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# Advanced Web Programming with **JavaScript and Google Maps**

**Voronezh State University**

**Voronezh (Russia)**

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# AJAX

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## Two classical examples

- **EXERCISE**
- A web page shows news headlines updated every 10 seconds

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```
<html>
<head>
<title>News headlines</title>
<meta http-equiv="refresh" content="10" />
</head>
<body>
<h1>News headlines</h1>
<?php
  // Randomly generate between 1 and 10 news
  $n = rand(1, 10);
  for($i = 1; $i <= $n; $i++) {
    echo "<h2>News $i</h2>\n";
   // Randomly repeat the string "Bla, bla, bla." between 1 and 5
   times
   echo "<p>" . str_repeat("Bla, bla, bla.", rand(1, 5)) .
   "</p>\n";
  }
?>
</body>
</html>
```



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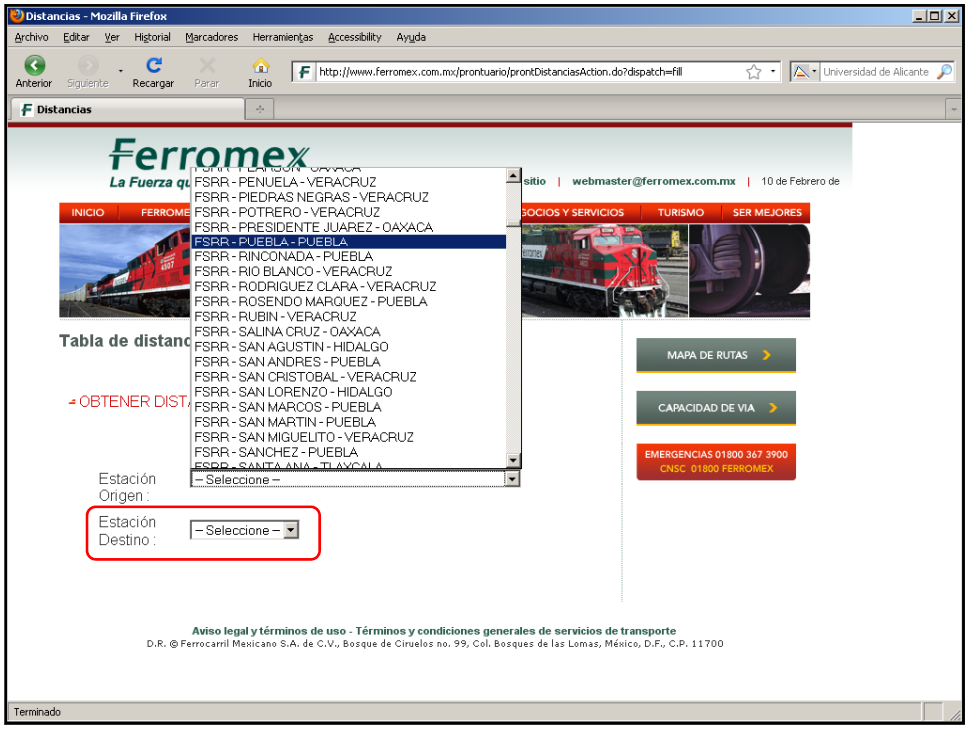
# Two classical examples

- **EXERCISE**
- A web page shows two lists (`<select>`):
  - Initially, the second list is empty or it doesn't appear
  - When selecting a value in the first list, the web page is reloaded and the second list shows new data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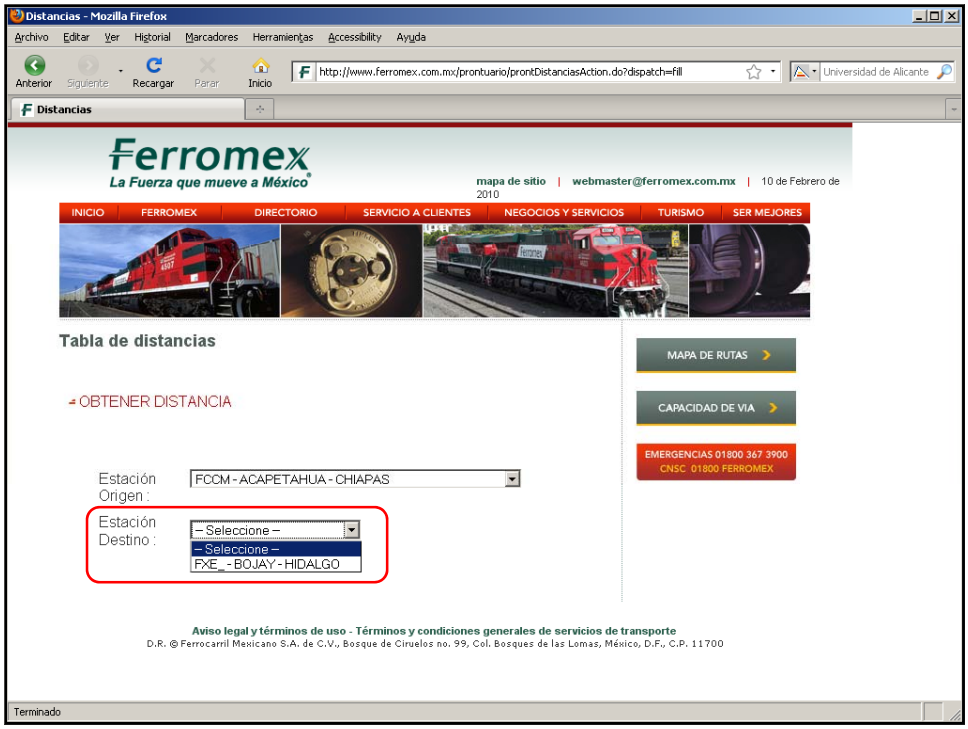
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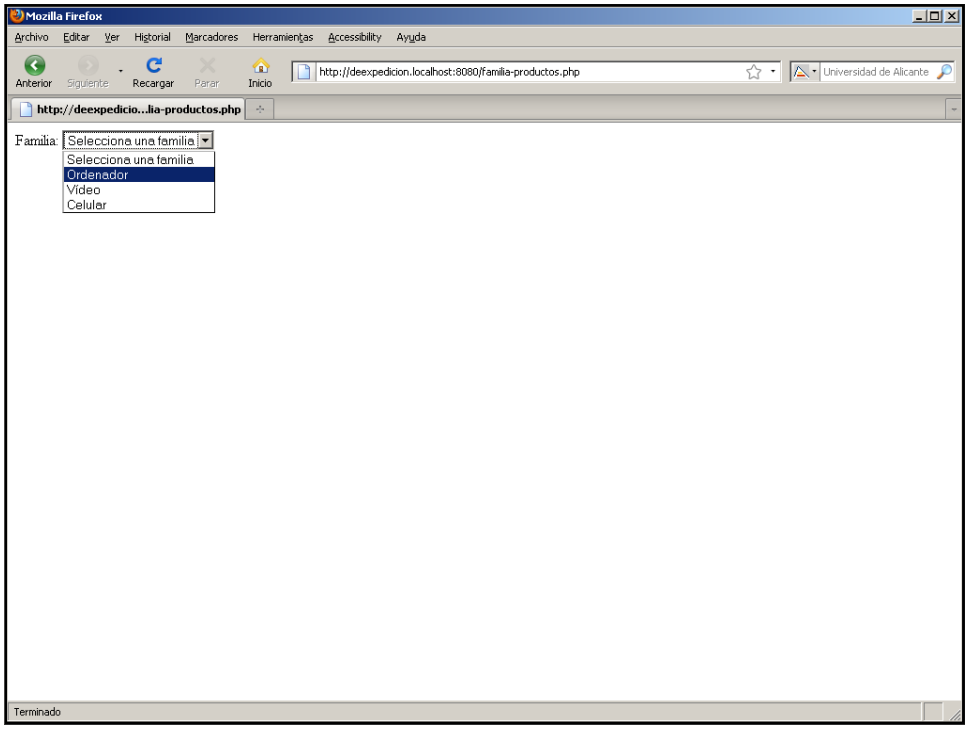
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Selecciona una familia
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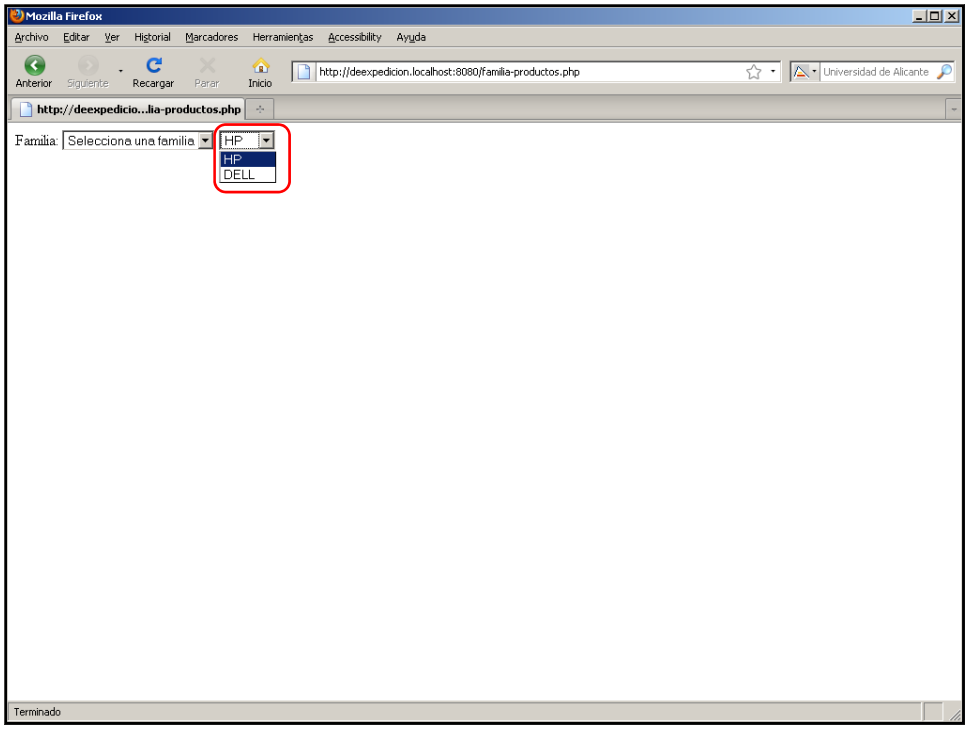
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Familia: Selecciona una familia
HP
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```
<html>
<head><title>List of products</title></head>
<body>
<form action="" method="post">
<p>
Family:
<select name="family" onchange="submit()">
<option value="">Select a family</option>
<option value="1">Computer</option>
<option value="2">Video</option>
<option value="3">Mobile phone</option>
</select>
<?php
  // Code for the second list with products
?>
</p>
</form>
</body>
</html>
```



