



# JavaScript Objects and Classes

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.NET

*In JavaScript, classes are "special functions". Just as you can define function expressions and function declarations, the class syntax has two components: class expressions and class declarations.*

[HTTPS://DEVELOPER.MOZILLA.ORG/EN-US/DOCS/WEB/JAVASCRIPT/REFERENCE/CLASSES](https://developer.mozilla.org/en-US/docs/web/javascript/reference/classes)

# JavaScript objects

[https://developer.mozilla.org/en-US/docs/Learn/JavaScript/First\\_steps/A\\_first\\_splash](https://developer.mozilla.org/en-US/docs/Learn/JavaScript/First_steps/A_first_splash)  
<https://javascript.info/object>

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In JavaScript, everything is an object. This means any variable in JS can potentially be used to store *properties* (*key:value* pairs) and even more complex entities.

JS objects are stored by *reference*, so the variable representing the object holds the memory location of the object on the *heap*. An empty *object* can be created in two ways.

```
1 let user = new Object(); // "object constructor" syntax
2 let user = {}; // "object literal" syntax
```

An *Object Literal* is created with properties. Property values are accessible using dot (.) notation.

```
1 let user = { // an object
2   name: "John", // by key "name" store value "John"
3   age: 30 // by key "age" store value 30
4 };
```

# JS Objects – Property Values and Shorthand

<https://javascript.info/object#property-value-shorthand>

JavaScript has a shorthand for declaring and setting object variables. The below examples are all equivalent objects but how they are declared determines if you end up with a reusable template for objects.

```
1 function makeUser(name, age) {  
2   return {  
3     name: name,  
4     age: age,  
5     // ...other properties  
6   };  
7 }  
8  
9 let user = makeUser("John", 30);  
10 alert(user.name); // John
```

makeUser is reusable

```
1 function makeUser(name, age) {  
2   return {  
3     name, // same as name: name  
4     age,  // same as age: age  
5     // ...  
6   };  
7 }
```

makeUser is reusable

```
1 let user = {  
2   name, // same as name:name  
3   age: 30  
4 };
```

user is NOT reusable

# JS Objects – Objects in Objects

<https://javascript.info/object#cloning-and-merging-object-assign>

An object can contain another object. In this example, you would access *height* with

***let height = user.sizes.height***

Another **object** or **function** can be assigned to an object after creation. Here, *user* is dynamically assigned the function **sayHi()** as a new property (also called **sayHi**).

```
1 let user = {  
2   name: "John",  
3   sizes: {  
4     height: 182,  
5     width: 50  
6   }  
7 };  
8  
9 alert( user.sizes.height ); // 182
```

```
1 let user = {  
2   // ...  
3 };  
4  
5 // first, declare  
6 function sayHi() {  
7   alert("Hello!");  
8 };  
9  
10 // then add as a method  
11 user.sayHi = sayHi;  
12  
13 user.sayHi(); // Hello!
```

# JS Objects - Accessing Properties

<https://javascript.info/object#property-existence-test-in-operator>  
<https://javascript.info/object#the-for-in-loop>

It's possible to access any property of an **object**. The below will return undefined if the property doesn't exist.

***let value = user.key;***

The **in** operator returns **true** if the property exists, **false** if not.

***let exists = "propertyName" in objectName***

Use the **for...in** loop to access each property of an object in sequence.

The keyword **this** can be used to specify the containing object to disambiguate variable names.

```
1 let user = {
2   name: "John",
3   age: 30,
4   isAdmin: true
5 };
6
7 for (let key in user) {
8   // keys
9   alert( key ); // name, age, isAdmin
10  // values for the keys
11  alert( user[key] ); // John, 30, true
12 }
```

```
1 let user = {
2   name: "John",
3   age: 30,
4
5   sayHi() {
6     // "this" is the "current object"
7     alert(this.name);
8   }
9
10 };
11
12 user.sayHi(); // John
```



# JS Functions – Constructors and ‘new’

<https://javascript.info/constructor-new>

A **constructor function** in JavaScript serves the same purpose as a **Class constructor** in C#. **Constructor functions** technically are regular functions.

