OOP in JS

OOP Using JavaScript

Outline

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

JavaScript OOP

Properties & Methods

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JavaScript OOP

- JavaScript object is a **dynamic** collection of **properties**
- An **object property** is association between a **key** and a **value**.
    - **Key** is a string that is unique within that object.
    - **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 notation
- **Instantiate a Class**: create a class then instantiate objects from the class
- **Create an object based on another object**: prototype-based programming
  - Make a prototype object then make new instances from it (objects inherit from objects)
    - Augment the new instances with new properties and methods

```
let cat = { legs : 4, eyes: 2 };
let myCat = { name: 'Garfield' };
Object.setPrototypeOf(myCat, cat);
```

Object Literal using JSON

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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 {}

- 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 gets 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 St'
    }
};

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

Class-based OOP

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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());
```

Prototypal Inheritance

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Prototypal Inheritance

- Prototypal Inheritance (aka 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 **Object.setPrototypeOf**(..) or to make new instances that inherit form 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!**

Prototypal Inheritance

- Make an object that you like (i.e., prototype object)
- Create new instances from that object
  - Resulting object **maintains an explicit** link (**delegation** pointer) to its prototype
  - JavaScript runtime is capable of dispatching the correct method or finding the right piece of data simply by following a series of delegation pointers until a match is found
- Changes in the prototype are visible to the new instances
- New objects can add their own custom properties and methods

Example

```
let cat = { legs : 4, eyes: 2 };
let myCat = { name: 'Garfield' };
Object.setPrototypeOf(myCat, cat);
myCat.breed = 'Persian';

console.log( `${myCat.name} is a ${myCat.breed}
           cat with ${myCat.legs} legs
           and ${myCat.eyes} eyes` );
```

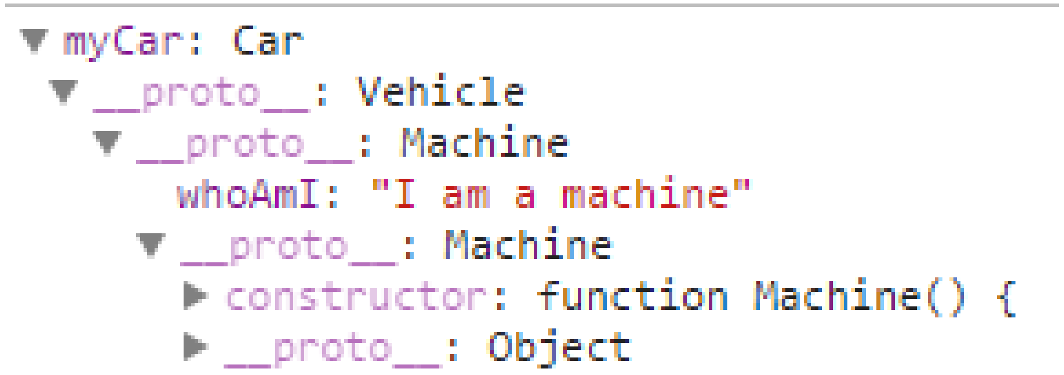
Object.assign() method

- 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

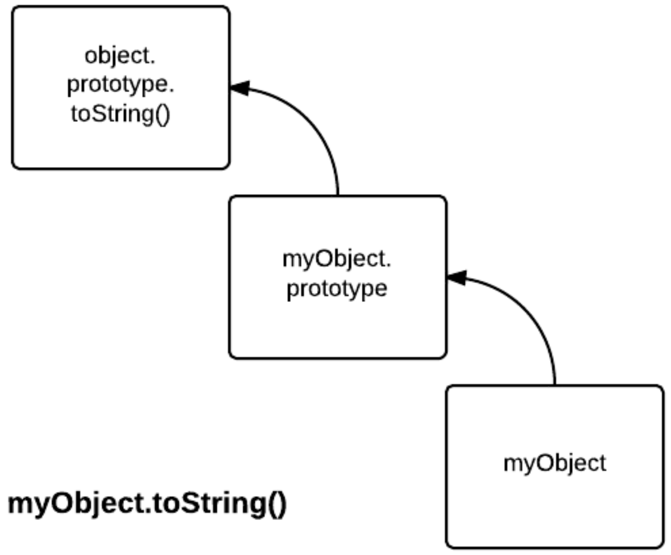
  - Used for cloning => no inheritance

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

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

console.log("movie1.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
```

