Assignment #7
(1/2)
- Due: 01/03/2013
- Assuming everyone has completed assignment #6 (thus we’ve completed a 2-tier application)
- In this assignment, we’re going to build a static website (without database connectivity) using Microsoft Expression Web.
  - Choose Expression Studio 4 Ultimate or Expression Studio 4 Web Professional

Assignment #7
(2/2)
- Please use Microsoft Expression Web’s template to create a website for your company.
  - Please assume you’re starting up a business and try to make a good corporate image on the web. (in other words, make it pretty!)
  - Please include all web pages for your core function. For now, just leave them as blank or “under construction”.
  - Note: TRY TO BE CURIOUS
  - Try observe HTML codes and CSS generated by Expression Web to familiarize yourself with HTML. If you are already familiar with HTML, try to predict what kind of tags Expression Web will generate for you.
  - Try to be curious about the functions & formats provided by Expression Web.

Assignment #8
(1/2)
- Based on the static website that you’ve built in assignment #7, dynamic content based on information from database is to be added in this assignment.
  - Database is the same as in assignment #6.
  - Basic functions required are listed in the next page (copied from assignment #6) are to be implemented using Microsoft Expression Web.
  - As in assignment #6, two or more extra functions not on the next page’s list should be implemented.
- Due: 01/17/2013

Assignment #8
(2/2)
- Add/change/remove a book information in the database.
- Add/change/remove a user in the trading system.
- Add/change/remove a sale/buy advertisement in the system.
- Add/change/remove a trading (history) in the system.
- Search for a used textbooks in the trading system.
  - By at least four different methods (e.g. by user, by price, by program, …)
- Final presentation on 1/17/2013
  - Each company should prepare a 15 – 20 minutes presentation. The content includes at least the following:
    - Business model (20%)
    - 2-tier application functionality (40%) 
    - 3-tier web site functionality (40%)

Today’s Topic
- Introduction to Web Services
- Web Service Requirements
- SOAP web service
  - XML
  - WSDL
  - SOAP
- REST-style web service
Current Status

- Software concept → requirement analysis → architecture design → detailed design → implementation
- We’ve programmed a desktop application and are going to develop a web application for maintain user data, used computer part information, and trading used parts.
- What is left to do?
  - Verification & validation
  - Electronic payment → data exchange with credit card agency or banks
  - Vertical integration: integrate your supplier, shipping company, ... → data exchange with your partners
- Issues
  - Data format (middleware), security, ...

Introduction

- Web services are services for applications.
  - Web pages and web applications are services for people
  - Can be seen as objects or function calls offered through the Internet using protocols developed for the Web.
  - Web services can be located anywhere on the planet Earth.
- We can use web services to integrate different information systems and applications through the Internet.

Web Service Requirements

- **Standard RPC mechanism**
  - HTTP is the most popular protocol and has been widely adopted on most platforms.
- **Standard data format**
  - Binary data is hardware dependent and difficult to debug (human unreadable) → use human-readable data format.
  - The data format needs to be extensible for all kinds of purposes (image, video, text, data record, map, ...)
- **Standard service description language**
  - Describe information that the web service is needed and returns
- **Standard service discovery mechanism**
  - Helps programmers find needed service for his/her applications

Two commonly used standards?

- **SOAP Web Service**
  - XML as data format
  - SOAP as RPC mechanism
  - UDDI for service discovery
  - WSDL for service description
- **REST-Style Web Service**
  - A style, not a standard for RPC mechanism
  - Data format are often JSON or XML.
  - No formal description or discovery mechanism

Data Format
XML

eXtensible Markup Language

• A markup language (recall HTML) that has tags enclosing data.
  – Tags: meaningful named tags to describe data enclosed.
  – Everything is in human-readable format.

```
<BOOK>
  <AUTHOR> Aho, A. V. </AUTHOR>
  <AUTHOR> Sethi, R. </AUTHOR>
  <AUTHOR> Ullman, J. D. </AUTHOR>
  <TITLE> Compilers: Principles, Techniques, and Tools </TITLE>
  <PUBLISHER> Addison-Wesley </PUBLISHER>
  <YEAR> 1985 </YEAR>
</BOOK>
```

Introduction

• Today, we have a lot of information on web pages (HTML). However, the data is difficult to be reused.
  – Mixed data and presentation

```
<note>
  <to> Tove </to>
  <from> Jani </from>
  <heading> Reminder </heading>
  <body> Don't forget me this weekend! </body>
</note>
```

