

How to unleash the power of

TypeScript

in your project





On the edge of 20's... remember 00's

Benefits of using typescript

Testing Trophy by Kent C. Dodds

THE FOUR TYPES OF TESTS

End to End

A helper robot that behaves like a user to click around the app and verify that it functions correctly.

Sometimes called "functional testing" or e2e.

Integration

Verify that several units work together in harmony.

Unit

Verify that individual, isolated parts work as expected.

Static

Catch typos and type errors as you write the code.



End to End

A helper robot that behaves like a user to click around the app and verify that it functions correctly.

Sometimes called “functional testing” or e2e.

Integration

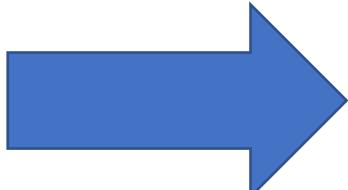
Verify that several units work together in harmony.

Unit

Verify that individual, isolated parts work as expected.

Static

Catch typos and type errors as you write the code.



Structural types = interoperability

```
interface Carriage {  
    no: number;  
}  
  
interface Train {  
    name: string;  
    carriages: Carriage[];  
}
```

```
interface Train {  
    name: string;  
    carriages: { no: number }[];  
}
```

TypeScript related obstacles

- False security
- Verbosity
- Repetition
- Impact on bundle size

Fight...

False type security

Hidden type loss ⇔ wasting time on debugging

```
export const stateMachine = Machine<Context, Schema, Events>({
  context: contextInitial,
  initial: "listAdvice",
  states: {
    Events: {
      Types of property 'on' are incompatible.
      Type '{ ""': { target: string; actions: AssignAction<Context, DeleteAdvice>; } }' is not assignable to type 'TransitionsConfig<Context, Events>'.
      Types of property '""' are incompatible.
      Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'string | number | StateNode<Context, any, Events> | TransitionConfig<Context, EventObject> | TransitionConfig<Context, EventObject>[] | undefined'.
      Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'undefined'. ts(2322)
    types.d.ts(368, 5): The expected type comes from property 'states' which is declared here on type 'MachineConfig<Context, { states: { listAdvice: {}; addAdvice: {}; deleteAdvice: { states: { confirm: {}; waitForDelete: {} }; }; }; }, Events>'
    Peek Problem  No quick fixes available
    deleteAdvice: {
      on: {
        """: {
          target: "listAdvice",
          actions: assign<Context, Events.DeleteAdvice>({
            list: (context, event) => context.list.filter(a => a.id !== event.id),
          }),
        },
      },
    },
  );
}
```

```
context: contextInitial,
initial: "listAdvice",
states: {
  Events: {
    Types of property 'on' are incompatible.
      Type '{ """: { target: string; actions: AssignAction<Context, DeleteAdvice>; }; }' is not assignable to type 'TransitionsConfig<Context, Events>'.
    Types of property '"""' are incompatible.
      Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'string | number | StateNode<Context, any, Events> | TransitionConfig<Context, EventObject> | TransitionConfig<Context, EventObject>[] | undefined'.
      Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'undefined'. ts(2322)
```

`types.d.ts(368, 5):` The expected type comes from property 'states' which is declared here on type 'MachineConfig<Context, { states: { listAdvice: {}; addAdvice: {}; deleteAdvice: { states: { confirm: {}; waitForDelete: {}; }; }; }, Events>'

Peek Problem No quick fixes available

```
deleteAdvice: {
  on: {
    """": {
      target: "listAdvice",
      actions: assign<Context, Events.DeleteAdvice>({
        list: (context, event) => context.list.filter(a => a.id !== event.id),
      }),
    },
  },
},
```

```
export const stateMachine = Machine<Context, Schema, Events>({
  context: contextInitial,
  initial: "listAdvice",
  states: {
    listAdvice: {
      on: {
        ADD_ADVICE: "addAdvice",
        DELETE_ADVICE: "deleteAdvice",
      },
    },
    addAdvice: {
      on: {
        SAVE_ADVICE: {
          target: "listAdvice",
          actions: assign({ list: (context, event) => [...context.list, event.wrongField] }),
        },
      },
    },
    deleteAdvice: {
      on: {
        "": {
          target: "listAdvice",
          actions: assign({ list: (context, event) => context.list.filter(a => a.id !== event.id) }),
        },
      },
    },
  },
});
```

any

Property 'wrongField' does not exist on type 'SaveAdvice' |
Property 'wrongField' does not exist on type 'SaveAdvice'

Peek Problem No quick fixes available

```
export const stateMachine = Machine<Context, Schema, Events>({  
  context: contextInitial,  
  initial: "listAdvice",  
  states: {  
    listAdvice: {  
      on: {  
        ADD_ADVICE: "addAdvice",  
        DELETE_ADVICE: "deleteAdvice",  
      },  
    },  
    addAdvice: {  
      on: {  
        SAVE_ADVICE: {  
          target: "listAdvice",  
          actions: assign({ list: (context, event) => [...context.list, event.advice] }),  
        },  
      },  
    },  
    deleteAdvice: {  
      on: {  
       "": {  
          target: "listAdvice",  
          actions: assign({ list: (context, event) => context.list.filter(a => a.id !== event.wrongField) }),  
        },  
      },  
    },  
  },  
})
```

A mistake!

```
export const stateMachine = Machine<Context, Schema, Events>({  
  context: contextInitial,  
  initial: "listAdvice",  
  states: { ←  
    listAdvice: {  
      on: {  
        ADD_ADVICE: "addAdvice",  
        DELETE_ADVICE: "deleteAdvice",  
      },  
    },  
    addAdvice: {  
      on: {  
        SAVE_ADVICE: {  
          target: "listAdvice",  
          actions: assign({ list: (context, event) => [...context.list, event.advice] }),  
        },  
      },  
    },  
    deleteAdvice: {  
      on: {  
        "": {  
          target: "listAdvice",  
          actions: assign<Context, Events.DeleteAdvice>({  
            list: (context, event) => context.list.filter(a => a.id !== event.wrongField),  
          }),  
        },  
      },  
    },  
  },  
});
```

Oh no, types broken!

Tighten types to catch
the error

```
export const stateMachine = Machine<Context, Schema, Events>({  
  context: contextInitial,  
  initial: "listAdvice",  
  states: {  
    Events: {  
      listAdvice: {  
        target: string;  
        actions: AssignAction<Context, DeleteAdvice>;  
      };  
      addAdvice: {  
        target: string;  
        actions: AssignAction<Context, CreateAdvice>;  
      };  
      deleteAdvice: {  
        target: string;  
        actions: AssignAction<Context, DeleteAdvice>;  
      };  
      confirm: {  
        target: string;  
        actions: AssignAction<Context, Confirm>;  
      };  
      waitForDelete: {  
        target: string;  
        actions: AssignAction<Context, Delete>;  
      };  
    },  
  },  
  Events: {  
    listAdvice: {  
      target: "listAdvice";  
      actions: assign<Context, Events.DeleteAdvice>({  
        list: (context, event) => context.list.filter(a => a.id !== event.id),  
      }),  
    },  
  },  
};
```

Still complaining!

Type '{ ""': { target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'TransitionsConfig<Context, Events>'.

Types of property '""' are incompatible.

Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'string | number | StateNode<Context, any, Events> | TransitionConfig<Context, EventObject> | TransitionConfig<Context, EventObject>[] | undefined'.

Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not assignable to type 'undefined'. ts(2322)

types.d.ts(368, 5): The expected type comes from property 'states' which is declared here on type 'MachineConfig<Context, { states: { listAdvice: {}; addAdvice: {}; deleteAdvice: { states: { confirm: {}; waitForDelete: {}; }; }; }, Events>'

Peek Problem No quick fixes available

```
deleteAdvice: {  
  on: {  
    "": {  
      target: "listAdvice",  
      actions: assign<Context, Events.DeleteAdvice>({  
        list: (context, event) => context.list.filter(a => a.id !== event.id),  
      }),  
    },  
  },  
},
```

Fixed the error

```
initial: "listAdvice",
states: {
  ...
  Types of property 'on' are incompatible.
    Type '{ """: { target: string; actions: AssignAction<Context, DeleteAdvice>; }; }' is not
  assignable to type 'TransitionsConfig<Context, Events>'.
  Types of property '""'' are incompatible.
    Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not
  assignable to type 'string | number | StateNode<Context, any, Events> | TransitionConfig<Context,
  eventObject> | TransitionConfig<Context, EventObject>[] | undefined'.
  Type '{ target: string; actions: AssignAction<Context, DeleteAdvice>; }' is not
  assignable to type 'undefined'. ts(2322)
```

```
types.d.ts(368, 5): The expected type comes from property 'states' which is declared here on type
MachineConfig<Context, { states: { listAdvice: {}; addAdvice: {}; deleteAdvice: { states: {
  confirm: {}; waitForDelete: {}; }; }; }, Events>'
```

week Problem No quick fixes available

```
deleteAdvice: {
  ...
  on: {
    """": {
      ...
      target: "listAdvice",
      actions: assign<Context, Events.DeleteAdvice>({
        ...
        list: (context, event) => context.list.filter(a => a.id !== event.id),
      }),
    }
  }
}
```

Someone ordered
undefined??

Hours spent on debugging and digging into
node_modules/@types/xstate

Or...

type proxy!

```
export const typeDeleteTransision = (tc: TransitionConfig<Context, Events.DeleteAdvice>) => tc;
```

```
export const stateMachine = Machine<Context, Events> {
    context: contextInitial,
    initial: "listAdvice",
    states: {
        listAdvice: {
            on: {
                A: {
                    D: {
                        ...
                    }
                }
            },
            addAdvice: {
                on: {
                    SAVE_ADVICE: {
                        target: "listAdvice",
                        actions: assign({ list: (context, event) => [...context.list, event.advice] })
                    }
                }
            }
        },
        deleteAdvice: {
            on: {
                "": typeDeleteTransision({
                    target: "listAdvice",
                    actions: assign({
                        list: (context, event) => context.list.filter(a => a.id !== event.id),
                    })
                })
            }
        }
    }
}
```

Type proxy defined

Still complaining

Type proxy used

Types of property 'deleteAdvice' are incompatible.

Type '{ on: { """: TransitionConfig<Context, DeleteAdvice>; }; }' is not assignable to type 'StateNodeConfig<Context, { states: { confirm: {}; waitForDelete: {}; }; }, Events>'.

Types of property 'on' are incompatible.

Type '{ """: TransitionConfig<Context, DeleteAdvice>; }' is not assignable to type 'TransitionsConfig<Context, Events>'.

Types of property '"""' are incompatible.

Type 'TransitionConfig<Context, DeleteAdvice>' is not assignable to type 'string | number | StateNode<Context, any, Events> | TransitionConfig<Context, EventObject> | TransitionConfig<Context, EventObject>[] | undefined'

Type 'TransitionConfig<Context, DeleteAdvice>' is not assignable to type 'TransitionConfig<Context, EventObject>'.

Types of property 'cond' are incompatible.

Type

'string | (Record<string, any> & { type: string; }) | ConditionPredicate<Context, DeleteAdvice> | GuardPredicate<Context, DeleteAdvice> | undefined'

is not assignable to type

'string | (Record<string, any> & { type: string; }) | ConditionPredicate<Context, EventObject> | GuardPredicate<Context, EventObject> | undefined'

Type 'ConditionPredicate<Context, DeleteAdvice>' is not assignable to type 'string | (Record<string, any> & { type: string; }) | ConditionPredicate<Context, EventObject> | GuardPredicate<Context, EventObject> | undefined'

Type 'ConditionPredicate<Context, DeleteAdvice>' is not assignable to type 'ConditionPredicate<Context, EventObject>'.

Type 'EventObject' is not assignable to type 'DeleteAdvice'.

Type 'ConditionPredicate<Context, DeleteAdvice>' is not assignable to type
'ConditionPredicate<Context, EventObject>'.

Type 'EventObject' is not assignable to type 'DeleteAdvice'.



Aha!

```
export const typeDeleteTransision = (tc: TransitionConfig<Context, Events.DeleteAdvice | EventObject>) => tc;
```

```
export const stateMachine = Machine<Context, Schema, Events>({
```

```
  context: contextInitial,
```

```
  initial: "listAdvice",
```

```
  states: {
```

```
    listAdvice: {
```

```
      on: {
```

```
        ADD_ADVICE: "addAdvice",
```

```
        DELETE_ADVICE: "deleteAdvice",
```

```
      },
```

```
    },
```

```
    addAdvice: {
```

```
      on: {
```

```
        SAVE_ADVICE: {
```

```
          target: "listAdvice",
```

```
          actions: assign({ list: (context, event) => [...context.list, event.advice] }),
```

```
        },
```

```
      },
```

```
    deleteAdvice: {
```

```
      on: {
```

```
       "": typeDeleteTransision({
```

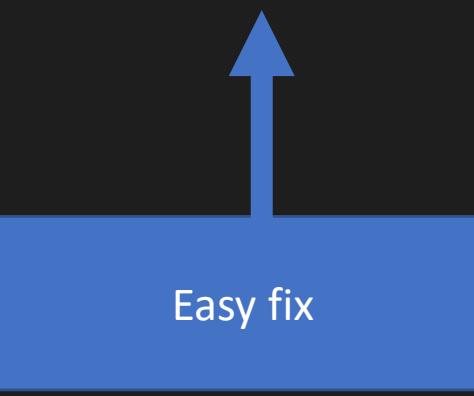
```
          target: "listAdvice",
```

```
          actions: assign({
```

```
            list: (context, event) => context.list.filter(a => a.id !== event.id),
```

```
          }),
```

```
        })
```