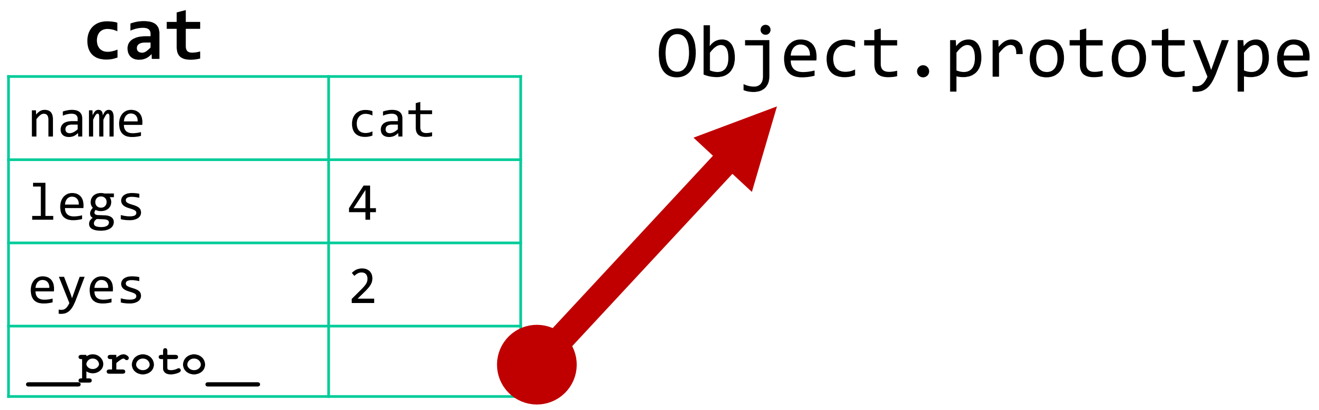


Back

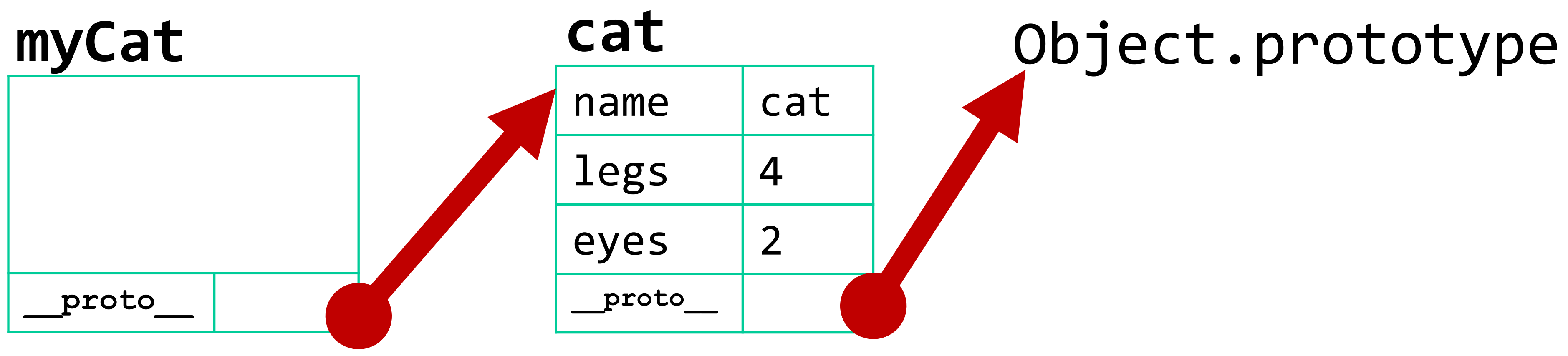
Prototype Chain

- **Prototype Chain** is the mechanism used for inheritance in JavaScript
    - Establish behavior-sharing between objects using delegation pointers (called Prototype Chain)
- Every object has a an internal __proto__ property **pointing** to another object
    - **`Object.prototype.__proto__`** equals null
- It can be accessed using `Object.getPrototypeOf(obj)` method

```
let cat = {
      name : 'cat',
      legs : 4,
      eyes : 2
};
```

