Web development

Client-side programming

Rich Internet Applications and AJAX

Rich Internet Application

- Rich Internet applications (RIA) are web applications that have the features and functionality of traditional desktop applications.
- RIAs typically
  - transfer the processing necessary for the user interface to the web client
  - keep the bulk of the data (i.e., maintaining the state of the program, the data etc) back on the application server.

Main goals of RIAs

- Most sophisticated RIAs exhibit a look and feel approaching a desktop environment.
  - **Richer**. User-interface behaviors not obtainable using only the HTML widgets available to standard browser-based Web applications: drag and drop, using a slider to change data, calculations performed by the client and which do not need to be sent back to the server, ...
  - **More responsive**. The interface behaviors are typically much more responsive than those of a standard Web browser that must always interact with a remote server.

Performance of RIAs

- **Client/Server balance**. The demand for client and server computing resources is better balanced. This frees server resources, allowing the same server hardware to handle more client sessions concurrently.

Performance of RIAs

- **Asynchronous communication**. The client engine can interact with the server without waiting for the user to perform an interface action such as clicking on a button or link. This allows the user to view and interact with the page asynchronously from the client engine's communication with the server.
  - Example: prefetching (an application anticipates a future need for certain data, and downloads it to the client before the user requests it)

Performance or RIAs

- **Network efficiency**. Network traffic may be significantly reduced because an application-specific client engine can be more intelligent than a Web browser when deciding what data needs to be exchanged with servers.
  - Less data is being transferred for each interaction, and overall network load is reduced.
  - However, use of asynchronous prefetching techniques can neutralize or even reverse this potential benefit.

AJAX definition

- Asynchronous JavaScript And XML.
- AJAX is a type of programming made popular in 2005 by Google (with Google Suggest).
- AJAX is not a new programming language, but a new way to use existing standards.
- With AJAX you can create better, faster, and more user-friendly web applications.
- AJAX is based on JavaScript and HTTP requests.

Key enabling technology

- With AJAX, your JavaScript can communicate directly with the server, using the JavaScript XMLHttpRequest object.
- By using the XMLHttpRequest object, a web developer can update a page with data from the **server -- after** the page has loaded!
- The XMLHttpRequest object is supported in Internet Explorer 5.0+, Safari 1.2, Mozilla 1.0 / Firefox, Opera 8+, and Netscape 7.
- **http://www.w3.org/TR/XMLHttpRequest/**

XMLHttpRequest – the name

- The name of the object is *wrong*, but maintained for historical reasons:
  - May receive any text-based content, not just XML
  - May use also HTTPS, not just HTTP protocol
  - May handle both Requests and Responses, of all HTTP methods

Standard definition

```
interface XMLHttpRequest {
  // event handler
           attribute EventListener onreadystatechange;
  // state
  const unsigned short UNSENT = 0;
  const unsigned short OPENED = 1;
  const unsigned short HEADERS_RECEIVED = 2;
  const unsigned short LOADING = 3;
  const unsigned short DONE = 4;
  readonly attribute unsigned short readyState;
```

Standard definition

```
  // request
  void open(in DOMString method, in DOMString url);
  void open(in DOMString method, in DOMString url, in boolean async);
  void open(in DOMString method, in DOMString url, in boolean async, in
DOMString user);
  void open(in DOMString method, in DOMString url, in boolean async, in
DOMString user, in DOMString password);
  void setRequestHeader(in DOMString header, in DOMString value);
  void send();
  void send(in DOMString data);
  void send(in Document data);
  void abort();
```

