The Web, revisited

The interactive WEB

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Credits: Some of the slides are based on material adapted from

www.telerik.com/documents/Telerik_and_AJAX.pdf

The old web: 1994

HTML pages (hyperlinks)

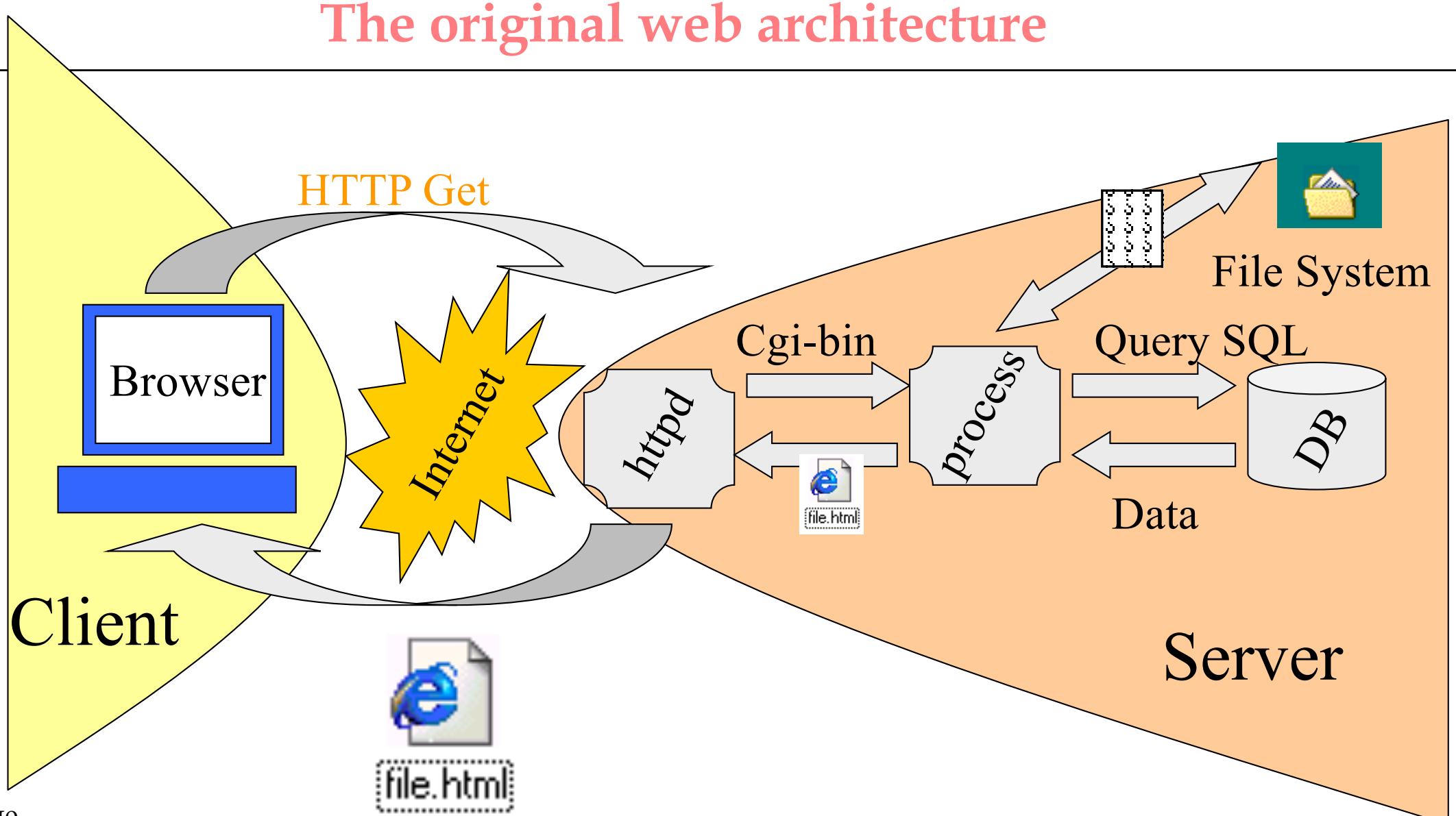
+ static graphics

+ cgi (active engines)

+ some separated dynamic graphics (Applets)

