JavaScript 3

CS571: Building User Interfaces

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Before Lecture

- Clone today's code to your machine.

JavaScript 2 Recap

Callback Functions

`then` and `catch` take a *callback function* as an argument.

Definition: A *callback function* (sometimes called a *function reference*) is passed into another function as an argument, which is then invoked inside the outer function to complete a routine or action.

More on callback functions

`processUserInput` takes a *callback function*.

```
const name = prompt('Please enter your name.');
function processUserInput(callback) {
  alert("Incoming message!")
  callback(name);
}
function greeting1(name) {
  alert('Hello ' + name);
}
const greeting2 = (name) => {
  alert('Whats up ' + name);
}
processUserInput(greeting1);
processUserInput(greeting2);
processUserInput((name) => alert("Welcome " + name));
```

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fetch()

```
fetch(url)
  .then((response) => response.json()) // implict return
  .then((data) => {
    // fetch has already parsed data from JSON to a JS object!
    // Do something with the data
  })
  .catch(error => console.error(error)) // Print errors
```

Fetching Jokes

Declarative vs Imperative Programming

We typically prefer *declarative* programming over *imperative* programming.

Declarative vs Imperative Programming

Declarative array functions include `forEach`, `map`, `slice`, `concat`, `filter`, `some`, `every`, and `reduce`.

Last time we learned about `forEach`, `filter`, and `map`. Today we'll learn about `slice`, `concat`, `some`, `every`, and `reduce`!

Warmup Problem

Given the following array, narrow the elements down such that we only keep elements that are numbers.

```
const things = ["dogs", 1.2, 0, false, {name: "Alice"}, -7]
```

Can you do this *imperatively*? Use `for (... of ...)`

Can you do this *declaratively*? Use `filter`

Warmup Imperative Solution

```
let newThings = [];
for(let thing of things) {
  if (typeof thing === 'number') {
    newThings.push(thing);
  }
}
```

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Warmup Declarative Solution

Using a Named Function

```
function isANumber(something) {
  return typeof something === 'number'
}

let newThings1 = things.filter(thing => isANumber(thing))
let newThings2 = things.filter(isANumber)
```

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Warmup Declarative Solution

Using an Anonymous Function

```
// Explicit Return
let newThings3 = things.filter((thing) => {
 return typeof thing === 'number'
})

// Implicit Return
let newThings4 = things.filter((thing) => typeof thing === 'number')
```

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Which is best?

