Experiment – 1 b: TypeScript

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Aim:

To study Basic constructs in TypeScript.

Problem Statement:

a) Create a base class **Student** with properties like name, studentId, grade, and a method getDetails() to display student information.
Create a subclass **GraduateStudent** that extends Student with additional properties like thesisTopic and a method getThesisTopic().
Override the getDetails() method in GraduateStudent to display specific information.
Create a non-subclass LibraryAccount (which does not inherit from Student) with properties like accountId, booksIssued, and a method getLibraryInfo().
Demonstrate composition over inheritance by associating a LibraryAccount object with a Student object instead of inheriting from Student.
Create instances of Student, GraduateStudent, and LibraryAccount, call their methods, and observe the behavior of inheritance versus independent class structures.

b) Design an employee management system using TypeScript. Create an Employee interface with properties for name, id, and role, and a method getDetails() that returns employee details. Then, create two classes, Manager and Developer, that implement the Employee interface. The Manager class should include a department property and override the getDetails() method to include the department. The Developer class should include a programmingLanguages array property and override the getDetails() method to include the programming languages. Finally, demonstrate the solution by creating instances of both Manager and Developer classes and displaying their details using the getDetails() method.

Theory:

1. **What are the different data types in TypeScript? What are Type Annotations in Typescript?**

   TypeScript provides several built-in data types, including primitive types like string, number, boolean, null, undefined, symbol, and bigint. It also includes object types such as Array, Tuple, Enum, Class, and Interface. Additionally, TypeScript has special types like any, unknown, void, and never.

   Type annotations in TypeScript allow developers to explicitly define the type of a variable, function parameter, or return value. For example, let age: number = 25; ensures that age can only hold numeric values, reducing runtime errors and improving code clarity.

2. **How do you compile TypeScript files?**

   To compile a TypeScript file, use the TypeScript compiler (tsc) by running the command tsc filename.ts in the terminal. This command translates the TypeScript code into JavaScript, generating a filename.js file that can be executed in a browser or Node.js environment.

3. **What is the difference between JavaScript and TypeScript?**

   JavaScript is a dynamically typed language, whereas TypeScript is statically typed, which helps catch errors at compile time. JavaScript does not support interfaces or strong type checking, while TypeScript allows defining interfaces for better structure. Additionally, JavaScript is interpreted, whereas TypeScript must be compiled into JavaScript before execution. TypeScript also provides modern ES features along with additional enhancements like generics and type annotations, making it more robust for large-scale applications.

4. **Compare how Javascript and Typescript implement Inheritance.**

   JavaScript uses prototype-based inheritance, where objects inherit properties and methods from other objects through the prototype chain. TypeScript, on the other hand, supports class-based inheritance using the class and extends keywords, making it more structured and similar to object-oriented programming in languages like Java or C#. This makes TypeScript more readable and maintainable compared to JavaScript’s traditional prototype-based approach.

5. **How generics make the code flexible and why we should use generics over other types. In the lab assignment 3, why the usage of generics is more suitable than using any data type to handle the input.**

   Generics provide type safety by ensuring that functions and data structures work with a specific type rather than accepting any type, as the any keyword does. This prevents runtime errors and improves code reusability while maintaining strict type rules. For example, a function using generics like function identity<T>(value: T): T { return value; } ensures that it always returns the same type that it receives as input. In Lab Assignment 3, using generics is more suitable than using any because it ensures that the input data type remains consistent while still allowing flexibility.

6. **What is the difference between Classes and Interfaces in Typescript? Where are interfaces used?**

   Classes in TypeScript define both the structure and implementation of an object, meaning they can have methods and properties, and they support instantiation. Interfaces, however, only define the structure without providing any implementation and cannot be instantiated. Interfaces are primarily used to define contracts for objects, ensuring that they have specific properties and methods. For example, an interface Person { name: string; age: number; } can be implemented by multiple classes to ensure they follow the same structure.

a) Student and GraduateStudent with Composition

Code:

```
// Base class Student

class Student {

    constructor(public name: string, public studentId: number, public grade: string) {}

    getDetails(): string {

        return `Student Name: ${this.name}, ID: ${this.studentId}, Grade: ${this.grade}`;
```

```
    }
  }
// Subclass GraduateStudent extending Student
  class GraduateStudent extends Student {
      constructor(name: string, studentId: number, grade: string, public thesisTopic:
  string) {
      super(name, studentId, grade);
    }
getThesisTopic(): string {
      return `Thesis Topic: ${this.thesisTopic}`;
    }

    override getDetails(): string {
      return `${super.getDetails()}, Thesis Topic: ${this.thesisTopic}`;
    }
  }

  // Independent class LibraryAccount
  class LibraryAccount {
    constructor(public accountId: number, public booksIssued: number) {}

    getLibraryInfo(): string {
          return `Library Account ID: ${this.accountId}, Books Issued:
  ${this.booksIssued}`;
```

