JavaScript.

The Fundamentals

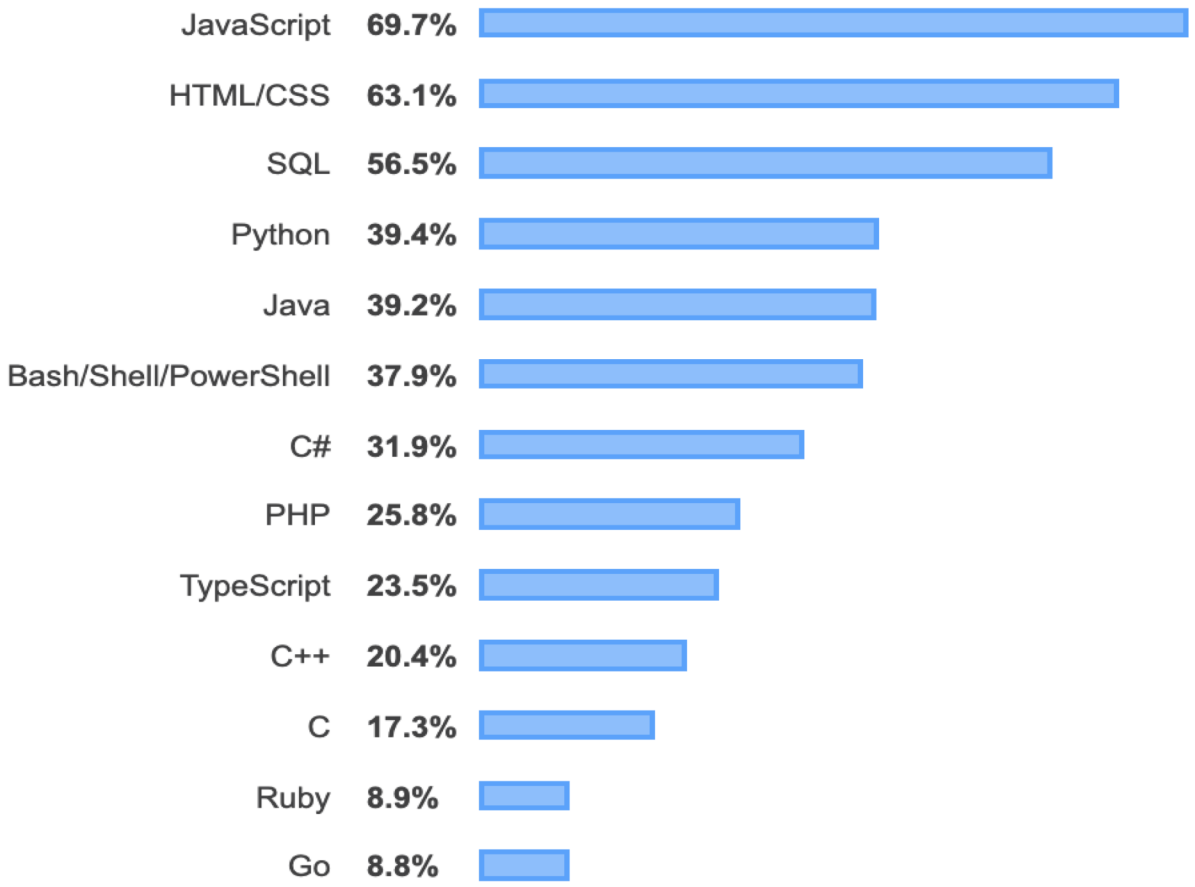
Topics

- **Background**
- **Data (State) representation**
  - **All about objects**
- **Behaviour (Logic) representation**
  - **All about functions**

Ref. https://insights.stackoverflow.com/survey/2019?

