Development of Web Applications
Principles and Practice

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Client Technologies

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Today’s agenda

- HTML, CSS and DOM
- JavaScript
- AJAX
- JSONP
- HTML5
- WebSockets
HTML, CSS and DOM
HTML  HyperText Markup Language

Terminology:

**Element:**

```html
<a href="http://example/">example</a>
```

**Tag:** `a`

**Attribute:** `href="http://example/"`

**Character entity reference:** `&amp; &lt;&lt;38;`

History:
<!DOCTYPE html>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=utf-8">
<link rel="stylesheet" type="text/css" href="resources/main.css">
<link rel="shortcut icon" href="resources/icon.png">
<script type="text/javascript" src="resources/main.js"></script>
<title>Title of the Page</title>
</head>
<body onload="vtst.onload();" lang="fr">
...
</body>
</html>
DOM Document Object Model

Document Object Model (DOM) is a language-independent API for manipulating HTML and XML documents. The HTML/XML document is manipulated as a tree, whose nodes are elements, attributes, and text. DOM also supports an event model. There are four levels of the DOM specification: Level 1 was released in 1998, Level 2 in 2000, Level 3 in 2004, and Level 4 is currently in development.
DOM Tree
DOM Example

HTML Document:

```html
<body>
    <a href="hello.html">Hello!</a>
</body>
```

Equivalent in DOM:

```javascript
a = document.createElement("a");
t = document.createTextNode("Hello!");
a.setAttribute("href", "hello.html");
document.body.appendChild(a);
```
DOM Events (level 0)

Inline model (in HTML):

```html
<a href="..."
    onclick="alert('Hello!');">Hello</a>
```

Traditional model (in JavaScript):

```javascript
element.onclick = function() {
    alert('Hello!');
    return false;  // prevent the default action
}
```
```javascript
document.addEventListener("click", function(event) {
    alert('Hello!');
    event.preventDefault();
}, false);
```
DOM Events (level 2): propagation

\[<a>&lt;b&gt;... &lt;/b&gt;&lt;/a&gt;\]

capture \texttt{true} \ addEventHandl er

bubbling \texttt{false} \ addEventHandl er
CSS  Cascading Style Sheets

CSS (Cascading Style Sheets) is a style sheet language used for describing the presentation semantics (the look and formatting) of a document written in a markup language (e.g., HTML, but also SVG, XUL, etc.).

5 levels (1, 2, 2.1, 3, and 4):

- Level 1 was published in 1996,
- Level 2.1 is the current standard (1998-2011),
- Level 3 is under implementation by most major browsers (2012-...),
- Level 4 is under development.
#name .class {
  font-family: sans-serif;
  color: red;
  background-color: #0f0;
}

a { text-decoration: none; }

a:hover { text-decoration: underline; }
The power of CSS selectors in DOM

```javascript
subElement = element.querySelector("#id .class");
subElements = element.querySelectorAll("a.class")
```
JavaScript
JavaScript

- prototype-based
- dynamic typing
- first-class functions
Prototypes

Prototypes use prototypes where many other OO languages use classes for inheritance.

A prototype is a function with a prototype property. A method is a function.

```javascript
MyClass = function() {
    // constructor
};

MyClass.prototype.myMethod = function() {
    // method
};

var myObject = new MyClass();
myObject.myMethod();
```
JavaScript minification and compilation

Why?

How?

Tools:
AJAX
AJAX Asynchronous JavaScript and XML

With AJAX, a JavaScript script can send data to, and retrieve data from, a server asynchronously (in the background) without interfering with the display and behavior of the existing page.

