

<WA/>

2026

JavaScript (basics)

“The” language of the Web

Fulvio Corno

Luigi De Russis

Enrico Masala

JS

JavaScript

Cheat Sheet

JS

Programming Language of Web

Number()

PROPERTIES

- POSITIVE_INFINITY** +∞ equivalent
- NEGATIVE_INFINITY** -∞ equivalent
- MAX_VALUE** largest positive value
- MIN_VALUE** smallest positive value
- EPSILON** diff between 1 & smallest >1
- NaN** not-a-number value

METHODS

- toExponential(dec)** exp. notation
- toFixed(dec)** fixed-point notation
- toPrecision(p)** change precision
- isFinite(n)** check if number is finite
- isInteger(n)** check if number is int.
- isNaN(n)** check if number is NaN
- parseInt(s, radix)** string to integer
- parseFloat(s, radix)** string to float

RegExp()

PROPERTIES

- lastIndex** index to start global regexp
- flags** active flags of current regexp
- global** flag g (search all matches)
- ignoreCase** flag i (match lower/upper)
- multiline** flag m (match multiple lines)
- sticky** flag y (search from lastIndex)
- unicode** flag u (enable unicode feat.)
- source** current regexp (w/o slashes)

METHODS

- exec(str)** exec search for a match
- test(str)** check if regexp match w/str

CLASSES

- any character `\t` tabulator
- digit `[0-9]` `\r` carriage return
- no digit `[^0-9]` `\n` line feed
- any alphanumeric char `[A-Za-z0-9_]`
- any space char (space, tab, enter...) `\s`
- no alphanumeric char `[^A-Za-z0-9_]`
- any space char (space, tab, enter...) `\s`
- no space char (space, tab, enter...) `\S`
- char with code `N` `\b` backspace
- char with unicode `N` `\0` NUL char

CHARACTER SETS OR ALTERNATION

- `[abc]` match any character set
- `[^abc]` match any char. set not enclosed
- `a|b` match a or b

BOUNDARIES

- `^` begin of input `$` end of input
- `\b` zero-width word boundary
- `\B` zero-width non-word boundary

GROUPING

- `(x)` capture group `(?:x)` no capture group
- `\n` reference to group `n` captured

QUANTIFIERS

- `*` preceding `x` 0 or more times `{0,}`
- `+` preceding `x` 1 or more times `{1,}`
- `?` preceding `x` 0 or 1 times `{0,1}`
- `{n}` `n` occurrences of `x`
- `{n,}` at least `n` occurrences of `x`
- `{n,m}` between `n` & `m` occurrences of `x`

ASSERTIONS

- `x(?:y)` `x` (only if `x` is followed by `y`)
- `x(?:!y)` `x` (only if `x` is not followed by `y`)

String()

PROPERTIES

- length** string size

METHODS

- charAt(index)** char at position `[]`
- charCodeAt(index)** unicode at pos.
- fromCharCode(n1, n2,...)** code to char
- concat(str1, str2,...)** combine text `+`
- startsWith(str, size)** check beginning
- endsWith(str, size)** check ending
- includes(str, from)** include substring?
- indexOf(str, from)** find substr index
- lastIndexOf(str, from)** find from end
- search(regex)** search & return index
- localeCompare(str, locale, options)**
- match(regex)** matches against string
- repeat(n)** repeat string `n` times
- replace(str|regex, newstr|func)**
- slice(ini, end)** str between ini/end
- substr(ini, len)** substr of len length
- substring(ini, end)** substr fragment
- split(sep|regex, limit)** divide string
- toLowerCase()** string to lowercase
- toUpperCase()** string to uppercase
- trim()** remove space from begin/end
- raw()** template strings with `$vars`

Date()

METHODS

- UTC(y, m, d, h, i, s, ms)** timestamp
- now()** timestamp of current time
- parse(str)** convert str to timestamp
- setTime(ts)** set UNIX timestamp
- getTime()** return UNIX timestamp

UNIT SETTERS (ALSO .setUTC() methods)

- setFullYear(y, m, d)** set year (yyyy)
- setMonth(m, d)** set month (0-11)
- setDate(d)** set day (1-31)
- setHours(h, m, s, ms)** set hour (0-23)
- setMinutes(m, s, ms)** set min (0-59)
- setSeconds(s, ms)** set sec (0-59)
- setMilliseconds(ms)** set ms (0-999)

UNIT GETTERS (ALSO .getUTC() methods)

- getDate()** return day (1-31)
- getDay()** return day of week (0-6)
- getMonth()** return month (0-11)
- getFullYear()** return year (yyyy)
- getHours()** return hour (0-23)
- getMinutes()** return minutes (0-59)
- getSeconds()** return seconds (0-59)
- getMilliseconds()** return ms (0-999)

LOCAL & TIMEZONE METHODS

- getTimezoneOffset()** offset in mins
- toLocaleDateString(locale, options)**
- toLocaleTimeString(locale, options)**
- toLocaleString(locale, options)**
- toUTCString()** return UTC date
- toString()** return American date
- toISOString()** return ISO8601 date
- toJSON()** return date ready for JSON

Array()

PROPERTIES

- length** number of elements

METHODS

- isArray(obj)** check if obj is array
- includes(obj, from)** include element?
- indexOf(obj, from)** find elem. index
- lastIndexOf(obj, from)** find from end
- join(sep)** join elements w/separator
- slice(ini, end)** return array portion
- concat(obj1, obj2,...)** return joined array

MODIFY SOURCE ARRAY METHODS

- copyWithin(pos, ini, end)** copy elems
- fill(fill, ini, end)** fill array with obj
- reverse()** reverse array & return it
- sort(compareFn)** sort array (unicode sort)
- splice(ini, del, o1, o2,...)** del&add elem

ITERATION METHODS

- entries()** iterate key/value pair array
- keys()** iterate only keys array
- values()** iterate only values array

CALLBACK FOR EACH METHODS

- every(cb(e,i,a), arg)** test until false
- some(cb(e,i,a), arg)** test until true
- map(cb(e,i,a), arg)** make array
- filter(cb(e,i,a), arg)** make array w/true
- find(cb(e,i,a), arg)** return elem w/true
- findIndex(cb(e,i,a), arg)** return index
- forEach(cb(e,i,a), arg)** exec for each
- reduce(cb(p,e,i,a), arg)** accumulative
- reduceRight(cb(p,e,i,a), arg)** from end

ADD/REMOVE METHODS

- pop()** remove & return last element
- push(o1, o2,...)** add element & return length
- shift()** remove & return first element
- unshift(o1, o2,...)** add element & return len

Boolean()

no own properties or methods

Function()

PROPERTIES

- length** return number of arguments
- name** return name of function
- prototype** prototype object

METHODS

- call(newthis, arg1, arg2,...)** change **this**
- apply(newthis, arg1)** with args array
- bind(newthis, arg1, arg2,...)** bound func

- number**
- NaN** (not-a-number)
- string**
- boolean** (true/false)
- array**

- date**
- regular expression**
- function**
- object**
- undefined**

only available on ECMAScript 6

- static** (ex: `Math.random()`)
- non-static** (ex: `new Date().getDate()`)

argument required
argument optional

 Politecnico di Torino

Web Applications - 2025/2026

 BY NC SA

Goal

- Learn JavaScript as a language
- Understand the specific semantics and programming patterns
 - We assume a programming knowledge in other languages
- Updated to ES6 (2015) language features
- Supported by server-side (Node.js) and client-side (browsers) run-time environments
 - More recent language additions also supported (through *transpiling*)

Outline

- What is JavaScript?
- History and versions
- Language structure
- Types, variables
- Expressions
- Control structures
- Arrays
- Strings

JavaScript – The language of the Web

WHAT IS JAVASCRIPT?

