Object oriented JavaScript

Advanced Objects

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Object Oriented

Object Oriented Javascript

- JS is not a strictly Object Oriented language like Java, but can still be used in an OO-like way
- This approach is called prototype based
- Modern versions of JS, after ES6, have more OO concepts built into the language
- We shall see examples of both these approaches

Prototype based language

- JavaScript uses a different approach than C# or C++ to create an object-oriented language
- It is a prototype-based language
  - The concept of prototyping implies that behavior can be reused by cloning existing objects that serve as prototypes
- Every object in JavaScript descends from a prototype which defines a set of functions and members that the object can use
- There were no classes in Javascript before ES6, only objects
- Every object can then be used as a prototype for another object

Prototype example

```
// Canine is called a Constructor Function
// typeof Canine is 'function'
let Canine = function (latinName) {
  this.genus = 'Canis';
  this.latinName = latinName;
};



// Use the new keyword to create new instances of this "class"

let dog = new Canine('Canis familiaris'); // { genus: 'Canis', latinName: 'Canis familiaris' }

let greyWolf = new Canine('Canis lupus'); // { genus: 'Canis', latinName: 'Canis lupus' }
```

Prototype example

```
// add methods and properties to the prototype of the Constructor Function
// able to use them on all instances of the "class"

Canine.prototype.howl = function () {
  console.log('AAAAWWWOOOOOO');
};

dog.howl(); //  AAAAWWWOOOOOO
greyWolf.howl(); //  AAAAWWWOOOOOO
```

Prototype example

```
// adding methods and properties to an instance does not apply them to all instances

dog.fetch = function () {
  console.log('dog wants to play fetch!');
};
greyWolf.hunt = function () {
  console.log('grey wolf is hunting its prey');
};

dog.fetch(); //  dog wants to play fetch!
dog.hunt(); //  Error: dog.hunt is not a function

greyWolf.fetch(); //  Error: greyWolf.fetch is not a function
greyWolf.hunt(); //  grey wolf is hunting its prey
```

Prototype chains

Prototype chains

- Every object in Javascript has a **[[prototype]]**
- Technically this is a “hidden” property added to the object when it is defined or instantiated
- **note:**
  - **__proto__** is an accessor property that allows us to access the prototype
  - **never** use __proto__ because it is risky and might be deprecated

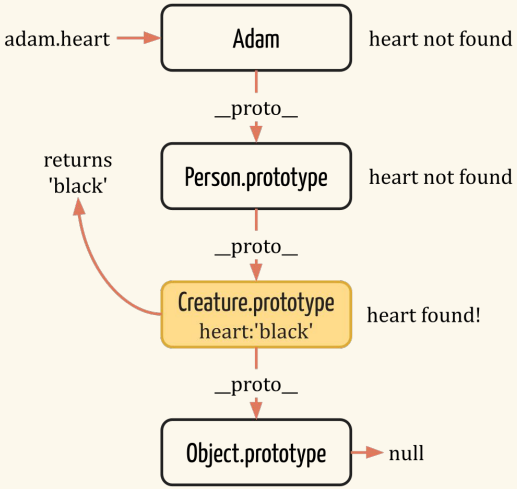
Prototype chains

- When a message reaches an object
  - JavaScript will attempt to find a property in that object first
  - If it cannot find it then the message will be sent to the object's prototype and so on
- This works just like single parent inheritance in a class based language

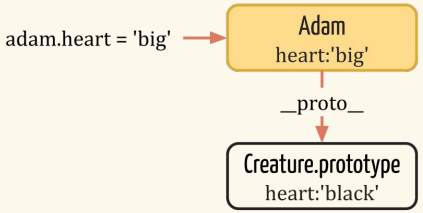
Prototype chains

Prototype chains

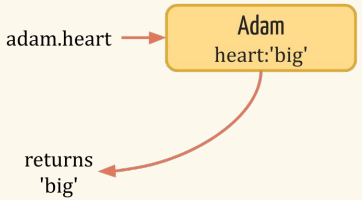
Get property: property not in object



Set property: new property on object



Get property: property now in object



Creating without constructors

Creating objects without a constructor

```
let person = {
  heart: 'black'
};

let adam = Object.create(person);
let sam = Object.create(person);

console.log(adam.heart); // black
console.log(sam.heart); // black
adam.heart = 'big';
console.log(adam.heart); // big
console.log(sam.heart); // black
```

References:

Object.create()

