**ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ**
**ΠΑΝΕΠΙΣΤΗΜΙΟ ΚΡΗΤΗΣ**

# Εισαγωγή στην Επιστήμη και Τεχνολογία των Υπηρεσιών

## Ενότητα 6: XML, XSLT and XPATH - 2

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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
# XSLT and XPATH (Part II)
# 605.444 / 635.444

David Silberberg

Lecture 13

# XPath

- Path of document elements and attributes is an important aspect of XSLT
- XPath provides a mechanism for pointing at parts of the source XML document
- XPath expressions specify **location path** in a document
  - Step-by-step instructions about how to get to a place in the source document
  - You need to know where you are to get to where you are going
  - Thus, there is implicit **context node** in XPath.
- Primarily important for XSLT
- Also important for other XML tools such as XQuery, XPointer, etc.

# XML Documents as Trees

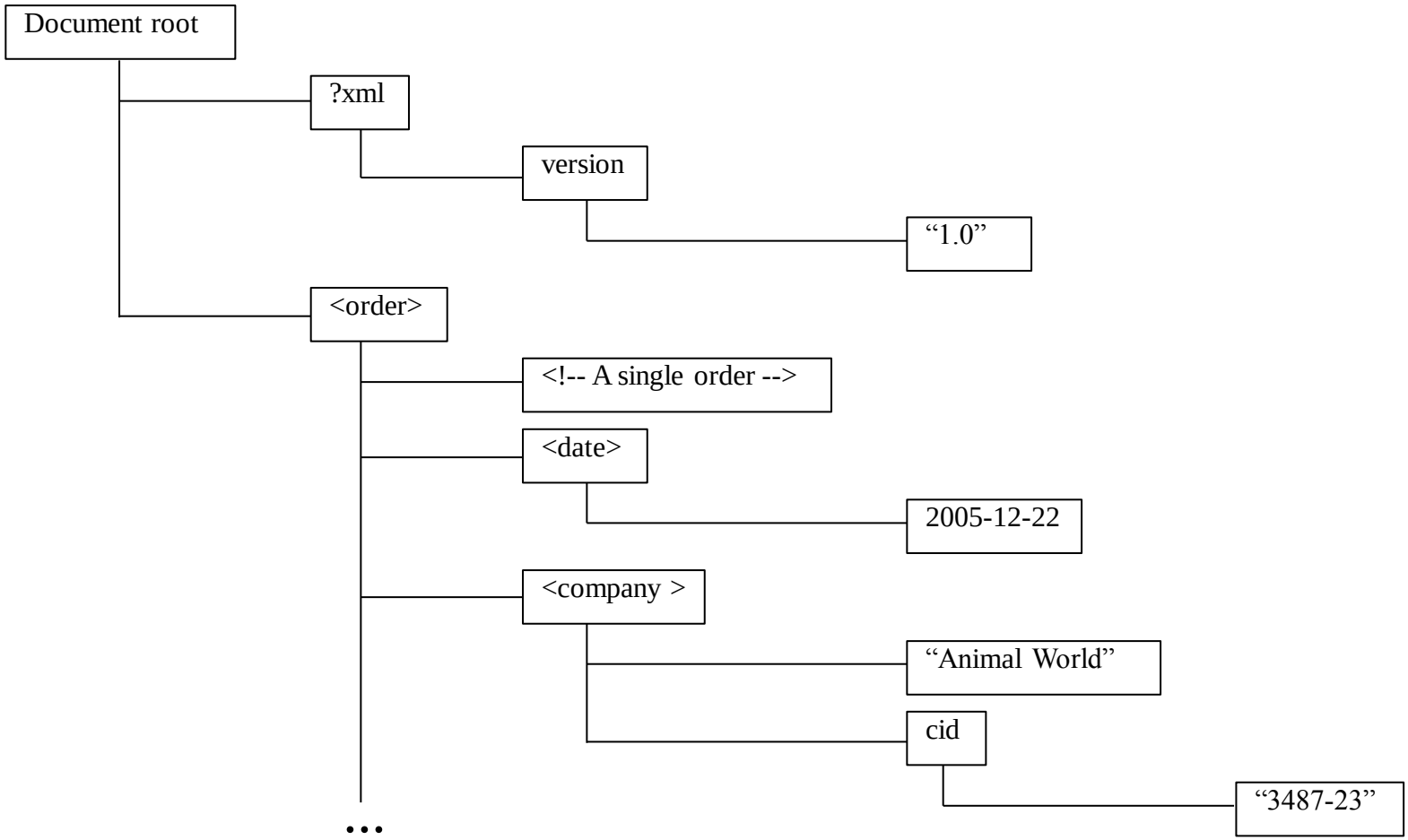
- Augmented *supplier.xml* document

```
<?xml version="1.0"?>
<order>
    <!-- A single order -->
    <date>2005-12-22</date>
    <company cid="3487-23">Animal World</company>
    <item>
        <code version="2.3">CC-10456</code>
        <description>Cat Chow</description>
        <qty>2</qty>
    </item>
    <for>
        <name>Frank Thomas</name>
        <street>10 Maple Street</street>
        <city country="US">Columbia, MD  22222</city>
    </for>
</order>
```