They have two conventions:

1. Their names are in Pascal case.
2. They should be executed only with "new" operator.

```
1 function User(name) {  
2   this.name = name;  
3   this.isAdmin = false;  
4 }  
5  
6 let user = new User("Jack");  
7  
8 alert(user.name); // Jack  
9 alert(user.isAdmin); // false
```

When a function is executed with **new**, it implicitly does the following steps:

1. A new empty object is created and assigned to **this**.
2. The function body executes. Usually it modifies **this**, by adding new properties to it.
3. The value of **this** is returned.

The main purpose of constructors is to implement reusable object creation code.

```
1 function User(name) {  
2   // this = {}; (implicitly)  
3  
4   // add properties to this  
5   this.name = name;  
6   this.isAdmin = false;  
7  
8   // return this; (implicitly)  
9 }
```

# JavaScript Classes

<https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes>

The **class** syntax does not introduce a new object-oriented inheritance model to JavaScript. Classes are "special functions".

Just as you can define *function expressions* and *function declarations*, the class syntax has two components: **class expressions** and **class declarations**.

Class Declaration	Class Expression
<pre>class Rectangle {   constructor(height, width) {     this.height = height;     this.width = width;   } }</pre>	Class expressions can be named or unnamed. There is an implicit 'name' property in the class object. The name given to a class expression is local to the class's body. It can be retrieved through the class's (not the instance's) name property.
A class must be declared <u>before</u> they can be accessed. (no <b>Hoisting</b> )	

```
1 // unnamed  
2 let Rectangle = class {  
3   constructor(height, width) {  
4     this.height = height;  
5     this.width = width;  
6   }  
7 };  
8 console.log(Rectangle.name);  
9 // output: "Rectangle"  
10  
11 // named  
12 let Rectangle = class Rectangle2 {  
13   constructor(height, width) {  
14     this.height = height;  
15     this.width = width;  
16   }  
17 };  
18 console.log(Rectangle.name);  
19 // output: "Rectangle2"
```



# JS Class Parts

<https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes>

- The **constructor method** creates and initializes an object created from a class template. There can be only one constructor in each class.
- **Instance Properties** must be defined inside of class methods.
- **Prototype Methods** are declared in the class and are available through an instance of the class.
- **Static Methods** are called without instantiating their class and cannot be called through a class instance. (below)

```
15 const p1 = new Point(5, 5);
16 const p2 = new Point(10, 10);
17 p1.distance; //undefined
18 p2.distance; //undefined
19
20 console.log(Point.distance(p1, p2));
```

```
1 class Point {
2   constructor(x, y) {
3     this.x = x;
4     this.y = y;
5   }
6
7   static distance(a, b) {
8     const dx = a.x - b.x;
9     const dy = a.y - b.y;
10
11     return Math.hypot(dx, dy);
12   }
13 }
```

```
1 class Rectangle {
2   constructor(height, width) {
3     this.height = height;
4     this.width = width;
5   }
6   // Getter
7   get area() {
8     return this.calcArea();
9   }
10  // Method
11  calcArea() {
12    return this.height * this.width;
13  }
14 }
15
16 const square = new Rectangle(10, 10);
17
18 console.log(square.area); // 100
```

# Getters and Setters

<https://javascript.info/property-accessors#getters-and-setters>

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**Accessor properties** (new to JS) are functions that **get** and **set** a value but look like regular **properties** to external code.

**Getters** and **Setters** are accessed like properties. (*instanceName.getterName*).

**Getters** and **Setters** allow validation to be written inside the class.

```
6   set name(value) {
7       if (value.length < 4) {
8           alert("Name is too short");
9           return;
10      }
11      this._name = value;
12  }
```

```
1  let user = {
2      name: "John",
3      surname: "Smith",
4
5      get fullName() {
6          return `${this.name} ${this.surname}`;
7      },
8
9      set fullName(value) {
10         [this.name, this.surname] = value.split(" ");
11     }
12 };
13
14 // set fullName is executed with the given value.
15 user.fullName = "Alice Cooper";
16
17 alert(user.name); // Alice
18 alert(user.surname); // Cooper
```

# JavaScript [[Prototypes]]

<https://javascript.info/prototype-inheritance>

Objects have a hidden property, `[[Prototype]]`, that is either `null` or references another object. This object is called a “*prototype*”. When we want to read a property from an object and it isn’t found, it’s taken from the *prototype*. This is called “*prototypal inheritance*”. `[[Prototype]]` is internal and hidden, but you can manually set it.