HTTP is a stateless protocol: cookies

The original web architecture



Evolution of the web: 1

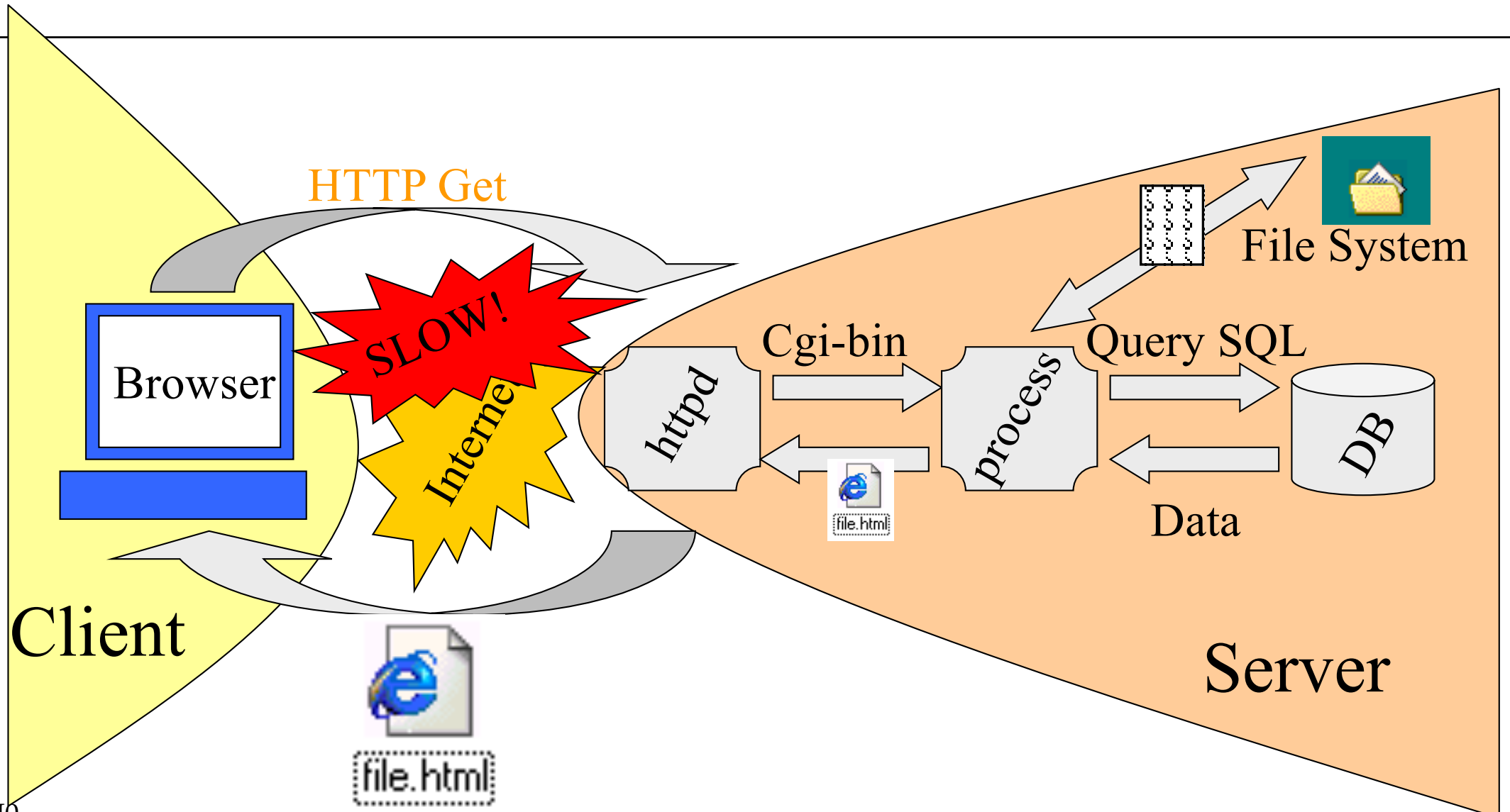
Better dynamic engines

Servlets, ASP, JSP (+ Php, Perl, Python...)

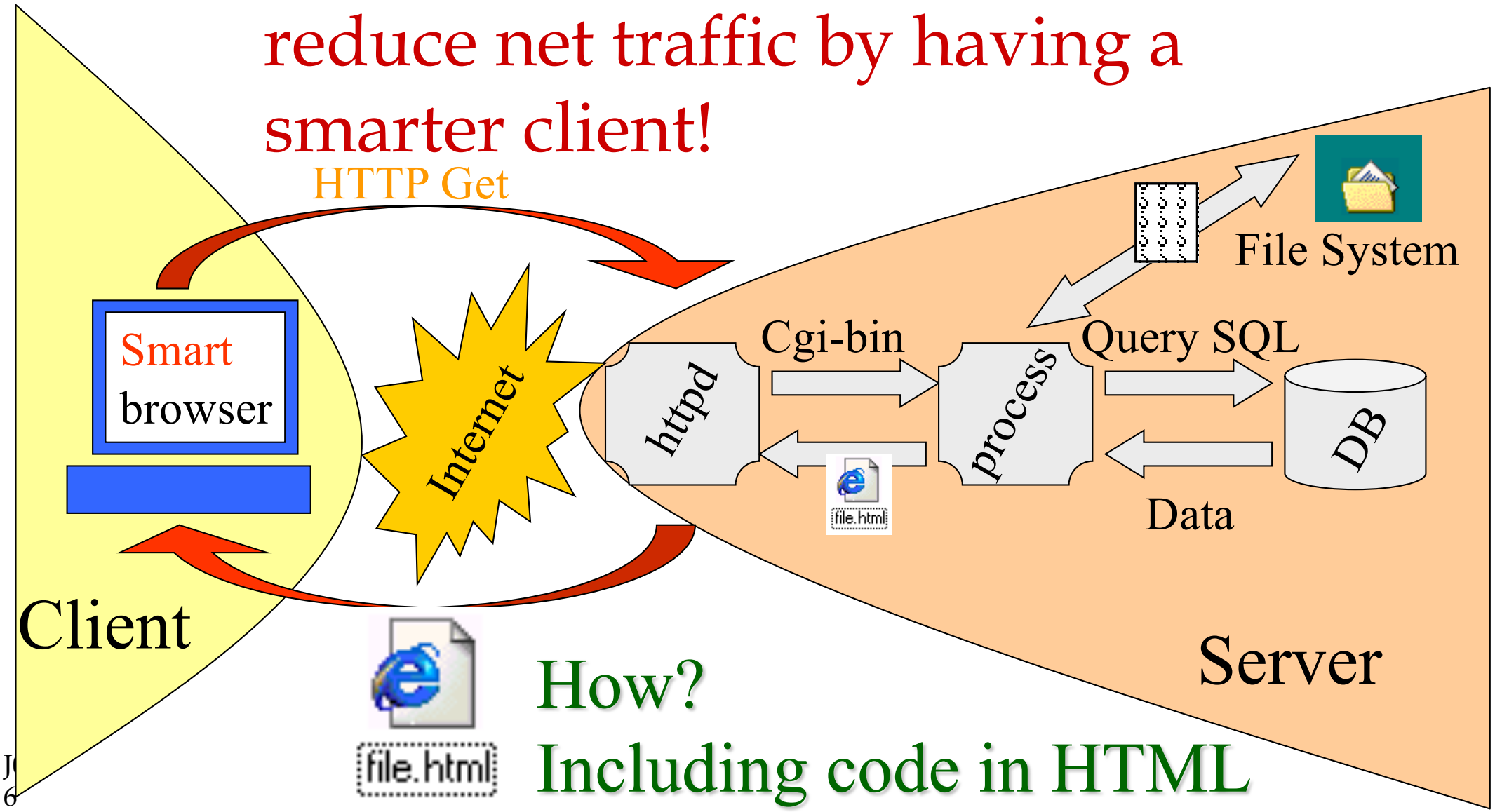
Better Server-side organization

EJB, frameworks (Struts, Hybernate, Spring)

The Bottleneck!