Programming, Scripting, and Markup Languages

All Respondents | Professional Developers



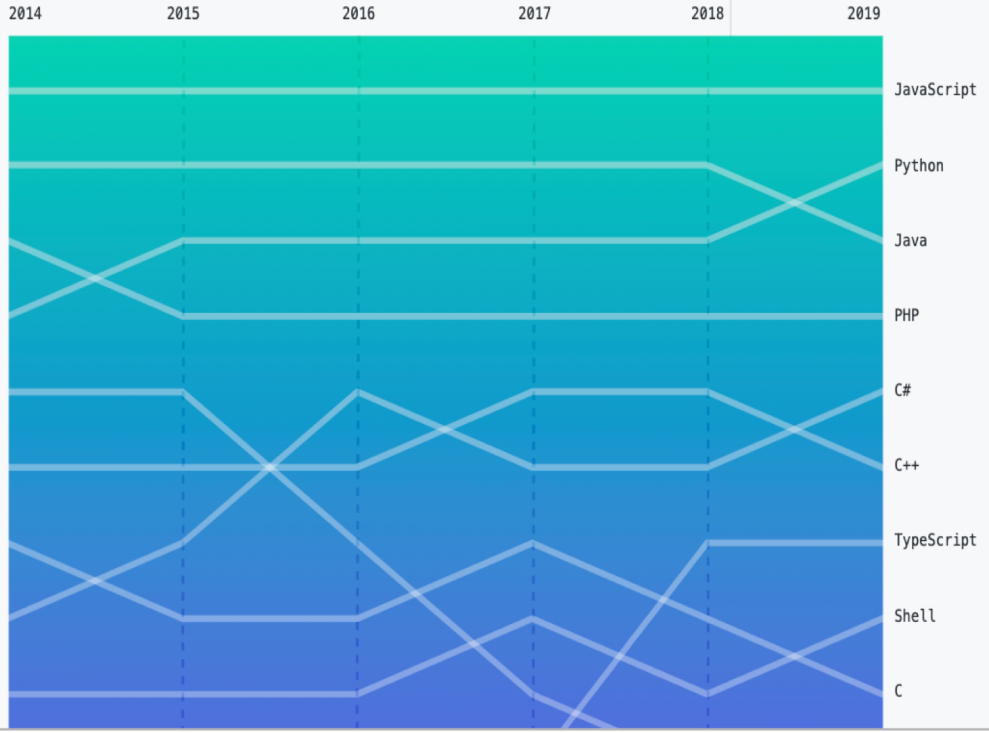
Ref : https://octoverse.github.com/#top-languages

Top languages

In the last year, developers collaborated in more than 370 primary languages on GitHub.

Top languages over time

This year, C# and Shell climbed the list. And for the first time, Python outranked Java as the second most popular language on GitHub by repository contributors.*



Background.

- **Designed by Brendan Eich, at Netscape Corp. (early 1990s).**
  - **Influenced heavily by Java, Self and Scheme.**
- **Named JavaScript to capitalizing on Java's popularity.**
- **Netscape submitted JavaScript to ECMA for Standardization. (ECMA – European Computer Manufacturers Association. Organization that standardizes information)**
- **Resulted in new language standard, known as ECMAScript.**
  - **JavaScript is an implementation of ECMAScript standard.**
  - **ES1: June 1997; ES2: June 1998; ES3: Dec. 1999; ES4: Abandoned**
  - **ES5: 2009; ES6: 2015 (ES2015); ES2016/7 ….**
- **The** node.js **platform (2009).**
  - **JavaScript on the server-side**
- **Douglas Crockford – 'JavaScript - Volume 1: The Early Years'**

Transpilation (using Babel)

- **Older Browsers cannot execute ES6+ JavaScript.**
  - **Must transpile code first.**
- **Newer browsers incrementally adopting ES6+.**
  - **Same for Node.js platform.**
- **The Babel tool suite.**
  - **One-stop shop for all transpilitation needs.**

JavaScript - Data representation.

