Cloud and Web Applications

Part 2 : Client-Side Techniques

@2016, Li Dan, Guizhou Academy of Sciences

Table of Contents

- HTTP
- HTML
  - HTML 5
- JavaScript
- DOM
- Ajax
- JSON

@2016, Li Dan, Guizhou Academy of Sciences

HTTP

@2016, Li Dan, Guizhou Academy of Sciences

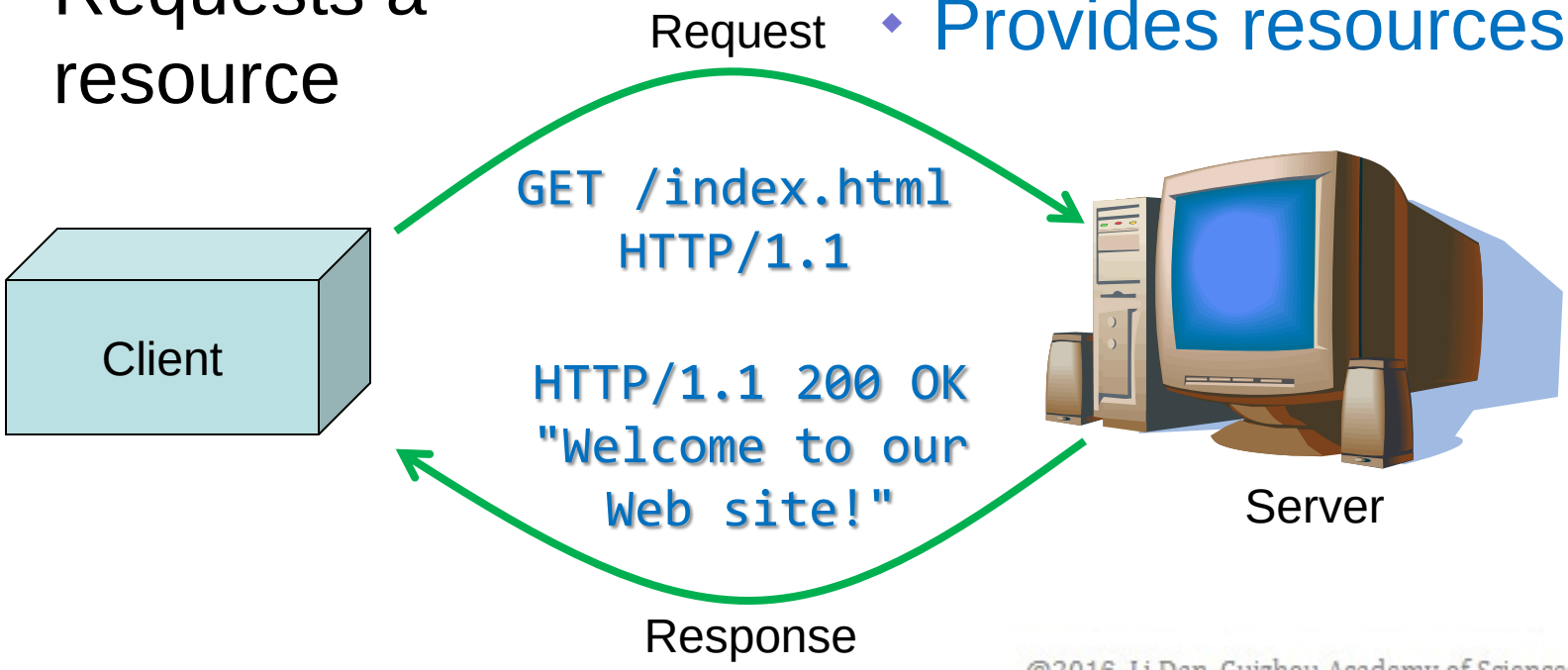
Client-Server Communication : HTTP

- Hyper Text Transfer Protocol (HTTP)
  - Client-server protocol for transferring Web resources (HTML files, images, styles, etc.)
- Important properties of HTTP
  - Request-response model
  - Text-based format
  - Relies on a unique resource URLs
  - Provides resource metadata (e.g. encoding)
  - Stateless

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Transaction: Request-Response

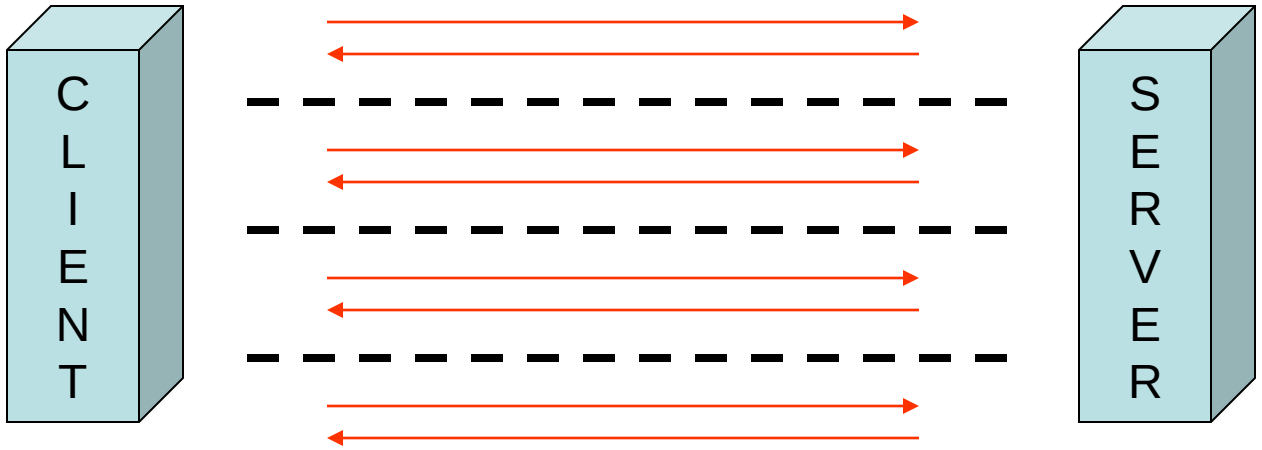
- Client program
  - Running on end host, e.g. Web browser
  - Requests a resource
- Server program
  - Running at the server, e.g. Web server
  - Provides resources



@2016, Li Dan, Guizhou Academy of Sciences

Statelessness

- There is no memory (preservation of state) between HTTP transactions.



- Each HTTP transaction is independent of the one before it and the one after it.
- Cookies can overcome that.

@2016, Li Dan, Guizhou Academy of Sciences

Uniform Resource Identifier (URI)

- Each web resource is identified by a unique URL
- Uniform Resource Locator (URL) is a kind of URI
- General form for a URL:
  <scheme><domain name><port>
  For example,
  http://www.mywebsite.net:80

  (the port is usually omitted and a default is used)

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Example

- HTTP request:

```
GET /academy/about.asp HTTP/1.1
Host: www.gzas.org.cn
User-Agent: Mozilla/5.0
<CRLF>
```

The empty line denotes the end of the request header

- HTTP response:

```
HTTP/1.1 200 OK
Date: Mon, 5 Jul 2013 13:09:03 GMT
Server: Microsoft-HTTPAPI/2.0
Last-Modified: Mon, 12 Jul 2010 15:33:23 GMT
Content-Length: 54
<CRLF>
<html><title>Hello</title>
Welcome to our site
</html>
```

The empty line denotes the end of the response header

HTTP Request

Request message sent by a client consists of

- Request line
  - request method (GET, POST, HEAD, ...)
  - resource URI,
  - and protocol version
- Request headers
  - additional parameters
- Body – optional data
  - E.g. posted form data, files, etc.

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Request Methods

- Each HTTP request contains a method attribute that identifies its purpose

- Valid methods include
  - ***GET*** retrieve a resource
  - ***POST*** submit data to be processed
  - *CONNECT* create a TCP/IP tunnel
  - ***DELETE*** delete a resource
  - *HEAD* get response headers only
  - *OPTIONS* get a list of supported methods
  - ***PUT*** replace a resource
  - *TRACE* echo the request

@2016, Li Dan, Guizhou Academy of Sciences

Main HTTP Request Methods

- GET
  - Return the specified resource, run a program at the server, or just download file, …
- HEAD
  - Return the meta-data associated with a resource (headers only)
- POST
  - Update a resource, provide input data for processing at the server, …

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Response Codes

- Each HTTP response contains a response code that indicates the general outcome
- Response code categories / examples:
  - `1xx`: informational (e.g., "`100 Continue`")
  - `2xx`: success (e.g., "`200 OK`")
  - `3xx`: redirection (e.g., "`304 Not Modified`", "`302 Found`")
  - `4xx`: client error (e.g., "`404 Not Found`")
  - `5xx`: server error (e.g., "`503 Service Unavailable`")
- "`302 Found`" is used for redirecting the Web browser to another URL

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Headers

- Each request and response message begins with header lines that provide meta-information

- Request header data examples:
  - method, resource, protocol version, host
- Response header data examples:
  - protocol version, response code, content type, content length, date

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Headers Example

HTTP Request Message

```
GET  /hello.html  HTTP/1.1
Host: www.gzas.org.cn
↵
```

HTTP Response Message

```
HTTP/1.1   200   OK
Server: Apache-Coyote/1.1
Content-Type: text/html
Content-Length: 37
Date: Fri, 07 Sep 2007 16:13:28 GMT
↵
<html>
<body>
Hello!
</body>
</html>
```

A blank line separates message headers from message body

@2016, Li Dan, Guizhou Academy of Sciences

HTTP POST Request – Example

```
POST /webmail/login.html HTTP/1.1
Host: www.163.com
Accept: */*
Accept-Language: cn
Accept-Encoding: gzip, deflate
User-Agent: Mozilla/4.0(compatible;MSIE 6.0;
Windows NT 5.0)
Connection: Keep-Alive
Cache-Control: no-cache
Content-Length: 59
<CRLF>
LOGIN_USER=wang
DOMAIN_NAME=tianyang
LOGIN_PASS=122*secret!
<CRLF>
```

HTTP request line

HTTP headers

The request body contains the submitted form data

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Request Handling

- Servers must correctly interpret HTTP request headers and respond appropriately
- Static content includes fixed files that are returned without any further computation
- Dynamic content is generated on request by an application component that is invoked by the server

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Response

- Typical HTTP response (includes resource)
  - content type
  - length of file
  - content