The solution:



Evolution of the web: 2

Better control of the browser

Javascript + DOM

Applet-Javascript interaction

Better separation of content and presentation

CSS

(DHTML=HTML4+Javascript+DOM+CSS)

XML+XSLT, Cocoon (XHTML)

Evolution of the web: 3

Better construction of interfaces (widgets)

.Net

Java Server Faces

Client Side ECMAScript & Document Object Model

JavaScript History

- JavaScript was born as "**LiveScript**" at the beginning of the 94's.
- Name changed into JavaScript (name owned by Netscape)
- Microsoft responds with Vbscript
- Microsoft introduces JScript (dialect of Javascript)
- A standard is defined: ECMAScript (ECMA-262, ISO-16262)

JavaScript Myths

JavaScript is NOT simple

Simple tasks are indeed simple

JavaScript is NOT Java

	Java	JavaScript
Browser Control	NO	YES
Networking	YES	NO
Graphics	YES	Partial

JavaScript is…

Scripted (not compiled)

Powerful

Object-based

Cross-Platform

Client and Server

JavaScript allows…

Dynamic Web Sites

Dynamic HTML (DHTML)

Interactive Pages/Forms

Server-Side CGI Functionality

Application Development

JavaScript can…

Build Objects

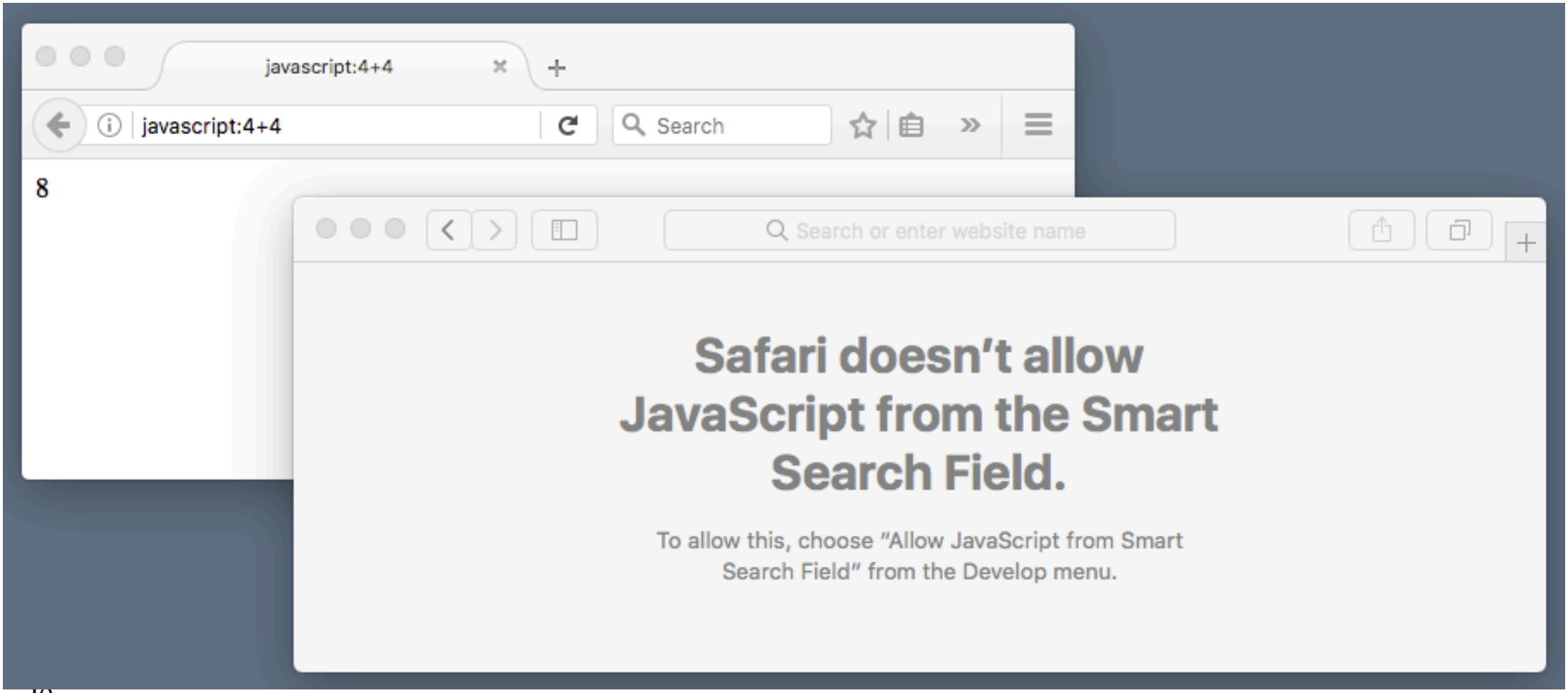
Use Events

Enforce Security

Embed or Componentize

Javascript in the url field

Firefox



Not working any more in Chrome

Core

Base

- Syntax is C-like (C++-like, Java-like)
  case-sensitive,
  statements end with (optional) semicolon ;
  //comment /*comment*/
  operators (=,*,+,++,+=,!=,==,&&,…)
- Basic data types
  integer, floating point, strings (more later)
- Loosely typed variables (Basic-like) var x=3;

Core

Statements

- if (expression) {statements} else {statements}
- switch (expression) {

  case value: statements; break;

  …

  default: statements; break;

  }
- while (expression) {statements}
- do (expression) while {statements}
- for (initialize ; test ; increment) {statements}

Core Variable hoisting

```
var z;
x = 5; // Assign 5 to x

z = x;
z = y;

var x; // Declare x – OK
var y=5; // Declare y – problem!
```

You can declare variables after using them!
Initialization are NOT hoisted!