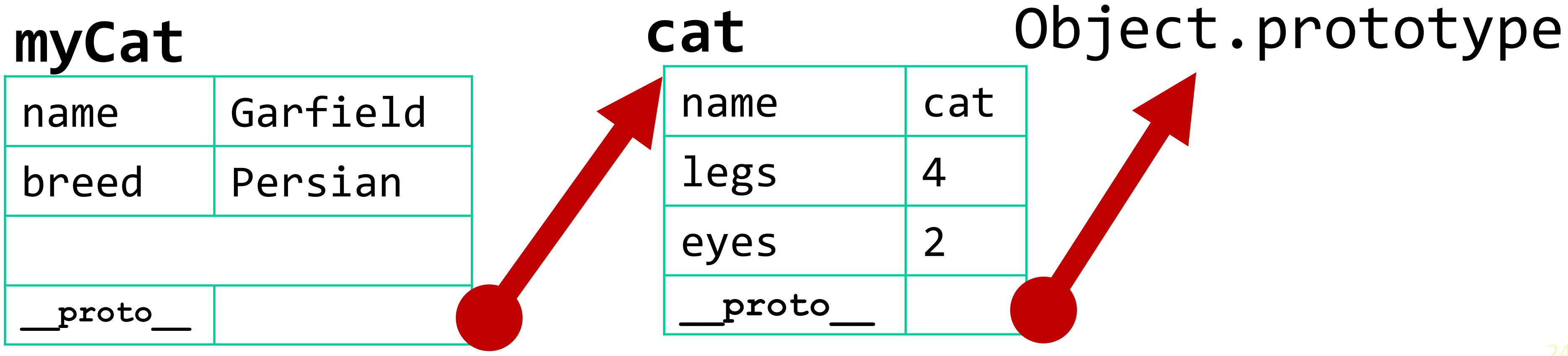


```
let cat = {
      name : 'cat',
      legs : 4,
      eyes : 2
};
let myCat = {};
Object.setPrototypeOf(myCat, cat);
```

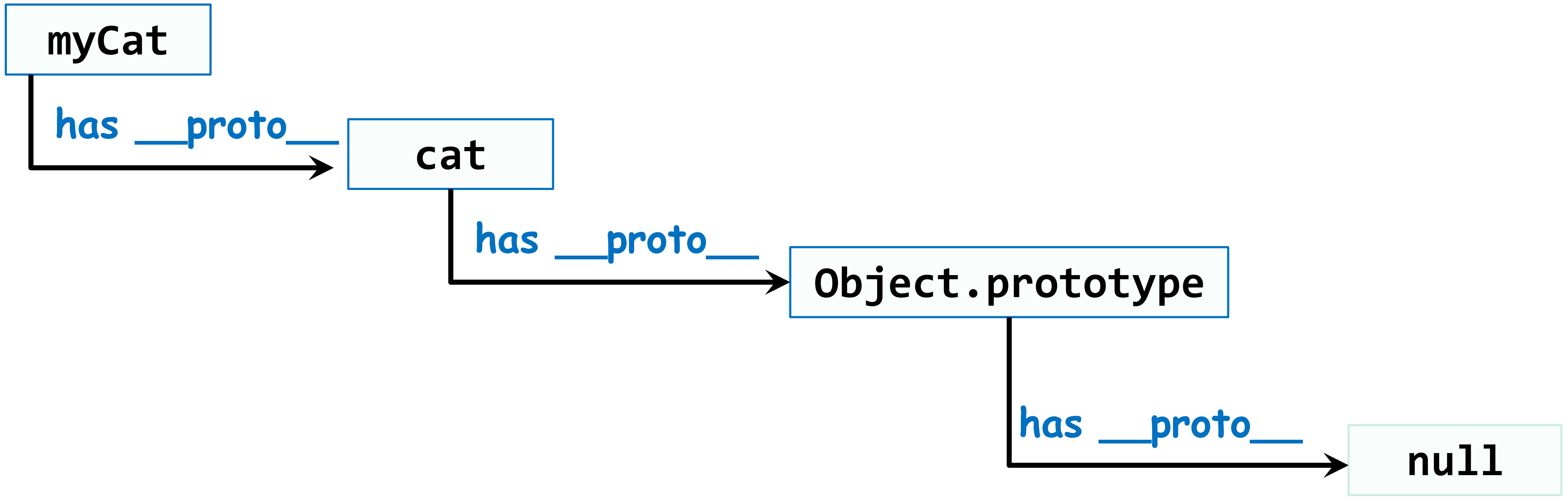


```
let cat = {
        name : 'cat',
        legs : 4,
        eyes : 2
};
let myCat = {};
Object.setPrototypeOf(myCat, cat);
myCat.name  = 'Garfield';
myCat.breed = 'Persian';
```

Changes to a child object are always recorded in the child object itself and never in its prototype (i.e. the child's value **shadows** the prototype's value rather than changing it).



