



OOP Using JavaScript

Outline

- JavaScript OOP
 - Object Literal using JSON
 - Class-based OOP
 - Object-Based Inheritance
- Prototype Chain
- Modules

JavaScript OOP

Properties & Methods

JavaScript OOP

- JavaScript object is a collection of **properties**
- An **object property** is association between a **name and a value**. A value can be either:
 - a **data** (e.g., a number or a string) or
 - a **method** (i.e., function)
- An object can be either instantiated from a class or it can be **created from another object**
- Classes and objects can be altered during the execution of a program

OOP in JavaScript

JavaScript has 3 ways to create an objects:

- **Object Literal**: create an object using JSON
- **Class-based OOP**: create a class then instantiate objects from the class
- **Object-Based Inheritance**: create objects from other objects
 - Creates new copies of objects from an existing object
 - Code reuse done by **cloning**

e.g, `let myCat = Object.create(animal);`

Object Literal using JSON

Create an Object Literal using JSON

```
let person = {  
  firstName: 'Samir',  
  lastName: 'Saghir',  
  height: 54,  
  getName () {  
    return `${this.firstName} ${this.lastName}`;  
  }  
};
```

```
//Two ways to access the object properties  
console.log(person['height'] === person.height);  
  
console.log(person.getName());
```

Creating an object using {} or new Object()

- Another way to create an object is to simply assigning {} to the variable

```
var joha = {}; //or new Object();
joha.name = "Juha Nasreddin";
joha.age = 28;

joha.toString = function() {
    return 'Name: ' + this.name + ', Age: '
        + this.age;
};
```

```
//Creating an object using variables
let name = 'Samir Saghir'; age = 25;
let person = {name, age};
```


Get, set and delete

- **get**

object.name

object[expression]

- **set**

object.name = value;

object[expression] = value;

- **delete**

delete object.name

delete object[expression]

JSON.stringify and JSON.parse

```
/* Serialise the object to a string in JSON  
   format -- only attributes getr serialised */
```

```
var jsonString = JSON.stringify(person);  
console.log(jsonString);
```

```
//Deserialise a JSON string to an object  
//Create an object from a string!
```

```
var personObject = JSON.parse(jsonString);  
console.log(personObject);
```

- More info <https://developer.mozilla.org/en-US/docs/JSON>

Destructuring Object

- Destructuring assignments allow to extract values from an object and assign them to variables in an easier way:

```
let person = {  
  name: 'Samir Saghir',  
  address: {  
    city: 'Doha',  
    street: 'University'  
  }  
};
```

```
let {name, address: {city}} = person;  
console.log(name, city);
```

Class-based OOP

Class-based OOP

- Class-based OOP uses classes

```
class Person {  
  constructor(firstname, lastname){  
    this.firstname = firstname;  
    this.lastname = lastname;  
  }  
  
  get fullname() {  
    return `${this.firstname} ${this.lastname}`;  
  }  
  
  set fullname(fullname) {  
    [this.firstname, this.lastname] = fullname.split(" ");  
  }  
  
  greet() {  
    return `Hello, my name is ${this.fullname}`;  
  }  
}
```

Constructor of the class

Getter, defines a
computed property

Method

Class-based Inheritance

- A class can extend another one

```
class Student extends Person {  
    constructor(firstname, lastname, gpa){  
        super(firstname, lastname);  
        this.gpa = gpa;  
    }  
    greet() {  
        return `${super.greet()}. My gpa is ${this.gpa}`;  
    }  
}
```

```
let student1 = new Student("Ali", "Faleh", 3.5);  
//Change the first name and last name  
student1.fullname = "Ahmed Saleh";  
console.log(student1.greet());
```

Object-Based Inheritance

Object-Based Inheritance

- Object-Based Inheritance enables creating objects from other objects (instead of creating them from classes)
 - Instead of creating classes, you **make prototype objects**, and then use the **Object.create(...)** to make new instances that inherit from the prototype object
 - Customize the new objects by adding new properties and methods
- We don't need classes to make lots of similar objects. **Objects inherit from objects!**

