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JavaScript: Objects and Functions

“The” language of the Web

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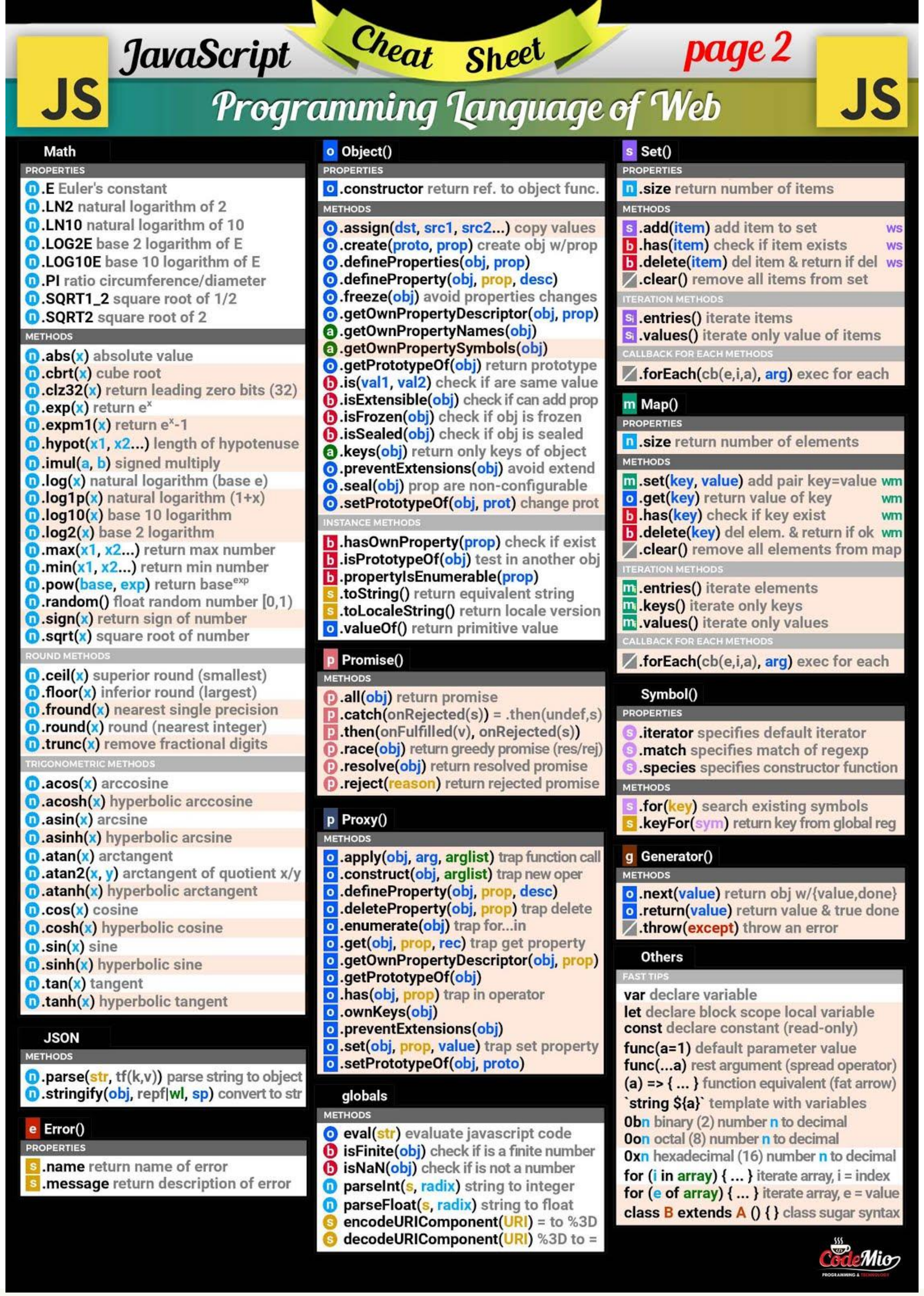


JavaScript Cheat Sheet page 2
JS
Programming Language of Web
JS

Math

PROPERTIES

.E Euler's constant
.LN2 natural logarithm of 2
.LN10 natural logarithm of 10
.LOG2E base 2 logarithm of E
.LOG10E base 10 logarithm of E
.PI ratio circumference/diameter
.SQRT1_2 square root of 1/2
.SQRT2 square root of 2

METHODS

.abs(x) absolute value
.cbrt(x) cube root
.clz32(x) return leading zero bits (32)
.exp(x) return e^x
.expm1(x) return e^x-1
.hypot(x1, x2...) length of hypotenuse
.imul(a, b) signed multiply
.log(x) natural logarithm (base e)
.log1p(x) natural logarithm (1+x)
.log10(x) base 10 logarithm
.log2(x) base 2 logarithm
.max(x1, x2...) return max number
.min(x1, x2...) return min number
.pow(base, exp) return $base^{exp}$
.random() float random number [0,1)
.sign(x) return sign of number
.sqrt(x) square root of number

ROUND METHODS

.ceil(x) superior round (smallest)
.floor(x) inferior round (largest)
.fround(x) nearest single precision
.round(x) round (nearest integer)
.trunc(x) remove fractional digits

TRIGONOMETRIC METHODS

.acos(x) arccosine
.acosh(x) hyperbolic arccosine
.asin(x) arcsine
.asinh(x) hyperbolic arcsine
.atan(x) arctangent
.atan2(x, y) arctangent of quotient x/y
.atanh(x) hyperbolic arctangent
.cos(x) cosine
.cosh(x) hyperbolic cosine
.sin(x) sine
.sinh(x) hyperbolic sine
.tan(x) tangent
.tanh(x) hyperbolic tangent

JSON

METHODS

.parse(str, tf(k,v)) parse string to object
.stringify(obj, repf|wl, sp) convert to str

Error()

PROPERTIES

.name return name of error
.message return description of error

Object()

PROPERTIES

.constructor return ref. to object func.