JavaScript

- JavaScript (JS) is a programming language
- It is currently the only programming language that a browser can execute natively...
- ... and it also run on a computer, like other programming languages (thanks to Node.js)
- It has **nothing** to do with Java
 - named that way for *marketing reasons*, only
- The first version was written in 10 days (!)
 - several fundamental language decisions were made because of company politics and not technical reasons!


JavaScript – The language of the Web

HISTORY AND VERSIONS

JAVASCRIPT VERSIONS



Brendan Eich

- ▶ **JAVASCRIPT (December 4th 1995)** Netscape and Sun press release
- ▶ **ECMAScript Standard Editions:** <https://www.ecma-international.org/ecma-262/> 
- ▶ **ES1 (June 1997)** Object-based, Scripting, Relaxed syntax, Prototypes
- ▶ **ES2 (June 1998)** Editorial changes for ISO 16262
- ▶ **ES3 (December 1999)** Regexp, Try/Catch, Do-While, String methods
- ▶ **ES5 (December 2009)** Strict mode, JSON, .bind, Object mts, Array mts
- ▶ **ES5.1 (June 2011)** Editorial changes for ISO 16262:2011
- ▶ **ES6 (June 2015)** Classes, Modules, Arrow Fs, Generators, Const/Let, Destructuring, Template Literals, Promise, Proxy, Symbol, Reflect
- ▶ **ES7 (June 2016)** Exponentiation operator (**) and Array Includes
- ▶ **ES8 (June 2017)** Async Fs, Shared Memory & Atomics

10
yrs

Main
target

ES9,
ES10,
...

Also: ES2015

Also: ES2016

Also: ES2017

JavaScript versions

- ECMAScript (also called ES) is the official name of JavaScript (JS) standard
- ES6, ES2015, ES2016 etc. are implementations of the standard
- All browsers used to run ECMAScript 3
- ES5, and ES2015 (=ES6) were huge versions of JavaScript
- Then, yearly release cycles started
 - By the committee behind JS: TC39, backed by Mozilla, Google, Facebook, Apple, Microsoft, Intel, PayPal, Salesforce, etc.
- **ES2015 (=ES6) is covered in this course**

Official ECMA standard (formal and unreadable)

Search...

TABLE OF CONTENTS

- Introduction
- 1 Scope
- 2 Conformance
- 3 Normative References
- 4 Overview
- 5 Notational Conventions
- 6 ECMAScript Data Types and Values
- 7 Abstract Operations
- 8 Executable Code and Execution Contexts
- 9 Ordinary and Exotic Objects Behaviours
- 10 ECMAScript Language: Source Code
- 11 ECMAScript Language: Lexical Grammar
- 12 ECMAScript Language: Expressions
- 13 ECMAScript Language: Statements and Declarations
- 14 ECMAScript Language: Functions and Classes
- 15 ECMAScript Language: Scripts and Modules
- 16 Error Handling and Language Extensions
- 17 ECMAScript Standard Built-in Objects
- 18 The Global Object
- 19 Fundamental Objects
- 20 Numbers and Dates
- 21 Text Processing
- 22 Indexed Collections
- 23 Keyed Collections
- 24 Structured Data
- 25 Control Abstraction Objects
- 26 Reflection
- 27 Memory Model
- A Grammar Summary
- B Additional ECMAScript Features for Web Browsers
- C The Strict Mode of ECMAScript
- D Corrections and Clarifications in ECMAScript 2015 with...
- E Additions and Changes That Introduce Incompatibilities...
- F Colophon
- G Bibliography
- H Copyright & Software License

ecma
INTERNATIONAL

ECMA-262, 10th edition, June 2019
ECMAScript® 2019 Language Specification

Contributing to this Specification

This specification is developed on GitHub with the help of the ECMAScript community. There are a number of ways to contribute to the development of this specification:

GitHub Repository: <https://github.com/tc39/ecma262>
Issues: [All Issues](#), [File a New Issue](#)
Pull Requests: [All Pull Requests](#), [Create a New Pull Request](#)
Test Suite: [Test262](#)

Editors:

- Brian Terlson (@bterlson)
- Bradley Farias (@bradleymeck)
- Jordan Harband (@ljharb)

Community:

- Mailing list: [es-discuss](#)
- IRC: [#tc39](#) on [freenode](#)

Refer to the [colophon](#) for more information on how this document is created.

Introduction

<https://www.ecma-international.org/ecma-262/>

JavaScript Engines

- V8 (Chrome V8) by Google
 - used in Chrome/Chromium, Node.js and Microsoft Edge
- SpiderMonkey by Mozilla Foundation
 - Used in Firefox/Gecko
- ChakraCore by Microsoft
 - it was used in Edge
- JavaScriptCore by Apple
 - used in Safari

Standard vs. Implementation (in browsers)

Browser compatibility

[Update compatibility data on GitHub](#)

		Desktop						Mobile					
		Chrome	Edge	Firefox	Internet Explorer	Opera	Safari	Android webview	Chrome for Android	Firefox for Android	Opera for Android	Safari on iOS	Samsung Internet
FetchEvent	⚠	40	Yes	44 ★	No	27	No	40	40	44	27	No	4.0
FetchEvent() constructor	⚠	40	Yes	44 ★	No	27	No	40	40	44	27	No	4.0
client	⚠ ⚠ ⚠	42	?	44	No	27	No	42	44	No	?	No	4.0
clientId	⚠	49	?	45 ★	No	36	No	49	49	45	36	No	5.0
isReload	⚠	45	17	44 ★	No	32	No	45	45	44	32	No	5.0
navigationPreload	⚠	59	?	?	No	46	No	59	59	?	43	No	7.0
preloadResponse	⚠	59	18	?	No	46	No	59	59	?	43	No	7.0
replacesClientId		No	18	65	No	No	No	No	No	65	No	No	No
request	⚠	Yes	?	44	No	Yes	No	Yes	Yes	?	Yes	No	Yes
respondWith	⚠	42 ★	?	59 ★	No	29	No	42 ★	42 ★	?	29	No	4.0
resultingClientId		72	18	65	No	60	No	72	72	65	50	No	No
targetClientId		?	?	?	No	?	No	?	?	?	?	No	?