Despite the name, the use of XML is not required. In fact, JSON is much more popular.
var xhr = new XMLHttpRequest();
xhr.open('get', 'http://example/method');

xhr.onload = function() {
  // Ready state 4 means the request is done
  if (xhr.readyState === 4) {
    if(xhr.status === 200){
      alert('Success: ' + xhr.responseText);
    } else {
      alert('Error: ' + xhr.status);
    }
  }
}

xhr.send(null);
AJAX: XML or JSON response

XML response:
xhr.responseTextType = "document";
xhr.responseXML.documentElement

JSON response:
xhr.responseTextType = "json";
eval(xhr.responseText)
Same origin policy

AJAX requests can be made only to URLs of the same domain (host and port) as the page. AJAX is hence useful for communication with the server of a web application, but not for doing calls to a third-party API. For remote API calls, several workarounds are used:

- JSONP (by far the most popular),
- Using the application server as a proxy (costly),
- Iframes / using the URL to communicate (tricky),
- Messages (the clean way, in HTML5).
JSONP
JSONP  JSON with Padding

How it works?

```html
<script>
    <script type="application/javascript"
        src="http://directory/?id=42">
        callback({
            "id": 42,
            "name": "Vincent Simonet"
        });
    </script>
</script>
```
The name of the padding is usually passed as an argument in the request:

```javascript
<script type="application/javascript" src="...?id=42&jsonp=mycallback">
mycallback({"id": 42,
    "name": "Vincent Simonet"});

$.ajax({url : 'http://.../?id=42',
    dataType : 'jsonp',
   jsonp : 'jsonp',
    success : function(data){}
});
```
JSONP limitations

- Only GET (POST is doable, but tricky),
- No access to HTTP headers (in request and response), including cookies.
HTML5
What is HTML5?

- The 5th version of the HTML language, subsuming HTML 4.01 and XHTML 1.1
- New/extended markup
- A galaxy of APIs
Specification status at the beginning of 2013
## Implementation status

<table>
<thead>
<tr>
<th>Source</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chrome 29</td>
<td>463/500</td>
</tr>
<tr>
<td>Opera 16</td>
<td>442/500</td>
</tr>
<tr>
<td>Firefox 24</td>
<td>414/500</td>
</tr>
<tr>
<td>Safari 6.0</td>
<td>378/500</td>
</tr>
<tr>
<td>Internet Explorer 10</td>
<td>320/500</td>
</tr>
</tbody>
</table>
Main HTML5 features

- Semantic tags,
- Improved forms,
- Microdata,
Tags in HTML5

- `<div>` `<span>`
- `<nav>` `<header>` `<footer>` `<section>`
- `<hgroup>` `<article>` `<aside>` `<time>`
- `<mark>`
- `<object>`
- `<audio>` `<video>`
- `<font>` `<center>` `<strike>` `<tt>`

(non-exhaustive list)
Improved forms

New input types:

```html
<input type="color" name="favcolor">
<input type="number" name="quantity" min="1" max="5">
```

New input attributes:

New elements: `<datalist>`, `<keygen>`, `<output>`
WebSockets
The problem

client
Workaround solutions

- The client can make periodic requests to the server,
- The client can make a request to the server, which will answer with an "infinite" response. Known as Comet.
- Several implementations:
  - Streaming (using iframe or special XmlHttpRequest),
  - Long polling (using XmlHttpRequest or script tags).
The HTML5 solution: WebSockets

WebSocket is a protocol providing full-duplex communications channels over a single TCP connection.

Enables a stream of messages. Its only relationship to HTTP are:

- its handshake is interpreted by HTTP servers as an Upgrade request,
- it is using port 80 as default port.
WebSocket protocol handshake

Request:
GET /mychat HTTP/1.1
Host: server.example.com
Upgrade: websocket
Connection: Upgrade
Sec-WebSocket-Key: x3JJHMbDL1EzLkh9GBhXDw==
Sec-WebSocket-Protocol: chat
Sec-WebSocket-Version: 13
Origin: http://example.com

Response:
HTTP/1.1 101 Switching Protocols
Upgrade: websocket
Connection: Upgrade
Sec-WebSocket-Accept: HSmrc0sM YUkAGm5OPpG2HaGWk=
Sec-WebSocket-Protocol: chat
var connection = new WebSocket('ws://.../echo',
['soap', 'xmpp']);

connection.onopen = function () {
    connection.send('Ping');
};

connection.onerror = function (error) {
    console.log('WebSocket Error ' + error);
};

connection.onmessage = function (e) {
    console.log('Server: ' + e.data);
};
Server-side implementations

- Java: Jetty
- Node.js: ws, WebSocket-Node
- Python: pywebsocket