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Functional Programming in JS

“The” language of the Web

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JavaScript: The Definitive Guide, 7th Edition
Chapter 6. Array
Chapter 7.8 Functional Programming

JavaScript – The language of the Web

FUNCTIONAL PROGRAMMING

Functional programming: A brief overview

- A programming paradigm where the developer mostly construct and structure code using *functions*
  - not JavaScript's main oriented paradigm, but JavaScript is well suited
- More “declarative stile” rather than “imperative style” (e.g., for loops)
- Can improve program readability:

```
new_array = array.filter (
filter_function ) ;
```

```
new_array = [] ;
for (const el in list)
        if ( filter_function(el) )
                new_array.push(el) ;
```

Notable features of the functional paradigm

- Functions are *first-class* citizens
  - functions can be used as if they were variables or constants, combined with other functions and generate new functions in the process, chained with other functions, etc.
- *Higher-order functions*
  - a function that operates on functions, taking one or more functions as arguments and typically returning a new function
- Function *composition*
  - composing/creating functions to simplify and compress your functions by taking functions as an argument and return an output
- Call *chaining*
  - returning a result of the same type of the argument, so that multiple functional operators may be applied consecutively

Functional Programming in JavaScript

- JavaScript supports the features of the paradigm “out of the box”
- Functional programming requires *avoiding mutability*
  - i.e., do not change objects in place!
  - e.g., if you need to perform a change in an array, return a new array

Iterating over Arrays

- Iterators: `for ... of`, `for (..;..;..)`
- Iterators: `forEach(f)`
  - Process each element with callback f
- Iterators: `every(f)`, `some(f)`
  - Check whether all/some elements in the array satisfy the Boolean callback `f`
- Iterators that return a new array: `map(f)`, `filter(f)`
  - Construct a new array
- Reduce: callback function on all items to progressively compute a result

```
reduce(callback( accumulator, currentValue[, index[, array]] )[, initialValue])
```

Functional style

.forEach()

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Array/forEach

- `forEach()` invokes your (synchronous) callback function once for each element of an **iterable**

```
const letters = [..."Hello world"] ;
let uppercase = "" ;
letters.forEach(letter => {
  uppercase += letter.toUpperCase();
});
console.log(uppercase); // HELLO WORLD
```

.forEach()

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Array/forEach

- `forEach()` invokes your (synchronous) callback function once for each element of an **iterable**
  - The callback may have 3 parameters
    - `currentValue`: The current element being processed in the array.
    - `index` (Optional): The index of `currentValue` in the array
    - `array` (Optional): The array forEach() was called upon.
  - Always **returns *undefined*** and is **not chainable**
  - No way to stop or break a `forEach()` loop other than by throwing an exception
- `forEach()` does not mutate the array on which it is called
  - however, its callback *may* do so

.every()

- `every()` tests whether **all elements** in the array pass the test implemented by the provided function
  - Callback: Same 3 arguments as forEach
  - It returns a Boolean value (*truthy/falsy*)
  - It executes its callback once for each element present in the array until it finds the one where the callback returns a falsy value
    - If such an element is found, **immediately** returns false

```
let a = [1, 2, 3, 4, 5];
a.every(x => x < 10) // => true: all values are < 10
a.every(x => x % 2 === 0) // false
```

.some()

- some() tests whether **at least one** element in the array passes the test implemented by the provided function
  - It returns a Boolean value
  - It executes its callback once for each element present in the array until it finds the one where the callback returns a truthy value
    - if such an element is found, **immediately** returns true

```
let a = [1, 2, 3, 4, 5];
a.some(x => x%2===0) // => true; a has some even numbers

a.some(isNaN)
```