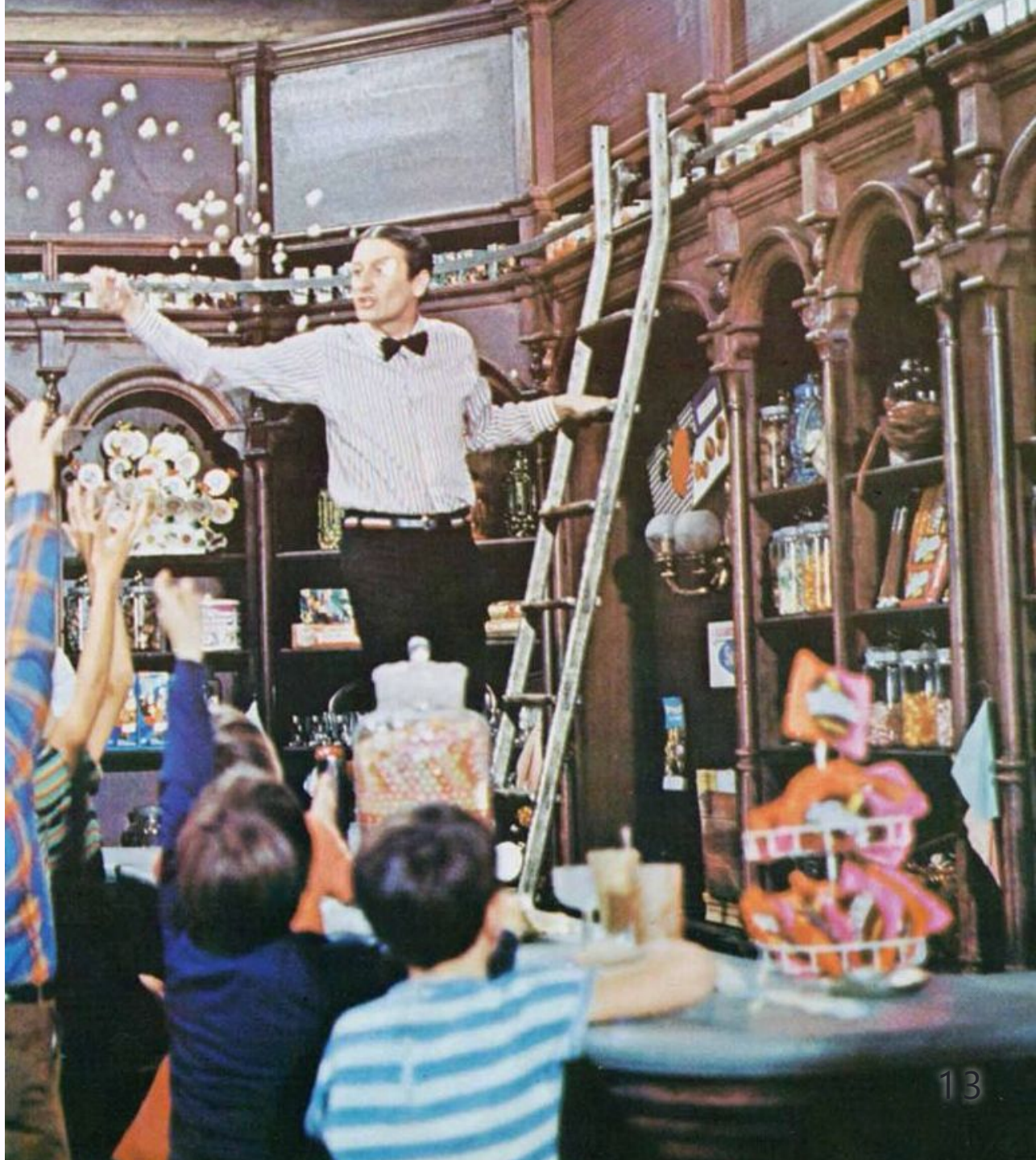
Are you going to re-use the same logic?

➜ Use named function

Is it one and done?

➜ Use anon function

Image from Willy Wonka (1971)



What will we learn today?

- How to use other declarative functions?
- How to use spreading and null coalescing?
- How to perform data copying?
- How to work with CSS libraries?

`slice(begI, endI)` and `concat(arr)`

`slice` returns a shallow copy with an optional beginning (inclusive) and ending (exclusive) index.

```
["apple", "banana", "coconut", "dragonfruit"].slice(1, 3); // ["banana", "coconut"]
```

`concat` joins two arrays together.

```
["apple"].concat(["banana", "coconut"]); // ["apple", "banana", "coconut"]
```

`some(cb)` and `every(cb)`

`some(cb)` returns `true` if the callback returns true for *some* element of the array, `false` otherwise.

```
["sam", "jacob", "jess"].some(p => p === "jess"); // true!
```

`every(cb)` returns `true` if the callback returns true for *every* element of the array, `false` otherwise.

```
["sam", "jacob", "jess"].every(p => p === "jess"); // false!
```

Your turn!

Fetch data from our API and do "interesting" things!

```
https://cs571.org/api/f23/weekly/week03
```

1. Can you get this data in Postman? How about using JavaScript?
2. What were the names of the first 3 presidents?
3. Was there *some* president named Thomas?
4. Were *all* the presidents born in the 18th century?

`reduce(cb, start)`

`reduce` takes a 2-parameter callback (previous and current values) and a starting value.

```
[2, 4, -1.1, 7.2].reduce((prev, curr) => prev + curr, 1.2); // 13.3
```

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Building Objects with `reduce`

```
const fruits = ['apple', 'banana', 'apple', 'orange', 'banana', 'apple'];
const countObj = fruits.reduce((acc, curr) => {
  acc[curr] = (acc[curr] || 0) + 1;
  return acc;
}, {});
console.log(countObj); // Output: { apple: 3, banana: 2, orange: 1 }
```

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`...` Spread Operator

We can spread arrays...

```
const cats = ["apricat", "barnaby", "bucky", "colby"];

const newCats = [...cats, "darcy"];
```

`...` Spread Operator

```
const defs = {
  erf: "a plot of land",
  popple: "turbulent seas"
}

const newDefs = {
  ...defs,
  futz: "waste of time"
}
```

... and also objects! These are both *shallow* copies.

