INTRODUCTION TO TYPESCRIPT

OUR TEAM

Cristóbal Jesús Sarmiento Rodríguez
cristobal.jesus.09@ull.edu.es

Marcos Llinares Montes
marcos.llinares.14@ull.edu.es

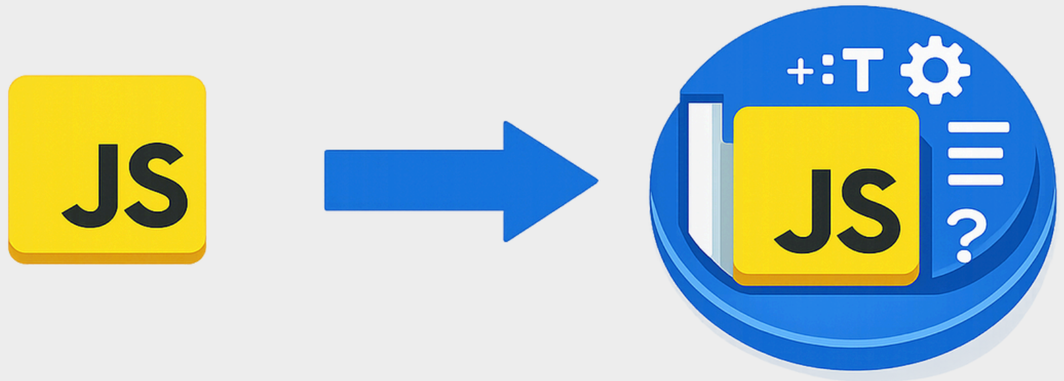
Paulo Padilla Domingues
padilla.domingues.37@ull.edu.es

INDEX

INTRODUCTION

WHAT IS TYPESCRIPT?

- **Superset of JavaScript.**
- Open-source.
- High-level programming language.
- Developed by Microsoft.
- **Strongly typed.**

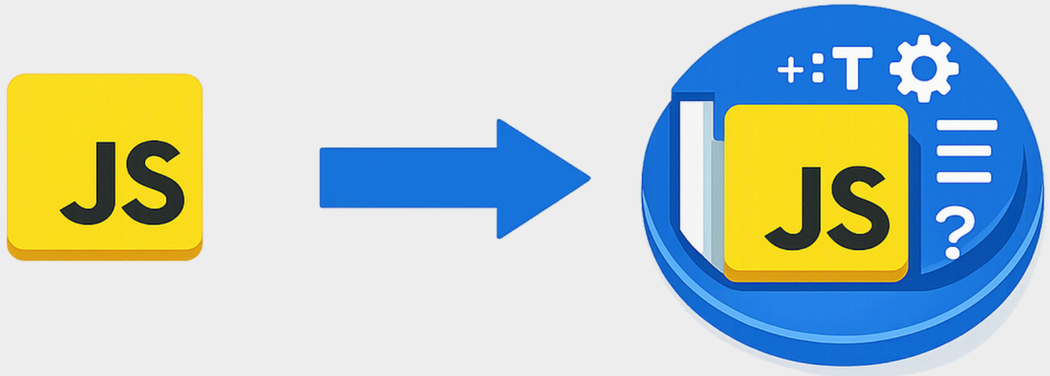


Goal: Layer of static type checking
allows to catch errors during development (**not in runtime** 💀).

WHAT IS TYPESCRIPT?

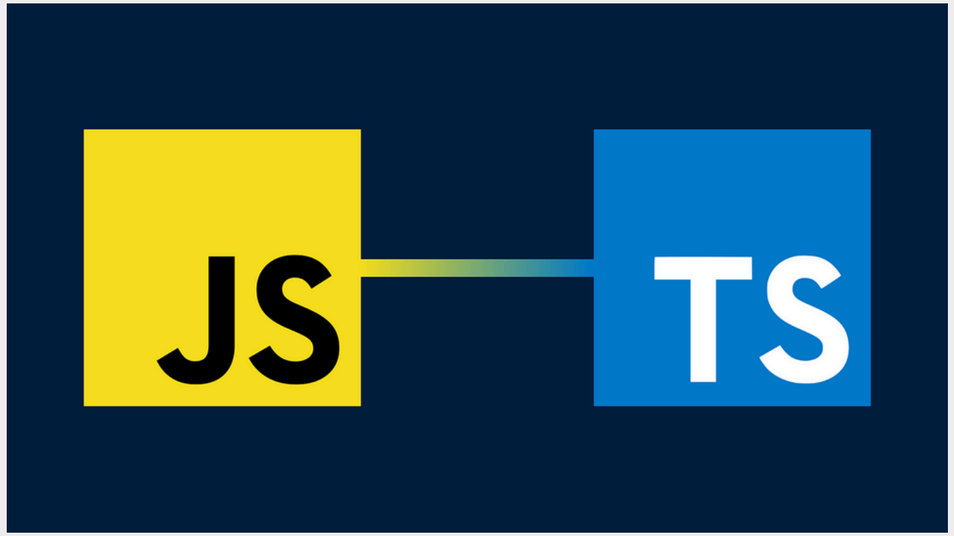
Compatibility: Any valid JavaScript code is also valid TypeScript code.

The "Transpiler" Model: Browsers and Node.js cannot run TS files. Code must be compiled (transpiled) into JavaScript.



MAIN DIFFERENCES

The main differences between this two languages are:



1. Typing.
2. Error Detection.
3. Object-oriented programming.
4. Improved developmet tools (Features).
5. Compilation Step.

BENEFITS OF TYPESCRIPT

1. Early Error Detection.
2. Self-Documenting Code.
3. Better Scalability & Maintainability.
4. Greater Productivity & Security.
5. Modern Features (latest ECMAScript).
6. Enhanced IDE Support.