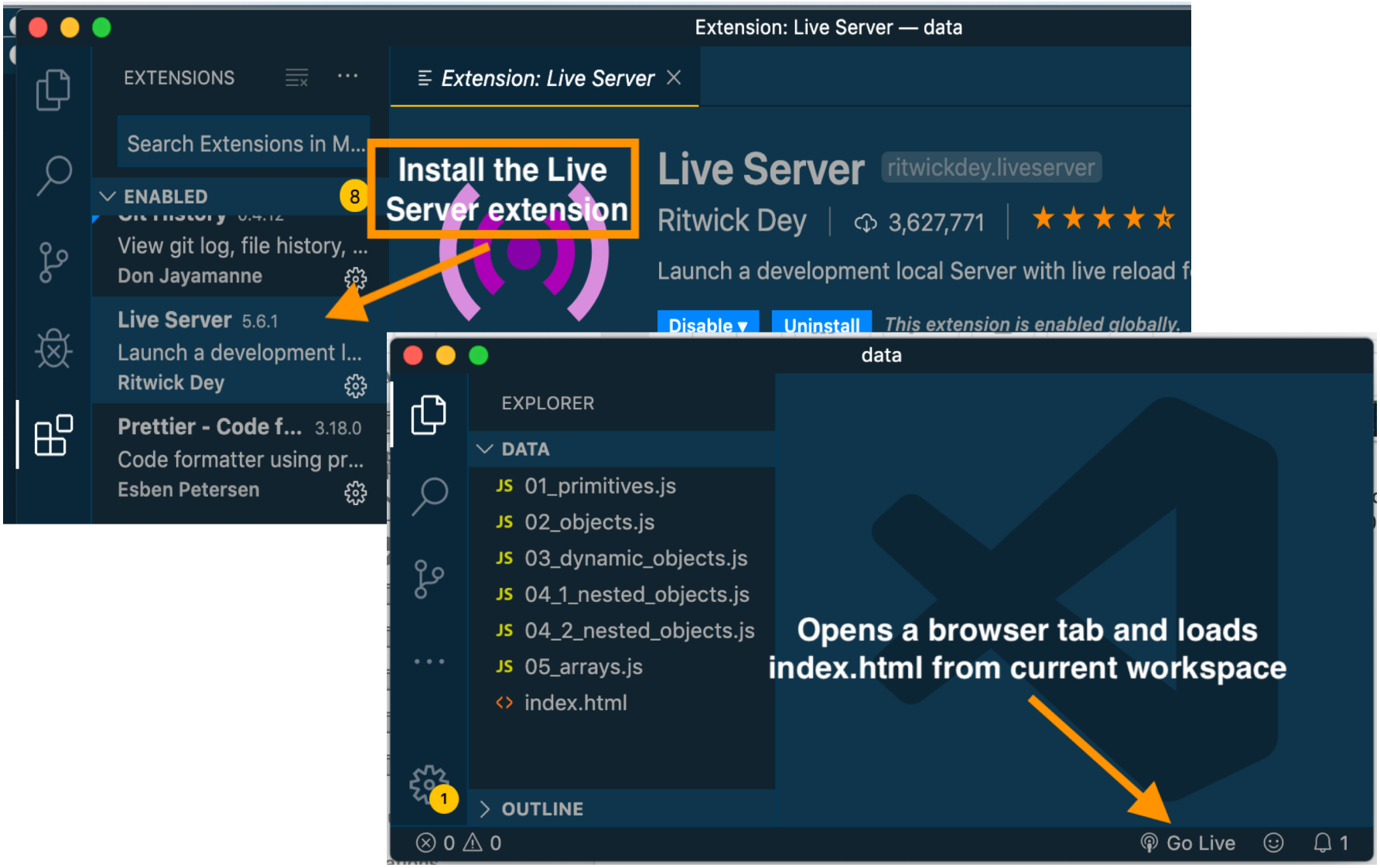
JavaScript Data Types.

- **Data types:**
  1. **Primitives: number, string, boolean, null, undefined.**

  2. **Everything else is an object.**

- **JS is a dynamically typed language.**

Demo setup


Extension: Live Server — data
EXTENSIONS
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8
View git log, file history, ...
Don Jayamanne
Live Server 5.6.1
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data
EXPLORER
DATA
01_primitives.js
02_objects.js
03_dynamic_objects.js
04_1_nested_objects.js
04_2_nested_objects.js
05_arrays.js
index.html
OUTLINE
Opens a browser tab and loads index.html from current workspace
0 0
Go Live
1