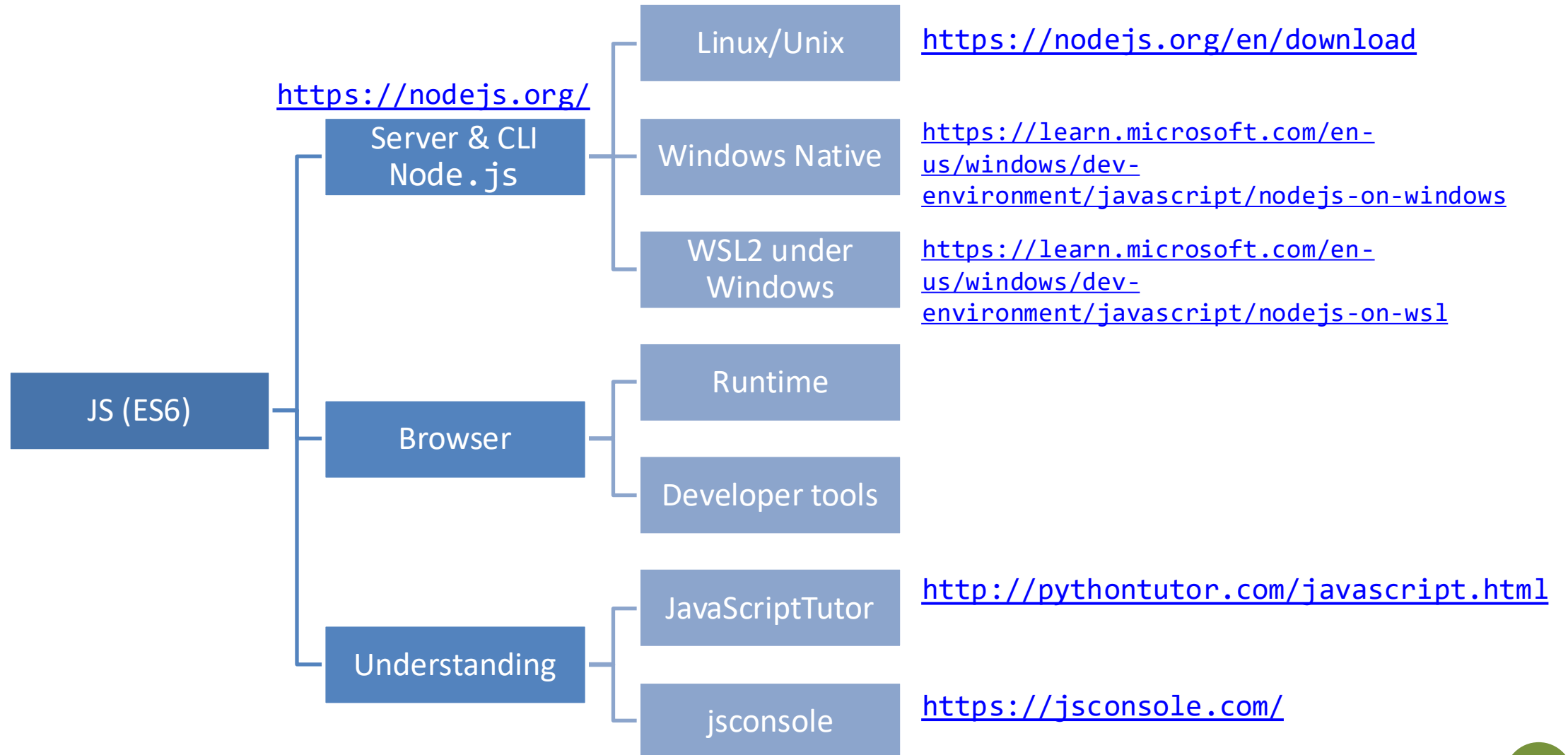
What are we missing?

- Full support
- Compatibility unknown
- Non-standard. Expect poor cross-browser support.
- See implementation notes.
- No support
- Experimental. Expect behavior to change in the future.
- Deprecated. Not for use in new websites.

JS Compatibility

- JS is *backward-compatible*
 - once something is accepted as valid JS, there will not be a future change to the language that causes that code to become invalid JS
 - TC39 members: "we don't break the web!"
- JS is not *forward-compatible*
 - new additions to the language will not run in an older JS engine and may crash the program
- **strict mode** was introduced to disable very old (and dangerous) semantics
- Supporting multiple versions is achieved by:
 - *Transpiling* – Babel (<https://babeljs.io>) converts from newer JS syntax to an equivalent older syntax
 - *Polyfilling* – user- (or library-)defined functions and methods that “fill” the lack of a feature by implementing the newest available one

JS Execution Environments



JavaScriptTutor

Write code in JavaScript ES6 (drag lower right corner to resize code editor)

```
1 let nome = "Fulvio" ;
2 let cognome = "Corno" ;
3
4 function hello(c, n) {
5   n = n || "sig."
6   const saluto = n + " " + c ;
7   return saluto ;
8 }
9
10 let s1 = hello(cognome, nome)
11 let s2 = hello(nome)
12
13 let nome2 = [...nome]
14 let cognome2 = [...cognome]
```

→ line that just executed

→ next line to execute

<< First < Prev Next > Last >>

Done running (16 steps)

Frames

Global frame	
hello	
nome	"Fulvio"
cognome	"Corno"
s1	"Fulvio Corno"
s2	"sig. Fulvio"
nome2	
cognome2	