INSTALLATION

REQUISITES

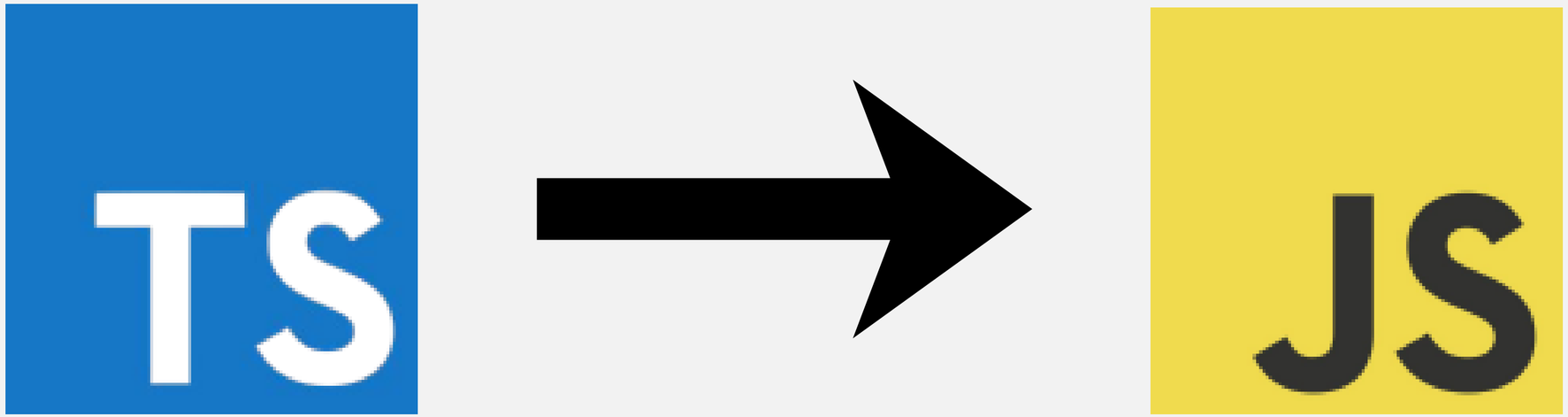
1. Necessary to install **Node.js** and a package manager (**npm** or **pnpm**).

2. **Fundamental:** TypeScript compiler.

- tsc.
- ts-node.

COMPILATION STRATEGIES

→ tsc



Javascript transpiled code is not designed to be read by humans.

COMPILATION STRATEGIES

→ tsc → Instalation

```
npm install - g typescript
```

COMPILATION STRATEGIES

- ts-node

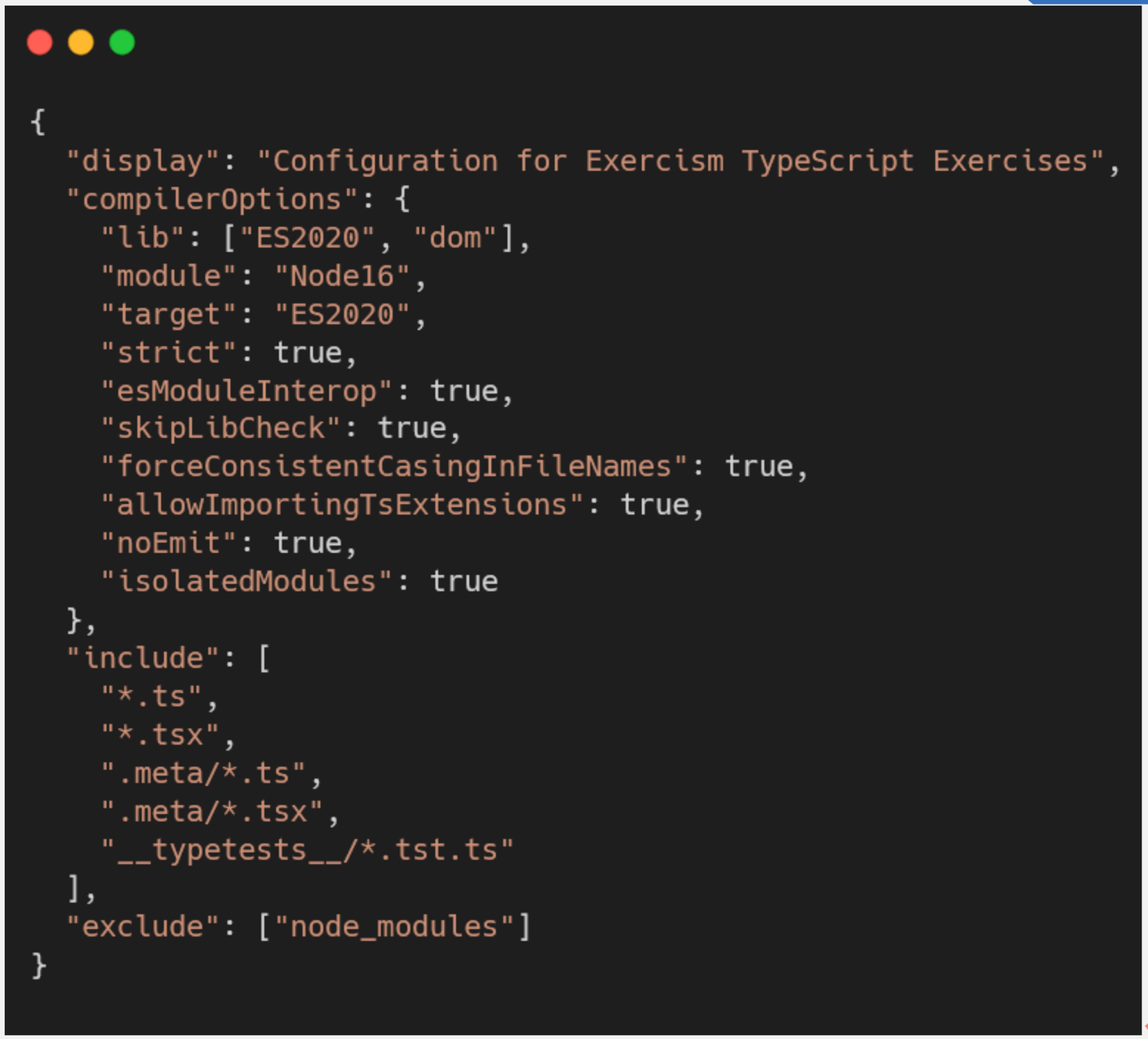
COMPILATION STRATEGIES

→ ts-node → Instalation

```
npm install -g ts-node
```

TSCONFIG FILE

- Configuration file for TypeScript.
- Defines how to compile the code.
- We can customize this file with many options.



```
{
  "display": "Configuration for Exercism TypeScript Exercises",
  "compilerOptions": {
    "lib": ["ES2020", "dom"],
    "module": "Node16",
    "target": "ES2020",
    "strict": true,
    "esModuleInterop": true,
    "skipLibCheck": true,
    "forceConsistentCasingInFileNames": true,
    "allowImportingTsExtensions": true,
    "noEmit": true,
    "isolatedModules": true
  },
  "include": [
    "*.ts",
    "*.tsx",
    ".meta/*.ts",
    ".meta/*.tsx",
    "__typetests__/*.tst.ts"
  ],
  "exclude": ["node_modules"]
}
```

