CS 4530: Fundamentals of Software Engineering
Module 3.1: Trusting TypeScript (or not!)

Adeel Bhutta, Rob Simmons, and Mitch Wand

Khoury College of Computer Sciences

Learning Goals for this Lesson

At the end of this lesson, you should be able to

- Explain how TypeScript types and documented preconditions influence what tests you need to write
- Explain the difference between the any vs unknown types in TypeScript

What Inputs Should We Test?

What input values do I need to test this function on?

```
/**
 * Prints "hello" repeatedly
 *
 * @param numHellos - number of times to print “hello”,
 *   must be an integer >= 0
 */
function helloNTimes(numHellos: number) {
  for (let i = numHellos; i !== 0; i--) {
    console.log('hello');
  }
}
```

What Inputs Should We Test?

What input values do I need to test this function on?

- Edge cases (definitely 0)
- Probably 1 and some larger number?
  But most numbers > 1 are kind of interchangeable.
  - If we want to sound fancy, we can call these “equivalence classes of inputs.”
- What about -3? 1.4? NaN? null? { lol: 'owned' } ?

```
/**
 * Prints "hello" repeatedly
 *
 * @param numHellos - number of times to print “hello”,
 *   must be an integer >= 0
 */
function helloNTimes(numHellos: number)
```

TypeScript Types Cannot Be Trusted

- TypeScript types are, at the end of the day,
  no better than preconditions mentioned in comments.

```
helloNTimes({ lol: 'owned ' } as unknown as number)
```

- They do at least make it less likely you’ll screw up *accidentally…*

TypeScript Types… Can Be Trusted?

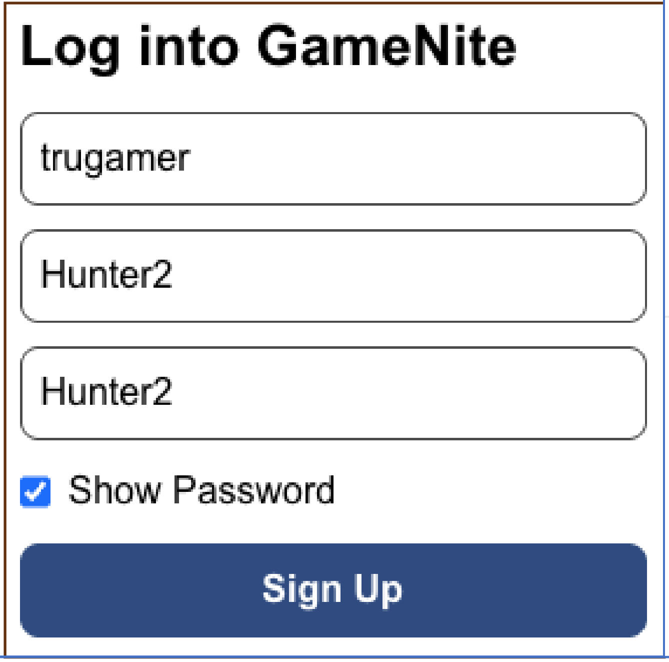
- If you use TypeScript with care, you can rely on the control it gives you over what might get passed to the function
  - If a function is only being called from other sources that respect contracts… then you can rely on the contracts being respected?
  - Don’t have contracts on functions that won’t be respected!

What Trusting Contracts Looks Like

```
/**
 * Adds a message to a chat, updating the chat
 *
 * @param chatId - Ostensible chat id
 * @param user - Authenticated user
 * @param messageId - Valid message id
 * @returns the updated chat info object
 * @throws if the chat id is not valid
 */
export function addMessageToChat(
  chatId: string,
  user: UserWithId,
  messageId: string
): ChatInfo {
```

