Client Side ECMAScript & Document Object Model

JavaScript History

- Java 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

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

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>
```

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
```

Core

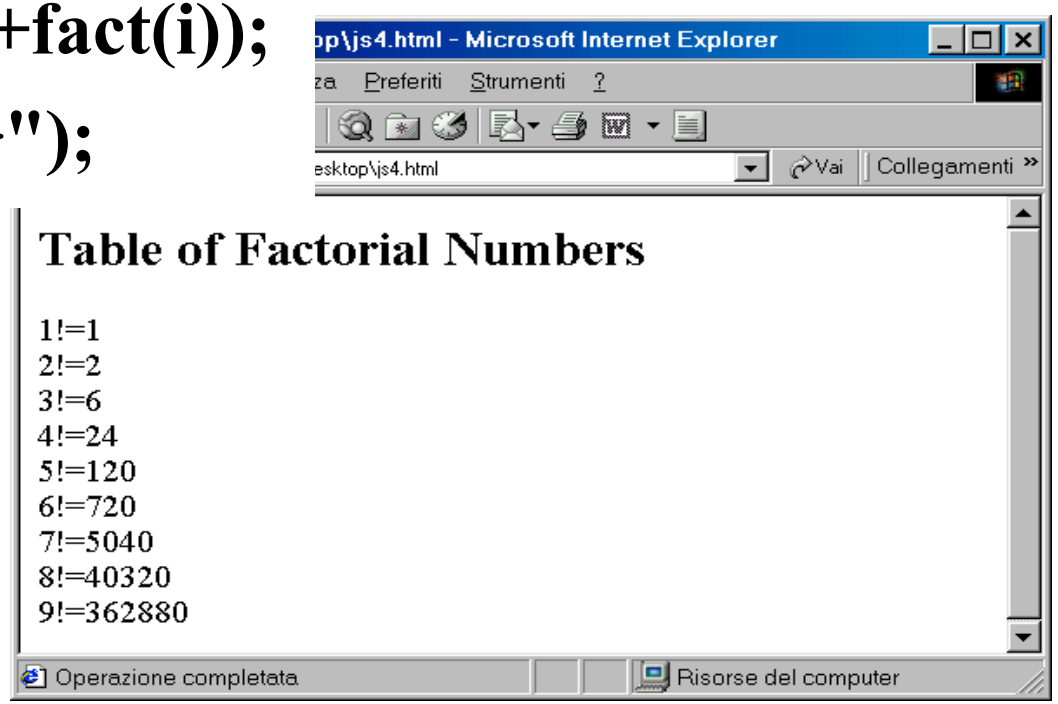
Example

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

Core

Example

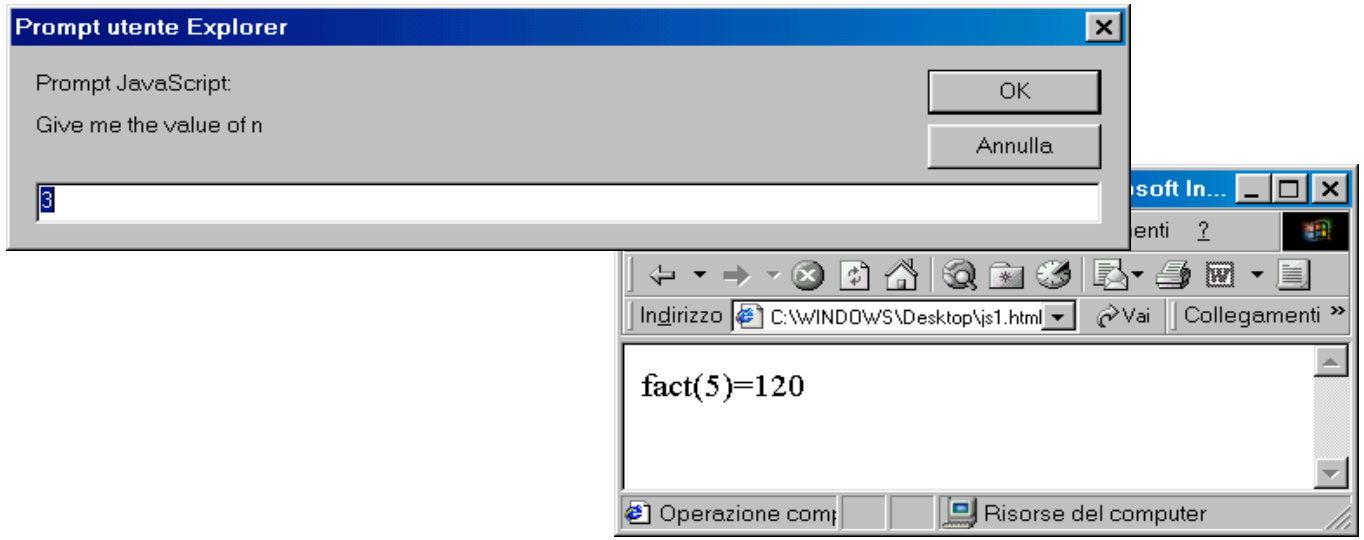
```
<BODY>
<H2>Table of  Factorial Numbers </H2>
<SCRIPT>
for (i=1; i<10; i++) {
    document.write(i+"!="+fact(i));
    document.write("<BR>");
}
</SCRIPT>
</BODY>
</HTML>
```