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# Two classical examples

```
<?php
  // Products for each family
  $products[1] =
   "<option>HP</option><option>DELL</option>";
  $products[2] =
   "<option>Sony</option><option>Panasonic</option>";
  $products[3] =
   "<option>Motorola</option><option>Samsung</option>";
  // Detects if there is a family
  if(isset($_POST["family"]))
  {
    echo '<select name="product">';
   echo $products[$_POST["family"]];
   echo '</select>';
  }
?>
```

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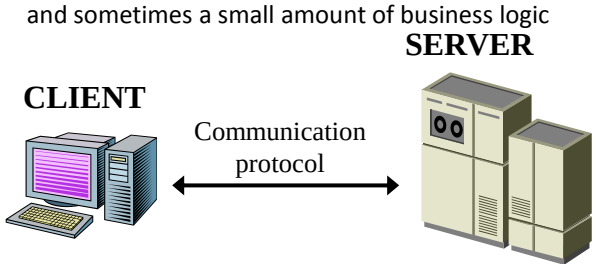
# Introduction

- Client-server architecture:
  - The client request a service and the server provides the service
  - Client part of the application only contains presentation logic and sometimes a small amount of business logic



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# Introduction

- Web applications:
  - Based on client-server architecture
  - Every user interaction generates a server request and reloads the web page
  - Sometimes, depending on the application and the user interface, too many requests can be generated
  - Problems:
    - Long waits of the client
    - Slow applications
    - Errors on the transmission

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## Introduction

- **Ajax**, shorthand for *Asynchronous JavaScript and XML.*
- Web development technique for creating interactive web applications.
- The intent is to make web pages feel more responsive by exchanging small amounts of data with the server behind the scenes, so that the entire web page does not have to be reloaded each time the user makes a change.
- This is meant to increase the web page's interactivity, speed, and usability.