Objects

```
function hello(c, n) {
  n = n || "sig."
  const saluto = n + " " + c ;
  return saluto ;
}
```

array

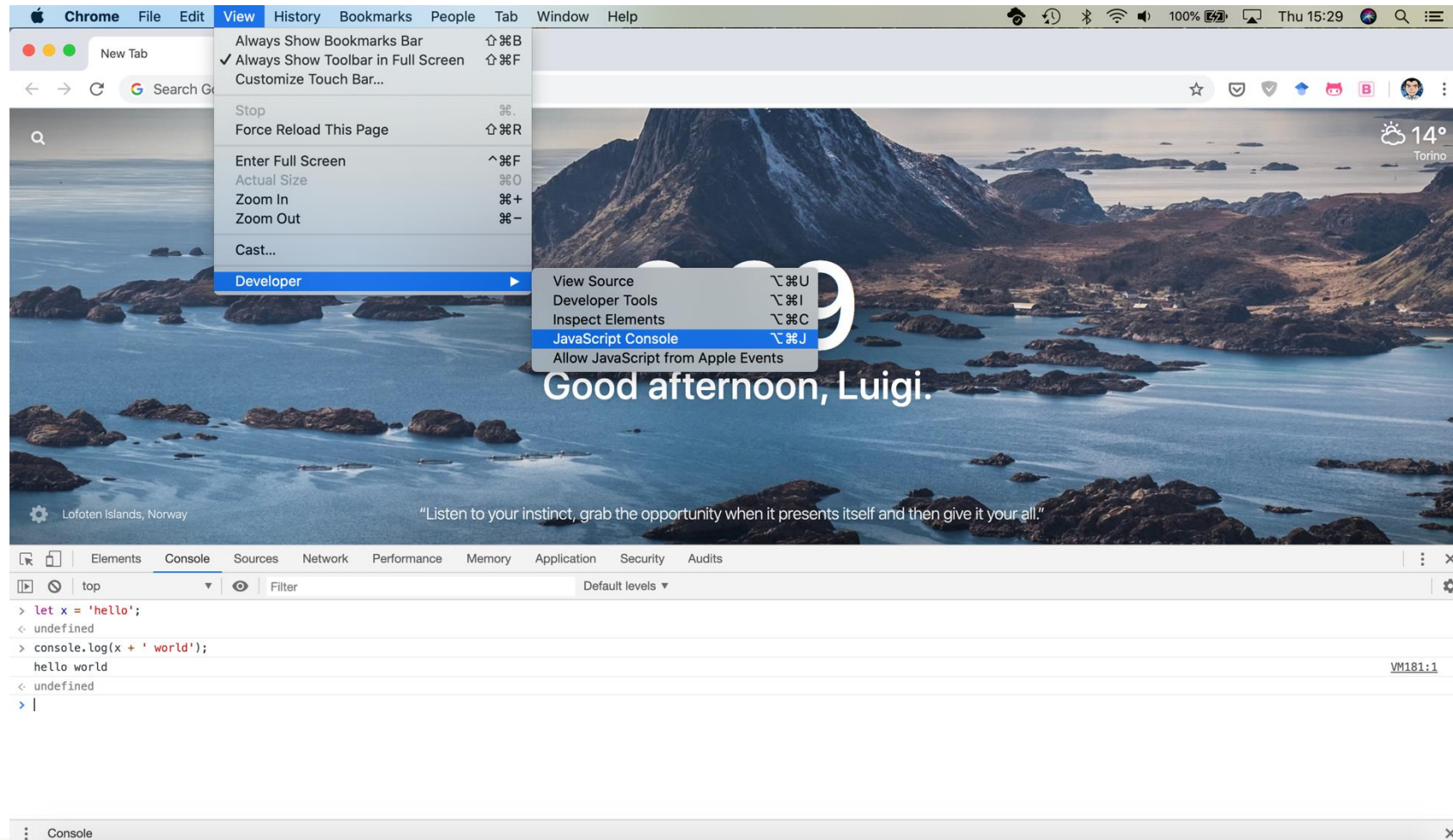
0	1	2	3	4	5
"F"	"u"	"l"	"v"	"i"	"o"

array

0	1	2	3	4
"C"	"o"	"r"	"n"	"o"

<http://pythontutor.com/javascript.html>

Browser and JS console



JavaScript – The language of the Web

LANGUAGE STRUCTURE

Lexical structure

- One File = One JS program
 - Each file is loaded independently and
 - Different files/programs may communicate through *global state*
 - The “module” mechanism extends that (provides state sharing in a clean way)
- The file is entirely *parsed*, and then *executed* from top to bottom
- Relies on a *standard library*
 - and many additional *APIs* provided by the execution environment

Lexical structure

```
> let ööö = 'appalled'  
> ööö  
'appalled'
```

- JavaScript is written in Unicode (do not abuse), so it also supports non-latin characters for names and strings
 - even emoji
- Semicolons (;) are not mandatory (automatically inserted)
- Case sensitive
- Comments as in C (/* . . */ and //)
- Literals and identifiers (start with letter, \$, _)
- Some reserved words
- C-like syntax

```
> let x = '😬';  
< undefined  
> console.log(x);  
😬
```

Semicolon (;)

- Argument of debate in the JS community
- JS inserts them as needed
 - When next line starts with code that breaks the current one
 - When the next line starts with }
 - When there is return, break, throw, continue on its own line
- Be careful that forgetting semicolon can lead to unexpected behavior
 - A newline does not automatically insert a semicolon: if the next line starts with (or [, it is interpreted as function call or array access
- We will **loosely** follow the Google style guide, so we will always insert semicolons after each statement
 - <https://google.github.io/styleguide/jsguide.html>

Strict Mode

```
// first line of file  
"use strict" ;  
// always!!
```

- Directive introduced in ES5: `"use strict" ;`
 - Compatible with older version (it is just a string)
- Code is executed in *strict mode*
 - This fixes some important language deficiencies and provides stronger error checking and security
 - Examples:
 - fixes mistakes that make it difficult for JavaScript engines to perform optimizations: strict mode code can sometimes be made to run faster than identical code that's not strict mode
 - eliminates some JavaScript silent errors by changing them to throw errors
 - functions invoked as functions and not as methods of an object have `this` undefined
 - cannot define 2 or more properties or function parameters with the same name
 - no octal literals (base 8, starting with 0)
 - ...