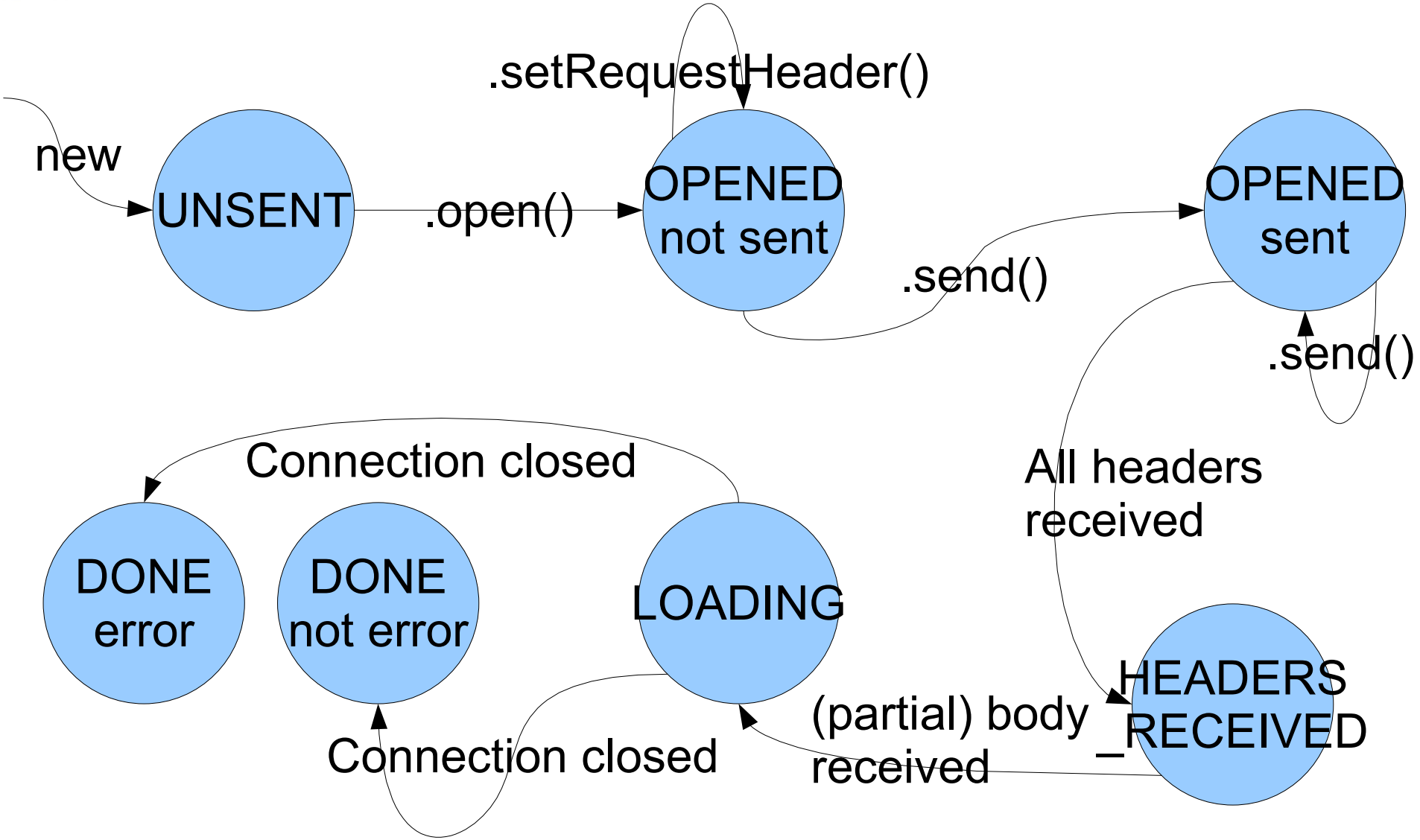
Standard definition

```
  // response
  DOMString getAllResponseHeaders();
  DOMString getResponseHeader(in DOMString header);
  readonly attribute DOMString responseText;
  readonly attribute Document responseXML;
  readonly attribute unsigned short status;
  readonly attribute DOMString statusText;
};
```

Request states

- UNSENT = 0
  - The request is not initialized
- OPENED = 1
  - The request has been set up
- HEADERS_RECEIVED = 2
  - The request has been sent
- LOADING = 3
  - The request is in process
- DONE = 4
  - The request is complete

State transition diagram



XMLHttpRequest properties

- onreadystatechange
  - stores the **function** that will process the response from a server
  - `xmlHttp.onreadystatechange = function() { ... }`
- readyState
  - holds the status of the server's response. Each time readyState changes, the onreadystatechange function will be executed.
- responseText
  - the data sent back from the server can be retrieved with the responseText property

Methods

- open(method, url, async, user, password)
  - method = “GET”, “POST”
  - url = complete URL to request
  - async = true/false (optional, default=true)
  - user, password (optional)
  - Interrupts any on-going send()
- setRequestHeader(header, value)
  - Adds a new header to the HTTP Request
  - Content-Type is one common header to send
    - Examples: text/xml, application/xml

Methods

- send(data)
  - Initiates the request
  - data = HTTP request body (optional)
    - May be a Document or DOMString
  - The URL was already given in open()
  - send() terminates immediately if async==true, but transfer continues in the background
    - Generates readystatechange events
  - send() transfers data synchronously if async==false

