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Advanced TypeScript

Unit 3

- **Conditional types**
- **Mapped types**
- **Template literal types**

Conditional types

Conditional types

- If condition for types
- Can be used in generics to derive a types based on conditions
  - Union types
  - Function overloads
- Powerful with template literal & mapped types
- Possibility to infer
- Can return never

Conditional types syntax

```
type Id<Type> = Type extends number ? {id: number} : Type
```

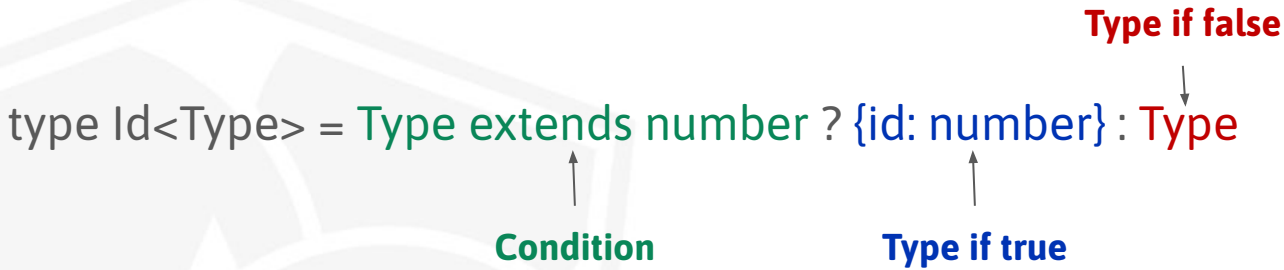
Conditional types syntax

```
type Id<Type> = Type extends number ? {id: number} : Type
```

Condition

Conditional types syntax

Conditional types syntax



Examples

```
type Immutable<Type> = Type extends object ? Readonly<Type> : Type;


type T1 = Immutable<number>; // number

type T2 = Immutable<{ id: number; name: string }>; // {readonly id: number, readonly name: string}
```

Examples

```
type Opposite<T extends number | string> = T extends number ? string : number;


type T1 = Opposite<number>; // string

type T2 = Opposite<string>; // number
```

infer

- Only available in conditional types
- Types after extend can inferred
- Inferenced type can be returned
  - Only in the true branch
- Works on utility types, functions,...

infer against types

```
type IdType<T> = T extends { id: infer Id } ? Id : never;


type T1 = IdType<{ id: string }>; // string

type T2 = IdType<{ id: number }>; // number

type T3 = IdType<{ id: bigint }>; // bigint
```

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Multiple infer against functions

```
type FnType<T> = T extends (a: infer A, b: infer B) => infer R? {args: [A, B], returned: R} : never;

const incrementer = (first: number) => first + 1
const adder = (first: number, second: number) => first + second;

type T1 = FnType<typeof incrementer> // {args: [number, undefined], returned: number}
type T2 = FnType<typeof adder> // {args: [number, number], returned: number}
```

Mapped types

Mapped types

- Generate a new type out of another
- Possibilities (in combination with conditional maps)
  - Renaming property (in combination with template literal types)
  - Changing type
  - Excluding property
  - Setting readonly
  - Setting optionally

Default mapping

```
export type Person = { id: number; firstname: string; lastname: string; birthdate: Date; };

type Clone<Type> = { [Property in keyof Type]: Type[Property] };

type ClonedPerson = Clone<Person>; // Person
```

Changing property types

```
export type Person = { id: number; firstname: string; lastname: string; birthdate: Date; };

type Getter<Type> = { [Property in keyof Type]: () => Type[Property] };

type PersonGetter<Type> = Getter<Person>;
```

Excluding properties (via never)

```
type StringExcluder<Type> = {
  [Property in keyof Type]: Property extends string ? Type[Property] : never;
};
type NumberExcluder<Type> = {
  [Property in keyof Type as Property extends "string"
    ? Property
    : never]: Type[Property];
};

type UnstringedPerson = StringExcluder<Person>;
type UnnumberedPerson = NumberExcluder<Person>;
```

ReadOnly<T>, Optional<T>

```
type Partial<Type> = { [Property in keyof Type]?: Type[Property] };
type UnPartial<Type> = { [Property in keyof Type]-?: Type[Property] };

type Readonly<Type> = { readonly [Property in keyof Type]: Type[Property] };
type NotReadonly<Type> = {
  -readonly [Property in keyof Type]: Type[Property];
};
```

Template literal types

Template Literal Types

- Possibility to construct instructions via "string interpolation"
- Most advanced technique in terms of meta-programming
- Feels a little bit like `eval()`
- Real power in combination with mapped & conditional types

Minimalistic example

```
type LocaleMaker<COUNTRY extends string, LANG extends string> = `${COUNTRY}-${LANG}`;

type AT = LocaleMaker<"at", "de">; // "at-de"
```

Extending with unions

```
type Engine = "diesel" | "petrol" | "electric";

type Shift = "manual" | "automatical";

type CarType = "sedan" | "suv" | "coupe";


type CarConfig = `${Engine}_${Shift}_${CarType}`;
```

combi with conditional types

```
type ValidLocale<T> = T extends `${infer Country}_${infer Language}`
  ? T
  : never;

type Austria = ValidLocale<"at_de">; // at_de
type InvalidLocale = ValidLocale<"at-de">; // never
```

combi with mapped types

```
type ValidLocale<T> = T extends `${infer Country}_${infer Language}`
  ? T
  : never;

type Austria = ValidLocale<"at_de">; // at_de
type InvalidLocale = ValidLocale<"at-de">; // never
```

String utility types

```
type LocaleMaker<COUNTRY extends string, LANG extends string> = `${COUNTRY}-${LANG}`;

type AT = LocaleMaker<"at", "de">; // "at-de"
```

Combination mapped types

```
export type Person = { id: number; firstname: string; lastname: string; birthdate: Date; };

type Getter<Type> = {

  [Property in keyof Type as `get${Capitalize<Property & string>}`]: () => Type[Property];

};

type PersonGetter<Type> = Getter<Person>;
```

Showing off 1: date types to getter methods

```ts
export type Person = {
  id: number;
  firstname: string;
  lastname: string;
  birthdate: Date;
};

type DateGetter<Type> = {
  [Property in keyof Type as Type[Property] extends Date
    ? `get${Capitalize<Property & string>}`
    : Property]: Type[Property] extends Date
    ? () => Type[Property]
    : Type[Property];
};

// {id: number, firstname: string, lastname: string, birthdate: () => Date}
type BetterPerson<Type> = DateGetter<Person>;
```

Showing off 2: recursive typing

```
export type Split<S extends string> = S extends `${infer Head} ${infer Tail}`
  ? [Head, ...Split<Tail>]
  : [S];

type T1 = Split<"this is a test">; // ["this", "is", "a", "test"]
```

Lab Time

Case Study ngrx: `createAction`

Case Study ngrx: `createFeature`

Further Reading

- https://www.typescriptlang.org/docs/
- https://effectivetypescript.com/2020/11/05/template-literal-types/
- https://medium.com/@bytefer
- https://fettblog.eu/

- https://github.com/type-challenges/type-challenges
- https://github.com/millsp/ts-toolbelt
- https://github.com/ghoullier/awesome-template-literal-types
- https://dev.to/phenomnominal/i-need-to-learn-about-typescript-template-literal-types-51po
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Recommended Libraries

- GitHub - sindresorhus/type-fest: A collection of essential TypeScript types
- GitHub - colinhacks/zod: TypeScript-first schema validation with static type inference