ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Εισαγωγή στην Επιστήμη και Τεχνολογία των Υπηρεσιών

Ενότητα 1: Εισαγωγή

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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

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Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

XML
Introduction
605.444 / 635.444

David Silberberg

Lesson 1

What is XML?

- XML stands for *eXtensible Markup Language*
- XML is a language to define other languages
  - This is called a *meta-language*
- XML's predecessor is SGML (Standard Generalized Markup Language)
  - XML is simpler
- XML uses a tag set to define some data construct
  - Tag names have meaning within some context
  - Tags are arranged in hierarchies
  - Thus, the tag placement within the hierarchy has meaning as well

Brief History of Markup Languages

- Originally, people created text or binary files to represent data
  - People needed to develop standards to ensure good interchange
  - However, standards were created for each set of applications
  - People recognized that there is a need for a standard markup language
- SGML was born
  - Complicated
  - Handles huge amounts of complex data
  - HTML was born from it
  - XML was born from it, too

HTML Tag Examples

- In HTML, tags are defined with specific meanings
  - <TABLE>, <H1>, <P>, etc. all have predefined meanings
  - Web browser software interprets tags and performs some corresponding action(s)
    - When <TABLE> is encountered, Web browsers set up tables
    - When <H1> is encountered, Web browsers set up first-level headers
    - When <P> is encountered, Web browsers break for a new paragraph
  - If a tag is undefined, the corresponding software may generate errors (or they might ignore it)
    - <BIRD>, <DOG>, <HARRY>, etc. have no meaning to Web browsers
    - Web browsers that encounter these terms might generate errors or they might ignore the tags
- HTML grammar defines the proper usage of the tags

HTML Tag Attributes

- Attributes augment some aspect of the tag
  - Grammar defines the attributes that correspond to tags
  - For example, <FONT> has attributes SIZE and COLOR
  - Usage: <FONT SIZE="3" COLOR="ORANGE">
  - BACKGROUND is not a valid attribute for <FONT>
- Tags may have corresponding end tags
  - <TABLE> starts a table while </TABLE>ends a table
  - <P> does not require its corresponding end tag
- Tags may be embedded within other tags

```
<HEAD>
   <TITLE>My Web Page</TITLE>
</HEAD>
```

XML Grammar

- All of the aspects defined above contribute to the HTML grammar
  - Tag names
  - Attributes
  - End tags
  - Tag nesting hierarchy
- XML does not define specific tags or a specific grammar
  - Completely extensible
  - You can choose:
    - Tag names
    - Attributes
    - Nesting hierarchy

XML Example

```
<?xml version="1.0"?>

<department>
    <name>Computer Science</name>
    <professor lastname="Smith" firstname="Fred">
        <rank>Full</rank>
        <specialty>XML</specialty>
        <office>23-204</office>
    </professor>
    <professor lastname="Chu" firstname="Harry">
        <rank>Associate</rank>
        <specialty>Artificial Intelligence</specialty>
        <office>23-225</office>
    </professor>
</department>
```

Another XML Example

```
<?xml version="1.0"?>
<store>
    <name>Giant</name>
    <location>Columbia</location>
    <section name="Produce">
        <vegetable>
            <name>Carrot</name>
            <quantity>275</quantity>
        </vegetable>
        <fruit>
            <name>Kiwi</name>
            <quantity>500</quantity>
        </fruit>
    </section>
    …
</store>
```

The same tag may occur in several contexts

Properties of XML Tags

- You can use pretty much any tag name you want
- You can associate any attribute you want with the tags
- You can define any nesting you want
- XML is flexible
- However, its flexibility also makes it ambiguous
  - Does quantity mean actual number of carrots or packages of carrots?
  - Does rank mean actual rank or rank aspiring to?
  - Should name be an attribute or an embedded tag?
  - Could *teacher* have been used instead of *professor*?
  - Is the grocery list an inventory list or a purchasing list?

