3 FIB - Aplicacions i Serveis Web

[transpes] Unit 2: Web Technologies

Unit 2: Web Technologies

- Core techs
  - URIs
  - HTTP
- Server-Side techs
  - Java Servlets
- Restful Web Services

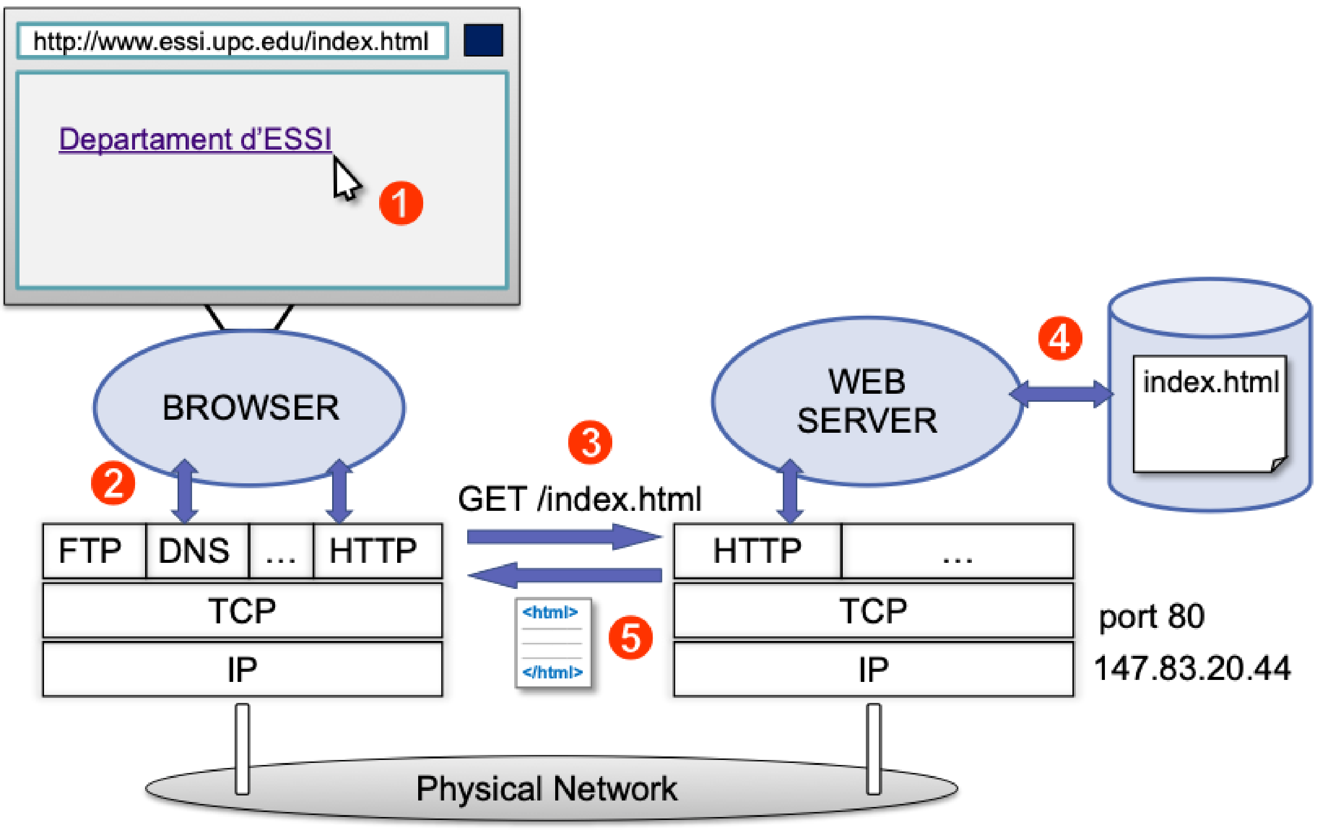
World Wide Web

*"The **World Wide Web** (known as "WWW', "Web" or "W3") is the universe of network-accessible information, the embodiment of human knowledge"*
W3C http://www.w3.org/WWW/

"Legend has it that every new technology is first used for something related to sex or pornography. That seems to be the way of humankind"
Tim Berners-Lee http://www.theguardian.com/technology/2005/aug/12/uknews.onlinesupplement

- The Web was created in 1989 by **Tim Berners-Lee** while working at the European Organization for Nuclear Research (CERN) in Geneva.
- The three initial basic components:
  - **HTML**: Markup language for formatting hypertext documents
  - **URI**: Uniform notation scheme for addressing accessible resources over the network
  - **HTTP**: Protocol for transporting messages over the network

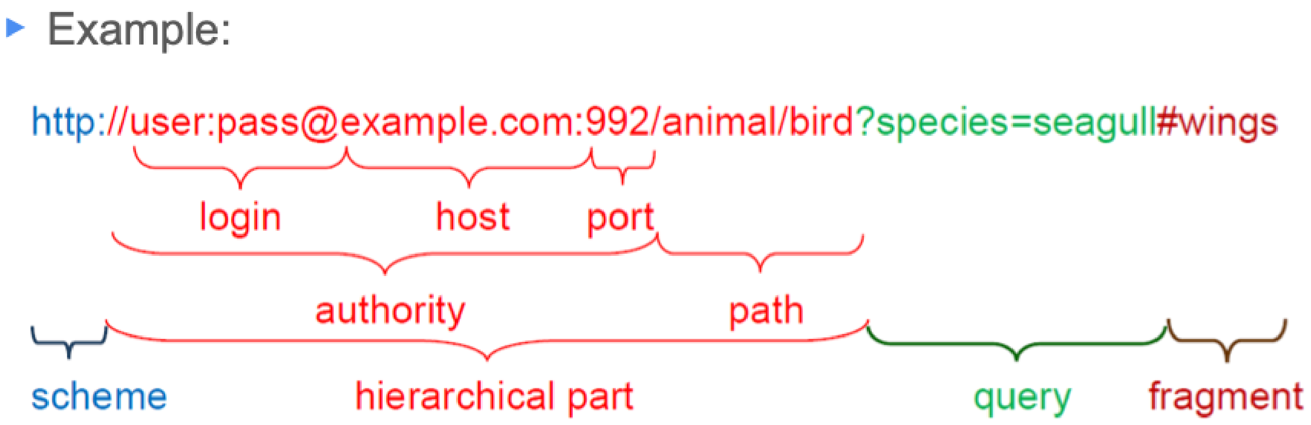
World Wide Web: Typical Interaction



Uniform Resource Identifier (URI)