Core

Example

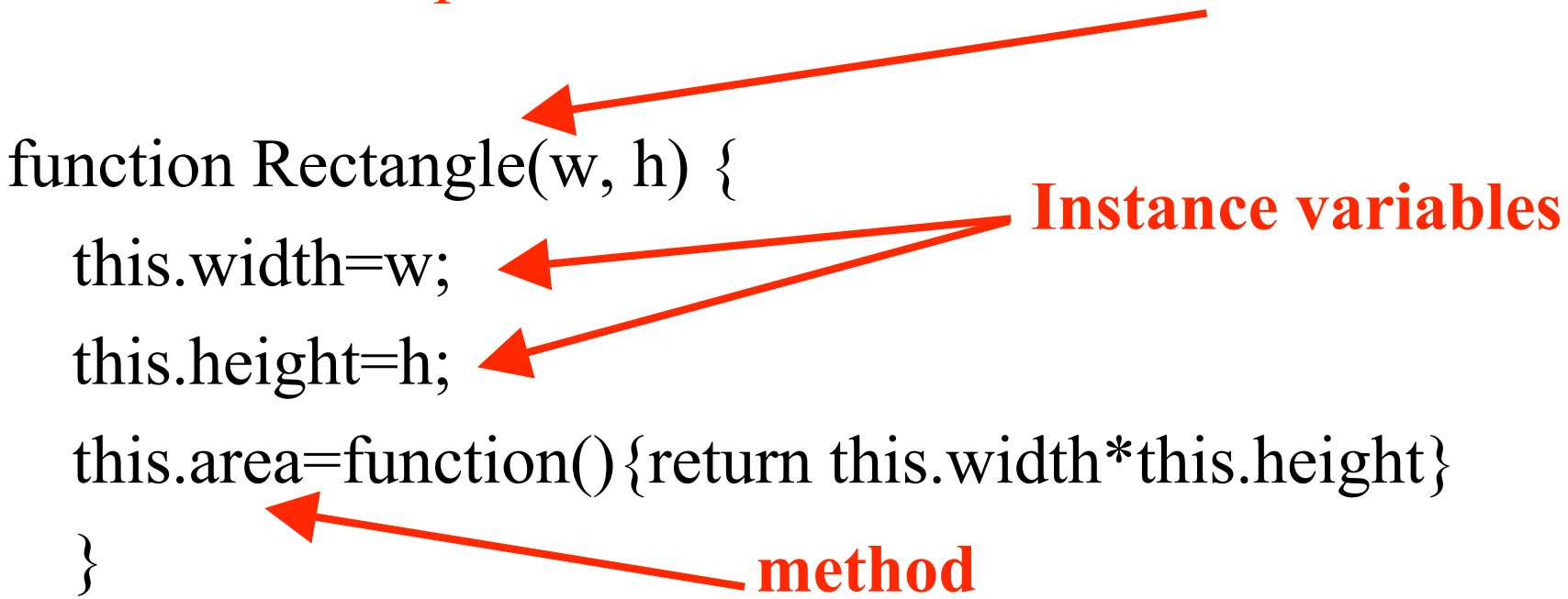
```
<BODY>
<SCRIPT>
n=window.prompt("Give me the value of n",3)
document.write("fact("+n+")="+fact(n));
document.write("<BR>");
</SCRIPT>
</BODY>
</HTML>
```



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 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 consideres 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