XML Example

1. XML Declaration (Prolog), including XML version and encoding
2. Root element: note, date is its attribute, "12/11/2002" is an attribute value for the attribute date.
3. - 6: 4 child elements of the root
7: closing tag

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<note date="12/11/2002">
  <to> Tove </to>
  <from> Jani </from>
  <heading> Reminder </heading>
  <body> Don't forget me this weekend! </body>
</note>
```

XML vs. HTML

• XML contains only data. HTML mixes data with presentation (<H1>, <I> ...)
• XML has no predefined tags. HTML tags are pre-defined so web browsers know how to render a HTML document.
• Both XML & HTML are human-readable, machine-independent text files.
• XML has more strict syntax than HTML
  – all elements must have a closing tag
  – Elements must be properly nested
  – Attribute values must be quoted
• Tags in XML are case-sensitive; HTML is case insensitive.
• XHTML  eXtensible HyperText Markup Language, should (not happening) replace HTML. Nearly identical to HTML 4.01. HTML 5.0 finalizing ...
  – XHTML elements must be properly nested
  – XHTML documents must be well-formed
  – Tag names must be in lowercase
  – All XHTML elements must be closed
Relationships

```xml
<book>
  <title>My First XML</title>
  <prod id="33-657" media="paper"></prod>
  <chapter>Introduction to XML</chapter>
  <para>What is HTML</para>
  <para>What is XML</para>
</book>
```

- Root element: book
- Child elements of book: title, prod, chapter
- Title, prod, chapter are siblings (or sister elements)

Element Contents

- Elements can have different content types.
  - An XML element is everything from (including) the element's start tag to (including) the element's end tag.
  - An element can have element content, mixed content, simple content, or empty content. An element can also have attributes.
  - In the previous example
    - Book has element content, because it contains other elements.
    - Chapter has mixed content (text + other elements).
    - Para has simple (text) content because it contains only text.
    - Prod has empty content, because it carries no information.
    - Prod element has attributes. The attribute named id has the value "33-657". The attribute named media has the value "paper".

Element Naming & Attribute

- Element Naming
  - Names can contain letters, numbers, and other characters
  - Names must not start with a number or punctuation character
  - Names must not start with the letters xml (or XML or Xml ..)
  - Names cannot contain spaces
- Attribute
  - `<img src="computer.gif">`
  - Provide information that is not a part of the data. In the example below, the file type is irrelevant to the data
  - `<file type="gif">computer.gif</file>`
  - Values of attributes must be enclosed by quotes (single or double)
  - If values contain double quote, then single quotes must be used.
  - If values contain single quote, then double quotes must be used.

```
<gangster name='George "Shotgun" Ziegler'>
  <gangster name="George 'Shotgun' Ziegler">
</gangster>
```

Well Formed and Valid XML

- Well formed XML
  - File content follows XML syntax
- Valid XML
  - Well-formed + conforming to rules in DTD or XSD
  - DTD: Document Type Definition (superseded by XSD)
  - XSD: XML Schema Definition

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE note SYSTEM "note.xsd">
<note>
  <to> Tove </to>
  <from> Jani </from>
  <heading> Reminder </heading>
  <body> Don't forget me this weekend! </body>
</note>
```

XSD

- XML Schema Definition
  - XSD defines
    - elements and attributes that can appear in a document
    - which elements are child elements
    - the order and number of child elements
    - whether an element is empty or can include text
    - data types for elements and attributes
    - default and fixed values for elements and attributes
  - XSD originally proposed by Microsoft, and became an official W3C recommendation in May 2001.
  - XSD uses XML syntax
  - Example: http://www.w3schools.com/schema/schema_intro.asp

XML Parser & Error Handling

- XML files are read by applications to get data inside.
  - Class libraries or functions designed to read XML data are called "XML parsers". (need to parse data file to get data)
  - Both Java & .NET have standard XML parsers.
  - Many free or commercial XML parsers exist.
- Error handling
  - W3C XML specification states that a program should not continue to process an XML document if it finds a validation error.
XML Transformation

- Most modern browsers can view XML data.
  - Native XML ➔ Mozilla and IE uses tree-view
  - XML can be translated/transformed into HTML through XSLT
- XSLT
  - XSLT is a language for transforming XML documents into XHTML documents or to other XML documents.
  - XSLT = XSL Transformation
  - XSL = Extensible Stylesheet Language
- Demo: XML ➔ XHTML

XML Parsing

- Reading data from XML in programming is usually done using parsers.
  - Parser: APIs or classes to help programmers extract data from XML documents.
- Two approaches for parsing XML documents:
  - SAX: Simple API for XML
    - Sequentially read given XML document, no turning back.
    - The parser generates a series of events (in sequence), and it is programmer’s responsibility to handle these events.
    - Element starts, element ends, text node
  - DOM: Document Object Model
    - View a document as an object, and each tag in its content is an attribute of the document.

