ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ

Εισαγωγή στην Επιστήμη και Τεχνολογία των Υπηρεσιών

Ενότητα 6: XML, XSLT and XPATH - 1

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Ευρωπαϊκή Ένωση
Ευρωπαϊκό Κοινωνικό Ταμείο
ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΠΡΟΓΡΑΜΜΑ
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επένδυση στην κοινωνία της γνώσης
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ & ΘΡΗΣΚΕΥΜΑΤΩΝ, ΠΟΛΙΤΙΣΜΟΥ & ΑΘΛΗΤΙΣΜΟΥ
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ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΩΝΙΚΟ ΤΑΜΕΙΟ
Με τη συγχρηματοδότηση της Ελλάδας και της Ευρωπαϊκής Ένωσης

Άδειες Χρήσης

Χρηματοδότηση

- Το παρόν εκπαιδευτικό υλικό έχει αναπτυχθεί στα πλαίσια του εκπαιδευτικού έργου του διδάσκοντα.
- Το έργο «**Ανοικτά Ακαδημαϊκά Μαθήματα στο Πανεπιστήμιο Κρήτης**» έχει χρηματοδοτήσει μόνο τη αναδιαμόρφωση του εκπαιδευτικού υλικού.
- Το έργο υλοποιείται στο πλαίσιο του Επιχειρησιακού Προγράμματος «Εκπαίδευση και Δια Βίου Μάθηση» και συγχρηματοδοτείται από την Ευρωπαϊκή Ένωση (Ευρωπαϊκό Κοινωνικό Ταμείο) και από εθνικούς πόρους.

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XML
XSLT and XPATH
605.444 / 635.444

David Silberberg

Lecture 12

Transformation of Data

- XML is a generic data representation language
  - Not concerned, per se, about presentation
  - Not concerned about tailoring representation to any particular application
  - It represents the data from a particular perspective
  - Data can be represented in a vendor-neutral way
    - Easy to parse (will see later)
    - Portable
    - Can be used in a Java environment (parsers, transformers, etc.)
  - But, how do you use XML in an application?
  - Furthermore, how do we use XML across multiple applications???

Transformation Tools

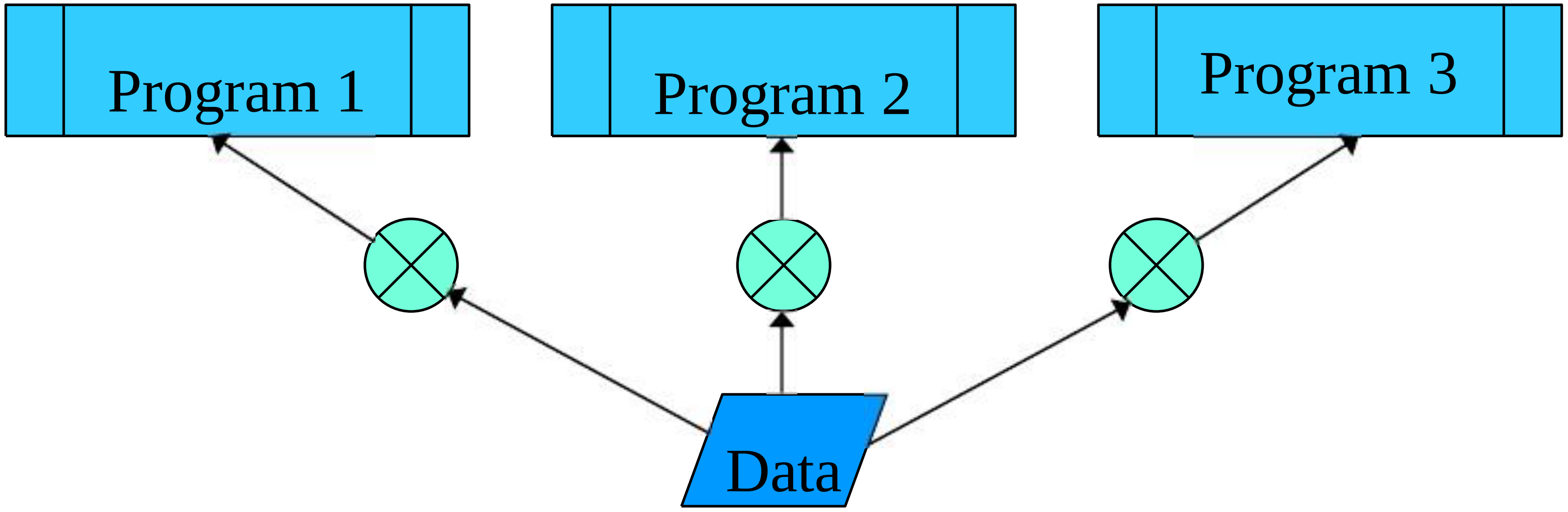
- There are parsers (SAX and DOM)
  - Can be used in conjunction with Java to parse XML
  - Programming language approach to transformation
  - Programs are very general and powerful
  - Programs are hard to maintain
  - Programs and their subsets cannot easily be reused
- We would like a simple declarative language for expressing transformations
  - Easy to use and maintain
  - Easy to share
  - Powerful transformation constructs

