JavaScript Classes

Constructor, Properties, Methods, Getters, Setters

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Table of Contents

Defining Classes

Constructor, Properties, Accessors

Class Definition

- **Structure** for objects
- Classes define:
  - **Data** (properties, attributes)
  - **Actions** (behavior)
- One class may have **many instances** (objects)
- Unlike functions, class declarations are **not hoisted**!

Class Body

- The class body contains **method definitions**

```
class Circle {
    constructor(r) {
        this.r = r;
    }
};
```

- The **constructor** is a special method for **creating** and **initializing** an object created with a class
- Instance **properties** are defined inside the **constructor**

Class Methods

- A class may have **methods**, which will be available to its **instances**

```
class Rectangle {
  constructor(height, width) {
    this.height = height;
    this.width = width;
  }
  // Method
  calcArea() { return this.height * this.width;  }
}
const square = new Rectangle(10, 10);
console.log(square.calcArea()); // 100
```

Instance Context

- **this** refers to the **instance** of the class

```
class Person {
  constructor(firstName, lastName) {
    this.firstName = firstName;
    this.lastName = lastName;
  }

  displayName() {
    console.log(`Name: ${this.firstName} ${this.lastName}`);
  }
};

const person = new Person("John", "Doe");
person.displayName();  // Name: John Doe
```

Problem: Person

- Write a **class** that represent a personal record
- It needs to have the following properties:
  - **firstName**, **lastName**, **age** and **email**
- And a **toString()** method

```
let person = new Person('Anna', 'Simpson', 22, 'anna@yahoo.com');
console.log(person.toString());
// Anna Simpson (age: 22, email: anna@yahoo.com)
```

Check your solution here: https://judge.softuni.org/Contests/Practice/Index/2766#0

Solution: Person

```
class Person {
    constructor(fName, lName, age, email) {
        this.firstName = fName;
        this.lastName = lName;
        this.age = age;
        this.email = email;
    }
    toString() {
        return `${this.firstName} ${this.lastName}
                (age: ${this.age}, email: ${this.email})`
    }
}
```

Instanceof Operator

- The **instanceof** operator returns **true** if the given object is an **instance** of the specified class

```
const circle = new Circle(5);

console.log(circle instanceof Circle); // true
console.log(circle instanceof Object); // true
console.log(circle instanceof String); // false
console.log(circle instanceof Number); // false
```

Static Methods

- The **static** keyword defines a **static method** for a class

```
class MyClass {
  static staticMethod() { return 'Static call'; }
}
```

- Static methods are **part of the class** and not of its instances

```
console.log(MyClass.staticMethod())
```

- They can **only** access other static methods via **this** context

```
static anotherStaticMethod() {
    return this.staticMethod() + ' from another method';
}
```

Problem: Point Distance

- Write a **class** representing a **Point** in the plane
  - Properties **x** and **y**, set through the **constructor**
  - **Static** method **`distance()`**
    - Takes **two parameters** of type **Point**
    - Returns **Euclidian distance** between them

Check your solution here: https://judge.softuni.org/Contests/Practice/Index/2768#3

Solution: Point Distance

```
class Point {
    constructor(x, y) {
        this.x = x;
        this.y = y;
    }

    static distance(p1, p2) {
        const dx = p1.x - p2.x;
        const dy = p1.y - p2.y;
        return Math.sqrt(dx ** 2 + dy ** 2);
    }
}
```

Accessor Properties

- Accessor properties are **methods** that **mimic values**
  - Keywords **get** and **set** with **matching identifiers**
  - They can be **accessed** and **assigned** to like properties

```
class Circle {
  constructor(r) { this.radius = r; }

  get area() {
    return Math.PI * (this.radius ** 2);
  }
}

const circle = new Circle(5);
console.log(circle.area); // 78.5398…
```

Accessing value without brackets

Accessor Properties Example

Property getter

Property setter

Read-only property area

```
class Circle {
  constructor(radius) { this.radius = radius; }
  get diameter() { return 2 * this.radius; }
  set diameter(value) {
    this.radius = value / 2;
  }
  get area() {
    return Math.PI * (this.radius ** 2);
  }
}

let c = new Circle(2);
c.diameter = 1.6;
console.log(`Radius: ${c.radius}`); // 0.8
console.log(`Diameter: ${c.diameter}`); // 1.6
console.log(`Area: ${c.area}`); // 2.0106…
```

Accessor Properties Application

- Accessors are often used for **validation**
  - The **setter** can verify that a **given value** meets requirements

```
set diameter(value) {
  if (value <= 0) {
    throw new Error('Diameter must be positive');
  }
  this.radius = value / 2;
}
```

- Properties **without** a setter are **read-only** (cannot be assigned)
- Getters can be used for a **validated** or **calculated** property

DOM Classes

Methods and Attributes

Review: DOM Elements as Class Instances

- All DOM objects are **instances** of standard DOM classes
  - Always created via **factory functions**, instead of with **new**

```
const divElement = document.createElement('div');
console.log(divElement instanceof HTMLDivElement); // true
```

- They provide many useful methods and properties
  - Already seen: **addEventListener**, **appendChild**, **remove**, **children**, **parentNode**, **textContent**, **value**, etc.