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## Introduction

- The first known use of the term in public was by Jesse James Garrett in his February 2005 article *Ajax: A New Approach to Web Applications.*
  - http://adaptivepath.com/publications/essays/archives/000385.php

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# Introduction

- The Ajax technique uses a combination of:
  - **XHTML** (or HTML), **CSS**, for marking up and styling information.
  - The **DOM** accessed with a client-side scripting language, especially ECMAScript implementations such as **JavaScript** and **JScript**, to dynamically display and interact with the information presented.
  - The **XMLHttpRequest** object to exchange data asynchronously with the web server. In some Ajax frameworks and in certain situations, an IFrame object is used instead of the XMLHttpRequest object to exchange data with the web server.
  - **XML** is sometimes used as the format for transferring data between the server and client, although any format will work, including **preformatted HTML**, **plain text**, **JSON** and other formats.
- Like DHTML, LAMP, or SPA, Ajax is not a technology in itself, but a term that refers to the use of a group of technologies together.

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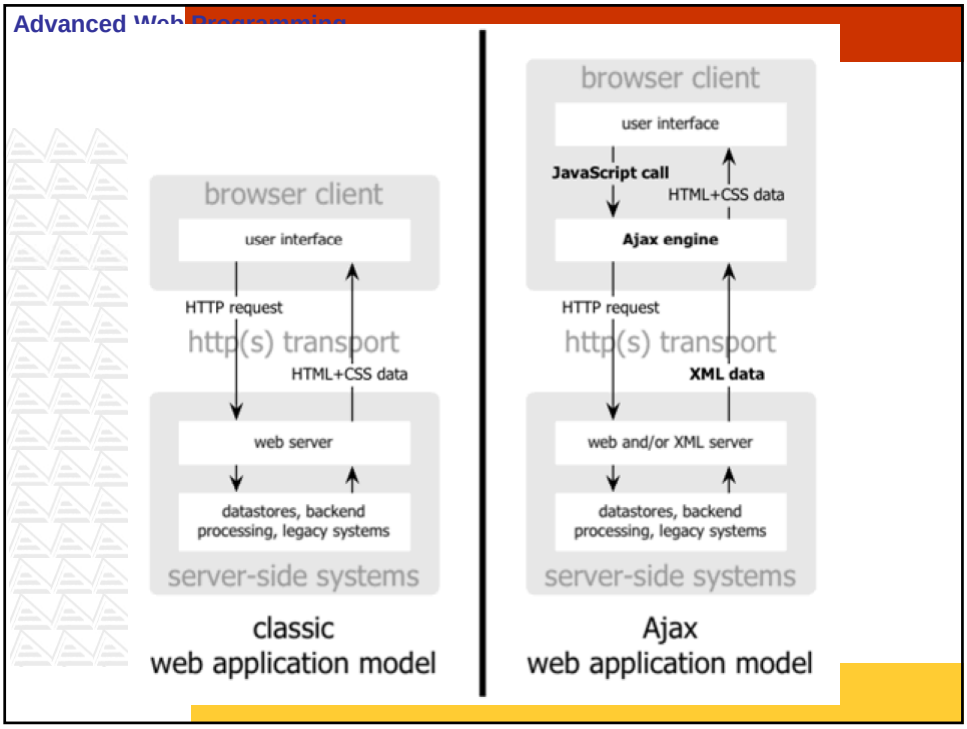
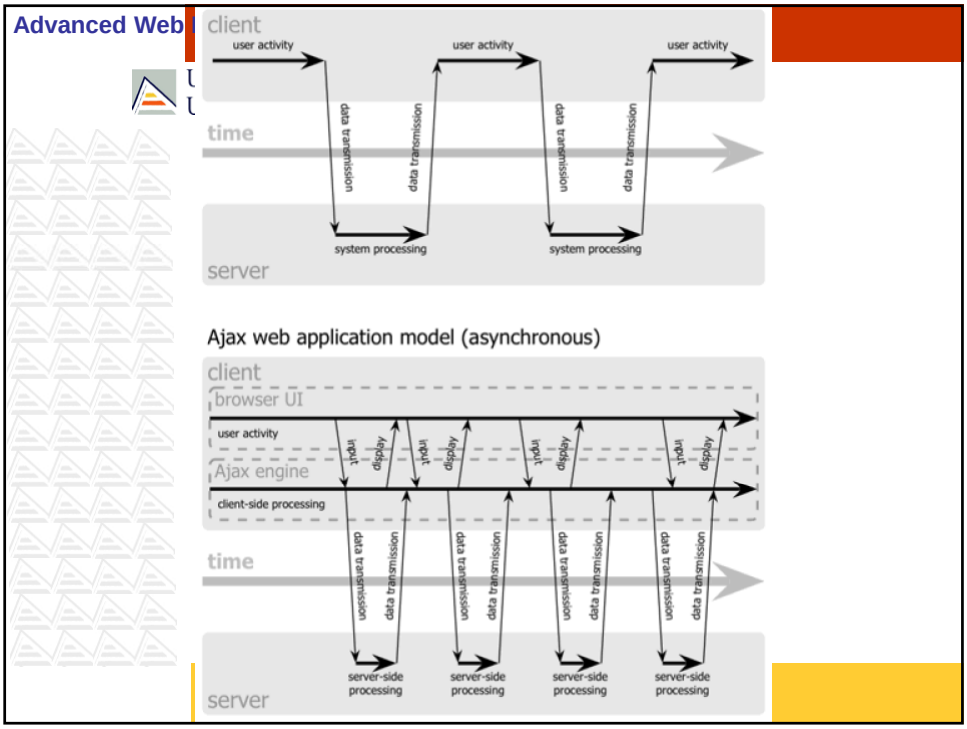
# How it works