XML Definition

- So what is XML?
  - Usually, XML refers not only to the language, but the entire tool suite associated with it.
  - XML defines the core language
  - Metadata framework
- Why use XML? Why make up a new language?
  - Couldn't we just impose a syntax on our files?
    - For example, addresses always are specified in the following order: name, street, city, state, zip
    - How could we differentiate between a 1- and 2-line street address?
    - How do we know which part is the salutation (Mr., Ms., Dr., etc.)?
  - XML provides a way to tag and describe all the data
  - A specific XML syntax permits:
    - General tools (e.g., parsers) to be created and used
    - A general format to be applied to many domains

How to Use XML

- XML is a data structure representation language
- XML alone would not fare too well
- However, there are many tools associated with it that can help
  - Java has a robust set of tools and APIs
  - Most of the tools exist for C, C++, and Perl
- As with any data structure, you must first parse it, then manipulate the data
- You might want to write out a new data structure as a result

Technologies to be Covered

- Transformation technologies
  - XSLT – *Extensible Stylesheet Language*
  - CSS – *Cascading Stylesheets*
  - SAX – *Simple API for XML*
  - DOM – *Document Object Model*
  - JDOM – *Java DOM*
  - JAXP – *Java API for XML Parsing*
  - TRAX – *Transformation API for XML*
- Search technologies
  - XPath – *XML Path*
  - XQuery – *XML Query*

Technologies to be Covered (2)

- Knowledge Representation
  - DTD – *Document Type Definition*
  - XML Schema
  - Namespaces
  - RDF – *Resource Description Framework*
  - RDFS – *RDF Schema*
  - OWL – *Web Ontology Language*
- Services
  - Web Services
  - JAXB – *Java Architecture for XML Binding*
  - RESTful Services
- Other
  - XLink – *XML Link*
  - XPointer – *XPointer*

Processing Instructions (PI) in XML

- A *processing instruction* is a command to the application and is embedded in the XML file
  - Mostly, XML represents data structures
  - Occasionally, processing instructions must sent to applications or parsers that read XML files
- Syntax: <?target instructions?>
  - Example <?xml version="1.0"?>
  - Instruction is: *version="1.0"*
  - Target is: *xml*
  - All XML parsers have a standard set of instructions that they should recognize

PIs (continued)

- Parsers may route PIs with external targets to other applications
- Example
  - <?purchasing buy_date="Monday"?>
  - Our grocery list may be a purchasing list
  - The PI indicates that the list must be routed to the Purchasing program

Document Type Definition (DTD)

- Establishes constraints for a set of XML documents
- Defines the grammar of XML documents
- Can be defined in
  - The XML document itself
  - Another (only one) external document
  - Both
- Defines
  - Valid tags: <professor>, <vegetable>, etc.
  - Valid attributes:<professor lastname="" firstname="">, etc.
  - Valid values: section name can be one of *produce, dairy, meat, etc.*
  - Valid nesting of tags: <vegetable> is embedded within <section>

XML Schema

- XML Schema replaces and improves the function of DTDs
  - Addresses limitations of DTD
    - More powerful definitions of XML files
    - More expressive
    - Represents what people want to express in XML
  - Uses XML-style approach to defining XML documents
  - Includes knowledge of hierarchy
  - Handles namespace conflicts
  - Can specify relationships among XML documents

- http://www.w3.org/XML/Schema

Namespaces

- A *namespace* is a mapping between an element prefix and a URI (Uniform Resource Indicator)
- Handles namespace collisions.
- Allows parsers to handle collisions
- Suppose we wanted to make <name> unambiguous
  - We could use tags like <store_name>, <fruit_name>, or <vegetable_name>
  - However, this is unnatural and can become tedious
  - Namespaces allow a more natural solution: <store:name>, <fruit:name>, and <vegetable:name>
- http://www.w3.org/TR/REC-xml-names