METHODS

.assign(dst, src1, src2...) copy values
.create(proto, prop) create obj w/prop
.defineProperties(obj, prop)
.defineProperty(obj, prop, desc)
.freeze(obj) avoid properties changes
.getOwnPropertyDescriptor(obj, prop)
.getOwnPropertyNames(obj)
.getOwnPropertySymbols(obj)
.getPrototypeOf(obj) return prototype
.is(val1, val2) check if are same value
.isExtensible(obj) check if can add prop
.isFrozen(obj) check if obj is frozen
.isSealed(obj) check if obj is sealed
.keys(obj) return only keys of object
.preventExtensions(obj) avoid extend
.seal(obj) prop are non-configurable
.setPrototypeOf(obj, prot) change prot

INSTANCE METHODS

.hasOwnProperty(prop) check if exist
.isPrototypeOf(obj) test in another obj
.propertyIsEnumerable(prop)
.toString() return equivalent string
.toLocaleString() return locale version
.valueOf() return primitive value

Promise()

METHODS

.all(obj) return promise
.catch(onRejected(s)) = .then(undef,s)
.then(onFulfilled(v), onRejected(s))
.race(obj) return greedy promise (res/rej)
.resolve(obj) return resolved promise
.reject(reason) return rejected promise

Proxy()

METHODS

.apply(obj, arg, arglist) trap function call
.construct(obj, arglist) trap new oper
.defineProperty(obj, prop, desc)
.deleteProperty(obj, prop) trap delete
.enumerate(obj) trap for...in
.get(obj, prop, rec) trap get property
.getOwnPropertyDescriptor(obj, prop)
.getPrototypeOf(obj)
.has(obj, prop) trap in operator
.ownKeys(obj)
.preventExtensions(obj)
.set(obj, prop, value) trap set property
.setPrototypeOf(obj, proto)

globals

METHODS

eval(str) evaluate javascript code
isFinite(obj) check if is a finite number
isNaN(obj) check if is not a number
parseInt(s, radix) string to integer
parseFloat(s, radix) string to float
encodeURIComponent(URI) = to %3D
decodeURIComponent(URI) %3D to =

Set()

PROPERTIES

.size return number of items

METHODS

.add(item) add item to set ws
.has(item) check if item exists ws
.delete(item) del item & return if del ws
.clear() remove all items from set

ITERATION METHODS

.entries() iterate items
.values() iterate only value of items

CALLBACK FOR EACH METHODS

.forEach(cb(e,i,a), arg) exec for each

Map()

PROPERTIES

.size return number of elements

METHODS

.set(key, value) add pair key=value wm
.get(key) return value of key wm
.has(key) check if key exist wm
.delete(key) del elem. & return if ok wm
.clear() remove all elements from map

ITERATION METHODS

.entries() iterate elements
.keys() iterate only keys
.values() iterate only values

CALLBACK FOR EACH METHODS

.forEach(cb(e,i,a), arg) exec for each

Symbol()

PROPERTIES

.iterator specifies default iterator
.match specifies match of regexp
.species specifies constructor function

METHODS

.for(key) search existing symbols
.keyFor(sym) return key from global reg

Generator()

METHODS

.next(value) return obj w/{value,done}
.return(value) return value & true done
.throw(except) throw an error

Others

FAST TIPS

var declare variable
let declare block scope local variable
const declare constant (read-only)
func(a=1) default parameter value
func(...a) rest argument (spread operator)
(a) => { ... } function equivalent (fat arrow)
`string ${a}` template with variables
0bn binary (2) number n to decimal
0on octal (8) number n to decimal
0xn hexadecimal (16) number n to decimal
for (i in array) { ... } iterate array, i = index
for (e of array) { ... } iterate array, e = value
class B extends A () { } class sugar syntax

CodeMio PROGRAMMING & TECHNOLOGY

Outline

- Objects
- Functions
  - Closures

JavaScript: The Definitive Guide, 7th Edition
Chapter 5. Objects

Mozilla Developer Network

- Learn web development JavaScript » Dynamic client-side scripting » Introducing JavaScript objects
- Web technology for developers » JavaScript » JavaScript reference » Standard built-in objects » Object
- Web technology for developers » JavaScript » JavaScript reference » Expressions and operators » in operator

