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INFO90002

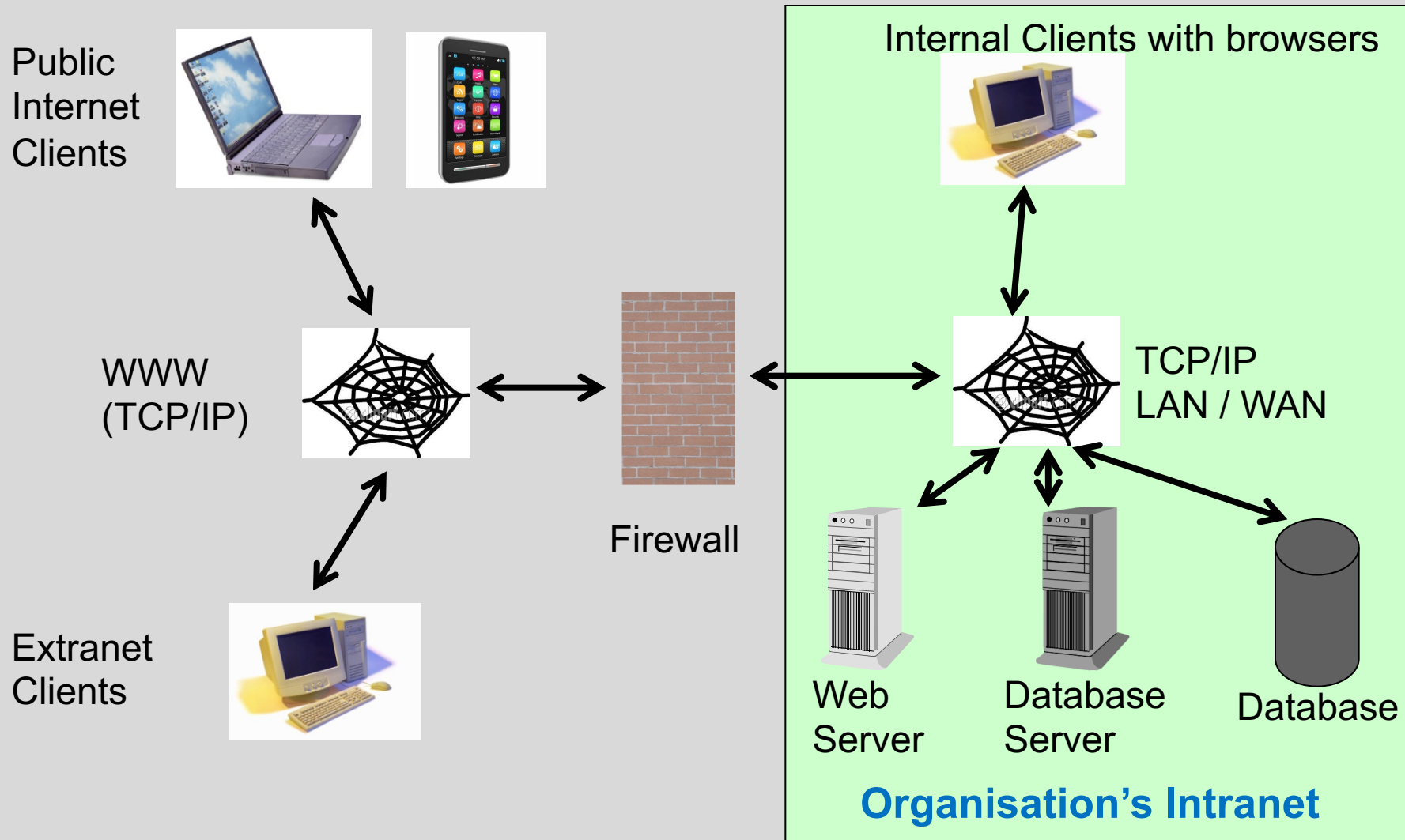
Database Systems & Information Modelling