Building Objects with `reduce` and `...`

```
const fruits = ['apple', 'banana', 'apple', 'orange', 'banana', 'apple'];
const countObj = fruits.reduce((acc, curr) => {
  return {
    ...acc,
    [curr]: (acc[curr] || 0) + 1
 // ^^^^^^ is replaced with apple, banana, or orange
  }
}, {});
console.log(countObj); // Output: { apple: 3, banana: 2, orange: 1 }
```

`??` Null Coalescing Operator

If left-hand is `null` or `undefined`, use right-hand.

```
const IS_ENABLED = env.IS_ENABLED ?? true;

const USERNAME = document.getElementById("username").value ?? "";
```

How does this compare to ternary?

```
const IS_ENABLED = env.IS_ENABLED ? env.IS_ENABLED : true; // always true!
```

Try it on MDN

Note: JavaScript changes quickly!

Both `...` (ES6/ES2015) and `??` (ES2020) are not yet supported by PythonTutor!

Your turn!

Using the same presidential data...

1. How many terms were served in total?
2. What are the unique political parties?
3. Construct an object mapping president name to political affiliation.

Data Copying

Why would we need to copy?

- We ❤️ using spread operator (see React!).
- Copying a template object.
- Passing an object to function where we don't want the object to be modified.
- Data safety.

Data Copying

`json.parse` and `json.stringify` can be useful for deep data copying.

```
let dog = ... // some complex data we wish to preserve
let newDog = JSON.parse(JSON.stringify(dog));

newDog.age = 2                  // does not change dog's age!
newDog.name.first = "Thomas"; // does not change dog's name!
```

When is deep copying with JSON.parse and JSON.stringify an issue?

lodash is the preferred way to copy

Data Copying

Sometimes we wish to make copies of data, e.g. we want to duplicate an array of student objects.

1. Reference Copy
2. Shallow Copy
3. Deep Copy

Recall: Variables are containers -- they contain a primitive value or a *pointer* to an object.

Reference Copy

What will the output be?

```
let myBasket = {
  basketId: 154,
  items: ["Apples", "Bananas", "Grapes"]
};
let myRefCopyBasket = myBasket; // *
myRefCopyBasket.basketId = 999;
myRefCopyBasket.items.push("Zucchinis");

console.log(myBasket);
console.log(myRefCopyBasket);
```

Interactive Exercise

Reference Copy

```
let myBasket = {
  basketId: 154,
  items: ["Apples", "Bananas", "Grapes"]
};
let myRefCopyBasket = myBasket; // *
myRefCopyBasket.basketId = 999;
myRefCopyBasket.items.push("Zucchinis");

console.log(myBasket);
console.log(myRefCopyBasket);
```

```
{basketId: 999, items: ['Apples', 'Bananas', 'Grapes', 'Zucchinis']}
{basketId: 999, items: ['Apples', 'Bananas', 'Grapes', 'Zucchinis']}
```

Shallow Copy

What will the output be?

```
let myBasket = {
  basketId: 154,
  items: ["Apples", "Bananas", "Grapes"]
};
let myShallowCopyBasket = {...myBasket}; // *
myShallowCopyBasket.basketId = 999;
myShallowCopyBasket.items.push("Zucchinis");

console.log(myBasket);
console.log(myShallowCopyBasket);
```

Interactive Exercise

Shallow Copy

```
let myBasket = {
  basketId: 154,
  items: ["Apples", "Bananas", "Grapes"]
};
let myShallowCopyBasket = {...myBasket}; // *
myShallowCopyBasket.basketId = 999;
myShallowCopyBasket.items.push("Zucchinis");

console.log(myShallowCopyBasket);
console.log(myRefCopyBasket);
```

```
{basketId: 154, items: ['Apples', 'Bananas', 'Grapes', 'Zucchinis']}
{basketId: 999, items: ['Apples', 'Bananas', 'Grapes', 'Zucchinis']}
```