JavaScript – The language of the Web

OBJECTS

Big Warnings *(a.k.a., forget Java objects)*

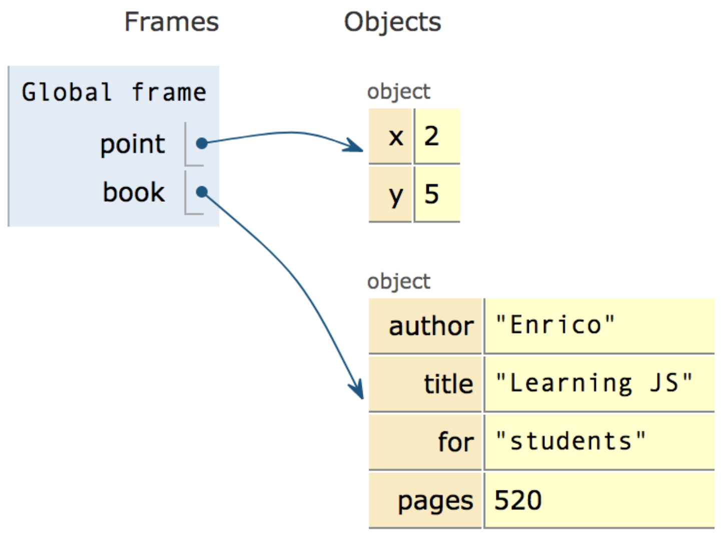
- In JavaScript, Objects may exist without Classes
  - Usually, Objects are created directly, without deriving them from a Class definition
- In JavaScript, Objects are dynamic
  - You may add, delete, redefine a *property* at any time
  - You may add, delete, redefine a *method* at any time
- In JavaScript, there are no access control methods
  - Every property and every method is always public (private/protected don't exist)
- There is no real difference between properties and methods (because of how JS functions work)

Object

- An object is an unordered collection of properties
  - Each property has a **name** (key), and a **value**
- You store and retrieve *property values*, through the *property names*
- Object creation and initialization:

```
let point = { x: 2, y: 5 };

let book = {
  author : "Enrico",
  title : "Learning JS",
  for: "students",
  pages: 520,
};
```

Object literals syntax:
`{"name": value, "name": value, }`
or:
`{name: value, name: value, }`



Object Properties

Property names are …

- Identified as a string
- Must be unique in each object
- Created at object initialization
- Added after object creation
  - With assignment
- Deleted after object creation
  - With `delete` operator

Property values are …

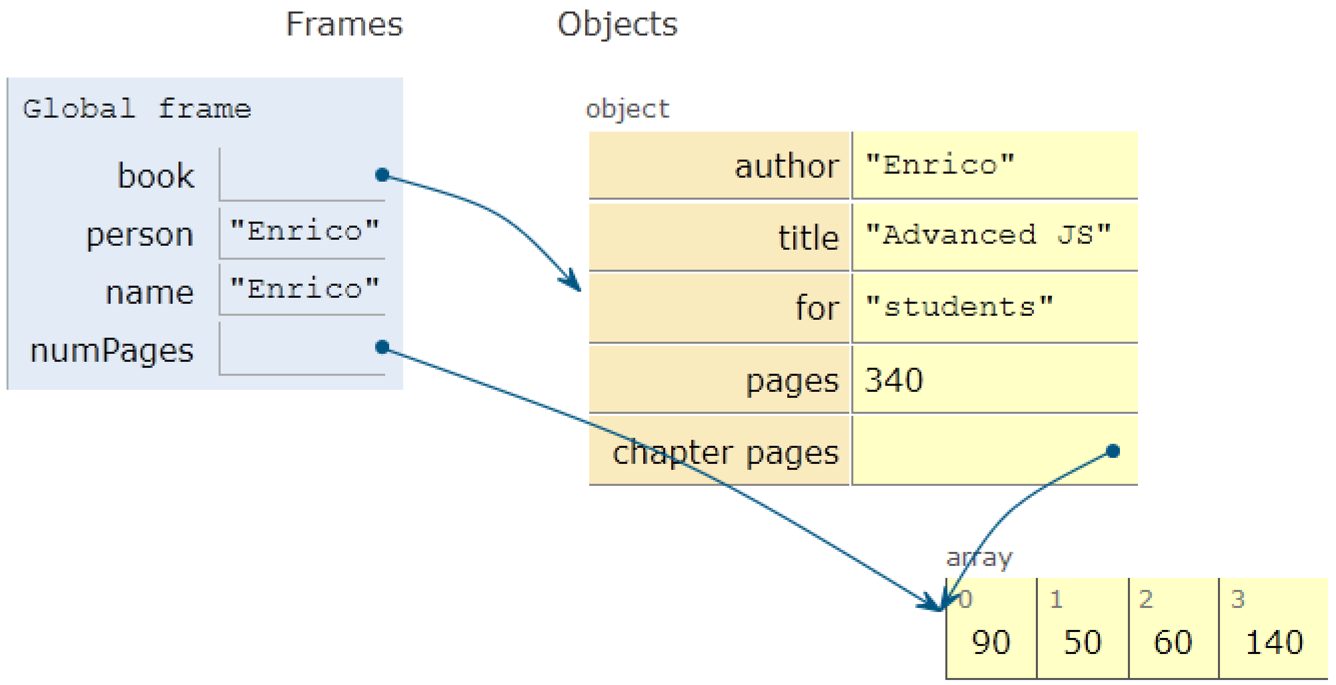
- Reference to any JS value
- Stored inside the object
- May be primitive types
- May be arrays, other objects, …
  - Beware: the object stores the reference, the value is *outside*
- May also be functions (*methods*)