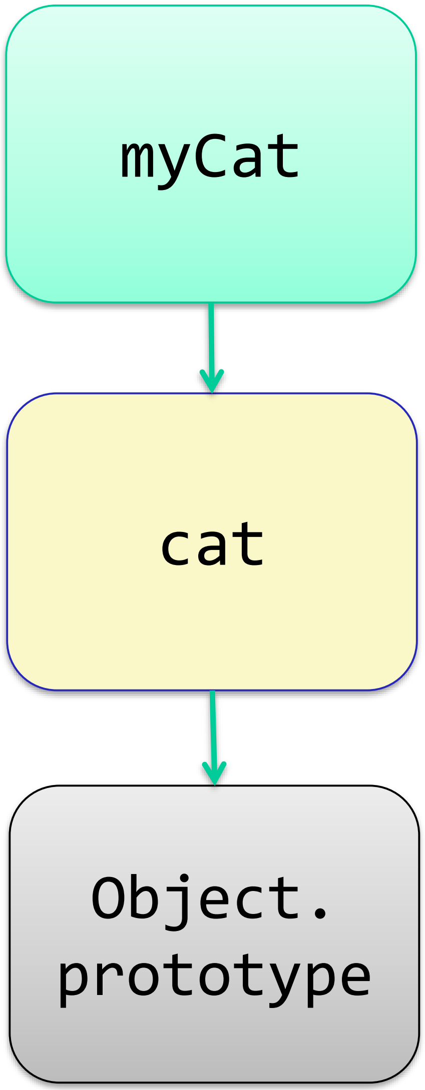
Prototype Chain example



__proto__ is the actual object that is used in **the lookup the chain** to resolve methods

Prototype Chain

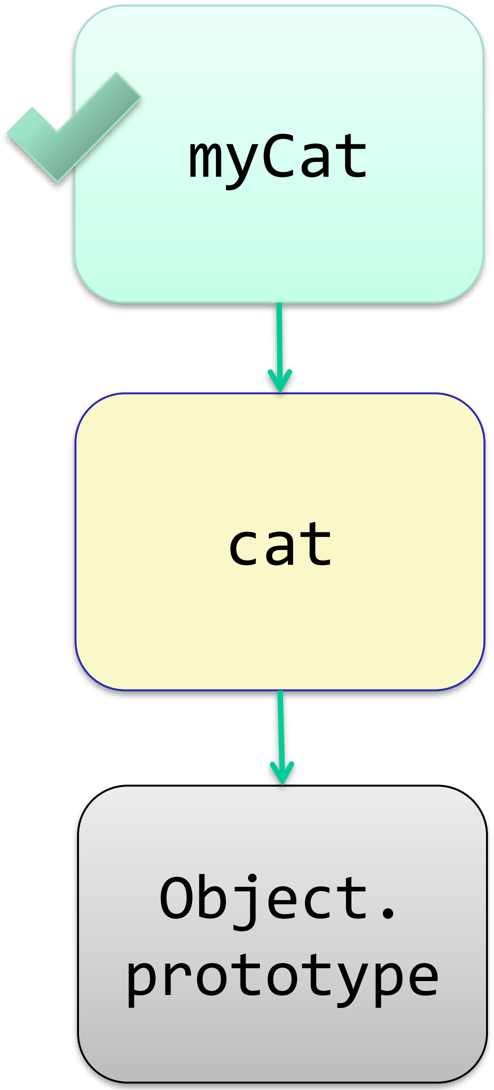
```
let cat = {
      name : 'cat',
      legs : 4,
      eyes : 2
};
let myCat = {};
Object.setPrototypeOf(myCat, cat);
myCat.name  = 'Garfield';
myCat.breed = 'Persian';
```



Prototype Chain (lookup myCat.name)

```
let cat = { name: 'cat', legs : 4, eyes: 2 };
let myCat = { name: 'Garfield' };
Object.setPrototypeOf(myCat, cat);
myCat.name = 'Garfield';
myCat.breed = 'Persian';
```

