Scaling JavaScript Applications with TypeScript

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Web Applications for Self Driving Cars!

What is ‘Scalability’?

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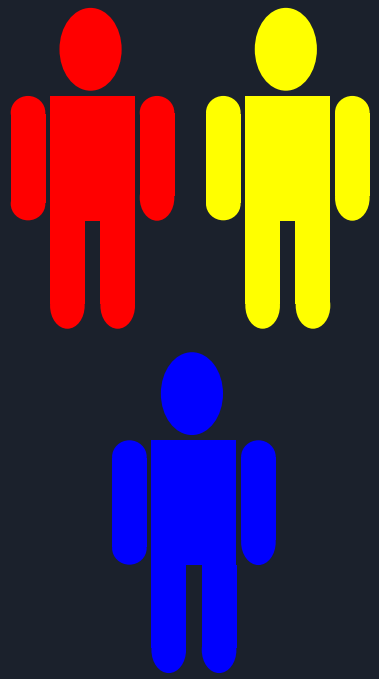
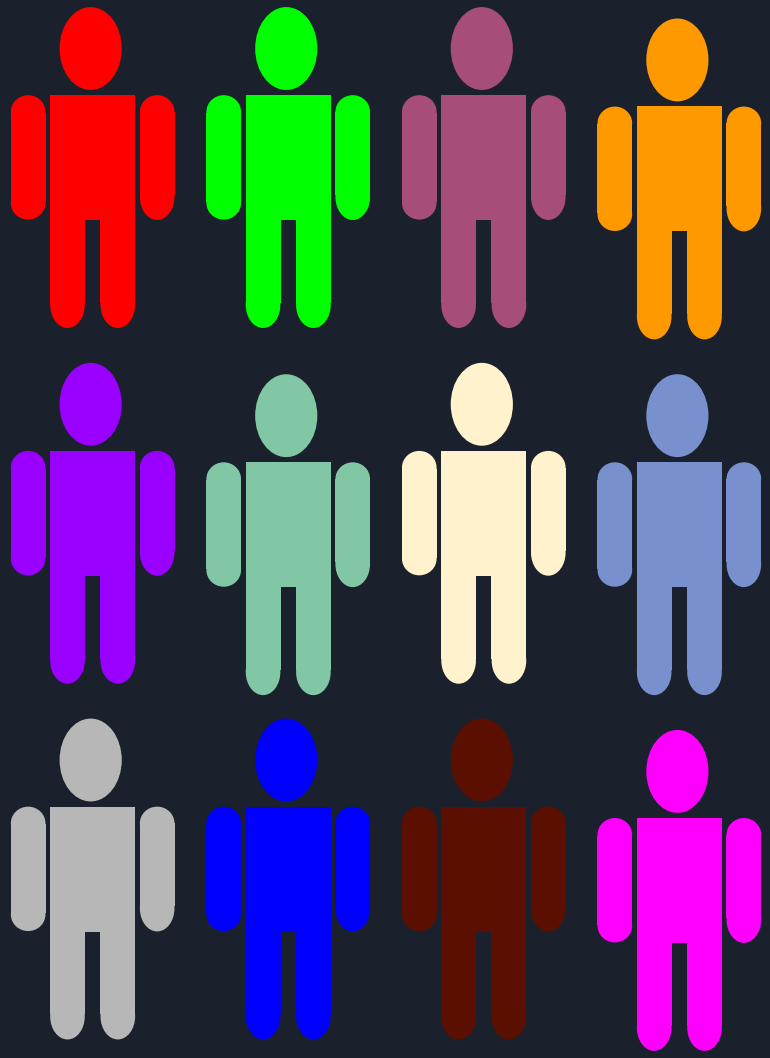
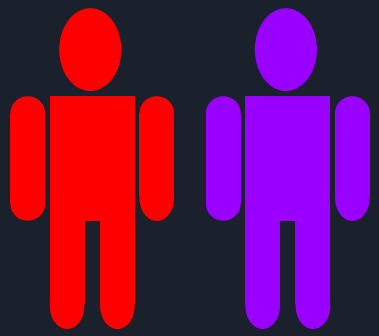