Accessing properties

- Dot (.) or square brackets [ ] notation

The . dot notation and omitting the quotes are allowed **when the property name is a valid identifier, only**.
`book.title` or `book['title']`
`book['my title']` and not ~~`book.my title`~~

```
let book = {
  author : "Enrico",
  title : "Learning JS",
  for: "students",
  pages: 340,
  "chapter pages": [90,50,60,140]
};

let person = book.author;
let name = book["author"];
let numPages =
    book["chapter pages"];
book.title = "Advanced JS";
book["pages"] = 340;
```



Objects as associative arrays

- The `[ ]` syntax looks like array access, but the index is *a string*
  - Generally known as *associative arrays*
- Setting a non-existing property creates it:
  - `person["telephone"] = "0110901234";`
  - `person.telephone = "0110901234";`
- Deleting properties
  - `delete person.telephone;`
  - `delete person["telephone"];`

Computed property names

- Flexibility in creating object properties
  - `{[prop]:value}` -> creates an object with property name equal to *the value of the variable* `prop`
  - [] can contain more complex expressions: e.g., `i`-th line of an object with multiple "address" properties (address1, address2, …): `person["address"+i]`
    - **Using expressions is not recommended…**
- Beware of quotes:
  - `book["title"]` -> property called `title`
    - Equivalent to `book.title`
  - `book[title]` -> property called with the value of variable `title` (if exists)
    - If `title=="author"`, then equivalent to `book["author"]`
    - No equivalent in dot-notation

Property access errors

- If a property is not defined, the (attempted) access returns `undefined`
- If unsure, must check before accessing
  - Remember: `undefined` is *falsy*, you may use it in Boolean expressions

```
let surname = undefined;
if (book) {
    if (book.author) {
        surname = book.author.surname;
    }
}
```

```
surname = book && book.author && book.author.surname;
```

Iterating over properties

- `for .. in` iterates over the properties

```
for( let a in {x: 0, y:3}) {
     console.log(a) ;
}
```

```
x
y
```

```
let book = {
  author : "Enrico",
  pages: 340,
  chapterPages: [90,50,60,140],
};

for (const prop in book)
  console.log(`${prop} = ${book[prop]}`);
```

```
author = Enrico
pages = 340
chapterPages = 90,50,60,140
```

Iterating over properties

- All the (enumerable) properties names (keys) of an object can be accessed as an array, with:
  - `let keys = Object.keys(my_object) ;`

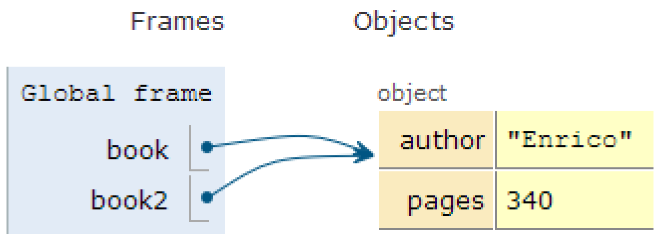
```
[ 'author', 'pages' ]
```

- All pairs [key, value] are returned as an array with:
  - `let keys_values = Object.entries(my_object)`

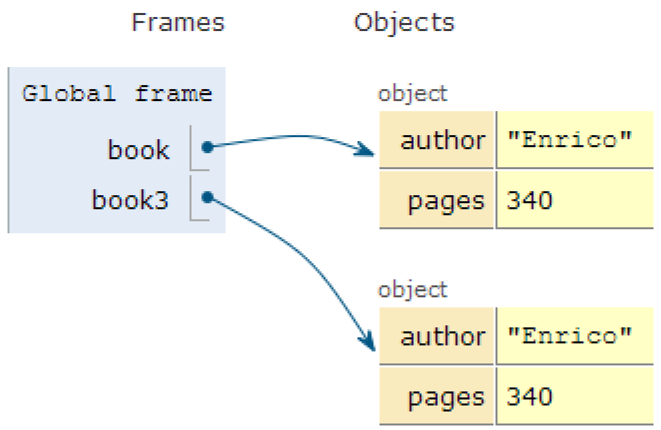
```
[ [ 'author', 'Enrico' ], [ 'pages', 340 ] ]
```

Copying objects

```
let book = {
  author : "Enrico",
  pages: 340,
};

let book2 = book;   // ALIAS
```



```
let book = {
  author : "Enrico",
  pages: 340,
};

let book3 =                // COPY
   Object.assign({}, book);
```