Deep Copy

What will the output be?

```
let myBasket = {
  basketId: 154,
  items: ["Apples", "Bananas", "Grapes"]
};
let myDeepCopyBasket = JSON.parse(JSON.stringify(myBasket)); // *
myDeepCopyBasket.basketId = 999;
myDeepCopyBasket.items.push("Zucchinis");

console.log(myBasket);
console.log(myDeepCopyBasket);
```

Interactive Exercise

Deep Copy

```
let myBasket = {
  basketId: 154,
  items: ["Apples", "Bananas", "Grapes"]
};
let myDeepCopyBasket = JSON.parse(JSON.stringify(myBasket)); // *
myDeepCopyBasket.basketId = 999;
myDeepCopyBasket.items.push("Zucchinis");

console.log(myBasket);
console.log(myDeepCopyBasket);
```

```
{basketId: 154, items: ['Apples', 'Bananas', 'Grapes']}
{basketId: 999, items: ['Apples', 'Bananas', 'Grapes', 'Zucchinis']}
```

Working with CSS Libraries

What are CSS Libraries?

Definition: Software libraries that abstract away the low-level CSS implementation of user-facing elements.

Some popular libraries include...

- Bootstrap
- Foundation
- Semantic UI
- Pure
- UIkit

Bootstrap

getbootstrap.com

Why does the web look alike?

Many, many, many (new) websites use Bootstrap!

OHWL

Partner Finder

CS571

Bootstrap: get (oneself or something) into or out of a situation using existing resources.

Oxford Dictionary

How Bootstrap Works

Bootstrap provides us with...

- Layouts
- Content
- Components
- Utilities

There is much more!

Bootstrap Categories: Layouts

Containers are the most basic element of layouts.

```
<div class="container">
  ...
</div>
```

```
<div class="container-fluid">
  ...
</div>
```

Grids

Often, containers will contain **rows** and **columns** to form a grid...

```
<div class="container">
  <div class="row">
    <div class="col-*"></div>
    <div class="col-*"></div>
  </div>
</div>
```

Where `*` is the *column span*.

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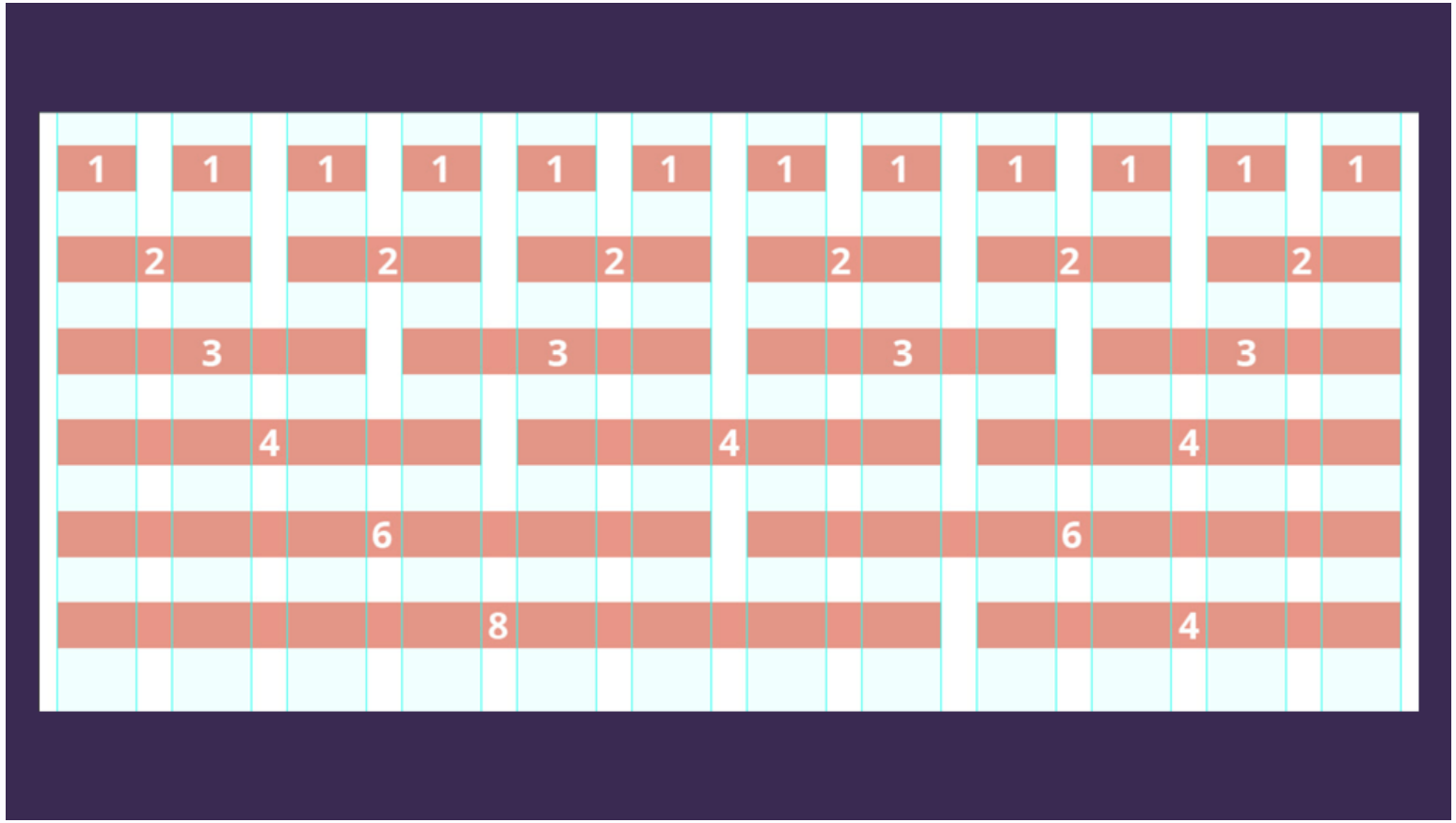
Grid System



Medium

Responsive Design

Definition: Responsive design adapts content to a variety of devices and screen sizes.

Width breakpoints determine whether the design will scale or be reorganized.

InVision

Responsive Design

What if we want our webpage to respond to different screen sizes, e.g. phone, tablet, and monitor?

```
<div class="container">
  <div class="row">
    <div class="col-12 col-md-6 col-lg-3"></div>
    <div class="col-12 col-md-6 col-lg-3"></div>
    <div class="col-12 col-md-6 col-lg-3"></div>
    <div class="col-12 col-md-6 col-lg-3"></div>
  </div>
</div>
```

Responsive Design Example

	Extra small <576px	Small ≥576px	Medium ≥768px	Large ≥992px	Extra large ≥1200px
Max container width	None (auto)	540px	720px	960px	1140px
Class prefix	`.col-`	`.col-sm-`	`.col-md-`	`.col-lg-`	`.col-xl-`
# of columns	12				
Gutter width	30px (15px on each side of a column)				
Nestable	Yes				
Column ordering	Yes				

Bootstrap Categories: Content

Content styling includes basic HTML elements, typography, code, images, tables, figures.

Basic HTML examples:

```
<h1></h1>
<ul></ul>
<input/>
<button></button>
```

These will get the default Bootstrap styling.

Styling of other elements

```
<img src="..." class="img-fluid">
```

```
<table class="table">
  <thead class="thead-dark">
    <tr>
      <th scope="col">...</th>
      ...
```

```
<div class="table-responsive-sm">
  <table class="table">
  ...
```

Bootstrap Categories: Components

Components include all other visual/interactive elements that make up the design, e.g., buttons, forms, navbar, tooltips, etc.

```
<button type="button" class="btn btn-primary">Fill button</button>

<button type="button" class="btn btn-outline-primary">Outline button</button>

<div class="btn-group-toggle" data-toggle="buttons">
  <label class="btn btn-secondary active">
    <input type="checkbox" checked autocomplete="off"> Switch
  </label>
</div>
```

Bootstrap Categories: Utilities

Utilities are not elements themselves, but they modify/control other elements, e.g., adding rounded corners to an image.

```
<img src="..." class="rounded">
```

```
<div class="shadow p-3 mb-5 bg-white rounded">Shadow</div>
```

Example Home Page

See in CodePen

Also, see cs571.org for responsive design.