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XSL and XSLT Example

- XML document

```
<?xml version="1.0"?>
<?xml-stylesheet href="hello.xsl" type="text/xsl"?>
<store>
    <name>Giant</name>
    <location>Columbia</location>
</store>
```

XML and XSLT Example (continued)

- XSLT stylesheet

```
<xsl:stylesheet xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
<xsl:template match="/store/">
<html>
 <head>
  <title>
   <xsl:value-of select="name"/>
  </title>
 </head>
 <body>
  <xsl:apply-templates/>
 </body>
</html>
</xsl:template>
```

XML and XSLT Example (continued)

```
<xsl:template match="location">
  <p>
      <xsl:apply-templates/>
  </p>
</xsl:template>
```

Output

```
<html>
    <head>
        <title>
                Giant
        </title>
    </head>
    <body>
        Columbia
    </body>
</html>
```

XPath

- XML Path (XPath) expressions specify how to locate items in XML documents
- Considers documents to be trees with nodes (elements, attributes, and text)
- XPath expressions identify nodes or subtrees that match the expressions
- Used heavily by XSLT, DOM and XQuery

- http://www.w3.org/TR/xpath

XQuery

- Many XML query languages have surfaced
  - XQL
  - UnQL - UPenn
  - Lorel -Stanford
  - A host of others
- XQuery is the new standard XML query language
  - Based on XML Query Algebra
- Allows document elements to be queried with respect to their inter-relationships

- http://www.w3.org/XML/Query

Sample XML Document

```
<?xml version="1.0"?>
<inventory>
    <book>
        <title>JAVA and XML</title>
        <author>Brett McLaughlin</author>
        <publisher>O'Reilly</publisher>
        <year>2000</year>
    </book>
    <book>
        <title>Beginning XML</title>
        <author>David Hunter</author>
        <publisher>Wrox</publisher>
        <year>2000</year>
    </book>
</inventory>
```

Sample XQuery Statement

List the titles of books published by O'Reilly in 2000.

```
FOR     $b IN document("bib.xml")//book
WHERE   $b/publisher = "O'Reilly" AND
        $b/year = "2000"
RETURN  $b/title
```

Result:

```
<title>JAVA and XML</title>
```

Parsers

- SAX (Simple API for XML)
  - SAX is not a parser, per se, but a framework for parsers
  - Provide access to data in an XML document
  - It is event-driven
    - APIs are defined for events like startDocument() and endDocument()
    - Parser authors supply their own code for what should happen at these events
- DOM (Document Object Model)
  - Provides a means to manipulate (not only access) XML document data
  - DOM reads the entire document first (taxes resources)
  - XML document is represented as a tree structure

Parsers (continued)

- Comparison of SAX and DOM
  - DOM is more powerful because it enables manipulation
  - However, it is slow because the whole document must be read at once
  - SAX is faster because you operate on data as you go
  - But, you can't manipulate the entire XML document at once
- JAXP (Sun's Java API for XML Parsing)
  - Provides cohesive and standard layer for parser functions
  - SAX and DOM sit underneath JAXP