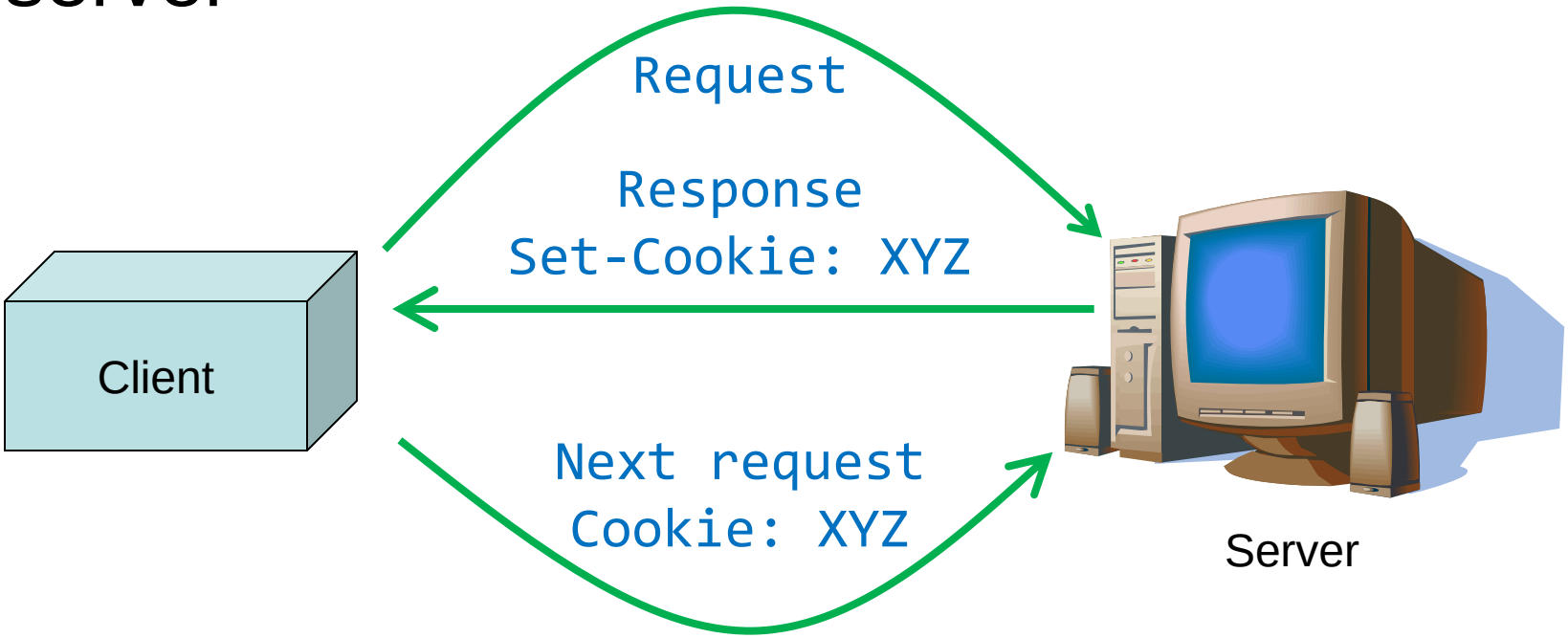
```
HTTP/1.1 200 OK
Date: Fri, 31 Aug 2012 23:18:59 GMT
Content-Type: text/html
Content-Length: 1354

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

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Cookies

- Cookie
- Cookies are small pieces of data stored by the client on behalf of the server
- Included in all future HTTP requests to the server



@2016, Li Dan, Guizhou Academy of Sciences

Cookies – Example

- The client requests to Google:

```
GET / HTTP/1.1
Host: www.google.com
```

- The server sets a cookie in the HTTP response:

```
HTTP/1.1 200 OK
Set-Cookie: PREFID=c0bf5fd5c3a25209; expires=Wed,
11-Jul-2013 16:13:22 GMT; domain=.google.com
```

- In further requests to Google the web browser sends the cookie in the HTTP head

```
GET / HTTP/1.1
Host: www.google.com
Cookie: PREFID=c0bf5fd5c3a25209
```

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Tools

- Firebug plug-in for Firefox
  - A must have for web developers
  - The ultimate tool for monitoring, editing and debugging HTTP, HTML, CSS, JavaScript, etc.
  - Free, open-source – www.getfirebug.com

- Fiddler – HTTP proxy
  - Intercepts the HTTP traffic
  - Analyzes the HTTP conversation
  - Free tool – www.fiddler2.com

- curl – command line tool

@2016, Li Dan, Guizhou Academy of Sciences

HTML

@2016, Li Dan, Guizhou Academy of Sciences

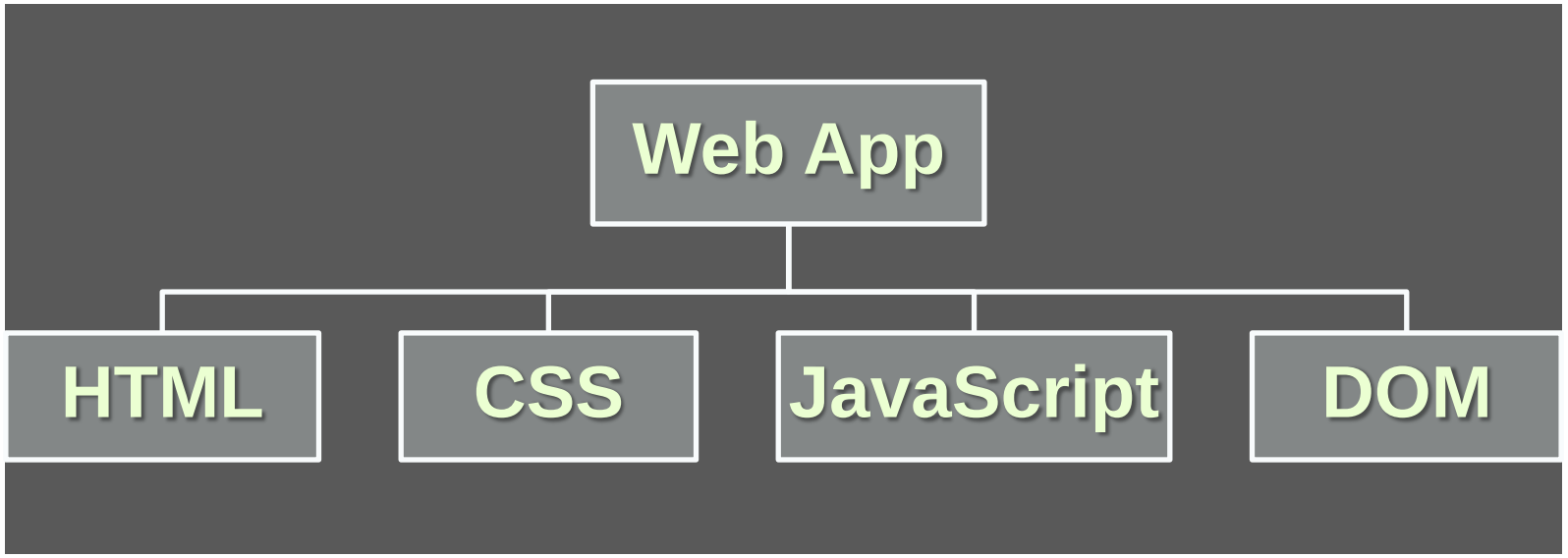
Client-Side Stack

- Five layers:
  - Design: Photoshop/Illustrator
  - Presentation: CSS
  - Interaction: JavaScript, DOM
  - Markup: HTML
  - Browser:

@2016, Li Dan, Guizhou Academy of Sciences

Web Apps in Front-end

- = HTML + CSS + JavaScript



@2016, Li Dan, Guizhou Academy of Sciences

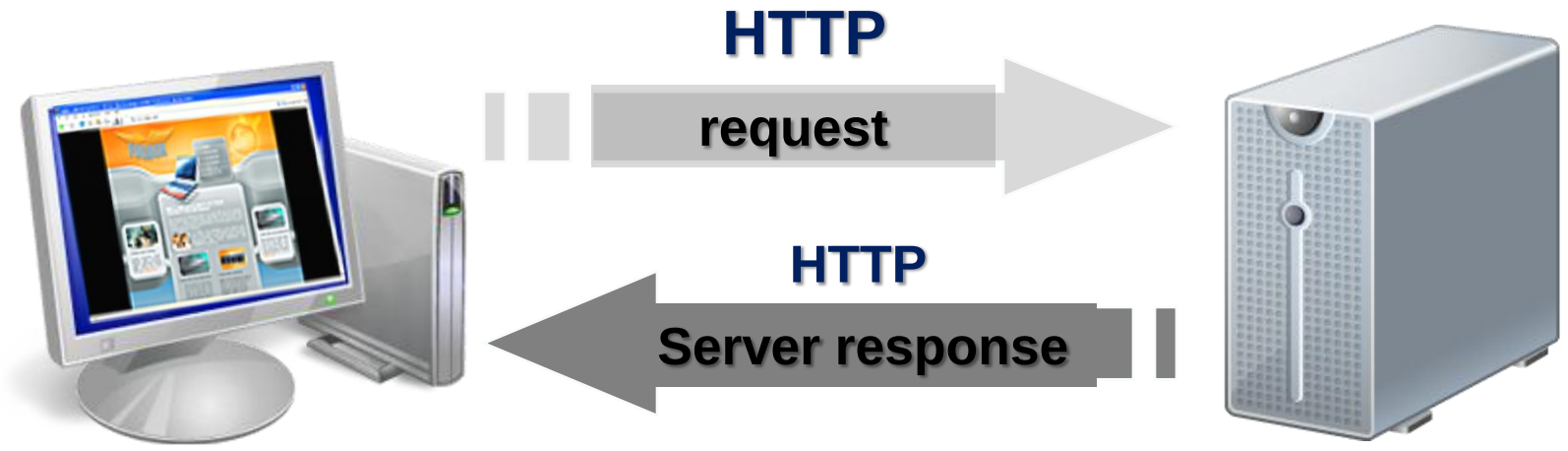
HTML + CSS + JavaScript

- HTML defines web page content through semantic tags (headings, paragraphs, lists, …)
- CSS defines 'rules' or 'styles' for presenting every aspect of an HTML document
  - Font (family, size, color, weight, etc.)
  - Background (color, image, position, repeat)
  - Position and layout (of any object on the page)
- JavaScript defines dynamic behavior
  - Programming logic for interaction with the user, to handle events, etc.

@2016, Li Dan, Guizhou Academy of Sciences

How the Web Works?

- Use classical client / server architecture
  - HTTP is text-based request-response protocol



@2016, Li Dan, Guizhou Academy of Sciences

HyperText Markup Language (HTML)

- A language for writing web pages
- HTML provides a notation for describing
  - document structure (semantic markup)
  - formatting (presentation markup)
- HTML is only about structure, not appearance
- Browsers tolerate invalid HTML code and parse errors – you should not.
- The current version is HTML 5

@2016, Li Dan, Guizhou Academy of Sciences

Creating HTML Pages

- An HTML file must have an `.htm` or `.html` file extension
- HTML files can be created with text editors:
  - NotePad, NotePad ++, PSPad
- Or HTML editors (WYSIWYG Editors):
  - Microsoft FrontPage
  - Macromedia Dreamweaver
  - Microsoft Word

@2016, Li Dan, Guizhou Academy of Sciences

HTML-enabled devices

Small screen
smartphones

320 x 240
4” display
16-bit color

larger screens
(desktop computers)

Desktop HD monitor
1920 x 1080
96 ppi
22” display

moderate screens
(laptops)

Laptop:
15.6” diagonal
1,366 x 768
96 ppi

large screen
devices

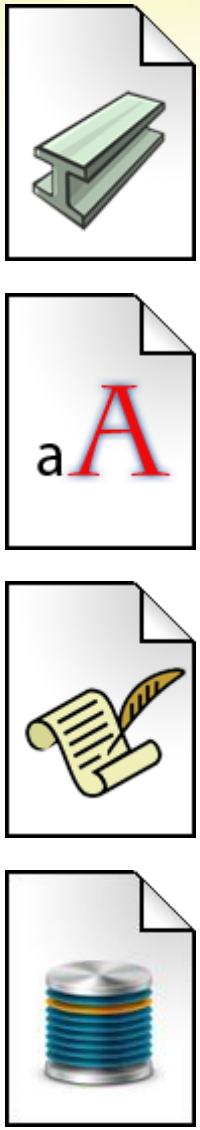
Tablet computer:
1024 x 600
170 ppi
7”

@2016, Li Dan, Guizhou Academy of Sciences

Foundations of HTML

Separation of concerns:

- structure
- presentation
- logic
- Data



@2016, Li Dan, Guizhou Academy of Sciences

HTML document

Three major groupings/elements:

- ***<html>*** defines which markup language, DTD
- ***<head>*** defines properties of page, meta, style and js connect
- **<body>** defines page content

@2016, Li Dan, Guizhou Academy of Sciences

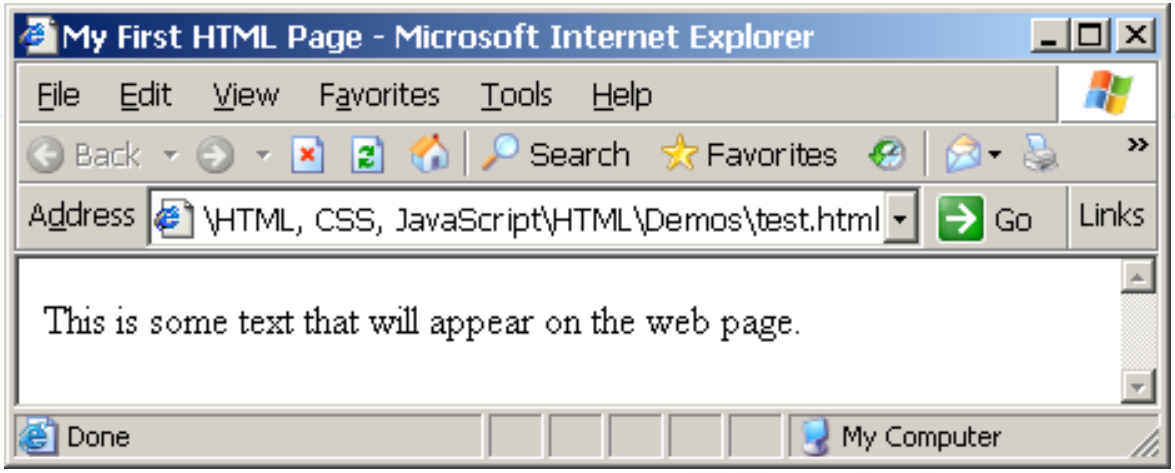
HTML Syntax

- Each HTML element is defined by a tag, or pair of tags
  - tags are delimited by angle brackets: < >
  - tags may include attributes (*name="value"*)
- Paired tags have content
  - e.g., paragraph: Hello!
- Empty tags contain nothing
  - e.g.,
,

@2016, Li Dan, Guizhou Academy of Sciences

First HTML Page

