces

Example: Extending interfaces

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```
class Computer {
    public RAM;
    constructor(r: number) { this.RAM = r; }
    showParams(): string { return `${this.RAM}`; }
}
interface Parts extends Computer {
    CPU: string;
    showParts(): string;
}
class PC extends Computer implements Parts {
    public keyboard;
    public CPU;
    constructor(RAM: number, CPU:string) { super(RAM); this.CPU = CPU; }
    showParts() {
        return `${this.RAM} ${this.CPU}`;
    }
}
```

Generics

Definition

- Used to build **reusable** software components
- The components will work with **multitude** of type instead of a single type
- Defined by type variable - **<LETTER>**
- Follow the **DRY** (**D**on`t **R**epeat **Y**ourself) principle
- Allow us to **abstract** the type
- Generics can be applied to **functions**, **classes** and **interfaces**

Example: Generic vs Non-generic

- Generic

```
function echo<T>(arg: T): T {
    console.log(typeof arg);
    //It will print number and
string when the function is
invoked
    return arg;
}
echo(11111);
echo('Hello');
```

- Non-generic

```
function echo(arg: number): number {
    return arg;
}
```

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

Generic functions

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- Generic functions allow us to work with user input with **unknown** data type
- It is a way of telling the function that whatever **type** is **passed** to it the **same** type shall be **returned**
- Put some **constraints** to user input
- We can put **more than one** type variable in the generic function

Example: Generic functions

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```
const takeLast = <T>(array: T[]) => {
    return array.pop();
}
const sample = takeLast(['Hello', 'World', 'TypeScript']);
const secondSample = takeLast([1, 2, 3, 4]);
console.log(sample, secondSample); //TypeScript, 4
```

```
const makeTuple = <T, V>(a: T, b: V) => {
    return [a, b];
}
const firstTuple = makeTuple(1, 2);
const secondTuple = makeTuple('a', 'b');
console.log(firstTuple, secondTuple); //[1, 2], [a, b]
```

Generic interfaces

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- Using **generic interfaces** we can define **generic functions** too

```
interface GenericConstructor<T, V> {
    (arg: T, param: V): [T, V];
}

const generatedFn: GenericConstructor<string, string> = <T, V>(arg: T, param: V)
 => {
       return [arg, param];
}

const sample = generatedFn('Hello', 'World');
console.log(sample); // [Hello, World]
```

Generic classes

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- Generics can be used on:
  - The **properties** of the class
  - The **methods** of the class
- To define generic class we put **<LETTER> after the name of the class**
- We can use **multiple** type variables
- Generic classes can implement generic interfaces

Example: Generic class using single parameter


```
class Collection<T> {
    public data: T[];
    constructor(...elements: T[]) { this.data = elements; }

    addElement(el: T) { this.data.push(el); }

    removElement(el: T) {
        let index = this.data.indexOf(el);
        if (index > -1) {
            this.data.splice(index, 1);
        }
    }

    reverseElements() { return this.data.reverse(); }

    showElements() { return this.data; }
}
```

Example: Generic class using multiple parameters

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```
class UserInput<F, S> {
    public first: F;
    public second: S;
    constructor (f: F, s: S) {
        this.first = f;
        this.second = s;
    }

    showBoth() {
        return `First: ${this.first}, second: ${this.second}`;
    }
}

let sample = new UserInput('Ten', 10);
let test = new UserInput(1, true);
console.log(sample.showBoth()); // First: Ten, second: 10
console.log(test.showBoth()); // First: 1, second: true
```

Example: Generic class implements interface

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```
interface ShowComponents<T, V> {
    print(key: T, value: V): string;
}

class Components<T, V> implements ShowComponents<T, V> {
    public key: T;
    public value: V;
    constructor(k: T, v: V) {
        this.key = k;
        this.value = v;
    }
    print(){
        return `Key: ${this.key} and value: ${this.value}`;
    }
}
let test: ShowComponents<string, string> = new Components('New', 'Test');
console.log(test.print('Test', 'Hello')); // Key: New and value: Test
```