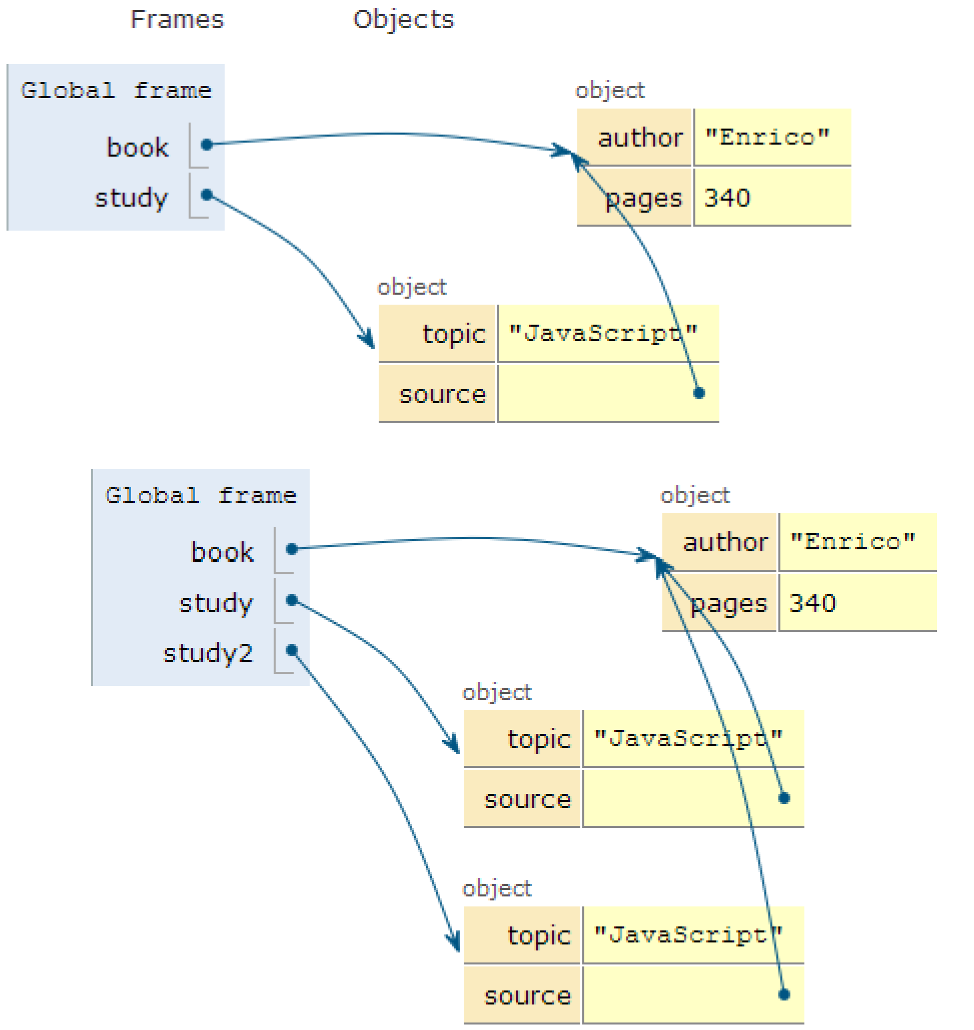
`Object.assign`

- `let new_object = Object.assign(target, source);`
- Assigns all the properties from the source object to the target one
- The target may be a new object: `{}`
- The target may be an existing object
- If properties already exists, they will be overwritten
- Returns the target object (after modification)

Beware! Shallow copy, only

```
let book = {
  author : "Enrico",
  pages: 340,
};

let study = {
  topic: "JavaScript",
  source: book,
};
```

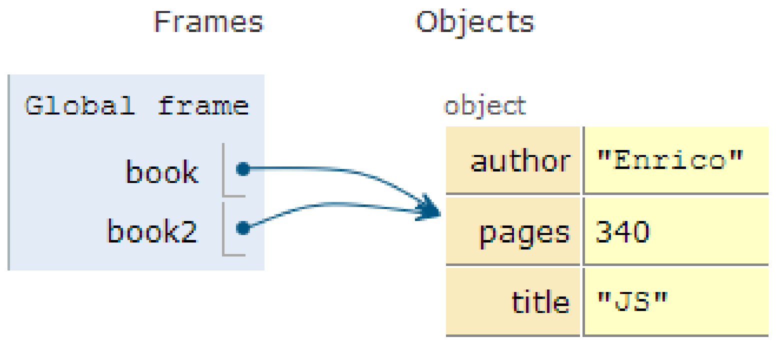
```
let study2 = Object.assign({},
study);
```



Merge properties (on existing object)

- `Object.assign(target, default values, ..other sources..);`

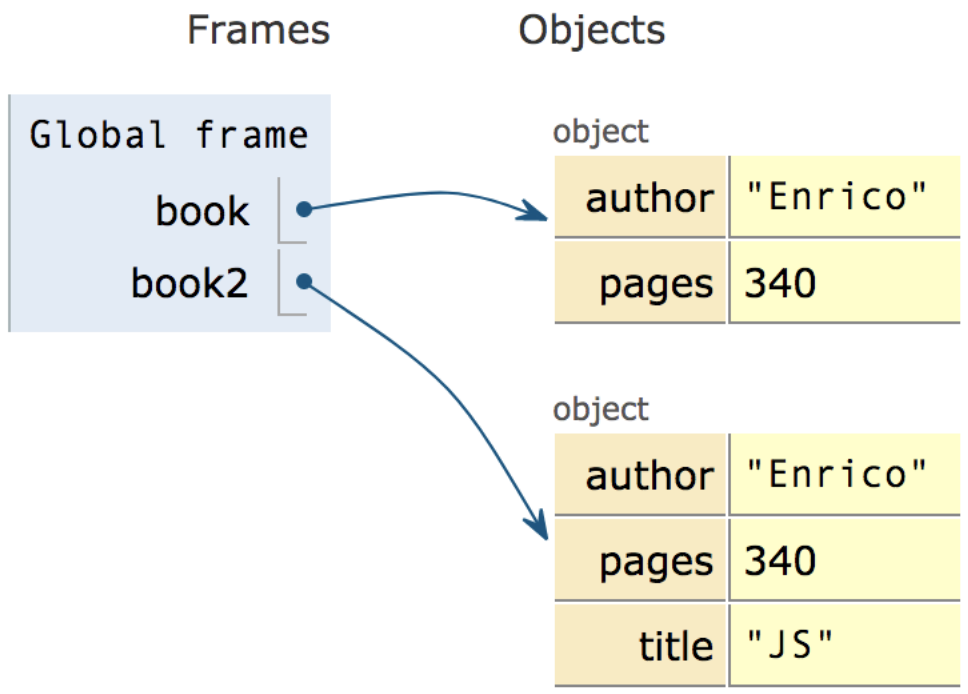
```
let book = {
  author : "Enrico",
  pages: 340,
};

let book2 = Object.assign(
 book, {title: "JS"}
);
```