- A new layer, called "Ajax engine", is inserted between the client and the server:
  - **XMLHttpRequest** object is used
  - This object communicates to the server
- The server response can be in different formats:
  - Plain text
  - HTML
  - XML
  - JSON
  - …


browser client
user interface
HTTP request
http(s) transport
HTML+CSS data
web server
datastores, backend processing, legacy systems
server-side systems
classic web application model
browser client
user interface
JavaScript call
HTML+CSS data
Ajax engine
HTTP request
http(s) transport
XML data
web and/or XML server
datastores, backend processing, legacy systems
server-side systems
Ajax web application model




client
user activity
data transmission
time
system processing
server
Ajax web application model (asynchronous)
client
browser UI
user activity
input
display
Ajax engine
client-side processing
time
server-side processing
server

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## Advantages

- Asynchronous transactions: users don't have to wait after a request
- Less amount of sent data
- Technologies based on open standards
- Similar to traditional applications in terms of interactivity and speed of response

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## Disdvantages

- The number of requests against the server can increase
- There are some incompatibilities between browsers:
  - The XMLHttpRequest object is not invoked in the same way in different browsers
- Loss of control over navigation:
  - The back and forward buttons of the browser stops working
  - Bookmarks to specific web pages can't be created, because it is always the same page → There are some partial solutions

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## XMLHttpRequest

- `XMLHttpRequest` is an API that can be used by JavaScript, JScript, VBScript and other web browser scripting languages to transfer and manipulate XML data to and from a web server using HTTP, establishing an independent connection channel between a web page's Client-Side and Server-Side.

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## XMLHttpRequest

- The `XMLHttpRequest` concept was originally developed by Microsoft.
- The Microsoft implementation is called XMLHTTP and, as an ActiveX object, it differs from the published standard in a few small ways. It has been available since Internet Explorer 5.0 and is accessible via JScript, VBScript and other scripting languages supported by IE browsers.

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## XMLHttpRequest

- The Mozilla project incorporated the first compatible native implementation of XMLHttpRequest in Mozilla 1.0 in 2002.
- This implementation was later followed by Apple since Safari 1.2, Konqueror, Opera Software since Opera 8.0 and iCab since 3.0b352.

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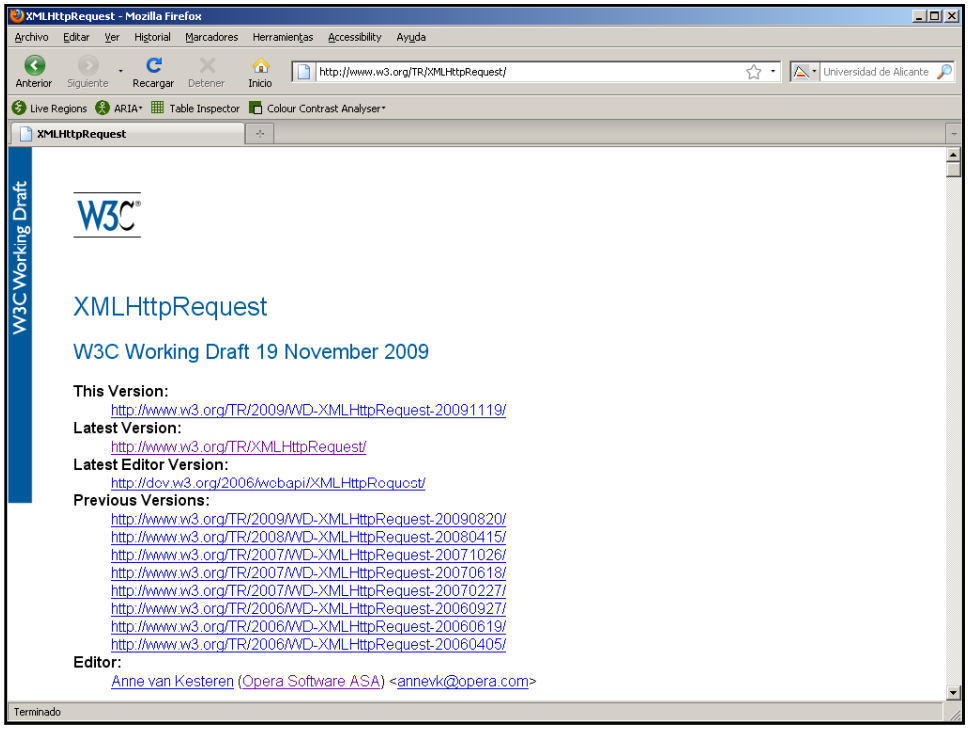
## XMLHttpRequest