- *"The Web is an information space. Human beings have a lot of mental machinery for manipulating, imagining, and finding their way in spaces. URIs are the points in that space"* (W3C)
- A URI is a compact sequence of characters that identifies an abstract or physical resource. Its generic syntax defines four parts:

  <scheme name> : <hierarchical part> [? <query>] [# <fragment>]

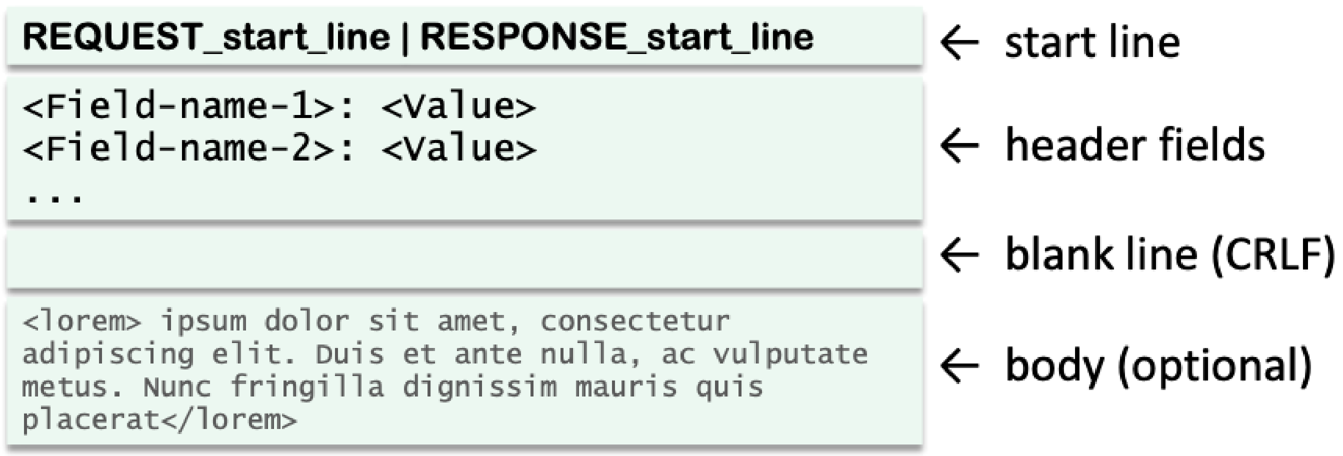


HyperText Transfer Protocol (HTTP)

- Request/response communication model
  - HTTP Request
  - HTTP Response
- Typical interaction (HTTP/1.0 or lower):
  - Web browser establishes a TCP/IP connection with the target Web server

    - Web browser sends a HTTP ASCII request over the TCP/IP connection.
    - Web server returns a HTTP MIME-like response and releases the TCP/IP connection
- HTTP/1.1 improvements:
    - Persistent connections: several request/response interactions in a single connection.
    - Request pipelining: multiple HTTP requests are sent without waiting for the corresponding responses.

HTTP Message Format



```
REQUEST_start_line | RESPONSE_start_line
<Field-name-1>: <Value>
<Field-name-2>: <Value>
...

<lorem> ipsum dolor sit amet, consectetur
adipiscing elit. Duis et ante nulla, ac vulputate
metus. Nunc fringilla dignissim mauris quis
placerat</lorem>
```

- Request and response messages have the same generic format

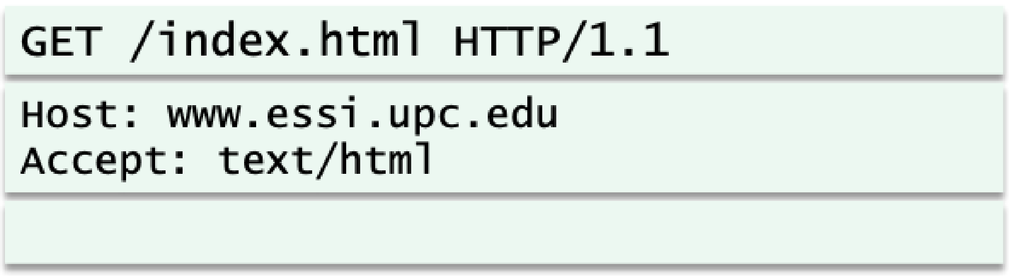
HTTP Request Message

REQUEST_start_line := METHOD <Resource_path> HTTP_Version

METHOD := GET | POST | HEAD | …

HTTP_Version := HTTP/1.0 | HTTP/1.1 | …

- Example:



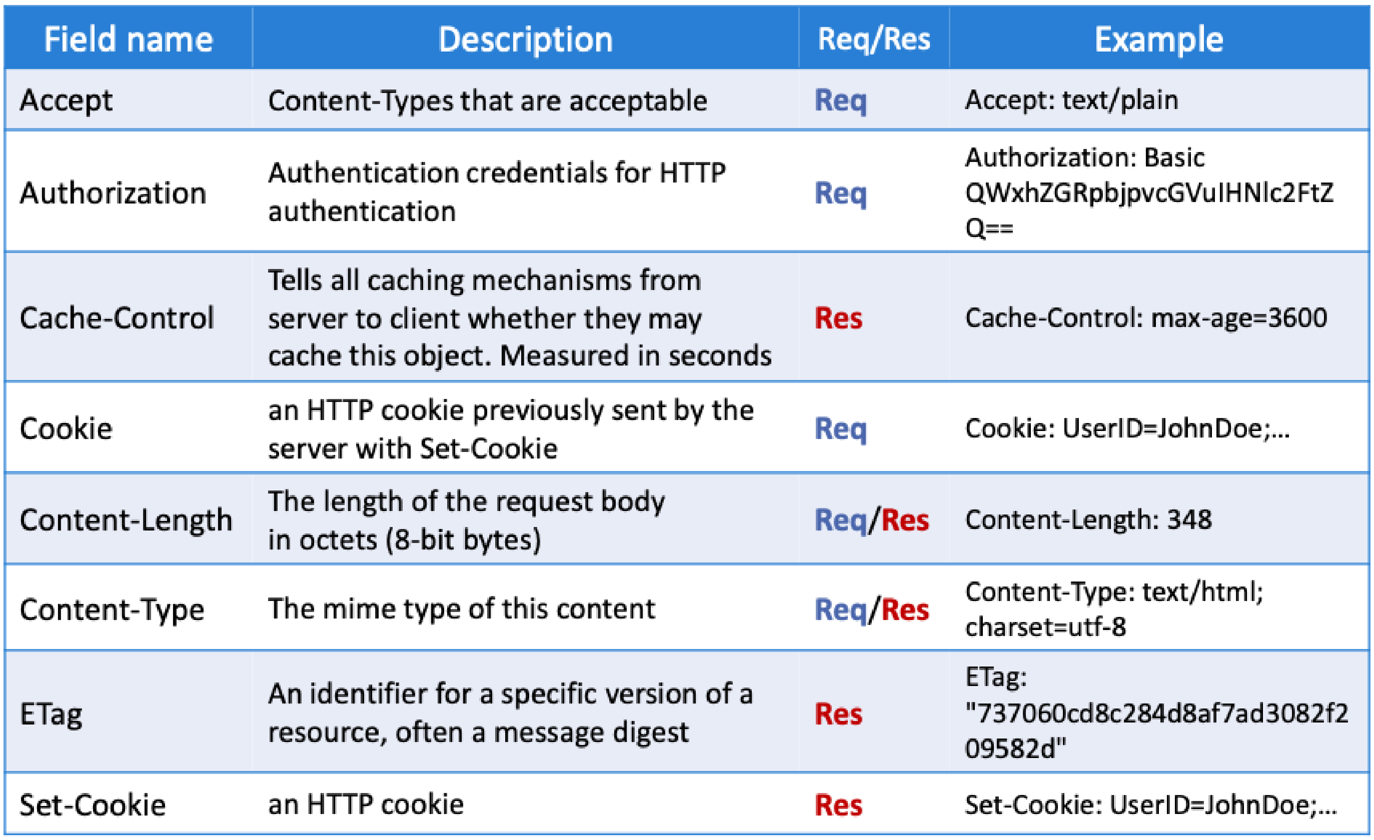
```
GET /index.html HTTP/1.1
Host: www.essi.upc.edu
Accept: text/html

```

HTTP Request Methods

GET	get a resource from the server
HEAD	get the header only (no response body)

POST	send data (usually in the request body) to the server
PUT	store request body on server
PATCH	pply partial modifications to a resource
TRACE	get the “final” request as it is received by the server (after it has potentially been modified by proxies)
OPTIONS	get a list of HTTP methods supported by the server
DELETE	delete a resource on the server

HTTP Header Fields in Req & Res



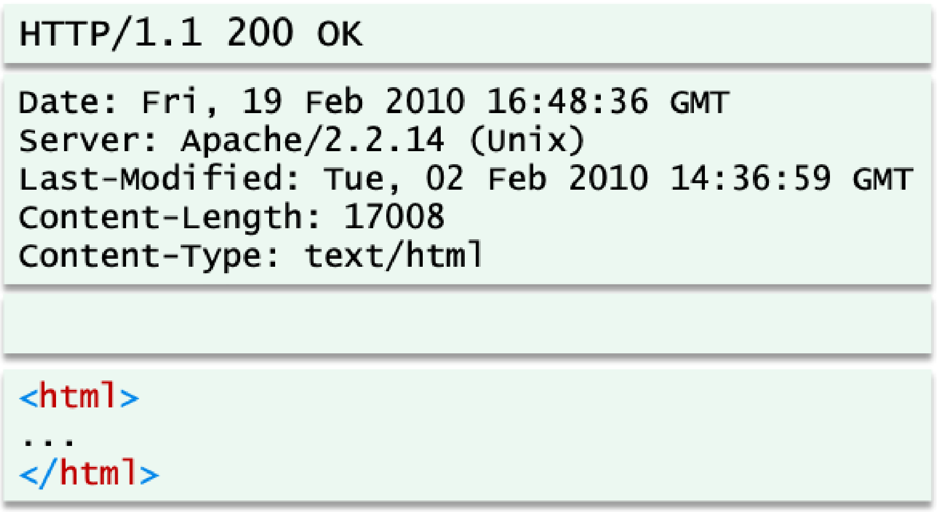
Field name	Description	Req/Res	Example
Accept	Content-Types that are acceptable	Req	Accept: text/plain
Authorization	Authentication credentials for HTTP authentication	Req	Authorization: Basic QWxhZGRpbjpvcGVuIHNlc2FtZQ==
Cache-Control	Tells all caching mechanisms from server to client whether they may cache this object. Measured in seconds	Res	Cache-Control: max-age=3600
Cookie	an HTTP cookie previously sent by the server with Set-Cookie	Req	Cookie: UserID=JohnDoe;...
Content-Length	The length of the request body in octets (8-bit bytes)	Req/Res	Content-Length: 348
Content-Type	The mime type of this content	Req/Res	Content-Type: text/html; charset=utf-8
ETag	An identifier for a specific version of a resource, often a message digest	Res	ETag: "737060cd8c284d8af7ad3082f209582d"
Set-Cookie	an HTTP cookie	Res	Set-Cookie: UserID=JohnDoe;...

HTTP Response Message

Response_start_line := HTTP_Version Status_Code [explanation]

Status_Code := 100 … 599

- Example:

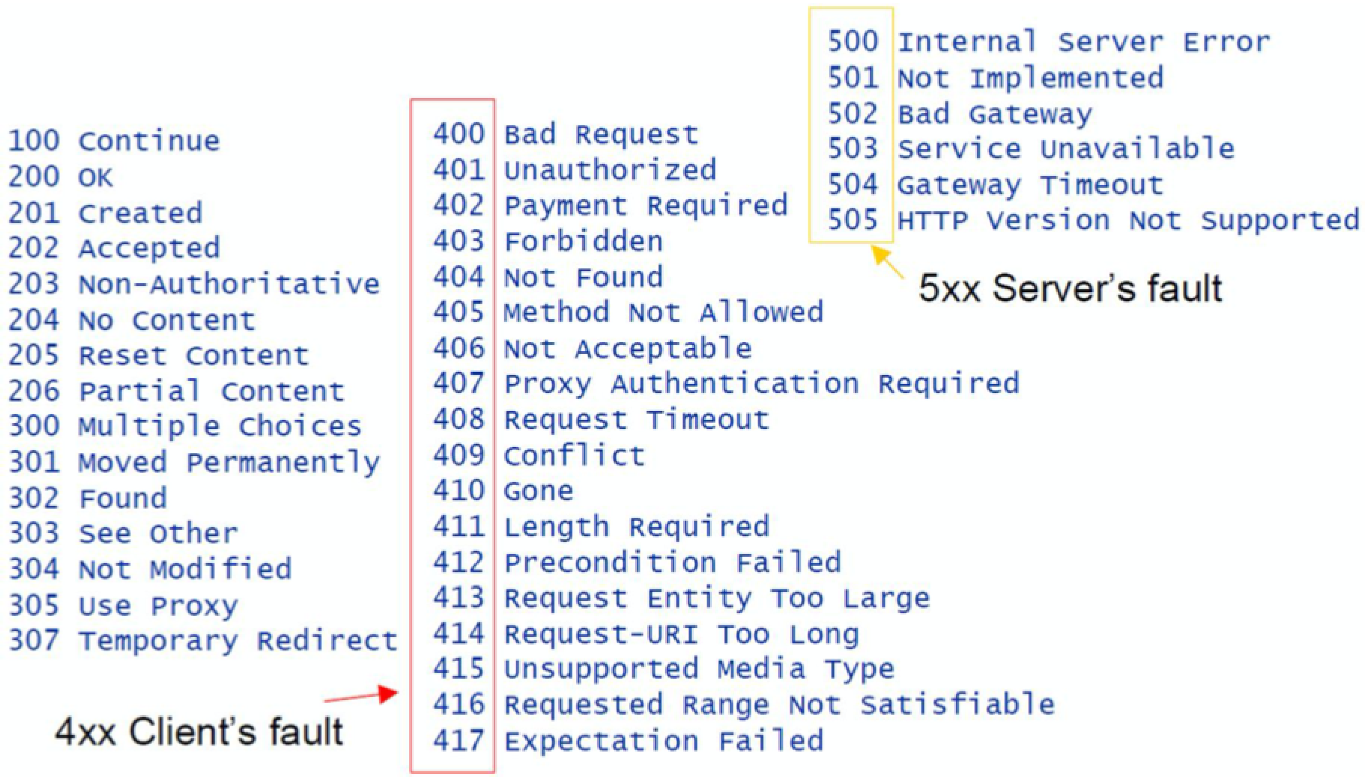


```
HTTP/1.1 200 OK
```

```
Date: Fri, 19 Feb 2010 16:48:36 GMT
Server: Apache/2.2.14 (Unix)
Last-Modified: Tue, 02 Feb 2010 14:36:59 GMT
Content-Length: 17008
Content-Type: text/html
```

```
<html>
...
</html>
```

HTTP Standard Status codes



100	Continue
200	OK
201	Created
202	Accepted
203	Non-Authoritative
204	No Content
205	Reset Content
206	Partial Content
300	Multiple Choices
301	Moved Permanently
302	Found
303	See Other
304	Not Modified
305	Use Proxy
307	Temporary Redirect

400	Bad Request
401	Unauthorized
402	Payment Required
403	Forbidden
404	Not Found
405	Method Not Allowed
406	Not Acceptable
407	Proxy Authentication Required
408	Request Timeout
409	Conflict
410	Gone
411	Length Required
412	Precondition Failed
413	Request Entity Too Large
414	Request-URI Too Long
415	Unsupported Media Type
416	Requested Range Not Satisfiable
417	Expectation Failed

500	Internal Server Error
501	Not Implemented
502	Bad Gateway
503	Service Unavailable
504	Gateway Timeout
505	HTTP Version Not Supported

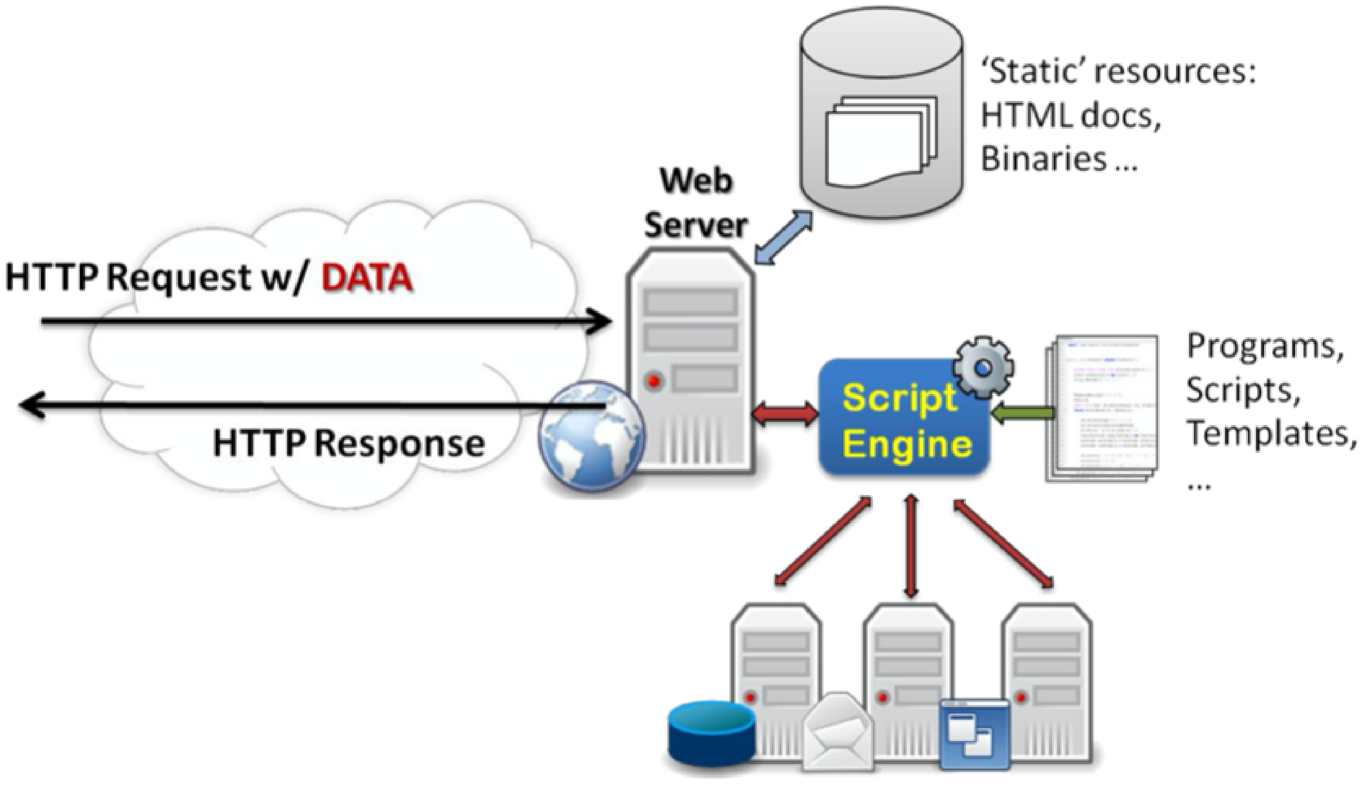
Multipurpose Internet Mail Extensions (MIME) Types

