TypeScript Class Notes

AltSchool Africa

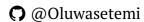
Are you ready to learn TypeScript? Press space on your keyboard \rightarrow







TypeScript is a strongly typed programming language that builds on JavaScript, giving you better tooling at any scale.



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JavaScript and More

TypeScript adds additional syntax to JavaScript to support a tighter integration with your editor. Catch errors early in your editor. A Result You Can Trust

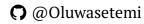
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Read more about TypeScript?



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TypeScript understands JavaScript and uses type inference to give you great tooling without additional code

Read more about TypeScript?

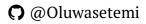


Table of Content

What are the things we will be covering?

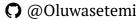
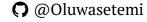


Table of Content

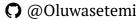
What are the things we will be covering?

- 1. The Basics
- 2. Everyday Types
- 3. functions
- 4. Peek into Generics
- 5. function overloading
- 6. Enums
- 7. Type Manipulation



The Basics

- Static type-checking
- Non-exception Failures
- Types for Tooling
- tsc, the TypeScript compiler
- Emitting with Errors
- Explicit Types
- Erased Types
- Downleveling
- Strictness
- noImplicitAny
- strictNullChecks



TypeScript Compiler tsc

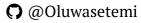
- The TypeScript compiler is a tool that takes TypeScript code and turns it into JavaScript code.
- The TypeScript compiler can be installed as a Node.js package.
- The TypeScript compiler can be run from the command line.
- The TypeScript compiler can be configured using a configuration file.
- The TypeScript compiler can be used to compile multiple files.
- The TypeScript compiler can be used to compile a project.

```
npm install -g typescript

tsc hello.ts

tsc --noEmitOnError hello.ts

tsc --init
```



 The tsconfig.json file is a configuration file that tells the TypeScript compiler how to compile your TypeScript code.

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- Emitting with Errors: You can use the noEmitOnError flag to prevent the TypeScript compiler from emitting JavaScript code if there are any errors.
- Explicit Types: You can use the noImplicitAny flag to prevent TypeScript from inferring the any type.

• Erased Types: You can use the noUnusedLocals and noUnusedParameters flags to prevent TypeScript from emitting JavaScript code if there are any unused variables or parameters.

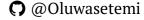
```
{
  "compilerOptions": {
    "strict": true,
    "noImplicitAny": true,
    "strictNullChecks": true,
    "target": "ES5",
    "noEmitOnError": true
}
```

```
let person: string | number = "OjoT99";

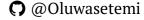
if (typeof person === "string") {
    person.split("T");
} else {
    // only number
    // person.toFixed(2);
}

let age: number = 99;

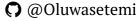
let isAltSchoolStudent = false;
let nothing = null;
let something = undefined;
```



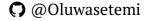
```
let arrayOfScores = [99, 45, 56, 67, 99];
let arrayOfScores2: number[] = [99, 45, 56, 67, 99];
let arrayOfNames: string[] = ["bisi", "sola", "augustina", "typescritina"];
let arrayOfTruths = [true, false];
let names: Array<string> = ["dancing", "eating", "sleeping"];
// <> -> generics Array<number> Array<boolean> Array<null>
let arrayInsideArrays = [["a"], ["b"]];
let newArr = [undefined];
```



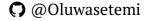
```
let obj: { name: string; age: number; job?: string } = {
 name: "ade",
 age: 99,
function greet(msg: string): string {
  return msg + "Hi :dance:";
if (typeof obj.job === "string") {
  // typequard
  greet(obj.job);
} else {
 // strictly undefined
  obj.job;
```



```
let profile: Record<string, number> = {
  age: 99,
  height: 6,
  weight: 100,
let objFlex: Record<string | symbol, string | boolean | number> = {};
objFlex.name = "lagbaja";
objFlex.animal = "cat";
objFlex[Symbol("id")] = true;
// any or never
let objFlexNumber: Record<string, number> = {
  age: 99,
};
```



```
// mixing types
const specialArr: Array<number | string | [] | {}> = [
  "name",
  99,
  {},
  Γ7,
 "ginia",
 100.
let result: number[] = person.split("T");
result;
console.log(result);
console.log("Hello", "AltSchool");
```