Core

Variable scope

```
{
  var x = 2;
}
// x CAN be used here


{
  let y = 2;
}
// y can NOT be used here
```

Core Variable redefinition

```
var x = 10;
// Here x is 10

{
  var x = 2;
  // Here x is 2
}

// Here x is 2
```

```
var x = 10;
// Here x is 10

{
  let x = 2;
  // Here x is 2
}

// Here x is 10
```

Core JavaScript and HTML

Between <SCRIPT> and </SCRIPT> tags

Between <SERVER> and </SERVER> tags

In a <SCRIPT SRC="url"></SCRIPT> tag

In an event handler:

```
<INPUT TYPE="button" VALUE="Ok"
        onClick="js code">
<B onMouseOver="Jscode">hello<B>
```

Core

Strings

a="foo"; b= 'tball'

Useful methods:

a+b => football a<b => true

a.charAt(0) => f

indexOf(substring), lastIndexOf(substring)

charCodeAt(n),fromCharCode(value,…)

concat(value,…),slice(start,end)

toLowerCase(), toUpperCase()

replace(regexp,string), search(regexp)

Strings

a=“foo”;

TAG-related methods:

a.bold() => <B>foo</B>

big(), blink(), fontcolor(), fontsize(), small(),

strike(), sup()

anchor(),link()

Core

Functions

```
function f(x) {return x*x}
```

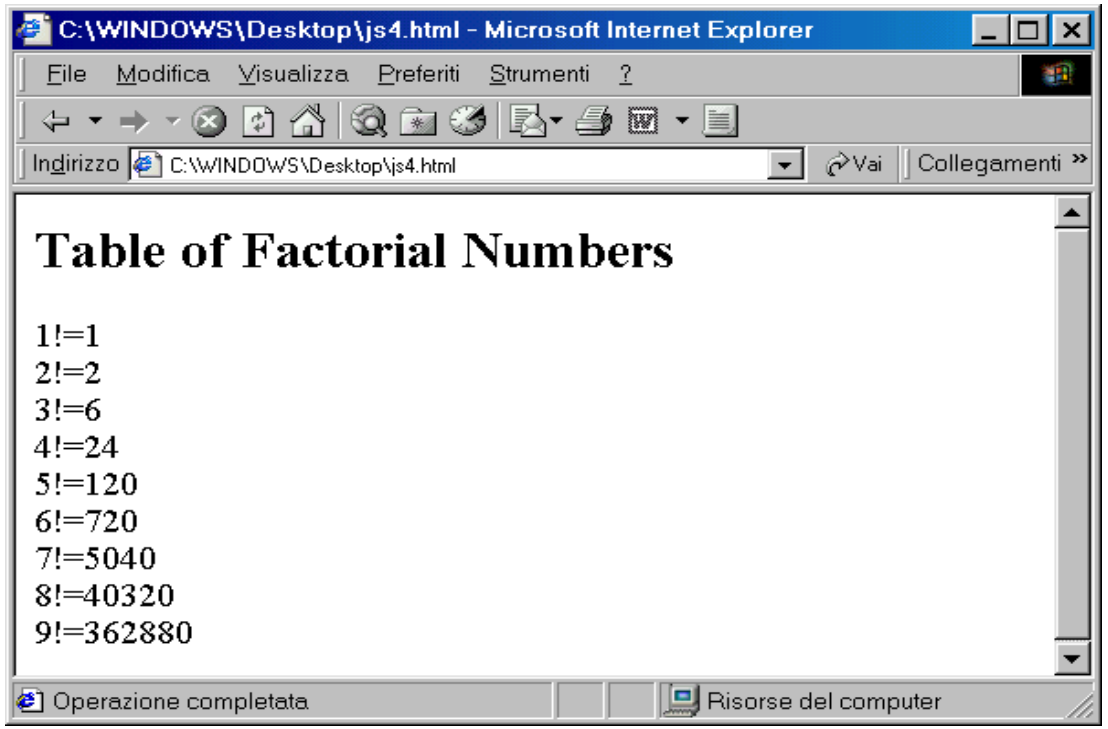
```
function add(x,y) {return x+y};
function multiply(x,y) {return x*y};
function operate(op,x,y) {return op(x,y)};

operate(add,3,2); => 5
```

Example

```
<HTML>
<HEAD>
<SCRIPT>
function fact(n) {
    if (n==1) return n;
    return n*fact(n-1);
}
</SCRIPT>
</HEAD>
…
```

Example

```
<BODY>
<H2>Table of  Factorial Numbers </H2>
<SCRIPT>
for (i=1; i<10; i++) {
    document.write(i+"!="+fact(i));
    document.write("<BR>");
}
</SCRIPT>
</BODY>
</HTML>
```

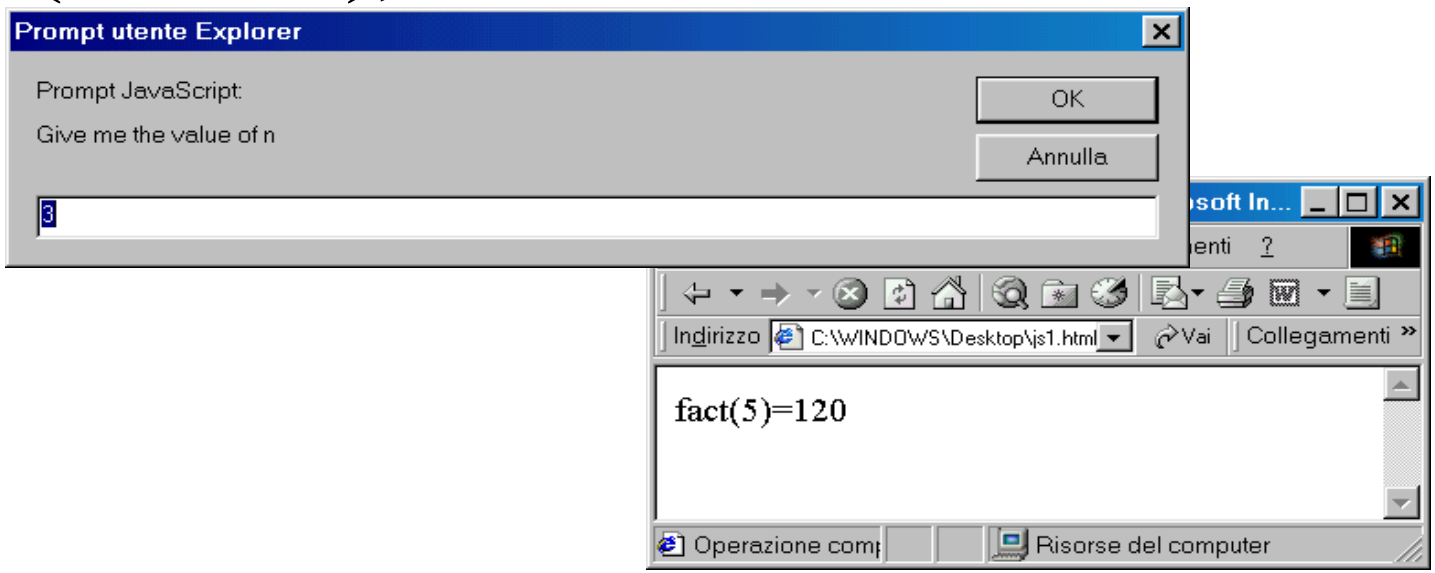


Using document.write() after an HTML document is loaded, will **delete all existing HTML**:

Core

Example

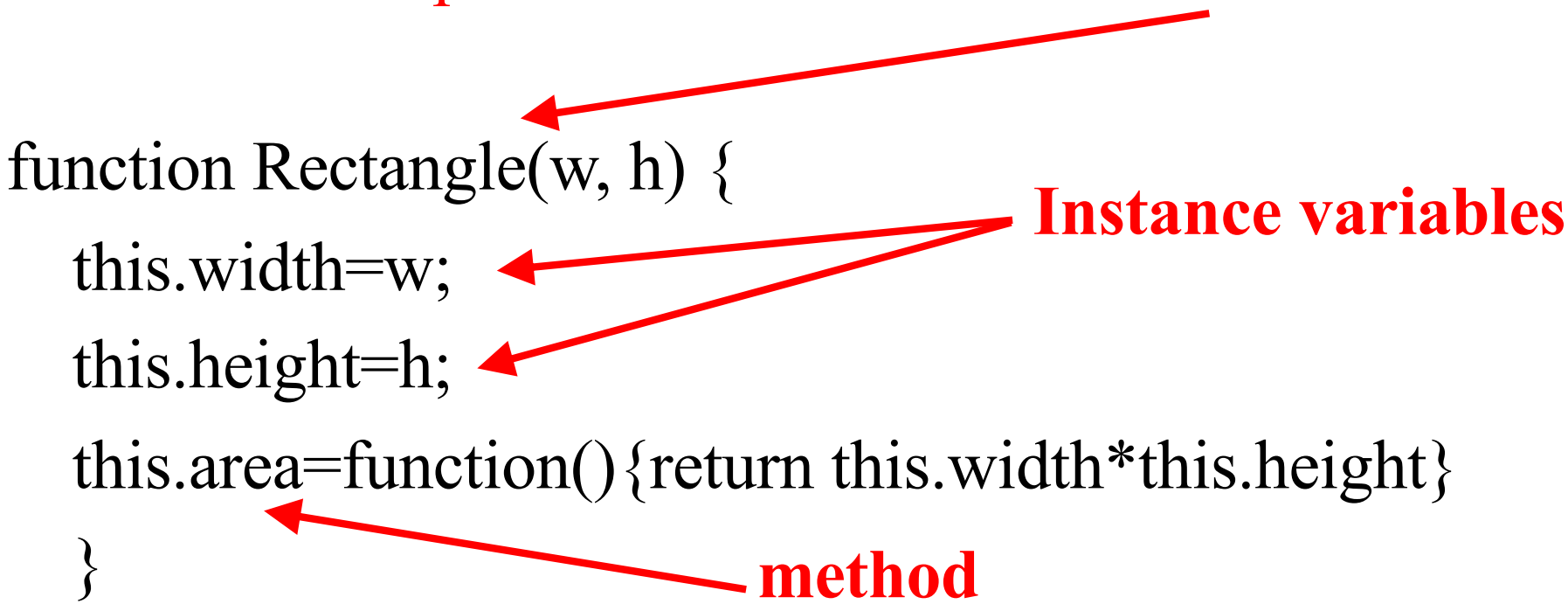
```
<BODY>
<SCRIPT>
n=window.prompt("Give me the value of n",3)
document.write("fact("+n+")="+fact(n));
document.write("<BR>");
</SCRIPT>
</BODY>
</HTML>
```



Core

Objects

Object: A data structure with methods;
a special method is the "constructor".



a=new Rectangle(3,4); a.area() => 12 a.width => 3

Core

Objects

Actually, JavaScript does NOT have traditional classes and inheritance.

Moreover, the approach we have shown is not the most efficient in terms of memory allocation.

It would be better to use the "prototype" feature, which can be considered a STATIC object

Rectangle.prototype.area=function(){return this.w*this.h}

Core

Arrays

a = new Array()

a[0]=3; a[1]="hello"; a[10]=new Rectangle(2,2);

a.length() => 11

Arrays can be

SPARSE, INHOMOGENEOUS , ASSOCIATIVE

a["name"]="Jaric"

z=new Rectangle(3,4); z["width"] ⇔ z.width

Core

Classes (ES6) (EcmaScript2015)

```
class Car {
      constructor(brand) {
        this.carname = brand;
      }
    }
    mycar = new Car("Ford");
```

Core

JS output

Writing into an HTML element, using innerHTML.

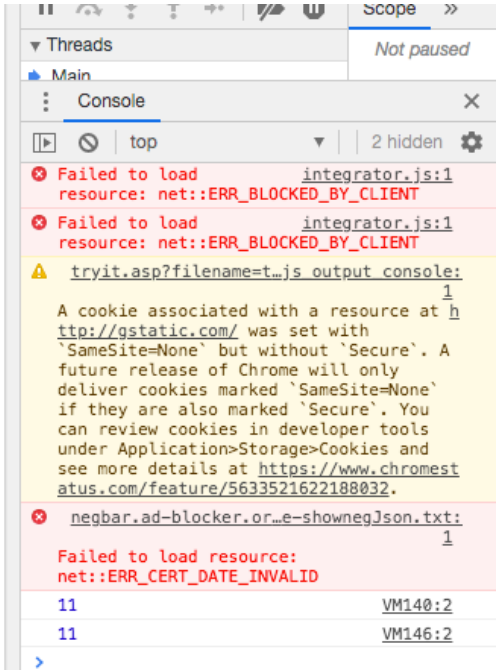
Writing into the HTML output using document.write().

Writing into an alert box, using window.alert().

Writing into the browser console, using console.log().

Activate debugging with F12

Select "Console" in the debugger menu. Then click Run again.

