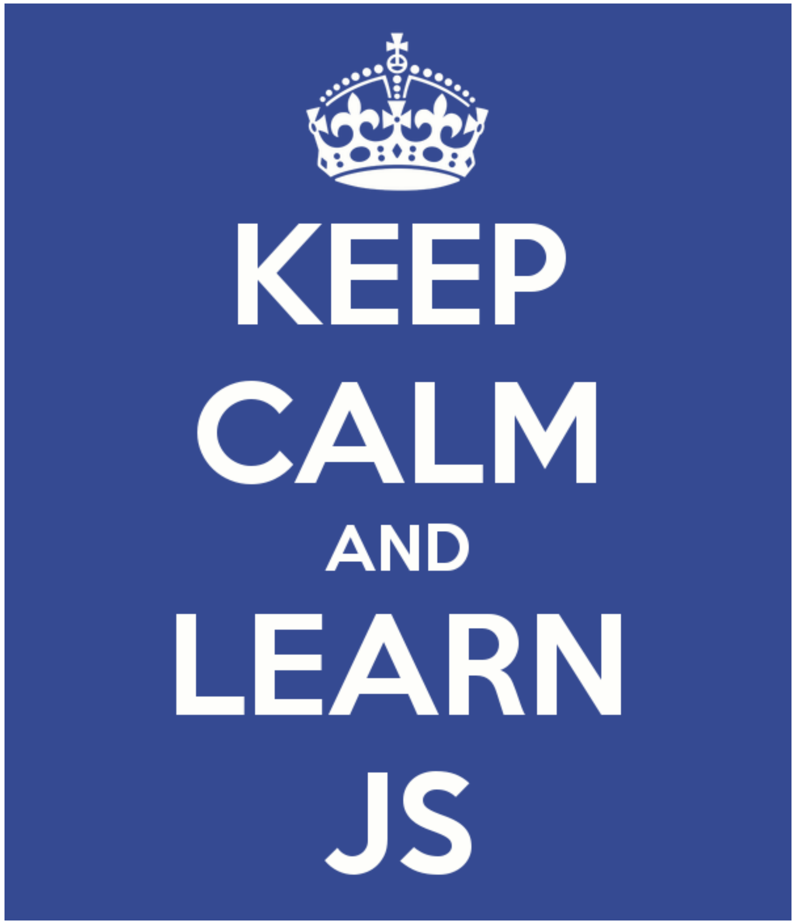
Introduction to JavaScript

Ambient intelligence: technology and design

Fulvio Corno

Politecnico di Torino, 2014/2015



Goal

- Learn about Javascript
- Learn about client-side programming mechanisms

Outline

- Introduction
- Language syntax
- Objects
- Functions
- Events
- The HTML Document Object Model

Client-side programming in the web

JAVASCRIPT / ECMASCRIPT

Client-side programming

- 4th layer of web architectures
  - Database (SQL)
  - Application server (PHP or JSP)
  - Presentation (HTML+CSS)
  - Interactivity (Javascript+DOM)
- Adds interactive functionality to client-side web pages

Client-side interactivity

- The HTML standard allows only 2 types of interaction with a page
  - Select a link (and jump to a new page)
  - Submit a form
    - Interact with form elements (input, select, ...)
- Every modification to a page requires re-loading it completely
  - Slow
  - Higher demand on the server
  - Decreases usability

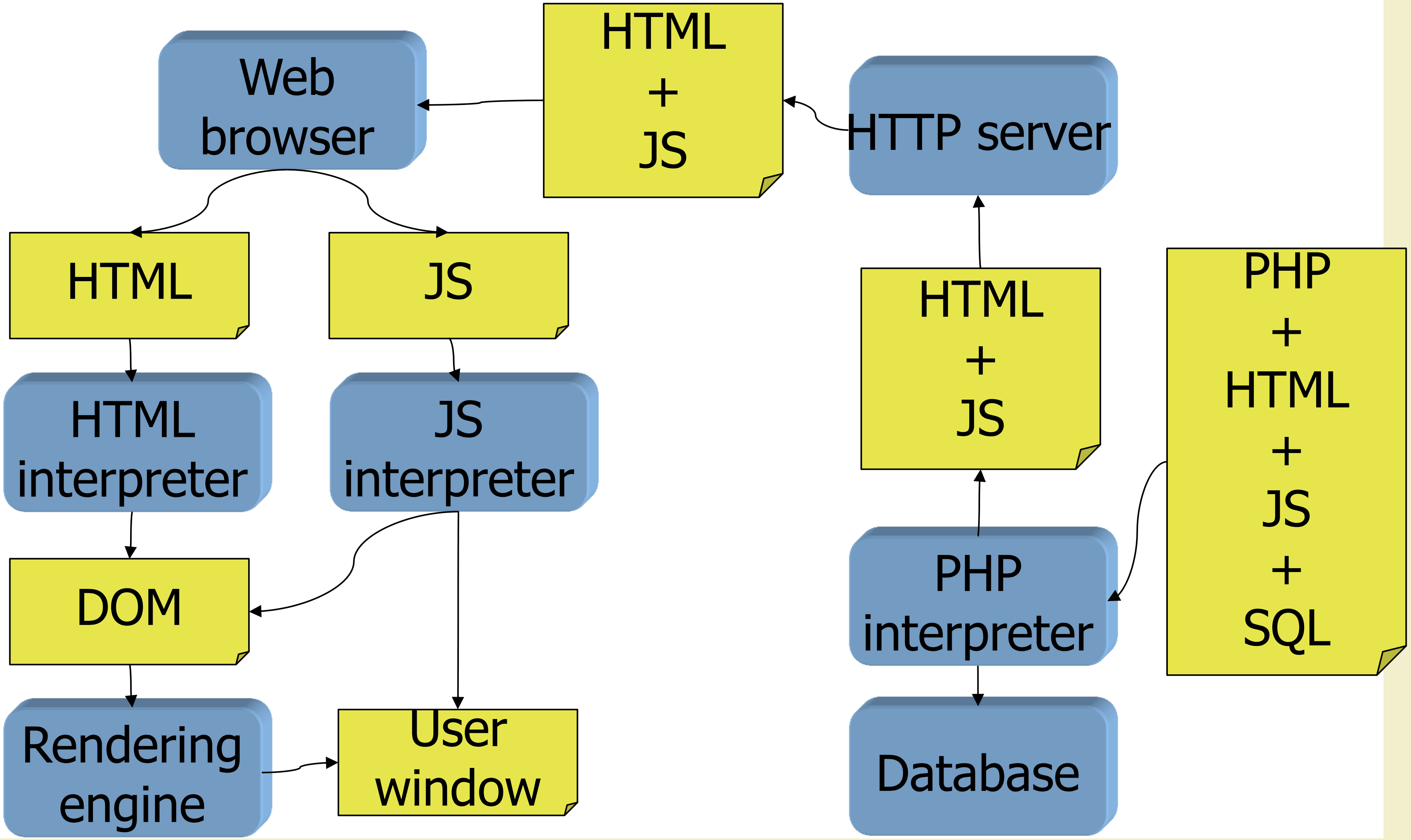
Some common problems

- Form validation
  - Avoid submitting a form unless validation rules are satisfied
  - Show validation errors immediately, and near to the error
- Form filling
  - Pre-load select lists dynamically
- Hide/show some page elements
  - Form filling instructions
  - Menus