- The MIME type defines the request or response body's content and is used for the appropriate processing
- Not only for mail
- See "Accept" and "Content-type" header fields

- Some examples:

MIME type	Description
text/plain	Raw textual data
text/html	HTML document
text/xml	XML document
application/javascript	Javascript
application/soap+xml	SOAP message
application/json	JSON data
multipart/form-data	HTML Form fields

Server-side computing


'Static' resources: HTML docs, Binaries ...
Web Server
HTTP Request w/ DATA
HTTP Response
Script Engine
Programs, Scripts, Templates, ...

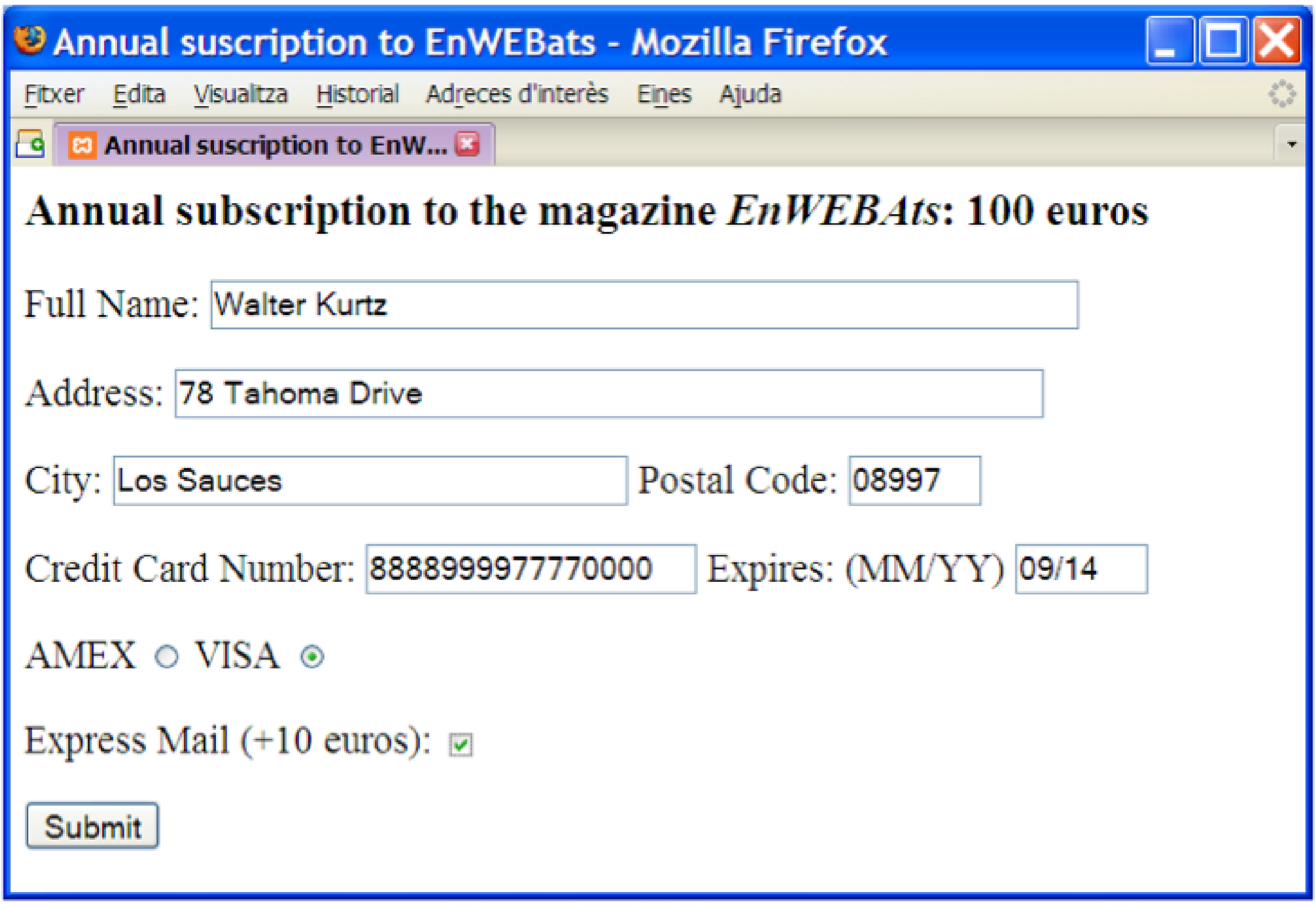
Passing data through HTTP requests

- Query string pairs key=value
  - `GET /directory.php?userid=3439`
- Path attributes:
  - `DELETE /users/3439`
- HTTP Request Body (POST & PUT)
  - `POST /asw01ss/wot HTTP/1.1`
  - `Content-type:application/x-www-form-urlencoded`
  - `author=Menganito&tweet_text=Text+de+prova`

- HTTP Headers: Standard and Custom
- Cookies

"EnWEBats" Example

The Web Form


Annual suscription to EnWEBats - Mozilla Firefox
Fitxer Edita Visualitza Historial Adreces d'interès Eines Ajuda
Annual suscription to EnW...
Submit