Other XML Technologies

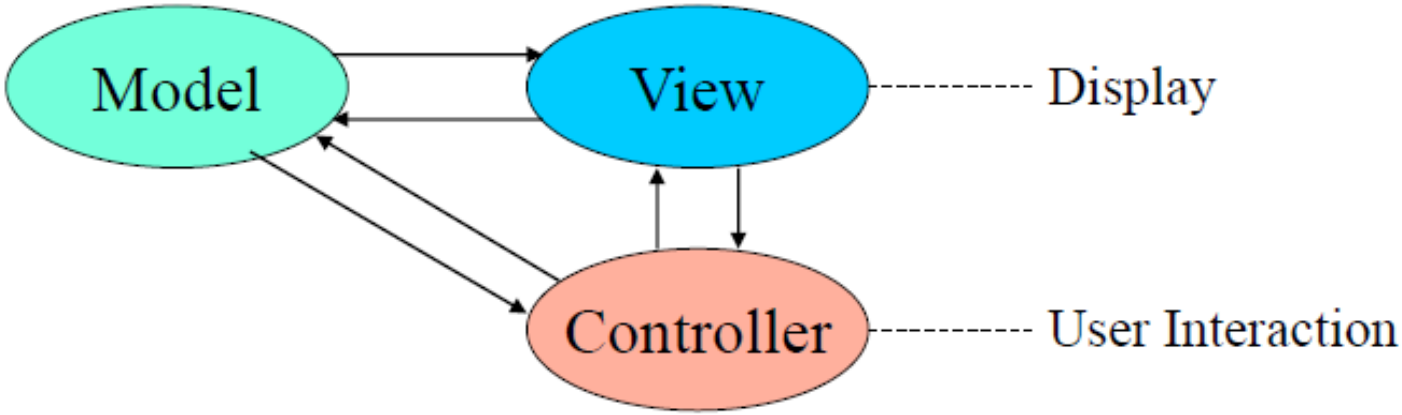
- Resource Description Framework (RDF)
  - Rudimentary definition of resources and objects
  - Basis of XML ontologies specifications (e.g., Web Ontology Language (OWL), DARPA Agent Markup Language (DAML))
- XLink & XPointer
  - HTML on steroids!
  - Super links
  - Can create your own web site environment based on other existing web sites.
- Web Services
  - Distributed systems development using XML
  - Ubiquitous data representation (XML) and ubiquitous transport protocol (HTTP)
  - RESTful web services
- Tons more
  - Check out http://www.w3.org/ !

How is XML Used Today?

- XML is not only a hot topic, but is used in many applications today
- It has caught on very quickly!
- Java itself has caught on very rapidly
- Together, they form a powerful technology
  - Java is portable code
  - XML is portable data
  - Let's explore some of XML's uses

XML for Presentation

- There are two aspects of data
  - Content - the model of the data
  - Presentation - the view of the data
- Has its roots in Smalltalk's Model-View-Controller framework

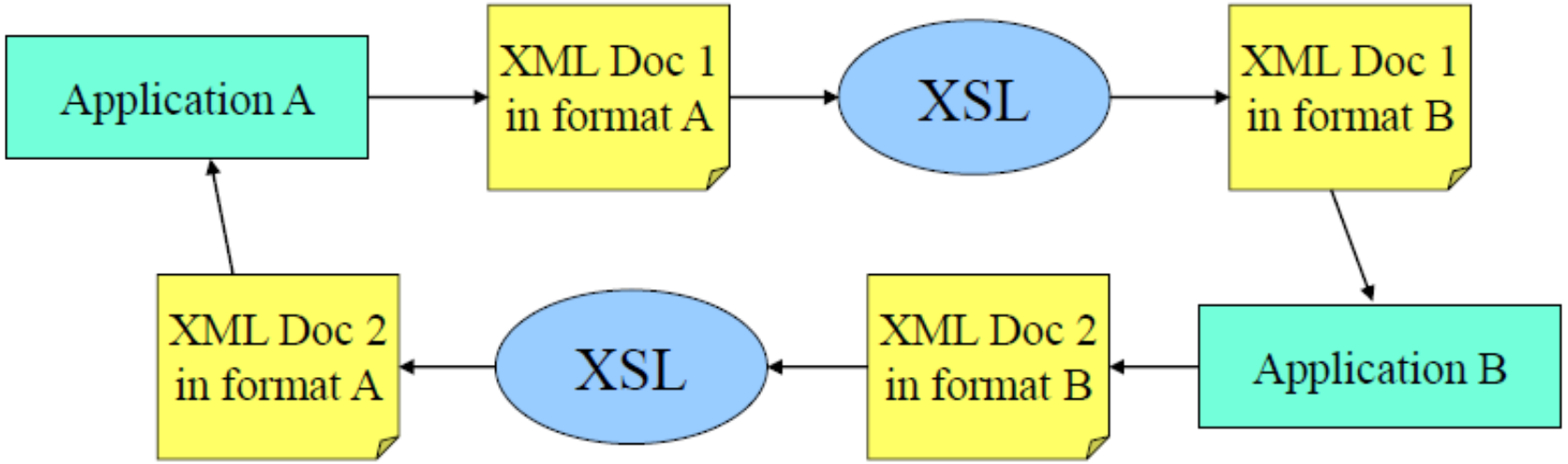


XML for Presentation (cont.)