The solution

- Add a language interpreter to the browser
- Instructions are embedded in the HTML page
  - “invisible” to the application server
  - “invisible” to the HTML presentation engine
- Instructions are processed by the browser, after HTML has been loaded

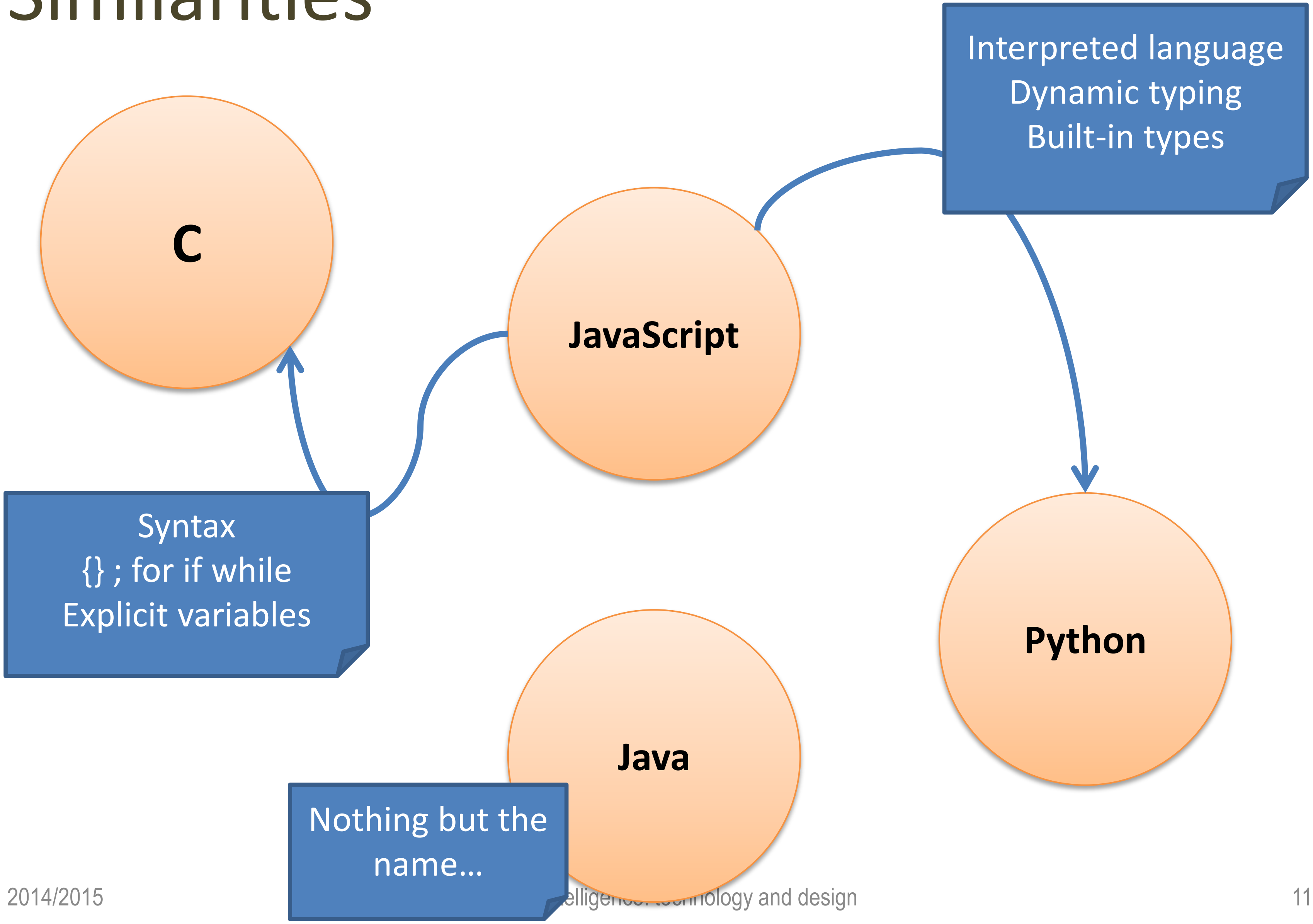
Architecture



The Javascript language

- First developed by Netscape in 1995
  - Nothing to do with the Java language, the name was chosen for marketing reasons
  - Syntax similar to C
  - Semantics of object-oriented language, with non-typed variables
- Similar versions implemented by all other browsers
  - Microsoft calls it Jscript
- Later standardized by ECMA (www.ecma.ch)
  - ECMAScript

Similarities



Embedding JS in HTML

- <script> element
- Embedded or external

Embedded JS

```
<script
type="text/javascript">
<!--

    [JavaScript code here]

// -->
</script>
```

HTML

```
<script
type="text/javascript">
// <![CDATA[

    [JavaScript code here]

// ]]>
</script>
```

XHTML

Where to embed JS code?

- In the head section: Scripts to be executed when they are called, or when an event is triggered, go in the head section. When you place a script in the head section, you will ensure that the script is loaded before anyone uses it.
- In the body section: Scripts to be executed when the page loads go in the body section. When you place a script in the body section it generates the content of the page.

External JS

```
<script
     type="text/javascript"
     src="script.js"></script>
```

```
<script type="text/javascript" src="script.js">
<!--

    [Page specific JavaScript code here]

// -->
</script>
```

Example 1

```
alert("Hello World!");
```

Exercise 1.1:
Create an HTML page including the above Javascript instruction (embedded)

Example 1

```
alert("Hello World!");
```

Exercise 1.1:
Create an HTML page including the above Javascript instruction (embedded)

Exercise 1.2:
Create a PHP page that includes a Javascript Alert than shows “Good morning” or “Good afternoon” or “Good Night” depending on the time of the day

Example 1

```
alert("Hello World!");
```

Exercise 1.1:
Create an HTML page including the above Javascript instruction (embedded)

Exercise 1.2:
at includes a Javascript
od morning" or "Good
light" depending on the
the day

Exercise 1.3:
Experiment with the following instruction:
confirm("xxx") ;

Example 2

```
document.write("Hello World!")
```

Exercise 2.1:
Create an HTML page including the above Javascript instruction (embedded)

Example 2

```
document.write("Hello World!")
```

Exercise 2.1:
Create an HTML page including the above Javascript instruction (embedded)

Exercise 2.2:
Create an HTML page that asks the user if it is morning, and then puts the right salutation into the body of the web page.