```
<!DOCTYPE HTML>
<html>
  <head>
    <title>My First HTML Page</title>
  </head>
  <body>
     <p>This is some text...</p>
  </body>
</html>
```



@2016, Li Dan, Guizhou Academy of Sciences

Some Tags

- Hyperlink Tags

```
<a href="http://www.gzas.org.cn/"
  target="_blank">Link to GZAS Web Site</a>
```

- Link to a document called `cat.html` on the same server in the subdirectory `stuff`:

```
<a href="stuff/cat.html">Catalog</a>
```

- Link to a document called `parent.html` on the same server in the parent directory:

```
<a href="../parent.html">Parent</a>
```

@2016, Li Dan, Guizhou Academy of Sciences

Hyperlinks

- Hyperlinks take the browser to other documents when clicked

- Format:

```
<a href=“ …url … “> …link text… </a>
```

e.g.,

- `<a href="standings.html">Current Team</a>`

@2016, Li Dan, Guizhou Academy of Sciences

Tags Attributes

- Tags can have attributes
  - Attributes specify properties and behavior
  - Example: image tag

```
<img src="logo.gif" alt="logo" />
```

Attribute `alt` with value "logo"

  - Few attributes can apply to every element:
    - `id`, `name`, `style`, `class`, `title`
    - The `id` is unique in the document
    - Content of `title` attribute is displayed as hint when the element is hovered with the mouse
    - Some elements have obligatory attributes

@2016, Li Dan, Guizhou Academy of Sciences

Headings、Paragraphs and Sections

- Heading Tags (h1 – h6)

```
<h1>Heading 1</h1>
<h2>Sub heading 2</h2>
<h3>Sub heading 3</h3>
```

- Paragraph Tags

```
<p>This is my first paragraph</p>
<p>This is my second paragraph</p>
```

- Sections: `div` and `span`

```
<div style="background: skyblue;">
   This is a div
</div>
```

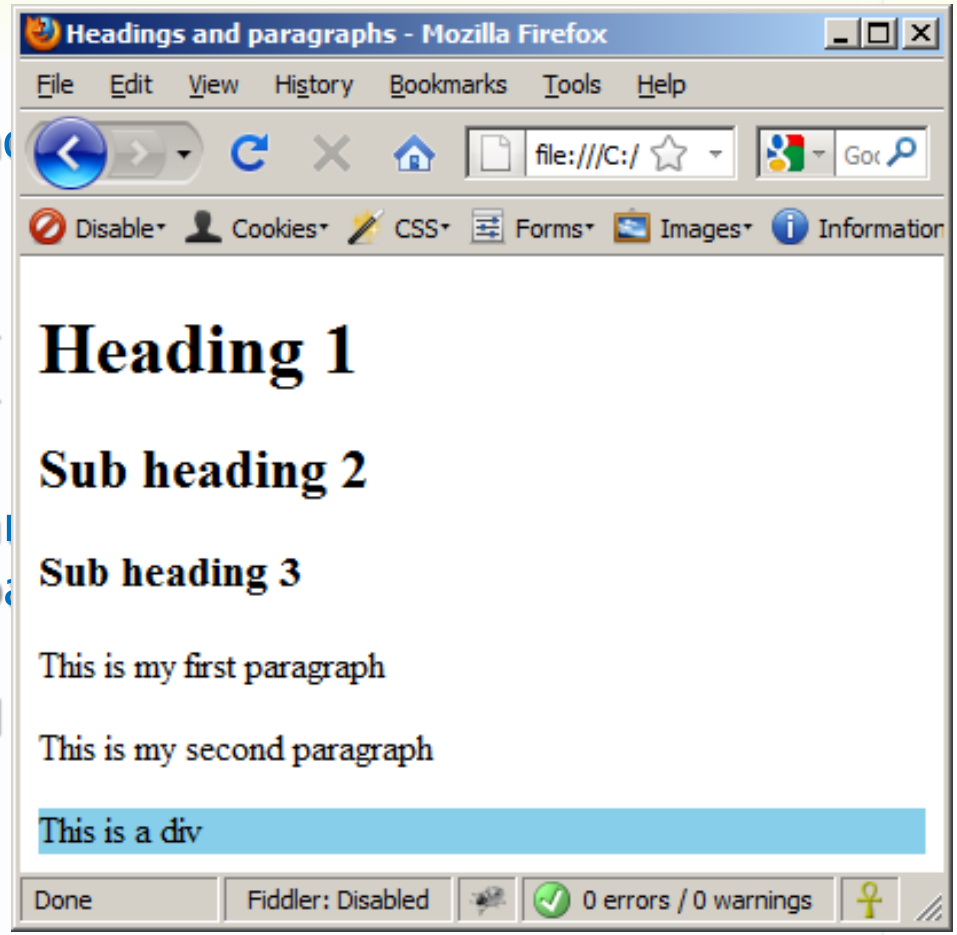
@2016, Li Dan, Guizhou Academy of Sciences

Tag Example

```
<!DOCTYPE HTML>
<html>
  <head><title>Headings an
  <body>
    <h1>Heading 1</h1>
    <h2>Sub heading 2</h2>
    <h3>Sub heading 3</h3>

    <p>This is my first pa
    <p>This is my second p

    <div style="background
      This is a div</div>
  </body>
</html>
```



@2016, Li Dan, Guizhou Academy of Sciences

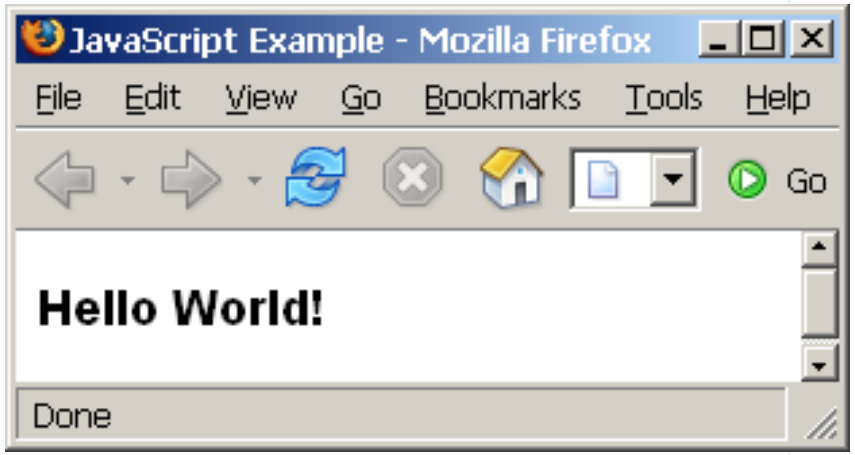
<head> Section: <script>

- The `<script>` element is used to embed scripts into an HTML document
  - Script are executed in the client's Web browser
  - Scripts can live in the `<head>` and in the `<body>` sections
- Supported client-side scripting languages:
  - **JavaScript** (it is not Java!)
  - VBScript
  - JScript

@2016, Li Dan, Guizhou Academy of Sciences

The <script> Tag – Example