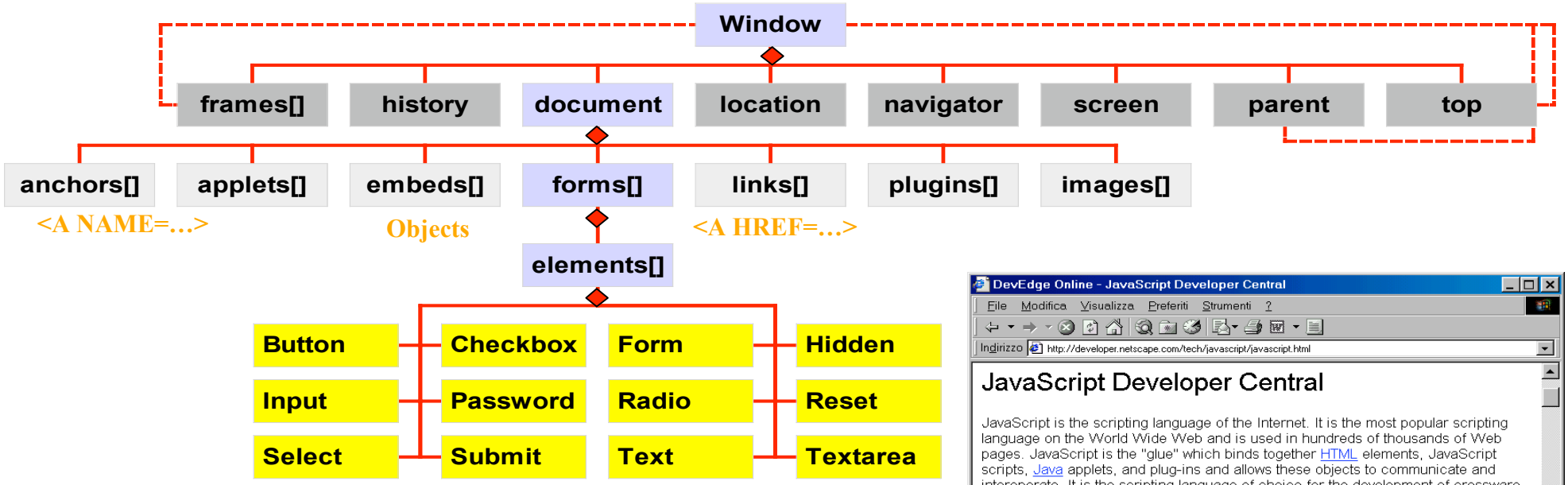
Arrays can be

SPARSE, INHOMOGENEOUS , ASSOCIATIVE

a["name"]="Jaric"

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

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

href

protocol, hostname, port

search

hash

Main methods

reload()

replace()

