# CIS 371 Web Application Programming

## TypeScript I

### Transition from Java to TypeScript


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Based on the original version by Professor Hans Dulimarta.

# Official Reference:
# The TypeScript Handbook

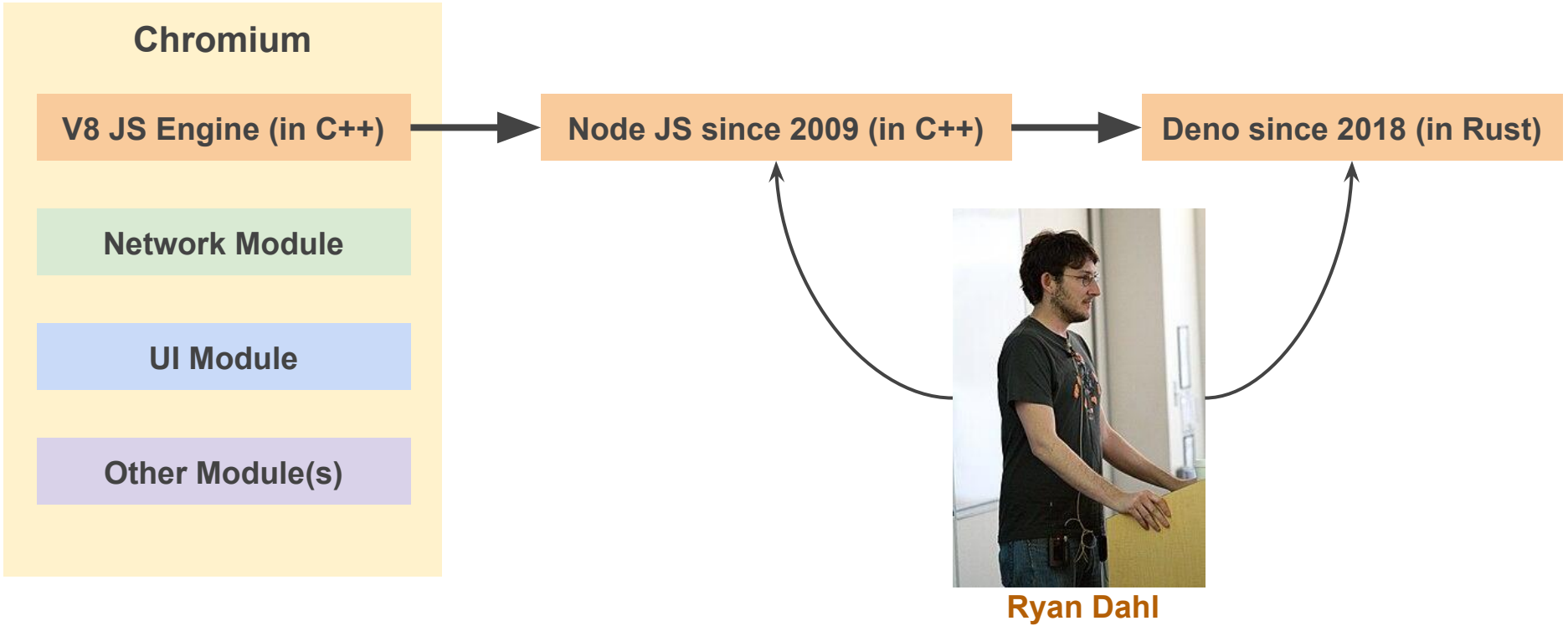
# JavaScript and TypeScript

| JS Edition | Release Date | Code Name | TypeScript Version |
|---|---|---|---|
| 1st-4th | June 1997, Jun 1998, Dec 1999 | | |
| 5th | June 2011 | | TypeScript 0.x (2012-2013) |
| 6th | June 2015 | ECMAScript 6 or ES2015 | |
| 7th | June 2016 | ECMAScript 2016 | TypeScript 2.0 |
| 8th | June 2017 | ECMAScript 2017 | |
| 9th | June 2018 | ECMAScript 2018 | TypeScript 3.0 |
| 10th | June 2019 | ECMAScript 2019 | |
| 11th | June 2020 | ECMAScript 2020 | TypeScript 4.0 |