```
<!DOCTYPE HTML>
<html>
  <head>
    <title>JavaScript Example</title>
    <script type="text/javascript">
      function sayHello() {
        document.write("<p>Hello World!<\/p>");
      }
    </script>
  </head>
  <body>
    <script type=
      "text/javascript">
      sayHello();
    </script>
  </body>
</html>
```

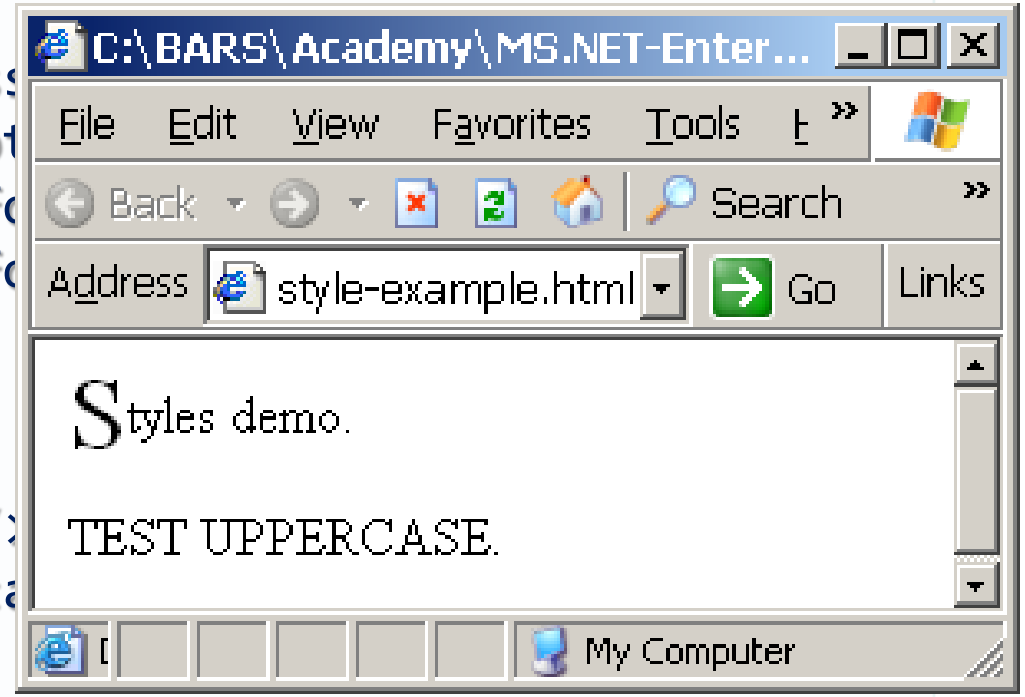


@2016, Li Dan, Guizhou Academy of Sciences

<head> Section: <style>

- The `<style>` element embeds formatting information (CSS styles) into an HTML page

```
<html>
  <head>
    <style type="text/cs
      p { font-size: 12pt
      p:first-letter { fo
      span { text-transfo
    </style>
  </head>
  <body>
    <p>Styles demo.<br />
       <span>Test upperca
    </p>
  </body>
</html>
```



@2016, Li Dan, Guizhou Academy of Sciences

Lists

- unordered (bullet) list
- ordered (numbered) list
- list item

```
<ul>
  <li>
   <a href="standings.html">Current Team</a>
  </li>
  <li>
    <a href="matches.html">This Week's Matches</a>
  </li>
  <li><a href="mailto:info@EHSL.org">Contact Us</a></li>
</ul>
```

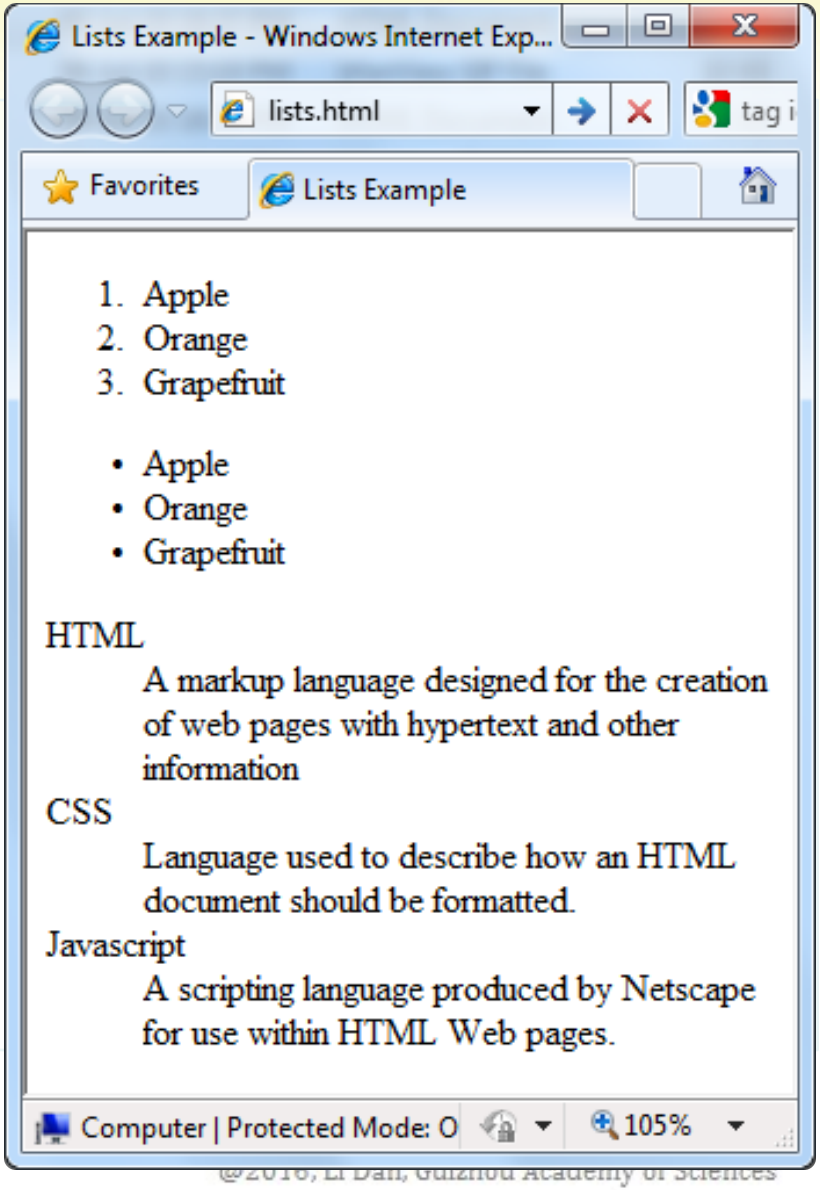
@2016, Li Dan, Guizhou Academy of Sciences

List Tags – Example

```
<ol type="1">
    <li>Apple</li>
    <li>Orange</li>
    <li>Grapefruit</li>
</ol>

<ul type="disc">
    <li>Apple</li>
    <li>Orange</li>
    <li>Grapefruit</li>
</ul>

<dl>
    <dt>HTML</dt>
    <dd>A markup lang…</dd>
</dl>
```



@2016, Li Dan, Guizhou Academy of Sciences

and Tags

- `<div>` is a block element that creates logical divisions within a page
- `<span>` is an inline element for modifying a specific portion of text
- Used with CSS and JavaScript

```
<div id="examDiv" style="f
color:red">DIV example</di

<p>This one is <span id="a
font-weight:bold">only a t
```

@2016, Li Dan, Guizhou Academy of Sciences

HTML Tables

- An HTML table presents data in a grid format

```
<table border="1">
 <caption>Table Caption</caption>
<tr>
    <td>R1,C1</td>
    <td>R1,C2</td>
    <td>R1,C3</td>
  </tr>
  <tr>
    <td>R2,C1</td>
    <td>R2,C2</td>
    <td>R2,C3</td>
  </tr>
</table>
```

Table Caption

R1,C1	R1,C2	R1,C3
R2,C1	R2,C2	R2,C3

@2016, Li Dan, Guizhou Academy of Sciences

HTML Tables (2)

- Start and end of a table

```
<table> ... </table>
```

- Start and end of a row

```
<tr> ... </tr>
```

- Start and end of a cell in a row

```
<td> ... </td>
```

@2016, Li Dan, Guizhou Academy of Sciences

HTML Forms

- HTML Form presents primary method for gathering data from client
- Form controls include
  - *text field, text area, and password box*
  - *select*
  - *check box*
  - *radio buttons*
  - *drop-down menus*
  - *buttons*
- Often used by JavaScript code

@2016, Li Dan, Guizhou Academy of Sciences

HTML Form Example

The “method" attribute tells how the form data should be sent – via GET or POST request

```
<form name="myForm" id=“formId”
method="post" action="path/to/some-script">
    ...
</form>
```

The "action" attribute tells where the form data should be sent

@2016, Li Dan, Guizhou Academy of Sciences

Form Fields

- Single-line text input fields:

```
<input type="text" id="FirstName" value="This
is a text field" />
```

- Multi-line textarea fields:

```
<textarea id="Comments">This is a multi-line
text field</textarea>
```

- Hidden fields contain data not shown to the user:

```
<input type="hidden" id="Account" value="This
is a hidden text field" />
```

@2016, Li Dan, Guizhou Academy of Sciences

Form Input Controls

- Checkboxes:

```
<input type="checkbox" name="fruit"
value="apple" />
```

- Radio buttons:

```
<input type="radio" name="title" value="Mr." />
```

- Radio buttons can be grouped, allowing only one to be selected from a group:

```
<input type="radio" name="city" value="Lom" />
<input type="radio" name="city" value="Ruse" />
```

@2016, Li Dan, Guizhou Academy of Sciences

Other Form Controls

- Dropdown menus:

```
<select id="gender" name="gender">
  <option value="Value 1"
    selected="selected">Male</option>
  <option value="Value 2">Female</option>
  <option value="Value 3">Other</option>
</select>
```

- Submit button:

```
<input type="submit" id="submitBtn"
value="Apply Now" />
```

@2016, Li Dan, Guizhou Academy of Sciences

Other Form Controls (2)

- File input – a field used for uploading files

```
<input type="file" name="photo" />
```

  - When used, it requires the form element to have a specific attribute:

```
<form enctype="multipart/form-data">
...
  <input type="file" name="photo" />
...
</form>
```

@2016, Li Dan, Guizhou Academy of Sciences

HTML 5

@2016, Li Dan, Guizhou Academy of Sciences

What is HTML5?

- Latest standard for HTML
- HTML5 page start with one DOCTYPE declaration

```
<!DOCTYPE html>
< html>
```

- Getting supported by all major browsers (Chrome, Firefox, Internet Explorer, Safari, Opera)

@2016, Li Dan, Guizhou Academy of Sciences

HTML5 - New Features

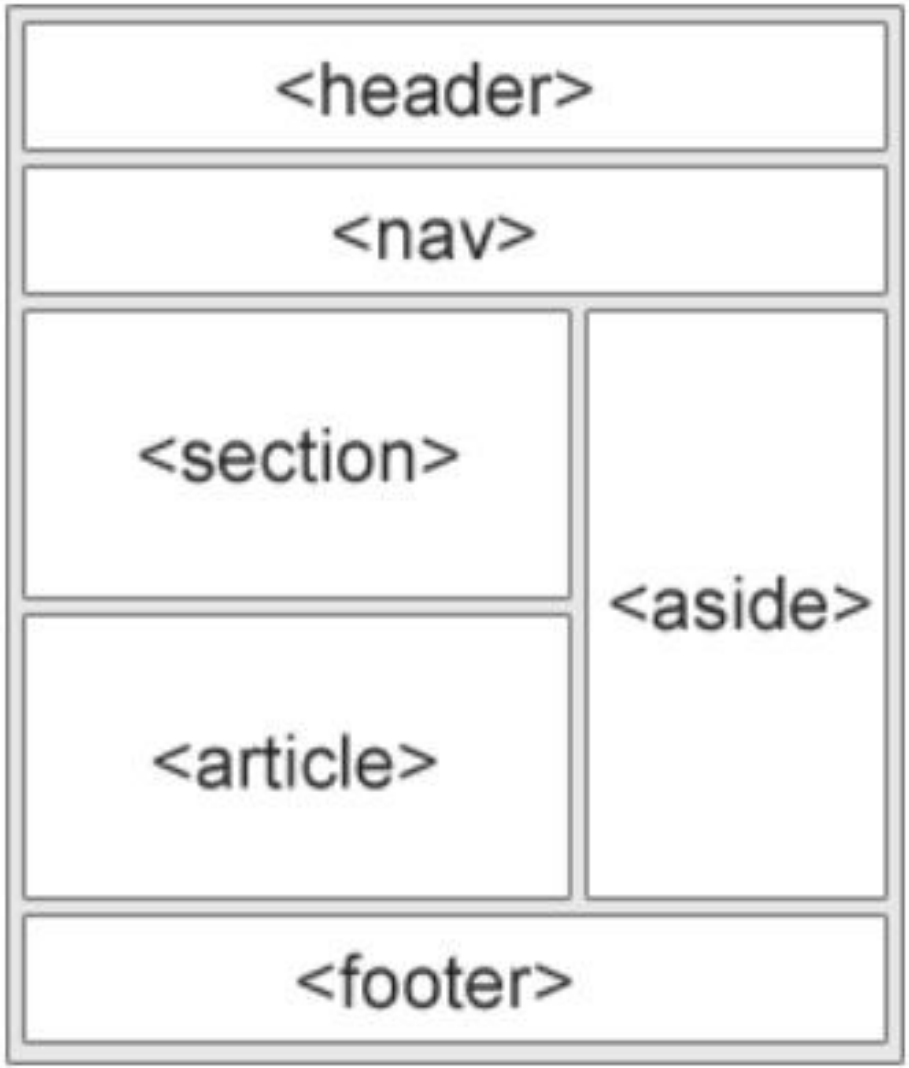
- Some of the most interesting new features in HTML5 are:
  - The `<canvas>` element for 2D drawing
  - The `<video>` and `<audio>` elements for media playback
  - Support for local storage
  - New content-specific elements, like `<article>`, `<footer>`, `<header>`, `<nav>`, `<section>`
  - New form controls, like `calendar`, `date`, `time`, `email`, `url`, `search`

@2016, Li Dan, Guizhou Academy of Sciences

HTML5 Layout

HTML5 offers new elements to clearly define different parts:

- <header>
- <nav>
- <section>
- <article>
- <aside>
- <figure>
- <figcaption>
- <footer>
- <details>
- <summary>
- <mark>
- <time>

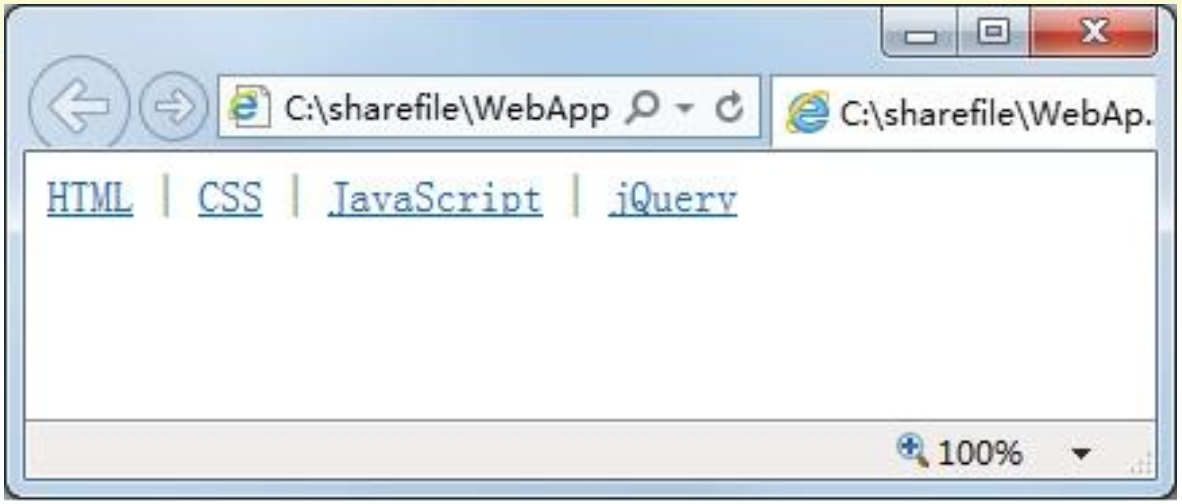


<nav> Element

```
<!DOCTYPE html>
<html>
<body>


<nav>
<a href="/html/">HTML</a> |
<a href="/css/">CSS</a> |
<a href="/js/">JavaScript</a> |
<a href="/jquery/">jQuery</a>
</nav>

</body>
</html>
```



@2016, Li Dan, Guizhou Academy of Sciences

Some New Form Attributes

- autofocus：get focus when the page loads

```
<input type="text" name="fname" autofocus>
```

- placeholder : display a short hint in the input field

```
<input type="text" name="fname" placeholder="First name">
```

- required： field must be filled

```
<input type="text" name="usrname" required>
```

- multiple: allowed more than one value

```
<input type="file" name="img" multiple>
```

@2016, Li Dan, Guizhou Academy of Sciences

Some Input Types/ Form Elements

- email: input an e-mail address

```
<input type="email" name="email">
```

- number: restrict on the number accepted

```
<input type="number" name="quant" min="1” max="5“>
```

- url: input a URL address

```
<input type=“url" name=“homepage">
```

- <datalist>: pre-defined values for list

```
<input list="browsers">
<datalist id="browsers">
  <option value=“IE">
  <option value="Firefox">
 </datalist>
```

@2016, Li Dan, Guizhou Academy of Sciences

Removed Elements

- The following HTML 4 elements has been removed from HTML5:

  <acronym>

  <applet>

  <basefont>

  <big>

  <dir>

  <font>

  <frame>

@2016, Li Dan, Guizhou Academy of Sciences

Note on HTML Editors

- You can easily edit HTML files using a WYSIWYG (what you see is what you get) editor like FrontPage or Dreamweaver, instead of writing your markup tags in a plain text file.
- However, if you want to be a skillful Web developer, we strongly recommend that you use a plain text editor to learn your primer HTML.

www.dotin.com

@2016, Li Dan, Guizhou Academy of Sciences

Lab: Install NotePad++

- Download NotePad++ from
  http://notepad-plus-plus.org/download/

- Install NotePad++

@2016, Li Dan, Guizhou Academy of Sciences

JAVASCRIPT

@2016, Li Dan, Guizhou Academy of Sciences

JavaScript Features (1/2)

- A scripting language
  - informal syntax, minimal coding
- Dynamic variable typing
  - boolean, number, string, function, object
  - implicit type conversions
  - potential problem w.r.t. correctness, security
- First-class functions
  - Functions can be passed as variable

@2016, Li Dan, Guizhou Academy of Sciences

JavaScript Features (2/2)

- Event-driven
  - Programs respond to user interface actions (mouse movement, click, keystroke, etc.)
- Server-Side or Client-Side
  - JavaScript can be used on either platform
- Client-Side functionality
  - JavaScript functions can add, change, or delete any HTML element by using DOM
  - Interaction for user interface

@2016, Li Dan, Guizhou Academy of Sciences

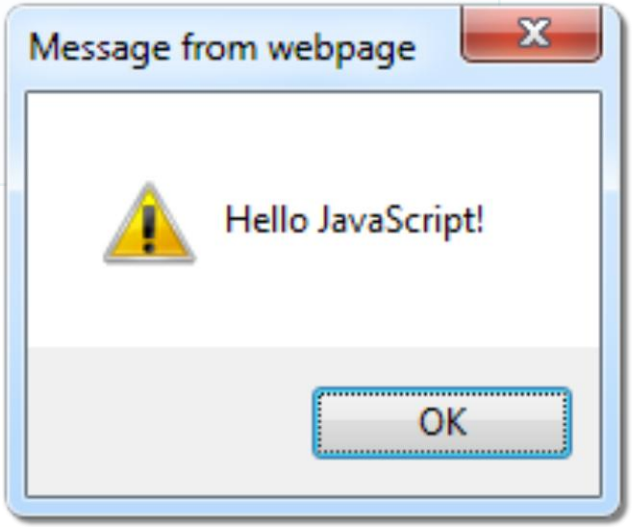
The First Example

first-script.html

```
<html>

<body>
  <script type="text/javascript">
     alert('Hello JavaScript!');
  </script>
</body>