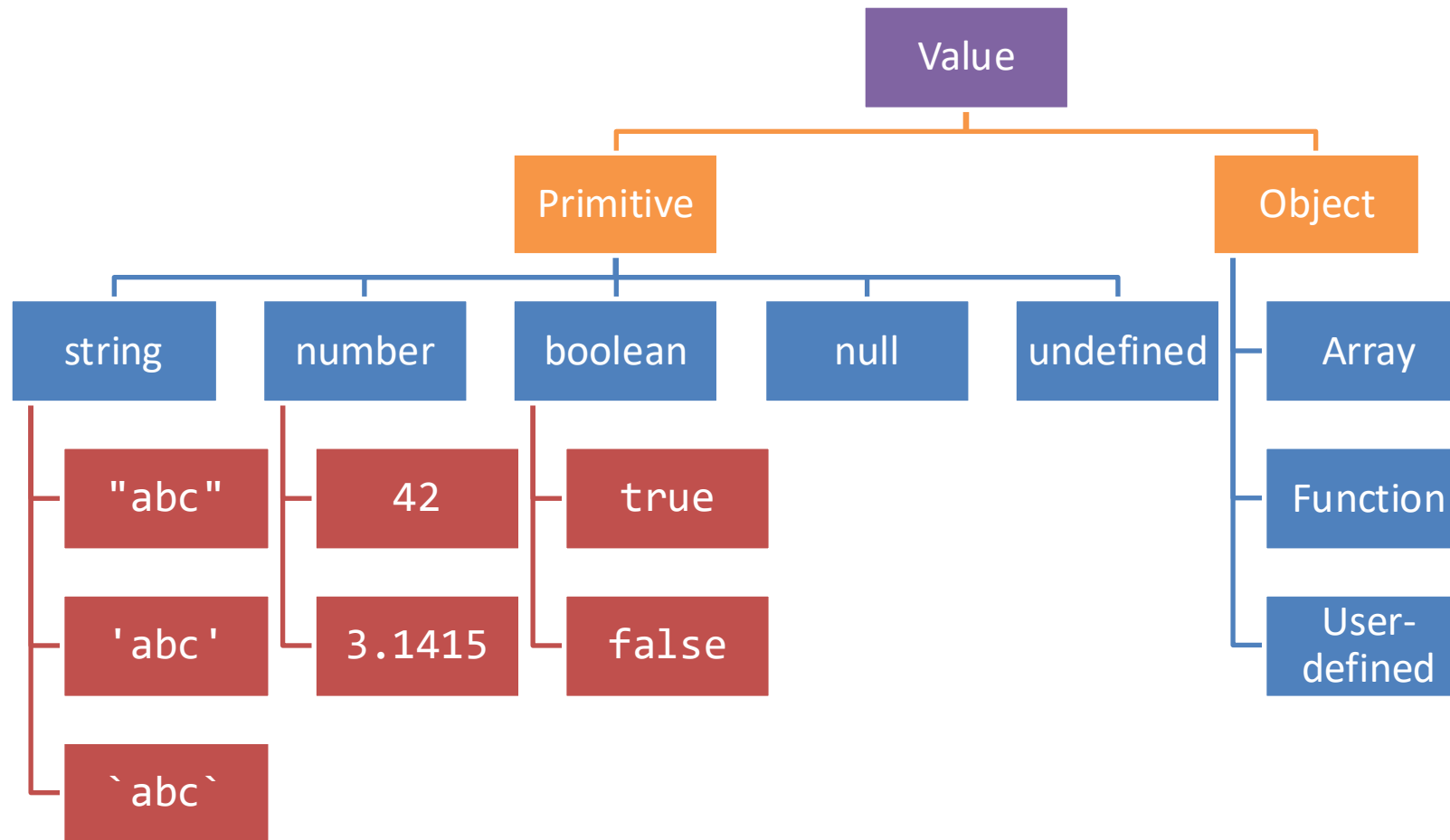


JavaScript – The language of the Web

TYPES AND VARIABLES

Values and Types

*Values have types.
Variables don't.*



Boolean, true-*truthy*, false-*falsy*, comparisons

- 'boolean' type with literal values: true, false
- When converting to boolean

- The following values are 'falsy'

- 0, -0, NaN, undefined, null, '' (empty string)

- Every other value is 'truthy'

- 3, 'false', [] (empty array), {} (empty object)

- Booleans and Comparisons

- a == b *// convert types and compare results*

- a === b *// inhibit automatic type conversion and compare results*

```
> Boolean(3)
true
> Boolean('')
false
> Boolean(' ')
true
```

Number

- No distinction between integers and reals
- Automatic conversions according to the operation
- There is also a distinct type "BigInt" (*ES11, July 2020*)
 - an arbitrary-precision integer, can represent 2^{53} numbers
 - 123456789n
 - With suffix 'n'

Special values

- **undefined**: variable declared but not initialized
 - Detect with: `typeof variable === 'undefined'`
 - `void x` always returns undefined
- **null**: an empty value
- Null and Undefined are called *nullish values*
- **NaN** (Not a Number)
 - It is actually a number
 - Invalid output from arithmetic operation or parse operation

Variables

- Variables are ***pure references***: they refer to a *value*
- The same variable may refer to different values (even of different types) at different times
- Declaring a variable:
 - **let**
 - **const**
 - **var**

```
> v = 7 ;  
7  
> v = 'hi' ;  
'hi'
```

```
> let a = 5  
> const b = 6  
> var c = 7  
> a = 8  
8  
> b = 9  
Thrown:  
TypeError: Assignment to  
constant variable.  
> c = 10  
10
```

Variable declarations

Declarator	Can reassign?	Can re-declare?	Scope	Hoisting *	Note
let	Yes	No	Enclosing block {...}	No	<i>Preferred</i>
const	No [§]	No	Enclosing block {...}	No	<i>Preferred</i>
var	Yes	Yes	Enclosing function, or global	Yes, to beginning of function or file	<i>Legacy, beware its quirks, try not to use</i>
None (implicit)	Yes	N/A	Global	Yes	<i>Forbidden in strict mode</i>

[§] Prevents reassignment (a=2), does not prevent changing the value of the referred object (a.b=2)

* Hoisting = “lifting up” the definition of a variable (not the initialization!) to the top of the current scope (e.g., the file or the function)

Scope

```
"use strict" ;
```

```
let a = 1 ;
```

```
const b = 2 ;
```

```
let c = true ;
```

```
let a = 5 ; // SyntaxError: Identifier 'a' has already been declared
```

Scope

Typically, you don't create a new scope in this way!

```
"use strict" ;

let a = 1 ;
const b = 2 ;
let c = true ;

{ // creating a new scope...
  let a = 5 ;
  console.log(a) ;
}

console.log(a) ;
```

Each { } is called a **block**. 'let' and 'const' variables are *block-scoped*.

They exist only in their defined and inner scopes.

Scope and Hoisting


```
"use strict" ;

function example(x) {
  let a = 1 ;
  console.log(a) ;    // 1
  console.log(b) ;    // ReferenceError: b is not defined
  console.log(c) ;    // undefined

  if( x>1 ) {
    let b = a+1 ;
    var c = a*2 ;
  }

  console.log(a) ; // 1
  console.log(b) ; // ReferenceError: b is not defined
  console.log(c) ; // 2
}

example(2) ;
```





JavaScript: The Definitive Guide, 7th Edition
Chapter 2. Types, Values, and Variables
Chapter 3. Expressions and Operators

Mozilla Developer Network
JavaScript Guide » Expressions and operators

JavaScript – The language of the Web

EXPRESSIONS

Operators

- Assignment operators
- Comparison operators
- Arithmetic operators
- Bitwise operators
- Logical operators
- String operators
- Conditional (ternary) operator
- Comma operator
- Unary operators
- Relational operators



Full reference and operator precedence:

https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Operators/Operator_Precedence#Table

Assignment

- `let variable = expression ;` `// declaration with initialization`
- `variable = expression ;` `// reassignment`