→ Example tsconfig.json

→ tsconfig.json documentation

BASIC CONCEPTS

BASIC TYPES

- Number
- String
- Boolean
- Bigint
- Symbol

Basic Types

SPECIAL TYPES

- Any
- Unknown
- Void
- Null
- Undefined
- Never

Special Types

COMPOSITE TYPES

- Array
- Tuple
- Object
- Enum

Composite Types

INFERENCE

Compiler automatically assigns the type based on the initial value.

C++ Similarity: Equivalent of using the **auto** keyword.

```ts
// Explicit Declaration
let myName: string = 'Cristobal';

// Type Inference
let myName = 'Cristobal'; // TS knows it is a string
let myAge = 22;           // TS knows it is a number
let isStudent = true;     // TS knows it is a boolean
```

¿Funciona con strict: true?

```ts
let mysteryVariable; // ERROR in strict mode: is a implicit 'any'
```

❌

```ts
let clearVariable = "Hello"; // OK: TS infers it is a string, not 'any'
```

✅

CAN WE USE *VAR*?

var does not respect block scope

```
function blockScopeInCorrect(): void {
  if (true) {
    var age = 18;
  }
  // Age is still accessible here
  console.log(age); // 10
}
```

```
function blockScopeCorrect(): void {
  if (true) {
    let age: number = 18;
  }
  console.log(age); // Error: Age is not defined
}
```

CAN WE USE *VAR*?

var allows variable redeclaration

```
function redeclarationExample(): void {
  var count = 1;
  var count = 2; // Allowed
  console.log(count); // 2
}
```

```
function redeclarationBlocked(): void {
  let count: number = 1;
  let count: number = 2; // Error
}
```

CAN WE USE *VAR*?

var causes unexpected behavior in loops

```
function loopVarExample(): void {
  for (var i = 0; i < 3; ++i) {
    setTimeout(() => {
      console.log(i);
    }, 100);
  }
}
// Output: 3, 3, 3
```

```
function loopLetExample(): void {
  for (let i = 0; i < 3; ++i) {
    setTimeout(() => {
      console.log(i);
    }, 100);
  }
}
// Output: 0, 1, 2
```

LOOPS: FOR/FOR OF

```
function forExample(): void {
  for (let i = 0; i < 3; ++i) {
    console.log(i);
  }
}
forExample();
```

```
function forOfExample(): void {
  let numbers: number[] = [1, 2, 3];

  for (let value of numbers) {
    console.log(value);
  }
}
forOfExample();
```

LOOPS: FOR IN/FOR EACH

```
function forInExample(): void {
  let user = {name: 'Ana', age: 25};

  for (let key in user) {
    console.log(key, user[key as keyof typeof user]);
  }
}
forInExample();
```

```
function forEachExample(): void {
  let numbers: number[] = [1, 2, 3];

  numbers.forEach((value) => {
    console.log(value);
  });
}
forEachExample();
```

UNION TYPES

- Union Types allow a variable to have more than one possible type.

- This is safer than using any.

Union Types

WHY UNION TYPES INSTEAD OF ANY

- With any, TypeScript stops checking types completely.
- With Union Types, we still have control over which types are allowed.

Not Any

TYPE ALIASES

- Create our own custom types in TypeScript.
- They help reduce repetition and make the code more readable.

Aliases

LITERAL TYPES

- We use exact values.
- Restrict a variable to a fixed set of possible values.

Literal Types

GOOGLE GTS

Google GTS

REMARKABLES FEATURES

TYPE ASSERTION

Type assertions tell the compiler how to treat a value when the developer knows its type.

```
function typeAssertionExample(): void {
  let value: unknown = 'Hello TypeScript';

  let length: number = (value as string).length;
  console.log(length);
}

typeAssertionExample();
```

OPTIONAL CHAINING

```
function optionalChainingObjectExample(): void {
  let user:
    | {
        name: string;
        address: {
          city: string;
        };
      }
    | undefined;

  let city = user?.address.city;

  console.log(city); // undefined, no error
}
optionalChainingObjectExample();
```

Optional chaining allows safe access to object properties that may be null or undefined.

NULLISH COALESCING OPERATOR

```
function nullishCoalescingExample(): void {
  let input: string | null = null;

  let username = input ?? 'Guest';
  console.log(username);
}
nullishCoalescingExample();
```

The nullish coalescing operator provides a default value only when the result is null or undefined.

SPREAD OPERATOR

```
function spreadOperatorExample(): void {
  let numbers1: number[] = [1, 2];
  let numbers2: number[] = [3, 4];

  let combined = [...numbers1, ...numbers2];
  console.log(combined);

  let user = { name: 'Ana', age: 25 };
  let copy = { ...user };

  console.log(copy);
}
spreadOperatorExample();
```

The spread operator allows copying and merging objects or arrays in a clean and readable way.

STYLE GUIDE

- Google provides its own TypeScript style guide.
- Shared JavaScript foundations
- TypeScript introduces some specific rules to avoid bad practices.