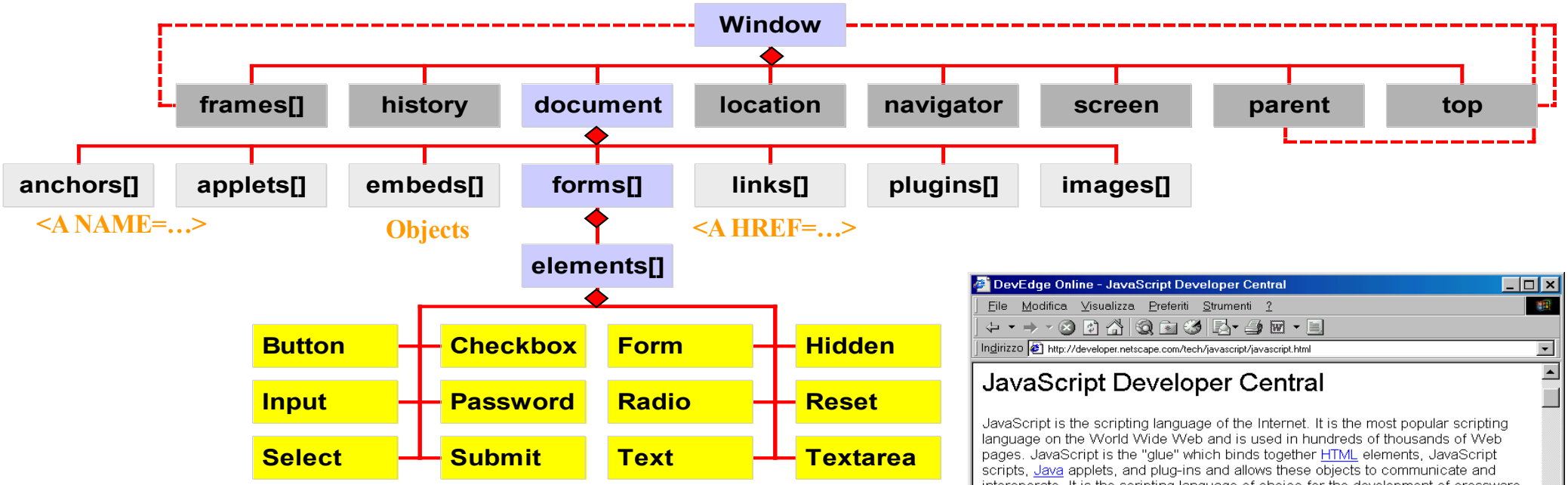


Core

JS output

```
<!DOCTYPE html>
<html>
<body>
<h1>My First Web Page</h1>
<p>My First Paragraph</p>
<p id="demo"></p>
<script>
document.getElementById("demo").innerHTML = “Hello!”;
</script>
</body>
</html>
```

DOM Object hierarchy



Symbol ◆ means containment (has-a)

Dashed line means “is an instance of”

DOM

Window

"A web browser window or frame"

Main properties

Objects

history

frames[]

document

location

navigator

screen

parent – top

Other properties

status – defaultStatus

name

DOM

Window

Main methods

alert(), prompt(), confirm()

focus(), blur()

moveBy(), moveTo()

resizeBy(), resizeTo()

scroll(), scrollBy(), scrollTo()

setInterval(), clearInterval()

setTimeout(), clearTimeout()

DOM

Screen

"Information about the display"

Main properties

availHeight, availWidth

height, width

colorDepth, pixelDepth

hash

DOM

Navigator

"Information about the browser in use"

Main properties

appName

appVersion

Platform

Main methods

javaEnabled()

Other properties

Info on available plugins, but only in Netscape Navigator!

DOM

History

"The URL history of the browser"

Main properties

lenght

Main methods

back()

forward()

go(+/-n)

go(target_substring)

DOM

Location

"The specification of the current URL"

Main properties	Main methods
href	reload()
protocol, hostname, port	replace()
search	
hash	

DOM

Document

"An HTML document"

Main properties

Arrays of Component Objects

anchors[]

applets[]

embeds[]

forms[]

links[]

plugins[]

Main methods

open()

close()

clear()

write()

Other properties

bgColor, fgColor, linkColor, vlinkColor

lastModified

title, URL, referrer, cookie

DOM

Image

"An image embedded in an HTML document"

Main properties

border *[width in pixels]*

height

width

src *[URL of the image to be displayed]*

DOM

Events

onClick	User clicks once. (*)	Link, button
onDblClick	User clicks twice	Document, Image, Link, button
onMouseDown	User presses mouse button (*)	Document, Image, Link, button
onMouseUp	User releases mouse button (*)	Document, Image, Link, button
onMouseOver	Mouse moves over element	Link, Image, Layer
onMouseOut	Mouse moves off element	Link, Image, Layer
onKeyDown	User presses key (*)	Document, Image, Link, Text elements
onKeyUp	User releases key	Document, Image, Link, Text elements
onKeyPress	KeyDown+KeyUp (*)	Document, Image, Link, Text elements

(*) Return false to cancel default action

DOM

Events

onFocus	**Element gains focus**	**TextElement, Window, all form elements**
onBlur	**Element loses focus**	**TextElement, Window, all form elements**
onChange	**User selects/deselects a text and moves focus away**	**Select, text input elements**
onError	**Error while loading image**	**Image**
onAbort	**Loading interrupted**	**Image**
onLoad	**Document or image finishes loading**	**Window, Image**
onUnload	**Document is unloaded**	**Window**
onResize	**Window is resized**	**Window**
onReset	**Form reset requested (*)**	**Form**
onSubmit	**Form submission requested(*)**	**Form**

(*) Return false to cancel default action

DOM

Input

Properties | **Methods** | **Event Handlers**

Objects

Objects	defaultValue	form	length	blur()	click()	focus()	select()	checked	defaultChecked	name	options[]	selectedIndex	type	value	onblur	onchange	onclick	onfocus
Button			X	X		X			X	X	X	X	X		X		X	X
Checkbox	X	X	X	X		X			X	X	X	X	X		X		X	X
Radio	X	X	X	X		X			X	X	X	X	X		X		X	X
Reset			X	X		X			X	X	X	X	X		X		X	X
Submit			X	X		X			X	X	X	X	X		X		X	X
Text		X	X	X		X			X	X	X		X	X	X	X		X
Textarea		X	X	X		X			X	X	X		X	X	X	X		X
Password		X	X	X		X			X	X	X		X	X	X	X		X
FileUpload		X	X	X		X			X	X	X		X	X	X	X		X
Select			X	X	X	X	X	X	X		X	X	X		X	X		X
Hidden			X	X		X			X	X								