Lecture 18
Web Applications and Databases

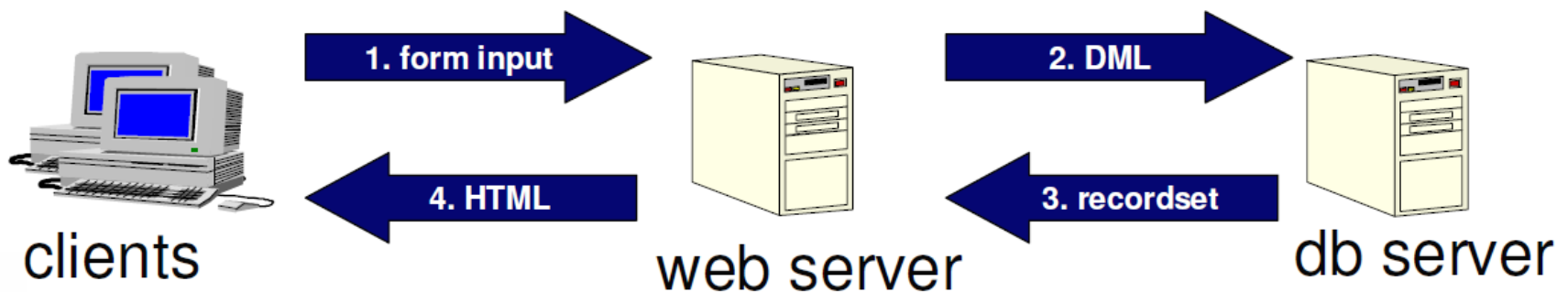
- Why web apps?
- How web apps work
- Making an HTML document
- Connecting to the DB
- Demo web app
- Web services



Architecture of a web app



- Web browsers are ubiquitous
- No need to install client software for external customers
- Simple communication protocols
- Platform and Operating System independent ("interoperable")
- Reduction in development time and cost
- Has enabled eGov, eBusiness, eCommerce, B2B, B2C



- Browser
 - Software that retrieves and displays HTML documents
- Web Server
 - Software that responds to requests from browsers by transmitting HTML and other documents to browsers
- Web pages (HTML documents)
 - Static web pages
 - content established at development time
 - Dynamic web pages
 - content dynamically generated using data from database
- World Wide Web (WWW)
 - The total set of interlinked hypertext documents residing on Web servers worldwide
- Internet
 - Global network infrastructure that hosts the WWW

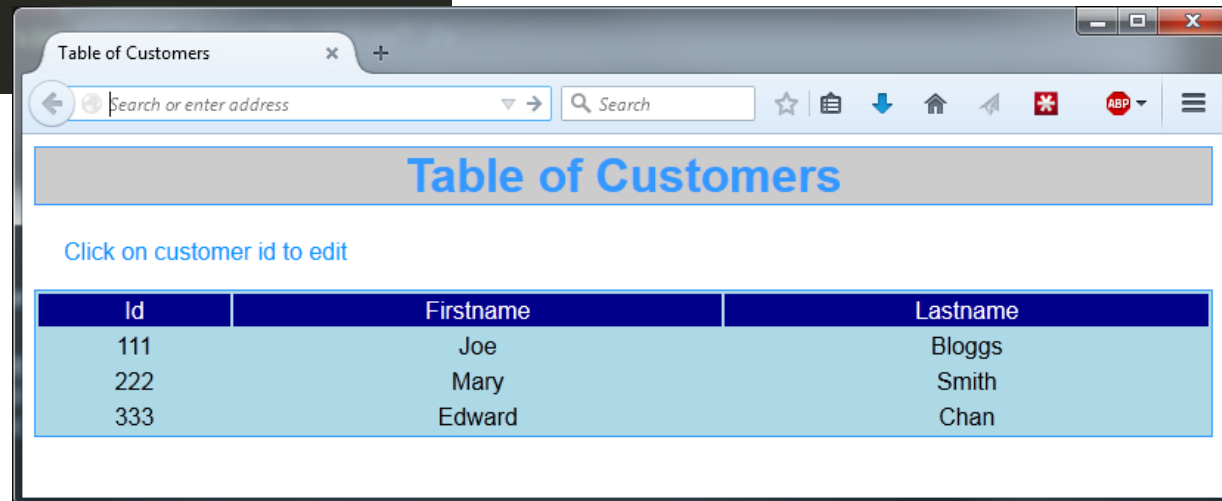
- Hypertext Markup Language (HTML)
 - Markup language used to define a web page
- Cascading Style Sheets (CSS)
 - Control appearance of an HTML document
- JavaScript (JS)
 - Scripting language that enable interactivity in HTML documents
- Extensible Markup Language (XML)
 - Markup language used to transport data between web services

For more info www.w3schools.com (but after you've finished EXAMS and NOT before!)