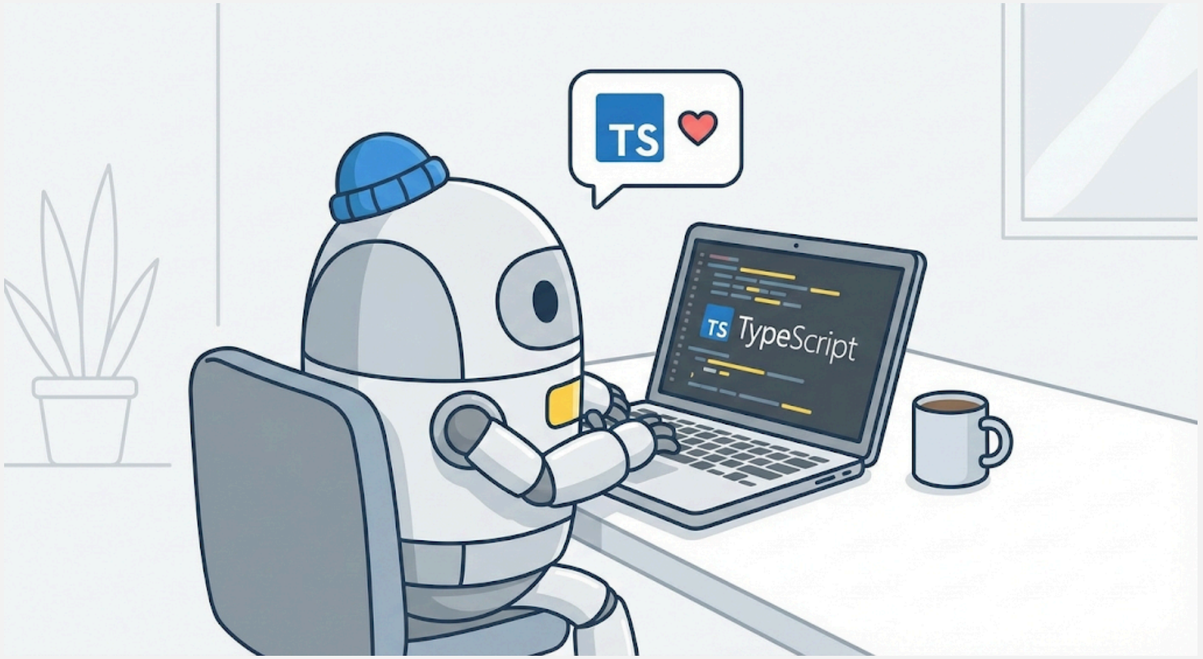
Google Style Guide

OOP

C++ VS TYPESCRIPT

→ TS

- constructor keyword.
- readonly modifier.
- Single constructor only.



C++ VS TYPESCRIPT

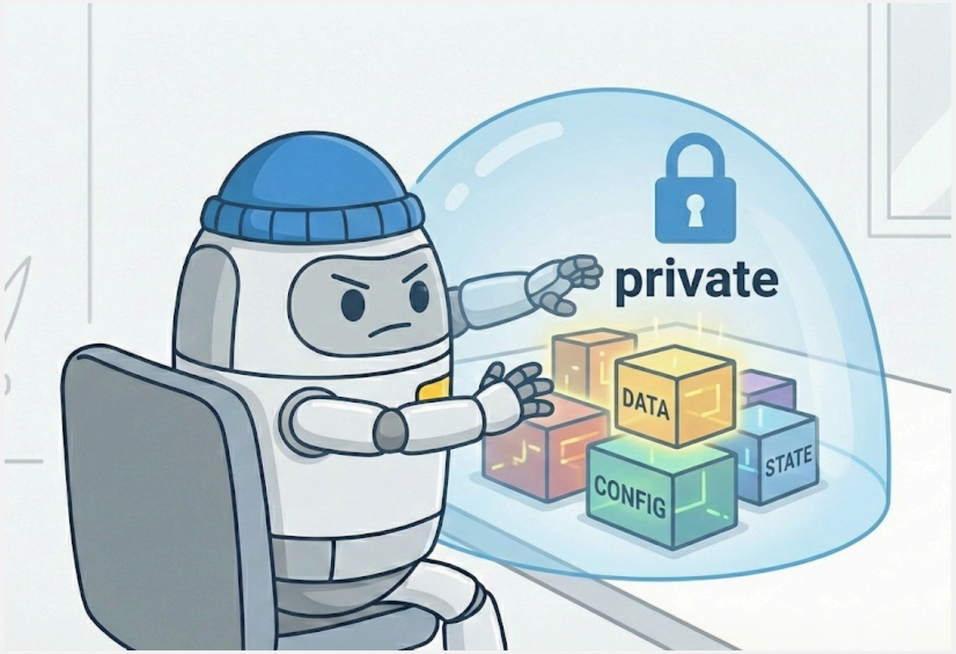
⟶ TS

- “**public**” by default.
- “**extends**” for inheritance.
- “**abstract**” classes & methods.
- Properties declared at top.
- No semicolon (;) required.