Object-Based Inheritance

- ◆ Create an object from another object! Clone an object then customize it. The cloned object inherits the properties and methods of the source object.
 - See ***7.object-based-inheritance.js*** example

```
let animal = {  
  eyes: 2,  
  legs: 4,  
  name: "Animal",  
  toString () {  
    return this.name + " with " + this.eyes + " eyes & " + this.legs + " legs."  
  }  
}
```

```
let myDog = Object.create(animal);  
myDog.name = "Max";  
//Add a new property to myDog object.  
myDog.avgLifeSpan = 13;  
myDog.speak = function() {  
  console.log(`${this.name}.speak... Woof, Woof`);  
}
```

Object.assign() method

- The **Object.assign()** method is used to merge one or more source objects to a target object while **replacing** values of properties with matching names.

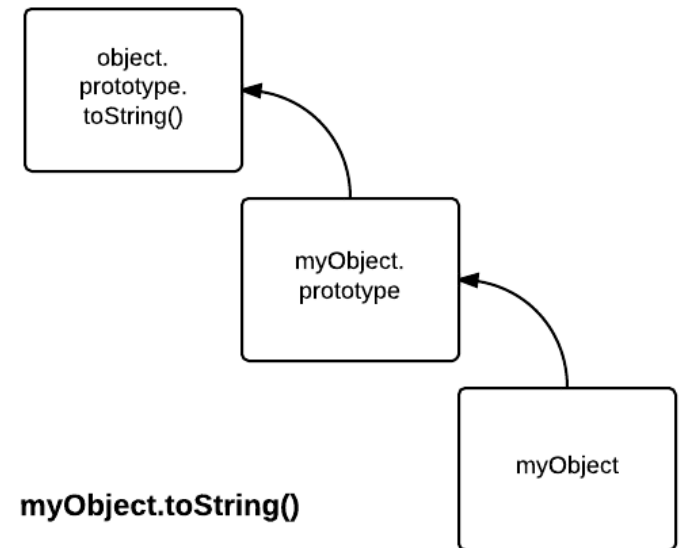
```
let movie1 = {  
  name: 'Star Wars',  
  episode: 7  
};
```

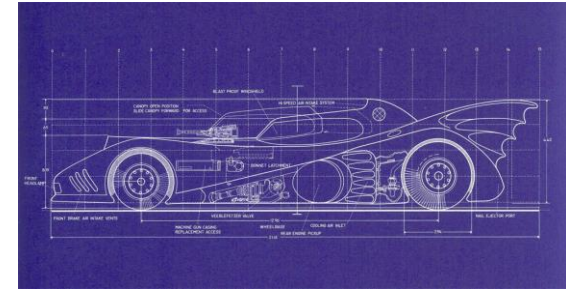
```
let movie2 = Object.assign({}, movie1, { episode: 8 });
```

```
console.log("\nmovie1.episode: ", movie1.episode); // writes 7  
console.log("movie1.episode: ", movie2.episode); // writes 8
```

Prototype Chain

```
▼ myCar: Car
  ▼ __proto__: Vehicle
    ▼ __proto__: Machine
      whoAmI: "I am a machine"
      ▼ __proto__: Machine
        ► constructor: function Machine() {
        ► __proto__: Object
```