Additional Resources

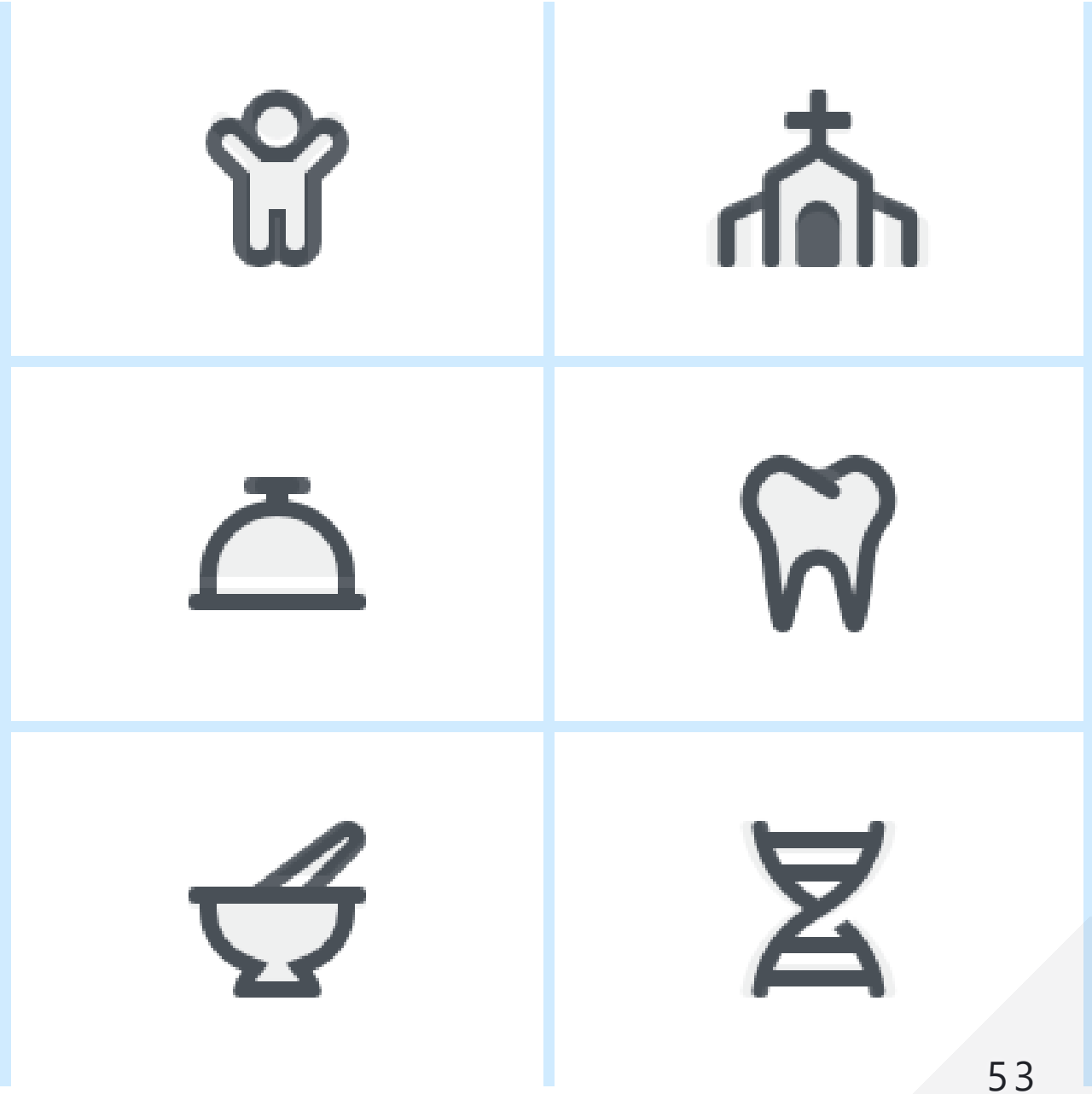
- Bootstrap Documentation
- Tutorial Republic
- W3 Schools

Assets

Asset libraries, e.g., icons, are usually used in conjunction with frameworks such as Bootstrap.

See icon libraries.

Image Source



Questions?