</html>
```



@2016, Li Dan, Guizhou Academy of Sciences

Using JavaScript

- The JavaScript code can be placed in:
  - `<script>` tag in the head
  - `<script>` tag in the body
  - External files, linked via `<script>` tag
    - Files usually have `.js` extension

```
<script src="scripts.js" type="text/javascript">
<!– code placed here will not be executed! -->
</script>
```

    - Highly recommended
    - The `.js` files get cached by the browser
    - Often placed before the <body> tag

@2016, Li Dan, Guizhou Academy of Sciences

Executing JavaScript

- JavaScript code is executed during the page loading or when the browser fires an event
  - Two blocks of code can't run simultaneously
  - Some statements just define functions that can be called later
- Function calls or code can be attached as "event handlers" via tag attributes
  - Executed when the event is fired by the browser

```
<img src="logo.gif" onclick="alert('clicked!')" />
```

@2016, Li Dan, Guizhou Academy of Sciences

Calling Function from Event Handler

```
<html>
<head>
<script type="text/javascript">
  function test (message) {
    alert(message);
  }
</script>
</head>

<body>
  <input type="button" va
    onclick="test('clicke
</body>
</html>
```

@2016, Li Dan, Guizhou Academy of Sciences

JavaScript Syntax

- The JavaScript syntax is similar to C# and Java
  - Operators (`+`, `*`, `=`, `!=`, `&&`, `++`, `...`)
  - Variables (typeless)
  - Conditional statements (`if`, `else`)
  - Loops (`for`, `while`)
  - Arrays (`my_array[]`) and associative arrays (`my_array['abc']`)
  - Functions (can return value)
  - Function variables (like the C# delegates)

@2016, Li Dan, Guizhou Academy of Sciences

Data Types

- JavaScript data types:
  - Numbers (integer, floating-point)
  - Boolean (true / false)
- String type – string of characters

```
var myName = "You can use both single or double
quotes for strings";
```

- Arrays

```
var my_array = [1, 5.3, "aaa"];
```

- Associative arrays (hash tables)

```
var my_hash = {a:2, b:3, c:"text"};
```

@2016, Li Dan, Guizhou Academy of Sciences

String Operations/methods

indexOf()	finds first instance of character
lastIndexOf()	finds last instance of character
charAt()	finds character at a position
length()	number characters in string
toLowerCase()	all letters lower case
toUpperCase()	all letters upper case
replace()	replaces one string with another
match()	looks for matches
split()	splits string into pieces
toString()	number-to-text, text array

@2016, Li Dan, Guizhou Academy of Sciences

Arrays Operations and Properties

- Declaring new empty array:

```
var arr = new Array();
```

- Declaring an array holding few elements:

```
var arr = [1, 2, 3, 4, 5];
```

- Appending an element / getting the last element:

```
arr.push(3);
var element = arr.pop();
```

- Reading the number of elements (array length):

```
arr.length;
```

@2016, Li Dan, Guizhou Academy of Sciences

Message Boxes

- Alert box with text and [OK] button
  - Just a message shown in a dialog box:

```
alert("Some text here");
```

- Confirmation box
  - Contains text, [OK] button and [Cancel] button:

```
confirm("Are you sure?");
```

- Prompt box
  - Contains text, input field with default value:

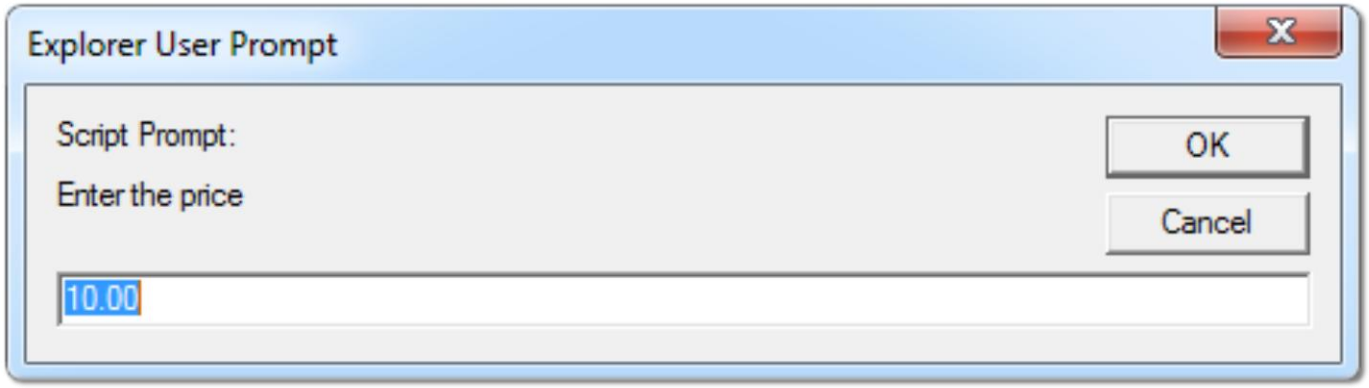
```
prompt ("enter amount", 10);
```

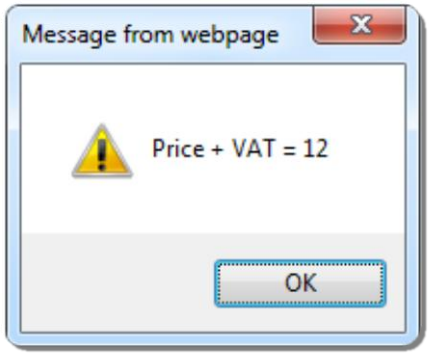
@2016, Li Dan, Guizhou Academy of Sciences

Prompt Box– Example

prompt.html

```
price = prompt("Enter the price", "10.00");
alert('Price + VAT = ' + price * 1.2);
```





@2016, Li Dan, Guizhou Academy of Sciences

Conditional Statement (`if`)

```
var unitPrice = 1.30;
if (quantity > 100) {
  unitPrice = 1.20;
} else {
}
```

Symbol	Meaning
>	Greater than
<	Less than
&&	and
||	or
==, ===	Equal
!=	Not equal

@2016, Li Dan, Guizhou Academy of Sciences

Switch Statement

- The `switch` statement works like in C# / Java:

```
switch (variable) {
  case 1:
    // do something
    break;
  case 'a':
    // do something else
    break;
  case 3.14:
    // another code
    break;
  default:
    // something completely different
}
```

@2016, Li Dan, Guizhou Academy of Sciences

Loops

- Like in C# / Java / C++
  - `for` loop
  - `while` loop
  - `do … while` loop

```
var counter;
for (counter=0; counter<4; counter++) {
  alert(counter);
};

while (counter < 5) {
  alert(++counter);
};
```

@2016, Li Dan, Guizhou Academy of Sciences

Function Arguments/Return Value

- Functions are not required to return a value
- When calling function it is not obligatory to specify all of its arguments
  - The function has access to all the arguments passed via `arguments` array

```
function sum() {
  var sum = 0;
  for (var i = 0; i < arguments.length; i ++)
    sum += parseInt(arguments[i]);
  return sum;
}
alert(sum(1, 2, 4));
```

@2016, Li Dan, Guizhou Academy of Sciences

Debugging JavaScript

- Microsoft Script Editor in IEs
  - Add-on for Internet Explorer
  - Supports breakpoints, watches
  - JavaScript `debugger` statement opens the debug window
  - Press F12

- Firebug- Firefox add-on for debugging JavaScript, CSS, HTML
  - Supports breakpoints, watches, JavaScript console editor
  - Shows AJAX requests and responses

@2016, Li Dan, Guizhou Academy of Sciences

DOM

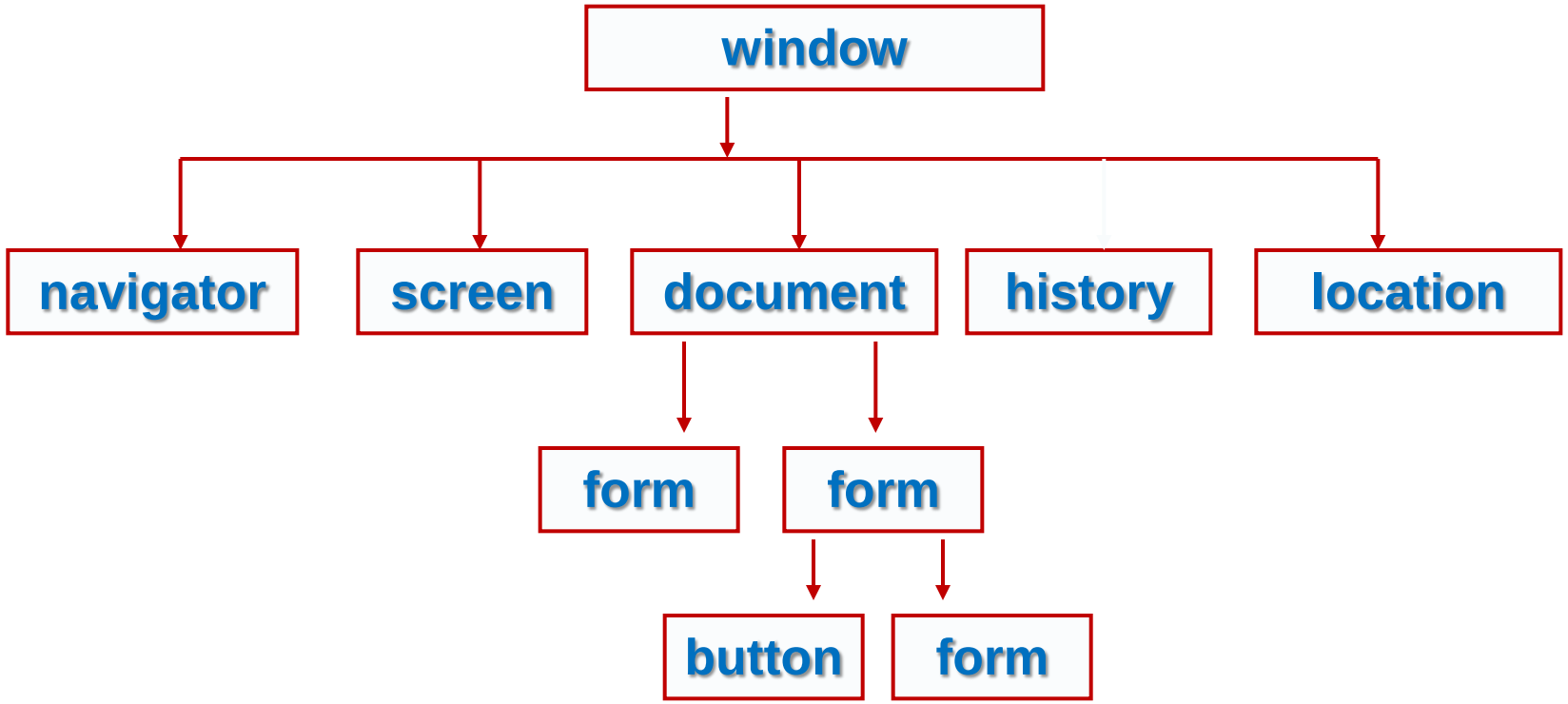
@2016, Li Dan, Guizhou Academy of Sciences

Document Object Model (DOM)

- An interface for manipulating HTML documents
- Document is represented as a tree of objects
- Program can traverse the tree, add/delete/read/write nodes

@2016, Li Dan, Guizhou Academy of Sciences

DOM Hierarchy – Example



@2016, Li Dan, Guizhou Academy of Sciences

Built-in Top DOM Objects

- The browser provides some read-only data via:
  - `window`
    - The top node of the DOM tree
    - Represents the browser window
  - `document`
    - Holds information the current loaded document
  - `screen`
    - Holds the user display properties
  - `browser`
    - Holds information about the browser

@2016, Li Dan, Guizhou Academy of Sciences

Properties of DOM

- Every HTML element is accessible via the JavaScript DOM API
- Most DOM objects can be manipulated by the programmer
- The event model lets a document to react when the user does something on the page
- Advantages
  - Create interactive pages
  - Updates the objects of a page without reloading it

@2016, Li Dan, Guizhou Academy of Sciences

JavaScript coding in DOM

- **Handling interactions:** *addEventListener* - *removeEventListener*
- **Accessing elements:** ***getElementById*** - *parentNode* - *childNodes*
- **Manipulating elements:** *createElement* - *appendChild* - *removeChild*
- **Setting attributes:** *getAttribute* - *setAttribute* - id - className - style - width - height - left - top

@2016, Li Dan, Guizhou Academy of Sciences

Access Elements through DOM Tree

- We can access elements in the DOM through some tree manipulation properties:
  - `element.childNodes`
  - `element.parentNode`
  - `element.nextSibling`
  - `element.previousSibling`
  - `element.firstChild`
  - `element.lastChild`

@2016, Li Dan, Guizhou Academy of Sciences

DOM Tree Navigation