# Prerequisites

- Software Required
  - NodeJS
    - node: for running JavaScript in a non-browser environment
    - npm (Node Package Manager): for installing JS/TS libraries
  - TypeScript
    - ts-node
    - tsc (TypeScript transpiler to JavaScript)

# Node JS & Deno

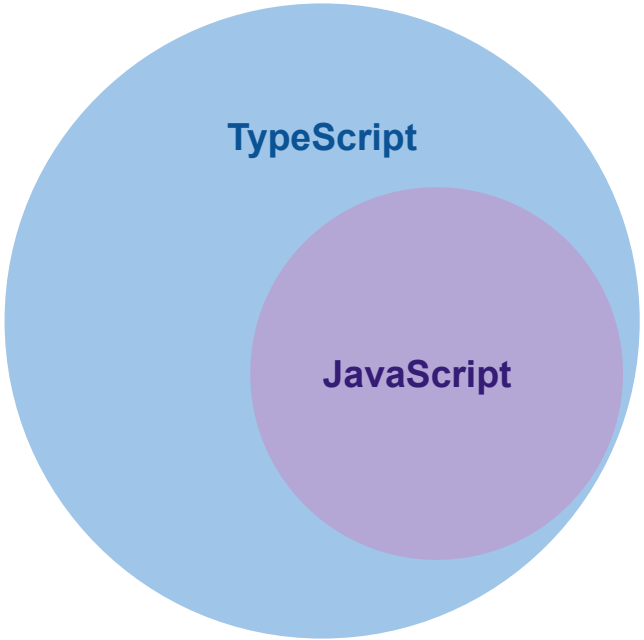

Chromium
V8 JS Engine (in C++)
Network Module
UI Module
Other Module(s)
Node JS since 2009 (in C++)
Deno since 2018 (in Rust)
Ryan Dahl

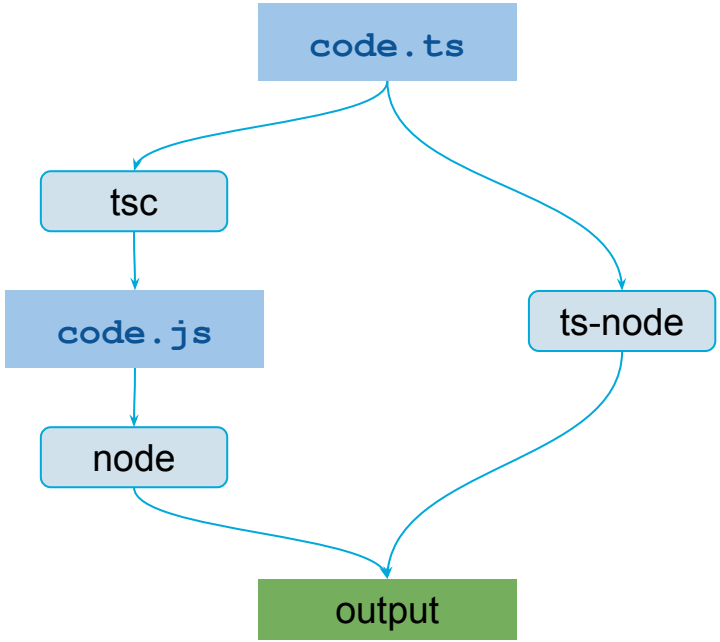
# Initial Setup For Node JS

- Using Docker
  - Please refer to the Docker slides for detailed steps on setting up NodeJS within a Docker container.
- Direct Installation
  - Download NodeJS (from https://nodejs.org)
    - Choose the LTS (Long Term Support) version.
- Verify Your Installation
    - Once installed, open a terminal, command prompt, console, or PowerShell.

```
node -v  # version 14.x.x (or newer)
npm -v   # version 7.x.x (or newer)
npx -v   # version 7.x.x (or newer)
```

# TypeScript vs. JavaScript



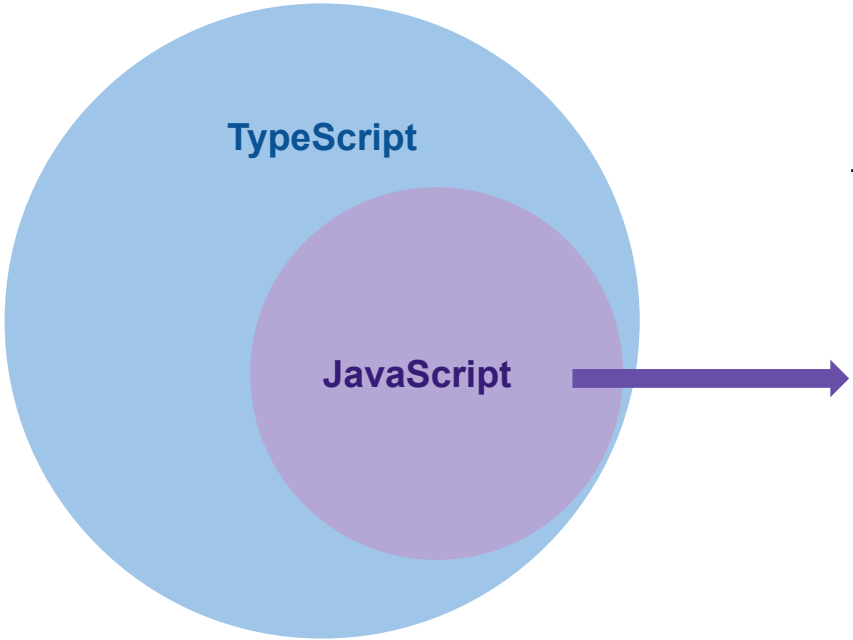

**TypeScript adds syntax on top of JavaScript, allowing developers to add types.**

# TypeScript: Online PlayGround

https://typescriptlang.org/play

https://replit.com/languages/typescript

# JavaScript: Online Reference




Use Mozilla Developer Network (MDN Web Docs) to lookup JS objects/classes:

- *Array,*
- *BigInt,*
- *Map,*
- *Number,*
- *String,*
- *Promise,*
- *etc…*

# Initialize a NodeJS (and TypeScript) Project

```
# Create a new (sub) directory
mkdir my-first-node-project
cd my-first-node-project

npm init -y                     # Creates package.json
npm install -D typescript       # Add typescript as development dependencies
npm install -D ts-node npx
tsc -init                       # Creates tsconfig.json

# Create hello.ts
…

# Run option 1: Use ts-node
npx ts-node hello.ts
# Run option 2: Use tsc and node
npx tsc hello.ts
node hello.js
```

# package.json

```
{
  "name": "sample-project",
  "version": "1.0.0",
  "author": "name <name.org>",
  "licence": "MIT",
  "dependencies": {
    "@js-joda/core": "3.0.1",
    "axios": "0.25.3",
    . . .
  },
  "devDependencies": {
    "ts-node": "x.y.z",
    "Nodemon": "x.y.z"
  }
}
```

Libraries needed to run/deploy your app

Libraries needed only during development of your app

# Hello World: Java vs. TypeScript

Demo.java

```
class Demo {
  public sayHello() {
    System.out.println("Hello, JS");
  }
}
```

hello.ts

```
console.log("Hello World");
console.error("Hello Again");
```

Say.java

```
class Say {
  public static void main(String[] argos) {
    System.out.println("Hello World!");
    System.err.println("Hello again");
    Demo d = new Demo();
    d.sayHello();
  }
}
```

say.ts

```
class Demo {
  sayHello(): void {
    console.log("Hello, TS");
  }
}

const d:Demo = new Demo();
d.sayHello();
```

# Functions vs. Methods

function-demo.ts

```
// Stand-alone fn
function sayHello(): void {
  console.log("Hello, TS");
}
```

method-demo.ts

```
class Demo {
  // a method of a class
  sayHello(): void {
    console.log("Hello, TS");
  }
}
```

- **Use *function*** keyword for standalone functions
- **No *function*** keyword methods in a class

# Data Types

| Java | TypeScript |
|---|---|
| boolean | boolean |
| char | string |
| String | string |
| float, double | number |
| short, int, long | number |
| | any (no type checking) |
| | unknown (strict type checking) |

# Variable Declaration

| Java | TypeScript |
|---|---|
| boolean  isHidden | let isHidden: boolean; |
| boolean  isHidden = false; | let isHidden = false; |
| final String name = “Tom”; | const name = “Tom” |
| float taxRate; | let taxRate: number; |
| short distance; | let distance: number; |

- Use let for mutable variables
- Use const for immutable “variables”

*Explicit type is not required when the compiler can infer the type from the surrounding context*

# Variable Declarations (uninitialized)

```
// Java (inside a class)
boolean isDarkMode;       // init to false
String lang;              // init to null
float total;              // init to 0.0f
```

```
// TypeScript (anywhere)
let isDarkMode: boolean; // init to undefined
let lang: string;        // init to undefined
let total: number;       // init to undefined
```

**null is different from undefined**

# TS Unions: multiple types

```
// TypeScript
let a: number | boolean;                    // init to undefined
let b: string | number | null = 6.5;        // current type is number

a = "can't do this";                        // Error, can't take a string type
a = false;                                  // current type is boolean

console.log(typeof b);                      // output "number"

b = "hello";
console.log(typeof b);                      // output "string"
```

**Use this feature in conjunction with typeof test at runtime**

# Type Assertions (or Typecast)

```
function doOne (x: number | string | null): void {
  console.debug(x.toUpperCase()); // Compile ERROR: toUpperCase() does not exist for number
  console.debug(x * 10);          // Compile ERROR: incorrect type for arithmetic
}
```

```
function doOne (x: number | string | null): void {
  console.debug((x as string).toUpperCase());
}
```

```
doOne("five"); // Output FIVE
doOne(5); // Runtime crash!
```

```
function doOne (x: number | string | null): void {
  console.debug((x as number) * 3);
}
```

```
doOne("five"); // Runtime crash!
doOne(5); // Output 15
```

SmartCast

```
function doOne (x: number | string | null): void {
  if (typeof x === 'number') console.debug(x * 3);
  else if (typeof x === 'string') console.debug(x.toUpperCase());
}
```

# == vs ===

| == | | === | |
|---|---|---|---|
| 5 == “5” | true | 5 === “5” | false |
| 0.123 == “0.123” | true | 0.123 === “0.123” | false |
| 1 == true | true | 1 === true | false |
| 5 == true | false | 5 === true | false |
| 0 == false | true | 0 === false | false |
| “0” == false | true | “0” === false | false |
| “1” == true | true | “1” === true | false |
| ***With internal type conversion*** | | ***No type conversion*** | |

# Arrays

```
// Create with initial values and capacity
const primes: number[] = [31, 43, 19];
const alsoPrimes: Array<number> = [31, 43, 19];

for (let k = 0; k < primes.length; k++) {
  console.debug("At", k, primes[k]);
}

// At 0 31
// At 1 43
// At 2 19
```

```
// Initialize with capacity
const values: number[] = new Array(5);
const nums = new Array<number>(7);

console.log(values.length);        // output 5
console.log(nums.length);          // output 7

console.debug(values[0]);          // Output "undefined"
```

# Arrays: for, for-in vs. for-of

```
const fruits = ["Apple", "Banana", "Cherry"];
```

```
for (let k = 0; k < fruits.length; k++) {
  console.debug("At", k, fruits[k]);
}
```

```
for (let k in fruits) {
  console.debug("At", k, fruits[k]);
}
```

*for-in*

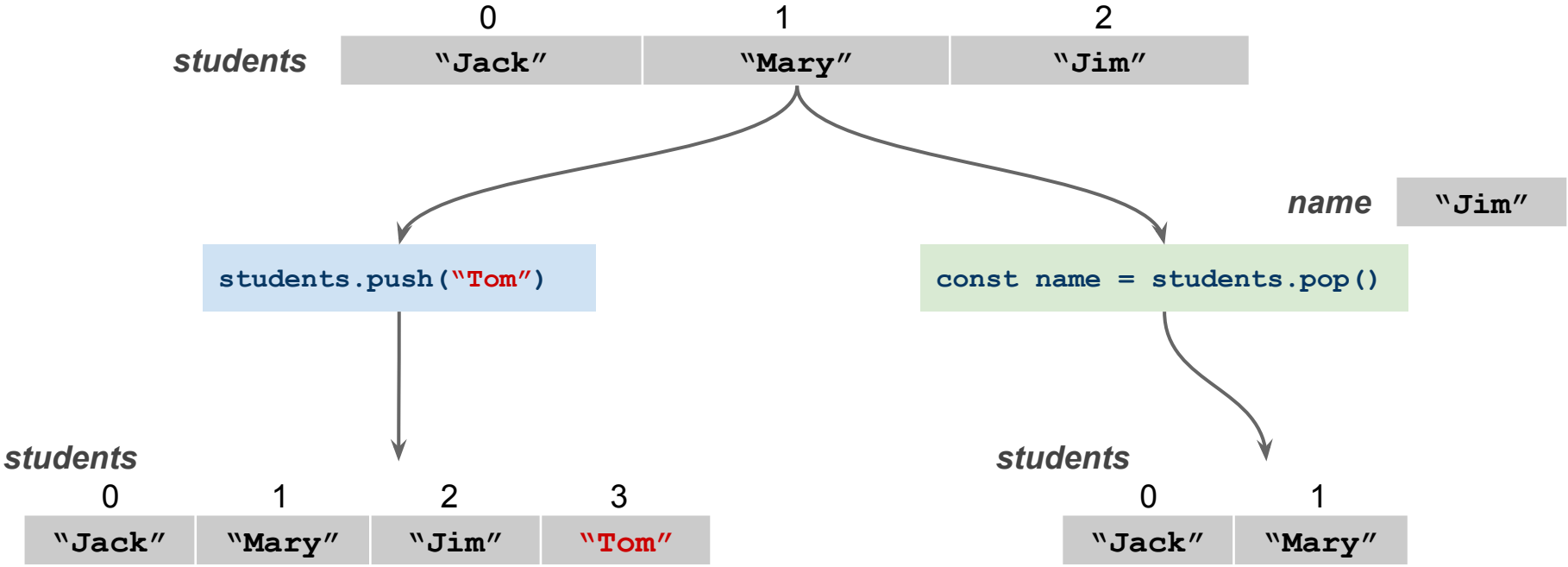
```
At 0 Apple
At 1 Banana
At 2 Cherry
```

```
for (let f of fruits) {
  console.debug(f);
}
```

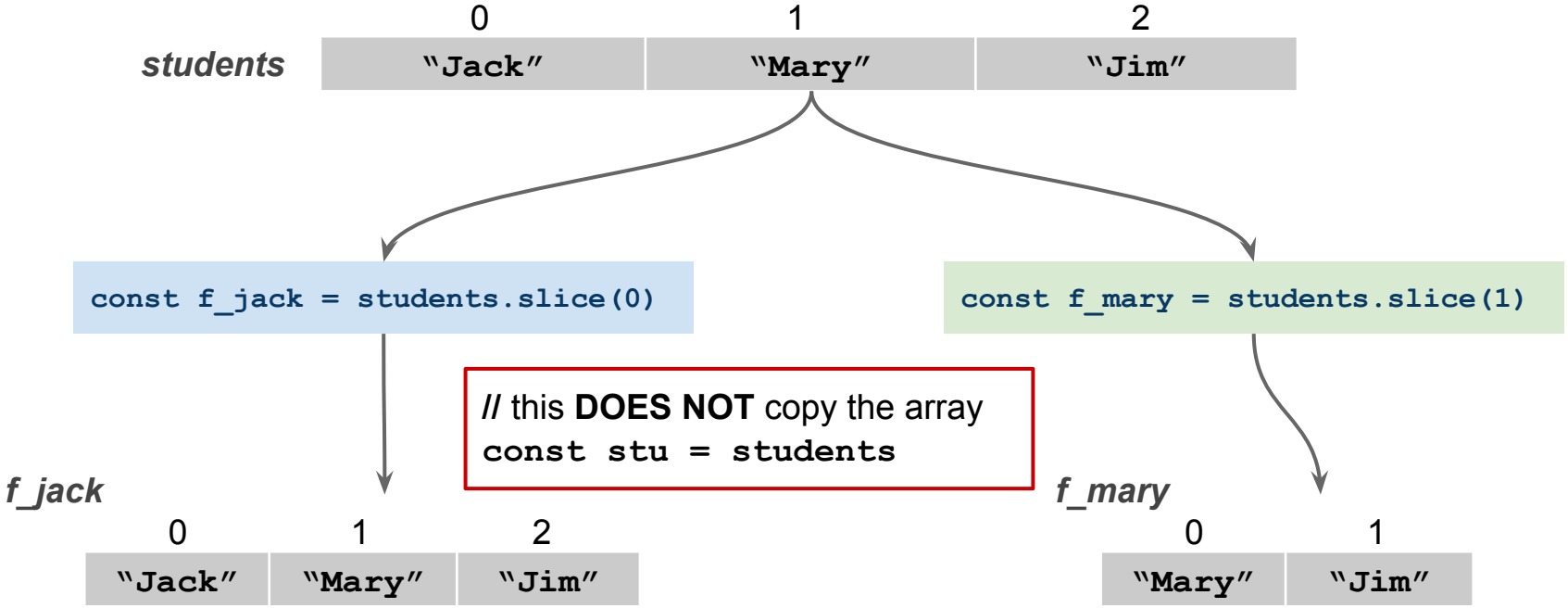
*for-of*

```
Apple
Banana
Cherry
```

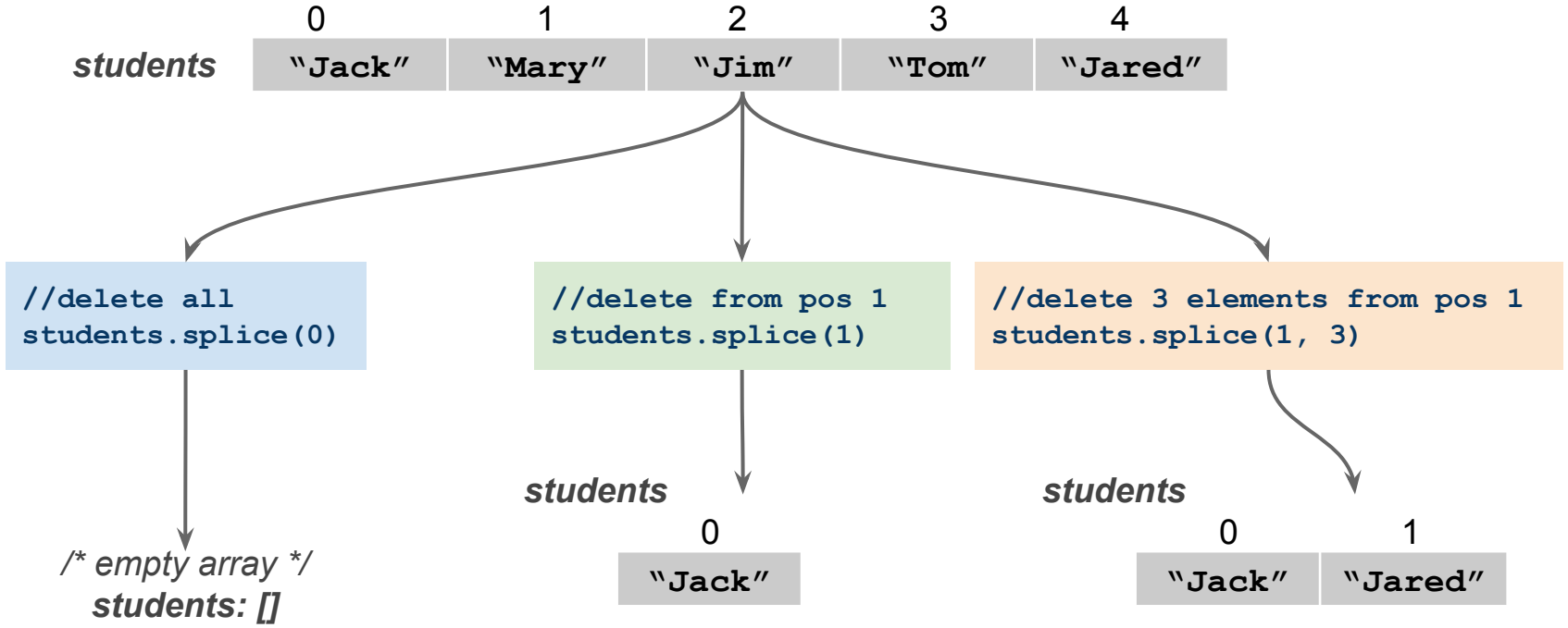
# Array: .push() and .pop()



# Array: .slice() creates a copy



# Array: .splice() delete elements



# Array: .splice() replaces elements