What more can we do?

- Generate dialog boxes
- Redirect a page
- Open new browser windows (pop-ups)
- Intercept mouse events
  - Clicks on links, buttons, ...
  - Mouse-overs
- Read user input in FORMs
- Modify HTML pages
  - Add/remove content
  - Change images
  - Modify FORM controls

What should we learn?

- JS variables and expressions
- JS language constructs (if, while, ...)
- What is a JS object
- Most important builtin objects
- Interacting with the user: mouse, keyboard
- Interacting with the browser: windows, pages
- Interacting with the page: the Document object

Introduction to Javascript

LANGUAGE SYNTAX

Javascript syntax

- The syntax of the Javascript language is very similar to the C language (and to PHP)
  - Choice, Looping and other constructs are equal
  - Blocks delimited by { }
  - Most operators are identical
- Variables are different
  - Variable types
  - ‘Object’ variables

Comments

- Line comments: from // to end of line
- Block comments: from /* to */

```
//this is a comment
document.write("Hello World!")
```

```
/* This is a comment
block. It contains
several lines */
document.write("Hello World!")
```

Variables in Javascript

- A variable is identified by its name
  - Case-sensitive
  - Declared with var
- The same variable may have different values
  - Even of different data types
- Data types are converted as needed
  - If all operands are numeric, then compute a numeric result
  - If some operands are string, then convert numbers to strings

Variable declaration

- var x ;
- var x = 10 ;
- var x = "Hello" ;

Variable assignment

- var x ;
- x = 10 ;
- x = "Hello" ;
- x = x + 1 ;
- x = any complex expression

Types of variables

- Boolean (false, true)
- Numbers
  - var x = 10
  - var y = 3.14
- Strings
  - var name = "Fulvio"
- ‘Objects’
  - var d = new Date()
  - var time = d.getHours()

Main Javascript operators (1/3)

- Numeric operators
  - +
  - -
  - *
  - /
  - % (remainder, or modulus)
- Increment operators
  - ++
  - --
- Assignment operators
  - =
  - +=   -=   *=   /=   %=

Main Javascript operators (2/3)

- String operator
  - + (concatenation)
- Comparison operators
  - == (same value)
  - === (same value and same type)
  - !=
  - >
  - <
  - >=
  - <=

Main Javascript operators (3/3)

- Boolean and Logic operators
  - && (logical “and”)
  - | | (logical “or”)
  - ! (logical “not”)

Warning

- String concatenation operator (+) is identical to numeric addition
  - Possible ambiguity
  - 3 + 2
  - "3" + "2"
- Difference between == and ===
  - 5 == "5"
  - 5 === 5
  - "5" === "5"
  - Not true: 5 === "5"

Choice statements (1/2)

```
if (condition)
{
  ...code...
}
```

```
if (condition)
{
  ...code if true...
}
else
{
  ...code if false...
}
```

```
if (condition1)
{
  ...code if 1 true...
}
else if (condition2)
{
  ...code if 2 true...
}
else
{
  ...if both false...
}
```

Choice statements (2/2)

```
switch(n)
{
case 1:
  code block 1
  break

case 2:
  code block 2
  break

default:
  code to be executed if n is
  different from case 1 and 2
}
```

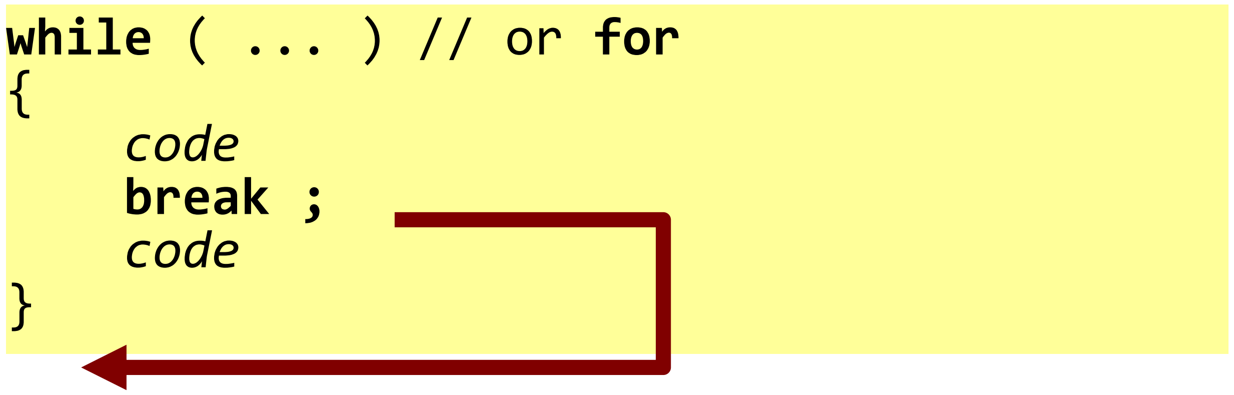
Loop statements (1/2)

```
for ( v = startvalue;
      v < endvalue;
      v = v+increment )
{
    code to be executed
}
```

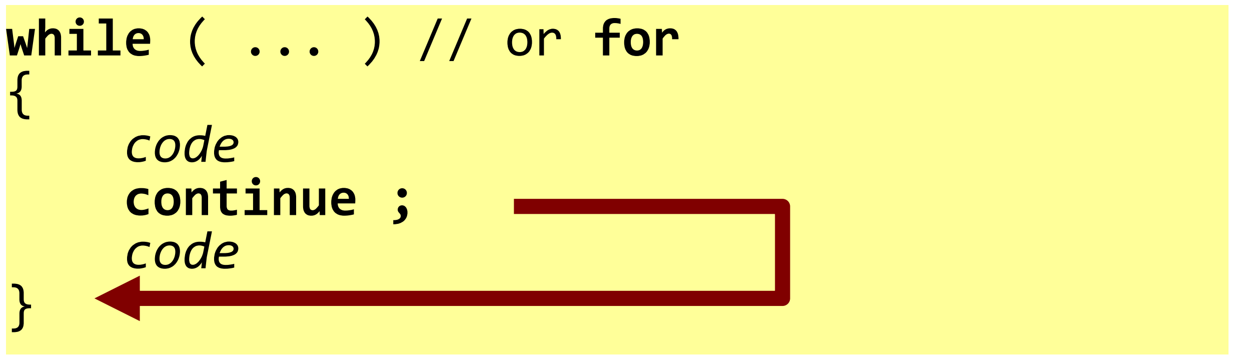
```
while ( condition_is_true )
{
    code to be executed
}
```

```
do {
    code to be executed
} while ( condition_is_true )
```

Loop statements (2/2)



```
while ( ... ) // or for
{
    code
    break ;
    code
}
```



```
while ( ... ) // or for
{
    code
    continue ;
    code
}
```