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**

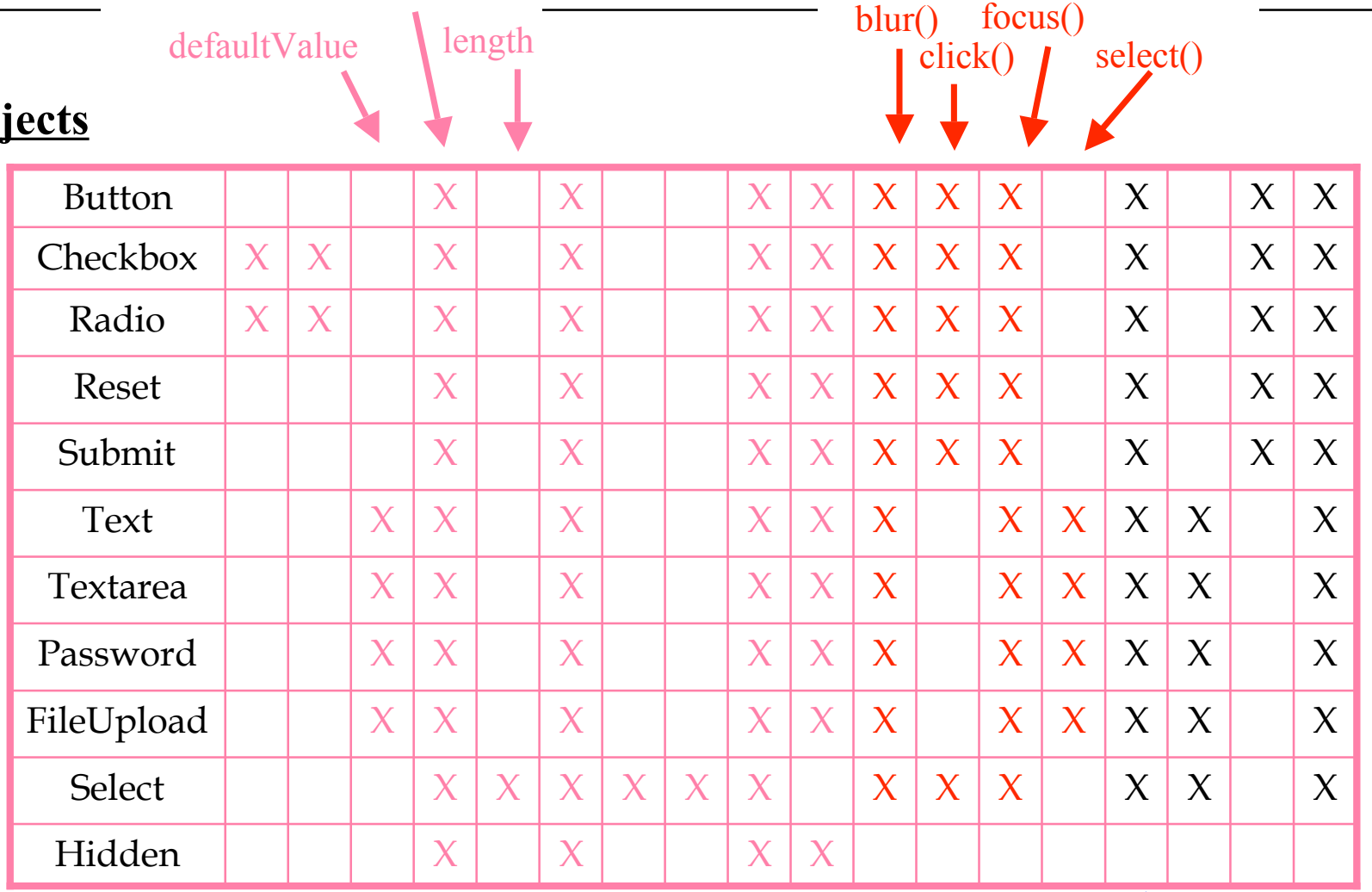
(*) Return false to cancel default action

DOM

Input

Properties | **Methods**

Objects



Button				X		X			X	X	X	X	X		X		X	X
Checkbox	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
Reset				X		X			X	X	X	X	X		X		X	X
Submit				X		X			X	X	X	X	X		X		X	X
Text			X	X		X			X	X	X		X	X	X	X		X
Textarea			X	X		X			X	X	X		X	X	X	X		X
Password			X	X		X			X	X	X		X	X	X	X		X
FileUpload			X	X		X			X	X	X		X	X	X	X		X
Select				X	X	X	X	X	X		X	X	X		X	X		X
Hidden				X		X			X	X								

Properties

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()

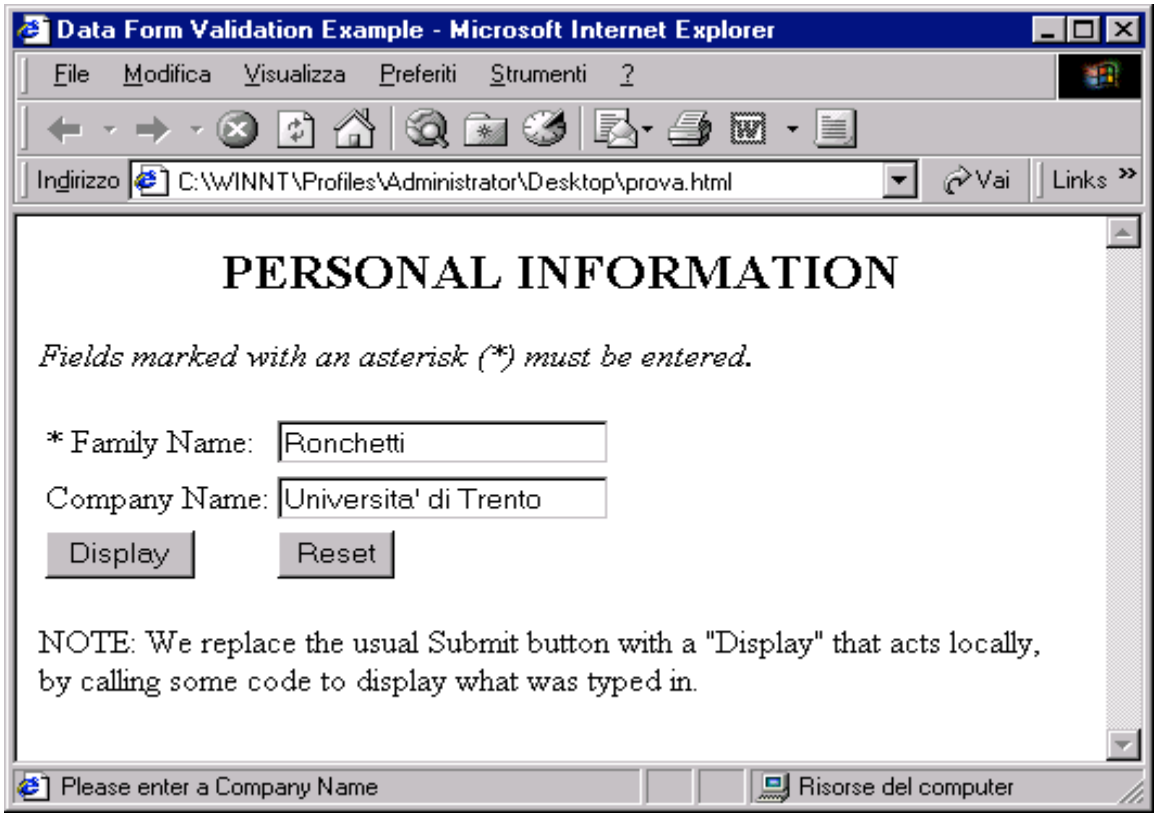
Events

```
<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>
```