Generic type constraints

- In TypeScript we can make sure that sudden type variable **has** at least **some information** containing in it
- Constraints are enforced by **extends** keyword

```
function fullName<T extends { fName: string, lName: string }>(obj: T) {

      return `The full name is ${obj.fName} ${obj.lName}.`;
}

let output = fullName({fName: 'Svetoslv', lName: 'Dimitrov'});

console.log(output);// The full name is Svetoslav Dimitrov
```

Live Exercises

Summary

- Generics are use to:
  - Abstract data types
  - Build reusable components
- We can use them in:
  - Functions
  - Classes - their properties and methods
  - Interfaces

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Namespaces and modules

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#Typescript

Namespaces

Definition

- Namespaces are used to **logically grouped** functionalities
- Previously referred as **internal modules** in TypeScript
- Defined with **namespace** keyword
- Namespaces may include **functions**, **classes**, **interfaces** and **variables**

Access

- The elements of the namespace that must be accessed from the outside must be marked with **export** keyword
- In order to access namespaces from different files we must use the reference syntax /// **<reference path = "file.ts" />**

Example: Namespace

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```
namespace printMessages {
    export function messenger(message: string | string[]) {
        return `${message}`;
    }
    export interface meetPerson {
        meetPerson(): string
    }
}
console.log(printMessages.messenger('Hello')); //Hello
```

namespace declaration

export to use the interface outside

Multiple Files Namespaces

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- In order to access namespaces from different files we must use the reference syntax **/// <reference path = “file.ts” />**
- In order to compile the file we must
  - Compile the ts file - **tsc fileName.ts**
  - Use the outFile - **tsc --outFile fileName.js fileName.ts**
  - Compile the js file - **node fileName**

Example: Multiple File Namespace

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```
/// <reference path = 'messages.ts'/>
class Person implements printMessages.meetPerson {
    public fullName: string;
    public greeting: string;

    constructor(fn: string, g: string) {
        this.fullName = fn;
        this.greeting = printMessages.messenger(g);
    }

    meetPerson(): string {
        return `Hello, ${this.fullName}, ${this.greeting}`;
    }
}
let p1 = new Person('Ivan Ivanov', 'pleasure to meet you!');
console.log(p1.meetPerson());
```

Aliases

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- Used to simplify the work with namespaces
- Used with **import** keyword
- Often used as nested namespaces

```
namespace Shops {
    export namespace TechStores {
        export class PCStore {}
        export class AudioStore {}
        export class TVStore {}
    }
}
--Name of file - app.ts
import stores = Shops.TechStores;
let pcStore = new stores.PCStore();
```

Modules

Definition

- Modules are executed in their **own scope**, not the global
- A **set of functions** to be included in applications
- Resolve name collisions
- In order to be accessed from the outside they need to be marked with **export** keyword

Access

- To consume a function, class, interface or variable exported from another module we must use an **import** form
  - **import** { name } from "./location" - import specific element
  - **import** * as variable from "./location"; - imports the entire module in single variable

Export Statements

- There are three ways to use **export** statements:
  - A:
  - B:
  - C:
  - D:

```
export function numberValidation(num: number): number {…}
```

```
export { numberValidation };
```

```
export { numberValidation as isValidNum }; //isValidNum is alias
```

```
export default function stringValidations(string: string): string {…}
```

- In cases **A** and **B** there is **no difference** rather than syntax
- There might be only one **export default** in a file

Example: Export and Import Statements

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```
--exports
export default function checkInput<T>(information: T): T {
    if (information) { return information; }
    else { throw new Error('The information passed is not valid') }
}
export function stringValidations(string: string): string {
    if (string.length > 0 && string.length <= 20) { return string;
}
    else { throw new Error('String is not valid'); }
}
export function numberValidation(num: number): number {
    if (num > 0 && num <= 999) { return num; }
    else { throw new Error('Number is not valid'); }
}
export { numberValidation as isValidNum };
```

Import Statements and File Compilation

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```
--Imports
import * as validations from './validations'; //validations is
alias
import checkInput from "./validations";
import { isValidNum } from "./validations";

// Some code logic
```