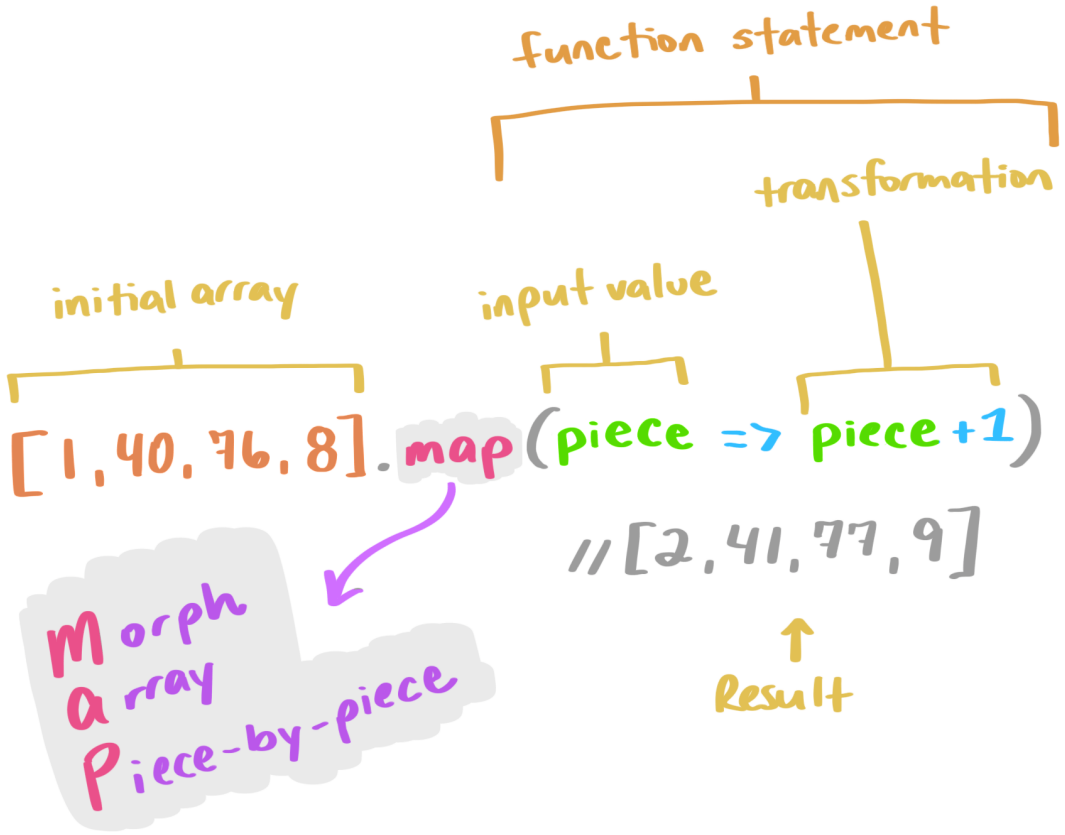
.map()

- `map()` passes each element of the **array** on which it is invoked to the function you specify
  - the callback should return a value
  - `map()` always returns **a *new* array** containing the values returned by the callback

```
const a = [1, 2, 3];

b = a.map(x => x*x);

console.log(b); // [1, 4, 9]
```

```
const letters = [..."Hello world"];

uppercase = letters.map(letter =>
letter.toUpperCase());

console.log(uppercase.join(''));
```

.map()



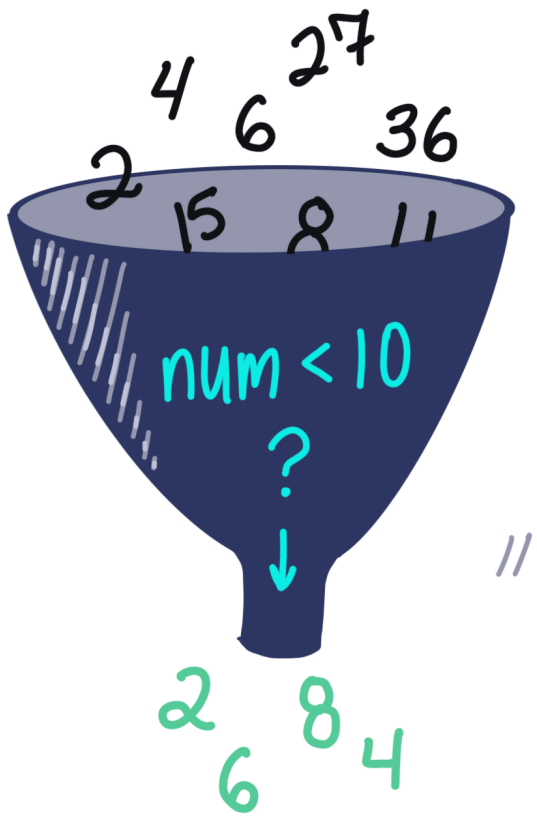
https://css-tricks.com/an-illustrated-and-musical-guide-to-map-reduce-and-filter-array-methods/