Merge properties (on new object)

- `Object.assign(target, default values, ..sources..);`

```
let book = {
  author : "Enrico",
  pages: 340,
};

let book2 = Object.assign(
 {}, {title: "JS"}, book
);
```



Copying with **spread** operator (**ES9** – ES2018)

```
let book = {
  author : "Enrico",
  pages: 340,
};

let book2 = {...book, title: "JS"};
let book3 = { ...book2 } ;
console.log(book2);
```

```
{ author: 'Enrico', pages: 340, title: 'JS' }
```

```
const {a,b,...others} =
   {a:1, b:2, c:3, d:4};

console.log(a);
console.log(b);
console.log(others);
```

```
1
2
{ c: 3, d: 4 }
```

Checking if properties exist

- Operator **`in`**
  - Returns true if property is in the object. Do <u>not</u> use with Array

```
let book = {
  author : "Enrico",
  pages: 340,
};

console.log('author' in book);
delete book.author;
console.log('author' in book);
```

```
true
false
```

```
const v=['a','b','c’];

console.log('b' in v);



console.log('PI' in Math);
```

```
false
true
```

Object creation (equivalent methods)

- By object literal: `const point = {x:2, y:5} ;`
- By object literal (empty object): `const point = {} ;`

Preferred

- By constructor: `const point = new Object() ;`
- By object static method create:
  `const point = Object.create({x:2,y:5}) ;`
- Using a *constructor function*

JavaScript: The Definitive Guide, 7th Edition
Chapter 7. Functions

JavaScript – The language of the Web

FUNCTIONS

Functions

- One of the most important elements in JavaScript
- Delimits a block of code with a private scope
- Can accept parameters and returns one value
  - Can also be an object
- Functions themselves **are objects** in JavaScript
  - They can be assigned to a variable
  - Can be passed as an argument
  - Used as a return value

Declaring functions: 3 ways

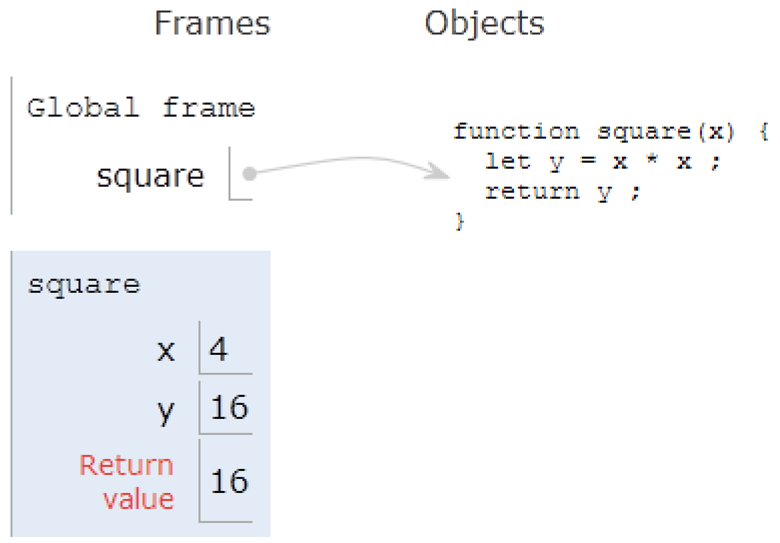
1) Classic

```
function do(params) {
  /* do something */
}
```

Classic functions

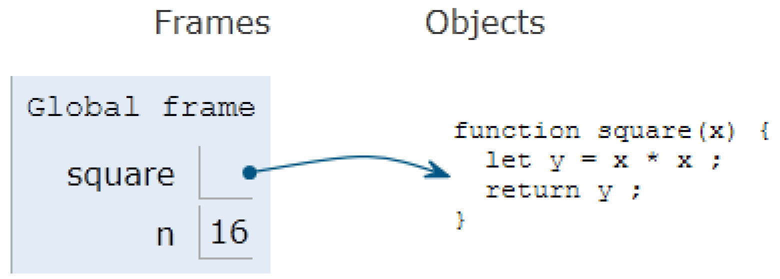
```
function square(x) {
  let y = x * x ;
  return y ;
}

let n = square(4) ;
```

During execution



```
function square(x) {
  let y = x * x ;
  return y ;
}
```

After execution



```
function square(x) {
  let y = x * x ;
  return y ;
}
```

Parameters

- Comma-separated list of parameter names
  - May assign a default value, e.g., `function(a, b=1) {}`
- Parameters are passed by-value
  - Copies of the reference to the object
- Parameters that are not passed in the function call get the value ‘`undefined`’
- Check missing/optional parameters with:
  - `if(p===undefined) p = default_value ;`
  - `p = p || default_value ;`