January 2018

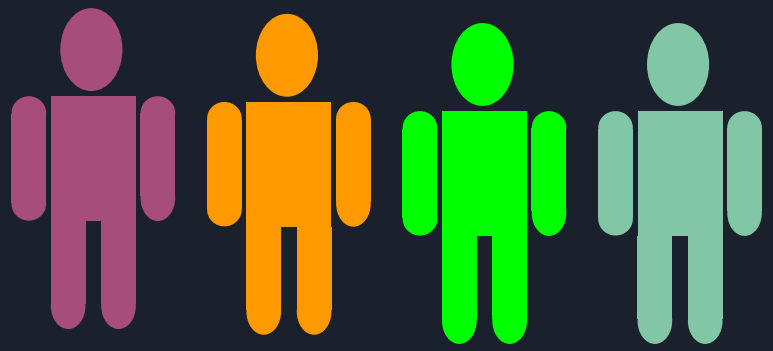


June 2018

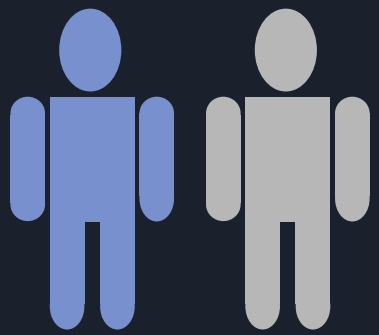
Pockets of Information



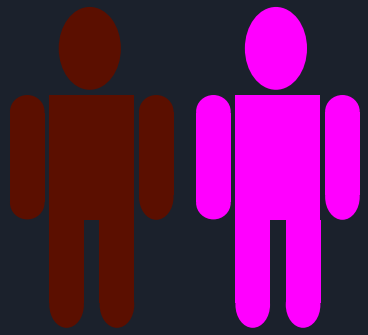
Authentication



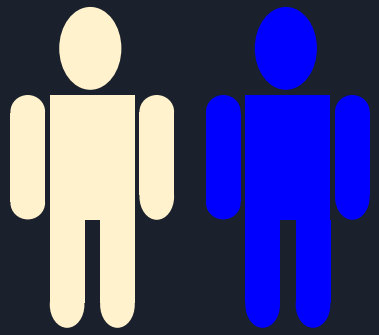
HTML Drawing



Infrastructure



Architecture



APIs

N(N-1)/2 = 10 Lines of Communication!

Code: Setting the State of a Traffic Bulb

```
function turnBulbOn(bulb) {
  bulb.isLit = true;
}
```

Team A: `boolean` representation

```
function toggleBulbState(bulb) {
  bulb.isLit = bulb.isLit ? 0 : 1;
}
```

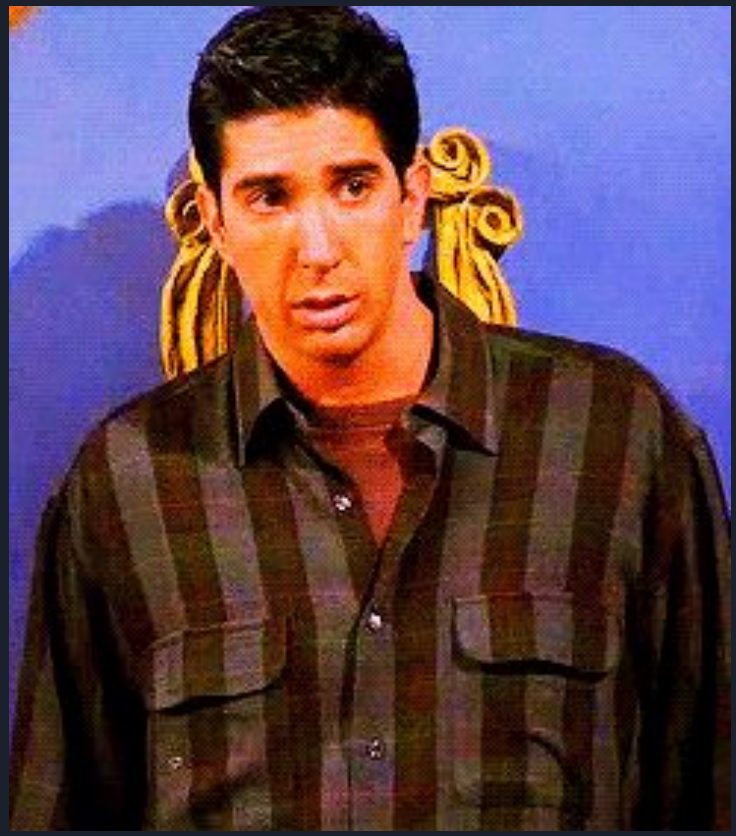
Team B: `number` representation

```
const bulbStates = Object.freeze({
  ON: 'on',
  OFF: 'off',
});

function turnBulbOn(bulb) {
  bulb.isLit = bulbStates.ON;
}
```

