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Corso	Web Developer
Unità Formativa	Programmazione - Javascript e Typescript
Argomento	Specificato nel titolo della slide successiva

Object oriented

Advanced Objects

Shadi Lahham - Web development

Object Oriented

Object Oriented Javascript

- JavaScript used to not be fully object-oriented like Java
- It supported object-oriented concepts through prototype-based inheritance
- As the language evolved, especially after ES6, it added more traditional object-oriented features like classes and modules
- This made JavaScript better for object-oriented programming
- Examples of both these approaches will be demonstrated

Prototype based language

- Before ES6, JavaScript didn't have classes, only objects
- JavaScript used to have a unique approach compared to C# or C++ for object-oriented programming
- It was prototype-based, meaning behavior could be reused by copying existing objects
- In JavaScript, every object inherits from a prototype, defining its functions and members
- Objects could serve as prototypes for creating other objects

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

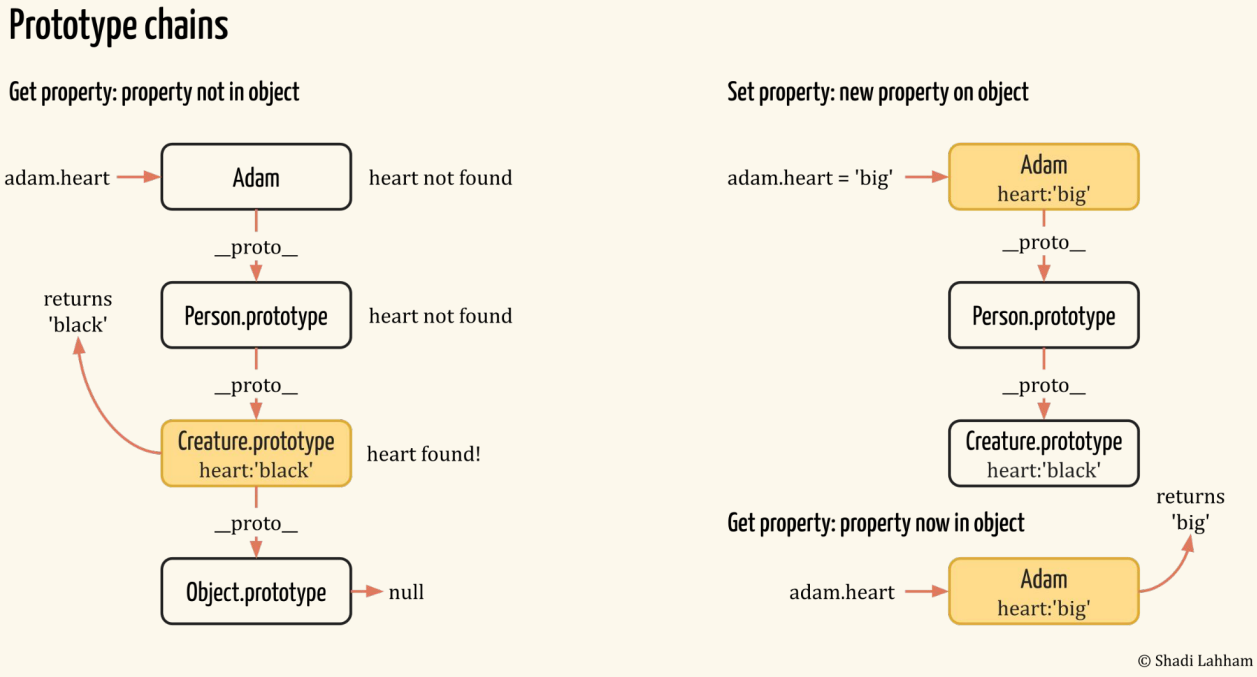
Prototype chains

- 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



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 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:

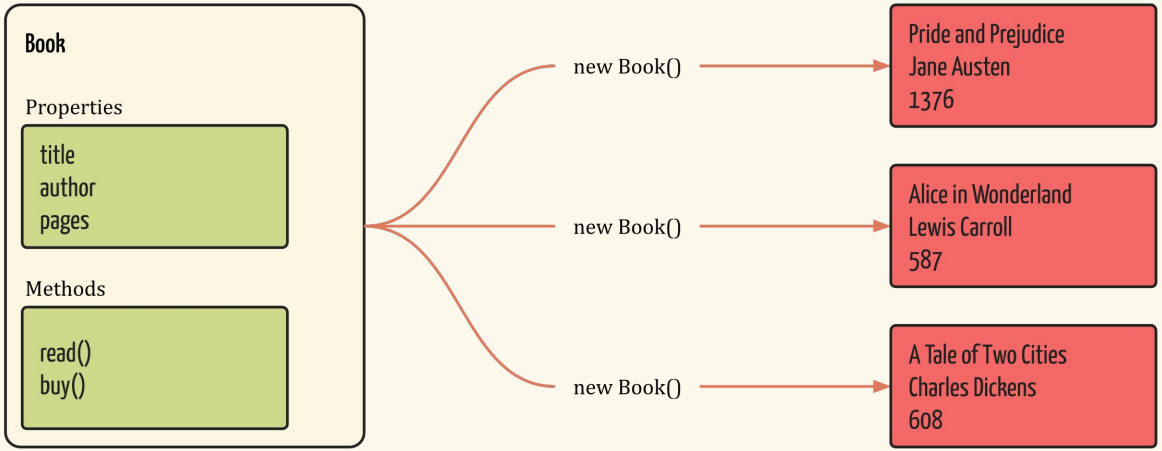
[The JavaScript Object Paradigm and Prototypes Explained Simply]
[Object.prototype.__proto__]
[Object.getPrototypeOf()]
[Object.setPrototypeOf()]

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 properties

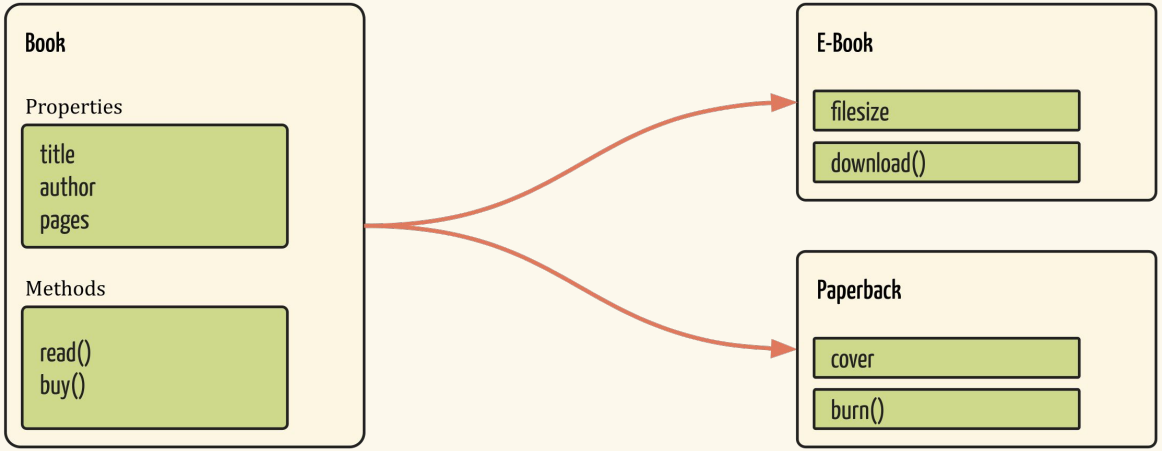
```
// some properties can be made optional by assigning default values
function Book(config) {
  this.title = config.title || 'Untitled';
  this.author = config.author || 'Unknown';
  this.numPages = config.numPages || 100;
  this.currentPage = 0;
}

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();
```

Operator instanceof

```
// book is a book, also paperback is a Book
console.log(book instanceof Book); // true
console.log(paperback instanceof Book); // true

// but book is not a PaperBack
console.log(paperback instanceof PaperBack); // true
console.log(book instanceof PaperBack); // false

// both are instances of Object because of prototype inheritance
console.log(book instanceof Object); // true
console.log(paperback instanceof Object); // true
```

Note

instanceof also works with Class inheritance

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 but add a new features that were 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));
```

References:

Private properties

Shorthand property syntax

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

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

// usage example
function createPerson(name, age) {
  return { name, age };
}
```

Dynamic properties

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

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

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

Get & set

```
class Bank {
  #money;

  constructor(money) {
    this.#money = money;
  }

  get money() {
    return this.#money < 1000 ? this.#money : 'you are rich!';
  }

  set money(newMoney) {
    this.#money = newMoney < 0 ? 0 : newMoney;
  }
}
```

Get & set

```
const bank = new Bank(80);
console.log(bank.money); // 80
bank.money = 30;
console.log(bank.money); // 30
bank.money = -100;
console.log(bank.money); // 0
bank.money = 1300;
console.log(bank.money); // 'you are rich!'
```

get - JavaScript | MDN
set - JavaScript | MDN

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()));
```

Continues on next page >>>

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
What is 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 also accepted**
- **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
static
Private properties

References

Older Prototype references

JavaScript Prototype in Plain Language

A Plain English Guide to JavaScript Prototypes

Simple Inheritance with JavaScript

Prototypes in JavaScript

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