Reference

- XML: http://www.w3schools.com/xml/xml_whatis.asp
- XHTML: http://www.w3schools.com/xhtml/
- XSD: http://www.w3schools.com/schema/schema_intro.asp
- XSLT: http://www.w3schools.com/xsl/

JSON

- JavaScript Object Notation. Although it originates from JavaScript standard, it is a compute-language neutral standard.
- A light-weight text-based data-interchange format.
  - Easy for human to read and write.
  - Easy for machines to parse and generate.
- Corresponds to two data types in computer languages:
  - unordered list (name/value pairs) ➔ object, struct, associative array, etc.
  - ordered list ➔ array.
- It is very popular for data interchange between JavaScript on webpages and web services. JavaScript has a eval() function to directly translate JSON data into a native object, and therefore programmers do not need to worry how to parse JSON data format.
- For other languages, there are many JSON parsers that can be used.

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

**In the example above, it describes an object (because of {...}). This object has one name/value pair. The name is “employees”.

The value paired with “employees” is an array (because of [...] containing three objects.

Each of the contained object has two name/value pairs.

Values can be nested structures (objects as an array element, array as the value for objects, etc.)
JSON

- JSON is different from XML in the following aspects:
  - There is no concept as "tag".
  - It is easier & faster to parse JSON than to parse XML.
  - JSON needs less data size to describe the same data.

- References
  - www.json.org
  - http://www.w3schools.com/json/json_intro.asp

WSDL

Web Service Description Language

- XML formatted.
- Describes SOAP web services.
- Content:
  - Description and format of messages that can be passed in <types> and <message> tags
  - Direction of message passing in <portType>:
    - Request-only, request-response, response-only
  - Message encoding in <binding> element (literal, etc.)
  - Location where service is offered in <service> element

Function Prototype

- Prototype in C/C++/Java:
  - Defines arguments/parameters and the returning information of functions
  - e.g. int func1(int a, int b, int c);

- Prototype in Web service
  - Web services provide functions through the Web
    - Prototype is required for each function provided through web services → WSDL!
  - In addition, the prototype also needs to identify where/how to invoke the function (e.g. URLs)

WSDL Example

```xml
<message name="getTermRequest">
  <part name="term" type="xs:string"/>
</message>

<message name="getTermResponse">
  <part name="value" type="xs:string"/>
</message>

<portType name="glossaryTerms">
  <operation name="getTerm">
    <input message="getTermRequest"/>
    <output message="getTermResponse"/>
  </operation>
</portType>
```

Similar to class A method of class glossaryTerms

glossaryTerms

Online WSDLs & References

- Amazon
  - Details at: http://aws.amazon.com/

- eBay

- Microsoft TerraService
  - http://terraservice.net/TerraService2.asmx?WSDL

- References:
  - http://www.w3schools.com/wsdl/default.asp
  - http://www.w3.org/TR/wsdl
SOAP

Simple Object Access Protocol

- A simple XML based protocol to let applications exchange information over HTTP → web services, communication between applications, platform independent.

- XML over HTTP
  - HTTP – for data transport, some headers are added to HTTP protocol
  - XML as data transmission format

- Key element of SOAP:
  - New MIME type: text/xml
  - Agreed definitions of data types, mandatory values, etc.

- Use URL to describe endpoints (how to access services)

SOAP Building Blocks

- A SOAP message is an ordinary XML document containing the following elements:
  - A required `<Envelope>` element that identifies the XML document as a SOAP message
  - An optional `<Header>` element that contains header information
  - A required `<Body>` element that contains call and response information
  - An optional `<Fault>` element that provides information about errors that occurred while processing the message

- The message is delivered to web server (service provider) through HTTP POST method

- The response from web services is gotten from server using HTTP GET method.