Methods

- getAllResponseHeaders()
  - Return all response headers as a single string, with headers separated by CR+LF
  - Invalid if UNSENT or OPENED
- getResponseHeader(header)
  - Returns the value of a single header
  - Invalid if UNSENT or OPENED

Receiving the response body

- responseText of type DOMString
  - If LOADING (partial body) or DONE
  - Allow access to a “raw string” of the response body
- responseXML of type Document
  - Only if DONE
  - For text/xml (or application/xml or *+xml) content types, otherwise null
  - Allows access to the DOM of the XML document

Example

- Create a standard HTML form with two text fields: username and time.
- The username field will be filled in by the user and the time field will be filled in using AJAX.
- No submit button is needed.

Example

```
<html>
<body> <form name="myForm">
Name: <input type="text" name="username" />
Time: <input type="text" name="time" />
</form> </body>
</html>
```

Creating an XMLHttpRequest object

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

  ...
}
</script>
```

Supporting all browsers

```
<script type="text/javascript">
function ajaxFunction()
{
var xmlHttp;
try {
  // Firefox, Opera 8.0+, Safari
  xmlHttp=new XMLHttpRequest();
  }
catch (e) {
  // Internet Explorer
  try { // Internet Explorer 6.0+
    xmlHttp=new ActiveXObject("Msxml2.XMLHTTP");
    }
  catch (e) {
    try { // Internet Explorer 5.5+
      xmlHttp=new ActiveXObject("Microsoft.XMLHTTP");
      }
    catch (e) {
      alert("Your browser does not support AJAX!");
      return false;
      }
    }
  }
}
</script>
```

Calling the server

```
xmlHttp.open("GET","time.jsp",true);
xmlHttp.send(null);
```

Processing the response

```
xmlHttp.onreadystatechange=function()
{
if(xmlHttp.readyState==4)
  {
  // Get the data from the server's response
  document.myForm.time.value=xmlHttp.responseText;
  }
}
```

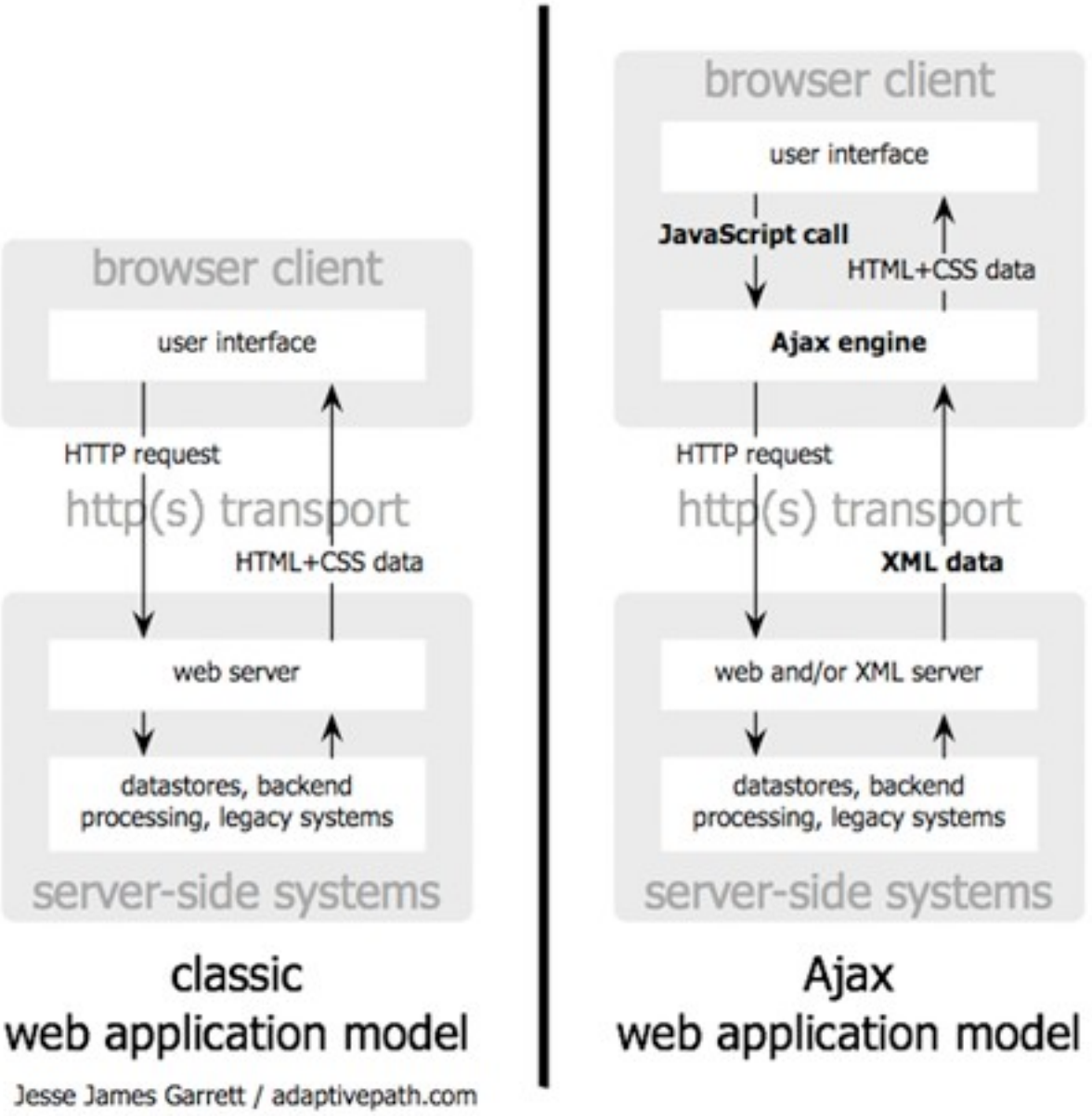
Attaching to an event