Annual subscription to the magazine *EnWEBAts*: 100 euros

Full Name: Walter Kurtz

Address: 78 Tahoma Drive

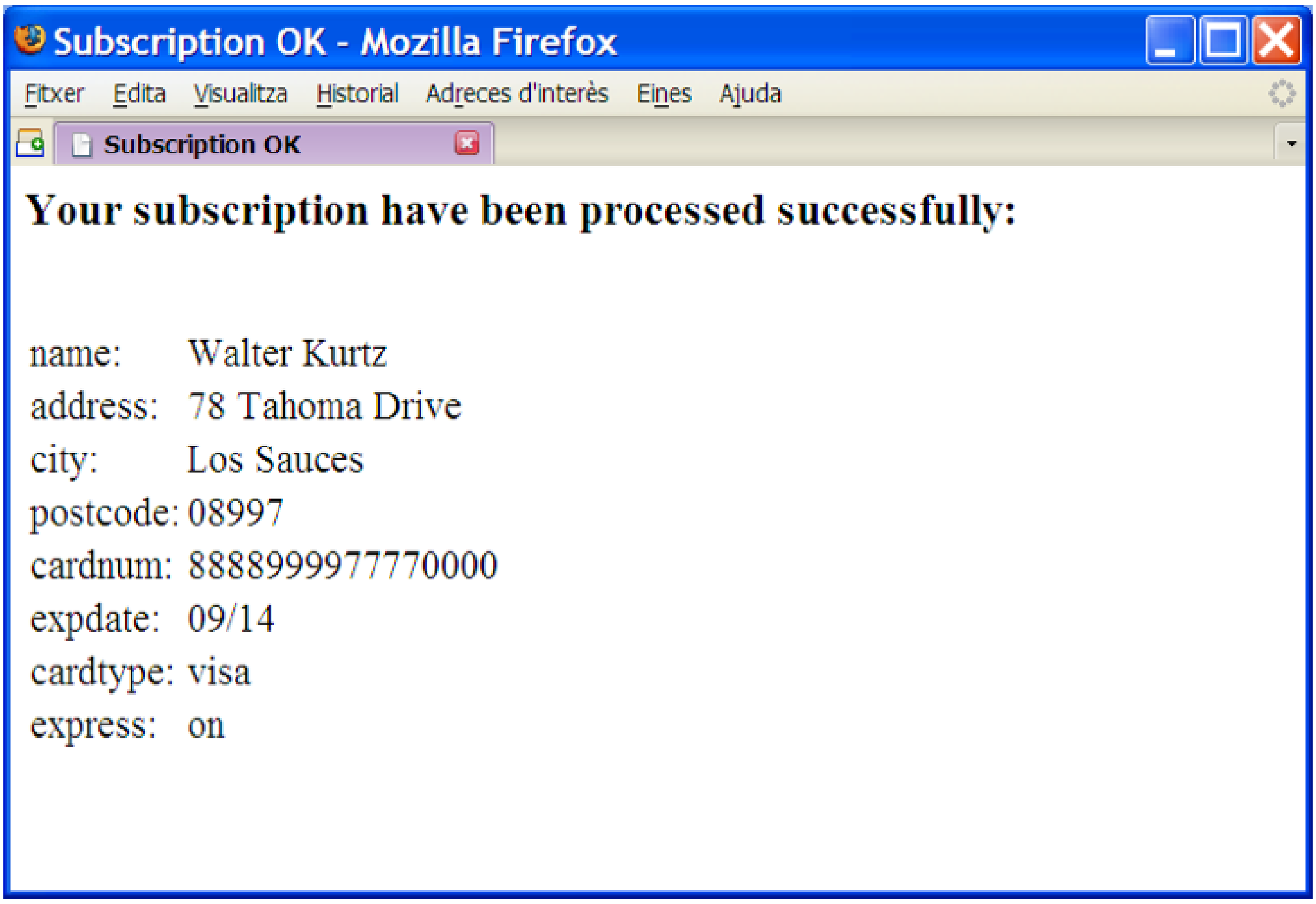
City: Los Sauces Postal Code: 08997

Credit Card Number: 8888999977770000 Expires: (MM/YY) 09/14

AMEX ○ [✓ VISA]

Express Mail (+10 euros): ✓

The Output



Your subscription have been processed successfully:

```
name:     Walter Kurtz
address:  78 Tahoma Drive
city:     Los Sauces
postcode: 08997
cardnum:  8888999977770000
expdate:  09/14
cardtype: visa
express:  on
```

enwebats.html

```html
<html>
....
<form action="subscribe" method="post">
Full Name: <input name="name" size="57">
Address: <input name="address" size="57">
City: <input name="city" size="32">
Postal Code: <input name="postcode" size="5">
Credit Card Number: <input name="cardnum" size="19">
Expires: (MM/YY) <input name="expdate" size="5">
AMEX <input name="cardtype" value="amex" type="radio">
  VISA <input name="cardtype" value="visa" type="radio">
Express Mail (+10 euros): <input name="express"
  type="checkbox">
<input value="Submit" type="submit"> </p> </form>
....
</html>
```

HTTP Request

```
POST /subscribe HTTP/1.1
```

```
Host: www.enwebats.com
Content-type: application/x-www-form-urlencoded
```

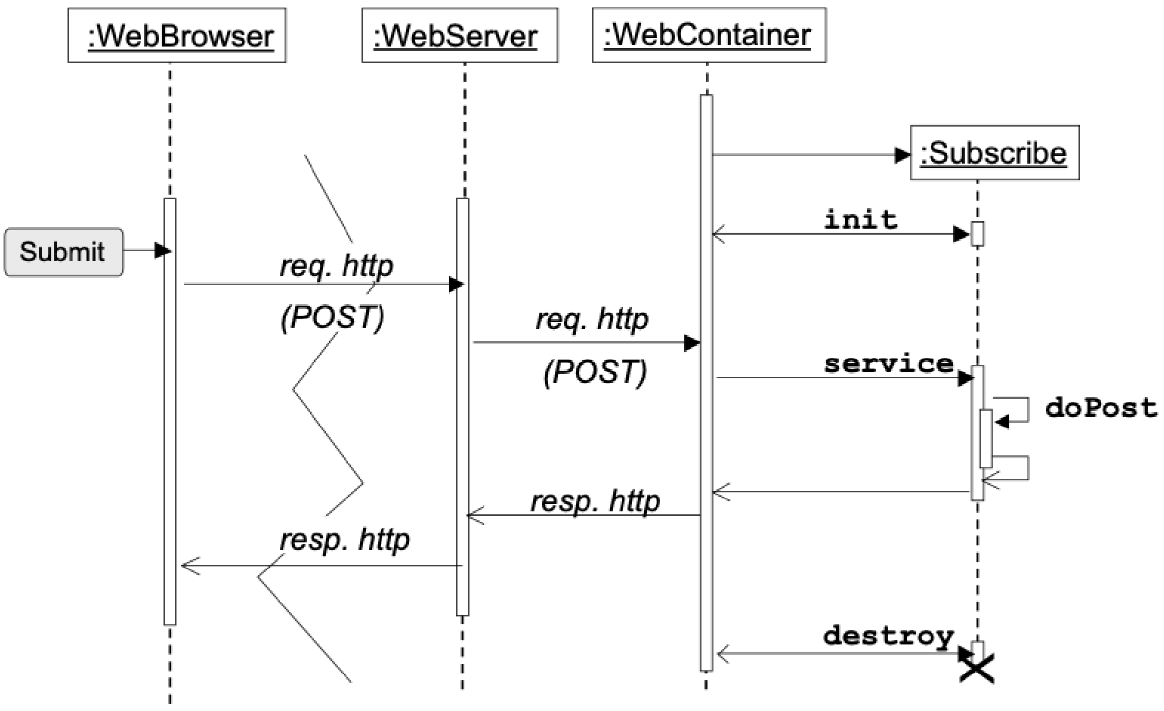
```

```

```
name=Walter+Kurtz&address=78+Tahoma+Drive&
city=Los+Sauces&postcode=08997&cardnum=88889
99977770000&expdate=09%2F14&cardtype=visa&expre
ss=on
```

Subscribe.java

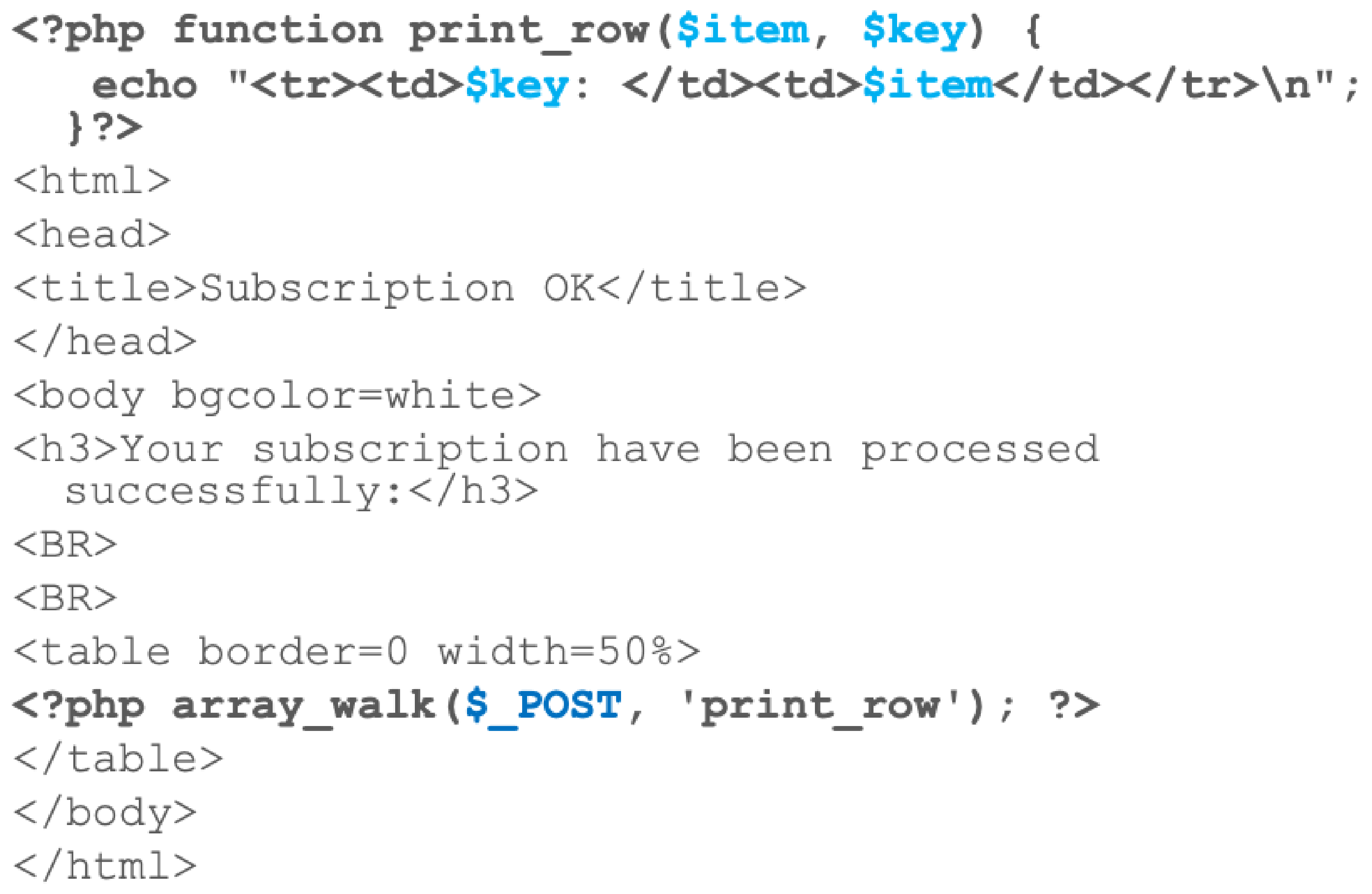
```
@WebServlet("/subscribe")
public class Subscribe extends HttpServlet {
    public void doPost(javax.servlet.http.HttpServletRequest req,
                                        javax.servlet.http.HttpServletResponse res)
                    throws ServletException, IOException {
    res.setContentType("text/html");
    PrintWriter output = res.getWriter();
    output.println("<html>");
    output.println("<title>Subscription OK</title>");
    output.println("<body bgcolor=white>");
    output.println("<h3>Your subscription have been processed
    successfully:</h3>");
    output.println("<table border=0>");
    Enumeration paramNames = req.getParameterNames();
    while (paramNames.hasMoreElements()) {
            String name = (String) paramNames.nextElement();
            String value = req.getParameter(name);
            output.println("<tr><td>"+name+": </td><td>"+value+"</td></tr>"); }
    output.println("</table></body></html>");
    output.close(); }}
```

Java Servlets: Request Scenario



- A Servlet is an object that receives a request and generates a response based on that request.
- A Web container is essentially the component of a Web server that interacts with the servlets. The Web container is responsible for
  - Managing the lifecycle of servlets.
  - Mapping a URI to a particular servlet.
  - Ensuring that the URI requester has the correct access rights.

subscribe.php

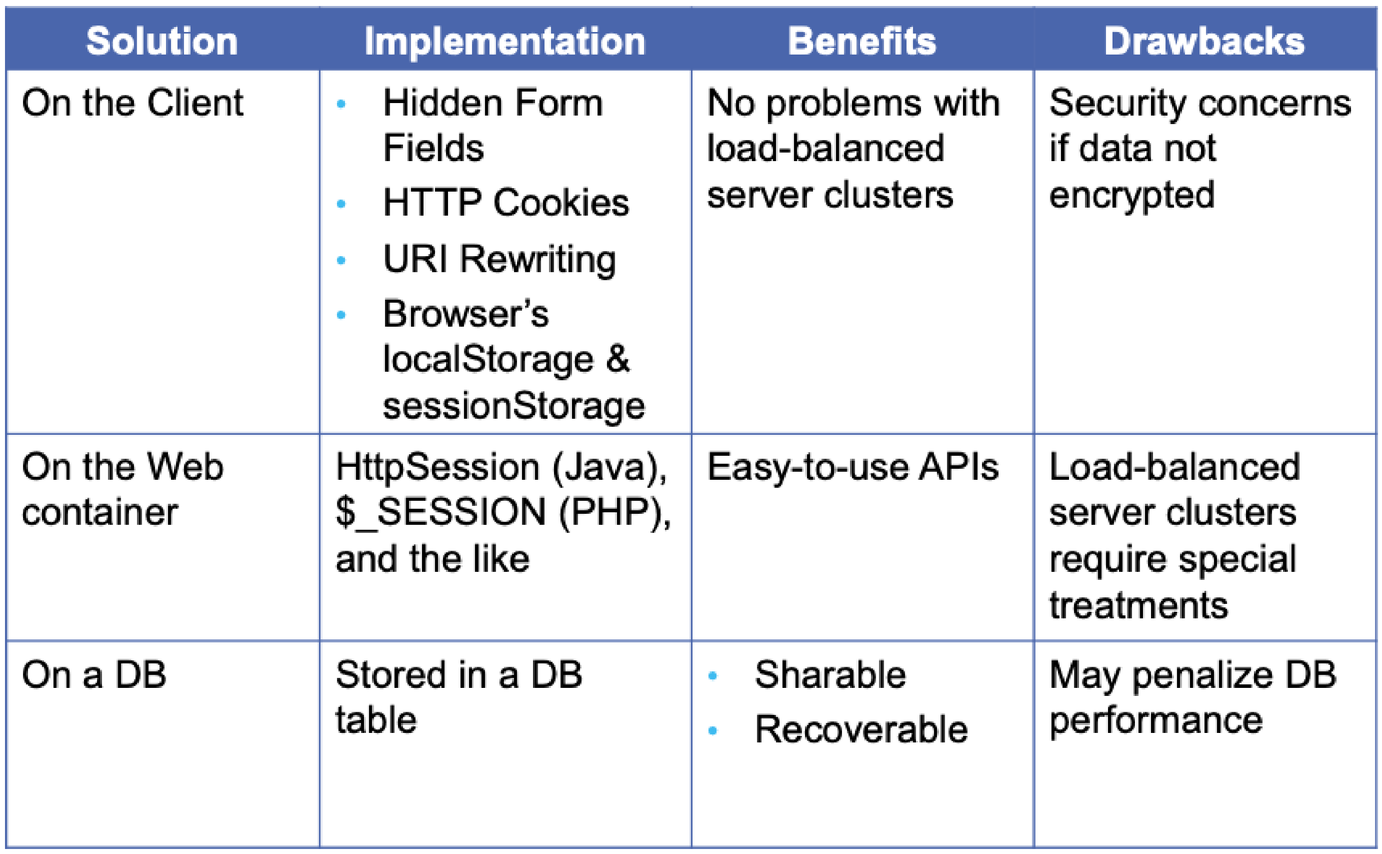


```
<?php function print_row($item, $key) {
    echo "<tr><td>$key: </td><td>$item</td></tr>\n";
  }?>
<html>
<head>
<title>Subscription OK</title>
</head>
<body bgcolor=white>
<h3>Your subscription have been processed
  successfully:</h3>
<BR>
<BR>
<table border=0 width=50%>
<?php array_walk($_POST, 'print_row'); ?>
</table>
</body>
</html>
```

HTTP: Two Important Remarks

- HTTP is stateless:
  - The Web Server handles each HTTP request independently and there is no easy way to keep track of each client request and to associate it with a previous one.
  - However, managing state is important for many applications: a single use case scenario often involves navigating through a number of Web pages. Without a state management mechanism, you would have to continually supply all previous information entered for each new Web page.
- HTTP is one-way:
  - Clearly separated roles: Clients -Web browsers- make requests to -Web- Servers, no vice versa.
  - HTTP 2.0 now supports push notifications.

Session State Management in Web Apps



Solution	Implementation	Benefits	Drawbacks
On the Client	• Hidden Form Fields • HTTP Cookies • URI Rewriting • Browser's localStorage & sessionStorage	No problems with load-balanced server clusters	Security concerns if data not encrypted
On the Web container	HttpSession (Java), $_SESSION (PHP), and the like	Easy-to-use APIs	Load-balanced server clusters require special treatments
On a DB	Stored in a DB table	• Sharable • Recoverable	May penalize DB performance

RESTful Web Services

- RESTFul Web Services expose their data and functionality trough resources identified by URI
- Uniform Interface Principle: Clients interact with resources through a fix set of verbs.
  - Example HTTP:
    - `POST (create) | GET (read) | PUT (update) | DELETE`
- Multiple representations (MIME types) for the same resource: XML, JSON, ...
- Hyperlinks model resource relationships and valid state transitions for dynamic protocol description and discovery

RESTful WS: URI Design Guidelines

- Two URI patterns per resource:
  - Collection: `/products` (plural noun)
  - Element: `/product/:id` (e.g. `/product/41714`)
- Filters:
  - `/products?made_in=Italy&state=in_stock`
- Versioning:
  - `/v1/products`
- Positioning:
  - `/products?limit=25&offset=50`
- Non-resources (e.g. calculate, convert, ...):
  - `/convert?from=EUR&to=CNY&amount=100` (**verbs**, not nouns)

RESTful WS: Example (adapted from Wikipedia)

Resource	GET	PUT	POST	DELETE
http://www.x.com/api/products	List the members (URIs and perhaps other details) of the collection. For example list all the products.	~~Replace the entire collection with another collection.~~	Create a new entry in the collection. The new entry's ID is assigned automatically and is usually returned by the operation.	~~Delete the entire collection.~~
http://www.x.com/api/products/41714	Retrieve a representation of the addressed member of the collection, expressed in an appropriate Internet media type.	Update the addressed member of the collection, or if it doesn't exist,create it.	~~Treat the addressed member as a collection in its own right and create a new entry in it.~~	Delete the addressed member of the collection.