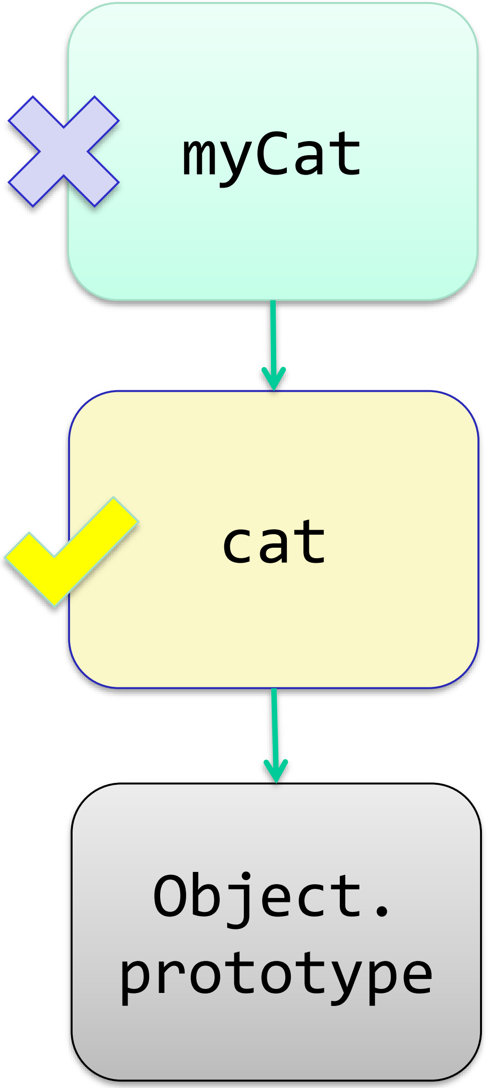
```
 console.log(myCat.name);

 console.log(myCat.legs);

 console.log(myCat.hasOwnProperty('eyes'));
```



Prototype Chain (lookup myCat.legs)

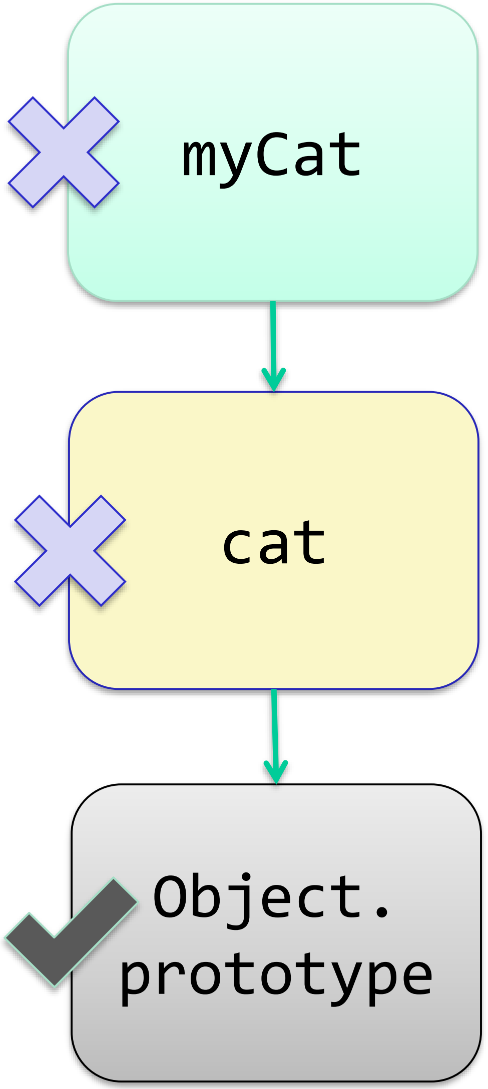
```
let cat = { name: 'cat', legs : 4, eyes: 2 };
let myCat = { name: 'Garfield' };
Object.setPrototypeOf(myCat, cat);
myCat.name = 'Garfield';
myCat.breed = 'Persian';
```

```
 console.log(myCat.name);

 console.log(myCat.legs);

 console.log(myCat.hasOwnProperty('eyes'));
```



Prototype Chain (lookup myCat. hasOwnProperty)

```
let cat = { name: 'cat', legs : 4, eyes: 2 };
let myCat = { name: 'Garfield' };
Object.setPrototypeOf(myCat, cat);
myCat.name = 'Garfield';
myCat.breed = 'Persian';



 console.log(myCat.name);

 console.log(myCat.legs);

 console.log(myCat.hasOwnProperty('eyes'));
```



Prototype can be used to extend classes

- **Classes** has a special property called **prototype**
- It can be used to add properties / methods to a class
  - Reflected on all instances of the class
  - Simply reference the **prototype** property on the class before adding the property

See *6.class-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 property to Add Functionality to Build-in Classes

- Dynamically add a function to a built-in class using the **prototype** property:

```
//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;
}

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

Attaching a method to the Array class

Here this means the array

Modules

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CommonJS Modules

- Modules are elegant way of encapsulating and reusing code
- CommonJS Modules implemented by Node.js
  - A simple synchronous 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));
```

ES6 Modules

- ES6 introduced new modules syntax
  - Each file decides what to **export** from its module
  - ES6 modules are mainly use for client-side scripts.

  (Not yet fully supported by 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 JavaScript eBooks

http://exploringjs.com/es6/

http://exploringjs.com/es2016-es2017/

- More Resources

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