Variable number of parameters

- Syntax for functions with variable number of parameters, using the `...` operator (called "rest")

```
function fun (par1, par2, ...arr) { }
```

- The "rest" parameter must be the last, and will deposit all extra arguments into an array

```
function sumAll(initVal, ...arr) {
  let sum = initVal;
  for (let a of arr) sum += a;
  return sum;
}
sumAll(0, 2, 4, 5); // 11
```

Declaring functions: 3 ways

1) Classic

```
function do(params) {
  /* do something */
}
```

2a) Function expression

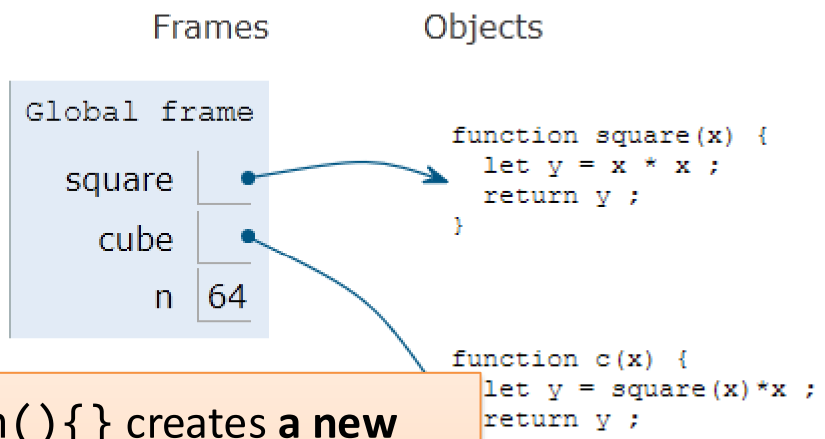
```
const fn = function(params) {
  /* do something */
}
```

2b) Named function expression

```
const fn = function do(params) {
  /* do something */
}
```

Function expression: indistinguishable

```
function square(x) {
  let y = x * x ;
  return y ;
}

let cube = function c(x) {
  let y = square(x)*x ;
  return y ;
}

let n = cube(4) ;
```



```
function square(x) {
  let y = x * x ;
  return y ;
}
```

```
function c(x) {
  let y = square(x)*x ;
  return y ;
```

The *expression* `function(){}` creates **a new object of type 'function'** and returns the result.

Any variable may "refer" to the function and call it. You can also store that reference into an array, an object property, pass it as a parameter to a function, redefine it, …

method

callback

Declaring functions: 3 ways

1) Classic

```
function do(params) {
  /* do something */
}
```

2a) Function expression

```
const fn = function(params) {
  /* do something */
}
```

3) Arrow function

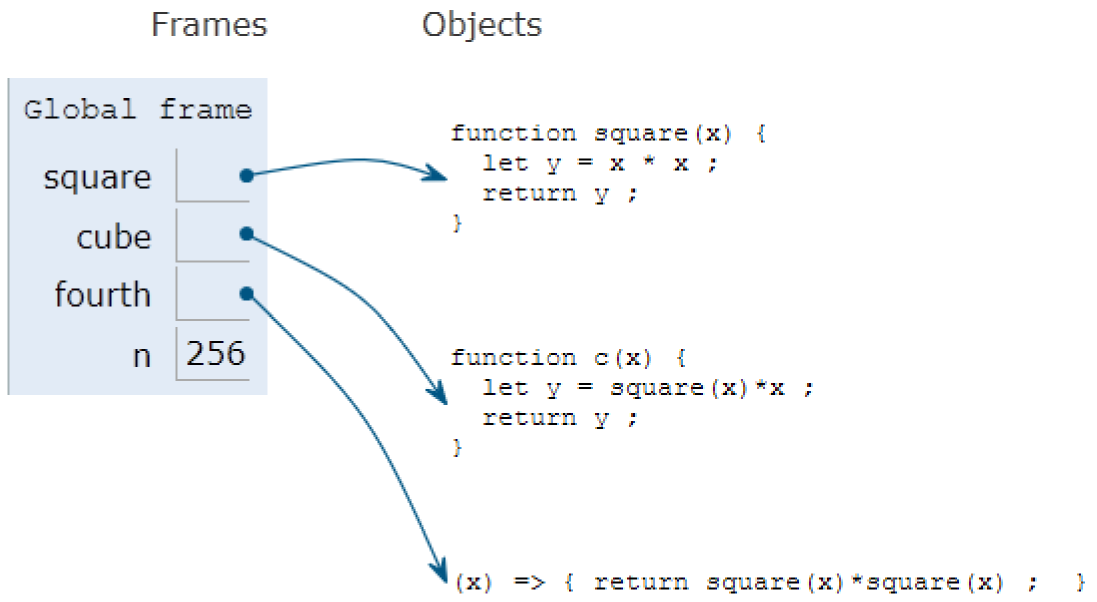
```
const fn = (params) => {
  /* do something */
}
```

2b) Named function expression

```
const fn = function do(params) {
  /* do something */
}
```