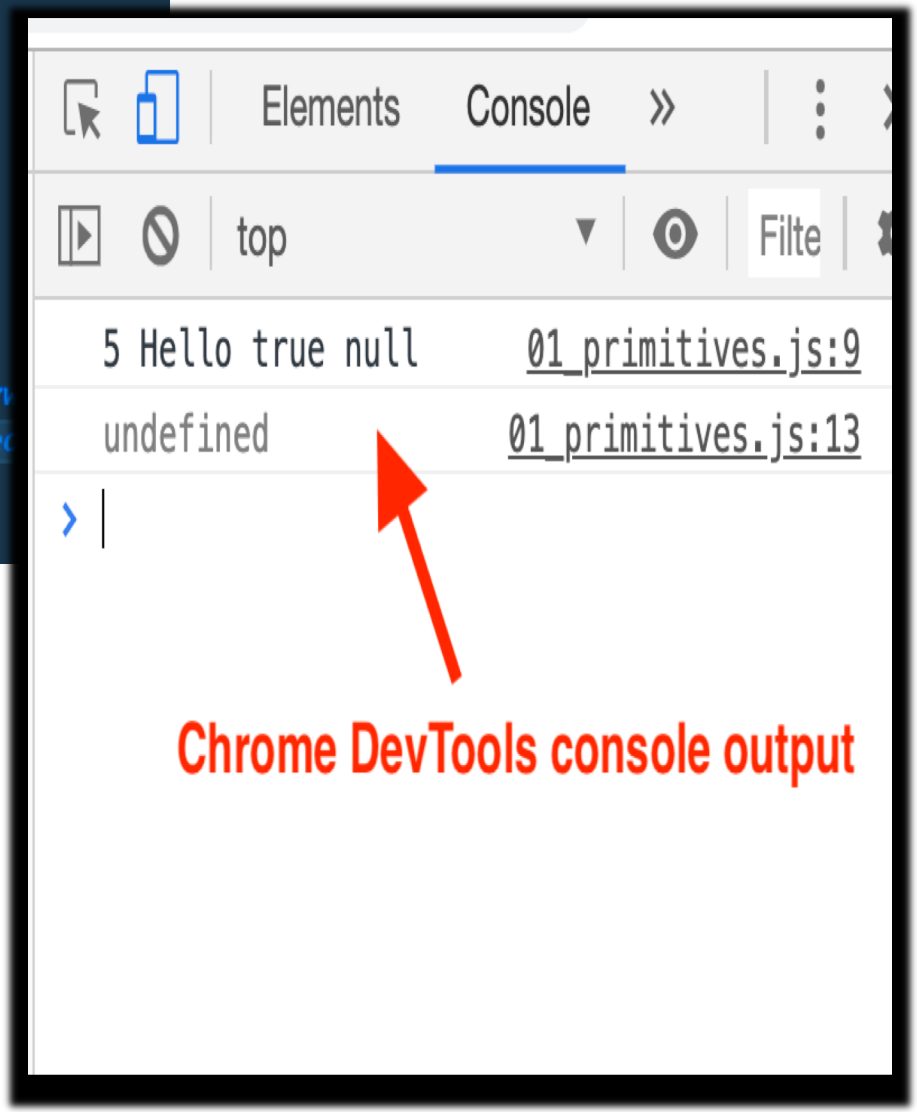
- **Ref data***01_primitives.js:*

Primitive types.

```
/*
  Primitive data types in JS
*/
let foo1 = 5 ;
let foo2 = 'Hello' ;
let foo3 = true
let foo4 = null
const foo5 = 22 // Constant
console.log( foo1 + ' ' + foo2 + ' '
           + foo3 + ' ' + foo4) ;
foo1 = 3 ;   // Reassign; Drop let key
foo2 = 10 ;  // JS is dynamically type
let foo6 ;
console.log (foo5) ;
```

index.html

```
<!DOCTYPE html>
<html>
  <head>
  </head>
  <body>
    <h1>JS Data</h1>
    <script src ="./01_primitives.js"></script>
  </body>
</html>
```



Primitive types (Basic syntax).

let foo1 = 5 ;