- Data is represented independent of display format
- Allows multiple applications to use the same data, but display them in different formats
- Different presentation formats are possible
  - Swing
  - HTML
  - WML (wireless)
  - In fact, the same data might need to be displayed using many different display styles
- Usually, XSL or XSLT converts format to display

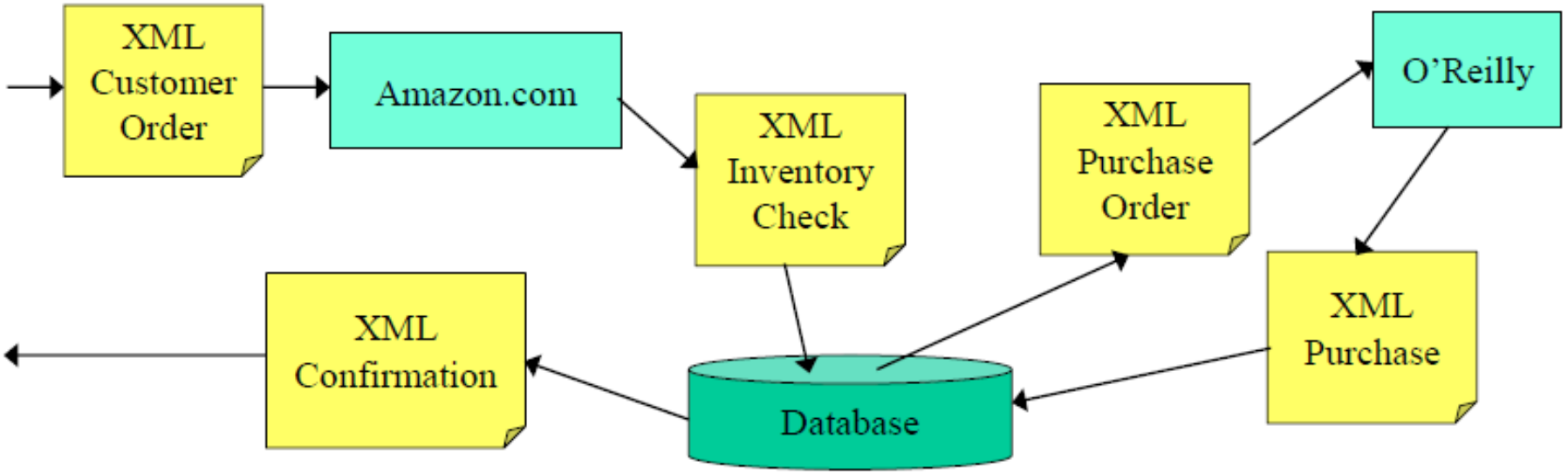
XML for Communication

- XML is not tied to any application or client
- Same data can be passed around among applications
- Data representation is easily passed around the network
- Programs transform data and pass them to other programs



Business-to-Business

- XML provides standard data exchange among business
- Passes data among multiple applications of multiple companies/departments
- Possibly, each application modifies and augments the XML document



Commercial Product Support

- Parsers
  - SAX, DOM, JDOM, JAXP, XSLT, TRAX, etc.
- Publishing frameworks
  - Apache Cocoon, SilkPage, etc.
- Editors and IDE
  - **oXygen**, XML Spy, Amaya, Komodo, etc.

Τέλος Ενότητας

Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο

ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
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επένδυση στην κοινωνία της γνώσης
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ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ

Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης