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Introduction to XML
Extensible Markup Language

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What is XML

- XML stands for eXtensible Markup Language.
- A markup language is used to provide information about a document.
- Tags are added to the document to provide the extra information.
- HTML tags tell a browser how to display the document.
- XML tags give a reader some idea what some of the data means.

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What is XML Used For?

- XML documents are used to transfer data from one place to another often over the Internet.
- XML subsets are designed for particular applications.
- One is RSS (Rich Site Summary or Really Simple Syndication). It is used to send breaking news bulletins from one web site to another.
- A number of fields have their own subsets. These include chemistry, mathematics, and books publishing.
- Most of these subsets are registered with the W3Consortium and are available for anyone's use.

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Advantages of XML

- XML is text (Unicode) based.
  - Takes up less space.
  - Can be transmitted efficiently.
- One XML document can be displayed differently in different media.
  - Html, video, CD, DVD,
  - You only have to change the XML document in order to change all the rest.
- XML documents can be modularized. Parts can be reused.

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Example of an HTML Document

```
<!Doctype html>
<html>
   <head><title>Example</title></head.
<body>
   <h1>This is a large header<h1>
   <h2>Smaller header is here</h2>
</body>
</html>
```

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Example of an XML Document

```
<?xml version="1.0" encoding="UTF-8"?>
<html>
   <head><title>Example</title></head>
<body>
   <h1>This is a large header</h1>
   <h2>Smaller header is here</h2>
</body>
</html>
```

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Typical example of an XML Document

```
<?xml version="1.0" encoding="UTF-8"?>
<address>
    <name>Alice Person</name>
    <email>aPerson@aol.com</email>
    <phone>212-346-1234</phone>
    <birthday>1985-03-22</birthday>
</address>
```

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Difference Between HTML and XML

- HTML tags have a fixed meaning and browsers know what it is.
- XML tags are different for different applications, and users know what they mean.
- HTML tags are used for display.
- XML tags are used to describe documents and data
  - NB They can be styled using XSL (XML Style Language) and transformed using XSLT (XSL Transformations).

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XML Rules

- Tags are enclosed in angle brackets.
- Tags come in pairs with start-tags and end-tags.
- Tags must be properly nested.
  - **<name><email>…</name></email> is not allowed.**
  - **<name><email>…</email><name> is.**
- Tags that do not have end-tags must be terminated by a ‘/’.
  -
 is an html example.

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More XML Rules

- Tags are case sensitive.
  - **<address> is not the same as <Address>**
- XML in any combination of cases is not allowed as part of a tag.
- Tags may not contain ‘<‘ or ‘&’.
- Tags follow Java naming conventions, except that a single colon and other characters are allowed. They must begin with a letter and may not contain white space.
- Documents must have a single *root* tag that begins the document.

Encoding

- XML (like Java) uses Unicode to encode characters.
- Unicode comes in many flavors. The most common one used in the West is UTF-8.
- UTF-8 is a variable length code. Characters are encoded in 1 byte, 2 bytes, or 4 bytes.
- The first 128 characters in Unicode are ASCII.
- In UTF-8, the numbers between 128 and 255 code for some of the more common characters used in western Europe, such as ã, á, å, or ç.
- Two byte codes are used for some characters not listed in the first 256 and some Asian ideographs.
- Four byte codes can handle any ideographs that are left.
- Those using non-western languages should investigate other versions of Unicode.

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Well-Formed Documents

- An XML document is said to be well-formed if it follows all the rules.
- An XML parser is used to check that all the rules have been obeyed.
- Recent browsers such as Internet Explorer 5 and Netscape 7 come with XML parsers.
- Parsers are also available for free download over the Internet. One is Xerces, from the Apache open-source project.
- Java 1.4 also supports an open-source parser.

XML Example Revisited

```
<?xml version=“1.0” encoding="UTF-8"?>
<address>
    <name>Alice Person</name>
    <email>aPerson@aol.com</email>
    <phone>212-346-1234</phone>
     <birthday>1985-03-22</birthday>
 </address>
```

- Markup for the data aids understanding of its purpose.
- A flat text file is not nearly so clear.

Alice Person
aPerson@aol.com
212-346-1234
1985-03-22

- The last line looks like a date, but what is it for?

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Expanded Example

```
<?xml version = “1.0” encoding="UTF-8"?>
<address>
    <name>
        <first>Alice</first>
        <last>Person</last>
    </name>
    <email>aPerson@aol.com</email>
    <phone>123-45-6789</phone>
    <birthday>
        <year>1983</year>
        <month>07</month>
        <day>15</day>
    </birthday>
</address>
```

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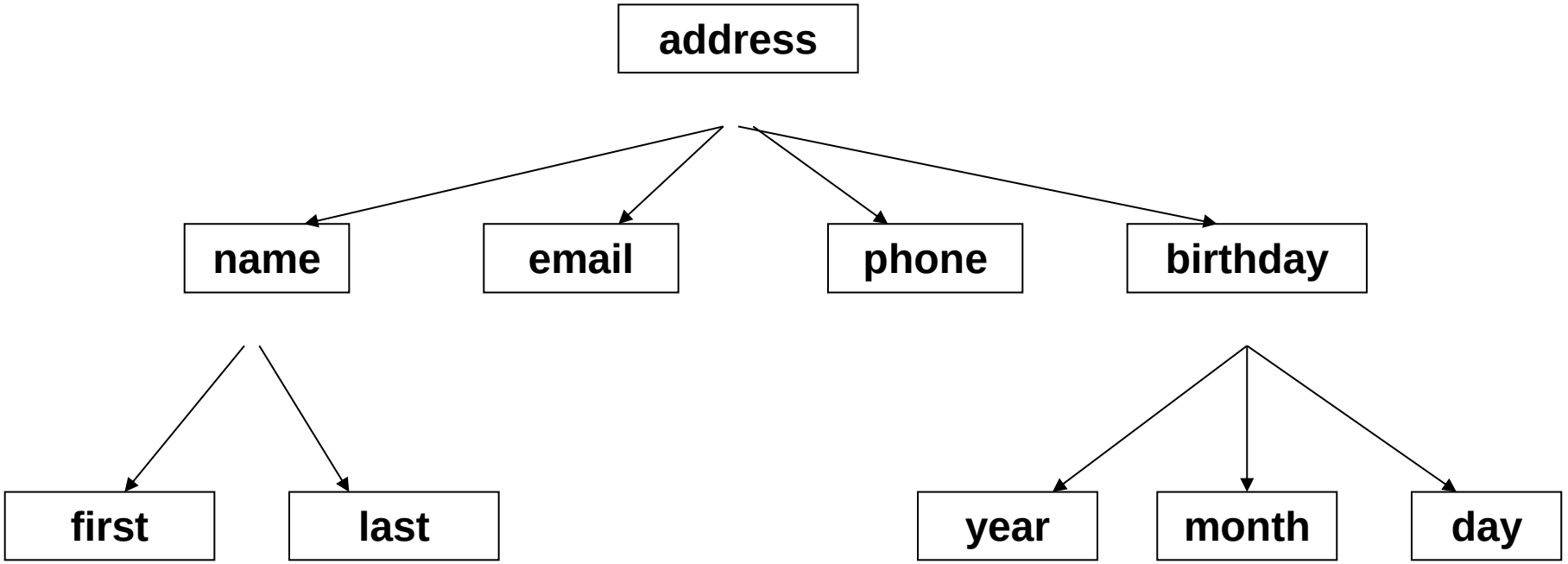
XML Files are Trees



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XML Trees

- An XML document has a single root node.
- The tree is a general ordered tree.
  - A parent node may have any number of children.
  - Child nodes are ordered, and may have siblings.
- Preorder traversals are usually used for getting information out of the tree.

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Validity

- A well-formed document has a tree structure and obeys all the XML rules.
- A particular application may add more rules in either a DTD (document type definition) or in a schema.
- Many specialized DTDs and schemas have been created to describe particular areas.
- These range from disseminating news bulletins (RSS) to chemical formulas.
- DTDs were developed first, so they are not as comprehensive as schema.

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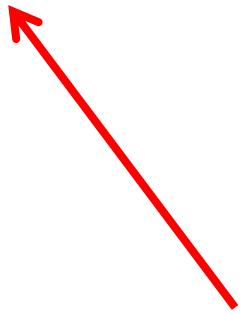
rss – xml file

```
<?xml version="1.0" encoding="UTF-8"?>
<rss>
   <channel>
      <item>
            <title>NYT Health</title>
            <link>http://www.nytimes.com/services/xml/rss/nyt/Research.xml</link>
      </item>
      <item>
            <title>CNN Entertainment</title>
            <link>http://rss.cnn.com/rss/cnn_showbiz.rss</link>
      </item>
      <item>
            <title>Flickr current images</title>
            <link>http://api.flickr.com/services/feeds/photos_public.gne?format=rss2</link>
      </item>
   </channel>
</rss>
```

usernames.xml example with ***styling***

```
<?xml version="1.0" ?>
<?xml-stylesheet type="text/xsl" href="usernames.xsl"?>
  <employees>
     <employee employee_id="ggl101">
       <FirstName>Jenny</FirstName>
       <LastName>Elisibirt</LastName>
       <gender>Female</gender>
     </employee>
     <employee employee_id="ggl121">
       <FirstName>Alfa</FirstName>
       <LastName>Romeo</LastName>
       <gender>Male</gender>
     </employee>
  </employees>
```



Name of the style file

usernames.xsl

```
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform" version="1.0">
<xsl:output method="text"/>

<xsl:template match="globalGuideLine">
  <xsl:apply-templates>
    <xsl:sort select="FirstName"/>
  </xsl:apply-templates>
</xsl:template>

<xsl:template match="employee">
  Employee ID:  <xsl:apply-templates select="@employee_id"/>
  First Name:   <xsl:apply-templates select="FirstName"/>
  Last Name:    <xsl:apply-templates select="LastName"/>
  Gender:       <xsl:apply-templates select="gender"/>
  <br/>
  <xsl:text>
  </xsl:text>
</xsl:template>

</xsl:stylesheet>
```

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Introduction to JSON Data

(sometimes referred to as the x in AJAX – javascript joke!)

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Data Interchange

- The key idea in Ajax.
- An alternative to page replacement.
- Applications delivered as pages.
- How should the data be delivered?
  - Variety of data formats around
  - Already seen the ***AJAX message pattern*** at play in the lab with text, partial html, XML and **JSON**

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JSON

- JavaScript Object Notation
- Minimal
- Textual
- Subset of JavaScript
- A Subset of ECMA-262 Third Edition.
- Language Independent,
  - available in many natural languages and programming languages
- Light-weight
- Easy to parse
  - **JSON is not a markup language.**

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JavaScript Object Notation (JSON)

- Standard for “serializing” data objects, usually in files
- Human-readable, useful for data interchange
- Also useful for representing & storing semistructured data

```
[ {
   "title": "My First entry",
   "slug": "first-entry",
   "description": "Lorem ipsum dolor sit amet.",
   "text": "Lorem ipsum dolor sit amet...",
   "timeCreated": "20/08/1989 12:45",
   "author": "John Doe"
  },
  {
   "title": "My Second entry",
   "slug": "second title entry",
…
```

JavaScript Object Notation (JSON)

- No longer tied to JavaScript
- Parsers for many languages

```
[ {
   "title": "My First entry",
   "slug": "first-entry",
   "description": "Lorem ipsum dolor sit amet.",
   "text": "Lorem ipsum dolor sit amet...",
   "timeCreated": "20/08/1989 12:45",
   "author": "John Doe"
  },
  {
   "title": "My Second entry",
   "slug": "second title entry",
…
```

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Object

- Objects are unordered containers of key/value pairs
- Objects are wrapped in `{ }`
- `,` separates key/value pairs
- `:` separates keys and values
- Keys are strings
- Values are JSON values
  - struct, record, hashtable, object

Object

```
{ "name":"CSWD",
"exam in module": true,
"grade":"honours",
"level":4,
"format":{
      "type":"elective",
      "lectures":true,
      "tutorials":false }
}
```

```
{
 "Books": [
  {
     "ISBN": "ISBN-0-59-651774-2",
     "Price": 20,
     "Edition": 1,
     "Title": "JavaScript: The Good Parts",
     "Authors": [
        {
           "First_Name": "Douglas",
           "Last_Name": "Crockford"
        }
     ]
  }
 ],
 "Magazines": [
  {
     "Title": "National Geographic",
     "Month": "January",
     "Year": 2008
  },
  {
     "Title": "Newsweek",
     "Month": "February",
     "Year": 2009
  }
 ]
}
```

Basic constructs (recursive)

- Base values

  number, string, boolean, …

- Objects { }

  sets of label-value pairs

- Arrays [ ]

  lists of values

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Array

- Arrays are ordered sequences of values
- Arrays are wrapped in `[]`
- `,` separates values
- JSON does not talk about indexing.
  - An implementation can start array indexing at 0 or 1.

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Array

```
["Sunday", "Monday", "Tuesday", "Wednesday",
   "Thursday", "Friday", "Saturday"]


[
    [0, -1, 0],
    [1, 0, 0],
    [0, 0, 1]
]
```

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Arrays vs Objects

- Use objects when the key names are arbitrary strings.
- Use arrays when the key names are sequential integers.

MIME Media Type

`application/json`

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Relational Model versus JSON

	Relational	JSON
Structure	Tables	Nested Sets Arrays
Schema	Fixed in advance	"self-describing" Flexible
Queries	Simple expressive languages	∅ widely used
Ordering	None.	Arrays.
Implementation	Native systems.	Coupled with PLs. NoSQL Systems.

JSON - XML

```
<?xml version="1.0" encoding="UTF-8" ?>
<Books>
        <ISBN>ISBN-0-59-651774-2</ISBN>
        <Price>20</Price>
        <Edition>1</Edition>
        <Title>JavaScript: The Good Parts</Title>
        <Authors>
                <First_Name>Douglas</First_Name>
                <Last_Name>Crockford</Last_Name>
        </Authors>
</Books>
<Magazines>
        <Title>National Geographic</Title>
        <Month>January</Month>
        <Year>2008</Year>
</Magazines>
<Magazines>
        <Title>Newsweek</Title>
        <Month>February</Month>
        <Year>2009</Year>
</Magazines>
```

Q[2]. Why is this XML file not **Well-Formed**?

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XML versus JSON

	XML	JSON
Verbosity	More	Less
Complexity	More	Less
Validity	DTDs widely used XSDs	JSON Schema not widely used
Prog. Interface	Clunky "Impedence mismatch"	More direct
Querying	XPath - XQuery XSLT -	JSON Path JAQL JSON Query

Syntactically valid JSON

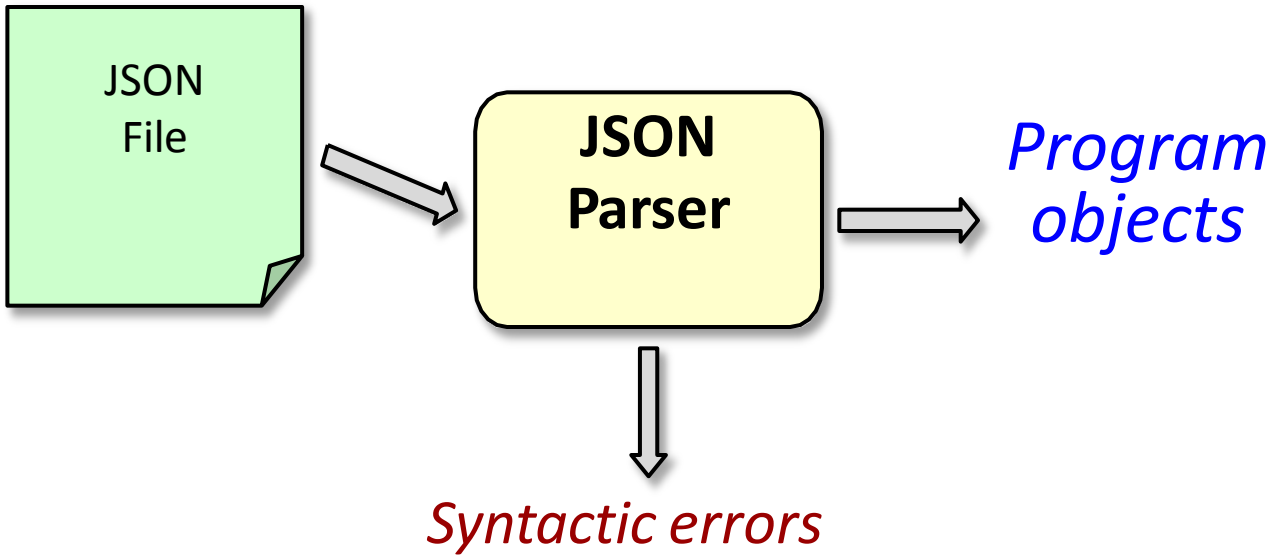
```
{
 "Books": [
  {
     "ISBN": "ISBN-0-59-651774-2",
     "Price": 20,
     "Edition": 1,
     "Title": "JavaScript: The Good Parts",
     "Authors": [
        {
           "First_Name": "Douglas",
           "Last_Name": "Crockford"
        }
     ]
  }
 ],
 "Magazines": [
  {
     "Title": "National Geographic",
     "Month": "January",
     "Year": 2008
  },
  {
     "Title": "Newsweek",
     "Month": "February",
     "Year": 2009
  }
 ]
}
```

Adheres to basic structural requirements

- Sets of label-value pairs
- Arrays of values
- Base values from predefined types

Adheres to basic structural requirements

- Sets of label-value pairs
- Arrays of values
- Base values from predefined types



supplant

```
var template = '<table border="{border}">' +
    '<tr><th>Last</th><td>{last}</td></tr>' +
    '<tr><th>First</th><td>{first}</td></tr>' +
    '</table>';

var data = {
    "first"  : "Jane",
    "last"   : "Doe",
    "border" : "2"
};

mydiv.innerHTML = template.supplant(data);
```

supplant

```
String.prototype.supplant = function (o) {
    return this.replace(/{([^{}]*)}/g,
        function (a, b) {
            var r = o[b];
            return typeof r === 'string' ?
                r : a;
        }
    );
};
```

Data Data Everywhere but not a drop to use!

- Where/How do we store this data?

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Why Local Storage?

- Data accessed over the internet can never be as fast as accessing data locally
- Data accessed over internet not secure
- HTML5 storage is **on client**

Persistent Local Storage

- Native client applications use operating system to store data such as preferences or runtime state
- Stored in registry, INI files, XML or other places using key/value pairs
- Web applications can’t do this

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Cookies

- Invented early in Web's history as a way to store persistent data ("magic cookies")
- Small pieces of information about a user stored by Web server as text files on user's computer
- Can be temporary or persistent

Cookies

- Included with every HTTP request – slows down application by transmitting same information repeatedly
- Sends unencrypted data over internet with every HTTP request
- Limited to 4KB data
- Example: filling out a text form field

Cookies not enough

- More storage space
- On the client
- Beyond page refresh
- Not transmitted to server

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HTML5 Storage

- Provides standardized API
- Implemented natively
- Consistent across browsers
- HTML5 storage is a specification named “Web Storage”
  - Previously part of HTML5 specifications
  - Split into its own specification
  - Different browsers may call it “Local Storage” or “DOM Storage”

Web Application Support

- Supported by latest version of all browsers!

IE 8+	Firefox 3.5+	Safari 4.0+	Chrome 4.0+	Opera 10.5+	IPhone 2.0+	Android 2.0+

- window object
- Before using, detect whether browser supports it

Check for HTML5 Storage

```
function supports_html5_storage() {
        try {
          return 'localStorage' in window
          && window['localStorage'] !== null;
        } catch (e) {
           return false;
        }
      }
```

Or use Modernizr

```
if (Modernizr.localstorage) {
   // window.localStorage is available!
} else {
   // no native support for HTML5 storage :(
   // maybe try dojox.storage or a third-party solution
}
```

