Magic TypeScript

A cheat sheet of TypeScript's most important/magic features

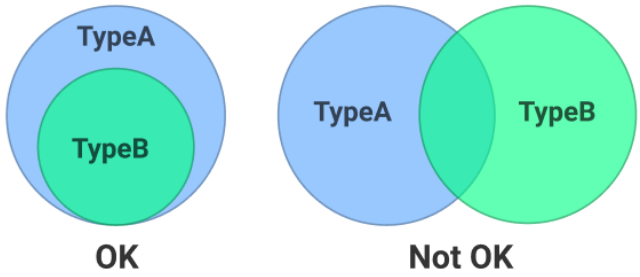
Subsets

This is the most important concept to understand about TypeScript. Think of all types as sets of values.

```
never // Special type meaning empty set
"dog" // Unit type. A set with only the value "dog"
"dog" | "cat" // Union type. A set with only the values "dog" and "cat"
string // A set containing every string value
number // A set containing every number
any // Special type which contains every value in its set
```

You can use one type in place of another as long as its set overlaps fully. In other words:

TypeA can be used in place of TypeB as long as TypeA has all or more values in its set.



Examples:

```
type Type1 = "apple" | "orange"
type Type2 = "apple"
type Type3 = "apple" | "banana"

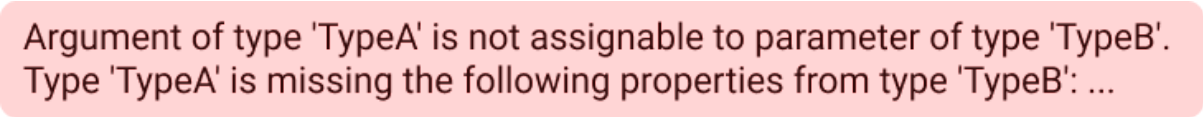
const func = (food: Type1) => { /* ... */}
// This function will let you pass in type Type1 and Type2 but not Type3
```

```
interface Pet {
  name: string
}

interface Dog {
  name: string
  favouriteToy: string
  furType: "curly" | "flat"
}
// Any function needing Pet as a parameter will happily also accept Dog
```

```
const fetchTranslation = (language: "English" | "Spanish" | "German") => {/* ... */}
const language = getRandomLanguage() // Type is string
fetchTranslation(language)
// This does NOT work since 'string' could be a bunch of values that
// are not "English", "Spanish", or "German"
```

Error message translation



This means that the set of TypeA is not contained inside the set of TypeB.

Inference

If you don't specify a type TypeScript will make a guess and assign one.

```
let name = "Carl" // Type is string
```

Using *const* makes TypeScript infer a different type. This is because *const* makes the variable immutable.

```
const name = "Carl" // Type is "Carl"
```

as const

TypeScript normally infers a pretty wide type for objects, but you can force it to narrow it with *as const.*

```
const person = {name: "Carl"} // Type is { name: string }
const person = {name: "Carl"} as const // Type is { name: "Carl" }
```

Narrowing with conditions

TypeScript can narrow a type depending on the context.

```
const user = getUserFromId("123") // Type is User | null
if (user) {
  // Type of user is User
} else {
  // Type of user is null
}
```

Type guards

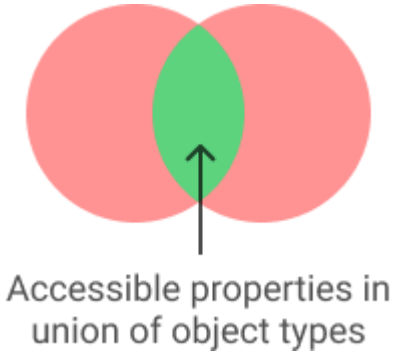
You can help the type system infer types with type guards. They allow you to define your own checks for types.

```
const isCat = (pet: Cat | Dog): pet is Cat => {
  return pet.latestMessage.includes("meow")
}

const pet = getRandomPet() // Type is Cat | Dog
if (isCat()) {
  // Type is Cat
} else {
  // Type is Dog
}
```

Unions

A union type is a type that has the possibility to be other types. When working with unions of objects, you can only access properties that both types have in common.




```
interface Cat {
  isSleeping: boolean
  isMeowing: boolean
}

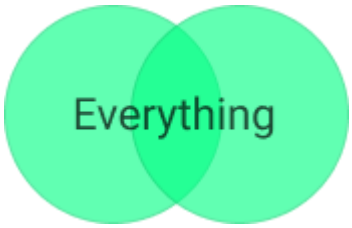
interface Dog {
  isSleeping: boolean
  isPlayingFetch: boolean
}

// Same as { isSleeping: boolean }
type Pet = Cat | Dog

const dog: Pet = getRandomDog() // OK
```

Intersections

Intersections are related to union types, but they combine everything into one set.




```
interface Person {
  name: string
  age: number
}

interface LocationData {
  country: string
  address: string
}

type PersonWithLocation = Person & LocationData // Same as:
// { name: string, age: number, country: string, address: string }
```

```
// TS Error: Type Person is missing: country, address
const person: PersonWithLocation = getRandomPerson()
```

Enums

Enums let you define a set of named constants. They act very similar to union types.

```
enum SeverityCode {
  CRITICAL = 0
  WARNING = 200
  NORMAL = 1000
}

if (getSeverity() === SeverityCode.CRITICAL) {
  // Panic!
}
```

This is a very broad type that will let you use keys you haven't defined. You can define the allowed set for the keys with the *in* keyword. It will even warn you if you don't define a value for all the keys. The global utility type *Record* uses this.

```
const ages: {[name in "Ernest" | "Chester"]: number} = {
  "Ernest": 36,
  "Chester": 21
}
ages["Ernest"] // 36
ages["Harvey"] // TS Error: Property 'Harvey' does not exist ...

// Exact same thing as above
const ages: Record<"Ernest" | "Chester", number> = {
  "Ernest": 36,
  "Chester": 21
}
```

Index signatures (key/value)

Index signatures allow you to define types for key value pairs.

```
const ages: {[name: string]: number} = {
  "Ernest": 36,
  "Chester": 21
}
ages["Ernest"] // 36
```

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  "Chester": 21
}
```

Mapping enums

```
const colors: Record<SeverityCode, string> = {
  [SeverityCode.CRITICAL]: "Red",
  [SeverityCode.WARNING]: "yellow",
  [SeverityCode.NORMAL]: "green",
}

colors[SeverityCode.WARNING] // "yellow"
colors[200] // "yellow"
```

Generics

Generics can be used to make types more flexible. They allow shared behavior for different types.

```
interface HTTPResponse<T> {
  status: number
  data: T
}

interface User {
  name: string
}

// Type is { status: number, data: { name: string} }
type UserHTTPResponse = HTTPResponse<User>

// Type is { status: number, data: string }
type StringHTTPResponse = HTTPResponse<string>
```

extends

The extends keyword can be used to limit which types are allowed to be used generically.

TypeA extends TypeB means that TypeA's set of values is contained within TypeB's.

```
const getUser = <T extends string | number>(id: T): {id: T, name: string} => {
  return fetchUser(id)
}

// TS Error: Argument of type 'boolean' is not assignable to string | number
getUser(true)

getUser(123) // Return type is { id: number, name: string }
getUser("abc") // Return type is { id: string name: string }
```

Conditional types

TypeScript supports conditional types inspired by JavaScript's ternary operator. You use *extends* as an assertion.

```
type BooleanFromString<T> = T extends "true" ? true : false

type Boolean1 = BooleanFromString<"true"> // Type is true
type Boolean2 = BooleanFromString<"false"> // Type is false
type Boolean3 = BooleanFromString<"true" | "false"> // Type is boolean
```

You can also use conditional types for the return type of a function.

typeof

The *typeof* keyword acts very differently depending on if it's in a JavaScript context or a TypeScript context. Reason being that TypeScript types don't exist when code is running.

```
const pet = getRandomPet()

// TypeScript context
// (Line does not exist when code is running)
type PetType = typeof pet // Type is Cat | Dog
```

```
 // JavaScript context
console.log(typeof pet) // Prints "object"
```

The only types that exist at runtime are: `bigint, boolean, function, number, object, string, symbol, undefined.`

keyof

keyof allows you to convert an object type into a union of its keys.

```
interface User {
  name: string
  age: number
}

type UserKeys = keyof User // Type is same as "name" | "age"
```

```
const select = <T>(data: T, key: keyof T) => {
  return data[key]
}

const user = {name: "Alice", age: 24}

select(user, "age") // Type is number
select(user, "height") // TS Error: "height" is not assignable to "age" | "name"
```

Template literal types

```
type Drink = "tea" | "coffee"
type Size = "S" | "M" | "L"

// Type is "S-tea" | "S-coffee" | "M-tea" | "M-coffee" | "L-tea" | "L-coffee"
type DrinkVariant = `${Size}-${Drink}`
```

Idea: Create an Index signature to map DrinkVariants to prices

Tuples

```
type Coordinates = [number, number]

const c1: Coordinates = [5, 12]
```

```
const c2: Coordinates = [4] // TS error: Has 1 element but requires 2
const c3: Coordinates = [7, "9"] // TS error: string is not assignable to type number
```

Spread tuples

```
// A person can be called mulitple names but always has at least one
type Names = [string, ...string[]]

const p1Names: Names = ["Albert", "Bert", "Al"]
const p2Names: Names = [] // TS error: Has 0 elements but requires 1
```

readonly

You can use the *readonly* modifier to prevent values from being mutated in unexpected ways.

```
const printArray = (array: readonly number[]) => {
  array[0] = 100 // TS error: only reading is permitted
}

const array = [1, 2, 3]
// We know for sure the function won't mutate our array
printArray(array)
```

Useful global utility types

Partial<T>

```
// Make all properties in T optional
type Partial<T> = {
    [P in keyof T]?: T[P]
}

type Example = Partial<{name: string, age: number}>
// { name?: string | undefined, age?: number | undefined }
```

Required<T>

```
// Make all properties in T required
type Required<T> = {
```

```
    [P in keyof T]-?: T[P]
}

type Example = Required<{name?: string, age?: number}>
// { name: string, age: number }
```

Pick<T>

```
// Keep only the properties in T which are in the union K
type Pick<T, K extends keyof T> = {
    [P in K]: T[P]
}

type Example = Pick<{id: string, name: string, age: number}, "id" | "name">
// { id: string, name: string }
```

Extract<T>

```
// Extract from union T what is also in union U
type Extract<T, U> = T extends U ? T : never

type Example = Extract<"a" | "b" | "c", "a" | "c">
// "a" | "c"
```

Exclude<T>

```
// Exclude from union T what is also in union U
type Exclude<T, U> = T extends U ? never : T

type Example = Exclude<"a" | "b" | "c", "a" | "c">
// "b"
```

Omit<T>

```
// Keep only the properties in T which share no keys with union K
type Omit<T, K extends keyof any> = Pick<T, Exclude<keyof T, K>>

type Example = Omit<{id: string, name: string, age: number}, "id" | "age">
// { name: string }
```

NonNullable<T>

```
// Exclude null and undefined from T
type NonNullable<T> = T extends null | undefined ? never : T
```

```
type Example = NonNullable<string | undefined | null>
// string
```

Others

Other global utility types not listed include:
Parameters<T>, ConstructorParameters<T>, ReturnType<T>, InstanceType<T>, Uppercase<S>, Lowercase<S>, Capitalize<S>, Uncapitalize<S>, ThisType<T>, Readonly<T>, ArrayLike<T>, Awaited<T>, Promise<T>, PromiseLike<T>