```
<html>
  <head><title>Headings and paragraphs</title></head>
  <body>
    <h1>Heading 1</h1>
      <p>This is a div</p>
  </body>
</html>
```

- The HTML page itself is called 'document'

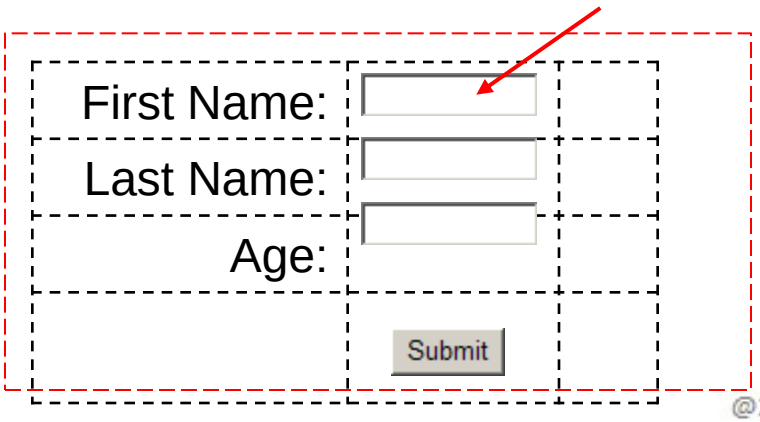
```
var objHTML = document.documentElement;          //<html>
var objHEAD = objHTML.firstChild;                //<head>
var objBODY = objHTML.lastChild;                 //<body>
var objHEAD_1 = objHTML.childNodes.item(0);      //<head>
var objBODY_1 = objHTML.childNodes.item(1);      //<body>
document.write (objHTML + '<br />');
document.write (objHEAD + '<br />');
document.write (objBODY + '<br />');
```

@2016, Li Dan, Guizhou Academy of Sciences

Access Elements for Forms

```
document.myform.FirstName
```

```
<form name="myForm" action="doForm">
      <input type="text" name="firstName" size="10">
</form>
```



@2016, Li Dan, Guizhou Academy of Sciences

Access Elements by ID and Others

- Access elements via their ID attribute

```
var elem = document.getElementById("some_id")
```

- Via the name attribute

```
var arr = document.getElementsByName("some_name")
```

- Via tag name

```
var imgTags = el.getElementsByTagName("img")
```

  - Returns array of descendant `<img>` elements of the element "`el`"

@2016, Li Dan, Guizhou Academy of Sciences

Access Elements

getElementById(“maintitle”) //one object

getElementsByName(“bodytext”) //array of objects

getElementsByTagName(“img”) //array of objects

getElementsByClass(“tt”) //array of objects

```
<body>
  <h1 name=“title” class=“tt” id=“maintitle”>
  <img name=“mavi” id=“leftfloat”>
  <p name=“bodytext” id=“intro1”>
  <p name=“bodytext” id=“izmirdescription”>
  <img name=“izmir” id=“rightfloat”>
  <p name=“navtext” id=“mainnav”>
  <h2 name=“title” class=“tt” id=“secondtitle”>
  <p name=“bodytext” id=“intro2”>
  <p name=“bodytext” id=“balcovadescription”>
```

@2016, Li Dan, Guizhou Academy of Sciences

Access Element Properties

- Most of the properties are derived from the HTML attributes of the tag
  - E.g. `id`, `name`, `href`, `alt`, `title`, `src`, etc…
- **`innerHTML`** – holds all the entire HTML code inside the element.
- Read-only properties with information for the current element and its state
  - `tagName`, `offsetWidth`, `offsetHeight`, `scrollHeight`, `scrollTop`, `nodeType`, etc…

@2016, Li Dan, Guizhou Academy of Sciences

Changing the Document

- To put information into the document:
  - Create new elements; replace, or append to, existing nodes

```
// Find thing to be replaced
var mainDiv = document.getElementById("main-page");
var orderForm = document.getElementById("target");
// Create replacement
var paragraph = document.createElement("p");
var text = document.createTextNode("Here is the new
text.");
paragraph.appendChild(text);
// Do the replacement
mainDiv.replaceChild(paragraph);
```

@2016, Li Dan, Guizhou Academy of Sciences

.innerHTML

- A property that gets or sets the text between the start and end tags
- Argument completely replaces elements' existing content
- If the new value contains HTML tags, it is parsed and formatted before being placed into the document.
- Example:

```
document.getElementById('fo‘).innerHTML=‘<p>tex</p>’
```

@2016, Li Dan, Guizhou Academy of Sciences

and

- Use to identify an element in the DOM
- Get or update its inner content.

```
<body>
    <h1>Test</h1>
    This is some normal text with
    a <span id="fo">span</span> in it.
    <div id="bar">And this is a div.</div>
    Here is some more normal text.
</body>
```

```
...
document.getElementById('fo').innerHTML = "<p>tex</p>";
...
```

@2016, Li Dan, Guizhou Academy of Sciences

DOM Events

- JavaScript can register event handlers
  - Events are fired by the browser and are sent to the specified JavaScript event handler function
  - Can be set with HTML attributes:

```
<img src="test.gif" onclick="imageClicked()" />
```

  - Can be accessed through the DOM:

```
var img = document.getElementById("myImage");
img.onclick = imageClicked;
```

@2016, Li Dan, Guizhou Academy of Sciences

DOM Events

User-Initiated

- click
- dlbclick
- keydown
- keyup
- keypress
- mouseover
- mouseout
- mousedown
- mouseup
- mousemove
- change
- resize
- scroll
- select
- blur
- focus
- reset
- submit

Browser-Initiated

- load
- unload
- error
- abort

@2016, Li Dan, Guizhou Academy of Sciences

Common DOM Events

- Mouse events:
  - onclick, onmousedown, onmouseup
  - onmouseover, onmouseout, onmousemove
- Key events: only for input fields
  - onkeypress, onkeydown, onkeyup
- Interface events:
  - onblur, onfocus
  - onscroll

@2016, Li Dan, Guizhou Academy of Sciences

Common DOM Events (2)

- Form events
  - `onchange` – for input fields
  - **`onsubmit`**
    - Allows you to cancel a form submission
    - Useful for form validation
- Miscellaneous events
  - **`onload`**, **`onunload`**
    - Allowed only for the `<body>` element
    - Fires when all content on the page was loaded / unloaded

@2016, Li Dan, Guizhou Academy of Sciences

Review: Importance Events

```
onblur        //exit field
onfocus       //entry to field
onload        //page entry
onselect      //highlight text
onchange      //data in field is edited
onclick       //when clicked on
onsubmit      //when submit form
```

@2016, Li Dan, Guizhou Academy of Sciences

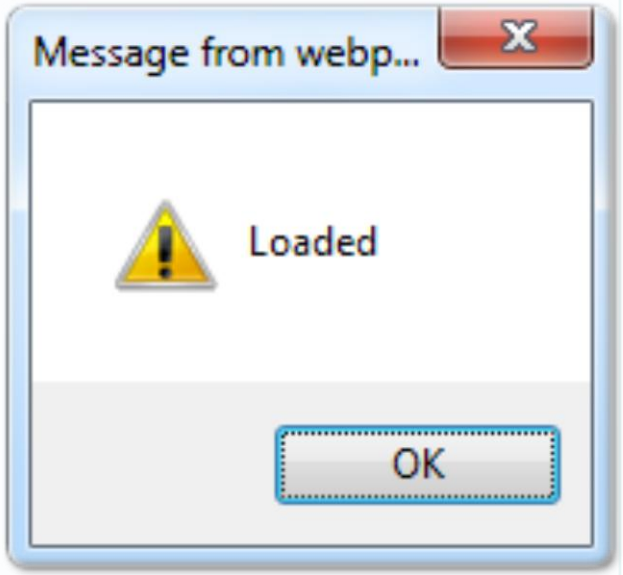
onload Event – Example

```
<html>

<head>
  <script type="text/javascript">
    function greet() {
      alert("Loaded.");
    }
  </script>
</head>