Additional DOM Methods

- **`cloneNode(deep)`** create a **duplicate** of the selected element
  - If ***deep*** is true, a **deep-copy** is created

```
const duplicate = divElement.cloneNode(true);
```

- **`replaceWith()`** **replaces** selected element with another

```
const span = document.createElement('span');
divElement.replaceWith(span);
```

- **`before()`** insert element before selected node
- **`after()`** insert element after selected node

Manipulate Element CSS Class

- **classList** - is a read-only property that returns a collection of the class attributes of specified element

```
<div id="myDiv" class="container div root"></div>
```

```
const element = document.getElementById('myDiv').classList;
// DOMTokenList(3)
["container", "div", "root", value: "container div root"]
```

Manipulate Element CSS Class

- **classList Methods**

```
<div id="myDiv" class="container div root"></div>
```

  - **add()** - Adds the specified class values

```
document.getElementById('myDiv').classList.add('testClass');
```

  - **remove()** - Removes the specified class values

```
document.getElementById('myDiv').classList.remove('container');
```

```
<div id="myDiv" class="div root testClass"></div>
```

HTML Attributes and Methods

- **getAttribute()** - returns the value of attributes of specified HTML element

```
<input type="text" name="username"/>
<input type="password" name="password"/>
```

```
const inputEle = document.getElementsByTagName('input')[0];
inputEle.getAttribute('type'); // text
inputEle.getAttribute('name'); // username
```

HTML Attributes and Methods

- **setAttribute()** - sets the value of an attribute on the specified HTML element

```
<input type="text" name="username"/>
<input type="password"/>
```

```
const inputPassEle = document.getElementsByTagName('input')[1];
inputPassEle.setAttribute('name', 'password');
```

```
<input type="text" name="username"/>
<input type="password" name="password"/>
```

HTML Attributes and Methods

- **removeAttribute()** - removes the attribute with the specified name from an HTML element

```
<input type="text" name="username" placeholder="Username..."/>
<input type="password" name="password" placeholder="Password..."/>
```

```
const inputPassEle = document.getElementsByTagName('input')[1];
inputPassEle.removeAttribute('placeholder');
```

```
<input type="text" name="username" placeholder="Username..."/>
<input type="password" name="password"/>
```

HTML Attributes and Methods

- **hasAttribute()** - method returns true if the specified attribute exists, otherwise it returns false

```
<input type="text" name="username" placeholder="Username..."/>
<input type="password" name="password" id="password"/>
```

```
const passwordElement = document.getElementById('password');
passwordElement.hasAttribute('name'); // true
passwordElement.hasAttribute('placeholder'); // false
```

- **dataset** obtain **DOMStringMap** of custom **data attributes**

Combining Elements and Behavior

- Classes can be used to **encapsulate** elements and behavior
  - Store **references** to DOM elements
  - Provide **event handlers**
  - **Methods** that **manipulate** the elements
- This is called the **Component Pattern**
  - Used in many **JS frameworks**, such as React, Vue, Angular
  - Used in the **Custom Web Component API**

Build-in Collections

What is a Map?

- A **Map** collection stores its elements in **insertion order**
- A for-of loop returns an array of **[key, value]** for each iteration
- Pure **JavaScript objects** are like **Maps** in that both let you:
  - Assign **values** to **keys**
  - Detect whether something is stored in a key
  - Delete keys

Adding / Accessing Elements

- `.set`(key, value) – adds a new key-value pair

```
let map = new Map();
map.set(1, "one"); // key - 1, value - one
map.set(2, "two"); // key - 2, value - two
```

- `.get`(key) – returns the value of the given key

```
map.get(2); // two
map.get(1); // one
```

- `.size` – **property**, holding the number of stored entries

Contains / Delete

- `.has(key)` - checks if the map has the given key

```
map.has(2); // true
map.has(4); // false
```

- `.delete(key)` - removes a key-value pair

```
map.delete(1); // Removes 1 from the map
```

- `.clear()` - removes all key-value pairs

Iterators

- `.entries()` - returns Iterator - array of **[key, value]**
- `.keys()` - returns Iterator with all the **keys**
- `.values()` - returns Iterator with all the **values**

```
let entries = Array.from(map.entries());
// [ [1, 'one'], [2, 'two'] ]
let keys = Array.from(map.keys()); // [1, 2]
let values = Array.from(map.values()); // ['one', 'two']
```

These methods return an Iterator, transform it into an Array

Iterating a Map

- To print a map simply use one of the **iterators** inside a **for-of**

```
let iterable = phonebookMap.keys();
for(let key of iterable) {
  console.log(`${key} => ${phonebookMap.get(key)}`);
}
```

```
for(let [key, value] of phonebookMap) {
  console.log(`${key} => ${value}`);
}
```

Map Sorting

- To **sort** a Map, first transform it into an **array**
- Then use the **sort()** method

Sort ascending by value

```
let map = new Map();
map.set("one", 1);
map.set("eight", 8);
map.set("two", 2);
let sorted = Array.from(map.entries())
                  .sort((a, b) => a[1] - b[1]);
for (let kvp of sorted) {
    console.log(`${kvp[0]} -> ${kvp[1]}`);
}
```

What is a Set?