DOM

Form

"An HTML input form"

Main properties

action *[destination URL]*

method *[get/post]*

name *[name of Form]*

name *[destination Window]*

Elements[] *[list ;of contained elements]*

Main methods

reset()

submit()

DOM

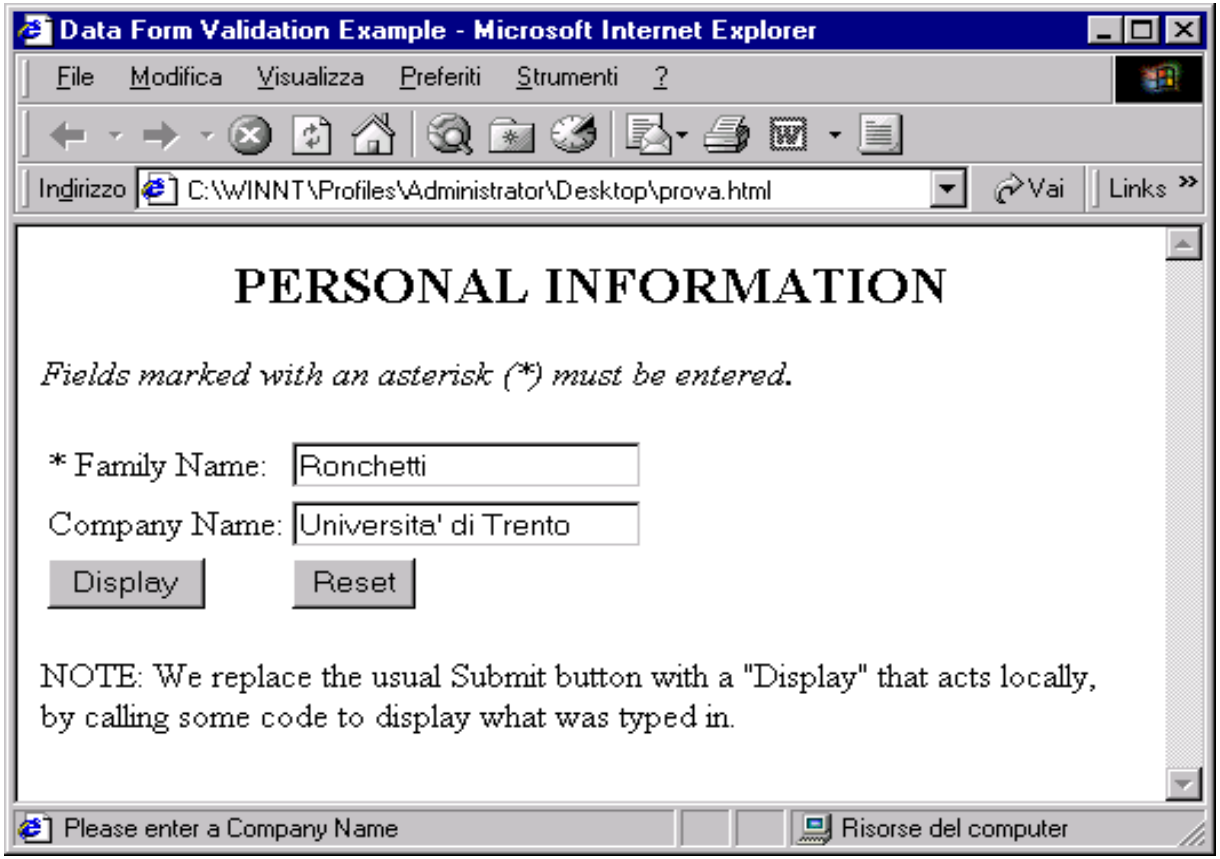
Events

```
<HTML>
<HEAD>
<TITLE>Form Example</TITLE>
<SCRIPT LANGUAGE="JavaScript1.2">
function setColor() {
    var choice;

    choice = document.colorForm.color.selectedIndex;

    switch(choice) {
        case 0: document.bgColor = "FF0000"; break;
        case 1: document.bgColor = "00FF00"; break;
        case 2: document.bgColor = "0000FF"; break;
        case 3: document.bgColor = "FFFFFF"; break;
        case 4: document.bgColor = "FFFF00"; break;
        case 5: document.bgColor = "FF00FF"; break;
    }
}
</SCRIPT>
```

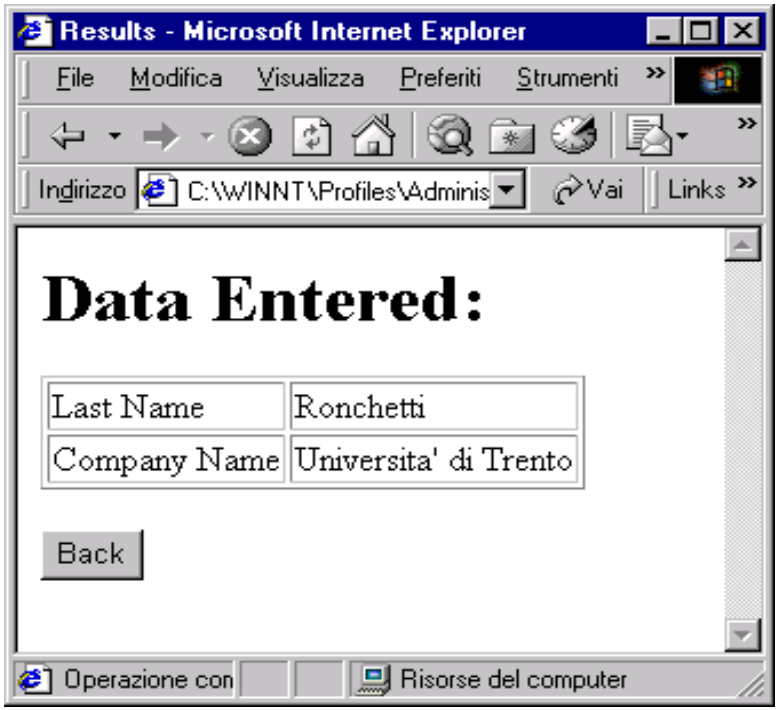
Events

```
<BODY>
<CENTER><H1>Color Changer</H1></CENTER>
<BR><BR>
Select Your Favorite Background Color:
<FORM NAME="colorForm">
<SELECT NAME="color" onChange=setColor() >
    <OPTION VALUE="red">Red                    <OPTION VALUE="green">Green
    <OPTION VALUE="blue">Blue                  <OPTION VALUE="white">White
    <OPTION VALUE="yellow">Yellow              <OPTION
    VALUE="purple">Purple
</SELECT>
</FORM>


</BODY>
</HTML>
```