Easy fix



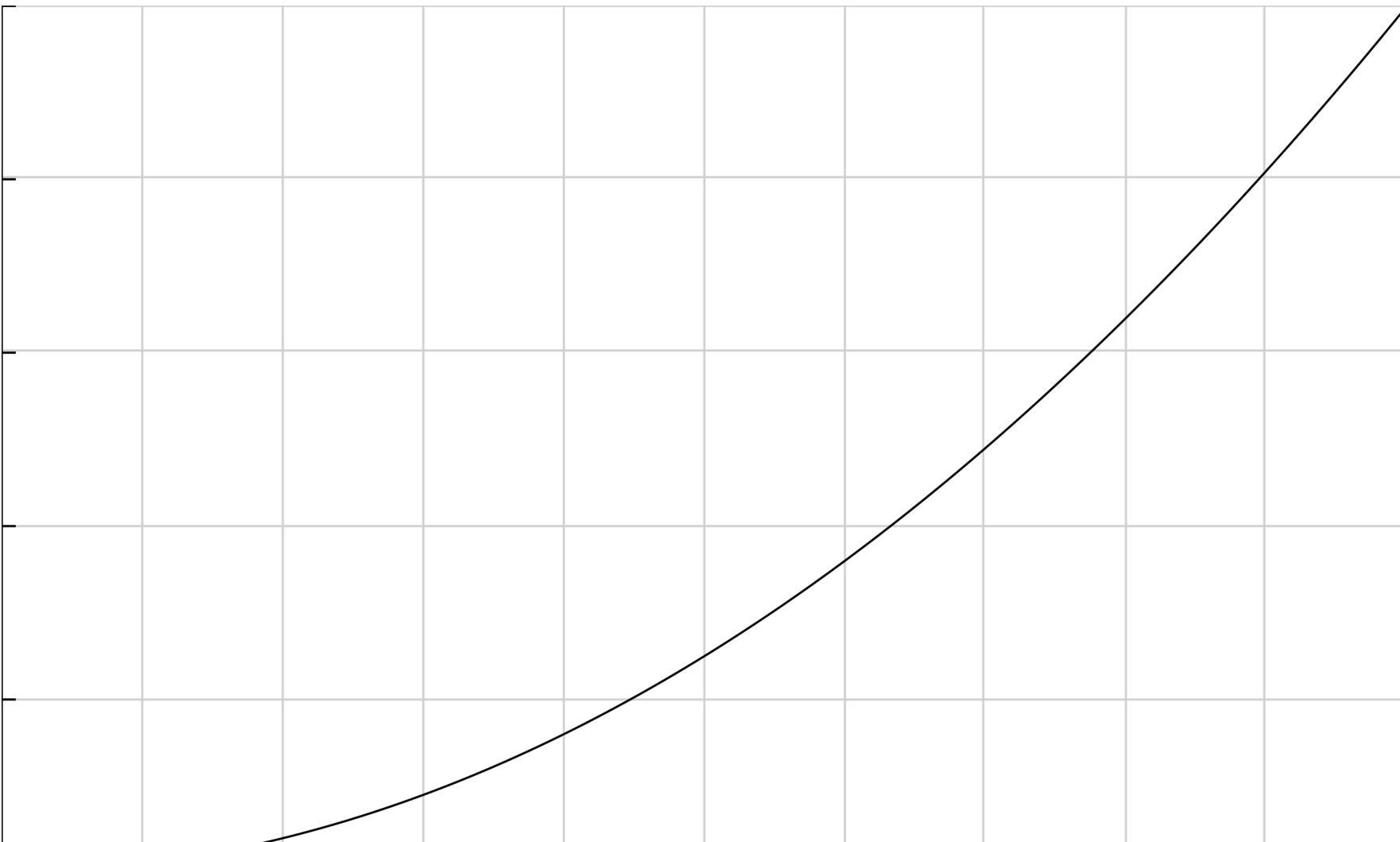
“Too big or not too big?”



“Your functions are always too big”



Error message complexity



Distance between type definition and check

Fight... False type security ...

TypeScript on input data boundary

TypeScript = compile-time only

TypeScript = ~~compile-time only~~
compile + runtime

TypeScript = ~~compile time only~~ compile + runtime

 README.md

typescript-json-schema

Generate json-schemas from your TypeScript sources.

Features

- Compiles your TypeScript program to get complete type information.
- Translates required properties, extends, annotation keywords, property initializers as defaults. You can find more features in the [test examples](#).

Usage

Command line

- Install with `npm install typescript-json-schema -g`
- Generate schema from a TypeScript type: `typescript-json-schema project/directory/tsconfig.json T`

To generate files for only *some* types in `tsconfig.json` specify filenames or globs with the `--include` option especially useful for large projects.

In case no `tsconfig.json` is available for your project, you can directly specify the `.ts` files (this is in this case without built-in compiler presets):

- Generate schema from a TypeScript type: `typescript-json-schema "project/directory/**/*.ts" TYPE`

The `TYPE` can either be a single, fully qualified type or `"*"` to generate the schema for all types.

 README.md

typescript-is

TypeScript transformer that generates run-time type-checks.

Installation

```
npm install --save typescript-is

# Ensure you have the required dependencies at compile time:
npm install --save-dev typescript

# If you want to use the decorators, ensure you have reflect-metadata in your dependencies:
npm install --save reflect-metadata
```

Use cases

If you've worked with [TypeScript](#) for a while, you know that sometimes you obtain `any` or `unknown` data that is not type-safe. You'd then have to write your own function with [type predicates](#) that checks the foreign object, and makes sure it is the type that you need.

This library automates writing the type predicate function for you.

At compile time, it inspects the type you want to have checked, and generates a function that can check the type of a wild object at run-time. When the function is invoked, it checks in detail if the given wild object complies with your favorite type.

```
export type wise_operation = wise_send_voteorder_operation | wise_set_rules_operation;

export type wise_send_voteorder_operation = ["v2:send_voteorder", wise_send_voteorder];
export type wise_set_rules_operation = ["v2:set_rules", wise_set_rules];

export interface wise_set_rules {
  voter: string;
  description?: string;
  rulesets: [string, wise_rule[][]][];
}

export interface wise_send_voteorder {
  delegator: string;
  ruleset: string;
  permlink: string;
  author: string;

  /**
   * Vote / flag weight
   *
   * @minimum -10000
   * @maximum 10000
   * @TJS-type integer
   */
  weight: number;
}
```

Modelling JSON-schema with
Typescript interfaces

```
$ typescript-json-schema --out "schema.json" tsconfig.json "wise_operation"
```

```
{  
  "$schema": "http://json-schema.org/draft-07/schema#",  
  "anyOf": [{  
    "additionalItems": {  
      "anyOf": [{  
        "enum": [  
          "v2:send_voteorder"  
        ],  
        "type": "string"  
      },  
      {  
        "$ref": "#/definitions/wise_send_voteorder"  
      }  
    ]  
  },  
  "items": [{  
    "enum": [  
      "v2:send_voteorder"  
    ],  
    "type": "string"  
  },  
  {  
    "$ref": "#/definitions/wise_send_voteorder"  
  }  
],  
  "minItems": 2,  
  "type": "array"  
},
```

Generated JSON-schema can be used with any validator
(available for almost all programming langs)

```
import { is } from "typescript-is";

type AllowedTransactionType = "get_account_history" | "get_block" | "get_head";

export interface BlockchainRequest {
    account: string;
    transactions: [AllowedTransactionType, object][]; 
}

function evilRequestMock(): any {
    return { account: "jblew", transactions: ["transfer_funds", { from: "jblew", to: "hacker" }] };
}

function executeRequest(req: BlockchainRequest) {
    if (!is<BlockchainRequest>(req)) throw new Error("Wrong blockchain request");
    console.log("Executing", req);
}

const request = evilRequestMock();
executeRequest(request);
```

TypeScript-is = runtime validation

```
function executeRequest(req) {
    if (!typescript_is_1.is(req, function (object) {
        var path = ["$"];

        function _string(object) {
            if (typeof object !== "string")
                return "validation failed at " + path.join("");
            else
                return null;
        }

        function _78(object) {
            if (object !== "get_account_history")
                return "validation failed at " + path.join(".") + ": expected string 'get_account_history'";
            else
                return null;
        }

        function _80(object) {
            if (object !== "get_block")
                return "validation failed at " + path.join(".") + ": expected string 'get_block'";
            else
                return null;
        }

        function _82(object) {
            if (object !== "get_head")
                return "validation failed at " + path.join(".") + ": expected string 'get_head'";
            else
                return null;
        }

        if (typescript_is_1.is(req, function (object) {
            if (object === "get_account_history")
                return _string;
            else if (object === "get_block")
                return _78;
            else if (object === "get_head")
                return _82;
            else
                return null;
        })) {
            var type = req.type;
            if (type === "string")
                return _string;
            else if (type === "number")
                return _78;
            else if (type === "block")
                return _82;
            else
                return null;
        }
    })) {
        var type = req.type;
        if (type === "string")
            return _string;
        else if (type === "number")
            return _78;
        else if (type === "block")
            return _82;
        else
            return null;
    }
}
```

Code generated by typescript-is

Problem?