Web page = HTML document

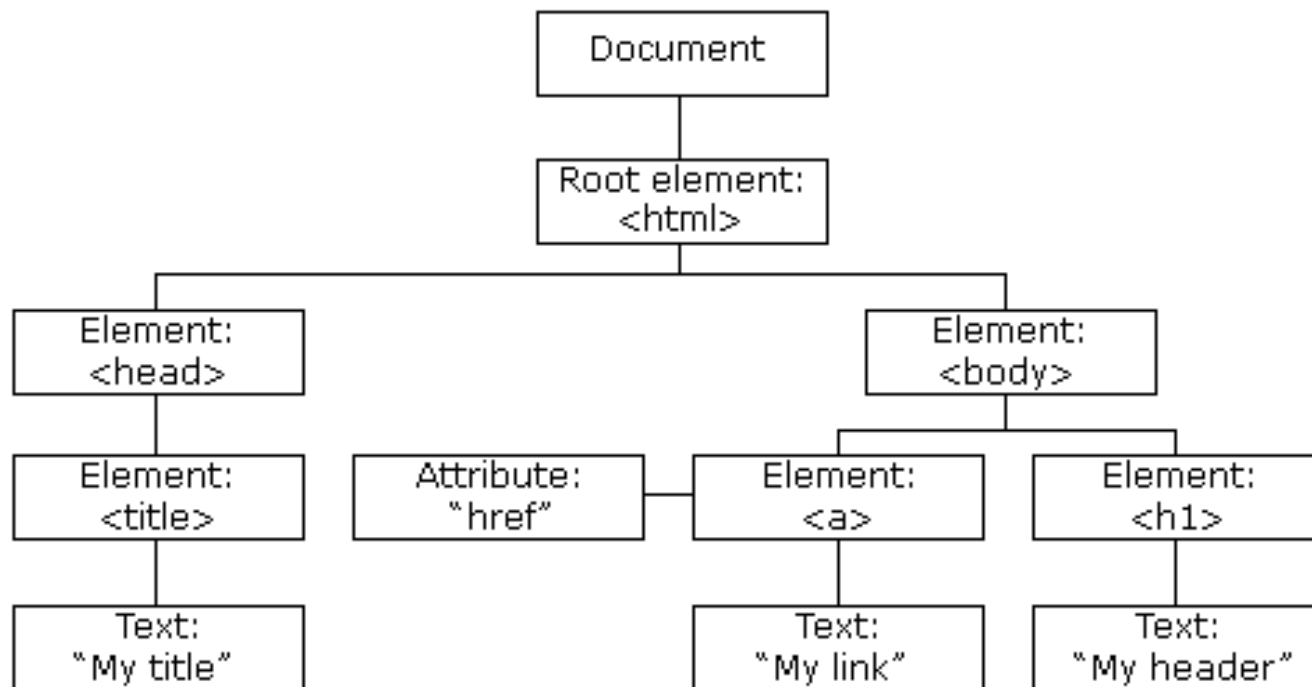
- a structured file of elements defined by HTML tags
- interpreted by web browser for display

```
1 <head>
2   <title>Table of Customers</title>
3   <link rel="stylesheet" href="simple.css" type="text/css" />
4 </head>
5
6 <body>
7   <h1>Table of Customers</h1>
8   <p>Click on customer id to edit</p>
9   <table>
10    <thead>
11      <tr><td>Id<td>Firstname<td>Lastname</tr>
12    </thead>
13    <tr><td>111<td>Joe<td>Bloggs</tr>
14    <tr><td>222<td>Mary<td>Smith</tr>
15    <tr><td>333<td>Edward<td>Chan</tr>
16  </table>
17 </body>
18
```



Structure of an HTML document

- elements are structured as a tree (one web page = one tree)
- divided into a HEAD and a BODY
- the BODY is what you see displayed in the browser
- BODY is divided into elements such as headings, paragraphs, tables, lists ...



picture source: W3 Schools

<HEAD> ... </HEAD>

- document header.