C++ VS TYPESCRIPT

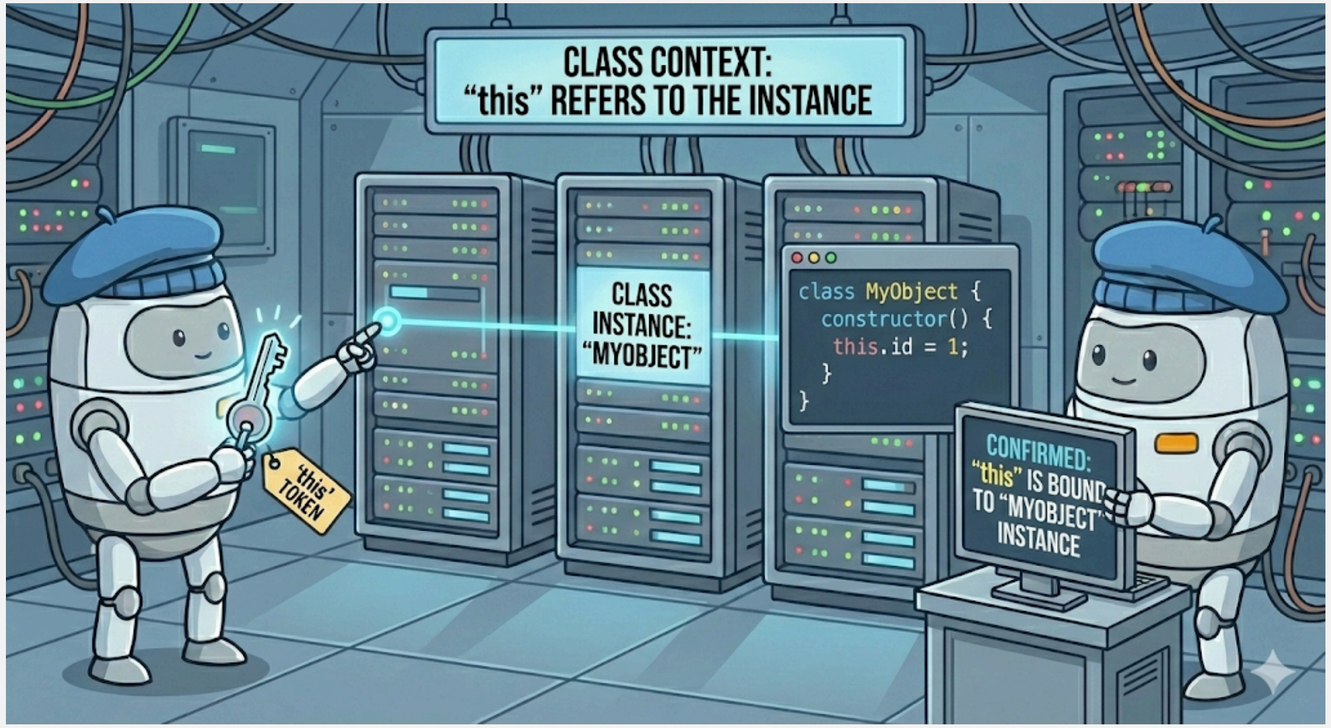
⟶ **TS**

- Access levels for all members.
- Methods implemented inside class.



KEYWORD THIS

- Refers to current object instance.
- Accesses class members (properties & methods).



Using this

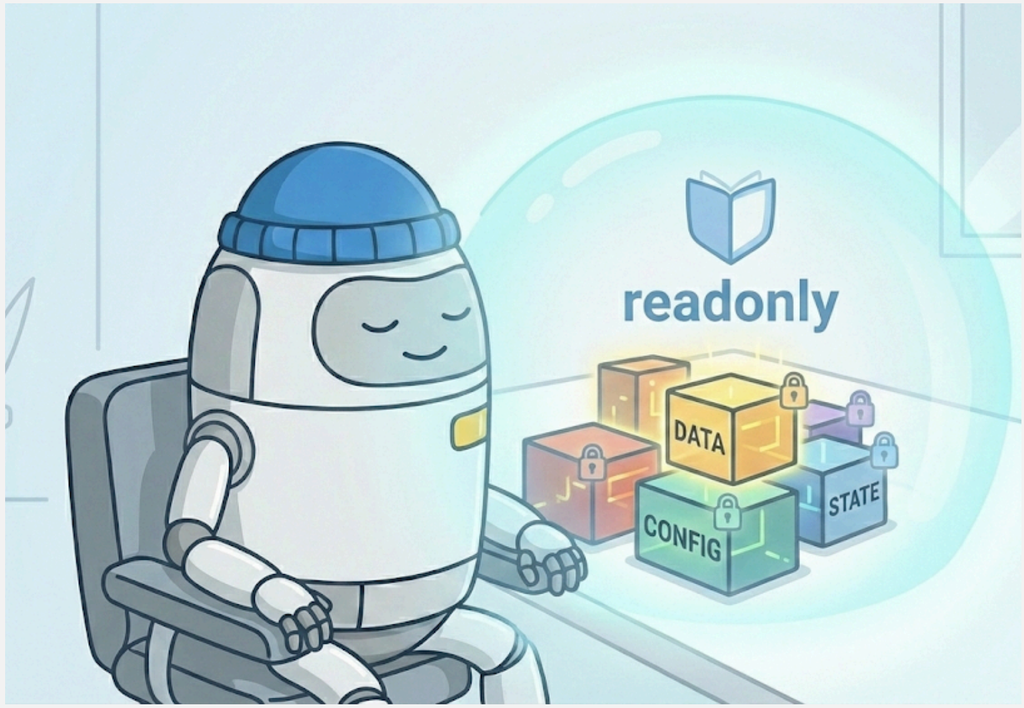
PARAMETER PROPERTIES

- TypeScript access modifiers in constructor parameters provide a shorthand to automatically declare and initialize class members.

Concise property initialization example.

READONLY PROPERTIES

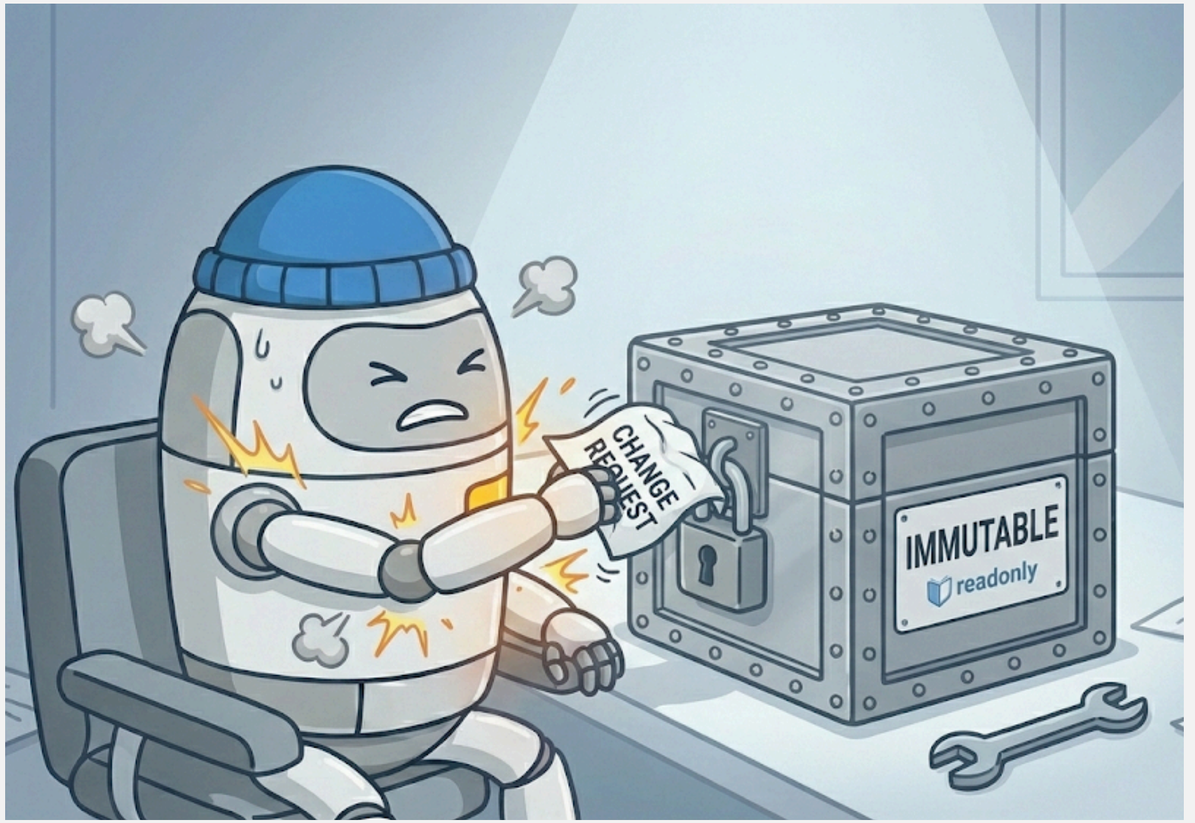
- Readonly properties enforce post-initialization immutability.
- Example here.