Requires ttypescript which is a wrapper around
tsc compiler

TypeScript-json-schema

- Great interoperability
- Use by external validators
- Additional build step
- Slow
- Big footprint of validation libraries (ajv is 300kB)

TypeScript-is

- Fast
- Small footprint (generated code + typescript-is = 1.8kB)
- Only inside ttypescript enabled projects

Fight false type security with...

Nominal typing

```
export interface Patient {
  uid: string;
  name: string;
}

export interface Doctor {
  uid: string;
  name: string;
}

function assignDoctorToPatient(doctorUid: string, patientUid: string) {}

const doctor = fetchDoctor();
const patient = fetchPatient();

assignDoctorToPatient(doctor.uid, patient.uid); // OK
assignDoctorToPatient(patient.uid, doctor.uid); // Ooops! Compiler had no chance to protect us from this error
```

A helper...

```
export type Nominal<TEntity, TLiteral>
  = TEntity & { _typeLiteral: TLiteral };
```

```
export type Nominal<TEntity, TLiteral> = TEntity & { _typeLiteral: TLiteral };

export type PatientUid = Nominal<string, "patient">;
export interface Patient {
    uid: PatientUid;
    name: string;
}

export type DoctorUid = Nominal<string, "doctor">;
export interface Doctor {
    uid: DoctorUid;
    name: string;
}

function assignDoctorToPatient(doctorUid: DoctorUid, patientUid: PatientUid) {}

const doctor = fetchDoctor();
const patient = fetchPatient();

assignDoctorToPatient(doctor.uid, patient.uid); // OK
assignDoctorToPatient(patient.uid, doctor.uid); // error! Type '"patient"' is not assignable to type '"doctor"'!
```

Helper applied

Blessed Error!

Fight false type security with...

Typing globals in ambient space

```
// environment.d.ts

declare namespace NodeJS {
  interface ProcessEnv {
    BASE_URL: string;
    NODE_ENV: "production" | "development";
  }
}

// or

declare global {
  interface Window {
    HOST_ENVIRONMENT: "production" | "preprod" | "staging";
    FIREBASE_CONFIG: FirebaseConfig;
  }
}
```

Process.env and window are now strongly typed across all submodules of the project

- No additional dependencies
- No boundary crossing
- Mergeable declarations

Fight...

Verbosity

Fight verbosity

The problem of enums

```
enum OperationType {  
  READ,  
  WRITE,  
}
```

Elegant

```
// generated code  
var OperationType;  
(function(OperationType) {  
  OperationType[(OperationType["READ"] = 0)] = "READ";  
  OperationType[(OperationType["WRITE"] = 1)] = "WRITE";  
}((OperationType = exports.OperationType || (exports.OperationType = {}))));
```

- Much boilerplate
- Impact on bundle size

```
// effective value of OperationType object  
var OperationType = { "0": "READ", "1": "WRITE", READ: 0, WRITE: 1 };
```

```
enum OperationType {  
    CREATE,  
    READ,  
    WRITE,  
}
```

```
// generated code  
var OperationType;  
(function(OperationType) {  
    OperationType[(OperationType["CREATE"] = 0)] = "CREATE";  
    OperationType[(OperationType["READ"] = 1)] = "READ";  
    OperationType[(OperationType["WRITE"] = 2)] = "WRITE";  
})((OperationType = exports.OperationType || (exports.OperationType = {})));
```

Oops, now READ = 1 !

Numeric enums are hard to debug

```
export enum OperationType {  
    CREATE = "create",  
    READ = "read",  
    WRITE = "write",  
}
```

Our API now accepts strings

```
// generated code  
var OperationType;  
(function(OperationType) {  
    OperationType["CREATE"] = "create";  
    OperationType["READ"] = "read";  
    OperationType["WRITE"] = "write";  
}((OperationType = exports.OperationType || (exports.OperationType = {})));//  
  
/**  
 * Surprise! Generated code is smaller than in numeric enums.  
 *  
 * 292B vs 235B = ** 20% saved **  
*/
```

```
export enum OperationType {  
    CREATE = "crate",  
    READ = "read",  
    WRITE = "write",  
}
```

Oops...

This error is going to be discovered by
integration testing...
... or production testing

```
// generated code  
var OperationType;  
(function(OperationType) {  
    OperationType["CREATE"] = "crate";  
    OperationType["READ"] = "read";  
    OperationType["WRITE"] = "write";  
})((OperationType = exports.OperationType || (exports.OperationType = {})));
```

```
/**  
 * Surprise! Generated code is smaller than in numeric enums.  
 */
```

```
declare function sendOperation(op: { type: "create" | "read" | "write" });

export const OperationType = {
  create: "create",
  read: "read",
  write: "write",
};

sendOperation({ type: OperationType.create });

/*
typeof OperationType = {
  create: string;
  read: string;
  write: string;
};
*/
```

Objects to rescue

Error: 'string' is not assignable to type
"create" | "read" | "write"

Bonus!
Very small footprint

```
declare function sendOperation(op: { type: "create" | "read" | "write" });

export const OperationType = {
  create: "create" as "create",
  read: "read" as "read",
  write: "write" as "write",
};

sendOperation({ type: OperationType.create });

/*
typeof OperationType = {
  create: "create";
  read: "read";
  write: "write";
};
*/
```

Works.

```
declare function sendOperation(op: { type: "create" | "read" | "write" });
```

```
export const OperationType = {  
  create: "delete" as "create",  
  read: "read" as "read",  
  write: "write" as "write",  
};
```

```
sendOperation({ type: OperationType.create });
```

```
/*  
typeof OperationType = {  
  create: "create";  
  read: "read";  
  write: "write";  
};
```

Also works.

```
declare function sendOperation(op: { type: "create" | "read" | "write" });

export const OperationType = {
  create: "create",
  read: "read",
  write: "write",
} as const;

sendOperation({ type: OperationType.create });

/*
typeof OperationType = {
  create: "create";
  read: "read";
  write: "write";
};

*/
```

Less repetitions. “delete” no longer possible

Still verbose...

Is that all we can achieve?

```
// source: https://github.com/Hotell/rex-tils/ Thank you!
type UnionFromTuple<T> = T extends Array<infer U> ? U : never;

export const Enum = <T extends string[]>(...args: T) => {
    return args.reduce((acc, next) => {
        return {
            ...acc,
            [next]: next,
        };
    }, Object.create(null)) as { [P in UnionFromTuple<typeof args>]: P };
};
```

A literal generator!

```
declare function sendOperation(op: { type: OperationType });

export const OperationType = Enum( "create", "read", "write" )
export type OperationType = keyof typeof OperationType

sendOperation({ type: OperationType.create });

/*
typeof OperationType = {
  create: "create";
  read: "read";
  write: "write";
};

type OperationType = "create" | "read" | "write"
*/
```

So clean! So short!

Smallest footprint if app has many enums!

All mistakes are visible

Fight verbosity with...

