TypeScript 102

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April 14, 2021

Generics

IN A WORLD WITHOUT ABSTRACTION OVER VALUES...

```
const doubleOne = () => 2;
const doubleTwo = () => 4;
const doubleThree = () => 6;

// ... approximately infinity lines later:

const tripleOne = () => 3;
const tripleTwo = () => 6;
const tripleThree = () => 9;
```

Generics, continued

Why is it hard? No abstracting over values. Really we're just using gussied-up constants.

Generics, continued

Futhermore, if we invented a new kind of number, we'll have to implement the relevant "functions":

```
const i = "i";

const doubleI = () => "2i";
const tripleI = () => "3i";
```

Generics, continued

IN A WORLD WITHOUT ABSTRACTION OVER VALUES, ONE RENEGADE PROGRAMMER INVENTED FUNCTIONS...

```
const doubleIt = (input: number): number => 2 * input;

doubleIt(4); // => 8
```

Generics, continued

Some terminology: `input` is a *parameter*. (Think *p* for *p*otential.)

```
const doubleIt = (input: number): number => 2 * input;
```

Dearest TypeScript:

I shall write you in the future and tell you what value to bind to `input`. Until then, all my love.

Forever yours (as I am `const` bound),
`doubleIt`, function.

Generics, continued

Some more terminology: the thing inside the parentheses is an *argument*. (Think *a* for *a*ctual.)

```
doubleIt(4); // => 8
```

Most Honorable `doubleIt`:

I write on behalf of TypeScript.

I am in receipt of the missive of last clock tick. It is with pleasure that I have bound the number 4 to `input`, and proceededing, *mutatis mutandis*, in the witty & delightful & v. droll manner that you have prescribed, thereby obtained the result 8.

Yr. faithful & obedient servant, &c.,
The JavaScript Runtime

Generics, continued

What did we just learn?

- If we can't abstract over values, the programmer, language, or framework must explicitly define the cases (as with `doubleOne` and `tripleTwo`).
- If we can't abstract over values, a language or framework cannot support operations with user-defined values, so the programmer must provide all implementations she will rely on (as with the new number `i`).

Generics, continued

```
const firstName: string | undefined | null = getFirstName();

const lastName: string | undefined | null = getLastName();
```

Annoy-ing! How about this:

```
type MaybeString = string | undefined | null;

const firstName: MaybeString = getFirstName();
const lastName: MaybeString = getLastName();
```

Generics, continued

IN A WORLD WITHOUT ABSTRACTION OVER ~~VALUES~~ TYPES...[1]

Imagine we whip up a library for this *Maybe* idea.

```
type MaybeString = string | undefined | null;
type MaybeNumber = number | undefined | null;
type MaybeBoolean = boolean | undefined | null;
type MaybeSymbol = symbol | undefined | null;
type MaybeObject = object | undefined | null;
```

⋮

If we can't abstract over ~~values~~ types, the programmer, language, or framework must explicitly define the cases.

[1] We don't actually have to imagine. This dystopian world is real. It is a place of weeping and gnashing of teeth: a place called Golang.

Generics, continued

IN A WORLD WITHOUT ABSTRACTION OVER ~~VALUES~~ TYPES...

But now our user has defined a `Name` interface. Our library is of no help, except as inspiration. Our user must implement `MaybeName` himself:

```
interface Name {
  givenName: string;
  familyName: string;
}

type MaybeName = Name | undefined | null;
```

If we can't abstract over ~~values~~ types, a language or framework cannot support operations with user-defined ~~values~~ types.

Generics, continued

IN A WORLD WITHOUT ABSTRACTION OVER ~~VALUES~~ TYPES, ONE RENEGADE PROGRAMMER INVENTED ~~FUNCTIONS~~ GENERICS...

```
type Maybe<T> = T | undefined | null;

type MaybeString = Maybe<string>;
type MaybeName = Maybe<Name>;
```

Generics, continued

Some terminology: `T` is a type *parameter*. (Think *p* for *p*otential.)

```
type Maybe<T> = T | undefined | null;
```

> Dearest TypeScript:
>
> I shall write you in the future and tell you what ~~value~~ type to bind to `T`. Until then, all my love.
>
> Possibly yours (as I have trouble with commitment),
> `Maybe`, generic type.

Generics, continued

Some more terminology: `String` is a type *argument*. (Think *a* for *a*ctual.)

```
type MaybeString = Maybe<String>; // => String | undefined | null
```

Most Honorable `Maybe`:

I am in receipt of your compile-time missive. It is with pleasure that I have bound the type `String` to `T`, and proceeding, *mutatis mutandis*, in the witty & delightful & v. droll manner that you have prescribed, thereby obtained the result `String | undefined | null`.

Yr. faithful & obedient servant, &c.,
The TypeScript Compiler[a]

[a] Oooh, interesting, this is a little different than last time. Is this—dare I even hope—foreshadowing a coming topic?

Generics, continued

So generics are like functions, except:

- You pass in a type instead of a value.
- You use < and > instead of (and).
- Instead of returning a value, the expression returns a type.