READONLY VS CONST

readonly

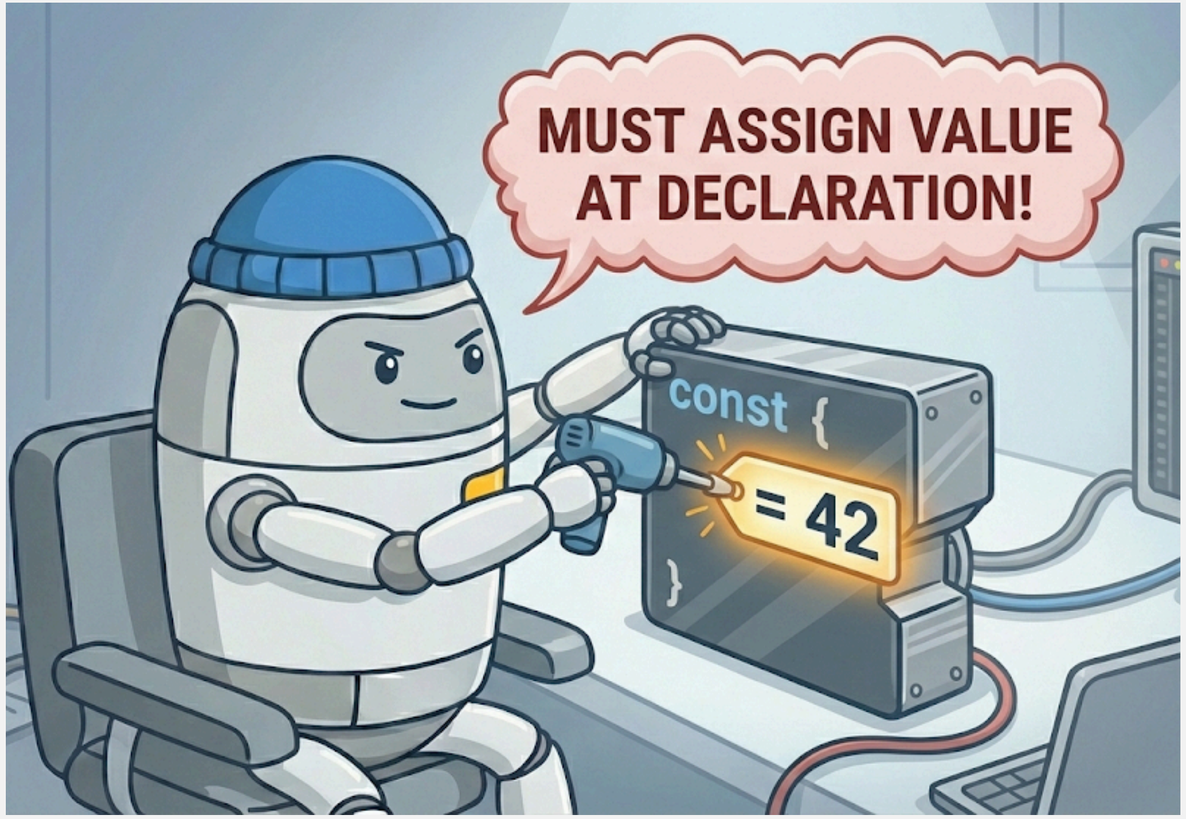
- Values become immutable.
- For class members only.



READONLY VS CONST

const

- Immediate initialization.
- For standalone variables.



CONSTRUCTOR OVERLOADING

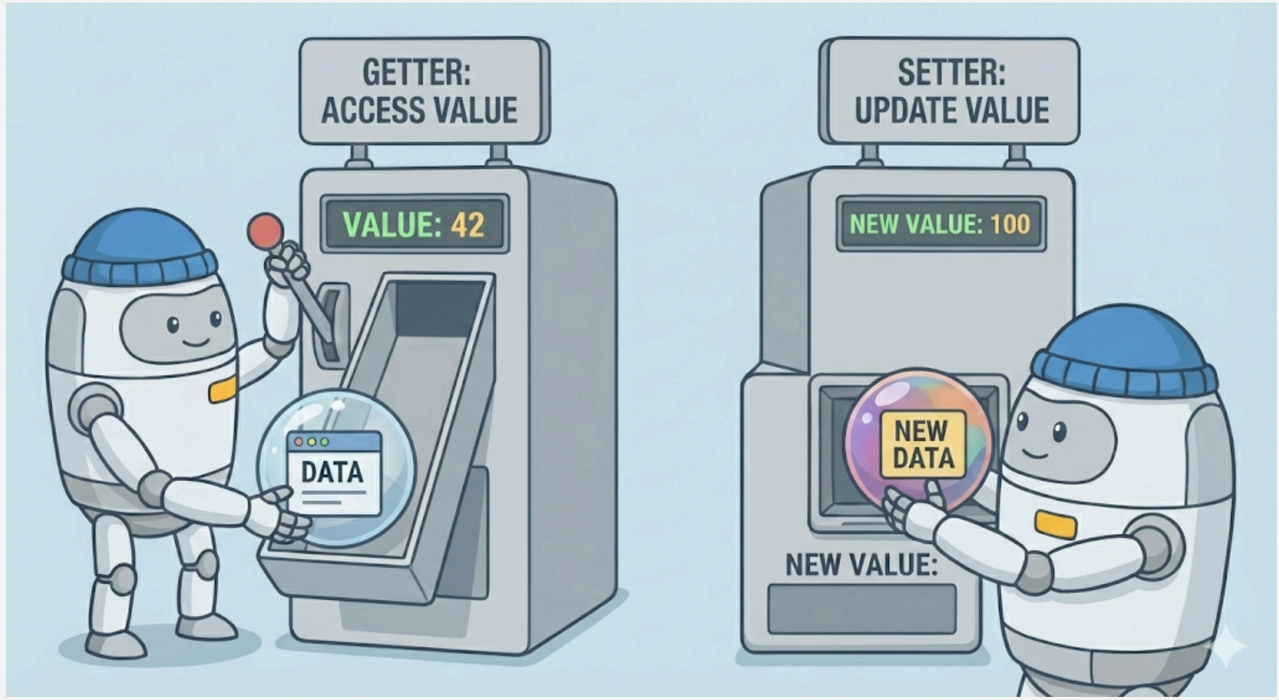
- Only a single constructor implementation body.
- Emulating multiple initialization patterns through optional constructor parameters.