Basic interaction methods

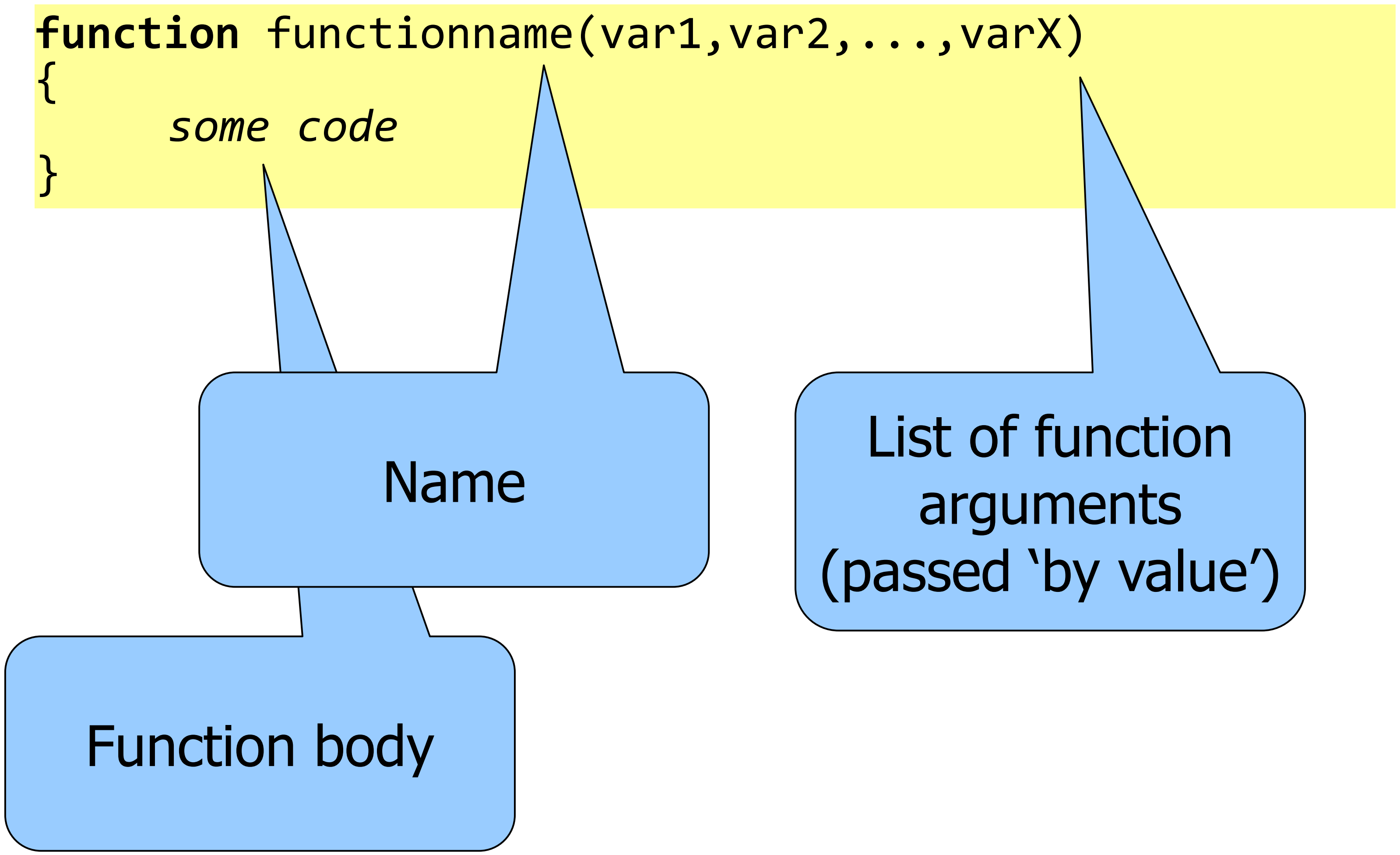
- Popup box (OK to confirm)
  - alert("text")
- Confirm box (OK, cancel)
  - confirm("text")
  - True if user clicked on OK
- Prompt box (let user insert a text)
  - prompt("prompt text", "initial value")
  - Returns a string with the text inserted by the user
  - Returns null if user clicked on Cancel

```
function() {
el.getElementsByTag
, il = inputs.leng
checked = false;
```

Introduction to Javascript

FUNCTIONS

Defining a new function (1/2)



```
function functionname(var1,var2,...,varX)
{
      some code
}
```

Defining a new function (2/2)

```
function functionname(var1,var2,...,varX)
{
     some code
}
```

```
function functionname()
{
     some code
}
```

No parameters

Return statement

- A function may return a value to its caller by executing the return statement
  - return value ;
- The value may be of any type (boolean, numeric, string, ...)

Example

```
<html>
<head>
<script type="text/javascript">
     function product(a,b)
     {
       return a*b;
     }
</script>
</head>

<body>
<script type="text/javascript">
       document.write(product(4,3)) ;
</script>
</body>
</html>
```

Introduction to Javascript

OBJECTS

Objects in Javascript

- An object is a complex data type characterized by
  - A current value
    - Sometimes the internal value is “hidden”
  - A set of properties
    - Various values that be read, associated in some way to the object value
    - Some values that may be written, that modify in some way the object value
  - A set of methods
    - Operations (with parameters) that can be asked to the object

Using objects

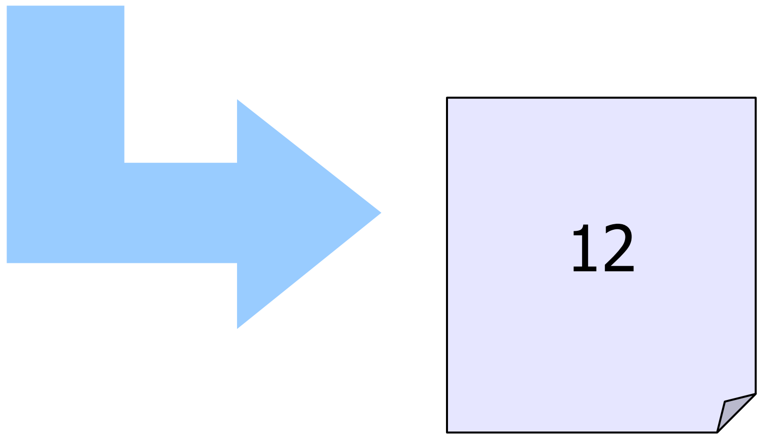
- Creating new objects
  - var d = new Date()
    - Create a new Object of type Date, and use the variable d as a reference to that object
- Properties and methods
  - var day = d.getDay() ;
  - d.setMinutes(34) ;

String objects

- Strings are used to store and manipulate sequences of characters
- Constant values are written between quotes "Hello"
- The only property is
  - .length (the number of characters in the string)
- Many methods implement several string operations

Example

```
var txt="Hello world!"
document.write(txt.length)
```



String methods (1/2)