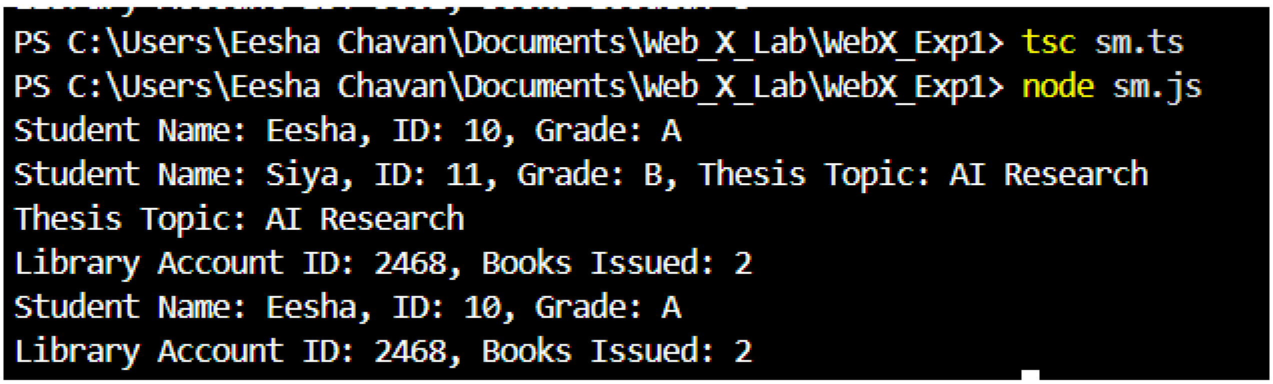
```
    }
}

// Demonstrating Composition: Associating LibraryAccount with Student
class StudentWithLibrary {
    constructor(public student: Student, public libraryAccount: LibraryAccount) {}

    getFullInfo(): string {
        return `${this.student.getDetails()}\n${this.libraryAccount.getLibraryInfo()}`;
    }
}

// Creating instances
const student1 = new Student("Eesha", 10, "A");
const gradStudent1 = new GraduateStudent("Siya", 11, "B", "AI Research"); const
libraryAcc1 = new LibraryAccount(2468, 2);

// Associating Student with LibraryAccount
const studentWithLibrary = new StudentWithLibrary(student1, libraryAcc1);

// Calling methods and observing behavior
console.log(student1.getDetails()); // Student details
console.log(gradStudent1.getDetails()); // GraduateStudent details with thesis
```

```
console.log(gradStudent1.getThesisTopic()); // Specific thesis topic

console.log(libraryAcc1.getLibraryInfo()); // Library account details

console.log(studentWithLibrary.getFullInfo()); // Composition example
```

GitHub Link:

https://github.com/eeshachavan/WebX_exp1_eesha

Output Screenshot:



```
PS C:\Users\Eesha Chavan\Documents\Web_X_Lab\WebX_Exp1> tsc sm.ts
PS C:\Users\Eesha Chavan\Documents\Web_X_Lab\WebX_Exp1> node sm.js
Student Name: Eesha, ID: 10, Grade: A
Student Name: Siya, ID: 11, Grade: B, Thesis Topic: AI Research
Thesis Topic: AI Research
Library Account ID: 2468, Books Issued: 2
Student Name: Eesha, ID: 10, Grade: A
Library Account ID: 2468, Books Issued: 2
```

b) Employee Management System

Code:

```
// Employee interface

interface Employee {

    name:

    string; id:

    number;

    role: string;

    getDetails(): string;

}


// Manager class implementing Employee interface

class Manager implements Employee {
```

```
    constructor(public name: string, public id: number, public role: string, public department: string) {}


  getDetails(): string {

        return `Manager Name: ${this.name}, ID: ${this.id}, Role: ${this.role}, Department: ${this.department}`;

  }

}


// Developer class implementing Employee interface

class Developer implements Employee {

    constructor(public name: string, public id: number, public role: string, public programmingLanguages: string[]) {}


  getDetails(): string {

        return `Developer Name: ${this.name}, ID: ${this.id}, Role: ${this.role}, Programming Languages: ${this.programmingLanguages.join(", ")}`;

  }

}


// Creating instances

const manager1 = new Manager("Eesha", 10, "Manager", "Marketing");

const developer1 = new Developer("Siya", 11, "Developer", [ "JavaScript", "Python"]);
```

// Displaying details

console.log(manager1.getDetails());

console.log(developer1.getDetails());

Output Screenshot:

```
PS C:\Users\Eesha Chavan\Documents\Web_X_Lab\WebX_Exp1> tsc em.ts
PS C:\Users\Eesha Chavan\Documents\Web_X_Lab\WebX_Exp1> node em.js
Manager Name: Eesha, ID: 101, Role: Manager, Department: Marketing
Developer Name: Siya, ID: 11, Role: Developer, Programming Languages: JavaScript, Python
```

Conclusion:

In this experiment, we studied the basic constructs of TypeScript, including inheritance, composition, and interfaces. We implemented class-based inheritance using Student and GraduateStudent, demonstrating method overriding. Composition was used to associate a LibraryAccount with a Student. Additionally, we designed an Employee Management System using interfaces, which ensured structure and type safety. This experiment effectively illustrated the advantages of TypeScript in terms of code readability, maintainability, and type checking.