Constructor-overloading-simulation

GETTERS AND SETTERS

- Use get / set keywords.
- Implement class accessors.

→ [Getters and Setters]



STATIC PROPERTY

- Associated with the class itself.
- Accessible across all objects.
- Ideal for global counters.

Static-property.

CLASS INHERITANCE

- Keyword **“extends”** is essential for establishing basic inheritance hierarchies.
- Multiple inheritance not supported.

Simple-inheritance

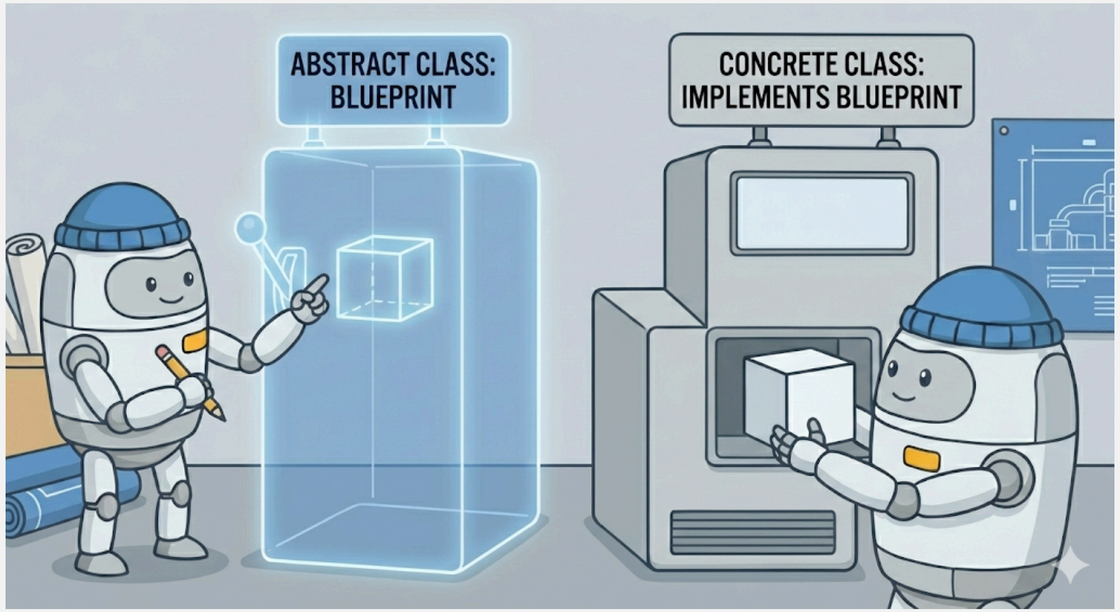
KEYWORD SUPER( )

- Invokes base constructor.
- Must call before “**this**”.
- Passes parent parameters.
- Access parent methods (“**super.method()**”).

Super-usage

ABSTRACT CLASSES

- Base templates for other classes.
- Cannot be instantiated directly.
- Must be extended by subclasses.
- Enforce core structure across classes.