- Access to the i-th character (starting from 0)
  - s.charAt(i)
- Concatenate two strings
  - s3 = s1.concat(s2)
- Find a substring
  - i = s.indexOf("abc") // -1 if not found
  - j = s.indexOf("abc", i+1)
  - s.lastIndexOf searches from the end
- Replace
  - s = s.replace("Belusconi", "Prodi")

String methods (2/2)

- Extract substring
  - s1 = s.substr(startPos, numChars)
  - s1 = s.substr(startPos) // until the end
  - s1 = s.substring(startPos, endPos)
- Case conversion
  - upper = s.toUpperCase()
  - lower = s.toLowerCase()

String methods for HTML formatting

- The String object has several methods to insert tags around the specified string
  - .big(), .small(), .italic(), .bold(), .fixed()
  - .fontcolor(c), .fontsize(s),
  - .anchor("name"), .link("url")

```
var txt="Hello world!"
document.write(txt.bold())
```

```
<b>Hello world!</b>
```

Exercise 1

- Use a pop-up window to ask the user his/her name
- Write the user’s name in the page heading <h1>

Exercise 2

- Use a pop-up window to ask the user his/her name
- Write the user’s name in the page heading <h1>, properly formatting it in “title case”
  - Example: if name = “fulvio CORNO”, then print “Fulvio Corno”

Date objects

- The Date object is used to work with dates and times
- New objects are created with the current timestamp
  - var d = new Date() // now!
- A specific value may be set
  - d.setFullYear(2007, 04, 23)
  - d.setHours(23, 59, 00)

Date querying methods

- Return numeric components of the date and time stored in the object:
  - .getDate(), .getDay() /*of week*/, .getMonth(), .getFullYear()
  - .getHours(), .getMinutes(), .getSeconds(), .getMilliseconds()
- Return a string representing the date
  - .toString(), .toLocaleString()
- Return milliseconds since 01/01/1970
  - .getTime()

Date setting methods

- Setting date and time from numeric components
  - .setMonth(m), .setDate(day_of_month), .setFullYear(y), .setFullYear(y, m, d)
  - .setHours(h), .setMinutes(m), setSeconds(s), setHours(h, m, s)
- Setting a date from a string
  - Date.parse("Apr 23, 2007") returns the number of milliseconds
  - d.setTime(Date.parse("Apr 23, 2007"))

Exercise 3

- Modify Exercise 2, and write the current date and time in the footer of a web page
- Add a salutation (Good Morning, Good Afternoon, Good Night, ...) according to the current time of the day
  - The salutation must be in the same <h1> as the name

Array objects

- Creating an empty array
  - var a = new Array()
  - var a = new Array(maxsize)
- Setting values
  - a[0] = "Fulvio"
  - a[1] = "Dario"
- Using values
  - document.write(a[0])
  - var s = a[1].toUpperCase()

Array properties

- The property .length returns the number of elements in the array
  - var N = a.length

```
var mycars = new Array()
mycars[0] = "Saab"
mycars[1] = "Volvo"
mycars[2] = "BMW"

for (i=0;i<mycars.length;i++)
{
  document.write(mycars[i] + "<br />")
}
```

Array methods (1/2)

- Concatenate two arrays
  - a3 = a1.concat(a2)
  - Creates a new array with all elements from a1, followed by all elements from a2
- Extract a sub-array
  - a2 = a1.slice(start_index, end_index)
- Sort in alphabetical order
  - a2 = a.sort()

Array methods (2/2)

- Convert an array to a string
  - var s = a.join() // "abc,def"
  - var s = a.join("-") // "abc-def"
- Convert a string to an array
  - var a = s.split(",")

Esercise 4

- Collect a set of number from the user
  - Each number in inserted in a pop-up window
  - The insertion is terminated by pressing Cancel
- Print in the HTML page the list of all inserted numbers
- Print in the HTML page the maximum, minimum and average of the inserted numbers

Math object

- The Math object is a special object: no variables may be created, but a lot of methods are defined, that may be called
- Think of Math as a “library” of mathematical functions

Math contants

- Math.E
- Math.PI
- Math.SQRT2   // √2
- Math.SQRT1_2 // √(1/2)
- Math.LN2   // loge(2)
- Math.LN10   // loge(10)
- Math.LOG2E   // log2(e)
- Math.LOG10E // log10(e)

Math functions (1/2)

- Trigonometric
  - Math.cos(x), Math.sin(x), Math.tan(x), Math.acos(x), Math.asin(x), Math.atan(x), Math.atan2(y, x)
- Exponential and logarithmic
  - Math.exp(x), Math.log(x), Math.pow(base,exp), Math.sqrt(x)

Math functions (2/2)

- Truncation and rounding
  - Math.ceil(x), Math.floor(x), Math.round(x)
- Signs and comparisons
  - Math.abs(x), Math.max(a,b), Math.min(a.b)
- Random
  - Math.random() // random number in interval [0,1)

Exercise 5

- Write a Javascript program to play the “Guess a number” game
- The program must generate a secret number between 1 and 100
- The user inserts a set of guesses into a pop-up windows
- Each time, the program tells the user if the guess was too high or too low
- The HTML page, at the end, will show the list of all guesses, and the number of attempts

Introduction to Javascript

EVENTS

Javascript event model

- An event is the indication that something happened on a web page
  - Some user interaction (click, move mouse, ...)
  - Some browser action (load page, ...)
- In Javascript, you may attach an event handler to most events
  - Any Javascript function
  - The Javascript interpreter calls the function anytime the event is generated

Example

```
<html>
  <head>
    <script type="text/javascript">
      function sayHello()
      {
        alert("Hello!")
      }
    </script>
  </head>

  <body>
    <form>
      <input type="button" onclick="sayHello()"
        value="Press me">
    </form>
  </body>
</html>
```