- In order to compile the file we must
  - Compile the ts file - **tsc fileName.ts**
  - Use the outFile - **tsc --module commonjs fileName.ts**
  - Compile the js file - **node fileName**

Problem: Modules

- You are given a task to calculate the **area and perimeter** of a **Square**, **Circle** and **Rectangle**. You should split the respective classes in a separate files and use modules afterwards
  - Use **interfaces**, in a new file, to define the functions for calculating the area and the perimeter
  - In the main file make a **Calculator** class that makes the calculations

Solution: Modules

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```
import * as make from "./interfacesCalc"
import * as shapes from "./shapes";
class Calculator //TODO: extends and implements {
    area(): number {
        return (this.height * this.base) / 2
    }
    perimeter(): number {
        return this.base * 3
    }
}
let calc = new Calculator(4, 4);
console.log(calc.area());
console.log(calc.perimeter());
```

Problem: Namespaces

- You are given a task to display the attendance to a business meeting. You should organize your program in different files using namespaces
  - Use **interface**, in a new file, to define the function for displaying the attendance
  - Use a **function** to invite the attendees. Note that the function takes two parameters -> full name of the employee and the position and returns them in an object
  - In the main file make a **Meeting** class that displays the attendees who went to the meeting

Solution: Namespaces

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```
/// <reference path = "attendees.ts" />
const a1 = attendance.createAttendee('Ivan Ivanov', 'R&D');
//invite two more people
class Meeting implements layout.showAttendance {
    public att;
    constructor(a: any) {
        this.att = a;
    }
    showAttendance(): string {
        let output = '';
        //implement the logic that prints the attendees
        return output;
    }
}
```

Live Exercises

Summary

- Namespaces are logically grouped functionalities
- Modules are a **set of functions** to be included in applications
- Modules do not pollute the global scope

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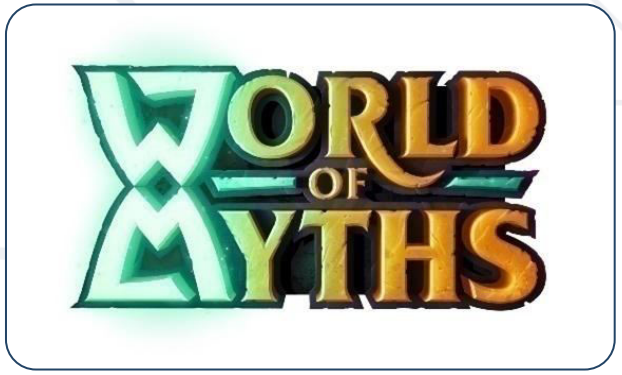

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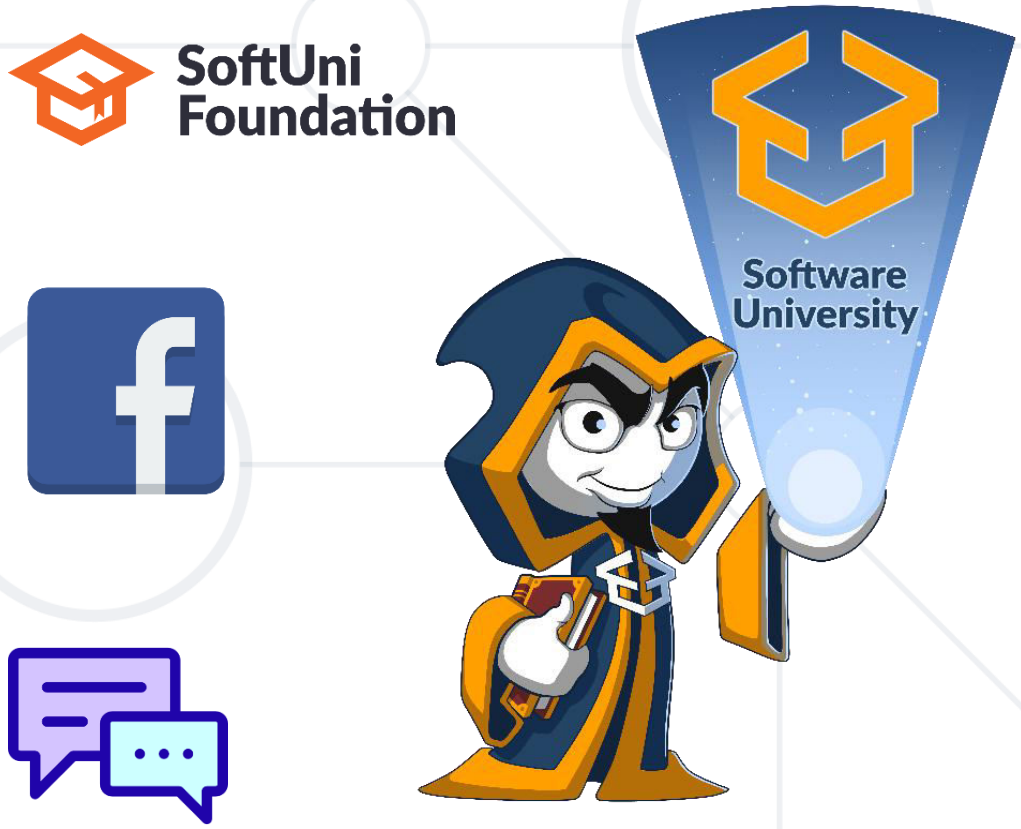
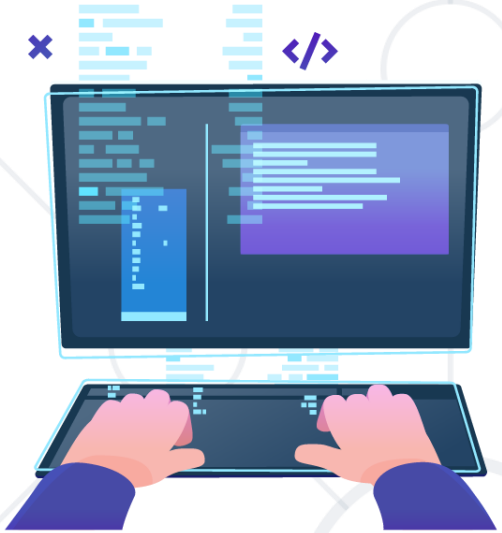


Decorators



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#Typescript

Decorators Overview

Definition

- Used in frameworks like **Angular**, **MobX** and others
- They are used to extend a functionality or add meta-data
- Use the form **@example** where **example** must evaluate to function that will be called at runtime

```
function example(target) {
  //some code logic
}
```

Decorate

- We can decorate **five** different **things**:
  - Class definitions, properties, methods, accessors, parameters
- The function that we implement is **dependent** on the **thing** we are **decorating**
- The **arguments** required to **decorate a class** are different to the **arguments** required **to decorate a method**

Enable decorators

- In the **tsconfig.json** file:

```
"target": "ES5",
"experimentalDecorators": true
```

- In the **command line**:

```
tsc --target ES5 --experimentalDecorators
```

- Note: Decorators are still stage 2 proposal for JavaScript and only experimental in TypeScript

Decorator evaluation

- There is well **defined order** to how decorators are applied:
  - **Parameter Decorators**, followed by **Method**, **Accessor**, or **Property Decorators** are applied for each **instance member**
  - **Parameter Decorators**, followed by **Method**, **Accessor**, or **Property Decorators** are applied for each **static member**
  - **Parameter Decorators** are applied for the **constructor**
  - **Class Decorators** are applied for the **class**

Class Decorators

Definition

- **Class Decorator** is **added just before** the class declaration
- The Class Decorator is applied to the **constructor** of the class
- Used to **observe**, **modify** or **replace** a class definition
- If the Class Decorator **returns a value**, it will **replace** the class declaration with the **provided constructor function**

Example: Class Decorator

```
function Frozen(construtor: Function) {
    Object.freeze(construtor);
    Object.freeze(construtor.prototype);
}

@Frozen class Person {
    constructor(private name: string) { }
}
```

@Frozen is a class decorator

Decorators and inheritance

- Subclasses do not inherit the decorations of the super class
- Every subclass needs to be decorated on its own

```
@ClassDecorator class Person {
    constructor(public name: string) { }
    @enumerable(false) greet() {
        return `Hello ${this.name}`
    }
}
class Teacher extends Person {
    constructor(private subject: string, name: string) {
        super(name);
    }
    introduce() {
      //some code logic
}
```

The Teacher class does not inherit the decorator

Decorator Factories

Definition

- **Function** that **returns** the **decorator** function **itself**
- Gives the flexibility to pass **custom data** when needed
- Mainly used in **method** and **property decoration**

```
function enumerable(value: boolean) {
    return function (target: Object, propertyKey:
string, descriptor: PropertyDescriptor) {
        descriptor.enumerable = value;
    };
}
```

Multiple Decorators

- Decorators are **composable**
- We can chain **multiple decorators** for each class declaration, method, property, accessor or parameter
- In those cases the decorators are applied from **top to bottom**

```
@Frozen
@Configurable
@OtherDecorator
class Person {
    constructor(private name: string) { }
}
```

Method Decorators

Definition

- The decorator function takes **three** arguments:
  - **target** - the parent **class**
  - **key** - the **name** of the function
  - **descriptor** - the actual **function** itself

```
function enumerable(value: boolean) {
    return function (target: Object,
                     key: string,
                     descriptor: PropertyDescriptor) {
        descriptor.enumerable = value;
    };
}
```

Example: Method Decorator

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```
function Confirmable(message: string) {
    return function (target: Object,
     key: string,
     descriptor: PropertyDescriptor) {
        const original = descriptor.value;
        descriptor.value = function (...args: any[]) {
            const allow = confirm(message);
            if (allow) {
                const result = original.apply(this, args);
                return result;
            } else { return null; }
        };
        return descriptor;
    };
}
```

Accessor Decorators

Definition

- TypeScript **does not allow** to decorate **both** the **getter** and the **setter**
- The **Property Descriptor** combines **both get** and **set** not each declaration separately
- Takes the following three arguments:
  - Either the **constructor function of the class** for a static member, or the **prototype of the class** for an instance member
  - The **name** of the member
  - The **Property Descriptor** for the member

Example: Accessor Decorator


```
class Point {
    private _x: number;
    private _y: number;
    constructor(x: number, y: number) {
        this._x = x;
        this._y = y;
    }

    @configurable(false)
    get x() { return this._x; }

    @configurable(false)
    get y() { return this._y; }
}
```

Property Decorators

Definition

- Property decorator can only be used to **observe** that a property of a specific name has been declared for a class
- Takes the following **two** arguments:
  - Either the **constructor function** of the class for a static member, or the **prototype** of the class for an instance member
  - The **name** of the member

Example: Accessor Decorator


```
class Greeter {
    @format("Hello, %s")
    greeting: string;

    constructor(message: string) {
        this.greeting = message;
    }

    greet() {
      let formatString = getFormat(this, "greeting");
      return formatString
            .replace("%s",   this.greeting);
    }
}
```

Summary

- Decorators are basically **functions**
- Add **additional functionalities** to a class or class members
- We can decorate **class declaration**, **methods**, **accessors**, **properties** and **parameters**
- To decorate different classes or class members the decorator functions takes **different arguments**

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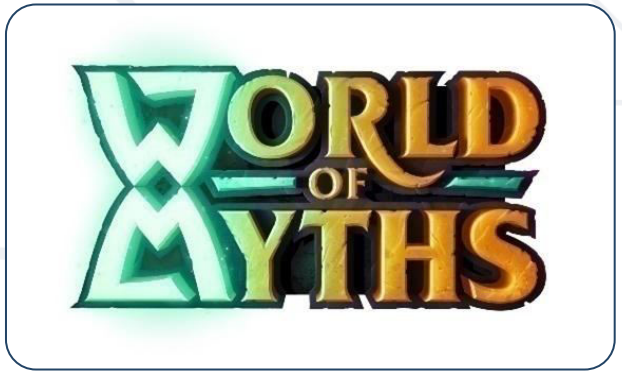

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