Arrow Function: just a shortcut

```
function square(x) {
  let y = x * x ;
  return y ;
}

let cube = function c(x) {
  let y = square(x)*x ;
  return y ;
}

let fourth = (x) => { return
square(x)*square(x) ;  }

let n = fourth(4) ;
```



```
function square(x) {
  let y = x * x ;
  return y ;
}
```

```
function c(x) {
  let y = square(x)*x ;
  return y ;
}
```

```
(x) => { return square(x)*square(x) ;  }
```

Parameters in arrow functions

```
const fun = () => {  /* do something */ }          // no params

const fun = param => {  /* do something */ }       // 1 param

const fun = (param) => {  /* do something */ }     // 1 param

const fun = (par1, par2) => {  /* smtg */ } // 2 params

const fun = (par1 = 1, par2 = 'abc') => {  /* smtg */ }   // default values
```

Return value

- Default: `undefined`
- Use `return` to return a value
- Only one value can be returned
- However, objects (or arrays) can be returned

```
const fun = () => {  return ['hello', 5] ; }
const [ str, num ] = fun() ;
console.log(str) ;
```

- Arrow functions have implicit return if there is only one value

```
let fourth = (x) => { return square(x)*square(x) ;  }
let fourth = x => square(x)*square(x) ;
```

Nested functions

- Function can be nested, i.e., defined within another function

```
function hypotenuse(a, b) {
    const square = x => x*x ;
    return Math.sqrt(square(a) + square(b));
}
```

=> Preferred in nested functions

```
function hypotenuse(a, b) {
    function square(x) { return x*x; }
    return Math.sqrt(square(a) + square(b));
}
```

- The inner function is *scoped within* the external function and cannot be called outside
- The inner function might *access variables declared* in the *outside* function

Closure: definition (somewhat cryptic)

A **closure** is a name given to a feature in the language by which a **nested** function executed **after** the execution of the outer function can still access **outer function’s scope**.

Really: one of the most important concepts in JS

https://medium.com/@vvkchandra/learn-javascript-closures-through-the-laws-of-karma-49d32d35b3f7

Closures

- JS uses *lexical scoping*
  - Each new functions defines a *scope* for the variables declared inside
  - Nested functions may access the scope of *all enclosing* functions
- Every function object remembers the scope where it is defined, even after the external function is no longer active → Closure

```
"use strict" ;

function greeter(name) {
    const myname = name ;

    const hello = function () {
        return "Hello " + myname ;
    }

    return hello ;
}

const helloTom = greeter("Tom") ;
const helloJerry = greeter("Jerry") ;

console.log(helloTom()) ;
console.log(helloJerry()) ;
```

Warning: not `return hello() ;`

Closures

- `hello` accesses the variable `myname`, defined in the outer scope
- The function is returned (as `helloTom` or `helloJerry`)
- Each of the functions “remembers” the reference to `myname`, when it was defined
- The variable `myname` goes out of scope, but is not destroyed
  - Still accessible (referred) by the `hello` functions.

```
"use strict" ;

function greeter(name) {
    const myname = name ;

    const hello = function () {
        return "Hello " + myname ;
    }

    return hello ;
}

const helloTom = greeter("Tom") ;
const helloJerry = greeter("Jerry") ;

console.log(helloTom()) ;
console.log(helloJerry()) ;
```

greeter scope

hello scope

Using closures to emulate objects

```
"use strict" ;

function counter() {
    let value = 0 ;

    const getNext = () => {
        value++;
        return value;
    }

    return getNext ;
}
```

```
const count1 = counter() ;
console.log(count1()) ;
console.log(count1()) ;
console.log(count1()) ;

const count2 = counter() ;
console.log(count2()) ;
console.log(count2()) ;
console.log(count2()) ;
```

```
1
2
3
1
2
3
```

Using closures to emulate objects (with methods)

```
"use strict";

function counter() {
    let n = 0;

    // return an object,
    // containing two function-valued
    // properties
    return {
        count: function() {
            return n++; },
        reset: function() { n = 0; }
    };
}
```

```
let c = counter(), d = counter();
       // Create two counters

c.count()
       // => 0

d.count()
       // => 0: they count independently

c.reset()
       // reset() and count() methods

c.count()
       // => 0: because we reset c

d.count()
       // => 1: d was not reset
```

Immediately Invoked Function Expressions (IIFE)

- Functions may protect the *scope* of variables and inner functions
- May declare a function
  - With internal variables
  - With inner functions
  - Call it only once, and discard everything

```
( function() {
    let a = 3 ;
    console.log(a) ;
} ) () ;
```

```
let num = ( function() {
    let a = 3 ;
    return a ;
} ) () ;
```

https://flaviocopes.com/javascript-iife/

https://medium.com/@vvkchandra/essential-javascript-mastering-immediately-invoked-function-expressions-67791338ddc6

Using IIFE to emulate objects (with methods)

```
"use strict";

const c = (
    function () {
        let n = 0;

        return {
            count: function () {
                return n++; },
            reset: function () {
                n = 0; }
        };
    })();
```

```
console.log(c.count());
console.log(c.count());
c.reset();
console.log(c.count());
console.log(c.count());
```

```
0
1
0
1
```

Construction functions

- Define the object type
  - Use a capital initial letter
  - Set the properties with the keyword **`this`**
- Create an instance of the object with **`new`**

```
function Car(make, model, year) {
  this.make = make;
  this.model = model;
  this.year = year;
  this.isNew = ()=>(year>2000);
}
```

```
let mycar = new Car('Eagle',
'Talon TSi', 1993);
```

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