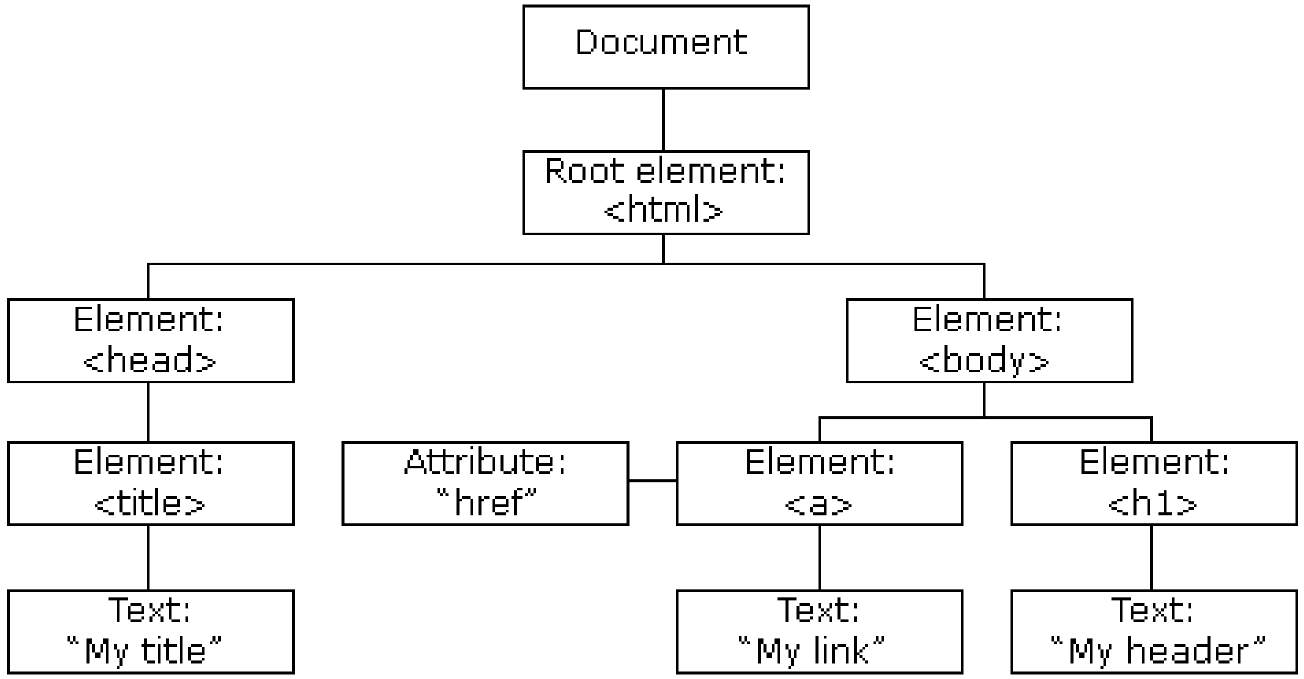
HTML Document Object Model (DOM)

HTML DOCUMENT OBJECT MODEL (DOM)

Document Object Model

- The HTML Document Object Model (HTML DOM) defines a standard way for accessing and manipulating HTML documents.
- The DOM presents an HTML document as a tree-structure (a node tree), with elements, attributes, and text.

DOM example


Document
Root element: <html>
Element: <head>
Element: <body>
Element: <title>
Attribute: "href"
Element: <a>
Element: <h1>
Text: "My title"
Text: "My link"
Text: "My header"

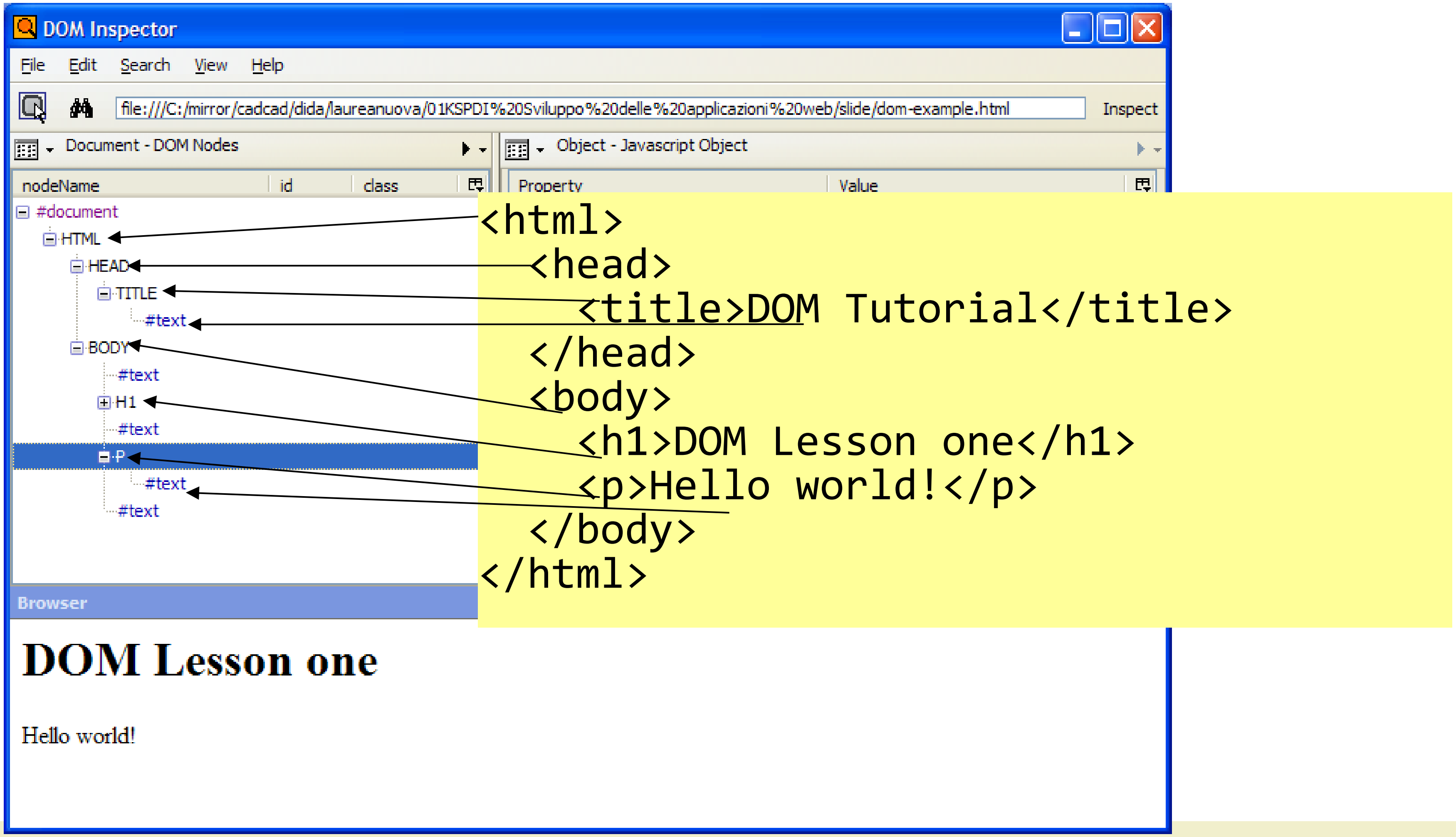
DOM structure

- The entire document is a document node
- Every HTML tag is an element node
- The texts contained in the HTML elements are text nodes
- Every HTML attribute is an attribute node
- Comments are comment nodes
- Nodes have a hierarchical relationship to each other

Example

```
<html>
  <head>
    <title>DOM Tutorial</title>
  </head>
  <body>
    <h1>DOM Lesson one</h1>
    <p>Hello world!</p>
  </body>
</html>
```