.filter()

- `filter()` creates **a *new* array** with all elements that pass the test implemented by the provided function
  - the callback is a function that returns either true or false
  - if no element passes the test, an empty array is returned

```
const a = [5, 4, 3, 2, 1];

a.filter(x => x < 3); // generates [2, 1], values less than 3

a.filter((element, index) => index%2 == 0); // [5, 3, 1]
```

.filter()




```
Const arr =
[15, 2, 8, 36, 11, 4, 6, 27]

Const smallNums =
  arr.filter(num => {
    return num < 10
  })

// smallNums =
[2, 8, 4, 6]
```

https://css-tricks.com/an-illustrated-and-musical-guide-to-map-reduce-and-filter-array-methods/

.reduce()

```
reduce(
        callback(accumulator, currentValue[, index[, array]])
        [, initialValue]
)
```

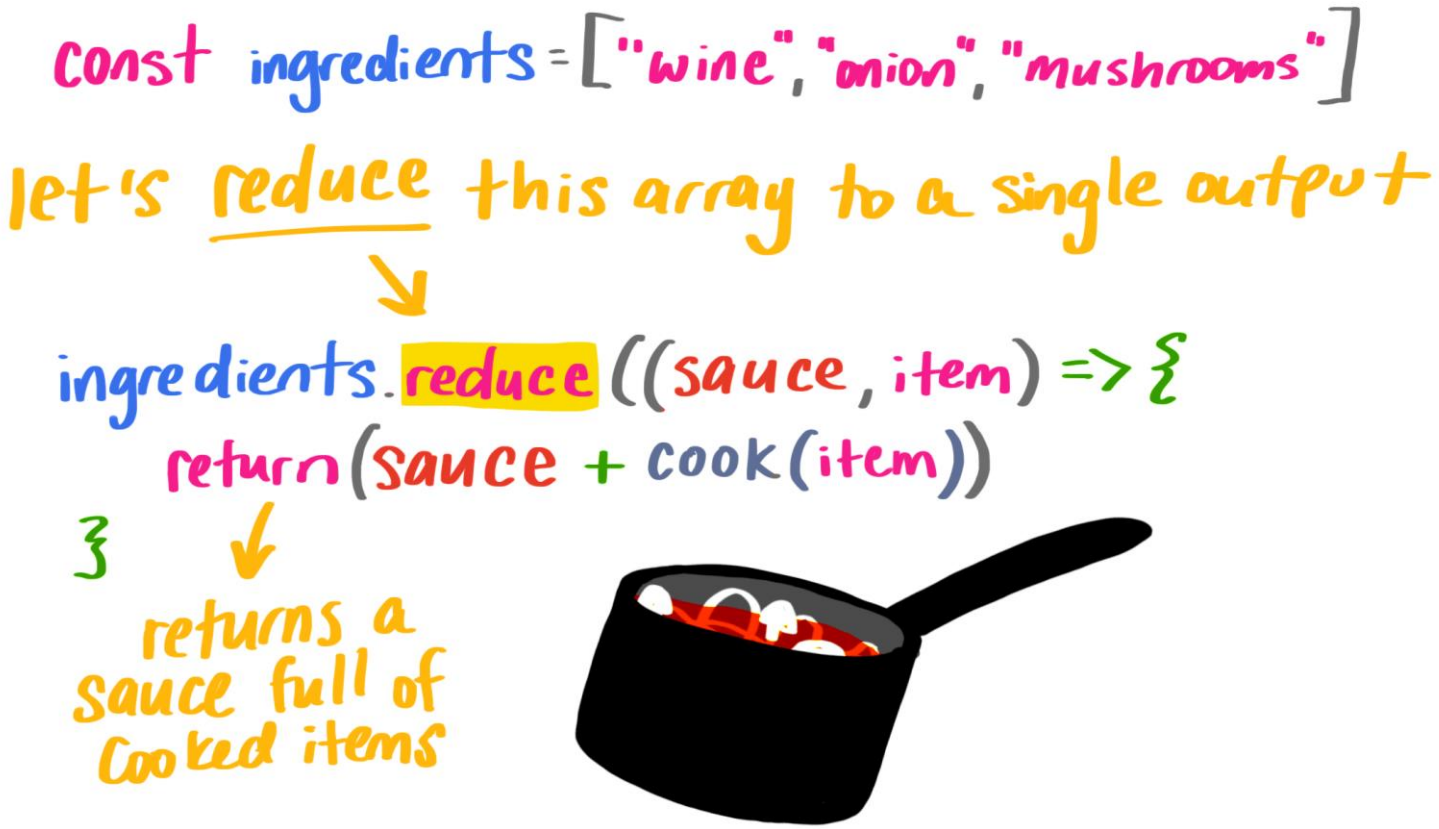
- `reduce()` combines the elements of an **array**, using the specified function, to produce **a *single* value**
  - this is a common operation in functional programming and goes by the names “inject” and “fold”
- `reduce` takes two arguments:
  1. the function (`callback`) that performs the reduction/combination operation (combine or **reduce 2 values into 1**)
  2. an (optional) **`initialValue`** to pass to the function; if not specified, it uses the first element of the array as initial value