Why Transform?

- XML represents a pure data layer
- Different applications need similar data
  - Data conceptually the same
  - Each application needs a different structure to operate on
- Different data architecture models
  - Central abstract data repository
    - Applications retrieve data and reformat as necessary
    - Often requires each application to write transforms
    - Applications pass data through data representation

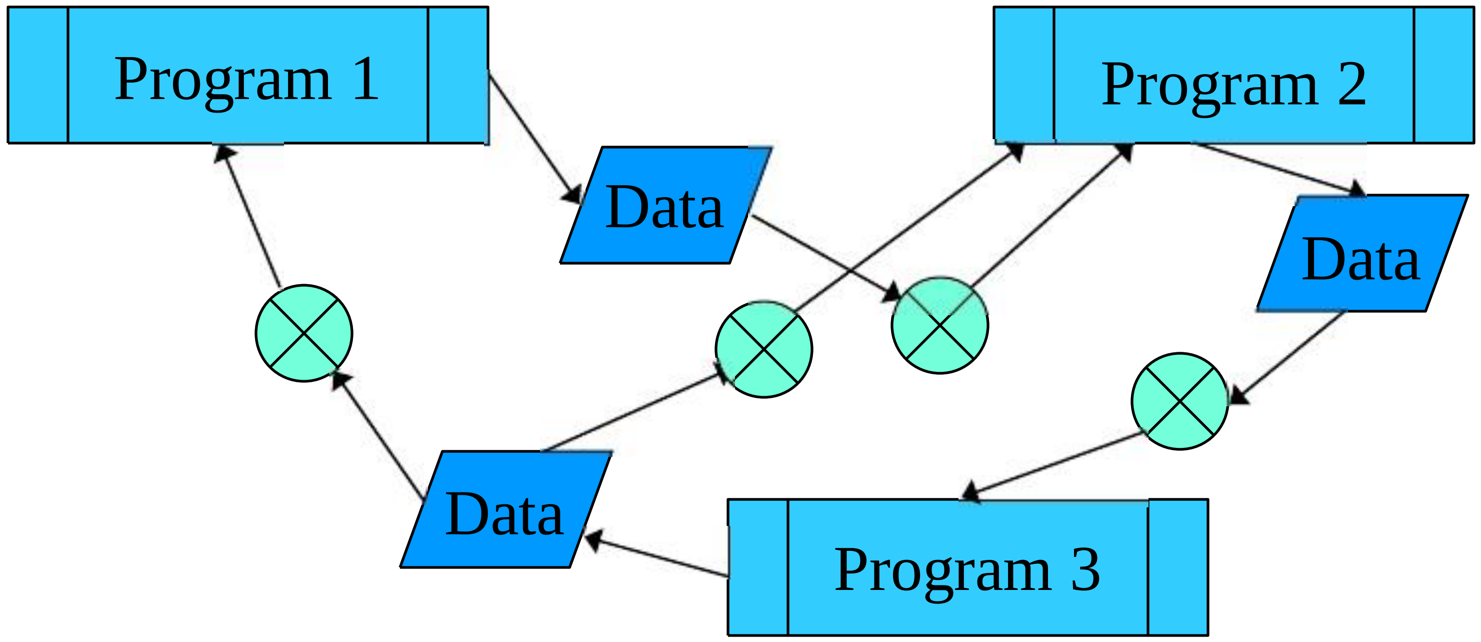
Transformation Architectures

- Different data architecture models
  - Central abstract data repository



Transformation Architectures (cont.)

– Enterprise data exchange architecture
  - Applications pass data and reformat as necessary
  - Often requires each application to write multiple transforms
  - There may not be a central repository



Data Transformation Architectures

- Any system can be composed of any combination of these constructs
- Data may undergo several transformations as they move from application to application
- Each transformation alters the structure of the data
- Data produced by a transformation is in a form usable by their corresponding program(s)
- Data may also need to be transformed for display
  - Pure HTML
  - Other display languages

General Data Structures

- Most often, program designers create data structures to satisfy their system needs
- Usually, the design is based on a narrow focus, which is usually geared toward their specific application
- System designers do not often know how others might use the data
- In the Web environment, it is even more difficult to know or anticipate the uses of the data by other systems
- Thus, there is a need to transform data from one representation to another in a general and powerful way

Example - Two Applications

- Application 1 - Sales Record
- The Animal World TM store takes orders for pet equipment
- The store is concerned with recording the activities of the sales people.
  - To calculate commissions
  - To know who is performing well
- Animal World TM also needs to keep a record of its customers so that it can “spam” them with sales circulars once a week.
- Animal World TM also needs to generate orders to their suppliers.

Application 1 - sales.xml

```
<?xml version="1.0"?>