- Multiple prototype inheritance is not allowed.
- `__proto__` does not support writing or deleting.
- Inheritance can be chained.
- Inheritance cannot be circular.
- Getters/Setters are also inherited.

```
1 let animal = {
2   eats: true,
3   walk() {
4     alert("Animal walk");
5   }
6 };
7
8 let rabbit = {
9   jumps: true,
10  __proto__: animal
11 };
12
13 // walk is taken from the prototype
14 rabbit.walk(); // Animal walk
```

Inherit  
Methods

```
1 let animal = {
2   eats: true,
3   walk() {
4     alert("Animal walk");
5   }
6 };
7
8 let rabbit = {
9   jumps: true,
10  __proto__: animal
11 };
12
13 let longEar = {
14   earLength: 10,
15  __proto__: rabbit
16 };
17
18 // walk is taken from the prototype chain
19 longEar.walk(); // Animal walk
20 alert(longEar.jumps); // true (from rabbit)
```

Hierarchical  
Inheritance

# JavaScript Prototypes

<https://javascript.info/function-prototype>

<https://javascript.info/prototype-methods>

*Prototypal Inheritance* was one of the core features of JS originally, but there was no direct access to it. The only method that worked reliably was a "prototype" property of the constructor function.

There are many scripts that still use `__proto__`. Remember that *prototype* is a default *property* provided in the *constructor*.

In this example, setting

***`Rabbit.prototype = animal`***

sets its *prototype* to *animal*.

```
1  let animal = {
2    eats: true
3  };
4
5  function Rabbit(name) {
6    this.name = name;
7  }
8
9  Rabbit.prototype = animal;
10
11 let rabbit = new Rabbit("White Rabbit");
12 // rabbit.__proto__ == animal
13 alert( rabbit.eats ); // true
```

# JavaScript Objects without `__proto__`

<https://javascript.info/function-prototype>

<https://javascript.info/prototype-methods>

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`__proto__` is outdated and deprecated.

Instead of `__proto__`, use:

- `Object.create(proto class)`. This creates an empty object with given proto class as `[[Prototype]]`
- `Object.create(proto class, {additional descriptors})` adds optional property descriptors.
- `Object.getPrototypeOf(obj)` – returns the `[[Prototype]]` of obj.
- `Object.setPrototypeOf(obj, proto)` – sets the `[[Prototype]]` of obj to proto.

```
1  let animal = {  
2    eats: true  
3  };  
4  
5  // create a new object with animal as a prototype  
6  let rabbit = Object.create(animal);  
7  
8  alert(rabbit.eats); // true  
9  
10 alert(Object.getPrototypeOf(rabbit) === animal); // true  
11  
12 Object.setPrototypeOf(rabbit, {}); // change the prototyp  
    // change the prototype of rabbit to {}
```

# JavaScript Class Inheritance

<https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes>

[https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes#Sub\\_classing\\_with\\_extends](https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Classes#Sub_classing_with_extends)

The **extends** keyword is used in class declarations or class expressions to create a **class** as a **child** of another **class**.

If there is a **constructor** present in the **subclass**, it needs to first call **super()** before using **this**.

If you want to inherit from a regular object, you can instead use **Object.setPrototypeOf()**

```
1 class Animal {
2   constructor(name) {
3     this.name = name;
4   }
5
6   speak() {
7     console.log(`${this.name} makes a noise.`);
8   }
9 }
10
11 class Dog extends Animal {
12   constructor(name) {
13     super(name); // call the super class constructor
14                 // and pass in the name parameter
15   }
16
17   speak() {
18     console.log(`${this.name} barks.`);
19   }
20 }
21
22 let d = new Dog('Mitzie');
23 d.speak(); // Mitzie barks.
```