<body onload="greet()" >
</body>

</html>
```



@2016, Li Dan, Guizhou Academy of Sciences

Review: JavaScript/DOM

- A scripting language for browsers
  - Can make pages interactive w/o sending requests to server
  - Syntax is very similar to Java, but internals are very different
  - Lots of small differences between browser implementations
- JavaScript can interact with the DOM
  - Examples: Read data from forms, replace parts of the page
  - Can register event handlers with DOM elements to respond to clicks, keypresses, mouse movements, selections...

@2016, Li Dan, Guizhou Academy of Sciences

AJAX

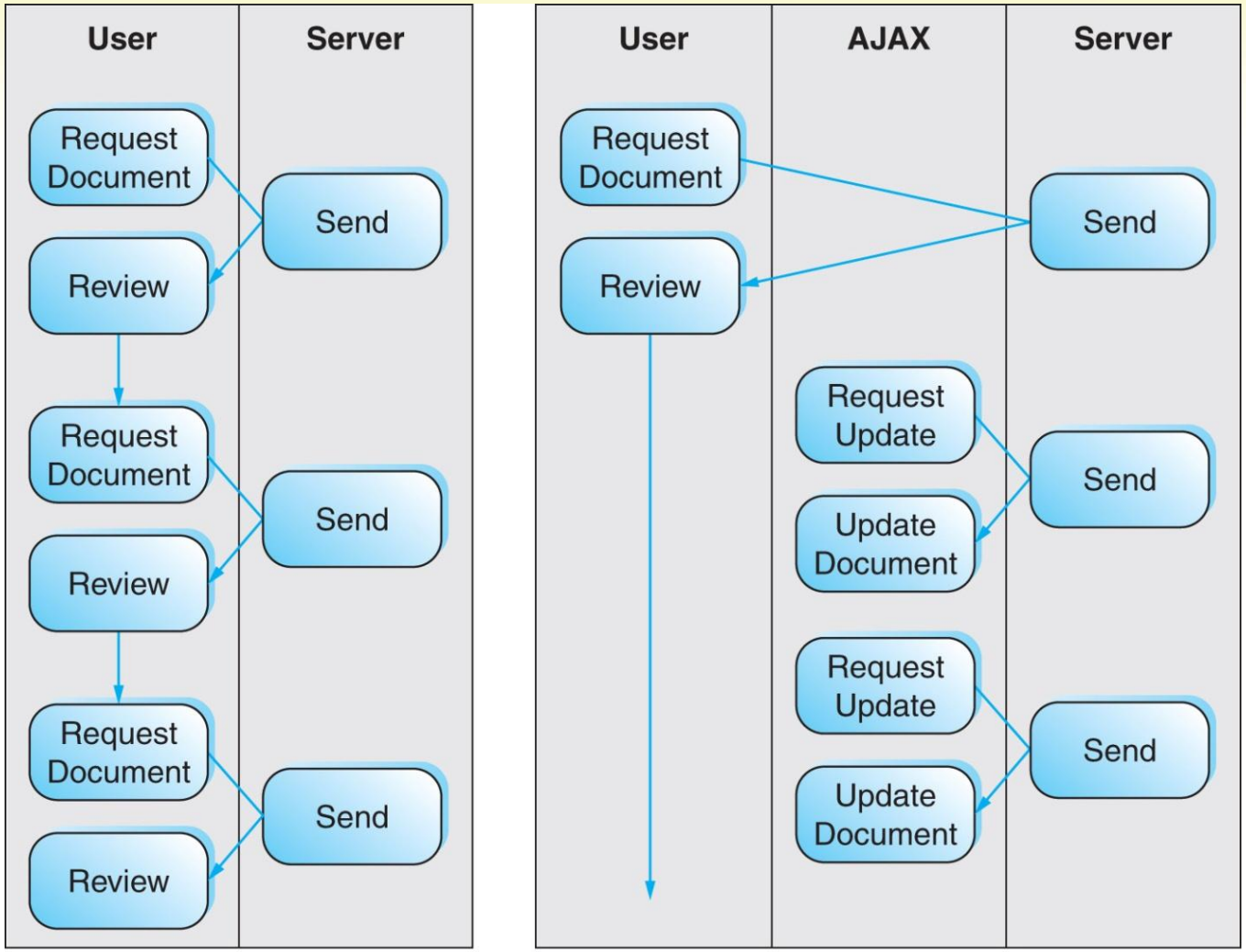
@2016, Li Dan, Guizhou Academy of Sciences

What is Ajax?

- Asynchronous JavaScript and XML
  - First mentioned by Jesse James Garrett in 2005
- Not a single technology - a mix of technologies for building faster web apps
  - HTML and CSS for presentation
  - DOM for dynamic display
  - XML or JSON for data interchange
  - XMLHttpRequest for asynchronous requests
  - JavaScript for binding everything together

@2016, Li Dan, Guizhou Academy of Sciences

Ajax



(a) Plain HTML

(b) HTML/AJAX

@2016, Li Dan, Guizhou Academy of Sciences

Ajax History

- Cornerstone for web apps.
- Invented by Microsoft; popularized by Google
- Microsoft (1999): XMLHttp with IE 5
- Support from other browsers: 2001-2004
- Gmail (2004)
- Google Maps (2005)

@2016, Li Dan, Guizhou Academy of Sciences

Advantages of Ajax

- Rich and responsive user interfaces
- Reduced HTTP traffic, increased response time.
- Merrill (2008)*:
  - -- 61% speed increase
  - -- 73% decrease in bytes transferred
- Full browser support
- Many libraries available

*Different researchers come up with different results

@2016, Li Dan, Guizhou Academy of Sciences

Disadvantages of Ajax

- Security; sandbox/server of origin
- Browser navigation tools defeated
- More complex that traditional web pages
- Increases design/development time

@2016, Li Dan, Guizhou Academy of Sciences

XMLHttpRequest

- A JavaScript object that enables web pages to dynamically load more content

- Request can be asynchronous
  - Browser performs the HTTP request in the background while the user continues to interact with the web page
  - Script defines a callback function that should be invoked when the requested content has arrived

@2016, Li Dan, Guizhou Academy of Sciences

XMLHttpRequest workflow

1. Instantiate a new XMLHttpRequest object
2. Prepare the object
   - Call open() to set the URL and the method (GET, POST, ...)
   - Can add headers, HTTP authentication, ...
   - Define a callback function that will be called by the browser when the results are available
3. Send the request
   - Invoke send(), optionally with data to submit (for POST)
4. Handle invocations of the callback function

@2016, Li Dan, Guizhou Academy of Sciences

Ajax Example

```
var xmlhttp =  new XMLHttpRequest();

xmlhttp.open('GET', url, true);

xmlhttp.onreadystatechange =  function() {
  if (xmlhttp.readyState == 4) {
    if (xmlhttp.status == 200) {
      var mess=document.getElementById(“messId”);
      mess.innerHTML = xmlhttp.responseText;
    } else
      alert('Ajax failed; status:'+xmlhttp.status);
  }
}

xmlhttp.send(null);
```

@2016, Li Dan, Guizhou Academy of Sciences

Ajax ReadyState Values

Ready State	Significance
0 Uninitialized	Request not yet opened
1 Loading	Not yet sent
2 Loaded	Sent; no information available
3 Interactive	Partial response received
4 Completed	Response complete

@2016, Li Dan, Guizhou Academy of Sciences

XMLHttpRequest properties

Property	Description
readyState	Current state of the object: 0 = UNSENT (before open() is called) 1 = OPENED (before send() is called) 2 = HEADERS_RECEIVED (header+status available) 3 = LOADING (partial data available) 4 = DONE (operation complete)
onreadystatechange	Can be assigned a function that is called whenever readyState changes (e.g., to process the response)
responseText	Response as text
responseXML	Response as a DOM document object (parsed as text/xml)
status	Status of the response (a HTTP result code, e.g. 200)
statusText	Response string returned by the server (e.g., '200 OK')

@2016, Li Dan, Guizhou Academy of Sciences

HTTP Respond Status

Status codes:

- 200 = OK
- 301 = moved permanently
- 302 = found/redirected
- 401 = unauthorized
- 403 = access denied
- 404 = not found

```
var xmlhttp = new XMLHttpRequest();
if (xmlhttp.status == 200)
```

@2016, Li Dan, Guizhou Academy of Sciences

Instantiating XMLHttpRequest for Browsers Varies

```
function getXMLHttpRequest() {
  var xmlhttp = null;
  try {xmlhttp = new XMLHttpRequest(); }
    catch(err1) {
       try{xmlhttp=new ActiveXObject("Microsoft.XMLHTTP"); }
       catch(err2) {
         try {xmlhttp = new ActiveXObject("Msxml2.XMLHTTP"); }
         catch(err3) {xmlhttp = null; }
       }
    }
    if (xmlhttp == null) alert("Error creating xmlhttp !");

   return xmlhttp;
}
```

@2016, Li Dan, Guizhou Academy of Sciences

Popular JavaScript Libraries

- **jQuery.** One of the most popular libraries. It is lightweight and focused on encapsulating events and Ajax, providing a convenient shortcut to the `getElementById` function, and supplying user interface effects.
- **Prototype.** It has fundamental support for events and Ajax, and has similar—but more extensive—shortcuts for accessing elements of web page; but the differentiator is that Prototype emphasis on classes and it support object oriented design using inheritance.
- **Dojo.** Dojo starts out with basic support for events and Ajax, and adds widgets—little collections of JavaScript, CSS, and HTML that together create a visual user interface object for displaying or manipulating data. The widgets developed for the library cover a wide range of needs: menus, sortable tables, drag-and-drop trees, calendars, faders, charts, etc.

@2016, Li Dan, Guizhou Academy of Sciences

Ajax without XML

- Despite its name, XMLHttpRequest can handle content other than XML
- JSON is another option to exchange data between client and server

@2016, Li Dan, Guizhou Academy of Sciences

JSON

@2016, Li Dan, Guizhou Academy of Sciences

JSON: JavaScript Object Notation

- Data interchange format
- Passes objects as strings from server to client
- Basic form: uses *name : value* pairs
- Strings in quotes; numbers not

```
{“firstname”: “Wang”}

firstname = “Wang”;
```

```
var student={“name”: “Ali”, “age”: 20, “major”: “MBBF” };

var nm1=student.name;
var nm2=student[“name”];
```

@2016, Li Dan, Guizhou Academy of Sciences

JSON

- Curly brackets define entities
- Square brackets define arrays of entities

```
var students = [
   {“name”:“Ali”, “age”:20, “major”:“MBBF” },
   {“name”:“Bahar”, “age”:21, “major”:“ITF”}
];

var ag=students[1].age;
```

@2016, Li Dan, Guizhou Academy of Sciences

Working with JSON

- On the client side:
  - Request data from the server
  - When the server returns JSON-encoded string, parsed with JSON.parse( ) and got a JSON object
- On the server side:
  - In the route callback, use JSON.stringify() to serialize a got a JSON object into a string
  - Send the string to then client

@2016, Li Dan, Guizhou Academy of Sciences