<BODY> ... </BODY>

- document body

<H1> ... </H1>

- Heading type 1

<H6> ... </H6>

- ... to Heading type 6.

<P> ... </P>

- paragraph.

<TABLE>

- table

<TR>

- table row

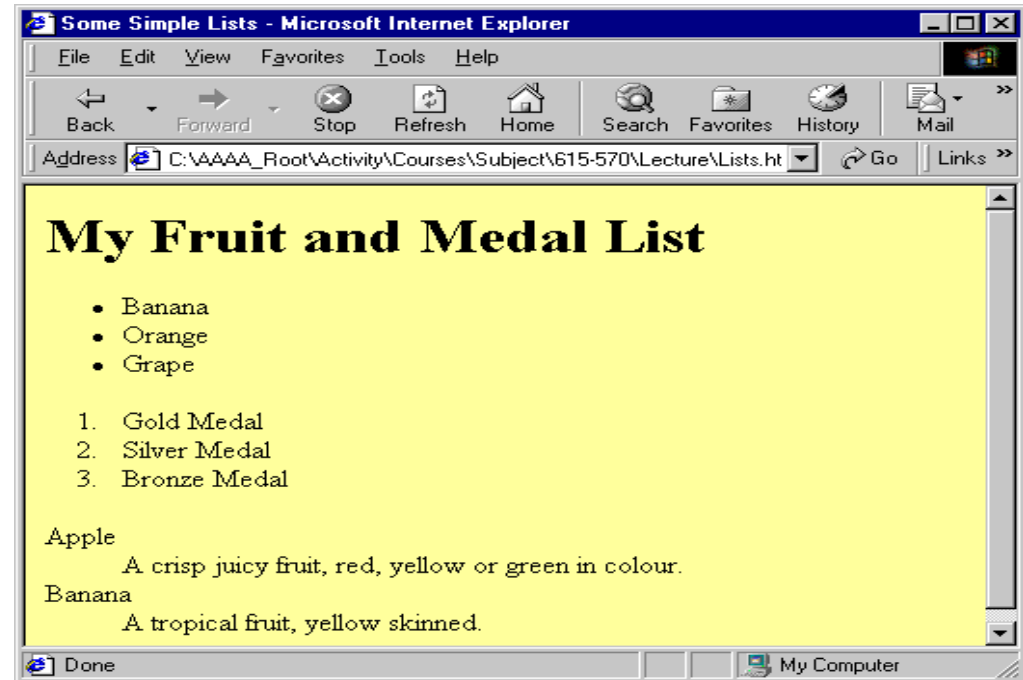
<TD>

- table data

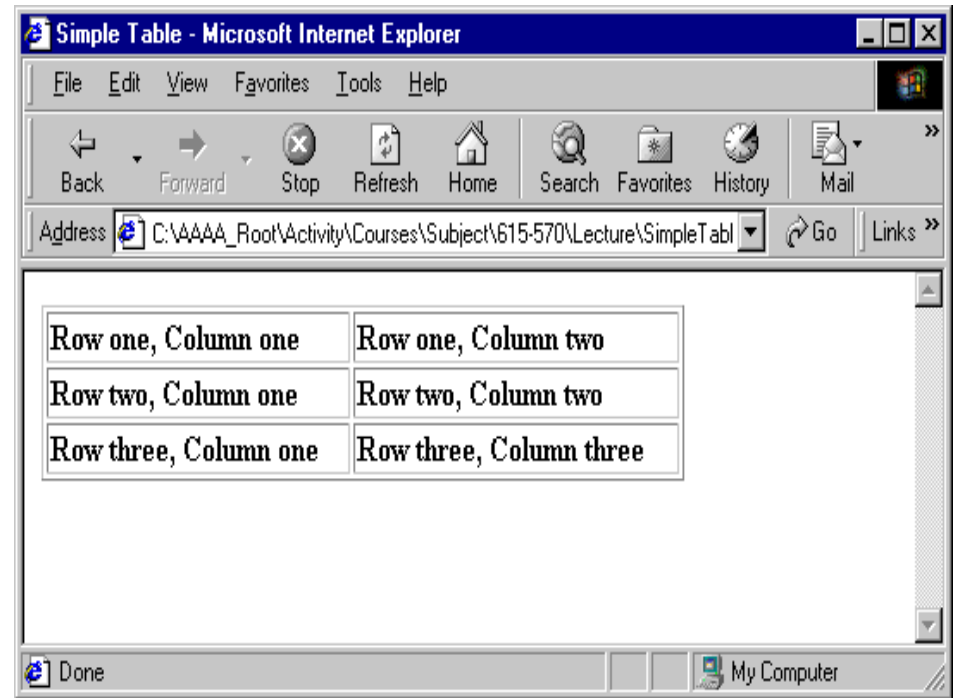
- list

- list item

```
<HTML> <HEAD> <title>Some Simple Lists</title> </HEAD>
<BODY bgcolor="#FFFF99">
<H1>My Fruit and Medal List </H1>
<UL>
  <LI>Banana</LI>
  <LI>Orange</LI>
  <LI>Grape</LI>
</UL>
<OL>
  <LI>Gold Medal</LI>
  <LI>Silver Medal</LI>
  <LI>Bronze Medal</LI>
</OL>
<DL>
  <DT>Apple
    <DD>A crisp juicy fruit, red, yellow or green in colour.
  <DT>Banana
    <DD>A tropical fruit, yellow skinned.
</DL>
</BODY> <HTML>
```



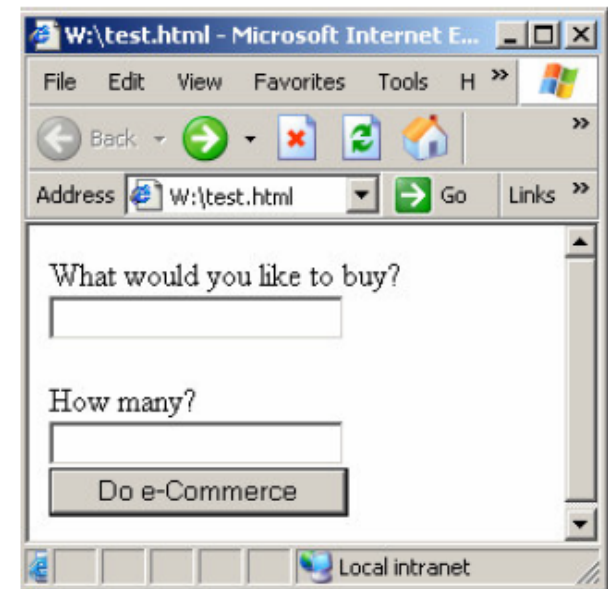
```
<HTML> <HEAD> <TITLE>Simple Table</TITLE>
<html>
<head>
<style>
table, th, td
{ border: 1px solid black;}
</style></HEAD>
<BODY>
<TABLE>
  <TR>
    <TD>Row one, Column one</TD>
    <TD>Row one, Column two</TD>
  </TR>
  <TR>
    <TD>Row two, Column one</TD>
    <TD>Row two, Column two</TD>
  </TR>
  <TR>
    <TD>Row three, Column one</TD>
    <TD>Row three, Column three</TD>
  </TR>
</TABLE> </BODY> </HTML>
```



- Forms allow users to input data to a web page
- The web server process the user's input using the file named in the 'action' attribute.

```
<form action = "buy.pl" method="post">  
  
<p> What would you like to buy? <br>  
<input type="text" name="product">  
  
<p> How many? <br>  
<input type="text" name="quantity"> <br>  
  
<input type="submit" value="Do e-Commerce">  
</form>
```