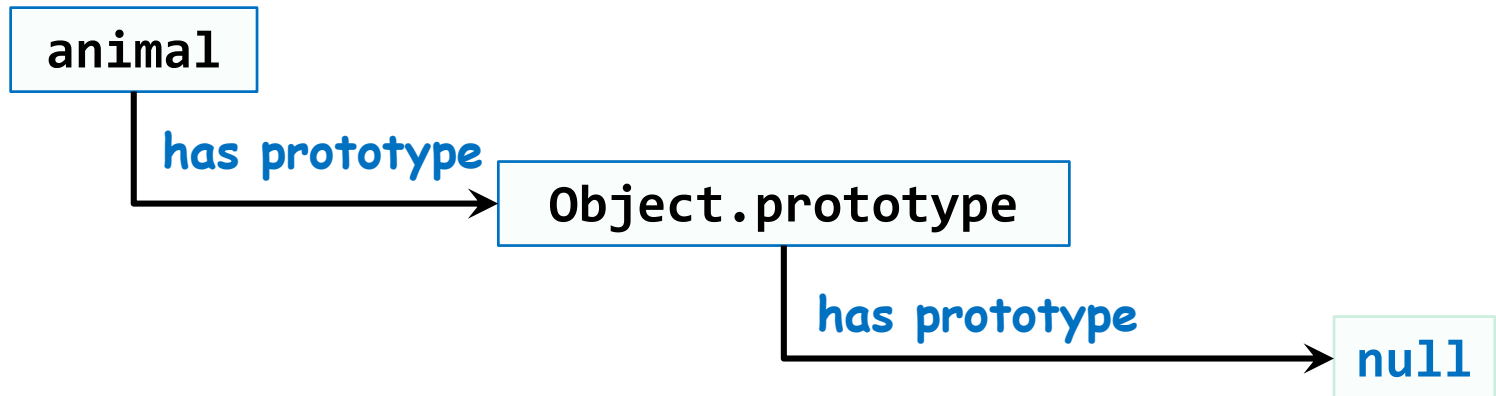
- Inheritance in JavaScript is based on the **Prototype Chain**
- Every object has a an internal **prototype** property pointing to another object or null. It can be used to:
 - **Extend a class** (i.e., add properties and methods to a class)
 - **Implement inheritance**
- Can be accessed using `Object.getPrototypeOf(obj)` method

Object Prototypes: Example

- Every object has its own prototype
 - By default, set to **Object.prototype**
 - This forms the so called "Prototype chain"
 - Object has for prototype null, ending the prototype chain

```
let animal = {  
  /* properties and methods */  
};
```

- ♦ The prototype chain is:



Prototype can be used to extend classes

- We can use the **prototype** object to add custom properties / methods to a class
 - That is reflected on all instances of the class
 - Simply reference the **prototype** property on the class before adding the custom property

See 6.inheritance2.js

```
class Circle {  
}  
Circle.prototype.pi = 3.14159;  
Circle.prototype.radius = 5;  
Circle.prototype.calculateArea = function () {  
    return this.pi * this.radius * 2;  
}  
let circle = new Circle();  
let area = circle.calculateArea();  
console.log(area); // 31.4159
```

Using **prototype** object to Add Functionality to Build-in Classes

- Dynamically add a function to a built-in class at runtime using the **prototype** object:

```
//adding a method to arrays to sum their number elements
Array.prototype.sum = function(){
  let sum = 0;
  for(let e of this){
    if(typeof e === "number"){
      sum += e;
    }
  }
  return sum;
}
```

Attaching a method to the Array class

Here **this** means the array

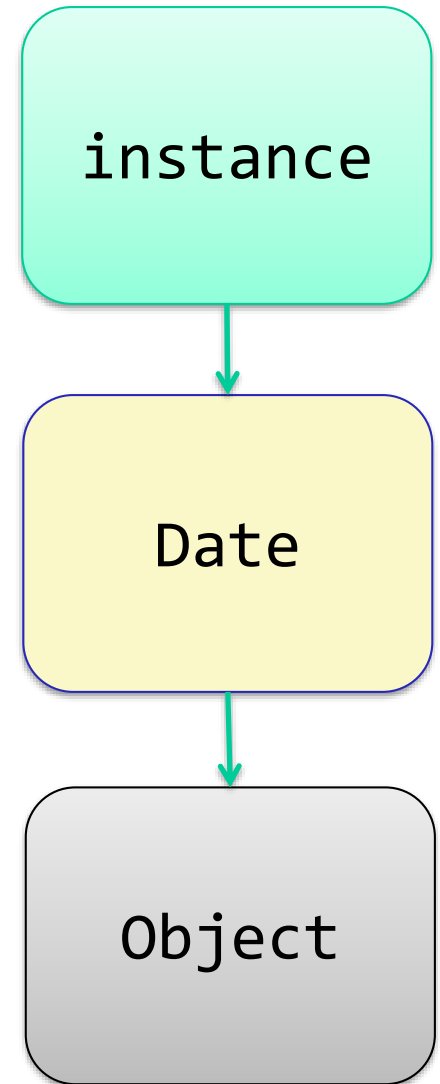
```
let numbers = [1,2,3,4,5];
console.log(numbers.sum()); //logs 15
```