- The World Wide Web Consortium published a Working Draft specification for the `XMLHttpRequest` object's API on 5 April 2006.
- While this is still a work in progress, its goal is "*to document a minimum set of interoperable features based on existing implementations, allowing Web developers to use these features without platform-specific code*".
- The draft specification is based upon existing popular implementations, to help improve and ensure interoperability of code across web platforms.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http://www.w3.org/TR/XMLHttpRequest/
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Live Regions ARIA Table Inspector Colour Contrast Analyser
XMLHttpRequest
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This Version:
http://www.w3.org/TR/2009/WD-XMLHttpRequest-20091119/
Latest Version:
http://www.w3.org/TR/XMLHttpRequest/
Latest Editor Version:
http://dev.w3.org/2006/webapi/XMLHttpRequest/
Previous Versions:
http://www.w3.org/TR/2009/WD-XMLHttpRequest-20090820/
http://www.w3.org/TR/2008/WD-XMLHttpRequest-20080415/
http://www.w3.org/TR/2007/WD-XMLHttpRequest-20071026/
http://www.w3.org/TR/2007/WD-XMLHttpRequest-20070618/
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Anne van Kesteren (Opera Software ASA) <annevk@opera.com>
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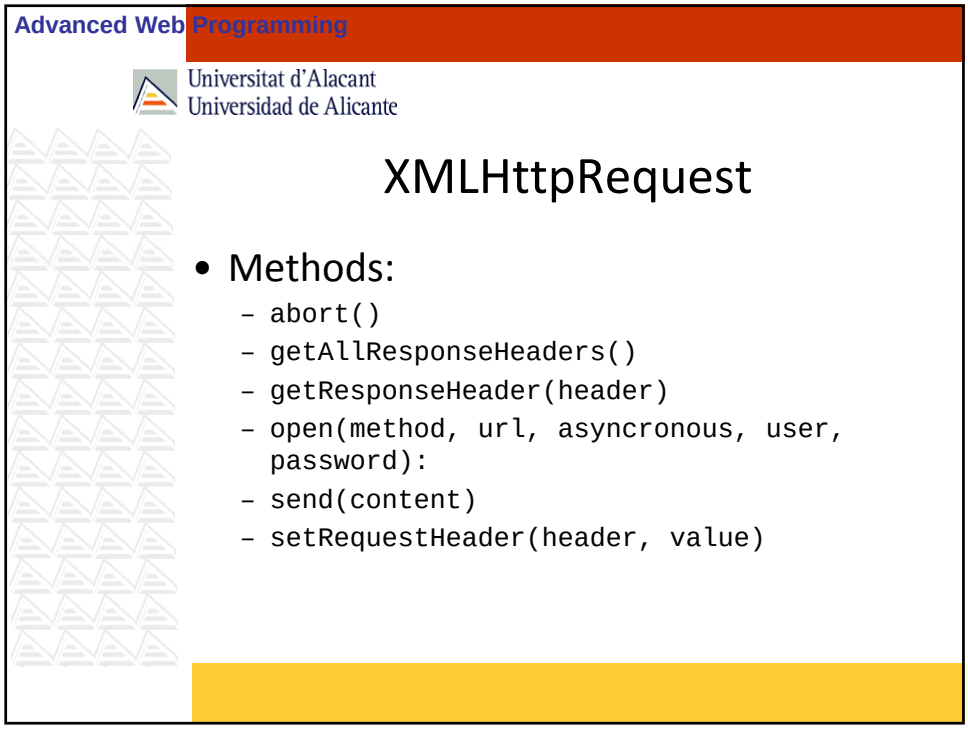
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XMLHttpRequest
• Methods:
– abort()
– getAllResponseHeaders()
– getResponseHeader(header)
– open(method, url, asyncronous, user, password):
– send(content)
– setRequestHeader(header, value)

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## XMLHttpRequest

- `open(method, url, async, user, password)`:
  - Initializes an XMLHTTP request.
  - Specifies the method, URL, and authentication information for the request.
  - After calling this method, you must call send to send the request and data, if any, to the server.

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## XMLHttpRequest

- `send(content)`:
  - Sends an HTTP request to the server and receives a response.
  - `null` for no data.

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## XMLHttpRequest

- Properties:
  - `onreadystatechange`
  - `readyState`
  - `responseText`
  - `responseXML`
  - `status`
  - `statusText`

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## XMLHttpRequest

- `onreadystatechange`:
  - Function than handles the different events.

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## XMLHttpRequest

- `readyState`:
  - The property is read-only.
  - It represents the state of the request as an integer.
  - The following values are defined:

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## XMLHttpRequest

- `readyState`: (W3C Recommendation)

**UNSENT** (numeric value 0)
The object has been constructed.

**OPENED** (numeric value 1)
The open() method has been successfully invoked. During this state request headers can be set using setRequestHeader() and the request can be made using the send() method.

**HEADERS_RECEIVED** (numeric value 2)
All HTTP headers have been received. Several response members of the object are now available.

**LOADING** (numeric value 3)
The response entity body is being received.

**DONE** (numeric value 4)
The data transfer has been completed or something went wrong during the transfer (e.g. infinite redirects).

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## XMLHttpRequest

- `responseText`:
  - The property is read-only.
  - This property represents only one of several forms in which the HTTP response can be returned.

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## XMLHttpRequest

- `responseXML`:
  - The property is read-only.
  - This property represents the parsed response entity body.

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## XMLHttpRequest

- `status`:
  - Return the HTTP status code.
  - RFC 2616 Hypertext Transfer Protocol -- HTTP/1.1:
    - http://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html
    - 2xx Successful (*200 OK*)
    - 3xx Redirection (*301 Moved Permanently*)
    - 4xx Client error (*404 Not Found*)
    - 5xx Server error (*500 Internal Server Error*)
- `statusText`:
  - Return the HTTP status text.

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## AJAX step by step

1. Create XMLHttpRequest object
2. Assign a function to the state change event
3. Send a request to the server
4. On a state change, manage the response
5. On a correct response, process the result and show to the user

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## Create XMLHttpRequest object

- Depending on the browser:
  - Internet Explorer

```
request = new
ActiveXObject("Microsoft.XMLHTTP");
```

  - Other browsers:

```
request = new XMLHttpRequest();
```

- Code adapted for different browsers:

```
if(window.XMLHttpRequest) {
   request = new XMLHttpRequest();
}
else if(window.ActiveXObject) {
   request = new ActiveXObject("Microsoft.XMLHTTP");
}
```

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## Create XMLHttpRequest object

- Another way, using exceptions:

```
try {
  request = new ActiveXObject("Msxml2.XMLHTTP");
} catch (e) {
  try {
    request = new ActiveXObject("Microsoft.XMLHTTP");
  } catch (ee) {
    try {
      request = new XMLHttpRequest();
    } catch(eee) {
        alert("Your browser doesn't support AJAX");
        return;
    }
  }
}
```

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## Assign a function to the state change event

- This function will be called automatically, every time the state of the `XMLHttpRequest` object changes:

```
request.onreadystatechange = nameOfFunction;
```

**Important**: without "( )", only the name



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## Send a request to the server

- Open the connection, define the method and the type of connection:
  - A synchronous connection (`false`) blocks the browser until the response is obtained
  - An asynchronous connection (`true` and default value) executes on the background
  - Important: the URL must belong to the same domain of the current page

```
request.open('GET','http://www.ua.es/ajax.jsp'
  , true);
```

- Send the additional data:

```
request.send(data or null);
```

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## On a state change, manage the response

- The handler is called every time there is a change:
  - `0: UNSET`
  - `1: OPENED`
  - `2: HEADERS_RECEIVED`
  - `3: LOADING`
  - `4: DONE`
- Example of handler:

```
if (request.readyState == 4) { // Finished
   if (request.status==200) { // OK
        // Process the result
   }
}
else {
   // Not finished
}
```