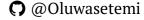


```
let user: "student" | "admin";
user = "temi";
user = "admin";
```

```
function add(): number {
  console.log("hello");
  return 99;
}

// typing arguments
function add2(a: number, b: number): number {
  return a + b;
}

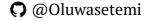
add2(99, 78);
```



```
// function overloading

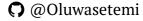
function add3(a: number, b: number): number;
function add3(a: string, b: string): string;
function add3(a: any, b: any): any {
   return a + b;
}

add3("na", "me");
add3(99, 78);
let name2: any = "wale";
let age2: any = 99;
add3(name2, age2);
```



```
// type alias
type Person = {
  name: string;
  age: number;
};

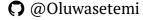
let person2: Person = {
  name: "ade",
  age: 99,
};
```



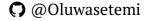
```
// interface
interface Person2 {
  name: string;
  age: number;
}

function greet2(person: Person2): string {
  return 'Hello ${person.name}';
}

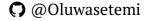
greet2({ name: "ade", age: 99 });
```



```
// type assertion
let res = JSON.parse('{"name": "ade"}') as { name: string };
```



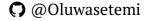
```
// 'satifies', 'as const', '!'
```



```
const addTwoNumbers = (a: number, b: number): number => {
   return a + b;
};

interface Params {
   a: number;
   b: number;
}: number;
}

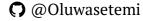
const addTwoNumberObject = (params: { a: number; b: number }): number => {
   return params.a + params.b;
};
```



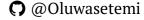
```
// extending the inteface(obj only!)
interface ThreeParams extends Params {
    c: number;
}
// conditional type
type NewParams = ThreeParams extends Params ? string : number;

const addThreeNumberObject = (params: ThreeParams): number => {
    return params.a + params.b + params.c;
};

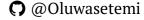
addThreeNumberObject({ a: 99, b: 78, c: 100 });
```



```
// make b optional
const addTwoNumberObject2 = (params: { a: number; b?: number }): number => {
   if (params.b) {
     return params.a + params.b;
   }
   return params.a;
};
console.log(addTwoNumberObject2({ a: 99 }));
```



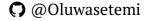
```
const addTwoNumberObject3 = (params: { a?: number; b?: number }): number => {
  if (params.a) {
    return params.a;
  }
  if (params.b) {
    return params.b;
  }
  return 5;
};
addTwoNumberObject3({});
```



```
const addTwoNumber3 = (a: number = 2, b: number = 5) => {
  return a + b;
};

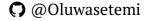
addTwoNumber3();

type Admin = {
  name: boolean;
};
```



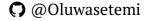
```
function getPersonName(admin: Admin) {
 return admin.name;
getPersonName({ name: false });
type AdminModified = {
 name: string;
 role: "client" | "admin" | "superadmin";
function getPersonString(admin: AdminModified) {
 return `${admin.name} is a ${admin.role}`;
getPersonString({ name: "ken", role: "superadmin" });
```

```
function getPersonName(admin: Admin) {
 return admin.name;
```

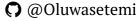


```
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 name: string;
 role: "client" | "admin" | "superadmin";
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 return `${admin.name} is a ${admin.role}`;
getPersonString({ name: "ken", role: "superadmin" });
```