A more complex example -1



A simple data entry validation page



A more complex example -2

Start of file "FormValidation.html"

```
<HTML>
<HEAD>
<TITLE>Data Form Validation Example</TITLE>

<SCRIPT LANGUAGE="JavaScript1.1" SRC="FormCheck.js"></SCRIPT>
```

Load file "FormCheck.js",
which contains several JavaScript functions

A more complex example -3

```
function isEmpty(s)
{   return ((s == null) || (s.length == 0))
}
```

Check that the string "s" is not empty

```
function warnEmpty (theField, s)
{
   var mPrefix = "You did not enter a value into the ";
   var mSuffix = " field. This is a required field. Please enter it now.";
   theField.focus();
   alert(mPrefix + s + mSuffix);
   return false;
}
```

Issue a warning message

All this is contained in the file "FormCheck.js"

A more complex example -4

```
function promptEntry (s)
{   window.status = "Please enter a " + s;
}

function validatePersonalInfo(form)
{   return (
      checkString(form.elements["LastName"],sLastName)
    )
}

function checkString (theField, s)
{
   if (isEmpty(theField.value)) return warnEmpty (theField, s);
   else return true;
}
```

Type a message in the status bar

Validate the form

(should run over all fields
And perform suitable checks)

Check that "theField" is not empty

All this is contained in the file "FormCheck.js"

A more complex example -5

```
<SCRIPT>
var sCompany="Company Name";  var sLastName="Last Name";  var
    form="PersonalInfo";

function displayPersonalInfo(form)
{   var outputTable = "<HTML><HEAD><TITLE>Results</TITLE></HEAD>" +
    "<BODY><H1>Data Entered:</H1><TABLE BORDER=1>" +
    "<TR><TD>" + sLastName + "</TD><TD>" + form.elements["LastName"].value +
    "</TD></TR>" +
    "<TR><TD>" + sCompany + "</TD><TD>" + form.elements["Company"].value +
    "</TD></TR></TABLE><FORM>“ +
    "<INPUT TYPE=\"BUTTON\" NAME=\"Back\" VALUE=\"Back\"
    onClick=\"history.back()\"> </FORM></BODY></HTML>"
    document.writeln(outputTable)
    document.close()
    return true
}   </SCRIPT>
</HEAD>
```

Global variables

Value-printing function

Add a Button to go back in history

End of “HEAD” portion of “FormValidation.html”

A more complex example -6

```
<BODY BGCOLOR="#ffffff">
<CENTER><H2>PERSONAL INFORMATION </H2></CENTER>
<P><P><I>Fields marked with an asterisk (*) must be entered.</I>
<FORM NAME="PersonalInfo">
<TABLE>
<TR>
   <TD>* Family Name:</TD>
   <TD><INPUT TYPE="text" NAME="LastName"
     onFocus="promptEntry(sLastName)"
     onChange="checkString(this,sLastName)" ></TD>
</TR>
<TR>
   <TD>Company Name:</TD>
   <TD><INPUT TYPE="text" NAME="Company"
     onFocus="promptEntry(sCompany)"></TD>
</TR>
```

First Field

Second Field

Start of "BODY" portion of "FormValidation.html"

A more complex example -7

```
<TR>
   <TD>
   <INPUT TYPE="BUTTON" NAME="fakeSubmit" VALUE="Display"
     onClick="if (validatePersonalInfo(this.form)) displayPersonalInfo(this.form); ">
   </TD>
   <TD><INPUT TYPE = "reset" VALUE = "Reset">
   </TD>
</TR>
</TABLE>
<P> NOTE: We replace the usual Submit button with a "Display" that acts locally,
<BR>by calling some code to display what was typed in.
</FORM>
</BODY>
</HTML>
```

First Button

Second Button

End of file "FormValidation.html"

DOM

Applet

"An applet embedded in a Web page"

Properties

Same as the public fields of the Java applet

Methods

Same as the public methods of the Java applet

Layout engines

A web browser engine (sometimes called layout engine or rendering engine) is a software component that takes

- marked up content (such as HTML, XML, image files, etc.) and
- formatting information (such as CSS, XSL, etc.)

and displays the formatted content on the screen.

It draws onto the content area of a window, which is displayed on a monitor or a printer.

- Blink (Chromium)
- Gecko (Mozilla)
- Trident (IE)
- Webkit (Safari, Android)

See:
https://en.wikipedia.org/wiki/Comparison_of_layout_engines_(ECMAScript)

ECMAScript Engine

An ECMAScript engine is a program that executes source code written in a version of the ECMAScript language standard

See https://en.wikipedia.org/wiki/List_of_ECMAScript_engines

Examples:

- V8 (chrome)
- SpiderMonkey (Mozilla)
- Chakra (I.E.)
- Squirrelfish/Nitro (Apple)
- Nashorn (Oracle – JDK)

References

Standard ECMA-262 ECMAScript Language Specification:

http://www.ecma-international.org/publications/standards/Ecma-262.htm

Books:

- D.Flanagan "Javascript. The definitive guide" O'Reilly.
- D.Goodman "Dynamic HTML. The definitive reference" O'Reilly

Server-Side JavaScript

A substitute for CGI.

Server-dependent technology to process the Web page ***before*** passing it to the client.

(An approach which started long ago (Netscape SSJS)

Then mostly forgotten, later revived by Rhino (a bridge between JS and Java) and recently by Node.js

Node.js

Node.js is an open-source, cross-platform JavaScript run-time environment for executing JavaScript code server-side. Node.js has an event-driven architecture capable of asynchronous I/O.

Optimize throughput and scalability

- in Web applications with many input/output operations,
- for real-time Web applications

https://www.w3schools.com/nodejs/default.asp