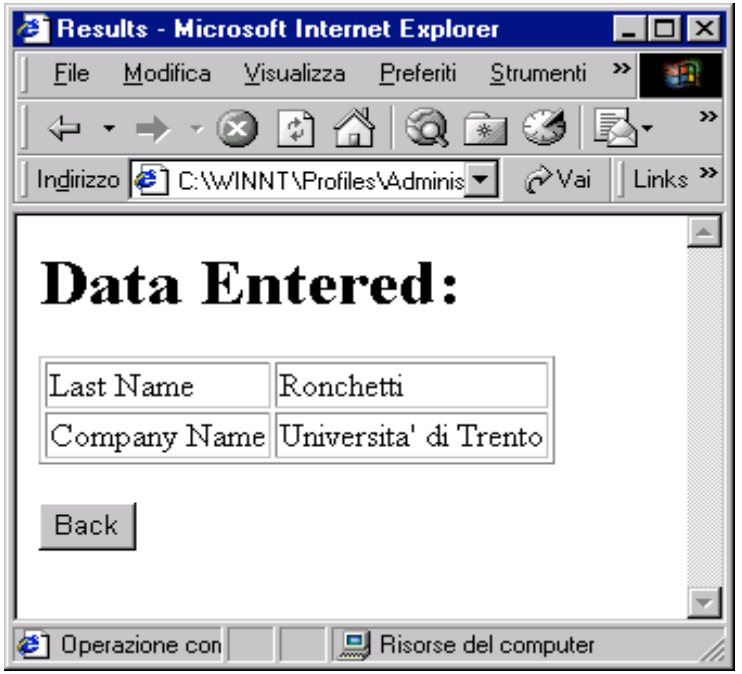
Events

```
<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

Server-Side JavaScript

Not discussed here!

A substitute for CGI.

Server-dependent technology to process the

Web page ***before*** passing it to the client.

(The Netscape SSJS object model is different from the Microsoft ASP object model, although JavaScript can be used as SSLanguage for ASP)

See http://en.wikipedia.org/wiki/Server-side_JavaScript

Rhino

Rhino is an open-source implementation of JavaScript written entirely in Java. It is typically embedded into Java applications to provide scripting to end users.

http://www.mozilla.org/rhino/

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

LiveConnect

A two-faced technology to let JavaScript interact with Java, so that:

- A JavaScript script can control and coordinate Java applets, and let Java applets interact with plugins.
- A Java Applet can execute JavaScript code.

- http://java.sun.com/j2se/1.5.0/docs/guide/plugin/developer_guide/java_js.html

Java-JavaScript interaction: JSObject

JSObject allows Java to manipulate objects that are defined in JavaScript.

Values passed from Java to JavaScript are converted as follows:
JSObject is converted to the original JavaScript object.
Any other Java object is converted to a JavaScript wrapper, which can be used to access methods and fields of the Java object.
Converting this wrapper to a string will call the **toString** method on the original object, converting to a number will call the **floatValue** method if possible and fail otherwise.
Converting to a boolean will try to call the **booleanValue** method in the same way.
Java arrays are wrapped with a JavaScript object that understands *array.length* and *array[index].*
A Java boolean is converted to a JavaScript boolean.
Java byte, char, short, int, long, float, and double are converted to JavaScript numbers.

Note If you call a Java method from JavaScript, this conversion happens automatically--you can pass in "int" argument and it works.

Java-JavaScript interaction: JSObject

Values passed from JavaScript to Java are converted as follows:

Objects that are wrappers around Java objects are unwrapped.

Other objects are wrapped with a *JSObject.*

Strings, numbers, and booleans are converted to String, Float, and Boolean objects respectively.

Examples
(String) window.getMember("name")
(JSObject) window.getMember("document")

Java-JavaScript interaction: JSObject

The netscape.javascript.JSObject class has the following methods:

Method	Description
Call	Calls a JavaScript method
Eval	Evaluates a JavaScript expression
getMember	Retrieves a named member of a JavaScript object
getSlot	Retrieves an indexed member of a JavaScript object
removeMember	Removes a named member of a JavaScript object
setMember	Sets a named member of a JavaScript object
setSlot	Sets an indexed member of a JavaScript object
toString	Converts a JSObject to a string

The netscape.javascript.JSObject class has the following static methods:

getWindow	Gets a JSObject for the window containing the given applet

Java-JavaScript interaction: JavaScript side