Example


DOM Inspector
File
Edit
Search
View
Help
file:///C:/mirror/cadcad/dida/laureanuova/01KSPDI%20Sviluppo%20delle%20applicazioni%20web/slide/dom-example.html
Inspect
Document - DOM Nodes
Object - Javascript Object
nodeName
id
class
Property
Value
Browser

```
#document
  HTML
    HEAD
      TITLE
        #text
    BODY
      #text
      H1
      #text
      P
        #text
      #text
```

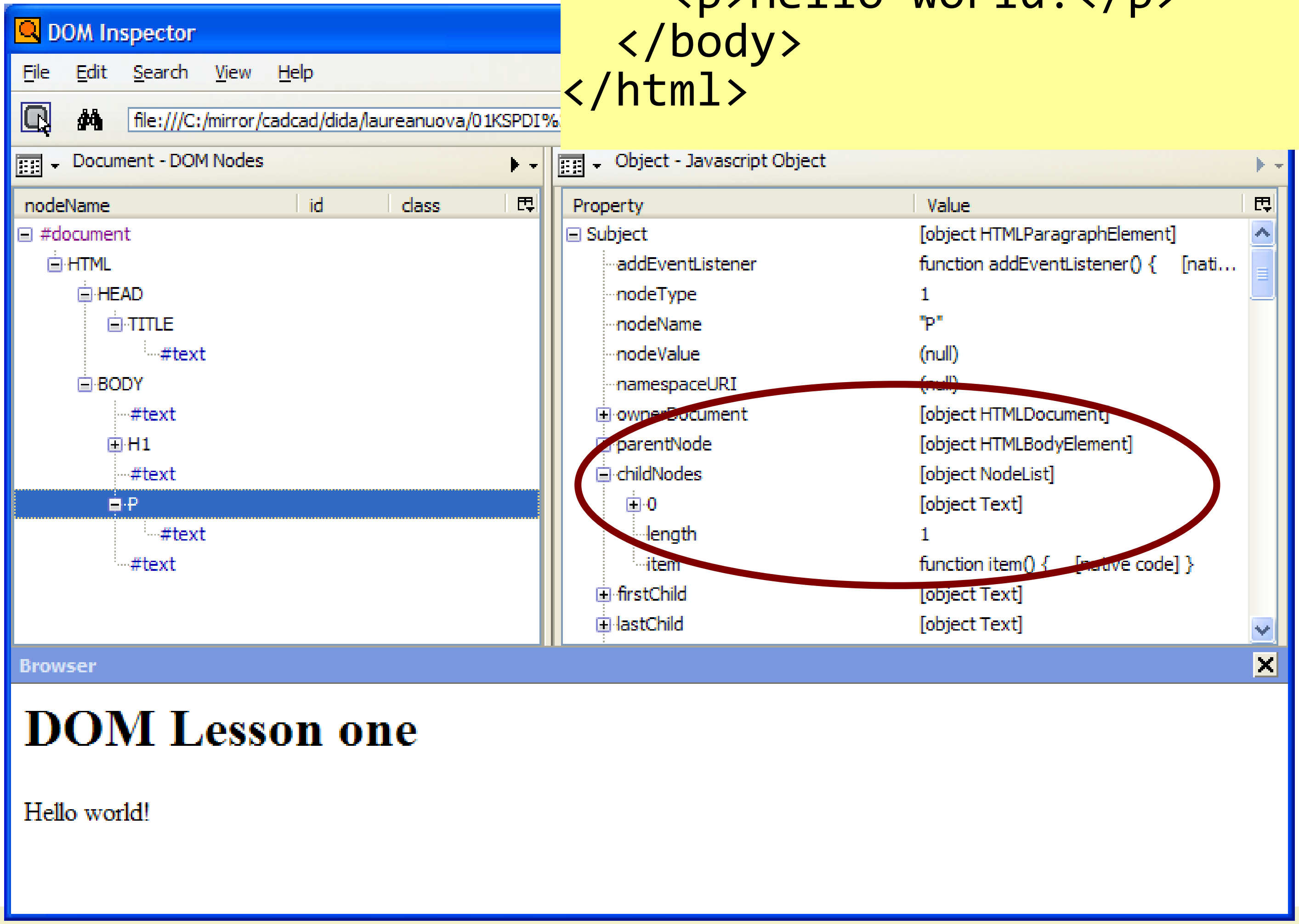
```
<html>
  <head>
    <title>DOM Tutorial</title>
  </head>
  <body>
    <h1>DOM Lesson one</h1>
    <p>Hello world!</p>
  </body>
</html>
```

DOM Lesson one

Hello world!

Example

```
<html>
  <head>
    <title>DOM Tutorial</title>
  </head>
  <body>
    <h1>DOM Lesson one</h1>
    <p>Hello world!</p>
  </body>
</html>
```


DOM Inspector
File Edit Search View Help
file:///C:/mirror/cadcad/dida/laureanuova/01KSPDI%
Document - DOM Nodes
Object - Javascript Object
Browser

```
nodeName          id    class
#document
  HTML
    HEAD
      TITLE
        #text
    BODY
      #text
      H1
      #text
      P
        #text
      #text
```

Property	Value
Subject	[object HTMLParagraphElement]
addEventListener	function addEventListener() { [nati…
nodeType	1
nodeName	"P"
nodeValue	(null)
namespaceURI	(null)
ownerDocument	[object HTMLDocument]
parentNode	[object HTMLBodyElement]
childNodes	[object NodeList]
0	[object Text]
length	1
item	function item() { [native code] }
firstChild	[object Text]
lastChild	[object Text]

DOM Lesson one

Hello world!

Javascript and the DOM

- Each node in the HTML DOM is automatically available as a corresponding Javascript object
- Methods and properties of the object correspond to content and attributes of the HTML element
- Any modification to the object fields are immediately reflected in the HTML page
- The object “document” is the top of the HTML page

Finding objects

- Alternative methods
  - Navigating through children and siblings, starting from the document node
  - Identifying specific elements by their tag name
    - Use getElementsByTagName("tag")
    - Returns all the elements with that tag
  - Identifying specific elements by their “id” attribute (recommended!)
    - Add an “id” attribute, with a unique value, to any HTML tag
    - Use getElementById("id")

Example (1/2)

```
<html>
  <head>
    <title>DOM Tutorial</title>
  </head>
  <body>
    <h1 id="banner">DOM Lesson two</h1>
    <p  id="mytext">Hello world!</p>

    <script>...</script>

  </body>
</html>
```

Example (2/2)