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## On a correct response, process the result and show to the user

- The result can be in different formats: plain text, HTML, JSON, XML, etc.
- `responseText` when not structured result as XML:

```
alert(request.responseText);
```

- `responseXML` when structured result as XML:
  - Returns an XMLDocument object
  - Use DOM functions

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# Example

```
<script type="text/javascript">
function ajaxFunction() {
  var xmlHttp;
  if (window.XMLHttpRequest)
    xmlHttp = new XMLHttpRequest();
  else
    xmlHttp = new ActiveXObject("Microsoft.XMLHTTP");

  xmlHttp.onreadystatechange=function() {
      if(xmlHttp.readyState == 4) {
        document.myForm.time.value += xmlHttp.responseText + "\n";
      }
   }
   xmlHttp.open("GET","time.php",true);
   xmlHttp.send(null);
}
</script>
```



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# Example

```
<script type="text/javascript">
function ajaxFunction() {
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   xmlHttp.send(null);
}
</script>
```

*Create XMLHttpRequest object*

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# Example

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<script type="text/javascript">
function ajaxFunction() {
  var xmlHttp;
  if (window.XMLHttpRequest)
    xmlHttp = new XMLHttpRequest();
  else
    xmlHttp = new ActiveXO
```

*Assign a function to the state change event*

```
  xmlHttp.onreadystatechange=function() {
      if(xmlHttp.readyState == 4) {
        document.myForm.time.value += xmlHttp.responseText + "\n";
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   }
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   xmlHttp.send(null);
}
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  xmlHttp.onreadystatechange=function() {
      if(xmlHttp.readyState == 4) {
        document.myForm.time.value += xmlHttp.responseText + "\n";
      }
   }
```

*Send a request to the server*

```
   xmlHttp.open("GET","time.php",true);
   xmlHttp.send(null);
}
</script>
```

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# Example

```
<script type="text/javascript">
function ajaxFunction() {
  var xmlHttp;
  if (window.XMLHttpRequest)
    xmlHttp = new XMLHttpRequest();
  else
    xmlHttp = new ActiveXObje
```

*On a state change, manage the response*

```
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      if(xmlHttp.readyState == 4) {
        document.myForm.time.value += xmlHttp.responseText + "\n";
      }
   }
   xmlHttp.open("GET","time.php",true);
   xmlHttp.send(null);
}
</script>
```

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# Example

```
<script type="text/javascript">
function ajaxFunction() {
  var xmlHttp;
  if (window.XMLHttpRequest)
    xmlHttp = new XMLHttpRequest();
  else
```

*On a correct response, process the result and show to the user*

```
  xmlHttp.onreadystatechange=function() {
      if(xmlHttp.readyState == 4) {
        document.myForm.time.value += xmlHttp.responseText + "\n";
      }
   }
   xmlHttp.open("GET","time.php",true);
   xmlHttp.send(null);
}
</script>
```

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## Example

```
<html>
<head>
<title>Ajax example</title>
<!-- script -->
</head>
<body>
<form name="myForm">
Name: <input type="text"
onkeyup="ajaxFunction();" name="username" />
<br />
Time: <textarea name="time" cols="40"
   rows="10"></textarea>
</form>
</body>
</html>
```



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## Example

- PHP:

```
<?php
  header("Expires: -1");
  $str1 = date('h:i:s A');
  sleep(2);
  $str2 = date('h:i:s A');
  echo "$str1 -- $str2";
?>
```

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## Sending data GET/POST

- GET:
  - Data is sent in the URL in the `open()` method
  - `encodeURIComponent()` codes data to be sent in the URL

```
var idFamily =
   document.getElementById("family").value;
xmlHttp.open("GET","productos.php?family=" +
   encodeURIComponent(idFamily), true);
```



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## Sending data GET/POST

- POST:
  - Data is sent in the `send()` method
  - `encodeURIComponent()` codes data to be sent
  - `setRequestHeader()` is used to define some HTTP headers

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## Sending data GET/POST

- POST:

```
var idFamily = document.getElementById("family").value;
var parameters = "family=" + encodeURIComponent(idFamily);
xmlHttp.open("POST","products.php", true);

xmlHttp.setRequestHeader("Content-Type", "application/x-
   www-form-urlencoded");
xmlHttp.setRequestHeader("Content-length",
   parameters.length);
xmlHttp.setRequestHeader("Connection", "close");

xmlHttp.send(parameters);
```



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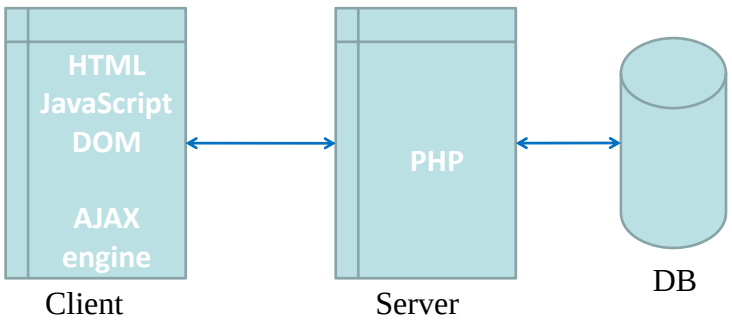
## Transformation to AJAX

- Separate client and server logic



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## Transformation to AJAX

- **EXERCISE**
- *Classical example (1)*: A web page shows news headlines updated every 10 seconds

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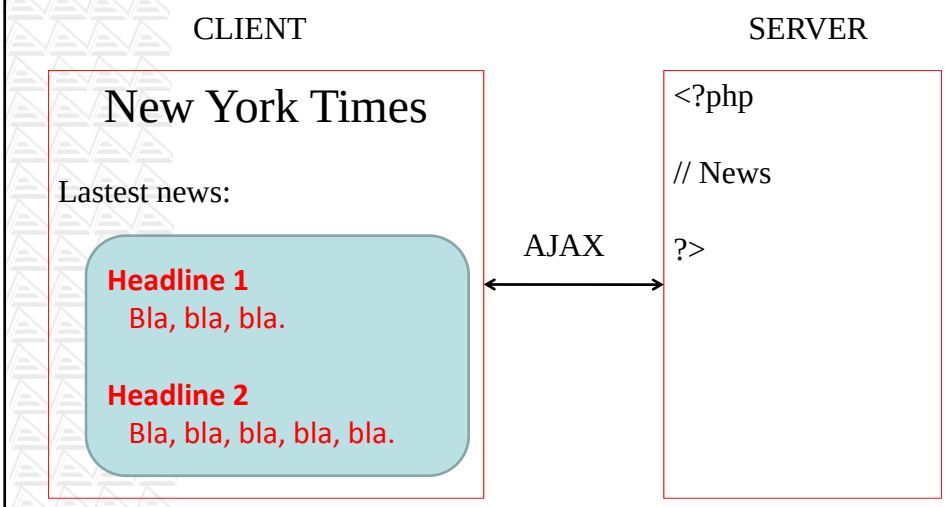

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## Transformation to AJAX

- **EXERCISE**
- *Classical example (2)*: A web page shows two lists (`<select>`):
  - Initially, the second list is empty or it doesn't appear
  - When selecting a value in the first list, the web page is reloaded and the second list shows new data



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## XML data format

- Property `responseXML` → XMLDocument object
- DOM properties and methods are used to access and traverse the XML document

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## XML data format

- Each node has a set of properties that relates to its "relatives":
  - `childNodes`
  - `firstChild`
  - `lastChild`
  - `parentNode`
  - `nextSibling`
  - `prevSibling`

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## XML data format

- getElementById("elementID")
  - Useful to get a specific element