<transaction>
    <salesman>
        <lastname>Smith</lastname>
        <firstname>Fred</firstname>
        <mi>P</mi>
    </salesman>
    <customer>
        <name>Frank Thomas</name>
        <address>10 Maple Street</address>
        <city>Columbia</city>
        <state>MD</state>
        <zip>22222</zip>
    </customer>
```

Application 1 - sales.xml (cont.)

```
        <date>
                <year>2005</year>
                <month>12</month>
                <day>22</day>
        </date>
        <item>
                <name>Cat Chow</name>
                <size>30</size>
                <qty>2</qty>
                <unitprice>9.95</unitprice>
        </item>
</transaction>
```

Application 2

- Application 2 - Supplier
- The Chow Train TM company fills orders from pet supply stores
- Chow Train TM sends the orders directly to the purchasers
- Chow Train TM bills the purchasers
- Chow Train TM sends the store a percentage of the price collected

Application 2 - supplier.xml

```
<?xml version=“1.0”?>
<order>
        <date>2005-12-22</date>
        <company>Animal World</company>
        <item>
                <code>CC-10456</code>
                <description>Cat Chow</description>
                <qty>2</qty>
        </item>
        <for>
                <name>Frank Thomas</name>
                <street>10 Maple Street</street>
                <city>Columbia, MD  22222</city>
        </for>
</order>
```

Extensible Stylesheet Language (XSL)

- XSL is a general language for
  - Transforming the structure of a document into another structure
  - Formatting the document for display
  - Specifications can be found at: http://www.w3c.org/TR/xslt
- Three standards are used
  - Extensible Stylesheet Language for Transformation (XSLT)
    - Language for transforming XML structures
  - XSL formatting objects (XSL-FO)
    - Browser-neutral publishing language for formatted outputs
      - Sets headers, footers, margins, etc.
      - Enables embedded graphics, etc.
      - Deals with non-Western writing – bidirectional lines, top-to-bottom, etc.
    - Not covered in this course – we will use CSS to format the output of XSLT
  - XML Path Language (XPath)
    - Language for describing node elements in an XML hierarchy