Name	Shorthand operator	Meaning
Assignment	<code>x = y</code>	<code>x = y</code>
Addition assignment	<code>x += y</code>	<code>x = x + y</code>
Subtraction assignment	<code>x -= y</code>	<code>x = x - y</code>
Multiplication assignment	<code>x *= y</code>	<code>x = x * y</code>
Division assignment	<code>x /= y</code>	<code>x = x / y</code>
Remainder assignment	<code>x %= y</code>	<code>x = x % y</code>
Exponentiation assignment 🔥	<code>x **= y</code>	<code>x = x ** y</code>
Left shift assignment	<code>x <<= y</code>	<code>x = x << y</code>
Right shift assignment	<code>x >>= y</code>	<code>x = x >> y</code>
Unsigned right shift assignment	<code>x >>>= y</code>	<code>x = x >>> y</code>
Bitwise AND assignment	<code>x &= y</code>	<code>x = x & y</code>
Bitwise XOR assignment	<code>x ^= y</code>	<code>x = x ^ y</code>
Bitwise OR assignment	<code>x = y</code>	<code>x = x y</code>

Comparison operators



Operator	Description	Examples returning true
Equal (==)	Returns <code>true</code> if the operands are equal.	<code>3 == var1</code> <code>"3" == var1</code> <code>3 == '3'</code>
Not equal (!=)	Returns <code>true</code> if the operands are not equal.	<code>var1 != 4</code> <code>var2 != "3"</code>
Strict equal (===)	Returns <code>true</code> if the operands are equal and of the same type. See also Object.is and sameness in JS .	<code>3 === var1</code>
Strict not equal (!==)	Returns <code>true</code> if the operands are of the same type but not equal, or are of different type.	<code>var1 !== "3"</code> <code>3 !== '3'</code>
Greater than (>)	Returns <code>true</code> if the left operand is greater than the right operand.	<code>var2 > var1</code> <code>"12" > 2</code>
Greater than or equal (>=)	Returns <code>true</code> if the left operand is greater than or equal to the right operand.	<code>var2 >= var1</code> <code>var1 >= 3</code>
Less than (<)	Returns <code>true</code> if the left operand is less than the right operand.	<code>var1 < var2</code> <code>"2" < 12</code>
Less than or equal (<=)	Returns <code>true</code> if the left operand is less than or equal to the right operand.	<code>var1 <= var2</code> <code>var2 <= 5</code>

Comparing Objects

- Comparison between objects with `==` or `===` compares the *references* to objects
 - True only if they are *the same object*
 - False if they are *identical objects*
- Comparison with `<` `>` `<=` `>=` first converts the object (into a Number, or more likely a String), and then compares the values
 - It works, but may be unpredictable, depending on the string format

```
> a={x:1}  
{ x: 1 }
```

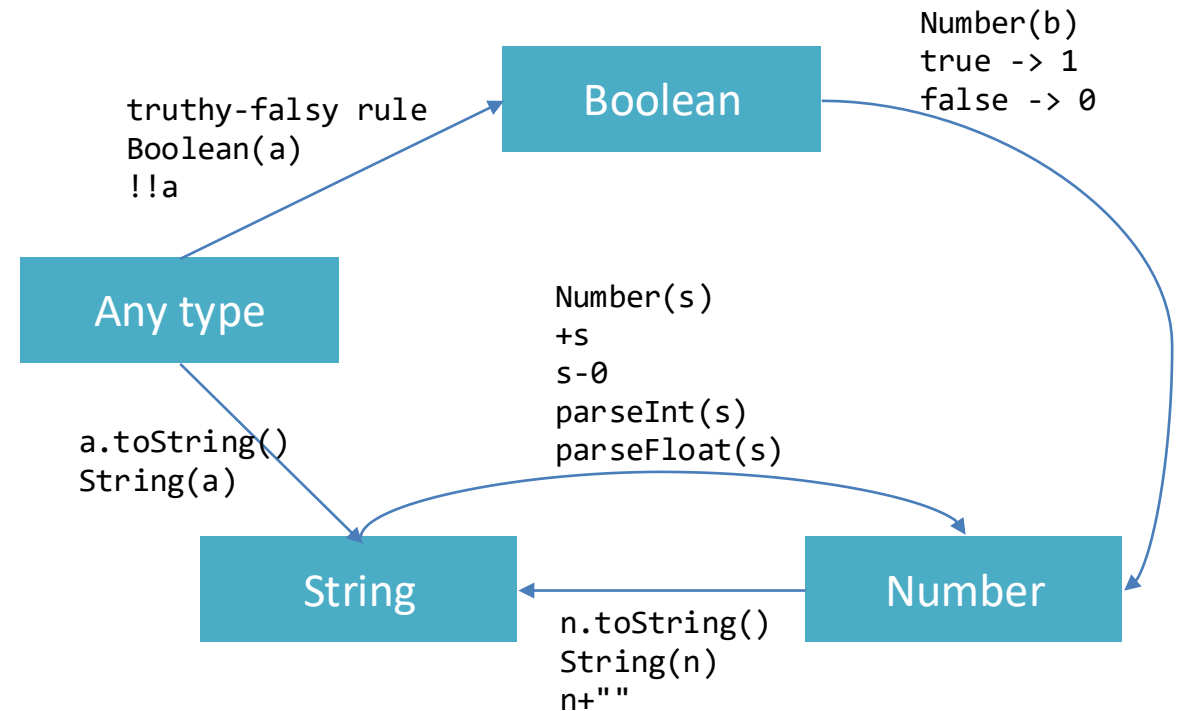
```
> b={x:1}  
{ x: 1 }
```

```
> a===b  
false
```

```
> a==b  
false
```

Automatic Type Conversions

- JS tries to apply type conversions between primitive types, before applying operators
- Some language constructs may be used to “force” the desired conversions
- Using `==` applies conversions
- Using `===` prevents conversions



Logical operators

Operator	Usage	Description
Logical AND (<code>&&</code>)	<code>expr1 && expr2</code>	Returns <code>expr1</code> if it can be converted to <code>false</code> ; otherwise, returns <code>expr2</code> . Thus, when used with Boolean values, <code>&&</code> returns <code>true</code> if both operands are true; otherwise, returns <code>false</code> .
Logical OR (<code> </code>)	<code>expr1 expr2</code>	Returns <code>expr1</code> if it can be converted to <code>true</code> ; otherwise, returns <code>expr2</code> . Thus, when used with Boolean values, <code> </code> returns <code>true</code> if either operand is true; if both are false, returns <code>false</code> .
Logical NOT (<code>!</code>)	<code>!expr</code>	Returns <code>false</code> if its single operand that can be converted to <code>true</code> ; otherwise, returns <code>true</code> .