Optional chaining (TS 3.7)

```
interface Label {  
  excercise?: {  
    respiratory?: {  
      comment?: string;  
    };  
    stretching?: {  
      comment?: string;  
    };  
  };  
}  
  
interface Sample {  
  label?: Label;  
  chunks: [string, Chunk][];  
}  
  
function getExcerciseComments(sample: Sample) {  
  const respiratoryComment =  
    sample.label &&  
    sample.label.excercise &&  
    sample.label.excercise.respiratory &&  
    sample.label.excercise.respiratory.comment;  
  
  const stretchingComment = // ... the same  
  
  return `${respiratoryComment || ""} ${stretchingComment || ""}`;  
}  
// Very ugly!
```

They are part of every JS app...

```
interface Label {  
  excercise?: {  
    respiratory?: {  
      comment?: string;  
    };  
    stretching?: {  
      comment?: string;  
    };  
  };  
}  
  
interface Sample {  
  label?: Label;  
  chunks: [string, Chunk][];  
}  
  
function getExcerciseComments(sample: Sample) {  
  const respiratoryComment = sample.label?.excercise?.respiratory?.comment;  
  const stretchingComment = sample.label?.excercise?.stretching?.comment;  
  
  return `${respiratoryComment || ""} ${stretchingComment || ""}`;  
}  
// Can be inputed so quickly!
```

Optional chaining

Optional chaining of functions

```
function getLogger(  
  properties: {  
    remote?: {  
      levelResolver?: (levelName: string) => boolean  
    }  
  }  
) {  
  const shouldPrintLog = properties.remote?.levelResolver?("warn") === true;  
  // ...  
}
```

```
// generated JS  
function getLogger(properties) {  
  var _a, _b, _c;  
  var shouldPrintLog = ((_c = (_a = properties.remote) === null || _a === void 0 ? void 0  
    : (_b = _a).levelResolver) === null || _c === void 0 ? void 0 : _c.call(_b, "warn")) === true;  
}
```

Fight verbosity with...

Nullish Coalescing (TS 3.7)

```
enum LogLevel {
  ERROR = 0,
  WARN = 1,
  INFO = 2,
}

function log(msg: string, config: { level?: number } = {}) {
  const level = config.level || LogLevel.INFO;

  console.log(`[${LogLevel[level]}] ${msg}`);
}

log("Critical failure", { level: LogLevel.ERROR });
```

Can you spot the mistake?

```
enum LogLevel {  
    ERROR = 0,  
    WARN = 1,  
    INFO = 2,  
}  
  
function log(msg: string, config: { level?: number } = {}) {  
    const level = config.level || LogLevel.INFO;  
  
    console.log(`[${LogLevel[level]}] ${msg}`);  
}  
  
log("Critical failure", { level: LogLevel.ERROR });
```

Can you spot the mistake?

Prints '[INFO] ...'

```
enum LogLevel {  
    ERROR = 0,  
    WARN = 1,  
    INFO = 2,  
}  
  
function log(msg: string, config: { level?: number } = {}) {  
    const level = config.level || LogLevel.INFO;  
  
    console.log(`[${LogLevel[level]}] ${msg}`);  
}  
  
log("Critical failure", { level: LogLevel.ERROR });
```

Can you spot the mistake?

ERROR = 0
0 = Falsy

```
enum LogLevel {
  ERROR = 0,
  WARN = 1,
  INFO = 2,
}

function log(msg: string, config: { level?: number } = {}) {
  const level = config.level !== undefined ? config.level : LogLevel.INFO;

  console.log(`[${LogLevel[level]}] ${msg}`);
}

log("Critical failure", { level: LogLevel.ERROR });
```

Fixed, but ugly

```
enum LogLevel {
  ERROR = 0,
  WARN = 1,
  INFO = 2,
}

function log(msg: string, config: { level?: number } = {}) {
  const level = config.level ?? LogLevel.INFO;

  console.log(`[${LogLevel[level]}] ${msg}`);
}

log("Critical failure", { level: LogLevel.ERROR });
```

`??` = nullish coalescing

Fight...

Repetitions

Stay DRY

Fight repetitions with...

Extracting types

```
interface ChatMessage {  
  id: string;  
  timestamp: number;  
  entityType: "chat_message";  
  msg: string;  
}  
  
export function createChatMessage(msg: string): ChatMessage {  
  return {  
    id: uuid(),  
    timestamp: Date.now(),  
    entityType: "chat_message",  
    msg,  
  };  
}
```

Verbose and explicit

```
function createChatMessage(msg: string) {  
    return {  
        id: uuid(),  
        timestamp: Date.now(),  
        entityType: "chat_message",  
        msg,  
    };  
}  
  
export type ChatMessage = ReturnType<typeof createChatMessage>;  
/*  
type ChatMessage = {  
    id: string;  
    timestamp: number;  
    entityType: string;  
    msg: string;  
}  
*/
```

Less typing

We are missing a type!

```
function createChatMessage(msg: string) {  
    return {  
        id: uuid(),  
        timestamp: Date.now(),  
        entityType: "chat_message",  
        msg,  
    };  
}  
  
export type ChatMessage = ReturnType<typeof createChatMessage>;  
/*  
type ChatMessage = {  
    id: string;  
    timestamp: number;  
    entityType: string;  
    msg: string;  
}  
*/  
  
export type ChatMessageEntityType = ChatMessage["entityType"]  
// type ChatMessageEntityType = string
```



We are missing a type!

```
function createChatMessage(msg: string) {
  return {
    id: uuid(),
    timestamp: Date.now(),
    entityType: "chat_message",
    msg,
  } as const;
}

export type ChatMessage = ReturnType<typeof createChatMessage>;
/*
type ChatMessage = {
  id: string;
  timestamp: number;
  entityType: string;
  msg: string;
}
*/
export type ChatMessageEntityType = ChatMessage["entityType"];
// type ChatMessageEntityType = "chat_message"
```

As const fixed the literal

```
const colors = {  
  red: "#ff0000" as const,  
  green: "#00ff00",  
  blue: "#0000ff",  
};
```

```
/*typeof colors = {  
  red: "#ff0000";  
  green: string;  
  blue: string;  
}  
*/
```

Can be used on a single property as well

Fight repetitions

What if an external library doesn't provide you with the type you want?

```
import * as firebase from "firebase/app"  
  
firebase.firestore().doc() // => returns DocumentReference  
  
type FirebaseDocumentReference = ?
```

We want it bad...

```
import * as firebase from "firebase/app"  
  
firebase.firestore().doc() // => returns DocumentReference  
  
type DatabaseReference = ?
```

We want it bad...

We can get it using lookup types!

```
import * as firebase from "firebase/app"  
  
firebase.firestore().doc() // => returns DocumentReference
```

We can get it using lookup types!

```
type FirebaseFirestoreGenerator = (typeof firebase)["firestore"]
```

```
// note that these string literals up there are also type checked  
type FirebaseFirestoreGenerator = (typeof firebase)["wrong_firestore"] // => Err: Property does not exist on type
```

```
import * as firebase from "firebase/app"  
  
firebase.firestore().doc() // => returns DocumentReference
```

We can get it using lookup types!

```
type FirebaseFirestoreGenerator = (typeof firebase)["firestore"]
```

```
// note that these string literals up there are also type checked  
type FirebaseFirestoreGenerator = (typeof firebase)["wrong_firestore"] // => Err: Property does not exist on type
```

```
import * as firebase from "firebase/app"

firebase.firestore().doc() // => returns DocumentReference

// type FirebaseFirestoreGenerator = (typeof firebase)["firestore"]

type FirebaseFirestore = ReturnType<(typeof firebase)["firestore"]>
```

```
import * as firebase from "firebase/app"

firebase.firestore().doc() // => returns DocumentReference

type FirebaseFirestore = ReturnType<(typeof firebase)["firestore"]>
type FirebaseDocumentReference = ReturnType<FirebaseFirestore["doc"]>
// success!

// oneliner:
type FirebaseDocumentReference = ReturnType<ReturnType<(typeof firebase)["firestore"]>["doc"]>;
```

What if we want a type of a
function argument?

```
import { as Function } from "Function"
Function.Function().as() // or return FunctionReference

type FunctionFactory = Returns<
    FunctionReference | Returns<any>
>; // success

// error cases
type FunctionReferenceFactory = Returns<any> & Function("Function")<"new">
```

```
import * as admin from "firebase-admin";  
  
admin.initializeApp({ // config as an argument  
  projectId: "some-id",  
});
```

We want the configuration type to strongly type our config file!

```
import * as admin from "firebase-admin";

admin.initializeApp({ // config as an argument
  projectId: "some-id",
});

type FirebaseAdminType = (typeof admin)["initializeApp"];
type FirebaseAdminParameters = Parameters<(typeof admin)["initializeApp"]>;

// type FirebaseAdminParameters
//       = [(admin.AppOptions | undefined)?, (string | undefined)?]
```

Parameters<> helper!

```
import * as admin from "firebase-admin";

admin.initializeApp({ // config as an argument
  projectId: "some-id",
});

type FirebaseAdminType = (typeof admin)["initializeApp"];
type FirebaseAdminParameters = Parameters<(typeof admin)["initializeApp"]>;
// type FirebaseAdminParameters
//     = [(admin.AppOptions | undefined)?, (string | undefined)?]

type FirebaseAdminConfig_ = Parameters<(typeof admin)["initializeApp"]>[0];
// typeof FirebaseAdminConfig_ = admin.AppOptions | undefined

type FirebaseAdminConfig = NonNullable<Parameters<(typeof admin)["initializeApp"]>[0]>;
// typeof FirebaseAdminConfig_ = admin.AppOptions
```

Another helper: NonNullable<>!