- let **– keyword to indicate we are declaring 'something' (and assigning it a literal value in above case).**
  - **Use** const **when declaring constants (cannot reassign).**
- Identifier **– 'foo' is an identifier for the thing being declared.**
  - **Lots of rules about valid format for identifiers (no spaces, don't start with numeric character, etc)**
- Operator **– e.g. +, =, * , –, [ ] (subscript) etc**
  - **Some rules about where they can appear in a statement.**
- Semicolon **(;) – statement terminator.**
  - **Optional.**
  - **Babel puts them back in - ASI.**
  - **When omitted, be careful with multi-line expressions.**

let & const

- let – **Declared variable CAN be reassigned**
- const – **Declared variable CANNOT be reassigned.**
  - **A Constant.**
  - **Use to clarify intent.**
  - **MUST be initialized on declaration.**

- **Both have block scope.**
  - **{ …. } encloses a block, e.g. for-loop, if, function, class**
  - **Same as Java**

Objects.

- **The fundamental structure for representing complex data.**
- **A unit of composition for data (or STATE).**
- **Literal syntax:**

  { <key1> : <value1>, <key2> : <value2>, ... }

  e.g.

  let me = { firstName: “Diarmuid”, lastName: “O’ Connor” } ;

- **Objects are a set of** key-value **pairs, termed** properties**.**
  - **Key (property name) - an identifier; must be unique within the object structure.**
  - **Value - can be a primitive value, another object (nesting) , array or function.**

Manipulating Object properties.

- **Two notations:**
  1. **Dot notation e.g** let fn = me.firstName ;
  2. **Subscript notation**

     e.g. let fn = me['firstName’] (Note quotes)
- **Same notations for** changing **a property value, e.g.**

  me.firstName = ‘Jeremiah’ ;

  me[‘lastName’] = ‘O Conchubhair’ ;
- **Subscript notation allows a variable reference as the key:**

  let key = ‘lastName’ ;

  console.log (‘Surname: ’ + me[key]) ;

  me[key] = …….. ;
- **Ref. data/02_objects.js**

Object characteristics.

- **Objects are dynamic:**
  - **Properties can be inserted and removed at run-time (JS is dynamic).**
  - **Ref. 03_dynamic_objects.js,**
- **Objects can be nested.**
  - **A property value may be an object structure.**
  - **Ref. 04_1_nested_objects.js**
- **A property value can be a variable reference.**
  - **Ref. 04_2_ nested_objects.js**

Object extras.

- **Objects declared with *const* ARE MUTABLE.**
  - ***const* cannot be reassigned, but its internal 'value' is mutable.**

- **Object.keys(objRef) – get all keys in an object structure.**

- **Object.values(objRef) – get all values in an object structure.**

- **The 'in' operator – Does an abject have a certain key? e.g.**

  'name' in me

- **Internally JS stores object keys as** strings**.**
  - **Hence the subscript notation** – me['address'].

Array data structure.

- **Dfn.: Array is an** ordered list **of values.**
  - **An object's properties are not ordered.**
- **Literal declaration syntax** :

  [<value1>, <value2>, ...]

- **Values can be of mixed** type (may reflect bad design!)**.**

- **Access elements with subscript notation.**
  - **Subscript termed an** index**.**

- **Ref 05_arrays.js**

Array data structure.

- **In JS, arrays are really just ‘special’ objects.**
  - **Index converted to a string for subscript notation:**

    nums[2] **becomes** nums[‘2’]

- **An array ‘objects’ has special properties built-in:**
  - **length property, e.g. const** len = nums.length
  - **Utility methods for manipulating elements e.g push, pop, shift, unshift, join etc.**

Nested collections.

- **Arrays and objects are collection types.**
- **They can be nested.**
- **Ex.:**
  - **An array where elements are also arrays -** array_outer[3][2]
  - **An array of objects -** array_outer[1].propertyX.
  - **An object with a property whose value is an array -** objectY.propertyX[5**].**
  - **etc.**

String templates (ES6)

- **String concatenation (ES5):**

```
console.log( foo1 + ' ' + foo2 + ' ' + foo3 + ' ' + foo4) ;
```

- **String template:**

```
console.log(` ${foo1} ${foo2} ${foo3} ${foo4} `) ;
```