Untrusted Inputs

Any input given to a web app can also be given by other means…

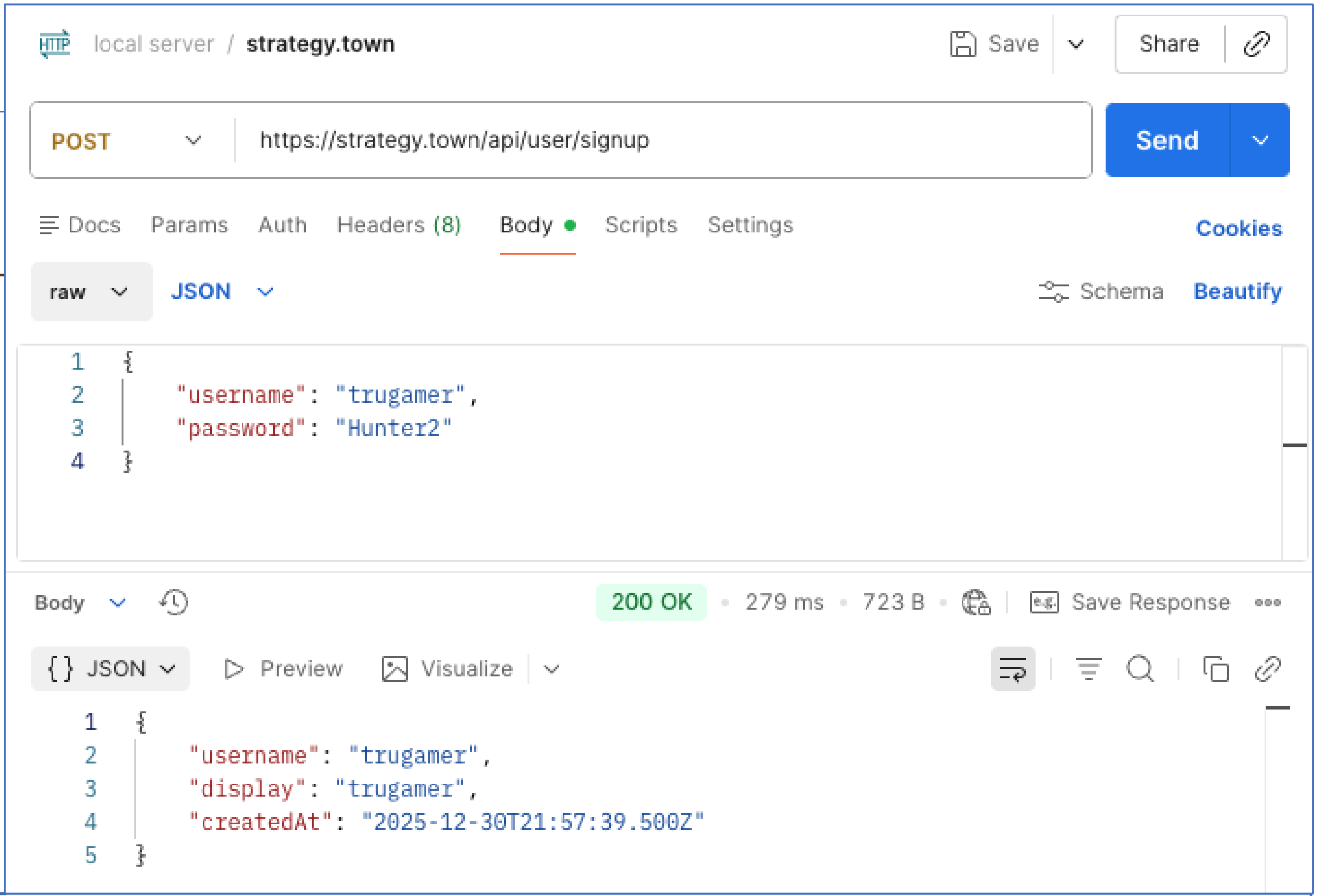

Log into GameNite

trugamer

Hunter2

Hunter2

✓ Show Password



POST https://strategy.town/api/user/signup

```
{
    "username": "trugamer",
    "password": "Hunter2"
}
```

Body 200 OK • 279 ms • 723 B

```
{
    "username": "trugamer",
    "display": "trugamer",
    "createdAt": "2025-12-30T21:57:39.500Z"
}
```

```
curl https://strategy.town/api/user/signup -H 'Content-Type: application/json' \
  --data '{ "username": "trugamer", "password": "Hunter2" }'
```

Untrusted Inputs should be unknown

- The appropriate TypeScript type for an unknown value is unknown

```
function lookAtMe(input: unknown) {
 console.log(input.toUpperCase());
 if (typeof input === "string") {
  console.log(input.toUpperCase());
 }
}
```

TypeScript error here!

it’s ok here!

- If you use the any type instead, TypeScript will just say “ok, I guess you know what you’re doing”

Untrusted Inputs Should be “unknown”

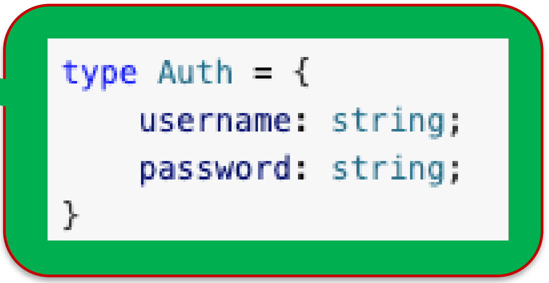
This can get complicated fast…

```
type Auth = { username: string, password: string }

function useAuth(x: unknown) {
  if (
    (typeof x === 'object' && x !== null) &&
    ('username' in x && typeof x.username === 'string’) &&
    ('password' in x && typeof x.password === 'string’)
  ) {
    const auth: Auth = { username: x.username, password: x.password };
    // write the code you care about here!
  }
}
```

Libraries Make Checking Types Easier

Zod is a library that makes testing the structure of inputs less tedious and error-prone.

```
import { z } from 'zod';

const zAuth = z.object({ username: z.string(), password: z.string() });
type Auth = z.infer<typeof zAuth>;
```



```
type Auth = {
    username: string;
    password: string;
}
```

```
// { success: false }
console.log(zAuth.safeParse({ username: 4, password: null }))
// { success: true, data: { username: "", password: "" } }
console.log(zAuth.safeParse({ username: "", password: "" }))
```

Using “any”: Common, Not Great

```
import express from 'express';
const app = express();
app.use(express.json());

type Auth = { username: string; password: string };
app.post('/', (req, res) => {
  const auth: Auth = req.body;


  if (auth.password !== 'secret') {
    res.status(403).send({ error: 'Wrong password' });
  } else {
    res.send({ message: `WELCOME,${auth.username.toUpperCase()}` });
  }
});

app.listen(8000, () => console.log(`Listening on port 8000`));
```

Only accept JSON

This has type “any” 😭

Zod In A Tiny Web Server

```
import { z } from 'zod';
import express from 'express';
const app = express();
app.use(express.json());

const zAuth = z.object({ username: z.string(); password: z.string() });
app.post('/', (req, res) => {
  const auth = zAuth.safeParse(req.body);
  if (auth.error) {
    res.status(400).send({ error: 'Unexpected message' });
  } else if (auth.data.password !== 'secret') {
    res.status(403).send({ error: 'Wrong password' });
  } else {
    res.send({ message: `WELCOME,${auth.data.username.toUpperCase()}` });
  }
});

app.listen(8000, () => console.log(`Listening on port 8000`));
```

Review

- One view of TypeScript is that it’s a handy way of documenting, and *imperfectly* checking, the contracts (preconditions and postconditions) of your code
- Do you need to test inputs that violate your contracts? It depends!
- You can never trust that the input to a web server will obey any sort of contract — important to test!