Fight repetitions with...

Shipping type containers using
conditional-infer

```
export interface AppMachine<  
    TContext,  
    TSchema,  
    TEvent extends EventObject,  
    TGetter extends { [x: string]: any }  
> {  
    (  
        vueInstance: Vue,  
        ): AppMachineAccessor<TContext, TEvent, TGetter>  
        id: string  
        stateMachine: StateMachine<TContext, TSchema, TEvent>  
        getters: MachineGetters.Definitions<TGetter, TContext, TEvent>  
    )  
}
```

So many generics!

Even more of them
And
... many repetitions

```
export interface AppInterpretedMachine<  
    ID_TYPE extends string,  
    TContext, TSchema,  
    TEvent extends EventObject, TGetter extends { [x: string]: any }  
> {  
    appMachine: AppMachine<TContext, TSchema, TEvent, TGetter> & { id: ID_TYPE; };  
    interpreter: Interpreter<TContext, TSchema, TEvent> & { id: ID_TYPE; };  
}  
  
export function make<  
    ID_TYPE extends string,  
    TContext, TSchema,  
    TEvent extends EventObject, TGetter extends { [x: string]: any }  
>(  
    appMachine: AppMachine<TContext, TSchema, TEvent, TGetter> & { id: ID_TYPE },  
    interpreter: Interpreter<TContext, TSchema, TEvent> & { id: ID_TYPE; },  
>: AppInterpretedMachine<ID_TYPE, TContext, TSchema, TEvent, TGetter> {  
    return Object.freeze({  
        appMachine,  
        interpreter,  
    });  
}
```

Let's refactor!

```
export interface AppMachine<  
    TContext,  
    TSchema,  
    TEvent extends EventObject,  
    TGetter extends { [x: string]: any }  
> {  
    (  
        vueInstance: Vue,  
        ): AppMachineAccessor<TContext, TEvent, TGetter>  
        id: string  
        stateMachine: StateMachine<TContext, TSchema, TEvent>  
        getters: MachineGetters.Definitions<TGetter, TContext, TEvent>  
    }  
  
export type AppMachineInfer<T> = T extends AppMachine<  
    infer TContext,  
    infer TSchema,  
    infer TEvent,  
    infer TGetter  
>  
    ? {  
        context: TContext  
        schema: TSchema  
        event: TEvent  
        getter: TGetter  
    }  
    : never
```

Type container

For given AppMachine returns a type

Of an object

That will never exist

... but if it existed

It would hold a types for all generics

(easily accessible via lookups)

```
export type AppMachineInfer<T> = T extends AppMachine<
  infer TContext,
  infer TSchema,
  infer TEvent,
  infer TGetter
>
? {
  context: TContext
  schema: TSchema
  event: TEvent
  getter: TGetter
}
: never
```

```
const sidebarUIMachine: AppMachine<...>

type Getter = AppMachineInfer<typeof sidebarUIMachine>["getter"]
type Context = AppMachineInfer<typeof sidebarUIMachine>["context"]
```

We can quickly infer any of the
subtypes
All around our app

```
export interface AppInterpretedMachine<  
    ID_TYPE extends string,  
    TContext, TSchema,  
    TEvent extends EventObject, TGetter extends { [x: string]: any }  
> {  
    appMachine: AppMachine<TContext, TSchema, TEvent, TGetter> & { id: ID_TYPE; };  
    interpreter: Interpreter<TContext, TSchema, TEvent> & { id: ID_TYPE; };  
}  
  
export function make<  
    ID_TYPE extends string,  
    TContext, TSchema,  
    TEvent extends EventObject, TGetter extends { [x: string]: any }  
>(  
    appMachine: AppMachine<TContext, TSchema, TEvent, TGetter> & { id: ID_TYPE },  
    interpreter: Interpreter<TContext, TSchema, TEvent> & { id: ID_TYPE },  
>: AppInterpretedMachine<ID_TYPE, TContext, TSchema, TEvent, TGetter> {  
    return Object.freeze({  
        appMachine,  
        interpreter,  
    });  
}
```

Let's apply our container to
AppInterpretedMachine

```
export interface AppInterpretedMachine<
  TIdType extends string,
  TAppMachine extends AppMachine<any, any, any, any>> {
  appMachine: TAppMachine & { id: TIdType }
  interpreter: Interpreter<
    AppMachineInfer<TAppMachine>['context'],
    AppMachineInfer<TAppMachine>['schema'],
    AppMachineInfer<TAppMachine>['event']
  > & { id: TIdType }
}

export function make<
  ID_TYPE extends string,
  TAppMachine extends AppMachine<any, any, any, any>> {
  appMachine: TAppMachine & { id: ID_TYPE },
  interpreter: Interpreter<
    AppMachineInfer<TAppMachine>['context'],
    AppMachineInfer<TAppMachine>['schema'],
    AppMachineInfer<TAppMachine>['event']
  > & { id: ID_TYPE },
): AppInterpretedMachine<ID_TYPE, TAppMachine> {
  return Object.freeze({
    appMachine,
    interpreter,
  })
}
```

Reduced

Reduced

Reduced

```
type InterpreterOfMachine<T extends AppMachine<any, any, any, any>>
= Interpreter<AppMachineInfer<T>['context'], AppMachineInfer<T>['schema'], AppMachineInfer<T>['event']>

export interface AppInterpretedMachine<
  TIdType extends string,
  TAppMachine extends AppMachine<any, any, any, any>
> {
  appMachine: TAppMachine & { id: TIdType }
  interpreter: InterpreterOfMachine<TAppMachine> & { id: TIdType }
}

export function make<
  ID_TYPE extends string,
  TAppMachine extends AppMachine<any, any, any, any>
>(
  appMachine: TAppMachine & { id: ID_TYPE },
  interpreter: InterpreterOfMachine<TAppMachine> & { id: ID_TYPE },
): AppInterpretedMachine<ID_TYPE, TAppMachine> {
  return Object.freeze({
    appMachine,
    interpreter,
  })
}
```

Interpreted machine
pulled up

```
type IdentifiedAppMachine<  
  ID_TYPE extends string,  
  TAppMachine extends AppMachine<any, any, any, any>  
> = TAppMachine & { id: ID_TYPE }  
  
type IdentifiedInterpreterOfMachine<T extends IdentifiedAppMachine<any, any>>  
= Interpreter<AppMachineInfer<T>['context'], AppMachineInfer<T>['schema'], AppMachineInfer<T>['event']>  
& { id: T["id"] }  
  
export interface AppInterpretedMachine<T extends IdentifiedAppMachine<any, any>> {  
  appMachine: T  
  interpreter: IdentifiedInterpreterOfMachine<T>  
}  
  
export function make<T extends IdentifiedAppMachine<any, any>>(  
  appMachine: T,  
  interpreter: IdentifiedInterpreterOfMachine<T>,  
>: AppInterpretedMachine<T> {  
  return Object.freeze({  
    appMachine,  
    interpreter,  
  })  
}
```

Finally... we can see
the code!