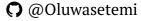
```
type AdminModified = {
 name: string;
 role: "client" | "admin" | "superadmin";
```



```
function getPersonString(admin: AdminModified) {
 return `${admin.name} is a ${admin.role}`;
```



```
getPersonString({ name: "ken", role: "superadmin" });
```



```
function getPersonName(admin: Admin) {
 return admin.name;
getPersonName({ name: false });
type AdminModified = {
 name: string;
 role: "client" | "admin" | "superadmin";
function getPersonString(admin: AdminModified) {
 return `${admin.name} is a ${admin.role}`;
getPersonString({ name: "ken", role: "superadmin" });
```

```
type Post = {
 title: string;
  author: string;
 id: number;
  body: string;
type AdminWithPosts = {
  posts: Array<Post>;
 name: string;
 role: "client" | "admin" | "superadmin";
function getPersonPost(person: AdminWithPosts): Array<Post> {
 return person.posts;
```

```
type NewPost = keyof (typeof res)[0]; // "title" | "author" | "id" | "body"
let newPostKey: NewPost = "author";
console.log(newPostKey);
```

```
type GitHubUser = {
  login: string;
  id: number:
 node_id: string;
  avatar_url: string;
  gravatar_id: string;
 url: string;
  html_url: string;
  followers_url: string;
  following_url: string;
  gists_url: string;
  starred url: string;
  subscriptions_url: string;
  organizations_url: string;
  repos_url: string;
  events_url: string;
  received_events_url: string;
  type: string;
  site_admin: boolean;
 name: string;
```

```
type NewGitHub = Pick<GitHubUser, "login" | "id" | "node_id">;

let newGitHub: NewGitHub = {
    login: "ade",
    id: 99,
    node_id: "node_id",
};

type newGitHubModified = Omit<NewGitHub, "node_id">;

let newGitHubModified: newGitHubModified = {
    login: "ade",
    id: 99,
};
```

```
async function fetchGitHubUser(username: string) {
  return fetch('https://api.github.com/users/${username}').then((res) =>
    res.json(),
  );
}

// (async () => {
  // let githubUser = await fetchGitHubUser("Oluwasetemi");
  // console.log(githubUser.avatar_url);
  // })();
```

```
const listOfStudent = new Set<string>();
listOfStudent.add("ade");
listOfStudent.add("ade");

listOfStudent.has("ade");

console.log(listOfStudent);

let mapOfStudentToScores = new Map<string, number>();

mapOfStudentToScores.set("ade", 99);
console.log(mapOfStudentToScores);
mapOfStudentToScores;
```

```
// tuples
let tuple: [string, number] = ["ade", 99];
let color: [number, number, number, number?];

color = [255, 0, 0, 0.1];
// rgba
let colorString = `rgb(${color.join(", ")})`;
```

```
// unions |
let str: number | string;
// at the level of types and interface
let advancePostU: Post | { tags: string[] } = {
 title: "hello",
 id: 1,
  author: "Authur Ts",
 body: "hello body",
 tags: ['hello', 'world']
// intersection &
type Tags = { tags: string[] };
let advancePost: Post & Tags = {
 title: "hello",
 id: 1,
  author: "Authur Ts",
  body: "hello body",
 tags: ["hello", "world"],
```

```
let NewStringIndex: { [index: number]: string };

NewStringIndex = ["1", "2", "3", "4", "5"];

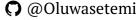
// NewStringIndex = {
    // name: "ade",
    // age: "99",
    // };

NewStringIndex[0] = "hello";

NewStringIndex["job"] = "developer";
```

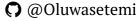
```
// readonly
let arrOfCommenter: readonly string[] = ["ade", "bisi", "sola"];
arrOfCommenter.push("aderemi");
let arrOfCommenter2: ReadonlyArray<string> = ["ade", "bisi", "sola"];
arrOfCommenter2.push("aderemi");
```

```
function longest<Type extends { length: number }>(a: Type, b: Type) {
 if (a.length >= b.length) {
