AJAX

ASYNCHRONOUS JAVASCRIPT AND XML

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DI TORINO

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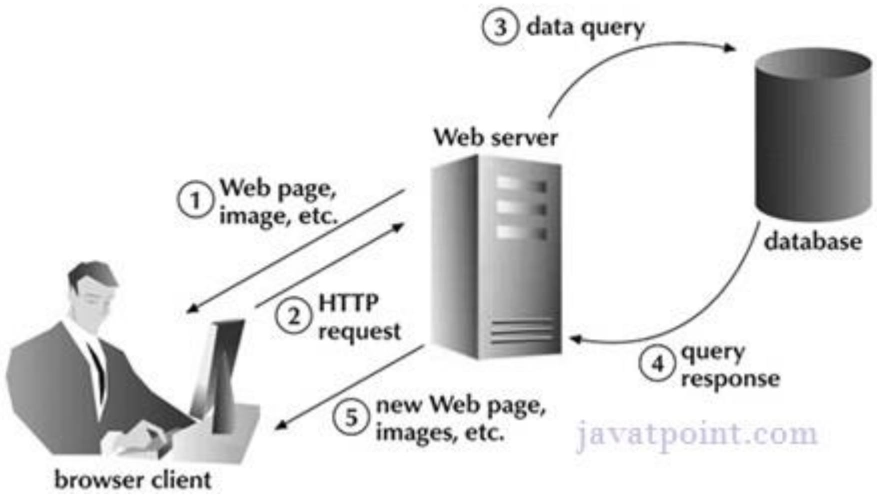
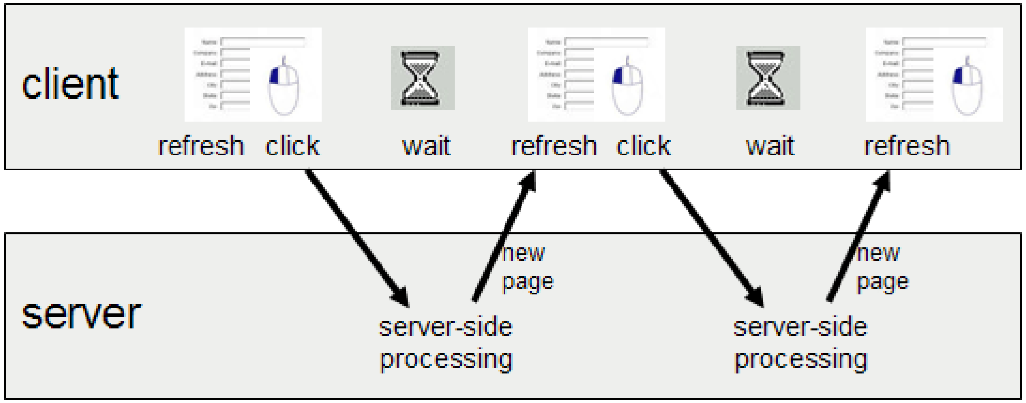
e-Lite

Rich-client asynchronous transactions

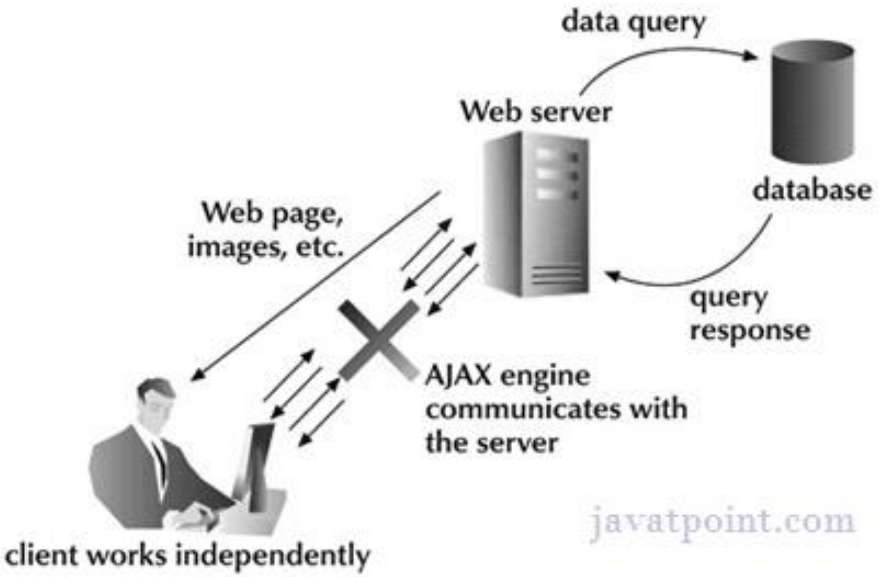
- In 2005, Jesse James Garrett wrote an online article titled “Ajax: A New Approach to Web Applications” (www.adaptivepath.com/ideas/essays/archives/000385.php)
- This article outlined a technique that he referred to as Ajax, short for Asynchronous JavaScript+XML, consisting in making server requests for additional data without unloading the web page, for a better user experience
- Garrett explained how this technique could be used to change the traditional click-and-wait paradigm that the Web had been stuck in since its start

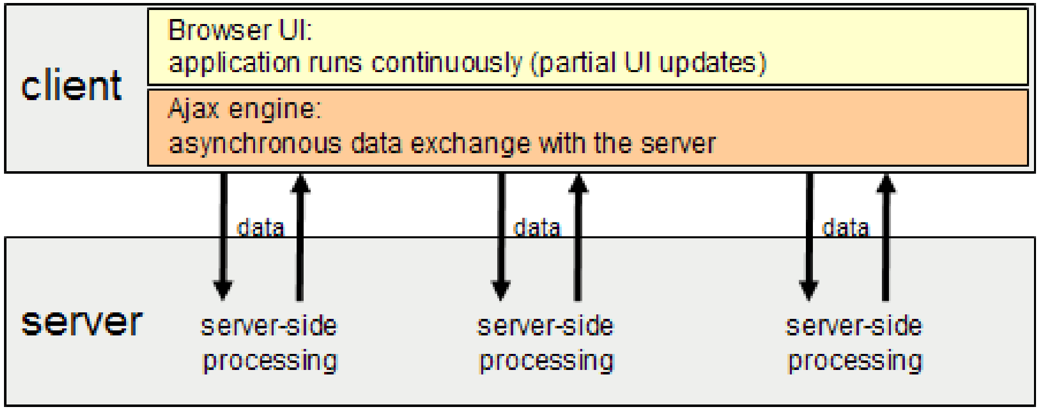
Synchronous (classic) web application model





Asynchronous web application model

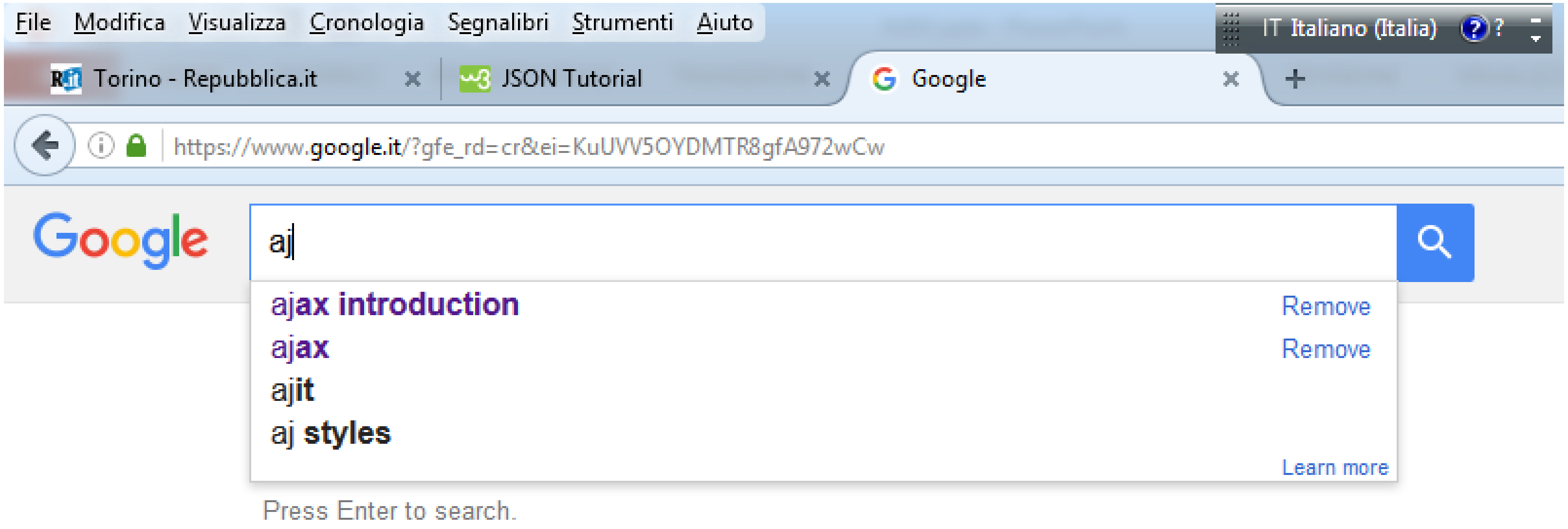




Browser UI:
application runs continuously (partial UI updates)

Ajax engine:
asynchronous data exchange with the server

Example



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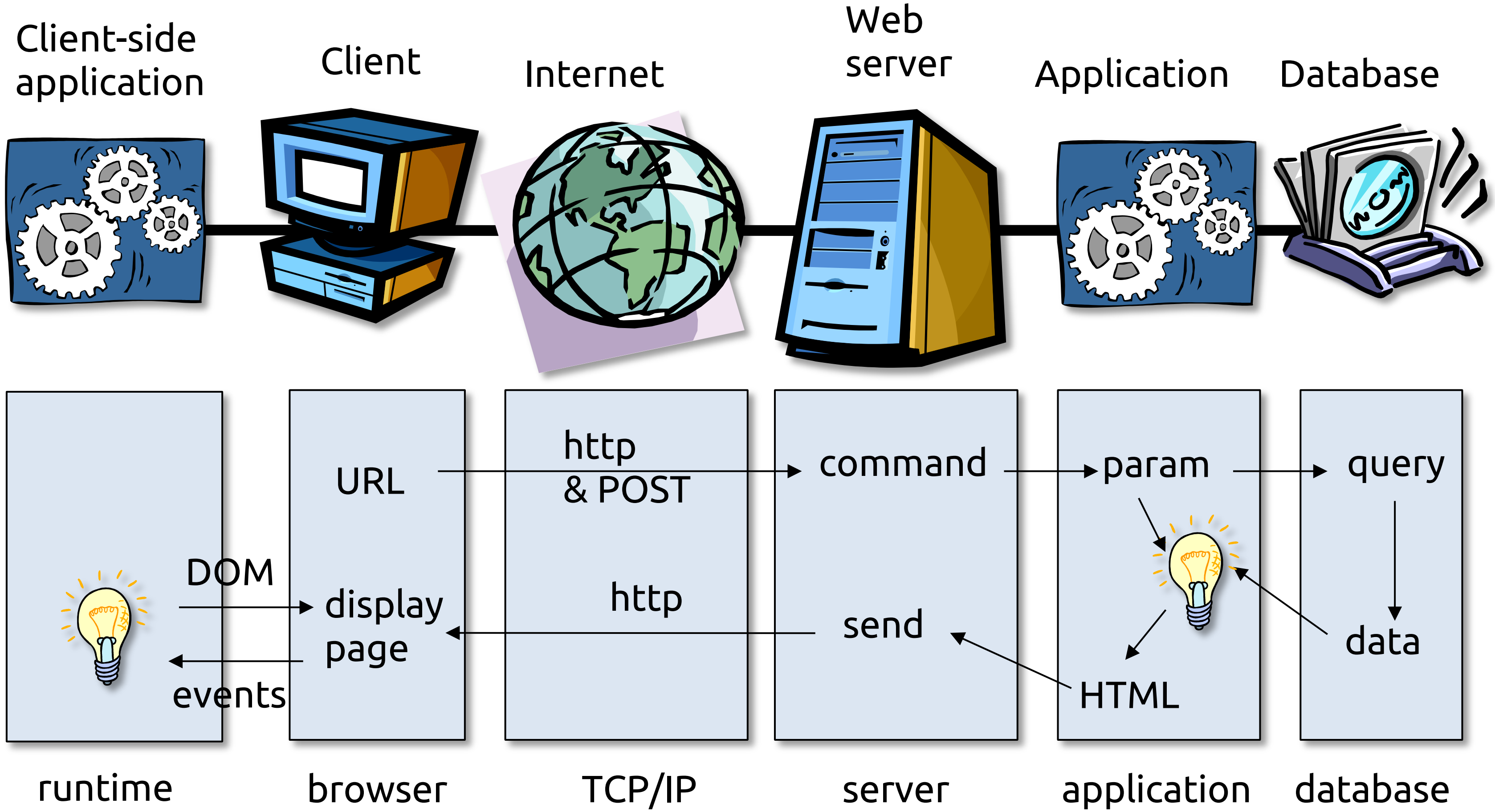
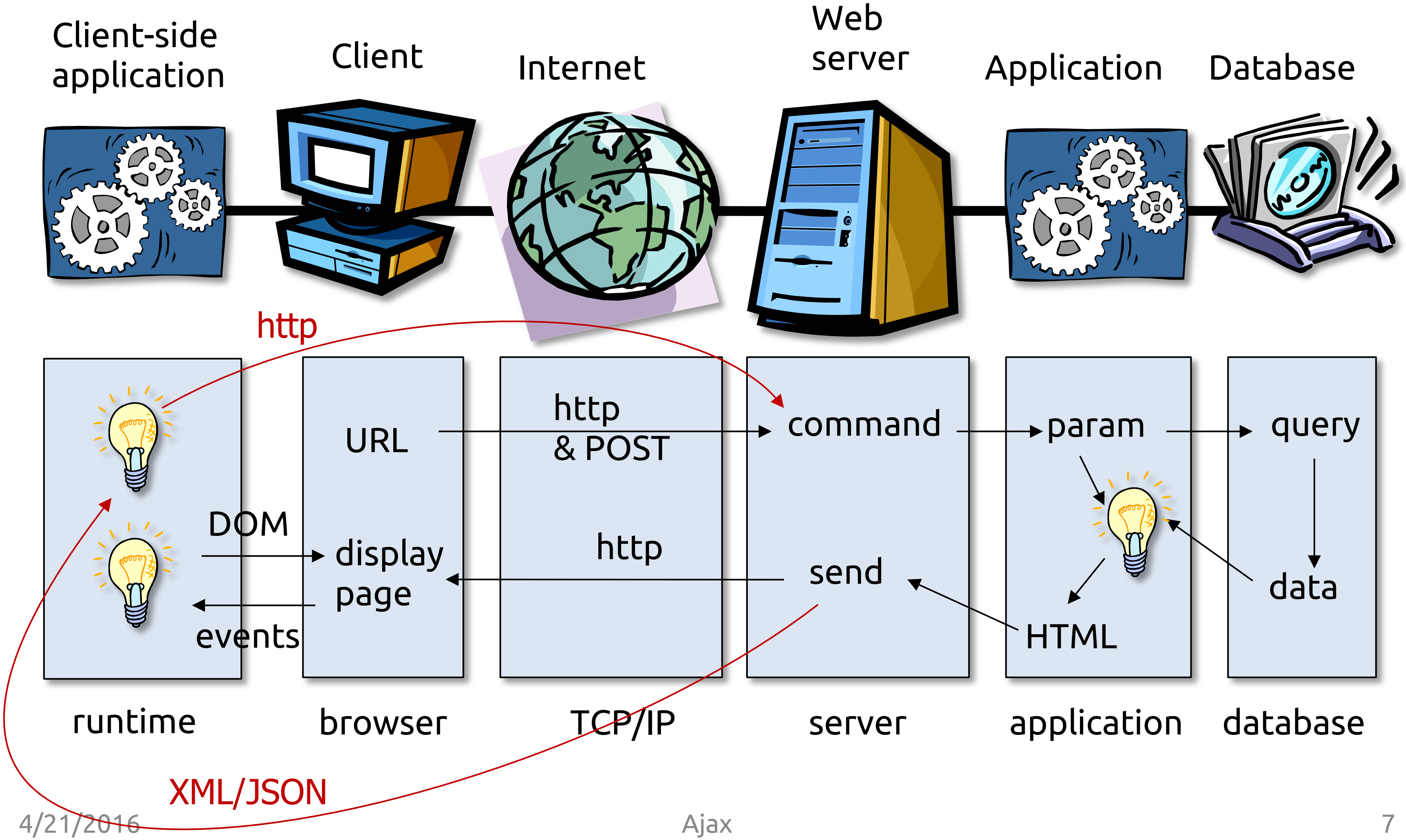
Rich-client transactions



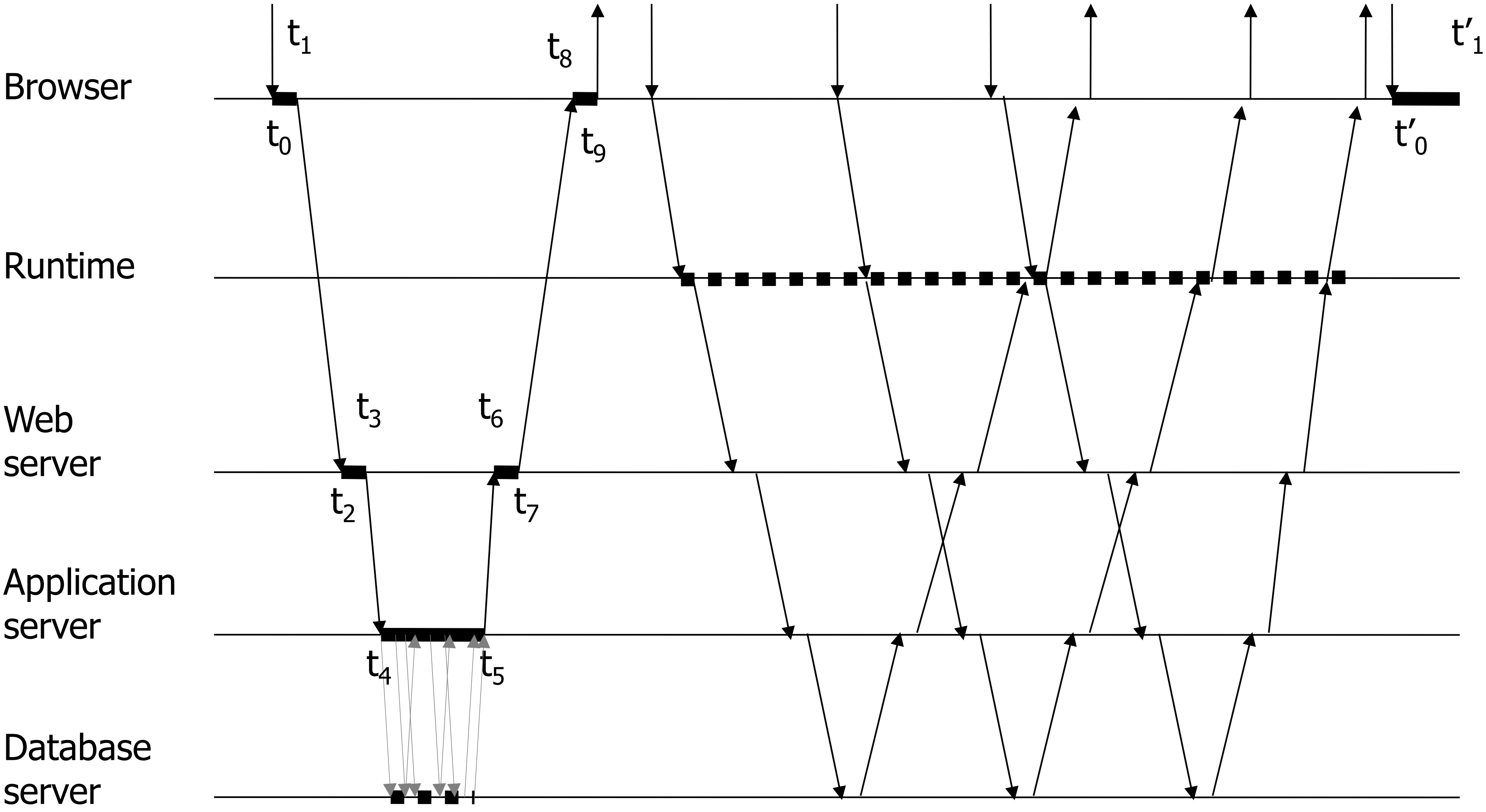
Rich-client asynchronous transactions



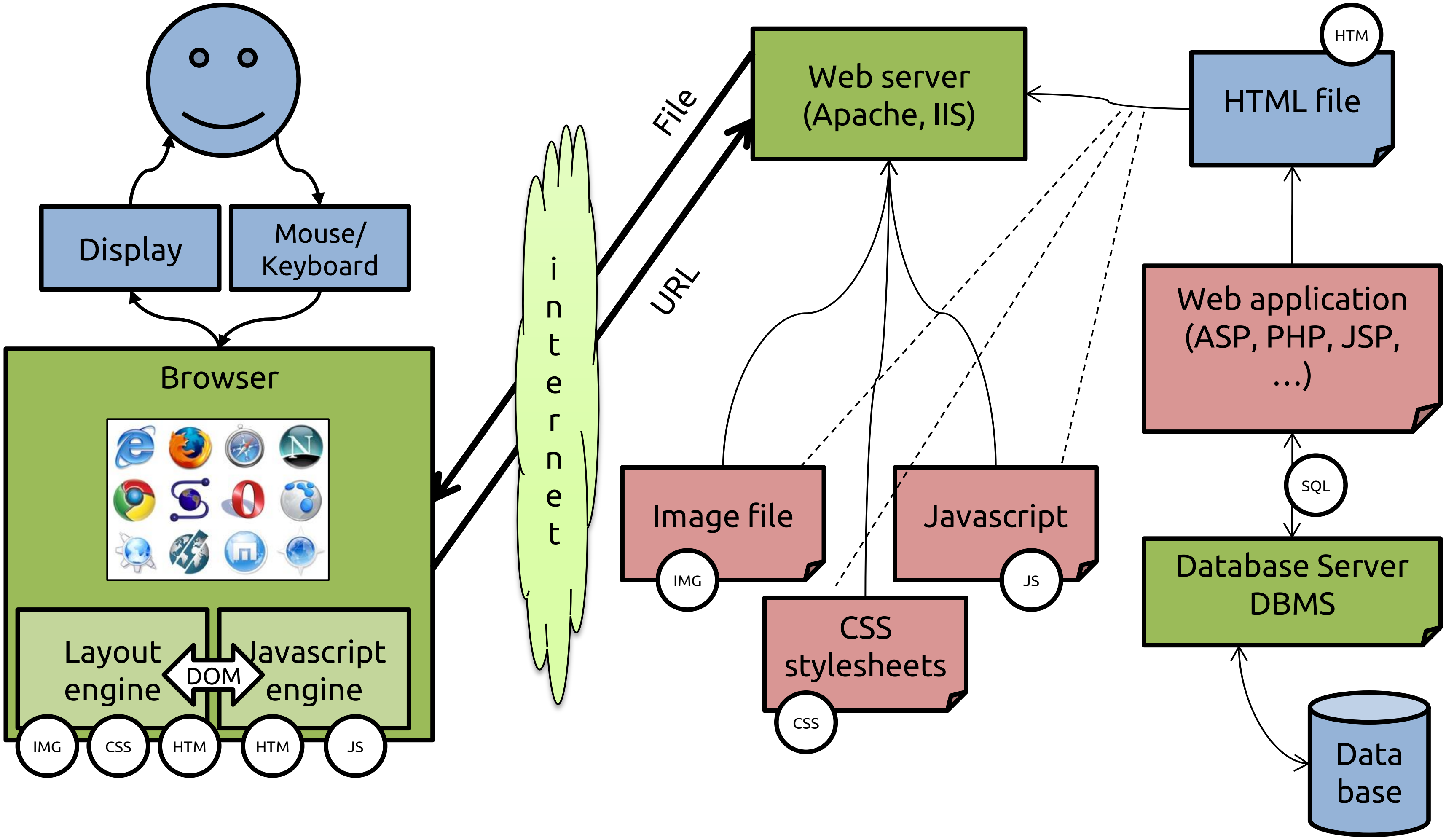
Adopted standards

- Dynamic HTML: DOM, Javascript, CSS
  - JavaScript
  - DOM (XHTML Document Object Model) to allow on-the fly modification of the web page
  - CSS 3 to modify attribute and handle objects
- AJAX: Asynchronous Javascript and XML
  - XMLHttpRequest for asynchronous communication to the server
  - Data transfer formats: JSON, XML, RDF, RSS, Atom, FOAF, ...
- Mash-up technology

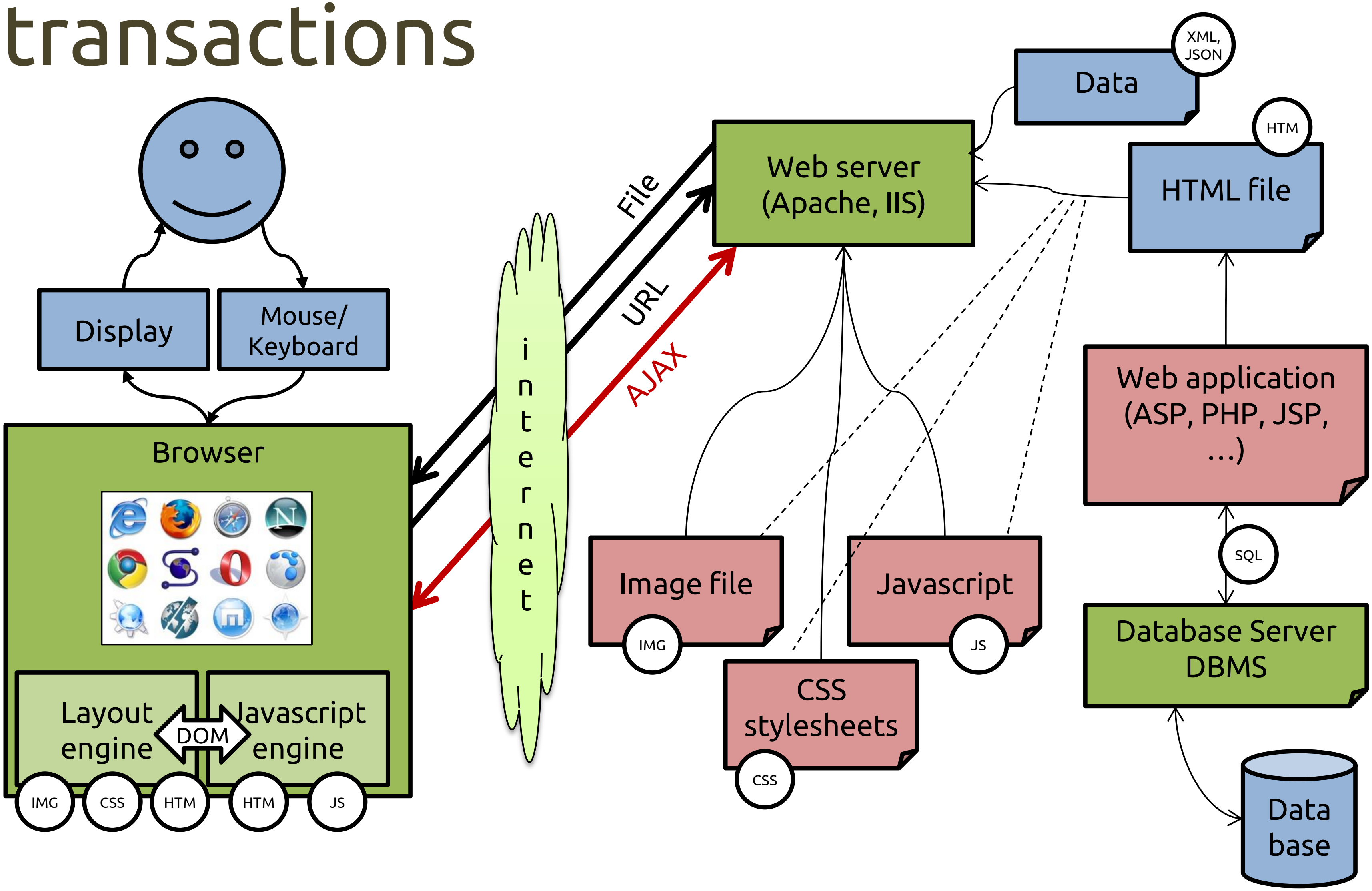
Rich-client transactions



Rich-client transactions



Rich-client asynchronous transactions



Asynchronous Javascript and XML

- AJAX is not a technology but group of inter-related technologies
- AJAX technologies include
  - HTML and CSS
  - DOM
  - JavaScript
  - XML or JSON (for carrying data to and from server)
  - XMLHttpRequest (for asynchronous communication between client and server)
- AJAX term coined in 2005 but
  - 1996: Iframe tag allows fetching content asynchronously
  - 1999: Microsoft introduced the XMLHTTP AcriveX in IE5, later adopted by all browsers as JS XMLHttpRequest obj
  - 2006: W3C draft specification of XMLHttpRequest
  - 2008: W3C draft on XMLHttpRequest 2 (now merged)

Other asynchronous tags

- How to load asynchronously (beside AJAX)?
- Asynchronous tags
  - <img> not really helpful for text data
  - Invisible <iframe>: inline frame, used to embed another document within the current HTML documen

```
<iframe src="demo_iframe.htm" width="200" height="200"></iframe>
```

  - <script> widely used
- Dynamic script tag injection
  - When the new <script> is added to the page, its “src” URL is automatically downloaded and executed.

```
var script = document.createElement("script");
script.setAttribute("src", url);
document.head.appendChild(script);
```

Data exchange formats: XML and JSON

- There was a time when XML was the de facto standard for transmitting structured data over the Internet
  - But XML is a verbose and redundant language
- JSON (JavaScript Object Notation) is a light-weight data format, not a programming language

XML

```
<siblings>
  <sibling>
    <firstName>Anna</firstName>
    <lastName>Clayton</lastName>
  </sibling>
 <sibling>
    <firstName>Alex</firstName>
    <lastName>Clayton</lastName>
  </sibling>
</siblings>
```

JSON

```
{ "employees":[
    {"firstName":"John", "lastName":"Doe"},
    {"firstName":"Anna", "lastName":"Smith"},
    {"firstName":"Peter", "lastName":"Jones"}
]}
```

JSON

- “JSON (JavaScript Object Notation) is a lightweight data-interchange format. It is easy for humans to read and write. It is easy for machines to parse and generate” – JSON.org
- Important: JSON is a subset of JavaScript
- JSON is built on two structures
  - A collection of name/value pairs: in various languages, this is realized as an object, record, struct, dictionary, hash table, keyed list, or associative array. { … }
  - An ordered list of values: in most languages, this is realized as an array, vector, list, or sequence. […]

JSON example

```
{
     "firstName": "John",
     "lastName": "Smith",
     "address": {
         "streetAddress": "21 2nd Street",
         "city": "New York",
         "state": "NY",
         "postalCode": 10021
     },
     "phoneNumbers": [
         "212 555-1234",
         "646 555-4567"
     ]
 }
```

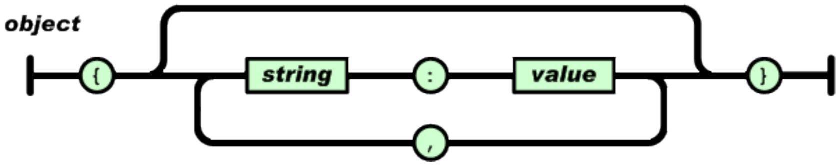
Name/Value Pairs

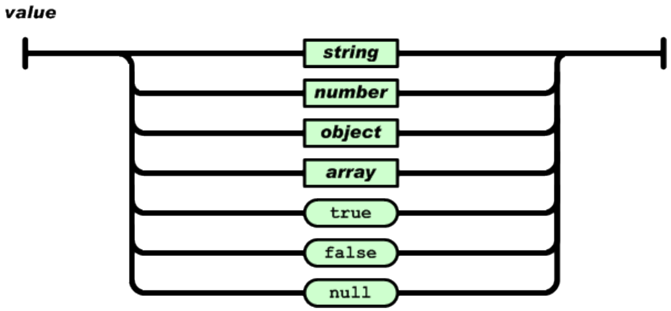
Child properties

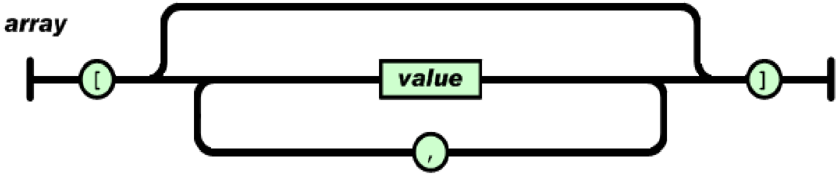
String Array

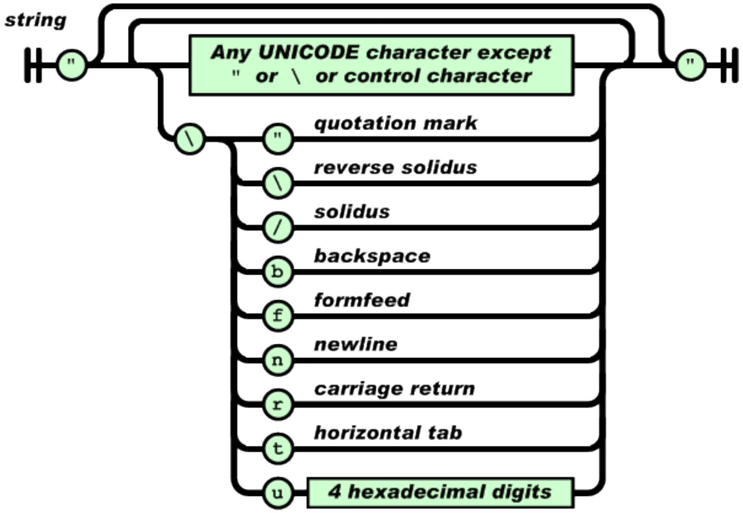
Number data type

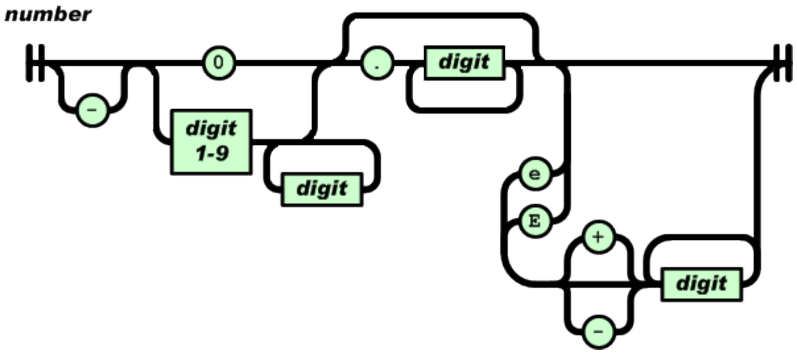
JSON data structures





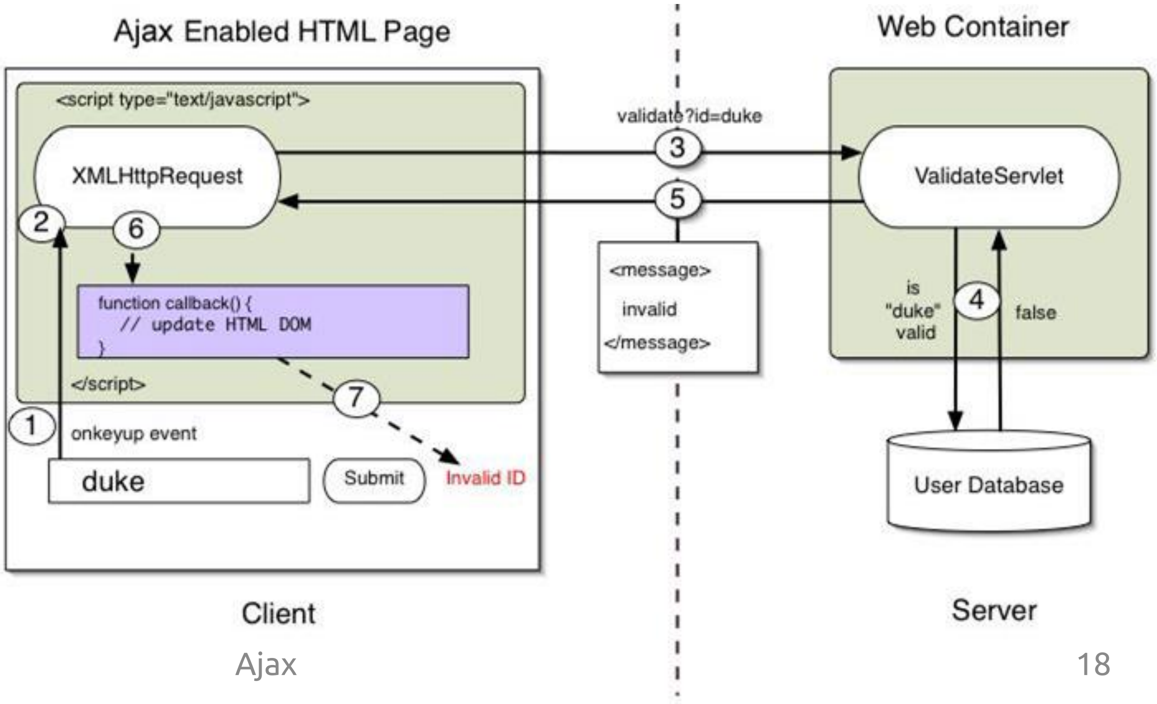






Asynchronous request/response

- What does asynchronous means?
  - The function (A) that sends the HTTP request returns before the response is received (does not wait)
  - Another function (B), the callback, is called when the browser gets the response
  - Attention: you must put the actions to do after the data is received after B, not after A



XMLHttpRequest (XHR) object

- Internet Explorer 5 was the first browser to introduce the XHR object
- Internet Explorer 7+, Firefox, Opera, Chrome, and Safari all support a native XHR object that can be created using the XMLHttpRequest constructor

```
var xhr = new XMLHttpRequest();
```

- To use an XHR object, the first step is to call the method open(), which accepts three arguments
  - The type of request to be sent (“get”, “post”, …)
  - The URL for the request
  - A Boolean value indicating if the request should be sent asynchronously
- Open() does not actually send the request, it simply prepares a request to be sent

```
// asynchronous GET request for example.php
xhr.open("get", "example.php", true);
```

XMLHttpRequest (XHR) object

- To send the specified request, you must call the send() method
  - The send() method accepts a single argument, which is data to be sent as the body of the request
  - If no body data needs to be sent, null is required
- Once send() is called, the request is dispatched to the server
- If the request is synchronous, the JavaScript code will wait for the response to return before continuing execution

```
xhr.open("get", "example.php", false);
xhr.send(null);
```

XMLHttpRequest (XHR) object

- When a response is received, the XHR object properties contain useful data
  - responseText: the text that was returned as the body of the response
  - responseXML: contains an XML DOM document with the response data if the response has a content type of “text/xml” or “application/xml”
  - status: the HTTP status of the response
  - statusText: the description of the HTTP status
- When a response is received, the first step is to check the status property to ensure that the response was returned successfully
  - Generally, HTTP status codes in the 200s are considered successful

```