Team C: `enum` representation

Where Does this Fragmentation Lead Us?

```
const bulbStates = Object.freeze({
  ON: 'on',
  OFF: 'off',
});

function turnBulbOn(bulb) {
  bulb.isLit = true;
}

function isBulbOn(bulb) {
  return bulb.isLit === bulbStates.ON;
}

const bulb = new Bulb();
turnBulbOn(bulb);
console.log(`Bulb state is ${isBulbOn(bulb)}`);
// Bulb state is false
```

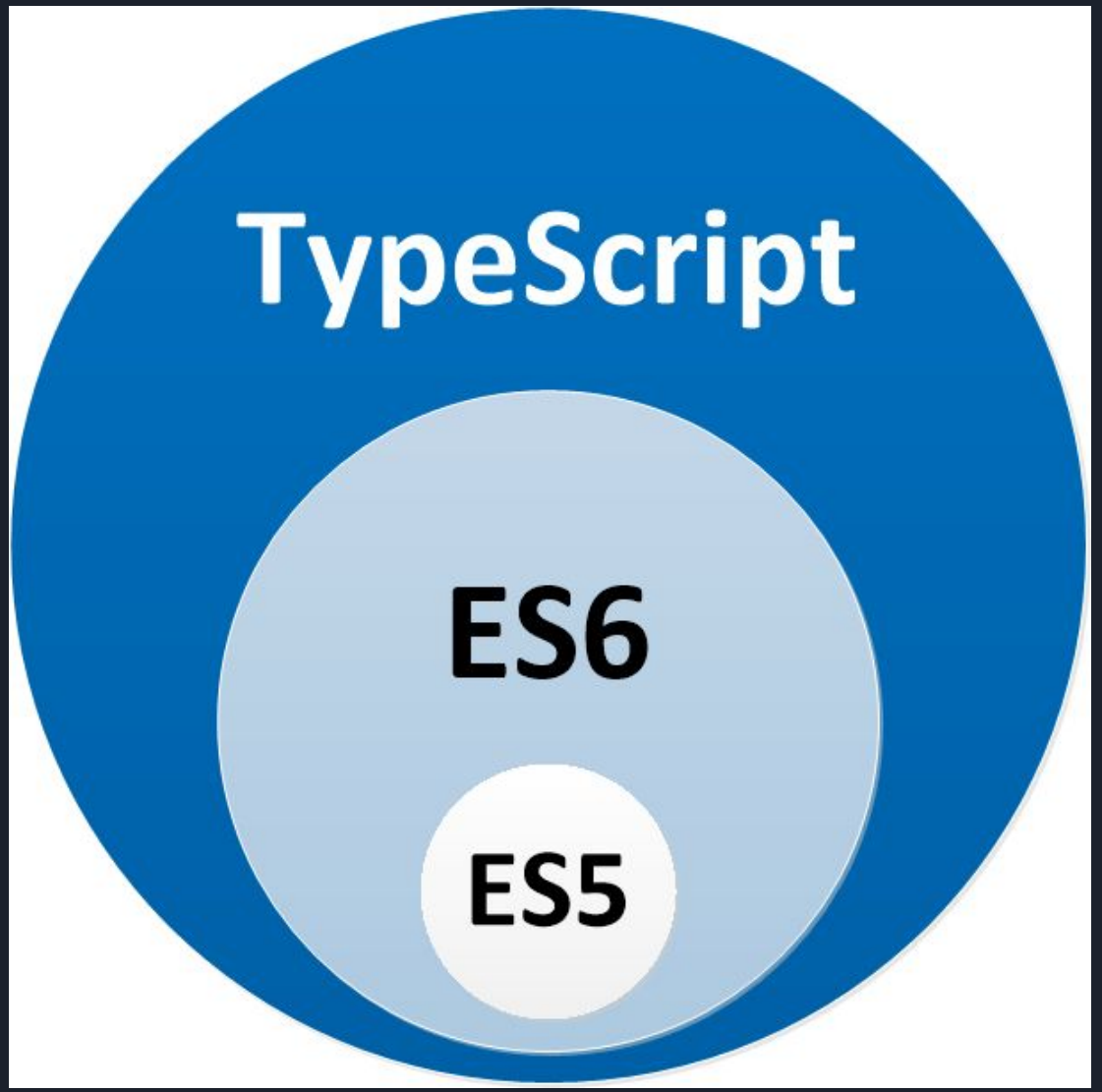


What Just Happened?

```
const bulbStates = Object.freeze({
  ON: 'on',
  OFF: 'off',
});

function turnBulbOn(bulb) {
  bulb.isLit = true;
}

function isBulbOn(bulb) {
  return bulb.isLit === bulbStates.ON;
}

const bulb = new Bulb();
turnBulbOn(bulb);
console.log(`Bulb state is ${isBulbOn(bulb)}`);
// Bulb state is false
```

- We tried to reuse code that was (presumably) tested
- There are two sources of truth, who's correct?
- Should we go back and 'fix' the 'wrong' code?