Common operators

Or string
concatenation

Addition (+)

Decrement (--)

Division (/)

Exponentiation (**)

Increment (++)

Multiplication (*)

Remainder (%)

Subtraction (-)

Unary negation (-)

Unary plus (+)

Logical AND (&&)

Logical OR (||)

Logical NOT (!)

Nullish coalescing
operator (??)

Conditional operator (c ?
t : f)

typeof

Useful idiom:
a || b
if a then a else b
(a, with default b)

Mathematical functions (**Math** global object)

- **Constants:** `Math.E`, `Math.LN10`, `Math.LN2`, `Math.LOG10E`, `Math.LOG2E`, `Math.PI`, `Math.SQRT1_2`, `Math.SQRT2`
- **Functions:** `Math.abs()`, `Math.acos()`, `Math.acosh()`, `Math.asin()`, `Math.asinh()`, `Math.atan()`, `Math.atan2()`, `Math.atanh()`, `Math.cbrt()`, `Math.ceil()`, `Math.clz32()`, `Math.cos()`, `Math.cosh()`, `Math.exp()`, `Math.expm1()`, `Math.floor()`, `Math.fround()`, `Math.hypot()`, `Math.imul()`, `Math.log()`, `Math.log10()`, `Math.log1p()`, `Math.log2()`, `Math.max()`, `Math.min()`, `Math.pow()`, `Math.random()`, `Math.round()`, `Math.sign()`, `Math.sin()`, `Math.sinh()`, `Math.sqrt()`, `Math.tan()`, `Math.tanh()`, `Math.trunc()`



JavaScript: The Definitive Guide, 7th Edition
Chapter 4. Statements

Mozilla Developer Network
JavaScript Guide » Control Flow and Error Handling
JavaScript Guide » Loops and Iteration

JavaScript – The language of the Web

CONTROL STRUCTURES

Conditional statements

```
if (condition) {  
    statement_1;  
} else {  
    statement_2;  
}
```

if truthy (beware!)

```
if (condition_1) {  
    statement_1;  
} else if (condition_2) {  
    statement_2;  
} else if (condition_n) {  
    statement_n;  
} else {  
    statement_last;  
}
```

```
switch (expression) {  
    case label_1:  
        statements_1  
        [break;]  
    case label_2:  
        statements_2  
        [break;]  
    ...  
    default:  
        statements_def  
        [break;]  
}
```

May also be a string

Loop statements

```
for ([initialExpression]; [condition]; [incrementExpression]) {  
    statement ;  
}
```

Usually declares loop
variable

```
do {  
    statement ;  
} while (condition);
```

May use break; or
continue;

```
while (condition) {  
    statement ;  
}
```

Special 'for' statements

```
for (variable in object) {  
  statement ;  
}
```

- Iterates the variable over all the enumerable **properties** of an **object**
- Do not use to traverse an array (use numerical indexes, or for-of)

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

x
y

```
for (variable of iterable) {  
  statement ;  
}
```

- Iterates the variable over all values of an *iterable object* (including Array, Map, Set, string, arguments ...)
- Returns the *values*, not the keys

```
for( let a of [4,7]) {  
  console.log(a) ;  
}
```

4
7

```
for( let a of "hi" ) {  
  console.log(a) ;  
}
```

h
i

Other iteration methods

- Functional programming (strongly supported by JS) allows other methods to iterate over a collection (or any iterable object)
 - `a.forEach()`
 - `a.map()`
- They will be analyzed later

Exception handling

```
try {  
  statements ;  
} catch(e) {  
  statements ;  
}
```

```
throw object ;
```

Exception object

```
try {  
  statements ;  
} catch(e) {  
  statements ;  
} finally {  
  statements ;  
}
```

Executed in any case, at
the end of try and catch
blocks

EvalError
RangeError
ReferenceError
SyntaxError
TypeError
URIError
DOMException

Contain fields: name,
message



JavaScript: The Definitive Guide, 7th Edition
Chapter 6. Arrays

Mozilla Developer Network
JavaScript Guide » Indexed Collections

JavaScript – The language of the Web

ARRAYS

Arrays

- Rich of functionalities
- Elements do not need to be of the same type
- Simplest syntax: `[]`
- Property `.length`
- Distinguish between methods that:
 - Modify the array (**in-place**)
 - Return a **new** array

Creating an array

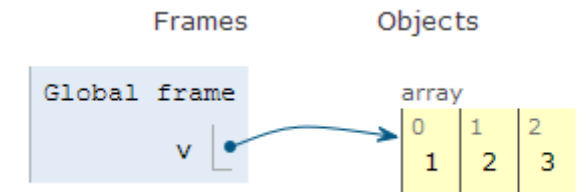
```
let v = [] ;
```

Elements are indexed at positions 0...length-1

Do not access elements outside range

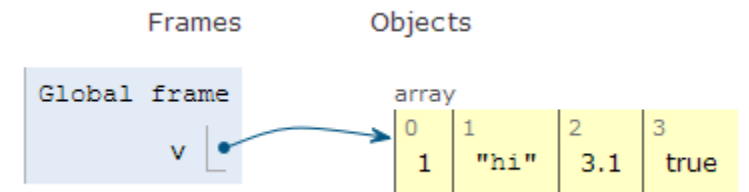
```
let v = [1, 2, 3] ;
```

```
let v = Array.of(1, 2, 3) ;
```



```
let v = [1, "hi", 3.1, true];
```

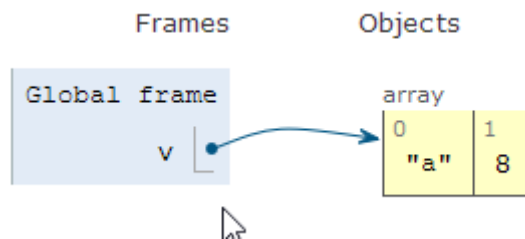
```
let v = Array.of(1, "hi", 3.1, true) ;
```



Adding elements

`.length` adjusts automatically

```
let v = [] ;  
v[0] = "a" ;  
v[1] = 8 ;  
v.length // 2
```



```
let v = [] ;  
v.push("a") ;  
v.push(8) ;  
v.length // 2
```

`.push()` adds at the end of the array

`.unshift()` adds at the beginning of the array

Adding and Removing from arrays (in-place)

`v.unshift(x)`

`v.push(x)`



`x = v.shift()`

`x = v.pop()`

Copying arrays

```
let v = [] ;  
v[0] = "a" ;  
v[1] = 8 ;  
  
let alias = v ;  
alias[1] = 5 ;
```