if ((xhr.status >= 200 && xhr.status < 300) || xhr.status == 304){
  alert(xhr.responseText);
} else { alert(“Request was unsuccessful: “ + xhr.status); }
```

XMLHttpRequest (XHR) object

- Although it's possible to make synchronous requests, most of the time it's better to make asynchronous requests that allow JavaScript code execution to continue without waiting for the response
- The XHR object has a readyState property that indicates what phase of the request/response cycle is currently active
  - 0 — Uninitialized: e open() method hasn't been called yet
  - 1 — Open: the open() method has been called but send() has not been called
  - 2 — Sent: the send() method has been called but no response has been received
  - 3 — Receiving: some response data has been retrieved
  - 4 — Complete: all of the response data has been retrieved and is available

XMLHttpRequest (XHR) object

- Whenever the readyState changes from one value to another, the readystatechange event is fired
  - Opportunity to check the value of readyState with an onreadystatechange event handler

```
var xhr = createXHR();
xhr.onreadystatechange = function(){
  if (xhr.readyState == 4){
    if ((xhr.status >= 200 && xhr.status < 300) || xhr.status == 304){
      document.getElementById('span_result').innerHTML = xhr.responseText;
    } else {
      alert("Request was unsuccessful: " + xhr.status);
    }
  }
};
xhr.open("get", "example.txt", true);
xhr.send(null);
```

GET requests

- The most common type of request to execute is a GET, which is typically made when the server is being queried for some sort of information
  - If necessary, query-string arguments can be appended to the end of the URL to pass information to the server
  - For XHR, this query string must be present and encoded correctly on the URL that is passed into the open() method

```
xhr.open("get", "example.php?name1=value1&name2=value2", true);
```

POST requests

- The second most frequent type of request is POST, which is typically used to send data to the server that should save data
  - The body of a POST request can contain a very large amount of data, and that data can be in any format
- setRequestHeader(header, value): adds HTTP headers to the request
  - Content-Type indicates to the server the type of data (MIME type) you are sending in the request body
  - setRequestHeader('Content-Type', 'application/json') to send a JSON string to the server

```
xhr.open("post", "postexample.php", true);
xhr.setRequestHeader("Content-Type", "application/json");
```

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