```
<form name="myForm">
Name: <input type="text"
onkeyup="ajaxFunction();" name="username" /
>
Time: <input type="text" name="time" />
</form>
```

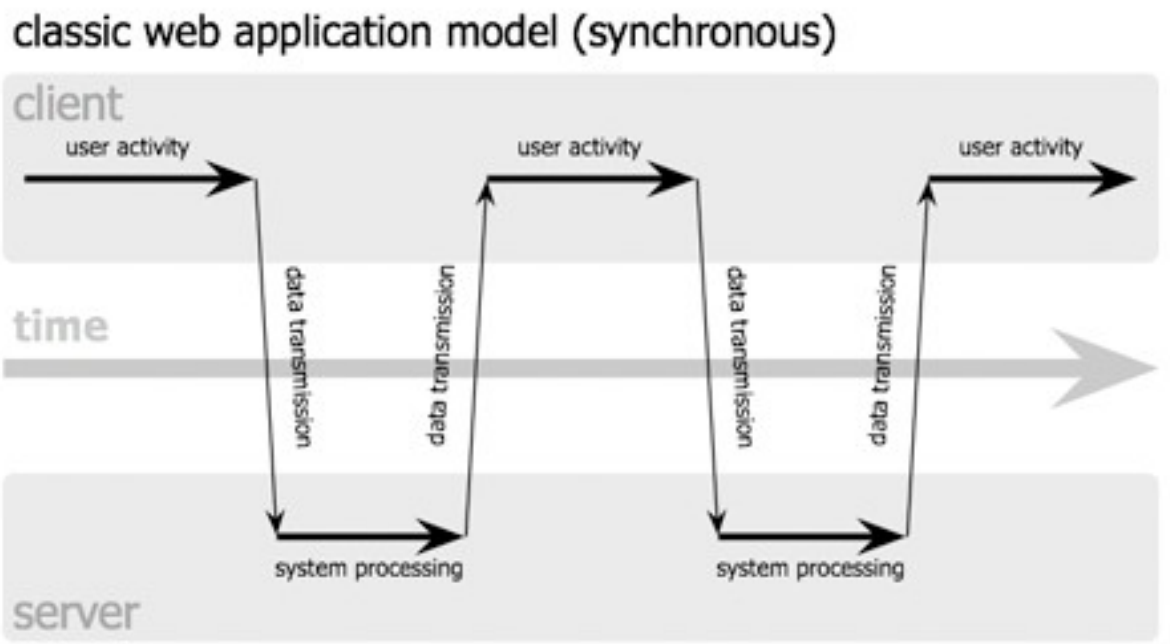
Complete example

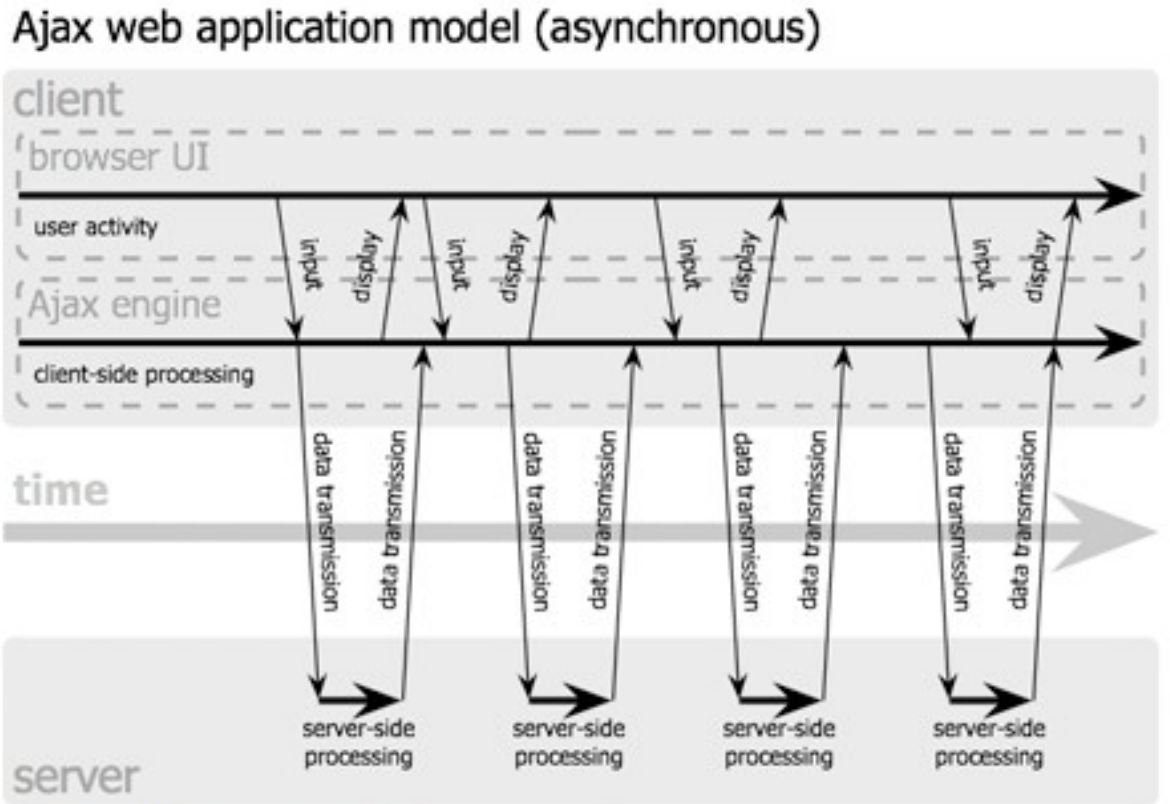
```
<html>
<body>
<script type="text/javascript">
function ajaxFunction()
{
  var xmlHttp=new XMLHttpRequest();

  xmlHttp.onreadystatechange=function()
    {
    if(xmlHttp.readyState==4)
      {
      document.myForm.time.value=xmlHttp.responseText;
      }
    }

  xmlHttp.open("GET","time.asp",true);
  xmlHttp.send(null);
  }
</script>
<form name="myForm">
Name: <input type="text"
onkeyup="ajaxFunction();" name="username" />
Time: <input type="text" name="time" />
</form> </body>
</html>
```

AJAX architecture



AJAX behavior





Jesse James Garrett / adaptivepath.com

Exercise 1

- Create an auto-complete feature for entering the name in a FORM
- For every typed letter, an associated text must be updated, reflecting the list of all possible names with those initial(s)
- Once submitted, the name adds up to the list
- Clicking on the suggestion auto-fills the box

Name Jo

Suggestions: Joe, Joseph, John

SUBMIT

Exercise 2

- Create a FORM for entering the name of a city, based on two drop-down menus (<select> tags).
  - The first <select> contains the list of all *provinces* (AO, BO, CN, MI, TO, ...)
  - The second <select> contains the list of all *cities* in the province
- Every time the user changes the province, then the list of cities MUST be updated
- The form may be submitted only if information is complete

References

- http://en.wikipedia.org/wiki/Rich_Internet_Applications
- http://en.wikipedia.org/wiki/AJAX
- http://www.w3schools.com/ajax/
- http://www.w3.org/TR/XMLHttpRequest/