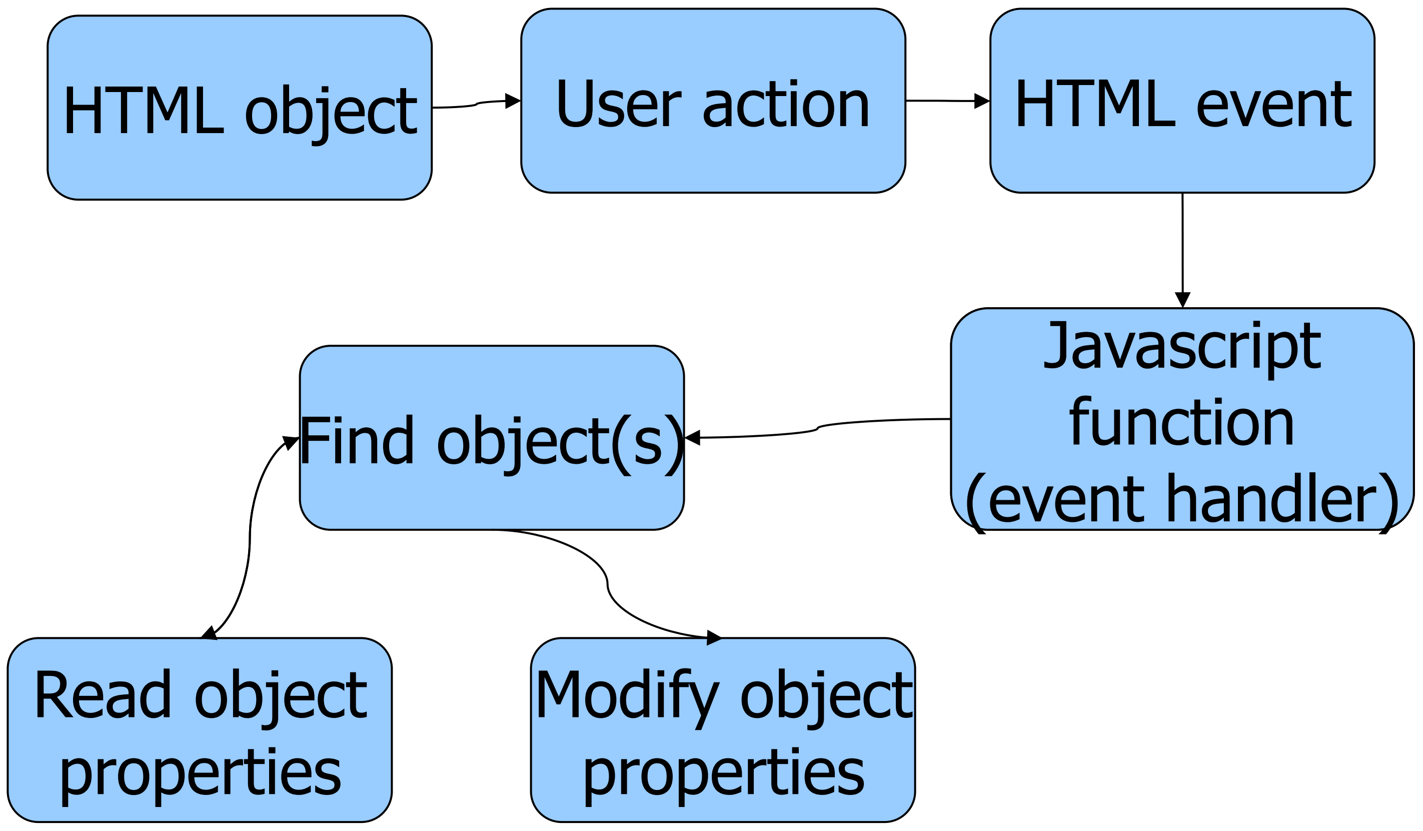
```
<script type="text/javascript">

  var x = document.getElementById("banner") ;
  alert( x.firstChild.nodeValue ) ;

  var y = document.getElementById("mytext") ;
  y.firstChild.nodeValue = "Hello again...." ;

</script>
```

Control sequence

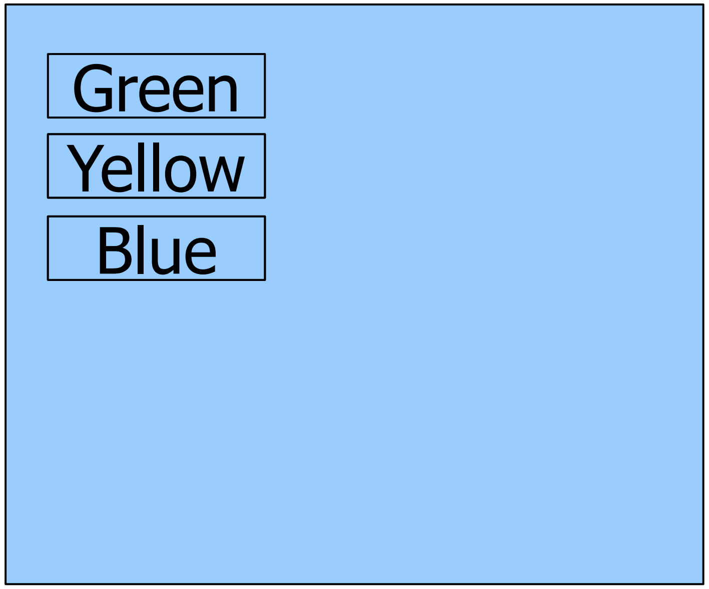


HTML events

<body>	`onload`
<body>	`onunload`
Form elements	`onchange`
Form elements	`onsubmit`
Form elements	`onreset`
Form elements	`onselect`
Form elements	`onblur`
Form elements	`onfocus`
Any element – keyboard	`onkeydown`
Any element – keyboard	`onkeypress`
Any element – keyboard	`onkeyup`
Any element – mouse	`onclick`
Any element – mouse	`ondblclick`
Any element – mouse	`onmousedown`
Any element – mouse	`onmousemove`
Any element – mouse	`onmouseover`
Any element – mouse	`onmouseout`
Any element – mouse	`onmouseup`

Exercise 6

- Create an HTML page with variable-color background.
- The background color is selected by the user by clicking on suitable text sentences



Form submission

- The submission of FORM data may be intercepted by the onsubmit event
- The event procedure may check for any errors
  - If everything is ok, the function returns true -> the browser takes the form action
  - In case of errors, the function returns false -> the form is not submitted

Exercise 7

- Create an HTML form for entering a username/password pair
- Do not allow the user to press the submit button unless:
  - Both username and password are present
  - Password is more than 4 characters long

Exercise 7b

- Create an HTML form for entering a username/password pair
- Do not allow the user to press the submit button unless:
  - Both username and password are present
  - Password is more than 4 characters long
- Whenever the user commits an error, display a message just besides the text box

Exercise 8

- Create an HTML form for selecting an item from a list of categories, including a “Other...” option
- If the user selects “Other...”, then he must fill a text box for specifying
- Otherwise, the text box should be invisible

References

- JavaScript Tutorial, http://www.w3schools.com/js/default.asp
- http://www.quirksmode.org/js/contents.html
- JavaScript Reference, http://www.w3schools.com/jsref/default.asp
- Standard ECMA-262 (3r d Edition - December 1999), http://www.ecma-international.org/publications/standards/Ecma-262.htm

License