Never use __proto__ directly

```
// dog is a simple javascript object, not a constructor function
let dog = {
  happy: true
};

// create buck setting dog as the prototype
// Object.create() works a bit differently than using new
let buck = Object.create(dog);

console.log(buck.happy); // true

console.log(buck.__proto__); // { happy: true }


// __proto__ is an accessor property that allows us to access [[prototype]]
// it is unofficial, risky and might get deprecated
// used here only used here to explain how prototype inheritance works
```

Getting and setting the prototype

```
// Object.getPrototypeOf() and Object.setPrototypeOf() are safer to use than __proto__

console.log(Object.getPrototypeOf(buck) === dog); // true
Object.setPrototypeOf(buck, {}); // change the prototype of buck
```

References:

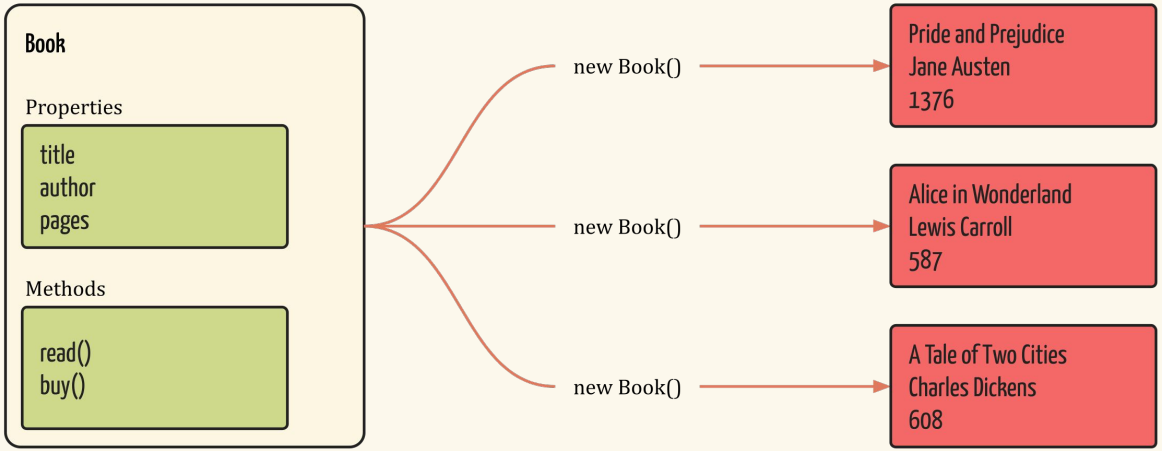
[The JavaScript Object Paradigm and Prototypes Explained Simply]
[Object.prototype.__proto__]
[Object.getPrototypeOf()]
[Object.setPrototypeOf()]

Creating objects

Creating Objects

Objects

Instances
Book is defined once
Each instance has the same properties and methods



Defining constructor functions and methods

```
// constructor function
function Book(title, author, numPages) {
  // The properties of this object
  this.title = title;
  this.author = author;
  this.numPages = numPages;
  this.currentPage = 0;
}

// adding a method to the prototype object
Book.prototype.read = function () {
  this.currentPage = this.numPages;
  console.log('You read ' + this.numPages + ' pages!');
};

// instantiating a new Book object
let book = new Book('Robot Dreams', 'Isaac Asimov', 320);
book.read();
```

How the reserved word new works

1. Creates a new Object
2. Creates and binds a new “this” to the object
3. Sets this new object's [[prototype]] to the value in the constructor function's prototype property
4. Executes the constructor function
5. Returns the newly created object

Cleaner Constructors

```
// better to pass a config object if many properties need to be set
function Book(config) {
  this.title = config.title;
  this.author = config.author;
  this.numPages = config.numPages;
  this.currentPage = 0;
}

let book = new Book({
  title: 'Robot Dreams',
  author: 'Isaac Asimov',
  numPages: 320
});
```