Generics, continued

```
const stringArray: Array<string> =
  ["Some", "good", "stuff"];

interface Bloop {
  grapplingHookLength: number;
  presenceOfPiranas: boolean;
}

const myBloopArray: Array<Bloop> = [
  { grapplingHookLength: 27, presenceOfPiranas: true },
  { grapplingHookLength: 5280, presenceOfPiranas: false },
];
```

Utility Types

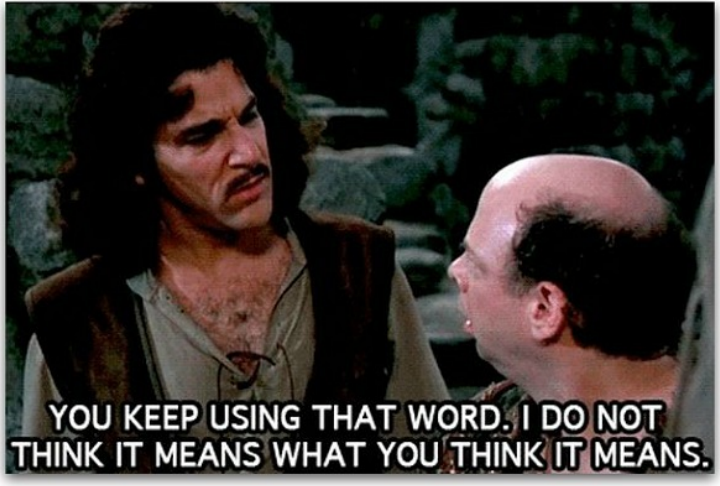
```ts
interface MysteryPerson {
  firstName?: string;
  lastName?: string;
}

const myMysteryPerson: MysteryPerson = {};

type ForthrightPerson = Required<MysteryPerson>;

// Type error: Type '{}' is missing the following properties from type
// 'Required<MysteryPerson>': firstName, lastName ts(2739)
const myForthrightPerson: ForthrightPerson = {};
```

Advanced Types

Let's build our own Utility Types!

Dauntlessly live coding.

const and readonly



React

To update

Runtime vs. Compile Time

Repeat this to yourself as a mantra:

> *TypeScript doesn't exist when my code runs.*
> *TypeScript doesn't exist when my code runs.*
> *TypeScript doesn't exist when my code runs.*
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> *TypeScript doesn't exist when my code runs.*

Example

Runtime vs. Compile Time, continued

```
interface TypeScriptDisillusionment {
  intensity: number;
  isRecoverable: boolean;
}

const myFeelingsRightNow: TypeScriptDisillusionment = {
  intensity: 42,
  isRecoverable: true,
}

if (typeof myFeelingsRightNow === "TypescriptDisillusionment") {
  console.log("Maybe I'm not so disillusioned after all.");
} else {
  console.log("I'm very disillusioned.")
}
```

Runtime vs. Compile Time, continued

Error message:

```
This condition will always return 'false' since the types '"string" |
"number" | "bigint" | "boolean" | "symbol" | "undefined" | "object" |
"function"' and '"TypescriptDisillusionment"' have no overlap.(2367)
```

Output (transpiled despite compiler errors):

```
[LOG]: "I'm very disillusioned."
```

Runtime vs. Compile Time, continued

TypeScript doesn't exist when my code runs.
TypeScript doesn't exist when my code runs.
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TypeScript doesn't exist when my code runs.
TypeScript doesn't exist when my code runs.

Type Guards

That's the main point. Is there any solution? Yes, kind of.

> Yo, TypeScript, programmer here. I know you get all weird and start yelling about, "I just can't with these runtime types" and all. I get it. But like, you trust me, right? I mean, you always let me say `any` and `@ts-ignore` and stuff, right?
>
> Okay, so I wrote this function that I promise will figure out the types at runtime. No, no, don't freak out. Just look at it, will you? Yes, at compile time. Yes, I know it doesn't run at compile time. You're missing my point.
>
> I promise it will work at runtime to figure out the types. So can you *please* look at it at compile time to make sure I'm getting everything else right. Aww, you're the best TypeScript.

Type Guards, continued

1. Manual non typesafe approach.
2. Reminder of TS awesomeness.
3. Demo of a type guard.
4. Not totally typesafe.
5. Using a dedicated field.

const and readonly, continued

```
type ArrayForever<T> = readonly T[];

const myArray: ArrayForever<Number> = [1, 2, 3];

// Error: Index signature in type 'ArrayForever<Number>'
// only permits reading.
myArray[0] = 33;
```

const and readonly, continued

```
interface Person {
  readonly firstName: string;
  readonly lastName: string;
  yesterdaysDinner: string;
}

const ethan: Person = {
  firstName: "Ethan",
  lastName: "Kent",
  yesterdaysDinner: "Rotisserie Chicken",
};

// Fine
ethan.yesterdaysDinner = "Bananas Foster";

// Error: Cannot assign to 'lastName' because it is a read-only property.
ethan.lastName = "Vigliodogsworthy";
```

Index Types

Fixme

Conditional Types

Implement me

Conditional Types, continued

```
type Validation<T> = (value: T) => boolean;

type FormValidation = {
  [k in keyof Form]: Form[k] extends object
    ? {
        [l in keyof Form[k]]: Form[k][l] extends object
          ? { [m in keyof Form[k][l]]: Validation<Form[k][l][m]> }
          : Validation<Form[k][l]>;
      }
    : Validation<Form[k]>;
};
```

Conditional Types, continued