Using HTML5 Storage example

localstorage object

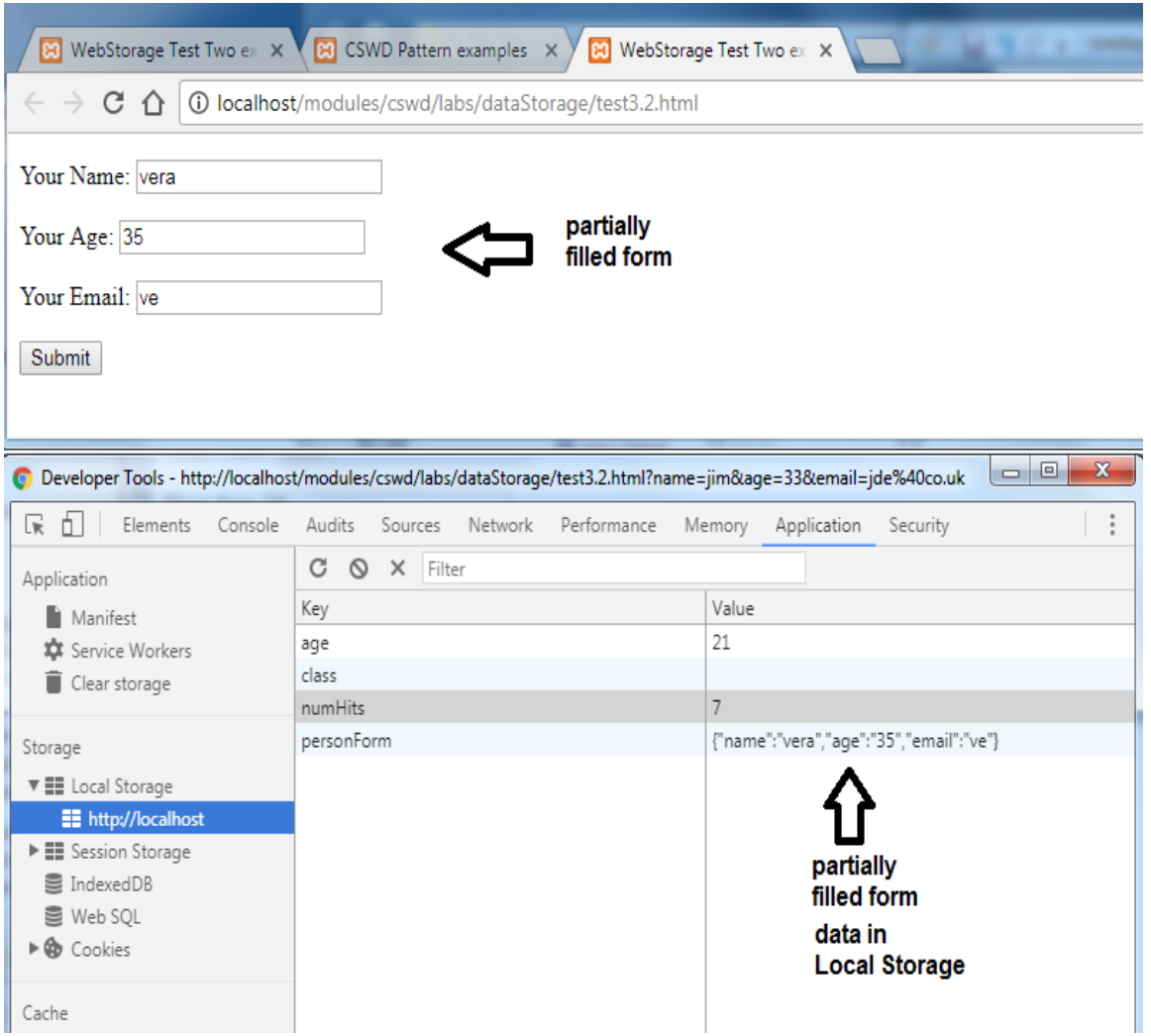
setItem( )

getItem( )

removeItem( )

clear( )

Image opposite shows partial completed form!



Using HTML5 Storage

Tracking changes to the HTML5 storage area

```
if (window.addEventListener) {
  window.addEventListener("storage", handle_storage, false);
} else {
  window.attachEvent("onstorage", handle_storage);
};
```

Using HTML5 Storage

Tracking changes to the HTML5 storage area

The handle_storage callback function will be called with a StorageEvent object, except in Internet Explorer where the event object is stored in window.event.

```
function handle_storage(e) {
  if (!e) { e = window.event; }
}
```

Using HTML5 Storage

StorageEvent Object

PROPERTY	TYPE	DESCRIPTION
`key`	string	the named key that was added, removed, or modified
`oldValue`	any	the previous value (now overwritten), or `null` if a new item was added
`newValue`	any	the new value, or `null` if an item was removed
`url`*	string	the page which called a method that triggered this change

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Using HTML5 Storage

- Limitations in current browsers:
- 5 MB of storage from each origin.
- Can not ask user for more storage (except for Opera, sort of)

Beyond Key/Value Pairs: Competing Visions

Indexed Database API

Formerly known as WebSimpleDB

Now colloquially referred to as “indexedDB”

Next Week