Optional Arguments

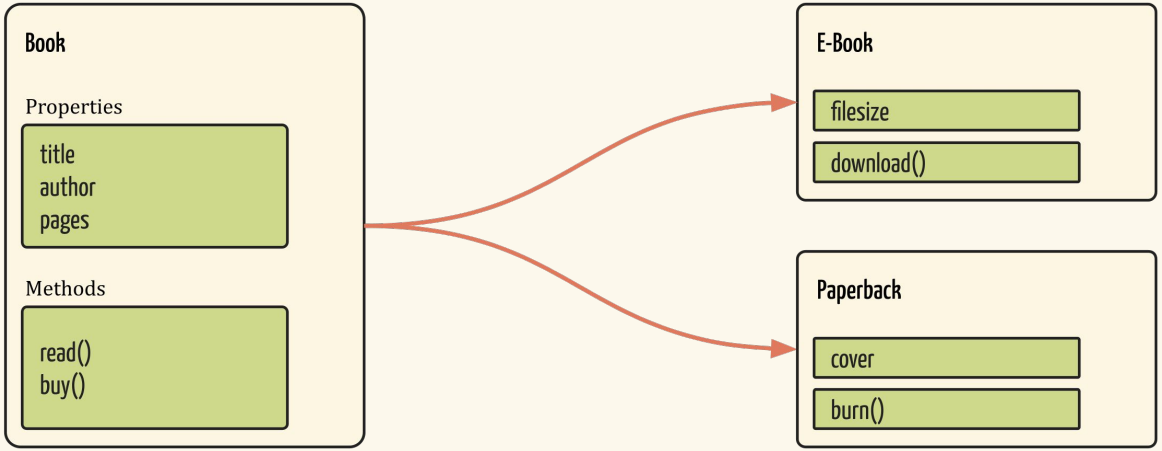
```
// some properties can be made optional by assigning default values
function Book(config) {
  this.title = config.title || 'Untitled';
  this.author = config.author || 'Unknown';
  this.numPages = config.numPages || 100;
  this.currentPage = 0;
}

let book = new Book({
  title: 'Robot Dreams',
  numPages: 320
});
```

Extending Objects

Inheritance

Objects can inherit properties and methods, implement parent methods differently and add new methods or properties



Extending Objects

```
// constructor function
function PaperBack(title, author, numPages, cover) {
  Book.call(this, title, author, numPages);
  this.cover = cover;
}
// extending the Book prototype object
PaperBack.prototype = Object.create(Book.prototype);

// adding a method to PaperBack's prototype object
PaperBack.prototype.burn = function () {
  console.log('Omg, you burnt all ' + this.numPages + ' pages');
  this.numPages = 0;
};

// instantiating a new PaperBack object
let paperback = new PaperBack('1984', 'George Orwell', 250, 'cover.jpg');
paperback.read();
paperback.burn();
```

Modern Javascript classes

A modern Javascript class

```
class Person {
 constructor(name) {
   this.name = name;
 }
 speak() {
   return 'My name is ' + this.name;
 }
}

class Teacher extends Person {
 speak() {
   return super.speak() + ', I am a teacher';
 }
}

let guy = new Teacher('James');
console.log(guy.speak());
```

Using class

```
// Book class
class Book {
 constructor(title, author, numPages) {
   this.title = title;
   this.author = author;
   this.numPages = numPages;
   this.currentPage = 0;
 }

 read() {
   this.currentPage = this.numPages;
   console.log('You read ' + this.numPages + ' pages!');
 }
}

// instantiating a new Book object
let book = new Book('Robot Dreams', 'Isaac Asimov', 320);
book.read();
```

Extending with classes

```
// PaperBack class
class PaperBack extends Book {
 constructor(title, author, numPages, cover) {
   super(title, author, numPages);
   this.cover = cover;
 }
 burn() {
   console.log('Omg, you burnt all ' + this.numPages + ' pages');
   this.numPages = 0;
 }
}

// instantiating a new PaperBack object
let paperback = new PaperBack('1984', 'George Orwell', 250, 'cover.jpg');
paperback.read();
paperback.burn();
```

Classes in modern Javascript

- Using classes makes the code simpler and similar to other programming languages
- Classes are not just syntactic sugar
    - they add a lot of features that are not possible with prototype inheritance in ES5

Static properties and methods

```
// static methods and properties are assigned to the class function itself, not to its "prototype"
class Car {
  constructor(color) {
    this.color = color; // this refers to the new instance
    Car.instances += 1;
  }

  static instances = 0;

  static getInstances = function () {
    return this.instances; // this refers to Car
    // return Car.instances; // could have used Car instead of this
  };
}

const cars = [new Car('red'), new Car('green'), new Car('orange')];
console.log(Car.getInstances()); // 3
```

Private properties and methods

```
class BankAccount {
  #widthdrawLimit = 500;

  #limitedWithdraw(amount) {
    if (amount < 0) return 0;
    if (amount > this.#widthdrawLimit) return this.#widthdrawLimit;
    return amount;
  }

  withdraw(amount) {
    return this.#limitedWithdraw(amount);
  }
}
```