The Prototype Chain

- Objects in JavaScript can have only a single prototype
 - Their prototype also has a prototype, etc...
 - This is called the **prototype chain**
- When a property is called on an object
 - This object is searched for the property
 - If the object does not contain such property, its prototype is checked for the property, etc...
 - If a null prototype is reached, the result is undefined

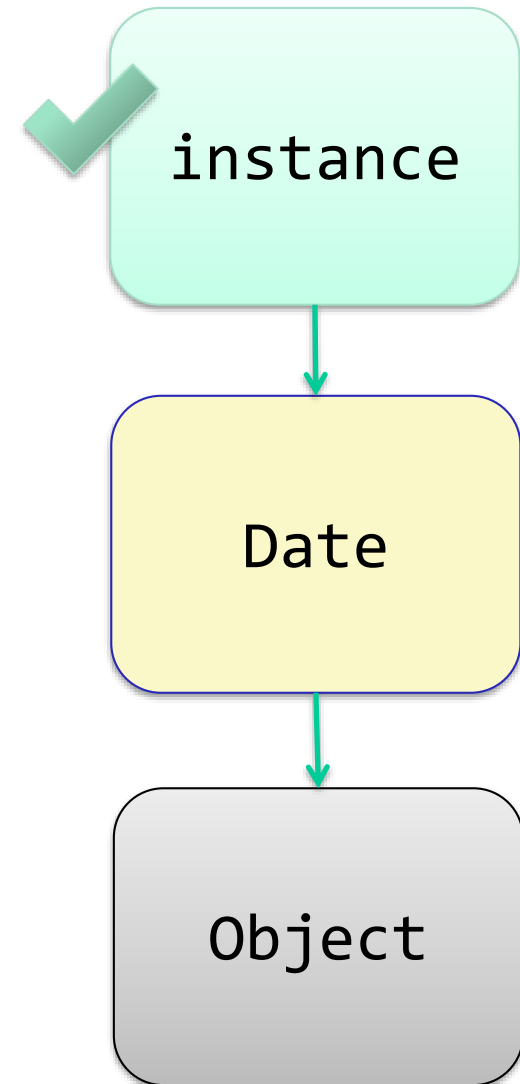
Property lookup chain

```
1 var instance = new Date();  
2 instance.foo = function() { alert("bar"); };  
3  
4 instance.foo();  
5 instance.getTime();  
6 instance.hasOwnProperty("foo");
```



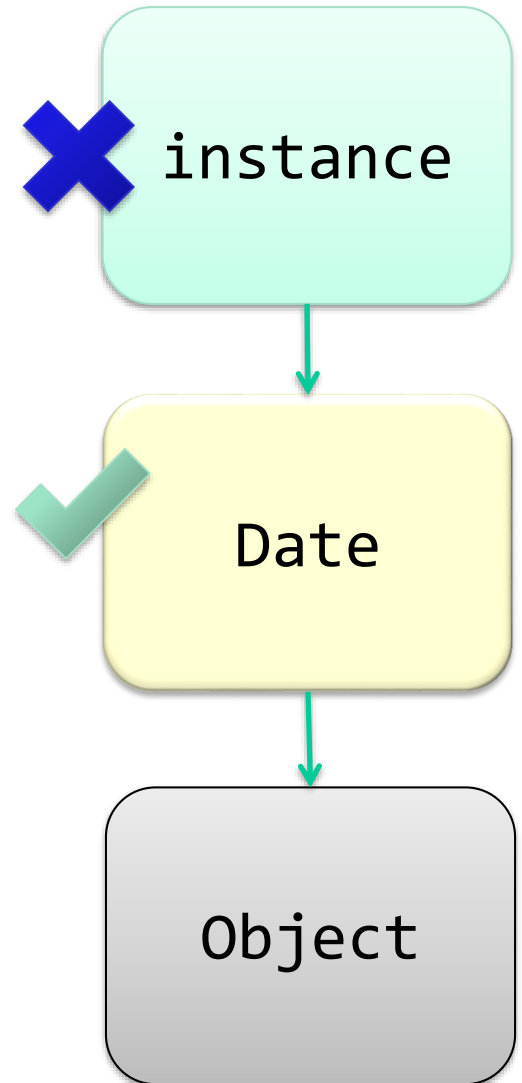
Property lookup chain (look up instance.foo)

```
1 var instance = new Date();
2 instance.foo = function() { alert("bar"); };
3
4 instance.foo();
5 instance.getTime();
6 instance.hasOwnProperty("foo");
7
8
9
10
11
12
```