```
<HTML>
  <head>
    <script>
       function g(x){return x+x}
       function f(){return "Called f()";}
    </script>
  </head>
  <body>
     <script type="text/JavaScript">
     <!-- //hide script from old browsers
   document.write("<h2>JavaScript is enabled.</h2>")
// end hiding contents from old browsers  -->
</script>
<noscript><h2>JavaScript is not enabled, or your browser has
restricted this file from showing active
content.</h2></noscript>
```

Java-JavaScript interaction: JavaScript side

```
<script>
      <!-- //hide script from old browsers
var jEnabled = navigator.javaEnabled();
if (jEnabled){
   document.write("<h2>JAVA is enabled.</h2>")
}else{
   document.write("<h2>JAVA is <i>NOT</i> enabled.</h2>")
}
// end hiding contents from old browsers  -->
</script>


<APPLET code="javascript.MyApplet.class" name="app"
codebase="classes/" align="baseline"
     width="200" height="200"
MAYSCRIPT>
<PARAM NAME="param" VALUE="1">
     If your browser is blocking the content, please click on the
bar above.
</APPLET>
```

Java-JavaScript interaction: JavaScript side

```
<script language="Javascript">
document.write(f());
</script>
<script language="Javascript">
document.write(app.comment);
app.r=255;
document.write(app.square("3");
</script>
<form>
  <input  name="ChangeColorButton" value="Change color"
type="button"
onclick="app.r=(app.r+100)%256;app.repaint()";/>
  </form>
<form>
  <input  title="writeButton" value="write on console"
type="button" onclick='java.lang.System.out.println("a java
message");';/>
</form>
</body>
</html>
```

Java-JavaScript interaction: applet side

```
package javascript;
import netscape.javascript.*;
import java.applet.*;
import java.awt.*;
public class MyApplet extends Applet {
  private JSObject mainWindow;
  private JSObject pageDoc;
  private JSObject location;

  private String s;
     public String comment="instanceVarContent";
     public void init() {
         System.out.println("initing");
         mainWindow = JSObject.getWindow(this);
         pageDoc = (JSObject) mainWindow.getMember("document");
         location = (JSObject) mainWindow.getMember("location");
         s = (String) location.getMember("href");  // document.location.href
     }
```

Java-JavaScript interaction: applet side

```
public int r=0;
public int g=255;
public int b=0;

public void start(){
  s=(String)mainWindow.call("f",null);
  String[] stringArgs = new String[1];
  stringArgs[0] = "5";
  s=(String)mainWindow.call("g", stringArgs);
  System.out.println (" Calling g returned "+s);
}

public void paint(Graphics gra) {
  if (s==null) s="NULL";
  gra.setColor(new Color(r,g,b));
  Dimension d=this.getSize();
  gra.fillRect(0,0,d.width,d.height);
  gra.setColor(new Color(0,0,0));
  gra.drawString("VERSION 1",80,80);
  gra.drawString(s,30,30);
}
```

Java-JavaScript interaction: applet side

```
    void changeColor(String s) {
      int x=Integer.parseInt(s);
      r=x;
      this.repaint();
     }

     public String square(String sx) {
      int x=Integer.parseInt(sx);
      return new Integer(x*x).toString();
     }

}
```