- Store **unique values** of any type, whether **primitive** values or **object** references
- Set objects are **collections** of values

```
let set = new Set([1, 2, 2, 4, 5]);
// Set(4) { 1, 2, 4, 5 }
set.add(7)); // Add value
console.log(set.has(1));
// Expected output: true
```

- Can **iterate** through the elements of a set in **insertion** order

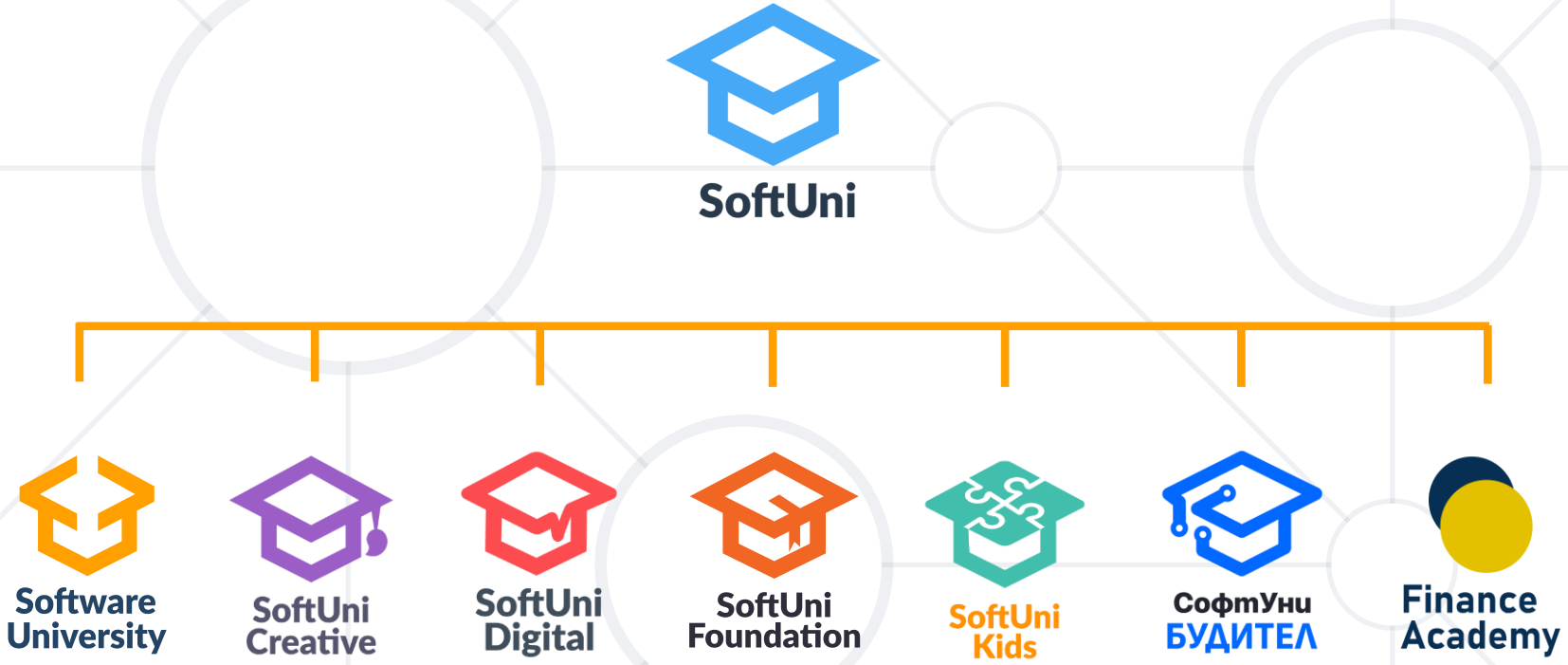
WeakMap and WeakSet

- **Special variants** of Map and Set
- Their elements **do not** count as **active** references
  - Reference types visible (in **scope**) in the program stack are **active**
  - Active references **remain in memory**
  - **Out-of-scope** references are **removed** by the **garbage collector**
- These collections are used in **memory-intensive** applications

Summary

- Classes - structure for objects, that may define
  - Constructors & Parameters
  - Methods & Properties
  - Getters & Setters
- DOM Classes: review and more
- Build-in Collections
  - Map & Set

Questions?



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