Where to get an XSLT Tool

- Different tools available – I have not tested all of them!
- The class will use the oXygen tool for XSLT tranformation
- Sun's version has been donated to apache.org
  - http://xml.apache.org/xalan-j/
  - Read instructions for operation
- James Clark's version for Windows
  - http://www.jclrk.com/xml/xt.html
  - Need Microsoft's Java VM (usually comes with IE)
  - *xt source stylesheet result*
- MSXML
  - http://msdn.microsoft.com/downloads/webtechnology/xml/msxml.asp

XSL is in XML Format

- XSL and its subset XSLT are XML languages
- Therefore, XSLT stylesheets must obey the formatting rules of XML.
- XSLT uses the *xsl:* namespace for all of its commands
  - Thus, an XSLT parser/processor can look at the tags of an XML document and determine which it must process.
  - The namespace is located at the W3C site.
  - http://www.w3.org/1999/XSL/Transform
- Other namespaces may be defined in the XSLT document, as well.
- The XSLT <u>stylesheet</u> declaration must come after the initial XML declaration <?xml … ?>.

Example Stylesheet Declaration

```
<?xml version=“1.0” ?>

<xsl:stylesheet
    xmlns:xsl=“http://www.w3.org/1999/XSL/Transform”
    xmlns:abc=“some other namespace”
    version=“1.0”>

<!-- transformation rules -->

</xsl:stylesheet>
```

XSLT Transformations

- XSLT built upon templates
- Tells the transformation engine
  - What to look for
  - What to output based on the input
- Each template matches (usually) one specific thing in the XML document and transforms it

```
<xsl:template match="[Xpath expression]">
    <!-- Format rules -->
</xsl:template>
```

XSLT Template

- Begin and end tags are
  - <xsl:stylesheet ...>
  - </xsl:stylesheet>
- Match tells the transformation tool what to match
- XPath is a specification language to identify places in an XML document.
- Format rules specify the output and its format.
- Typical stylesheets have multiple templates.
- If multiple templates match an XML tag, there are implicit rules about which template will be chosen.

Simple Match

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

    <xsl:template match="transaction">A transaction was found.
    </xsl:template>

</xsl:stylesheet>
```

Output when applied to XML document 1:

A transaction was found.

What Just Happened

- XSLT processor found all tags labeled “transaction”.
- Then, it printed the string “**A transaction was found.**”
- The transformation rule can be applied 0 or many times to the document.
- If there were two transaction tags, the XSLT processor would have printed:

  A transaction was found.

  A transaction was found.
- Of course, there can only be one document root element.

XSLT Template and Output

- XSLT transformation

```
<xsl:template match=“transaction”>
    <xsl:apply-templates/>
</xsl:template>

<xsl:template match=“name”>A name tag was found.
</xsl:template>
```

- Output of XSLT processor

```
A name tag was found.
A name tag was found.
```

What Just Happened

- When a match is encountered, the entire hierarchy of that tag and below is read in.
- The next rule “xsl:apply-templates” tells the XML processor to apply the rest of the templates to the hierarchy matched and read in.
- If no rule was there:

<xsl:template match=“transaction”/>

or

<xsl:template match=“transaction” >

</xsl:template>

The entire tree is read in and the <u>data</u> is printed out.

Example of Hierarchy Match

- Applying this to sales.xml:

```
<xsl:template match="transaction" >
</xsl:template>
```

- Produces:

```
Smith
Fred
P

Frank Thomas
10 Maple Street
Columbia
MD
22222
etc.
```

Simple Web Page Transformation ...

- Applying this to sales.xml:

```
<xsl:template match="transaction" >
    <html>
      <head>
         <title>Transaction Web Page</title>
      </head>
      <body>
         <xsl:apply-templates/>
      </body>
    </html>
</xsl:template>
```

Becomes this Web Page

- Yields:

```
<html>
   <head>
      <title>Transaction Web Page</title>
   </head>
   <body>
          Smith
          Fred
          P

          Frank Thomas
          10 Maple Street
          Columbia
          etc.
   </body>
</html>
```

Selection of Items

- Let’s do something a bit more complicated
- Print good customers from a file called *customer.xml*

```
<?xml version=“1.0”?>
<customers>
        <good>
                <name>Jones, Fred</name>
                <name>Li, Sue</name>
                <name>Carnot, John</name>
        </good>
        <bad>
                <name>Tell, William</name>
                <name>Carr, Sam</name>
        </bad>
</customers>
```

Print All Customers

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

    <xsl:template match="customers">
        <html><head><title>Customer Web Page</title></head>
           <body>
              <xsl:apply-templates/>
           </body>
        </html>
    </xsl:template>

    <xsl:template match="name">
        <xsl:value-of select="."/>
    </xsl:template>

</xsl:stylesheet>
```

Print All Customers Output

```
<html><head><title>Customer Web Page</title></head>
  <body>
        Jones, Fred
        Li, Sue
        Carnot, John
        Tell, William
        Carr, Sam
  </body>
</html>
```

What Happened

- The outer template was matched by:

  ```
  <xsl:template match="customers">
  </xsl:template>
  ```

- The HTML text was printed when the match was encountered
- The command <xsl:apply-templates/> caused the <customer> element and its children to be scanned.
- The name tags were matched by

  ```
  <xsl:template match="name">
  </xsl:template >
  ```

- The name data was printed by

  ```
  <xsl:value-of select="."/>
  ```

Print Good Customers

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

        <xsl:template match="/">
            <html><head><title>Good Customer Web Page</title></head>
              <body>
                  <xsl:for-each select="/customers/good/name">
                      <p><xsl:value-of select="."/></p>
                  </xsl:for-each>
              </body>
            </html>
        </xsl:template>

</xsl:stylesheet>
```

Good Customer Output

```
<html><head><title>Good Customer Web Page</title></head>
    <body>
        <p>Jones, Fred</p>
        <p>Li, Sue</p>
        <p>Carnot, John</p>
    </body>
</html>
```

What Happened

- The root of the document was matched by:

```
<xsl:template match="/">
</xsl:template>
```

- The HTML text was printed when the match was encountered
- The following command caused all the tags in the hierarchy */customer/good/name* to be found

```
<xsl:for-each select="/customers/good/name">
</xsl:for-each>
```

- The *customer/good/name* data was printed by

```
<xsl:value-of select="."/>
```

Sort the Bad Customers

```
<?xml version=“1.0” ?>
<xsl:stylesheet xmlns:xsl=“http://www.w3.org/1999/XSL/Transform” version=“1.0”>

        <xsl:template match=“/”>
            <html><head><title>Bad Customer Web Page</title></head>
              <body>
                <xsl:for-each select=“/customers/bad/name”>
                    <xsl:sort select=“.”/>
                    <xsl:copy-of select=“text()”/> <BR/>
                </xsl:for-each>
              </body>
            </html>
        </xsl:template>

</xsl:stylesheet>
```

Sorted Bad Customers

```
<html><head><title>Bad Customer Web Page</title></head>
        <body>
                Carr, Sam<BR/>Tell, William<BR/>
        </body>
</html>
```

XSLT Has No Side Effects

- In most programming languages
  - The order of operations is important
  - Operations leave side effects (e.g., variable values change)
- In XSLT
  - We are not concerned about the order of operations
  - XSLT processor looks for matches and applies applicable templates
  - The order of the template definitions do not matter
  - If multiple templates apply to a tag, there are implicit rules as to which template is selected.
  - However, this is not dependent on the order of template definitions
  - No variable values are set by the templates

Τέλος Ενότητας