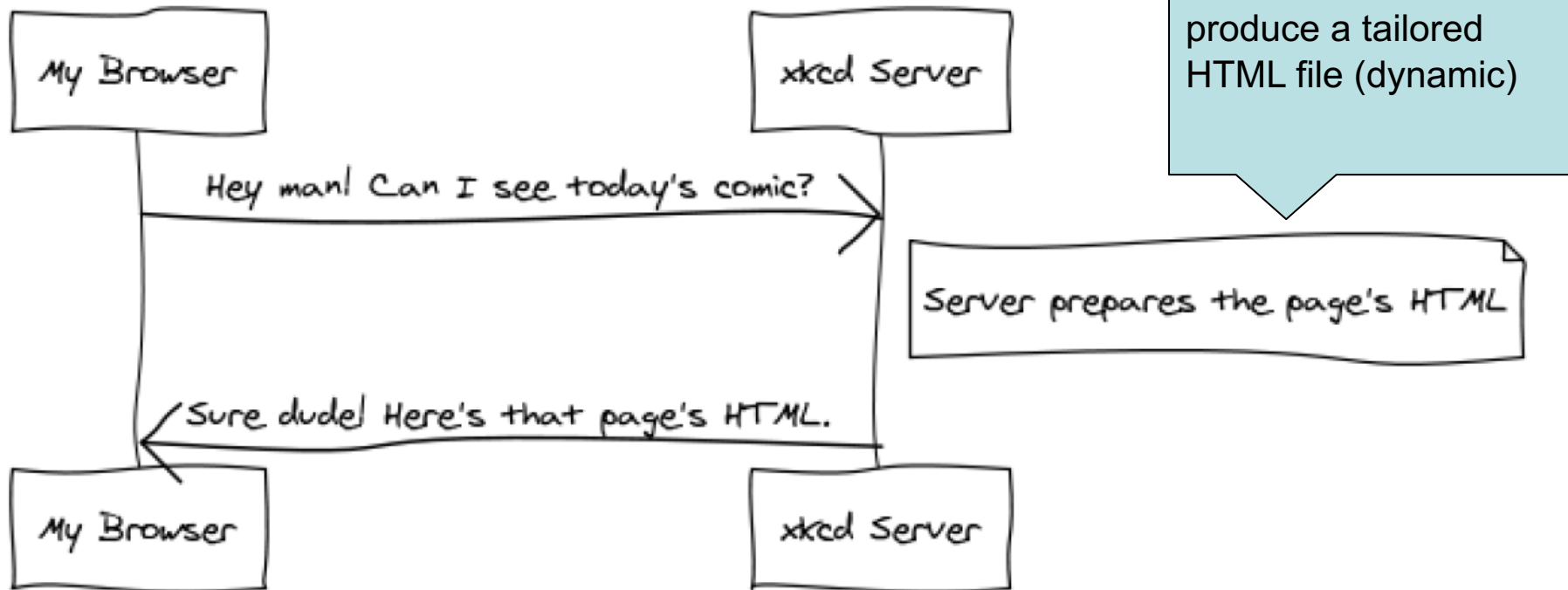
Example HTML form



*browser displays form,
sends input data to a script called 'buy.pl'*

HTTP: how HTML documents move

- User wants to see a web page
- Types URL into browser
- Browser fetches page from server and displays it



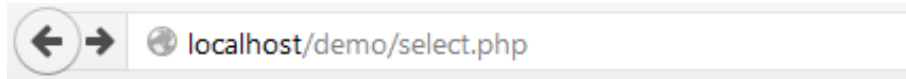
picture source: Symfony Book

- STATIC web page
 - the URL identifies a file on the server's file system
 - server fetches the file and sends it to the browser
 - the file contains HTML
 - browser interprets the HTML for display on screen
- DYNAMIC web page
 - URL identifies a program to be run
 - web app runs the program
 - program typically retrieves data from database
 - elements such as TABLE, LIST are populated with data
 - web app uses LOOPS to fill the contents of TABLEs and LISTs.
 - e.g. `SELECT * FROM Product;` (returns a set of product entities)
 - `FOR p IN ProductList, print a row in HTML table`

- program logs into db
- selects all rows from database table
- displays them inside an HTML table

```
1 <?php
2
3 print '<h1> This page selects from a table </h1>';
4
5 print '<p> connecting to database ... </p>';
6 // connect to server, select database
7 $link = mysql_connect('localhost', 'root', '')
8       or die('Could not connect: ' . mysql_error());
9 print '<p> connected successfully </p>';
10 mysql_select_db('webappdemo') or die('could not select database');
11
12 // perform SQL query
13 $query = 'SELECT * FROM mytable';
14 $result = mysql_query($query) or die('Query failed: ' . mysql_error());
15
16 print '<h2> table starts now </h2>';
17
18 // print results in an HTML table
19 print "&<table>\n";
20 while ($line = mysql_fetch_array($result, MYSQL_ASSOC)) {
21     print "\t<tr>\n";
22     foreach ($line as $col_value) {
23         print "\t\t<td>$col_value</td>\n";
24     }
25     print "\t</tr>\n";
26 }
27 print "</table>\n";
28
```

```
1 <?php
2
3 print '<h1> This page selects from a table </h1>';
4
5 print '<p> connecting to database ... </p>';
6 // connect to server, select database
7 $link = mysql_connect('localhost', 'root', '');
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21     print "\t<tr>\n";
22     foreach ($line as $col_value) {
23         print "\t\t<td>$col_value</td>\n";
24     }
25     print "\t</tr>\n";
26 }
27 print "</table>\n";
28
```