Fight repetitions with...

Assertion functions (new in TS 3.7)

```
interface VaultSecretResponse {  
  data: { secret: string; hash: string };  
}  
  
interface VaultPolicyResponse {  
  data: { policy: object };  
}  
  
type VaultResponse = VaultSecretResponse | VaultPolicyResponse;  
  
declare class Vault {  
  getSecret(name: string): Promise<string>;  
  private getValue(path: string): Promise<{ data: any }>;  
  
  private validateSecretResponse(response: VaultResponse);  
}
```

The stage,
The actors,
The types

```
interface VaultSecretResponse { data: { secret: string; hash: string }; }
interface VaultPolicyResponse { data: { policy: object }; }
type VaultResponse = VaultSecretResponse | VaultPolicyResponse;

class Vault {
    async getSecret(name: string): Promise<string> {
        const response = await this.getValue(`v1/secret/${name}`);
        this.validateSecretResponse(response);

        if ((response as VaultSecretResponse).data.secret) {
            return (response as VaultSecretResponse).data.secret;
        } else {
            throw new Error("Dont care about message, this error will be never thrown");
        }
    }

    private validateSecretResponse(response: VaultResponse) {
        if (!(response as VaultSecretResponse).data.secret) throw new Error("Invalid vault response: missing secret");
        if (!(response as VaultSecretResponse).data.hash) throw new Error("Invalid vault response missing hash");
        // ... some other validations
    }
}
```

TypeScript imposes
this `if` on us

But we already
checked!

```
interface VaultSecretResponse { data: { secret: string; hash: string }; }
interface VaultPolicyResponse { data: { policy: object }; }
type VaultResponse = VaultSecretResponse | VaultPolicyResponse;

class Vault {
    async getSecret(name: string): Promise<string> {
        const response = await this.getValue(`v1/secret/${name}`);

        if (this.isValidSecretResponse(response)) {
            return (response as VaultSecretResponse).data.secret;
        } else {
            throw new Error("Vault secret response is invalid");
        }
    }

    private isValidSecretResponse(response: VaultResponse): response is VaultSecretResponse {
        return !(response as VaultSecretResponse).data.secret && !(response as VaultSecretResponse).data.hash;
    }
}
```

Using type guard

We lost the detailed
error messages

```
interface VaultSecretResponse { data: { secret: string; hash: string }; }
interface VaultPolicyResponse { data: { policy: object }; }
type VaultResponse = VaultSecretResponse | VaultPolicyResponse;

class Vault {
    async getSecret(name: string): Promise<string> {
        const response = await this.getValue(`v1/secret/${name}`);
        this.validateSecretResponse(response);

        // compiler now knows that data.secret is checked and not undefined
        return response.data.secret;
    }

    private validateSecretResponse(response: VaultResponse): asserts response is VaultSecretResponse {
        if (!(response as VaultSecretResponse).data.secret) throw new Error("Invalid vault response: missing secret");
        if (!(response as VaultSecretResponse).data.hash) throw new Error("Invalid vault response missing hash");
    }
}
```

This is an assert function

Fight repetitions with...

Appending types to external
libraries

```
// I am sometimes using it a lot
CombinedVueInstance<any, any, any, any, any>
```

```
// So I create a typings.d.ts file somewhere in my /src
import Vue from 'vue'
import { CombinedVueInstance } from 'vue/types/vue'

declare module 'vue' {
  export type AnyVueInstance = CombinedVueInstance<Vue, any, any, any, any>
}

// AnyVueInstance accessible across the app
import Vue, { AnyVueInstance } from 'vue'

export type DispatcherFn<PAYLOAD_TYPE> = (
  dispatchFn: Dispatch | AnyVueInstance,
  payload: PAYLOAD_TYPE,
) => ReturnType<Dispatch>;
```

```
// Before
export interface EpicActions {
    initialize(): ThunkAction<Promise<InitializeAction>, ContainingStoreState>;
    logout(): ThunkAction<Promise<LogoutAction>, ContainingStoreState>;
    checkRole(role: string): ThunkAction<Promise<CheckRoleAction>, ContainingStoreState>;
}

// thunk.d.ts
import { ContainingStoreState } from "./ContainingStoreState";

declare module "redux-thunk" {
    export type AsyncThunk<A extends Action> = ThunkAction<Promise<A>, ContainingStoreState, {}, A>;
}

//After applying thunk.d.ts
import { AsyncThunk } from "redux-thunk";

export interface EpicActions {
    initialize(): AsyncThunk<InitializeAction>;
    logout(): AsyncThunk<LogoutAction>;
    checkRole(role: string): AsyncThunk<CheckRoleAction>;
}
```

```
// extend-vue.d.ts
declare module "vue/types/vue" {
    interface Vue {
        $showSnackbar: (msg: string) => void;
    }
}
```

```
ERROR in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/node_modules/firestore-roles-vuex-module/dist/module/RolesAuthModule.d.ts
1:10 Module '"vue/types/vue"' has no exported member 'CombinedVueInstance'.
> 1 | import { CombinedVueInstance } from "vue/types/vue";
|   ^
2 | import { Action as VuexAction, ActionContext as VuexActionContext, Dispatch } from "vuex";
3 | import { Account } from "../Account";
4 | declare type ActionFn = VuexAction<RolesAuthModule.State, RolesAuthModule.State>;
```

```
[error] in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/node_modules/vuex-notifications-module/dist/NotificationsModule.d.ts
```

```
ERROR in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/node_modules/vuex-notifications-module/dist/NotificationsModule.d.ts
1:10 Module '"vue/types/vue"' has no exported member 'CombinedVueInstance'.
> 1 | import { CombinedVueInstance } from "vue/types/vue";
|   ^
2 | import { Action as VuexAction, ActionContext as VuexActionContext, Dispatch } from "vuex";
3 | declare type ActionFn = VuexAction<NotificationsModule.State, NotificationsModule.State>;
4 | declare type ActionContext = VuexActionContext<NotificationsModule.State, NotificationsModule.State>;
```

```
[error] in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/src/adapter/EvidenceHashAdapter.ts
```

```
ERROR in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/src/adapter/EvidenceHashAdapter.ts
1:10 Module '"/Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/node_modules/amerykahospital-personalizedadvice-businesslogic/dist"' has no exported member 'EvidenceHash'.
> 1 | import { EvidenceHash } from "amerykahospital-personalizedadvice-businesslogic";
|   ^
2 | import { Configuration } from "@config/Configuration";
3 |
4 | export namespace EvidenceHashAdapter {
```

```
[error] in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/src/components/layout/ProfileComponent.vue
```

```
ERROR in /Users/teofil/git-repository/amerykahospital-personalizedadvice/medicalprofessional-app/src/components/layout/ProfileComponent.vue
62:58 Property '$store' does not exist on type 'CombinedVueInstance<Vue, { text: { signOut: string; }; }, { signOut(): void; }, { authenticated: boolean; account: AccountRecord | undefined; photoUrl: string; name: string; }, Readonly<Record<never, any>>>'.
60 |     methods: {
61 |         signOut() {
62 |             RolesAuthModule.Actions.Logout.dispatch(this.$store.dispatch);
|               ^
63 |         },
64 |     },
65 |     filters: {
```

```
// extend-vue.d.ts
import Vue from "vue";

declare module "vue/types/vue" {
  interface Vue {
    $showSnackbar: (msg: string) => void;
  }
}
```