- **Use backquote (`) to enclose template, not single quote.**

- **Interpolation: Embed variable / expressions using ${ …. }.**
  - **Expression is evaluated and result inserted into string**

- **Multi-line strings.**

String templates (ES6)

```
1   const name = 'Diarmuid' ;
2   const height = 5.8 ;
3   const toMeters = function(feet) { return (feet*0.3048).toFixed(2) }
4   let text =
5       `My name is ${name} and my height is ${toMeters(height)} meters`;
6   console.log(text);
7   // Multi-line strings
8   text = (
9   `My name is ${name}
10  and my height is ${toMeters(height)} meters
11  `);
12  console.log(text);
13  // Embedded quotes in a string
14  text =
15   `I'm "amazed" that we have so many quotation marks to choose from!` ;
16  console.log(text);
```

```
My name is Diarmuid and my height is 1.77 meters
My name is Diarmuid
and my height is 1.77 meters


I'm "amazed" that we have so many quotation marks to choose from!
```

JavaScript - Behavior structures

JavaScript functions.

- **Fundamental unit of composition for logic (or BEHAVIOUR).**

- **Function syntax:**
  - **ES5:**
    - **Function declarations.**
    - **Function expressions**
  - **ES6:**
    - **Arrow functions.**
    - **Shorthand arrow functions.**
  - **Anonymous functions.**

- **Ref. functions/01_functionBasics.js**
- Hoisting **(ES5) – all functions moved to the top of the current scope at runtime.**
  - **Function call can appear before its declaration.**

Function characteristics

- Constructor functions **– function for creating objects of a certain type, e.g.**

  function Person(……) {. . . . . }

  let him = new Person('joe Bloggs', '1 Main Street','m', ...)

  – **Same purpose as classes in Java.**
- **Side-effects – when a function "**modifies some state variable value(s) outside its local environment", e.g.

  addMiddleName() causes side effects.

  salute() does not cause side effects.

  – **Performing I/O also considered a side effect.**
- **Pure function – has no side effects; will always return the same result for a given set of parameters.**

  – **Functional programming.**

Higher Order Functions (HOF).

- **A function that takes a function as a parameter (and/or returns a function).**
  - **Function parameter termed a** callback.

    function someHOF(. . ., callback, ….)
  - **Callback usually coded as** anonymous **function using the** arrow **syntax.**

- **Case study – The Array HOFs:**
  - **forEach()**
  - **filter()**
  - **map()**
  - **reduce()**

Array HOFs – forEach().

- **An alternative to the for-loop, e.g.**

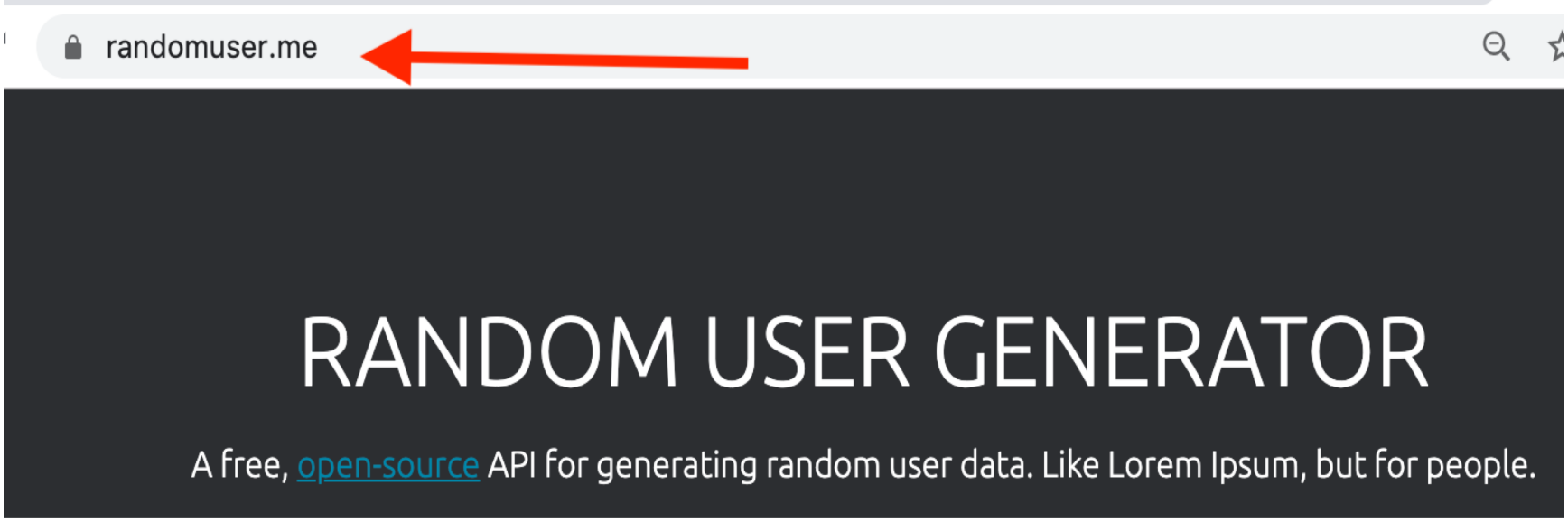
```
const nums = [12, 22, 5, 28]
 nums.forEach(
    (n, index, array) => {.      // Anonymous function
          console.log(`${n} at index ${index} of ${array}` )
    }
 )
```

[index **and** array **arguments are optional.**]

Output:

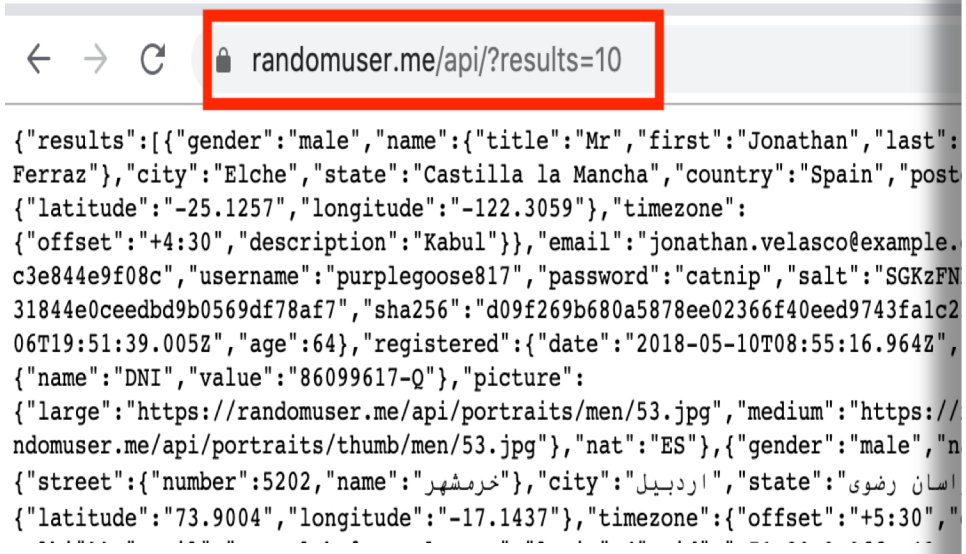
```
12 at index 0 of 12,22,5,28
22 at index 1 of 12,22,5,28
5 at index 2 of 12,22,5,28
 28 at index 3 of 12,22,5,28
```