```
var element = document.getElementById("myTable")
```

- getElementsByTagName("tagName"):
  - Useful to get a set of elements of the same type

```
var images = document.getElementsByTagName("img")
```

  - The special value "*" all the tags (elements)
- getAttribute("attrName"):

```
– var element = document.getElementById("myTable").
getAttribute("width");
```

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## XML data format

```
xmlDoc = xmlHttp.responseXML;

x = xmlDoc.documentElement.childNodes;

for (i=0 ; i < x.length; i++)
{
  document.write("Nodename: " + x[i].nodeName);
  document.write(" (nodetype: " + x[i].nodeType +
")<br />");
}
```



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## XML data format

- In the server, appropriate MIME type has to be used:

```
<?php
  header("Content-Type: text/xml");
  // O también
  header("Content-Type: application/xml");
?>
```

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## JSON data format

- JSON (*JavaScript Object Notation*) is a light exchange data format based on plain text
- JSON Specification RFC 4627:
  - http://tools.ietf.org/html/rfc4627
- JSON Validator:
  - http://www.jsonlint.com/

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## JSON data format

- It's used to serialized structured data:
  - Arrays:
    - The list of values between square brackets ([ ]) and separated by commas (,)
  - Objects:
    - Pairs property/value closed between curly braces ({ }) and separated by commas
    - Property and value are separated by colon
  - In both cases, properties and values of string type must be between double quotes

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## JSON data format

- Array example:

```
[1, 2, 3, 4, 5]

["Voronezh", "Moscow", "Saratov"]
```

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## JSON data format

- Object example:

```
{"name": "Sergio", "surnames": "Luján Mora"}

{"position": {"x": 10, "y": 20}}
```

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# JSON data format

- Example:

```
{"menu": {
  "id": "file",
   "value": "File",
   "popup": {
    "menuitem": [
     {"value": "New", "onclick": "CreateDoc()"},
     {"value": "Open", "onclick": "OpenDoc()"},
     {"value": "Close", "onclick": "CloseDoc()"}
    ]
  }
}}
```

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# JSON data format

- Example:

```
{
  "Image": {
    "Width": 800,
    "Height": 600,
    "Title": "View from 15th Floor",
    "Thumbnail": {
      "Url": "http://www.ex.com/image/481989943",
      "Height": 125,
      "Width": "100"
    }
  }
}
```

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## JSON data format

- Data sent in JSON format is available in `responseText`
- For "rebuilding" the original array or object, use `eval()`:

```
var json_data = xmlHttp.responseText;
myObject = eval('(' + json_data + ')');
```

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## More information

- AJAX (Wikipedia):
  - http://es.wikipedia.org/wiki/AJAX
- Ajax: A New Approach to Web Applications:
  - http://adaptivepath.com/publications/essays/archives/000385.php
- AJAX un nuevo acercamiento a aplicaciones web (traducción del anterior):
  - http://www.uberbin.net/archivos/internet/ajax-un-nuevo-acercamiento-a-aplicaciones-web.php
- "Hola mundo" en Ajax:
  - http://www.maestrosdelweb.com/editorial/ajaxpaso/
- Introducción a Ajax:
  - http://www.librosweb.es/ajax/index.html

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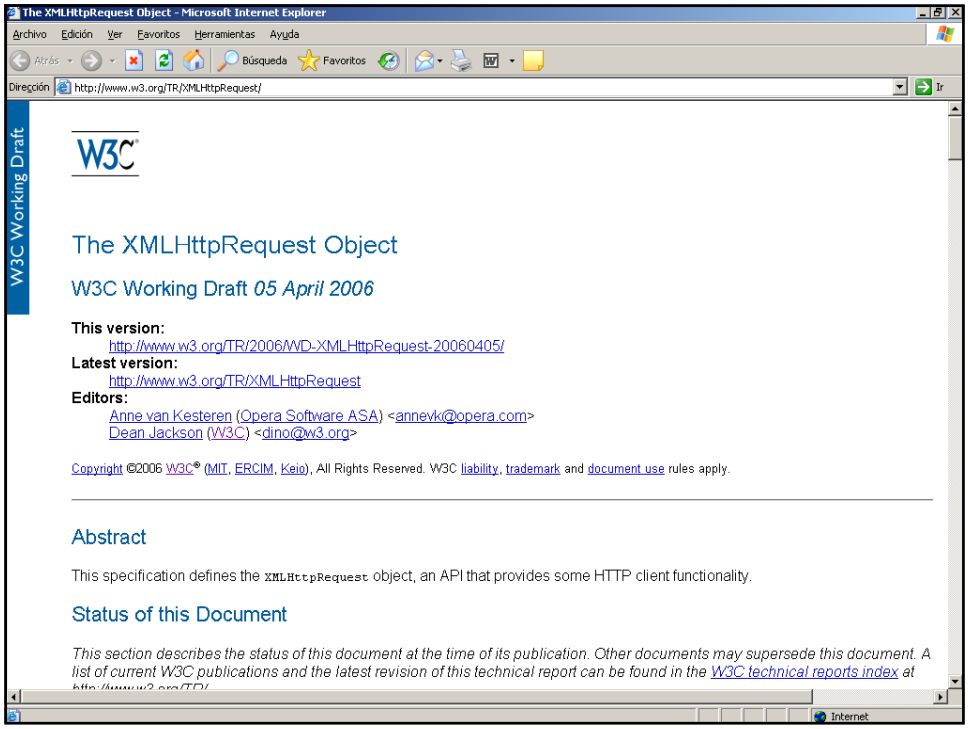
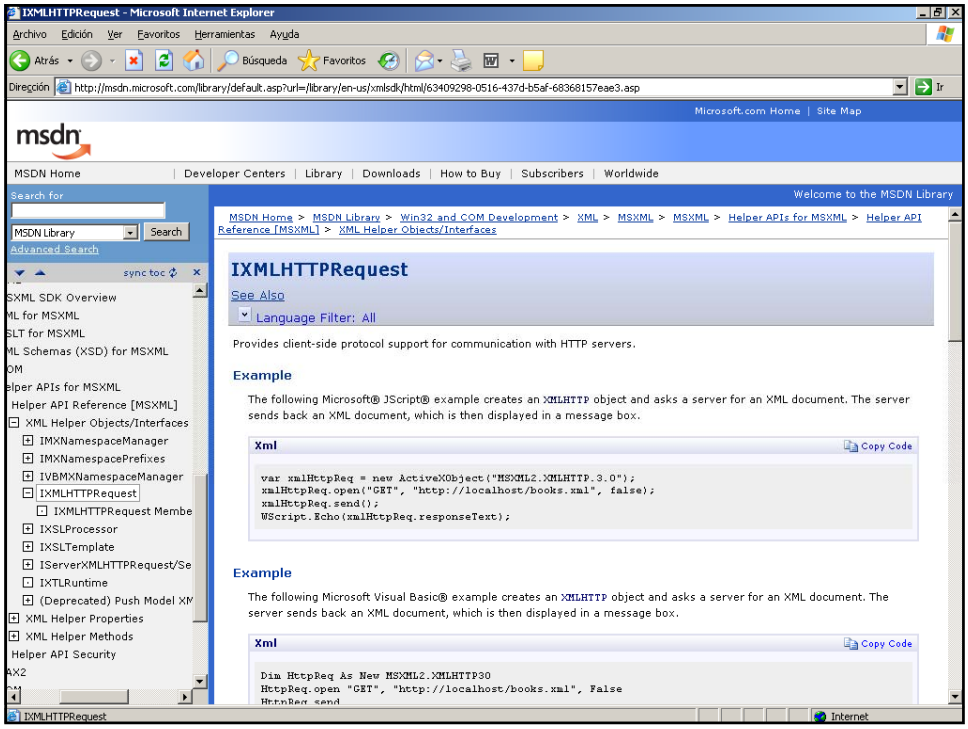
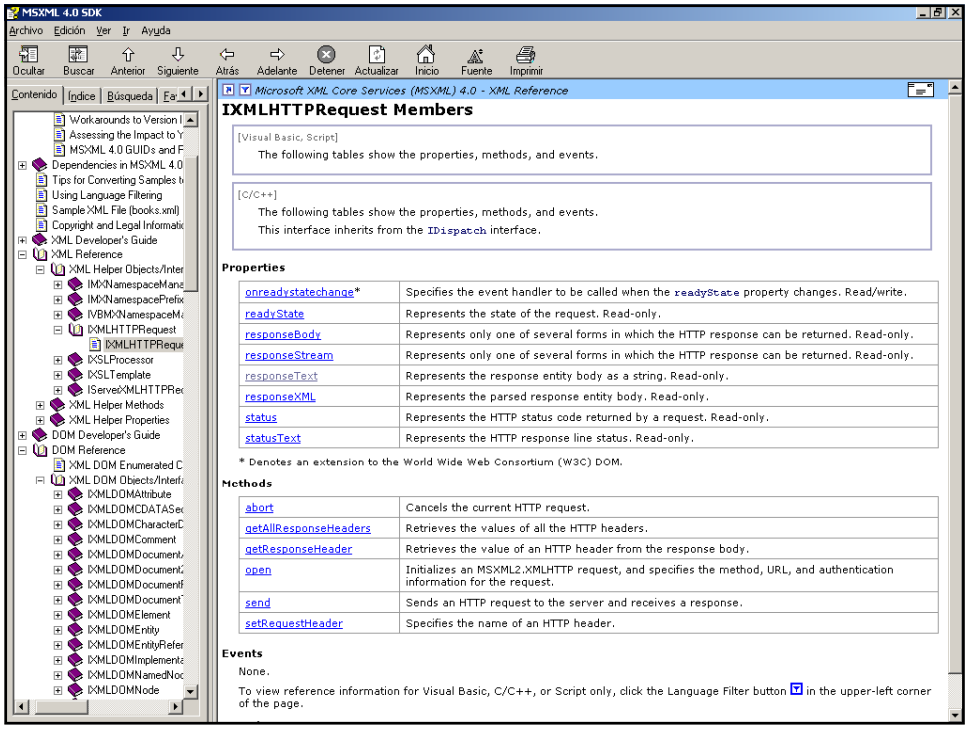
# More information

- W3C:
  - The XMLHttpRequest Object (W3C Working Draft 05 April 2006)
  - http://www.w3.org/TR/XMLHttpRequest/
- Microsoft:
  - MSDN: IXMLHTTPRequest
  - MSXML 4.0 SDK
  - http://msdn.microsoft.com/library/default.asp?url=/library/en-us/xmlsdk/html/xmobjxmlhttprequest.asp




IXMLHTTPRequest - Microsoft Internet Explorer
msdn
IXMLHTTPRequest
Provides client-side protocol support for communication with HTTP servers.
Example
Example


MSXML 4.0 SDK
IXMLHTTPRequest Members
Properties
Methods
Events