Private properties and methods

```
let account = new BankAccount();

// can't access privates from outside of the class
account.#limitedWithdraw(123); // Error
account.#widthdrawLimit = 1000; // Error
console.log(account.withdraw(-40));
console.log(account.withdraw(40));
console.log(account.withdraw(600));
```

Note:
private properties are a recent addition to the language and still in the proposal stage
most new browsers already implement them, but the spec might change in the future

References:
Private class features

Simpler property syntax

```
const name = 'james';
const person = {
  name,
  age: 26
};

// same as
const name = 'james';
const person = {
  name: name,
  age: 26
};
```

Dynamic properties

```
const getStatus = function () {
  return 'employee';
};

const person = {
  name: 'adam',
  [getStatus() + '_' + 'number']: 13324
};

console.log(person.employee_number); // 13324
```

Your turn

1.DogSpeak

Add a method to the String prototype called dogSpeak() that works as follows:

```
let s = 'We like to learn';
s.dogSpeak();

'Dogs are smart'.dogSpeak();

// Console output
// We like to learn Woof!
// Dogs are smart Woof!
```

Think about the following question:
Is it a good idea to extend prototypes of built-in Javascript objects such as String, Array, etc?

2.Digital Age

- A Video has the following methods and properties
  - title (a string)
  - seconds (a number)
  - watch(x seconds [optional]) prints "You watched **X** seconds of **'TITLE'**" e.g. "You watched 120 seconds of 'Lord of the rings'". If x is missing prints "You watched all **SECONDS** seconds of **'TITLE'**" e.g. "You watched all 160 seconds of 'Lord of the rings'"
- A MusicVideo extends Video and has these extra methods and properties
  - artist (a string)
  - play() prints "You played **'TITLE'** by **'ARTIST'**" e.g. "You played 'Another Brick in the Wall' by 'Pink Floyd'"

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2.Digital Age

- Use the prototype method, not classes, to write a constructors for Video and MusicVideo
  - The constructor functions accept a single config object
  - All arguments are optional, use defaults if missing
- Create an array that contains a mix of Video and MusicVideo instances
- Loop on the Array and for each item
  - call the watch() method
  - call the play() method only if it's a MusicVideo. Hint: Use instanceof
- Optional:
  - in a new folder, repeat the exercise using the class syntax rather than the prototype method
  - All behaviors should be identical

3.Strange Kebab

Add a method to the String prototype called toStrangeKebab() that transforms strings to kebab-case

```
// Given the following array
const source = [
  'MyNameIsMyPassportVerifyMe',
  'My Name     Is   My Passport Verify Me MMM',
  '   -- -My?Name&*is**my$$Passport???p??',
  'mY--name---  is- - 2023---',
  'mynameismypassport',
  '2022 my name is',
  '2024-my-name-is'
];

source.forEach(item => console.log(item.toStrangeKebab()));
```

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3.Strange Kebab

The output should exactly match this:

```
my-name-is-my-passport-verify-me
my-name-is-my-passport-verify-me-m-m-m
my-name-is-my-passport-p
m-y-name-is-2023
mynameismypassport
my-name-is
my-name-is
```

Note:
This implementation of kebab-case is not standard. It was invented for this exercise
You might want to use regular expressions in your solution
[Regular expressions in JavaScript]
[Regex101]

Group work

4.Do we know ‘this’?

Create a short clear presentation to explain the ‘this’ keyword in Javascript

Refer to the following articles:
Understanding the "this" keyword in JavaScript
Gentle Explanation of "this" in JavaScript

Additional article:
Understand JavaScript’s “this” With Clarity, and Master It

You can skip the case of Call & Apply until you do the next exercise
Once you do the next exercise, complete this one

Notes:

- **English is prefered but Italian is also accepted**
- **You may do this exercise in groups of 2 people**
- **You may create a single presentation for this exercise and the next one**

5.Call, Apply and Bind

Create a short clear presentation to explain Call, Apply and Bind in Javascript

Refer to the following articles:
JavaScript .call() .apply() and .bind() — explained to a total noob
The Difference Between Call and Apply in Javascript

And method documentation:
Function.prototype.call()
Function.prototype.apply()
Function.prototype.bind()

Notes:

- **English is prefered but Italian is accepted also**
- **You may do this exercise in groups of 2 people**
- **You may create a single presentation for this exercise and the previous one**

References

JavaScript Constructor Function

JavaScript Prototype guide

JavaScript Prototypes

Object.create()

Classes

References

Older Prototype references

JavaScript Prototype in Plain Language

A Plain English Guide to JavaScript Prototypes

Simple Inheritance with JavaScript

Prototypes in JavaScript