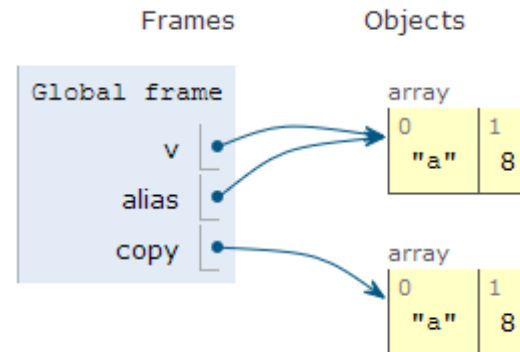
```
> console.log(v);  
[ 'a', 5 ]  
undefined  
> console.log(alias);  
[ 'a', 5 ]  
undefined
```

Copying arrays

```
let v = [] ;  
v[0] = "a" ;  
v[1] = 8 ;  
  
let alias = v ;  
let copy = Array.from(v) ;
```

Array.from creates a
shallow copy

Creates an array from
any iterable object



Iterating over Arrays

Preferred

- Iterators: `for ... of`, `for (...;...;...)`
- Iterators: `forEach(f)`
 - `f` is a function that processes the element
- Iterators: `every(f)`, `some(f)`
 - `f` is a function that returns true or false
- Iterators that return a new array: `map(f)`, `filter(f)`
 - `f` works on the element of the array passed as parameter
- Reduce: exec a callback function on all items to progressively compute a result

Functional style – later

Main array methods

- `.concat()`
 - joins two or more arrays and returns a **new** array.
- `.join(delimiter = ',')`
 - joins all elements of an array into a (**new**) string.
- `.slice(start_index, upto_index)`
 - extracts a section of an array and returns a **new** array.
- `.splice(index, count_to_remove, addElement1, addElement2, ...)`
 - removes elements from an array and (optionally) replaces them, **in place**
- `.reverse()`
 - transposes the elements of an array, **in place**
- `.sort()`
 - sorts the elements of an array **in place**
- `.indexOf(searchElement[, fromIndex])`
 - searches the array for searchElement and returns the **index** of the first match
- `.lastIndexOf(searchElement[, fromIndex])`
 - like indexOf, but starts at the end
- `.includes(valueToFind[, fromIndex])`
 - search for a certain value among its entries, returning true or false

Destructuring assignment

- Value of the right-hand side of equal sign are extracted and stored in the variables on the left

```
let [x,y] = [1,2];  
[x,y] = [y,x]; // swap
```

```
var foo = ['one', 'two', 'three'];  
var [one, two, three] = foo;
```

- Useful especially with passing and returning values from functions

```
let [x,y] = toCartesian(r,theta);
```

Spread operator (3 dots: `...`)

- Expands an iterable object in its parts, when the syntax requires a comma-separated list of elements

```
let [x, ...y] = [1,2,3,4]; // we obtain y == [2,3,4]
```

```
const parts = ['shoulders', 'knees'];  
const lyrics = ['head', ...parts, 'and', 'toes']; // ["head", "shoulders",  
"knees", "and", "toes"]
```

- Works on the left- and right-hand side of the assignment

Curiosity

- Copy by value:
 - `const b = Array.from(a)`
- Can be emulated by
 - `const b = Array.of(...a)`
 - `const b = [...a]`

Frequent
idiom



JavaScript: The Definitive Guide, 7th Edition
Chapter 2. Types, Values, and Variables

Mozilla Developer Network
JavaScript Guide » Text Formatting

JavaScript – The language of the Web

STRINGS

Strings in JS

- A string is an **immutable** ordered sequence of Unicode^(*) characters
- The **length** of a string is the number of characters it contains (not bytes)
- JavaScript's strings use zero-based indexing
 - The empty string is the string of length 0
- JavaScript does not have a special type that represents a single character (use length-1 strings).
- String literals may be defined with 'abc' or "abc"
 - Note: when dealing with JSON parsing, only " " can be correctly parsed

String operations

- All operations always return **new** strings
 - Consequence of immutability
- `s[3]`: indexing
- `s1 + s2`: concatenation
- `s.length`: number of characters
 - Note: `.length` , not ~~`.length()`~~

String methods

Method	Description
<code>charAt</code> , <code>charCodeAt</code> , <code>codePointAt</code>	Return the character or character code at the specified position in string.
<code>indexOf</code> , <code>lastIndexOf</code>	Return the position of specified substring in the string or last position of specified substring, respectively.
<code>startsWith</code> , <code>endsWith</code> , <code>includes</code>	Returns whether or not the string starts, ends or contains a specified string.
<code>concat</code>	Combines the text of two strings and returns a new string.
<code>fromCharCode</code> , <code>fromCodePoint</code>	Constructs a string from the specified sequence of Unicode values. This is a method of the String class, not a String instance.
<code>split</code>	Splits a <code>String</code> object into an array of strings by separating the string into substrings.
<code>slice</code>	Extracts a section of a string and returns a new string.
<code>substring</code> , <code>substr</code>	Return the specified subset of the string, either by specifying the start and end indexes or the start index and a length.
<code>match</code> , <code>matchAll</code> , <code>replace</code> , <code>search</code>	Work with regular expressions.
<code>toLowerCase</code> , <code>toUpperCase</code>	Return the string in all lowercase or all uppercase, respectively.
<code>normalize</code>	Returns the Unicode Normalization Form of the calling string value.
<code>repeat</code>	Returns a string consisting of the elements of the object repeated the given times.
<code>trim</code>	Trims whitespace from the beginning and end of the string.

Unicode issues

- Strings are a sequence of 16-bit Unicode ‘code units’
 - Fine for all Unicode characters from 0000 to FFFF
 - Characters (‘graphemes’) from 010000 to 10FFFF are represented by *a pair of code units* (and they occupy 2 index positions)
 - Therefore, not all string methods work well with Unicode characters above FFFF (e.g., emojis, flags, ...)
- For more details: <https://dmitripavlutin.com/what-every-javascript-developer-should-know-about-unicode/>

Template literals

- Strings included in ``backticks`` can embed expressions delimited by `${}`
- The **value** of the expression is *interpolated* into the string

```
let name = "Bill";  
let greeting = `Hello ${ name }.`;  
// greeting == "Hello Bill."
```

- Very useful and quick for string formatting
- Template literals may also span multiple lines

License

- These slides are distributed under a Creative Commons license “**Attribution-NonCommercial-ShareAlike 4.0 International (CC BY-NC-SA 4.0)**”
- **You are free to:**
 - **Share** — copy and redistribute the material in any medium or format
 - **Adapt** — remix, transform, and build upon the material
 - The licensor cannot revoke these freedoms as long as you follow the license terms.
- **Under the following terms:**
 - **Attribution** — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
 - **NonCommercial** — You may not use the material for [commercial purposes](#).
 - **ShareAlike** — If you remix, transform, or build upon the material, you must distribute your contributions under the [same license](#) as the original.
 - **No additional restrictions** — You may not apply legal terms or [technological measures](#) that legally restrict others from doing anything the license permits.
- <https://creativecommons.org/licenses/by-nc-sa/4.0/>