.reduce()

- Callbacks used with `reduce()` are different than the ones used with `forEach()` and `map()`
  - the *first* argument of the callback (*reducer function*) is the accumulated result of the reduction so far
  - on the first call to this function, its first argument is the initial value
  - on subsequent calls, it is the value returned by the previous invocation of the reducer function

```
const a = [5, 4, 3, 2, 1];

a.reduce( (accumulator, currentValue) =>
accumulator + currentValue,     0);
// 15; the sum of the values


a.reduce((acc, val) => acc*val,  1);
// 120; the product of the values


a.reduce((acc, val) => (acc > val) ? acc
: val);
// 5; the largest of the values
```

.reduce()



https://css-tricks.com/an-illustrated-and-musical-guide-to-map-reduce-and-filter-array-methods/

Example: average price of all SUVs

```
const vehicles = [
  { make: 'Honda',  model: 'CR-V',     type: 'suv',   price: 24045 },
  { make: 'Honda',  model: 'Accord',   type: 'sedan', price: 22455 },
  { make: 'Mazda',  model: 'Mazda 6',  type: 'sedan', price: 24195 },
  { make: 'Mazda',  model: 'CX-9',     type: 'suv',   price: 31520 },
  { make: 'Toyota', model: '4Runner',  type: 'suv',   price: 34210 },
  { make: 'Toyota', model: 'Sequoia',  type: 'suv',   price: 45560 },
  { make: 'Toyota', model: 'Tacoma',   type: 'truck', price: 24320 },
  { make: 'Ford',   model: 'F-150',    type: 'truck', price: 27110 },
  { make: 'Ford',   model: 'Fusion',   type: 'sedan', price: 22120 },
  { make: 'Ford',   model: 'Explorer', type: 'suv',   price: 31660 }
];

const averageSUVPrice = vehicles
  .filter(v => v.type === 'suv')
  .map(v => v.price)
  .reduce( (sum, price, i, array) => sum + price / array.length, 0);

console.log(averageSUVPrice); // 33399
```

https://opensource.com/article/17/6/functional-javascript

Example: working with DOM elements

```
// Add event listener for click on all elements in a sidebar
document.querySelectorAll("#left-sidebar a").forEach(item => { // forEach works on any iterable
    item.addEventListener("click", (event) => {
      // toggle the clicked one
      event.target.classList.toggle("active");

      // Check which elem have "active" class, and return their id
      const nodeList = document.querySelectorAll("#left-sidebar a");

      // nodeList is not a "true" array (does not support map,filter,...), convert it
      const filterList = [...nodeList]    //or Array.from(nodeList)
        .filter(filtItem => filtItem.classList.contains("active"))
        .map(filtItem => filtItem.id);

      // filterList = e.g. ['filter-important', 'filter-private']
      do_action(filterList);
    });
});
```

Where To Go From Here…

- Going deeper in (or "enforcing") functional programming in JavaScript is out of scope for this course
- "JavaScript: The Definitive Guide, 7th Edition", chapter 7.8 provides some additional pointers
- Other interesting links:
  - https://www.freecodecamp.org/news/functional-programming-principles-in-javascript-1b8fc6c3563f/
  - https://medium.com/javascript-scene/master-the-javascript-interview-what-is-functional-programming-7f218c68b3a0

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