    return a;
 } else {
    return b;
let res34 = longest({ length: 4 }, { length: 6 });
function merge<T, U>(first0bject: T, second0bject: U): T & U {
 return {
    ...firstObject,
    ...secondObject,
 };
let res35 = merge({ name: "ade" }, { age: 99 });
let res37 = merge({ school: "AltSchool" }, { job: "cleaner" });
```



```
// enums - user (ADMIN, CLIENT, SUPERADMIN)
enum Role {
 ADMIN,
  CLIENT,
 SUPERADMIN,
type User = {
 id: string;
 // enum
 role: Role;
 // union types
 // role: "CLIENT" | "ADMIN" | "SUPERADMIN";
 name: string;
  address: string;
```

```
function checkUserRole(user: User): string {
  const { role } = user;
 if (role === Role.ADMIN) {
   return "admin";
 } else if (role === Role.CLIENT) {
   return "client";
 return "superadmin";
let userAltSchool: User = {
 id: "001",
 role: Role.ADMIN,
 name: "ade ojo",
  address: "lagos",
let resultAltSchool = checkUserRole(userAltSchool);
console.log(resultAltSchool);
```



```
// Type manipulation - keyof, typeof, in, infer, extends, in, as, is, &

type U = keyof {x: string, y: number} // 'x' | 'y'

type KeyOfUserType = keyof User;

type Arrayish = { [n: number]: string }; // string[]

type keyOfArray = keyof Arrayish;

let sampleArray: { [n: number]: string } = ["ade", "bisi", "sola"];

let keyOfUser: KeyOfUserType = "name";
```

```
// typeof
let myName = "ade";
type Name = typeof myName;

type Predicate = (x: unknown) => boolean;
type K = ReturnType<Predicate>;

type CheckUserRole = ReturnType<typeof checkUserRole>;

function f() {
   return { x: 10, y: 3 };
}
// infer
type P = ReturnType<typeof f>;
```

```
// indexed access types
type Person3 = { name: string; age: number; address: string };
type Age = Person3["address" | "age"];

// Conditional Types
// SomeType extends OtherType ? TrueType : FalseType
type Exclude<T, U> = T extends U ? never : T;
// type T = Exclude<"a" | "b" | "c", "a" | "c">; // "b"
```

```
// mapped types
type Person4 = {
    [key: string]: string;
};

// Template Literal Types
type World = "world";
type Greeting = `hello ${World}`;
```

```
let person: string | number = "helloTtypescript";

let result: number[] = person.split("T");

Type 'string[]' is not assignable to type 'number[]'.
    Type 'string' is not assignable to type 'number'.

// //^?

console.log(result);
console.log("Hello", "AltSchool");
```

```
function greeter(fn: (a: string) => void) {
  fn("Hello, World");
}

function printToConsole(s: string) {
  console.log(s);
}

greeter(printToConsole);
```

```
type GreetFunction = (a: string) => void;
function greeter(fn: GreetFunction) {
  fn("Hello, World");
}
function printToConsole(s: string) {
  console.log(s);
}
greeter(printToConsole);
```

```
type DescribableFunction = {
  description: string;
  (someArg: number): boolean;
};
function doSomething(fn: DescribableFunction) {
  console.log(fn.description + " returned " + fn(6));
};
function myFunc(someArg: number) {
  return someArg > 3;
myFunc.description = "default description";
doSomething(myFunc);
```

```
// call signatures and constructors
type DescribableFunction = {
  description: string;
  (someArg: number): boolean;
};

type SomeConstructor = {
  new (s: string): SomeObject;
};

function fn(ctor: SomeConstructor) {
  return new ctor("hello");
}
```

```
type DescribableFunction = {
  description: string;
  (someArg: number): boolean;
function doSomething(fn: DescribableFunction) {
  console.log(fn.description + " returned " + fn(6));
function myFunc(someArg: number) {
 return someArg > 3;
myFunc.description = "default description";
doSomething(myFunc);
default description returned true
```

