Classes, Interfaces and Generics

Session-2

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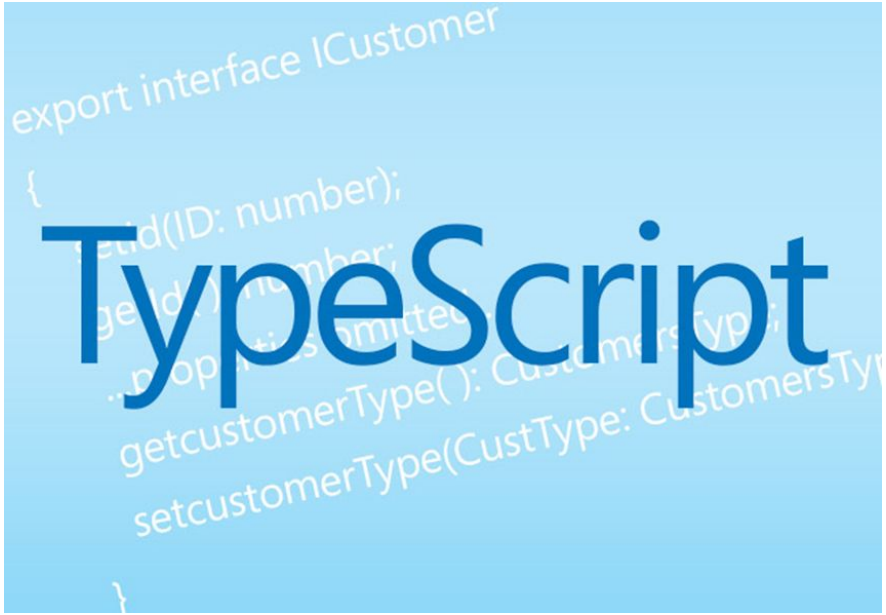
Did you finish Typescript pre-class material?

Play Kahoot!

1 Classes

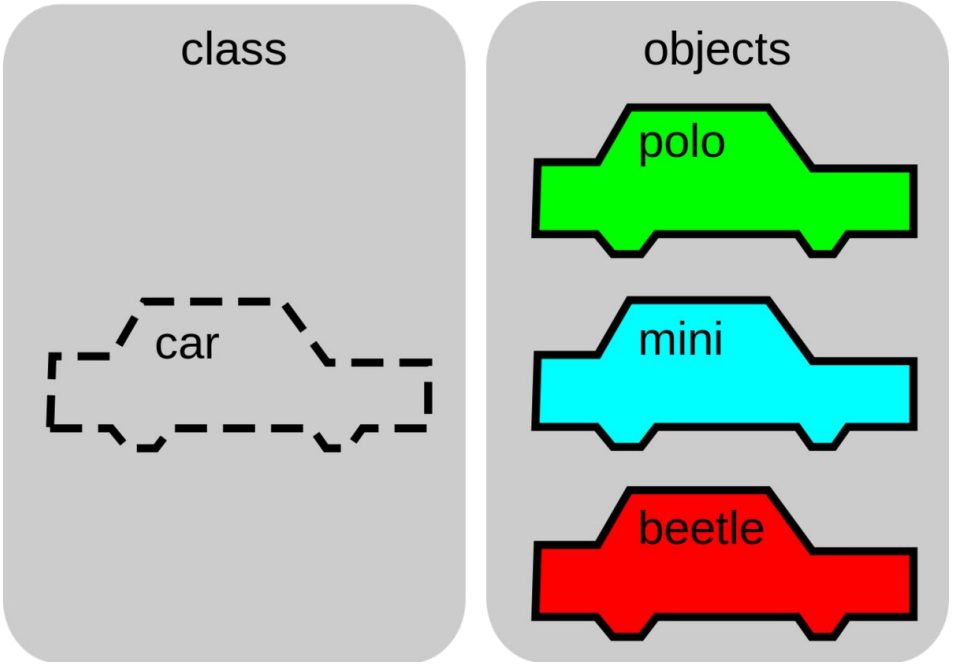

export interface ICustomer
{
getcustomerType( ):
setcustomerType(CustType:
}
TypeScript

Classes

In object-oriented programming languages like Java and C#, classes are the fundamental entities used to create reusable components.

Functionalities are passed down to classes.

Objects are created from classes.