This page selects from a table

connecting to database ...

connected successfully

table starts now

1 first row

2 second row

3 third row - working nicely

form starts now

3
hird row - working nicely
Submit Query


```
37 print '<h2> form starts now </h2>';
38
39 // display a form for entering data
40 print '<form action="insert.php" method="post">';
41 print '<input type="text" name="number" value="type a number" />';
42 print '<input type="text" name="string" value="type a string" />';
43 print '<input type="submit" value="send to database" />';
44 print '</form>';
45 ?>
```

form starts now

third row - working nicely

Submit Query

```
1 <?php
2
3 print '<p> connecting to database ... </p>';
4 // connect to server, select database
5 $link = mysql_connect('localhost', 'root', '')
6       or die('Could not connect: ' . mysql_error());
7 print '<p> connected successfully </p>';
8 mysql_select_db('webappdemo') or die('could not select database');
9
10 // form the INSERT statement from the user's input
11 $sql="insert into mytable values ('$_POST[number]', '$_POST[string]')";
12
13 // run the INSERT statement
14 if (!mysql_query($sql,$link))
15     die('Error: ' . mysql_error());
16
17 // print friendly message
18 print "<p> 1 record added: </p>";
19 print "<ul>";
20 print "<li>the number was: " . $_POST['number'];
21 print "<li>the string was: " . $_POST['string'];
22 print "</ul>";
23
24 // close connection to database
25 mysql_close($link);
26
27 ?>
```

localhost/demo/insert.php

connecting to database ...

connected successfully

1 record added:

- the number was: 3
- the string was: third row - working nicely

```
29 //save login event
30 $sql = "insert into EVENT values (null, null, 'L', '$_SESSION['thisClient'] . '", 'logged in')";
31 mysql_query($sql);
32
```

- Placing “raw” SQL inside PHP/HTML files
 - Mixes presentation, business, database logic
 - Hard to maintain when things change
 - Want separation of concerns e.g. MVC
- Lots of reinvention of wheels
 - each dev writes their own solution to common features
 - e.g. login security, presentation templates, database access
- Increasing variety of clients e.g. phones and tablets
 - Manually program for different platforms
- => web application frameworks
 - examples: Ruby on Rails, .Net, Symfony, AngularJS, Django





- The WWW allows humans to access remote databases
- Web Services allow *computers* to access remote databases
- 2 major approaches: SOAP and REST
 - Simple Object Access Protocol
 - Representational State Transfer
- structured data usually returned in XML or JSON format
- REST nouns are resources, addressed via URIs
- REST verbs correspond to DML statements
- GET (select), POST (insert), PUT (update), DELETE (delete)
- Try this example web service
<https://www.googleapis.com/books/v1/volumes?q=quilting>

- used by web services for data exchange

The following JSON example defines an employees object, with an array of 3 employee records:

JSON Example

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

- XML
eXtensible Markup Language
- JSON
JavaScript Object Notation

Source: www.w3school.org

The following XML example also defines an employees object with 3 employee records:

XML Example

```
<employees>  
  <employee>  
    <firstName>John</firstName> <lastName>Doe</lastName>  
  </employee>  
  <employee>  
    <firstName>Anna</firstName> <lastName>Smith</lastName>  
  </employee>  
  <employee>  
    <firstName>Peter</firstName> <lastName>Jones</lastName>  
  </employee>  
</employees>
```



- Web languages
- Web architecture
- HTML elements
- How static and dynamic web pages work (high level)

* All material is examinable – these are the suggested key skills you would need to demonstrate in an exam scenario

- Data Warehousing