Peek into Generics

```
// Inside ./snippets/external.ts
export function emptyArray<T>(length: number) {
  return Array.from<T>({ length })
}
```

Put emptyArray function to work

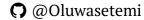
Peek into Generics

```
// Inside ./snippets/external.ts
export function emptyArray<T>(length: number) {
  return Array.from<T>({ length })
}
```

Put emptyArray function to work

```
import { emptyArray } from './external'
console.log(emptyArray<number>(10).reduce(fib => [...fib, fib.at(-1)! + fib.at(-2)!], [1, 1]))

[1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144]
```



Peek into Generics

```
// Inside ./snippets/external.ts
export function emptyArray<T>(length: number) {
  return Array.from<T>({ length })
}
```

Put emptyArray function to work

```
import { emptyArray } from './external'
console.log(emptyArray<number>(10).reduce(fib => [...fib, fib.at(-1)! + fib.at(-2)!], [1, 1]))

[1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144]

function firstElement<Type>(arr: Type[]): Type | undefined {
   return arr[0];
}
// Note that we didn't have to specify Type in this sample.
// The type was inferred - chosen automatically - by TypeScript.
let s1 = firstElement([1, 2, 4, 5])
let s2 = firstElement(['hello', 'dance'])
```

Solve this using TS Generics

```
function getRandomNumberElement(items: number[]): number {
    let randomIndex = Math.floor(Math.random() * items.length);
    return items[randomIndex];
}

let randyValue = getRandomNumberElement(['ayo', 'ade', 'ojo', 'jerry'])

console.log(randyValue)

ade
```

```
function map<Input, Output>(arr: Input[], func: (arg: Input) => Output): Output[] {
    return arr.map(func);
}

// Parameter 'n' is of type 'string'
// 'parsed' is of type 'number[]'
const parsed = map(["1", "2", "3"], (n) => parseInt(n));
```

```
function map<Input, Output>(arr: Input[], func: (arg: Input) => Output): Output[] {
   return arr.map(func);
 // Parameter 'n' is of type 'string'
 // 'parsed' is of type 'number[]'
 const parsed = map(["1", "2", "3"], (n) => parseInt(n));
function longest<Type extends { length: number }>(a: Type, b: Type) {
 if (a.length >= b.length) {
   return a;
 } else {
   return b;
// longerArray is of type 'number[]'
const longerArray = longest([1, 2], [1, 2, 3]);
// longerString is of type 'alice' | 'bob'
const longerString = longest("alice", "bob");
// Error! Numbers don't have a 'length' property
const notOK = longest(10, 100);
 Argument of type 'number' is not assignable to parameter of type '{ length: number; }'.
```

```
function minimumLength<Type extends { length: number }>(
  obj: Type,
 minimum: number
): Type {
 if (obj.length >= minimum) {
   return obj;
 } else {
   return { length: minimum };
// 'arr' gets value { length: 6 }
const arr = minimumLength([1, 2, 3], 6);
// and crashes here because arrays have
// a 'slice' method, but not the returned object!
console.log(arr.slice(0));
TypeError: arr.slice is not a function
```

```
function combine<Type>(arr1: Type[], arr2: Type[]): Type[] {
    return arr1.concat(arr2);
}

// const arr = combine([1, 2, 3], ["hello"]);
const arr = combine<string | number>([1, 2, 3], ["hello"]);

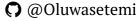
console.log(arr)

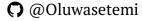
[1, 2, 3, "hello"]
```

```
function merge<T, U>(firstObject: T, secondObject: U): T & U {
 return {
   ...firstObject,
   ...secondObject,
 };
type Result<T extends Function> = T extends (...args: never[]) => infer R
 ? R
 : never;
let res35 = merge({ name: "ade" }, { age: 99 });
console.log(res35)
let res37 = merge({ school: "AltSchool" }, { job: "cleaner" });
console.log(res37)
  "name": "ade",
  "age": 99
  "school": "AltSchool",
  "job": "cleaner"
```

```
type FuncWithOneObjectArgument<P extends { [x: string]: any }, R> = (
 props: P
) => R;
type DestructuredArgsOfFunction<</pre>
  F extends FuncWithOneObjectArgument<any, any>
> = F extends FuncWithOneObjectArgument<infer P, any> ? P : never;
const myFunction = (props: { x: number; y: number }): string => {
 return "OK";
};
const props: DestructuredArgsOfFunction<typeof myFunction> = {
 x: 1,
 y: 2
```

Click the play button to run the code





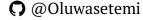
Push Type Parameters Down

- Push Type Parameters Down
- Use Fewer Type Parameters

```
function filter1<Type>(arr: Type[], func: (arg: Type) => boolean): Type[] {
   return arr.filter(func);
}

function filter2<Type, Func extends (arg: Type) => boolean>(
   arr: Type[],
   func: Func
): Type[] {
   return arr.filter(func);
}

const val = filter1([1, 2, 3, 4], n => n % 2 === 0)
const val2 = filter2([1, 2, 3, 4], n => n % 2 === 0)
```



- Push Type Parameters Down
- Use Fewer Type Parameters

```
function filter1<Type>(arr: Type[], func: (arg: Type) => boolean): Type[] {
    return arr.filter(func);
}

function filter2<Type, Func extends (arg: Type) => boolean>(
    arr: Type[],
    func: Func
): Type[] {
    return arr.filter(func);
}

const val = filter1([1, 2, 3, 4], n => n % 2 === 0)
const val2 = filter2([1, 2, 3, 4], n => n % 2 === 0)
```

Type Parameters(Or any annotation used) Should Appear Twice

function overloading

```
function add3(a: number, b: number): number;
function add3(a: string, b: string): string;
function add3(a: any, b: any): any {
   return a + b;
}

add3("na", "me");
add3(99, 78);
let name2: any = "wale";
let age2: any = 99;
add3(name2, age2);
```

Enums

```
enum Role {
 ADMIN,
 CLIENT,
 SUPERADMIN,
type User = {
 id: string;
 // enum
 role: Role;
 // union types
 // role: "CLIENT" | "ADMIN" | "SUPERADMIN";
 name: string;
 address: string;
```

```
enum Role { ADMIN, CLIENT, SUPERADMIN, };
type User = { id: string; role: Role; name: string; address: string; };
// union types // role: "CLIENT" | "ADMIN" | "SUPERADMIN";
function checkUserRole(user: User): string {
  const { role } = user;
  if (role === Role.ADMIN) {
   return "admin";
 } else if (role === Role.CLIENT) {
   return "client";
  // Role.SUPERADMIN;
 return "superadmin";
let userAltSchool: User = {
 id: "001",
 role: Role.ADMIN,
 name: "ade ojo",
  address: "lagos",
let resultAltSchool = checkUserRole(userAltSchool);
console.log(resultAltSchool);
```

admin

keyof

- keyof
- typeof

- keyof
- typeof
- indexed access types

- keyof
- typeof
- indexed access types
- conditional types

- keyof
- typeof
- indexed access types
- conditional types
- mapped types

- keyof
- typeof
- indexed access types
- conditional types
- mapped types
- template-literal-types