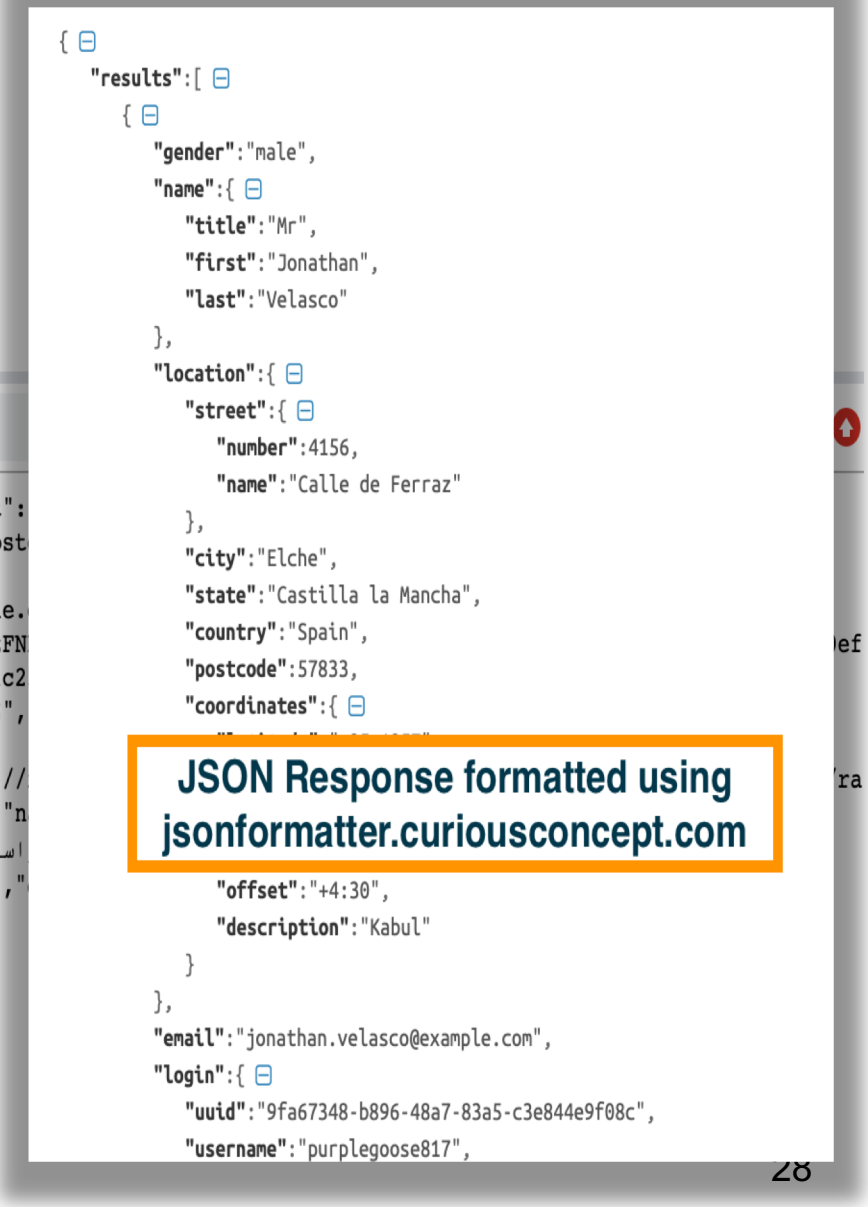
Array HOF demos context



- **Open Web API.**
- **Accepts HTTP GET requests, e.g.**
  https://randomuser.me/api/?results=10 - generate 10 user profiles.
- **Returns JSON response.**

Array HOF demos context





- **Ref functions/webAPI.js**

Array HOF demos.

- **filter()**
  - **Select entries from an array, based on some criteria.**
  - **Selected entries added to a new array.**
  - **Source array unchanged (Pure).**
  - **Ref. functions/03_filtering.js**

- **map()**
  - **Creates a new array with the results of calling a function for every array element.**
  - **Source array unchanged (Pure)**
  - **Ref. functions/04_mapping.js**

Array HOF demos.

- **reduce()**
  - **reduces the array to a** single accumulated value**. reduce() executes a provided function for each element of the array (from left-to-right). The return value of the function is stored in an accumulator (result/total). The parameters of reduce() are: accumulator from the previous function call; current array element, current index and full array.**

```
sourceArray.reduce(
    (acc, element, index, array) => {
        . . . . . .
        return updatedAccumulator
    }, initialAccumulator )
```

Note initialAccumulator argument.

  - **Ref functions/05_reducing.js**

Summary

- **Representing Data / State**
  - **Primitives.**
  - **Objects.**
    - **Dynamic, nested.**
  - **Arrays.**
  - **String templates**

- **Defining Behavior.**
  - **Functions:**
    - **ES5 – Function declarations; Function expressions.**
    - **ES6 – Arrow functions. Shorthand.**
    - **Anonymous functions.**
    - **Higher Order functions.**