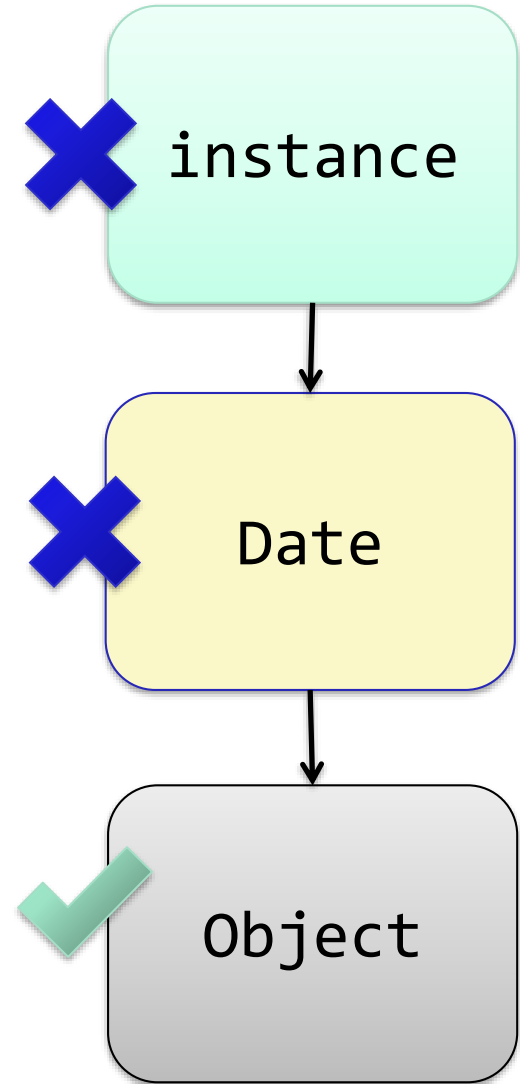
Property lookup chain (lookup instance.getTime)

```
1 var instance = new Date();  
2 instance.foo = function() { alert("bar"); };  
3  
4 instance.foo();  
5 instance.getTime();  
6 instance.hasOwnProperty("foo");
```



Property lookup chain (look up instance.hasOwnProperty)

```
1 var instance = new Date();  
2 instance.foo = function() { alert("bar"); };  
3  
4 instance.foo();  
5 instance.getTime();  
6 instance.hasOwnProperty("foo");
```



Modules

Node.js Modules

- An elegant way of encapsulating and reusing code
- Node has a simple module loading system: files correspond to modules

circle.js

```
//Export 2 functions to make functions available in other files  
exports.area = r => Math.PI * r * r;  
exports.circumference = r => 2 * Math.PI * r;
```

app.js

```
let circle = require('./circle.js');  
console.log('The area of radius 4: ' +  
            circle.area(4));
```

ES 2015 Modules

- ES2015 introduced new modules syntax
 - Each file decides what to **export** from its module
 - ES2015 modules are mainly use for client-side scripts. **Does not work yet with Node.js**

- Export the objects you want from a module:

```
// Car.js
```

```
export class Car { ... }
```

```
export class Convertible extends Car { ... }
```

- Use the module in another file:

```
// App.js
```

```
import {Car, Convertible} from 'Car';
```

```
let bmw = new Car();
```

```
let cabrio = new Convertible();
```

Resources

- Learn ES2015

<https://babeljs.io/learn-es2015/>

- Best ES 2015 eBook

<http://exploringjs.com/es6/>

- More Resources

<https://github.com/ericdouglas/ES6-Learning>