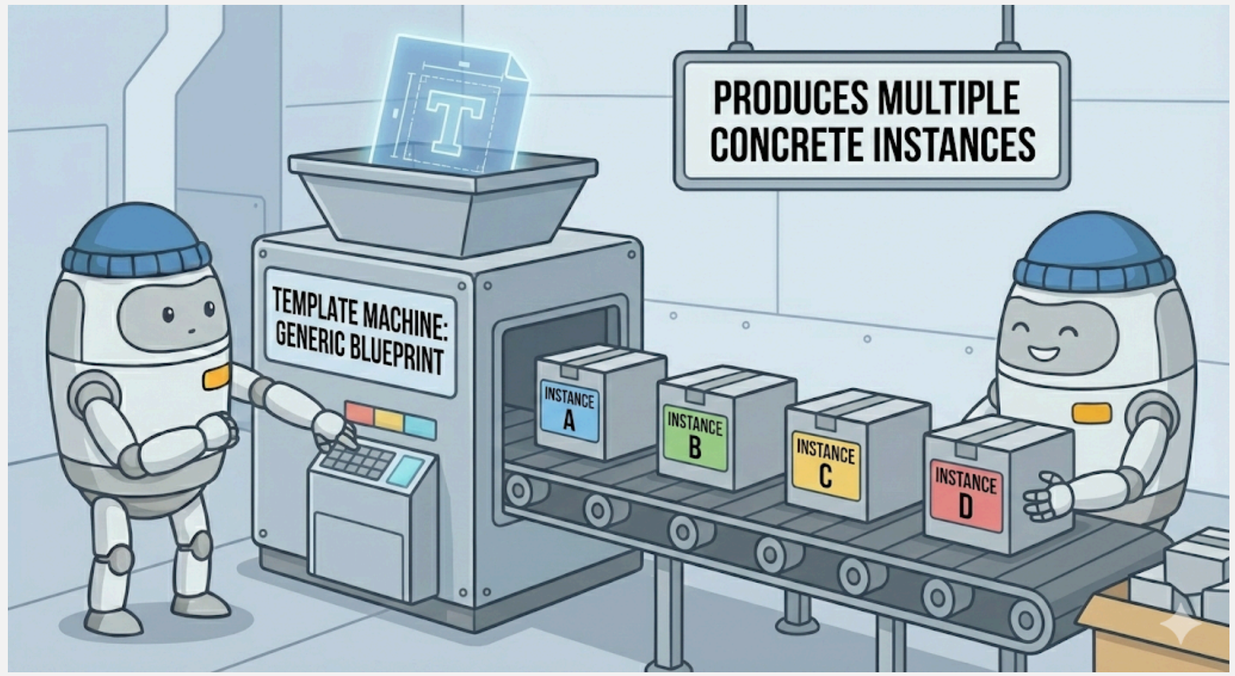
ABSTRACT CLASSES

- “**abstract**” keyword required.
- Signatures without implementation.
- Force implementation in subclasses.
- Mix of abstract & concrete members.

Abstract-classes

TEMPLATE IN CLASSES

- Operate with various types.
- Single implementation.
- Flexible & adaptable code.

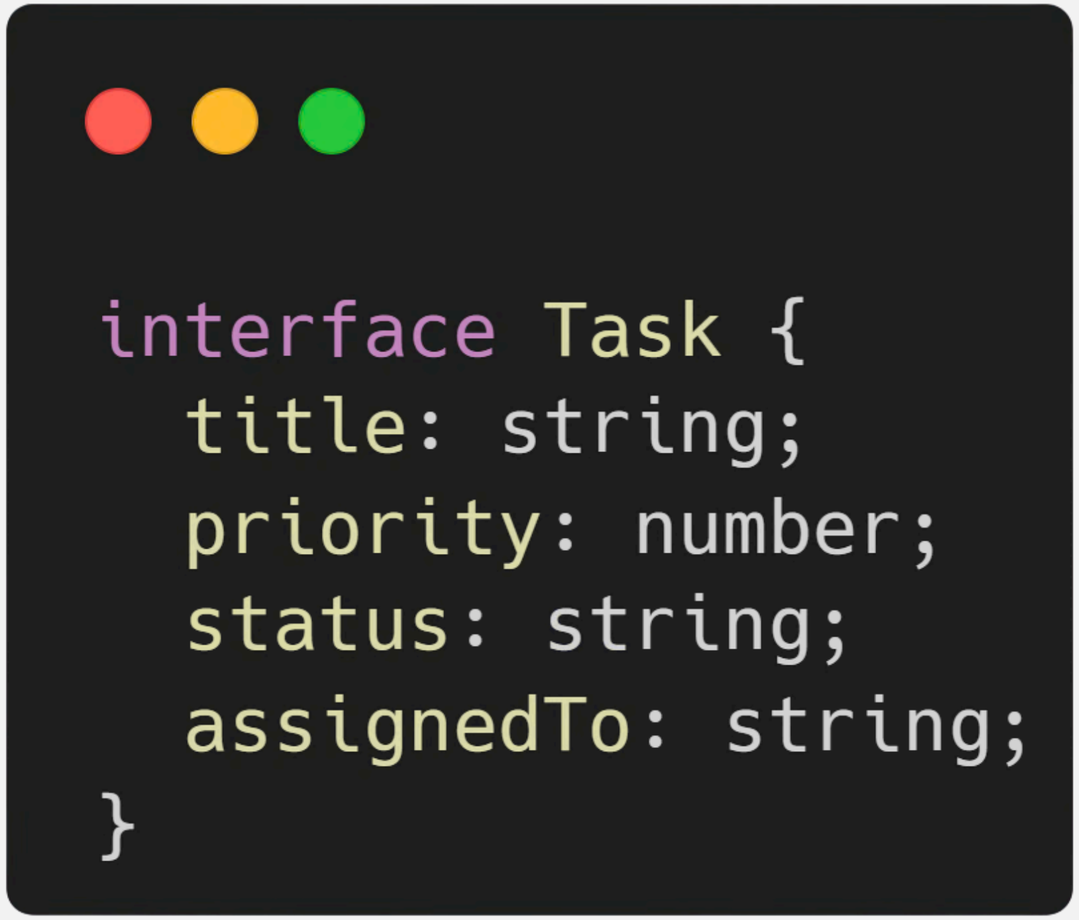


→ [Template-with-classes]

INTERFACES

INTERFACES

- Define object shape.
- Enforce properties & methods.
- Implicitly public.



```
interface Task {
  title: string;
  priority: number;
  status: string;
  assignedTo: string;
}
```

INTERFACES VS ABSTRACT CLASSES

- They are completely abstract.
- A class can implement multiple interfaces.
- They act as contracts.
- Everything is public.

- Mix between already implemented methods and abstract methods.
- A class can only inherit /extend a single abstract class.
- They have all available typesof visibility.
- They can have a constructor.

INTERFACE EXTENSION

- **Declaration Merging**: Automatically combines multiple definitions with the same name into one single contract.
- **Interface Inheritance**: Uses the extends keyword to inherit members from other interfaces.

Interface-extension

INTERFACE INTERSECTION

- Combines definitions using the & operator.
- Enforces all properties from every intersected type simultaneously.

[Interface-intersection]

EXTENSION VS INTERSECTION

Extension

- Validates compatibility before merging.
- Errors on type conflicts immediately.
- Recommended approach for scalability.

EXTENSION VS INTERSECTION

Intersection

- Combines definitions without name restrictions.
- Merges conflicts, potentially resolving to “**never**”.
- Risk of unexpected or unusable results.

MODULES

MODULES

- Structure complex codebases.
- Partition code into logical units.

ADVANTAGES

- Prevents name collisions (Encapsulation).
- Facilitates code reuse.

TYPES OF MODULES

CommonJS

- Legacy ecosystem standard.
- Sequential execution (Synchronous).
- **require()** & **module.exports**

TYPES OF MODULES

ESModules

- Modern official specification.
- Non-blocking / Efficient processing.
- **import** & **export**.

ESModules

MODULES ADITIONAL

Enloquent
Javascript

CONCLUSION