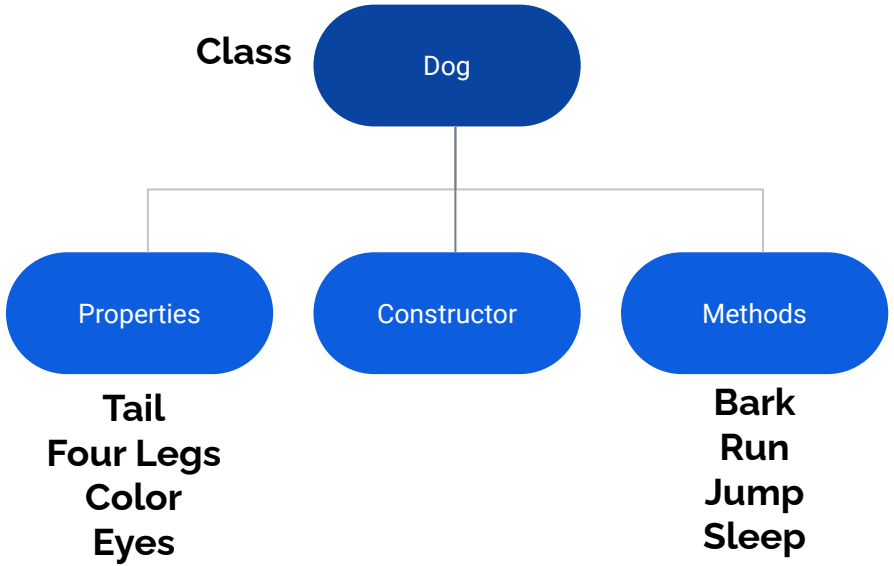


Classes

Class code is compiled to target JS version (ES5, ES6 etc.) functions to work across platforms and browsers.

A class can include the following:

- Constructor
- Properties
- Methods



Classes - Creating Instance

An object of the class can be created using the **new** keyword.

It is not necessary for a class to have a constructor.

If a class doesn't have any constructor, we cannot pass values while creating an object.

```
class Employee {
  empCode: number;
  empName: string;

  constructor (code:number, name: string)
{
    this.empCode = code;
    this.empName = name
  }
}

let emp = new Employee(100, "John")
```

Classes Inheritance

- TypeScript classes can inherit using the keyword **extends**.
- The employee class now includes all the members of the person class.
- The constructor of the employee class is using a special keyword **super**, and initialises its own properties.
- We must call super() method first before assigning values to properties in the constructor of the child class.

```
class Person {
  name: string;
  constructor(name: string) {
    this.name = name
  }
}

class Employee extends Person {
  empCode: number;
  constructor(code: number, name:string) {
    super(name);
    this.empCode = code
  }
  displayName():void {
    console.log(this.name, this.empCode)
  }
}
```

Implement Interface

```
interface IPerson {
    name: string;
    display():void;
}

interface IEmployee {
    empCode: number;
}

class Employee implements IPerson, IEmployee {
    empCode: number;
    name: string;

    constructor(empcode: number, name:string) {
        this.empCode = empcode;
        this.name = name;
    }

    display(): void {
        console.log("Name = " + this.name +  ", Employee Code = " + this.empCode);
    }
}

let per:IPerson = new Employee(100, "Bill");
per.display(); // Name = Bill, Employee Code = 100

let emp:IEmployee = new Employee(100, "Bill");
emp.display(); //Compiler Error: Property 'display' does not exist on type 'IEmployee'
```

In this example, the employee class implements two interfaces, IPerson and IEmployee .

So, an instance of the employee class can be assigned to a variable of IPerson or IEmployee type.

However, an object of type iemployee cannot call the **display()** method because iemployee does not include it.

You can only use properties and methods specific to the object type.

Interface Extends Class

An interface can also extend a class to represent a type.

In this example, iemployee is an interface that extends the person class. So, we can declare a variable of type IEmployee with two properties.

```
class Person {
    name: string;
}

interface IEmployee extends Person {
    empCode: number;
}

let emp: IEmployee = { empCode  : 1, name:"James Bond" }
```

Extends vs. Implements

	Extends	Implements
Class	1 Super Class	1+ Interface
Interface	1+ Class & 1+ Interface	Does not implement

A class can extend only one class and can implement any number of the interface.

An interface can extend more than one interfaces but **cannot** implement any interface.

Abstract Class

Typescript allows us to define an abstract class using keyword **abstract**.

Abstract classes are mainly for defining structure of class, where there are no implementation code. Therefore they cannot be instantiated.

An abstract class typically includes one or more abstract methods or property declarations. **The child class must define all the abstract methods.**

We can think as abstract methods/properties are a placeholder that will be defined when it is inherited.

Abstract Class

```
abstract class Person {
 name: string;
 constructor(name: string) {
  this.name = name;
 }

 display(): void {
  console.log(this.name);
 }
 abstract find(string): Person;
}

class Employee extends Person {
 empCode: number;
 constructor(name: string, code: number) {
  super(name); // must call super()
  this.empCode = code;
 }
 find(name: string): Person {
  // execute AJAX request to find an employee from a db
  return new Employee(name, 1);
 }
}

let emp: Person = new Employee("James", 100);
emp.display(); //James
let emp2: Person = emp.find('Steve');
```

The class which implements an abstract class must call super() in the constructor.

Person is an abstract class has one property and two methods. The find() method is an abstract method and so must be defined in the derived class.

The Employee class should define implementation code for the **find()** method.

The Employee class should implement all the abstract methods of the Person class, otherwise the compiler will show an error.

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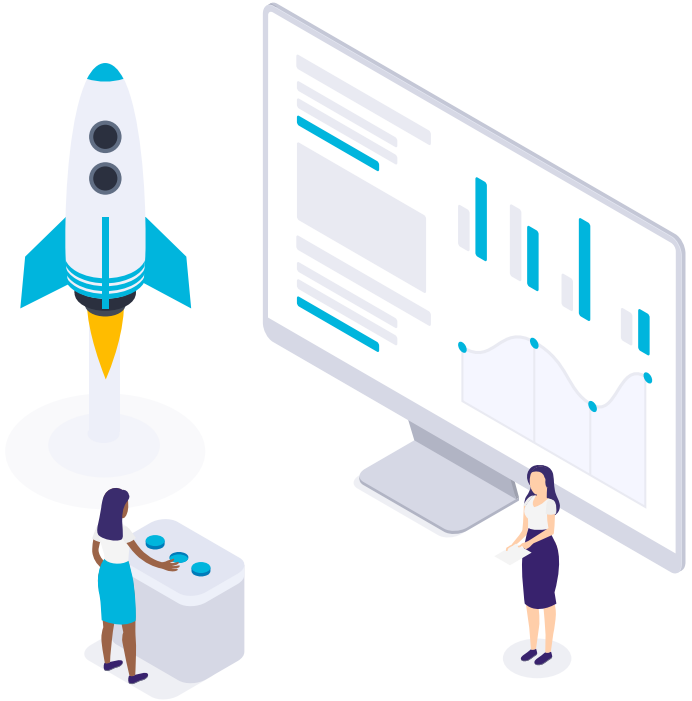
Interfaces

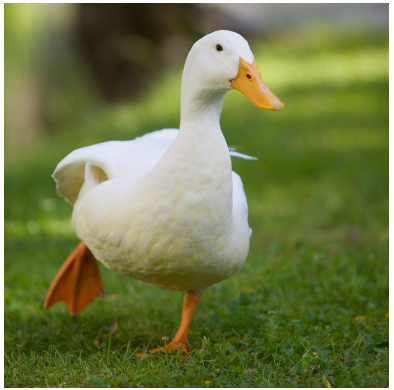


Interfaces

- Interface is a structure that defines the ***contract***. It defines the syntax for classes to follow. Classes must follow the derived interface structure.

- The typescript compiler **does not** convert interface to JavaScript. Just for type checking. "duck typing" or "structural subtyping".

- An interface is defined with the keyword `interface` it can only include properties and method declarations. **No implementation code** can be written.



Interface declaration

We use interfaces to define the shape of objects and classes.

```
interface Calendar {
  events: string[];
  addEvent(event: string): void;
}

class LmsCalendar implements Calendar {
  events: string[];
  constructor() {
    this.events = [];
  }
  addEvent(event: string): void {
    this.events.push(event)
  }
}
```

Interface vs type aliases

In TypeScript, interfaces and type aliases can be used interchangeably.

Both can be used to describe the shape of an object

```
interface Person {
  name: string;
}

let person: Person = {
  name: "John"
}
```

```
type Person = {
  name: string;
}

let person: Person = {
  name: "John"
}
```

Interface and type aliases

We can add more properties to Interfaces later inside our code, whereas in type aliases can't.
In type aliases we need to union previous type alias into new alias.

```
interface Point {
  x: number;
}

interface Point {
  y: number
}

const point: Point = {x: 1, y: 2}
```

```
type PointX = {
  x: number;
}

type PointY = {
  y: number
}

type Point = PointX & PointY

const point: Point = {x: 1, y: 2}
```

Interfaces

- Interface can only contain declaration of properties and methods, no value or no implementation details are allowed.
- A class can implement more than one interface, but can only implement one super class, (single inheritance)

```
interface Color {
  color: { r: number, g: number, b: number }
}

interface Shape {
  area: number;
}

class Square implements Color, Shape {
  color: { r: number, g: number, b: number }
  area: number;
  constructor(c: { r: number, g: number, b: number }, a:
number) {
    this.color = c;
    this.area = a;
  }
}
```

Interfaces

- Interface can only contain declaration of properties and methods, no value or no implementation details are allowed.
- A class can implement more than one interface, but can only implement one super class, (single inheritance)

```
interface Dim2 {
  x: number;
  y: number;
  width: number;
  height: number;
}
interface Shape {
  area: number;
  type: ShapeType;
}
class Square implements Dim2, Shape {
  // ...
}
```

```
class Rectange {
  x: number;
  y: number;
  width: number;
  height: number;
}

class Prism extends Rectangle {
  // ...
}
```

Interfaces as function type

- We can define function type using interface, to assign a function a variable, typescript can enforce specific function.

```
interface NumKey {
  (key: number, value: string): void
}

function addKeyVal(k: number, v: string): void {
  console.log("adding key value", k, v)
}

function update(index: number, newVal: string): void {
  console.log("updating key value", index, newVal)
}

let kvp: NumKey = addKeyVal;
kvp(1, 'John')
kvp = update
kvp(2, 'Jane')
```

DATA MODIFIERS

In object-oriented programming, the concept of 'encapsulation' is used to make class members public or private i.e. A class can control the visibility of its data members. This is done using access modifiers.

There are three types of access modifiers in typescript:

- **public**
- **private**
- **protected**

DATA MODIFIERS - Public

By default, all members of a class in Typescript are public.

All the public members can be accessed anywhere without any restrictions.

```
class Employee {
    public empCode: string;
    empName: string;
}

let emp = new Employee();
emp.empCode = 123;
emp.empName = "Swati";
```

DATA MODIFIERS - Private

The **private** access modifier ensures that class members are visible only to that class and are not accessible outside the containing class.

When we create an object emp and try to access the emp.empCode member, it will give an error.

```
class Employee {
    private empCode: number;
    empName: string;
}

let emp = new Employee();
emp.empCode = 123; // Compiler Error
emp.empName = "Swati";//OK
```

DATA MODIFIERS - Protected

Protected is similar to the private modifier, child class can access protected members.

In this example, we have a class employee with two members, **public** empname and **protected** property empcode.

We create a subclass **salesEmployee** that extends from the parent class employee.

We cannot access the protected member from outside the class. We get compiler error.

```
class Employee {
    public empName: string;
    protected empCode: number;

    constructor(name: string, code: number){
        this.empName = name;
        this.empCode = code;
    }
}

class SalesEmployee extends Employee{
    private department: string;

    constructor(name: string, code: number, department: string) {
        super(name, code);
        this.department = department;
    }
}

let emp = new SalesEmployee("John Smith", 123, "Sales");
empObj.empCode; //Compiler Error
```

READONLY

In addition to the access modifiers, typescript provides two more keywords: **read-only** and **static**.

Prefix **read-only** is used to make a property as read-only. Read-only members can be accessed outside the class, but their value cannot be changed after initialization. If we try to change the value of empcode after the object has been initialized, We get compiler error.

```
class Employee {
    readonly empCode: number;
    empName: string;

    constructor(code: number, name: string)     {
        this.empCode = code;
        this.empName = name;
    }
}
let emp = new Employee(10, "John");
emp.empCode = 20; //Compiler Error
emp.empName = 'Bill'; //Compiler Error
```

STATIC

ES6 includes static members and so does TypeScript. The static members of a class are accessed using the class name and dot notation, without creating an object.

The static members can be defined by using the keyword static.

Circle class includes a static property and a static method.

Inside the static method calculateArea, the static property can be accessed using this keyword or using the class name circle.Pi.

```
class Circle {
    static pi: number = 3.14;

    static calculateArea(radius:number) {
        return this.pi * radius * radius;
    }
}
Circle.pi; // returns 3.14
Circle.calculateArea(5); // returns 78.5
```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Generics

Generics

- TypeScript Generics is a tool which provides a way to create **reusable components** (functions, interfaces and classes)
- Generics in typescript is almost similar to C# generics.
- A generic type has one or more generic type parameters in angle brackets. e.g.: <T> or <T,U> *using uppercase single letter is a convention*
- When using generic types, we should supply arguments for generic type parameters or let the compiler infer them (if possible).

Generics

- Problem

```
function getArray(items: any[]): any[] {
  return new Array().concat(items)
}
let numArr = getArray([1, 2, 3])
let strArr = getArray(["John", "Jane"])
numArr.push(4); // OK
strArr.push("Jake"); // OK
numArr.push("Tim"); // OK
strArr.push(5); // OK
console.log(numArr); // [ 1, 2, 3, 4, 'Tim' ]
console.log(strArr); // [ 'John', 'Jane', 'Jake', 5 ]
```

- Solution

```
function getArray<T>(items: T[]): T[] {
  return new Array<T>().concat(items)
}
let numArr = getArray([1, 2, 3])
let strArr = getArray(["John", "Jane"])
numArr.push(4); // OK
strArr.push("Jake"); // OK
numArr.push("Tim"); // Compiler Error
strArr.push(5); // Compiler Error
```

Generics

- Generic Interfaces

```
interface Result<T> {
  data: T | null;
}
```

- Generic Function

```
function wrapInArr<T>(value: T) {
  return [value]
}

let arr = wrapInArr(1)
```

- Generic Classes

```
class KeyValuePair<K,V> {
  constructor(public key: K, public value: V) {}
}

let kvp = new KeyValuePair<number, string>(1,'a')
let shorter = new KeyValuePair(1,'a')
```

Generics

- Multiple generic parameter

```
function displayType<T, U>(param1: T, param2: U) {
  console.log(`param1: ${typeof(param1)}, param2: ${typeof(param2)}`);

}
displayType<number, string>(34, "Istanbul");
displayType<string, number>("Price", 250);
displayType(console.log, 5 > 8);
```

- Single parameter with non-generic

```
function displayType<T>(param1: T, param2: string) {
  console.log(`param1: ${typeof(param1)}, param2: ${typeof(param2)}`);

}
displayType<number>(34, "Istanbul");
displayType<string>("Price", 250);
displayType(console.log, "5 > 8");
```

Generics Constraints

- We can constrain generic type arguments by using the **extends** keyword after generic type parameters. T extends Person or T

```
function echo<T extends number | string>(value: T) {}
// Restrict using a shape object
function echo<T extends { name: string }>(value: T) {}
// Restrict using an interface or a class
function echo<T extends Person>(value: T) {}
```

```
// Passing on generic type parameters
class CompressibleStore<T> extends Store<T> { }
// Constraining generic type parameters
class SearchableStore<T extends { name: string }> extends Store<T> { }
// Fixing generic type parameters
class ProductStore extends Store<Product> { }
```

Generics Constraints

- The **keyof** operator helps by producing a union of the keys of the given object. We can constrain parameters of a function to be only in given list, no new property.

```
interface Product {
 name: string;
 price: number;
}
let property: keyof Product;
// Same as
let property: 'name' | 'price';
property = 'name';
property = 'price';
property = 'otherValue'; // Invalid
```

```
interface Product {
 name: string;
 price: number;
}
function update<T extends object, K extends keyof T>
            (obj: T, prop: K, newValue: T[K]) {
  //
}
const product1: Product = {name: "Headphones", price: 50}
update(product1, "price", "Powerbank");  🤔
update(product1, "count", 5); 🤦‍♂️
```

Generics Utility Types

- Using type mapping we can create new types based off of existing types. For example, a new type with all the properties of another type where these properties are readonly, optional, etc.
- TypeScript comes with several utility types that perform type mapping for us.

  Examples are: **Partial<T>, Required<T>, Readonly<T>**, etc.
- See the complete list of utility types:

  https://www.typescriptlang.org/docs/handbook/utility-types.html

Generics Utility Types

- Type mapping

```
type ReadOnly<T> = {
 readonly [K in keyof T]: T[K];
};
type Optional<T> = {
 [K in keyof T]?: T[K];
};
type Nullable<T> = {
 [K in keyof T]: T[K] | null;
};
```

- Utility types

```
interface Product {
 id: number;
 name: string;
 price: number;
}
// A Product where all properties are optional
let product: Partial<Product>;
// A Product where all properties are required
let product: Required<Product>;
// A Product where all properties are read-only
let product: Readonly<Product>;
// A Product with two properties only (id and price)
let product: Pick<Product, 'id' | 'price'>;
// A Product without a name
let product: Omit<Product, 'name'>;
```

Generics Advantages

1. **Type-safety:** Only a single type of objects in generics. It doesn't allow to store other objects.
2. **Typecasting is not required:** no need to typecast the object.
3. **Compile-Time Checking:** checked at compile time so prevents the problem at runtime.

THANKS!

Any questions?