“Declaration merging”
Not overriding

Optimizing bundle size

In Typescript apps

Optimizing bundle size

importHelpers

```
"use strict";
/* tslint:disable:no-console */
var __assign = (this && this.__assign) || function () {
  __assign = Object.assign || function(t) {
    for (var s, i = 1, n = arguments.length; i < n; i++) {
      s = arguments[i];
      for (var p in s) if (Object.prototype.hasOwnProperty.call(s, p))
        t[p] = s[p];
    }
    return t;
  };
  return __assign.apply(this, arguments);
};
exports.__esModule = true;
var LiveLogConfig_1 = require("./config/LiveLogConfig");
var LogLevel_1 = require("./config/LogLevel");
var LogMetadata_1 = require("./config/LogMetadata");
var StaticConfig_1 = require("./config/StaticConfig");
var LogFormats_1 = require("./format/LogFormats");
var ParseLogMsg_1 = require("./parse/ParseLogMsg");
var Properties_1 = require("./Properties");
```

__assign is one of the import helpers

Tsc appends them to the output

This library has only 19 files

The screenshot shows a code editor interface with a search results panel on the left and a code file on the right.

Search Results Panel:

- SEARCH icon
- Replace input field: var __assign
- AB button
- File inclusion: ./steem-wise/universe-log/dist
- File exclusion: ./steem-wise/universe-log/dist
- 3 results in 3 files
- File 1: JsonLogFormat.js (1 result): var __assign = (this && this.__assign) || function () {
- File 2: LogEngine.js (1 result): var __assign = (this && this.__assign) || function () {
- File 3: ParseLogMsg.js (1 result): var __assign = (this && this.__assign) || function () {

Code File View:

tsconfig.json steem-wise-core

steem-wise > universe-log > dist > parse > ParseLogMsg.js > ...

```
1 "use strict";
2 var __assign = (this && this.__assign) || function () {
3     __assign = Object.assign || function(t) {
4         for (var s, i = 1, n = arguments.length; i < n; i++) {
5             s = arguments[i];
6             for (var p in s) if (!Object.prototype.hasOwnProperty.call(s, p))
7                 t[p] = s[p];
8         }
9         return t;
10    };
11    return __assign.apply(this, arguments);
12 };
13 exports.__esModule = true;
14 var typescript_chained_error_1 = require("typescript-chained-error");
15 var LogLevel_1 = require("../config(LogLevel");
16 var TimeUtils_1 = require("../util/TimeUtils");
17 var ParseLogMsg = /** @class */ (function () {
18     function ParseLogMsg()
19     {

```

__assign helper outputted 3 times!

{

```
"compilerOptions": {  
    "module": "commonjs",  
    "target": "es6",  
    "strict": true,  
    "declaration": true,  
    "moduleResolution": "node",  
    "allowSyntheticDefaultImports": false,  
    "noImplicitAny": true,  
    "allowJs": false,  
    "sourceMap": true,  
    "outDir": "dist",  
    "baseUrl": "src/",  
    "importHelpers": true,  
    "paths": {  
        "*": [  
            "node_modules/*",  
            "src/types/*"  
        ]  
    }  
},  
"include": [  
    "src/**/*"  
],  
"exclude": [  
    "src/**/*.test.ts"  
]
```

ES6: 1.8kB ES6 + importHelpers: 1.6kB

ES5: 2.6kB ES5 + importHelpers: 2kB
(23% reduction)

Enabling
importHelpers

Don't forget to add `tslib` to your
dependencies

}

Optimizing bundle size

importing() only types

```
// using import()  
import * as _ from "lodash";  
  
type Debounce = typeof _.debounce  
type Debounce = (typeof import("lodash"))["debounce"];
```

Apparently, tsc knows by itself if you are using types or implementation

```
// NOT USING import()  
import * as _ from "lodash";  
type Debounce = typeof _.debounce;  
export const d: Debounce = <T>(f: () => T) => f();
```

```
// Output generated by tsc when not using import()  
"use strict";  
exports.__esModule = true;  
exports.d = function (f) { return f(); };
```

We do not need to tell typescript to be smart
It is smart by default!

Optimizing bundle size

Using `const enums`

```
enum ParcelFlags {
  HandOver, Corporate, PremiumDelivery, IntermediateStop,
  Cargo, Delicate, SMSNotification,
}
interface Parcel { id: string; flags: ParcelFlags[]; }

function notify(p: Parcel) {
  if (p.flags.indexOf(ParcelFlags.SMSNotification) !== -1) sendSMS();
  if (p.flags.indexOf(ParcelFlags.PremiumDelivery) !== -1) callClient();
}

function doWeNeedManualHandling(parcels: Parcel[]) {
  const requiresManual = (p: Parcel) =>
    p.flags.indexOf(ParcelFlags.Cargo) !== -1 || p.flags.indexOf(ParcelFlags.Delicate) !== -1;
  return !parcels.find(p => requiresManual(p));
}

function getNumberOfEuropallets(parcels: Parcel[]) {
  return parcels.filter(p => p.flags.indexOf(ParcelFlags.Cargo) !== -1).length;
}

const parcels: Parcel[] = [
  { id: "1", flags: [ParcelFlags.Cargo, ParcelFlags.PremiumDelivery] },
  { id: "2", flags: [ParcelFlags.Delicate, ParcelFlags.SMSNotification] },
];

orderEuropallets(getNumberOfEuropallets(parcels));
if (doWeNeedManualHandling(parcels)) requestHuman();
parcels.forEach(p => notify(p));
```

Heavy use of enums

~1.4kB compiled to JS



```
const enum ParcelFlags {
  HandOver, Corporate, PremiumDelivery, IntermediateStop,
  Cargo, Delicate, SMSNotification,
}

interface Parcel { id: string; flags: ParcelFlags[]; }

function notify(p: Parcel) {
  if (p.flags.indexOf(ParcelFlags.SMSNotification) !== -1) sendSMS();
  if (p.flags.indexOf(ParcelFlags.PremiumDelivery) !== -1) callClient();
}

function doWeNeedManualHandling(parcels: Parcel[]) {
  const requiresManual = (p: Parcel) =>
    p.flags.indexOf(ParcelFlags.Cargo) !== -1 || p.flags.indexOf(ParcelFlags.Delicate) !== -1;
  return !parcels.find(p => requiresManual(p));
}

function getNumberOfEuropallets(parcels: Parcel[]) {
  return parcels.filter(p => p.flags.indexOf(ParcelFlags.Cargo) !== -1).length;
}

const parcels: Parcel[] = [
  { id: "1", flags: [ParcelFlags.Cargo, ParcelFlags.PremiumDelivery] },
  { id: "2", flags: [ParcelFlags.Delicate, ParcelFlags.SMSNotification] },
];

orderEuropallets(getNumberOfEuropallets(parcels));
if (doWeNeedManualHandling(parcels)) requestHuman();
parcels.forEach(p => notify(p));
```

We only changed the type of enum to
'const enum'

output: ~734B = 50% saved!

```
function notify(p) {  
    if (p.flags.indexOf(6) !== -1)  
        sendSMS();  
    if (p.flags.indexOf(2) !== -1)  
        callClient();  
}  
  
function doWeNeedManualHandling(parcels) {  
    var requiresManual = function (p) {  
        return p.flags.indexOf(4) !== -1 || p.flags.indexOf(5) !== -1;  
    };  
    return !!parcels.find(function (p) { return requiresManual(p); });  
}  
// ... and so on
```

All enums replaced with numbers

Beware! Do not export const enums in
public api of a library



wise team

AMERYKA



Keynote available at

[//jedrzej.lewandowski.doctor](http://jedrzej.lewandowski.doctor)