SOAP Example (Sending)

```xml
POST /InStock HTTP/1.1
Host: www.stock.org
Content-Type: application/soap+xml; charset=utf-8
Content-Length: nnn

<?xml version="1.0"?>
<soap:Envelope
  xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
  soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
  <soap:Body xmlns:m="http://www.stock.org/stock">
    <m:GetStockPrice>
      <m:StockName>IBM</m:StockName>
    </m:GetStockPrice>
  </soap:Body>
</soap:Envelope>
```

SOAP Example (Response)

```xml
HTTP/1.1 200 OK
Content-Type: application/soap; charset=utf-8
Content-Length: nnn

<?xml version="1.0"?>
<soap:Envelope
  xmlns:soap="http://www.w3.org/2001/12/soap-envelope"
  soap:encodingStyle="http://www.w3.org/2001/12/soap-encoding">
  <soap:Body xmlns:m="http://www.stock.org/stock">
    <m:GetStockPriceResponse>
      <m:Price>34.5</m:Price>
    </m:GetStockPriceResponse>
  </soap:Body>
</soap:Envelope>
```

Reference

- [http://www.w3.org/TR/soap12-part0/](http://www.w3.org/TR/soap12-part0/)
- [http://www.w3schools.com/soap/default.asp](http://www.w3schools.com/soap/default.asp)
- [http://terraservice.net/](http://terraservice.net/)
  - [http://terraservice.net/TerraService2.asmx](http://terraservice.net/TerraService2.asmx)
  - [http://terraservice.net/TerraService2.asmx?WSDL](http://terraservice.net/TerraService2.asmx?WSDL)
- [http://liveado慈.de/Programmers_Guide/wsmo monitor3.htm](http://liveado慈.de/Programmers_Guide/wsmo monitor3.htm)
- [http://www.soapware.org/bdg](http://www.soapware.org/bdg)
**UDDI**

**Universal Description, Discovery, and Integration**

- Defines a standard of being yellow pages (directory service) for web service providers.
- UBR: UDDI Business Registry
  - Global public directory of businesses and services

**Some Online Web Services**


**A super simple web service**


Adder.php:

```php
<?php
if(isset($_GET['a'])) {
    $a = $_GET['a'];
    if(isset($_GET['b'])) {
        $b = $_GET['b'];
        echo $a + $b;
        return;
    }
} else {
    echo "ERROR!";
}
?>
```

**REST-style web service**

- REST: Representational State Transfer
- RESTful web service
- It's a style, a way of architecting software. There is no standard for rest-style web service.
- It can be implemented using any technology
- REST-style was inspired by world-wide-web, which is a highly-scalable system.

**Actions and Resources**

- In HTTP, there are four types of requests that maps well to CRUD in database.

<table>
<thead>
<tr>
<th>Formats</th>
<th>HTTP</th>
<th>SQL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create</td>
<td>PUT</td>
<td>INSERT</td>
</tr>
<tr>
<td>Read</td>
<td>GET</td>
<td>SELECT</td>
</tr>
<tr>
<td>Update</td>
<td>POST</td>
<td>UPDATE</td>
</tr>
<tr>
<td>Delete</td>
<td>DELETE</td>
<td>DELETE</td>
</tr>
</tbody>
</table>

- Use URI to specify resource; use HTTP request to specify actions to be performed.
  - HTTP/GET on [http://localhost/users](http://localhost/users) - list users in the system
  - HTTP/DELETE on [http://localhost/users/3](http://localhost/users/3) - delete user id=3

**Stateless (無狀態)**

- Since HTTP is a stateless protocol, REST-style WS is also stateless.
- In other words, all the arguments needed must be from the caller. Calls should not rely on the state of previous function invocation.

Compilers: Principles, Techniques, and Tools is a computer science textbook by Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman about compiler construction. First published in 1986, it is widely regarded as the classic definitive compiler technology text. It is affectionately known as the Dragon Book to generations of computer scientists as its cover depicts a knight and a dragon in battle, a metaphor for conquering complexity. This name can also refer to Aho and Ullman's older Principles, Techniques, and Tools (Second Edition). Book Â· January 2007 with 1,353 Reads. Publisher: Addison-Wesley. In the compiler literature, parsing algorithms for context-free grammars are presented using string rewriting systems or abstract machines such as pushdown automata. Unfortunately, the resulting descriptions can be baroque, and even a basic understanding of some parsing algorithms, such as Earleyâ€™s algorithm for general context-free grammars, can be elusive.