TypeScript



Static Typing

JavaScript itself has six primitive types

- *boolean, number, string, null, undefined, Symbol*

TypeScript is a *statically typed* language

Declare the *type* that variables will have within our code

```
class Bulb {
  constructor(color, isLit) {
    this.color = color;
    this.isLit = isLit;
  }

  setIsLit(newLitValue) {
    this.isLit = newLitValue;
  }
}
```

```
class Bulb {
  constructor(public color: string, public isLit: boolean) {
    this.color = color;
    this.isLit = isLit;
  }

  setIsLit(newLitValue: boolean) {
    this.isLit = newLitValue;
  }
}
    this.isLit = newLitValue;
  }
}
```

So...How Does My Code Run in the Browser?

```ts
class Bulb {
  constructor(public color: string, public isLit: boolean) {
    this.color = color;
    this.isLit = isLit;
  }

  setIsLit(newLitValue: boolean) {
    this.isLit = newLitValue;
  }
}
```

TS Compiler

tsconfig.json

```ts
class Bulb {
  constructor(color, isLit) {
    this.color = color;
    this.isLit = isLit;
  }

  setIsLit(newLitValue) {
    this.isLit = newLitValue;
  }
}
```

How Does Static Typing Benefit Us?

```
class Bulb {
  constructor(public color: string, public isLit: boolean) {
    this.color = color;
    this.isLit = isLit;
  }

  setIsLit(newLitValue: boolean) {
    this.isLit = newLitValue;
  }
}
```

```
// Argument of type '0' is not assignable to parameter of type 'boolean'.
const redBulb = new Bulb('red', 0);
// Argument of type 'false' is not assignable to parameter of type 'string'.
const yellowBulb = new Bulb(false, 'yellow');
// Expected 2 arguments, but got 3.
const greenBulb = new Bulb('green', true, 'left arrow');
// Correct types, used in the correct order :-)
const workingBulb = new Bulb('green', true);
```

Finding Bugs through Conversion

```
1   class Bulb {
2     constructor(public color: string, public isLit: boolean) {
3       this.color = color;
4       this.isLit = isLit;
5     }
6
7     setIsLit(newLitValue: boolean) {
8       this.isLit = newLitValue;
9     }
10  }
11
12  class TrafficLight {
13    constructor(private bulbs: Bulb[]) {
14      this.bulbs = bulbs;
15    }
16
17    setLitBulbByColor(colorToLight: string) {
18      this.bulbs.forEach((bulb) => {
19        bulb.isLit = (colorToLight === bulb.colour);
20      });
21    }
22  }
23
24  const light = new TrafficLight(['red', 'yellow', 'green']);
25  light.setLitBulbByColor('red');
26
```

Adopting TypeScript: Should We Do This?

1. Is there team interest?
2. Can we get buy-in?
3. Technologically speaking, could we do this?

When *Doesn't* TypeScript Make Sense

- Framework support/lack of examples
- Infrastructure is too hard to migrate
- Your Team May Want to Look at Alternatives

Adopting TypeScript: Let's Tackle It!

1. Start Small - Convert 1 JS file to TS
    a. Right Click -> Rename file -> yourFile.ts
2. Let's update our build file to compile TS files
    a. Generate tsconfig file
        i. `npm install -g typescript`
        ii. `tsc --init`
    b. Integrating TS w/Build Systems: https://bit.ly/2J5n2AZ
3. Build!
4. Fix Type Errors
5. Accept this may be a gradual process
6. Rinse, Repeat
7. Linting + Formatting

Lessons Learned Along the Way

1. We didn’t know everything at first - that’s OK!
2. Standardizing our builds really helped attain consistency
3. There’s always room for improvement
4. Gradualism is key!

Thank You!

Slides - https://bit.ly/2xcmCY5

TypeScript - https://www.typescriptlang.org/

Integrating TS w/Build Tools - https://bit.ly/2J5n2AZ

A Decade after DARPA Our View on the State of the Art in Self Driving Cars - https://bit.ly/2s6DgDg