# Document Representation

- Parts of a document are called **nodes**
  - Elements
  - Attributes
  - Comments
  - Processing Instructions
- Nodes are just parts of a document tree
- **node-sets** are sets of nodes
  - If XPath specifies a location path for elements, several nodes may be returned
  - The set of these nodes is called, not surprisingly, a **node-set**

# Tree Representation of supplier.xml



# Document Root

- Matching the document root
  - /
  - <xsl:template match="/"> … </xsl:template>
- Document root serves as a reference for all other nodes
- To move to the *order* node
  - Absolute path
    - /order
    - <xsl:template match="/order">
  - Relative path
    - Assuming that the root node (/) is the current **context node**
    - order (without the absolute path from the root node)
    - <xsl:template match="order">

# Recursive Descent

- Descend the entire document looking for matches
- For example, look for all names in *customer.xml*
  - //name
  - The node *name* can be at any level
- Attributes are accessible with the @ symbol
  - To find the xml version
  - /?xml/@version
  - To find all versions in the document
  - //@version
    - Picks up /?xml/@version
    - Picks up /order/item/code/@version

# Recursive Descent (cont.)

- Recursive descent is very powerful.
- It is inefficient because entire document must be read.
- Use it sparingly!
- It can significantly slow your XSLT processor.

# Specific Location Paths

To access specific nodes:

- Match can be based on having sub-elements
- Match can be based on having sub-attributes
- Search for nodes with specific data values
- Use the [] notation
  - Filters the nodes selected
  - /order[date]
    - Matches all tags <order> that are direct children of the document root (/) and that also have a date element (<date>) child
  - order[date]
    - Matches all tags <order> that are direct children of current context and that also have a date element (<date>) child

# Specific Location Paths (cont.)

- company[@cid]
  - Matches all tags <company> that are direct children of the current context and that also have a cid attribute
- company[@cid = ‘3487-23’]
  - Matches all tags <company> that are direct children of the current context and that also have a cid attribute with value ‘3487-23’
  - Notice that single quotes are used.
  - This is because the XPath expression will be inside of double quotes.
    - <xsl:template match=“company[@cid=‘3487-23’]”>
  - This could be reversed - just need to keep it straight
    - <xsl:template match='company[@cid="3487-23"]'>

# Specific Location Paths (cont.)

- company/@cid
  - Matches all attributes *cid* that are attributes of elements <company> with respect to the current context
- order[company = ‘Animal World’]
  - Matches all tags <order> that are direct children of the current context and that also have a company element with a value ‘Animal World’
- company[. = ‘Animal World’]
  - Matches all tags <company> that are direct children of the current context and that also have a value ‘Animal World’

# Specific Location Paths (cont.)

- Location paths can be arbitrarily complex
- /order//code[@version = ‘2.3’]
  - Matches all tags <code> that are direct or indirect descendents of the <order> tag, which is a direct child of the document root, and that has an attribute *version* with a value of ‘2.3’.
- //order[company/@cid = ‘3487-23’]
  - Matches all tags <order> that are direct or indirect descendents of the document root and that have a child element <company> that has an attribute *cid* with a value of ‘3487-23’

# Reading Location Paths

- /order[date = ‘2005-12-22’]/item/code[@version = ‘2.3’]
- First, break it down into the path
  - /order/item/code
- Then, select the most specific elements
  - /order/item/code[@version = ‘2.3’]
- Finally, select only those paths with certain dates
  - /order[date = ‘2005-12-22’]/item/code[@version = ‘2.3’]
- With a little practice, it should become easy to read.

# XPath Functions

- Sometimes, pure path expressions are not powerful enough to retrieve what is desired
- Beyond parent/child and element/attribute relationships
- Can work with strings and numbers
- Can format values for output
- Syntax:
  - function(parameters)
  - function()

# Node Functions - name()

- Node functions work with nodes
- name()
  - Returns the name of the node
  - Can be called with a parameter: name(.)
    - Name of context node
    - Same as name()
  - To return a sorted list of names of nodes that are children of <order>:

```
<xsl:template match="/order">
    <xsl:for-each select="*">
        <p><xsl:sort select="name()"/></p>
    </xsl:for-each>
</xsl:template>
```

# Node Functions - node()

- node() returns the node itself
- Same as .
- Not really necessary

# Node Functions - processing-instruction()

- Returns processing instructions
- This:

```
<xsl:template match="processing-instruction()">
    <xsl:value-of select="."/>
</xsl:template>
```

- Returns all processing instructions
- This:

```
<xsl:template match="processing-instruction('xml')">
    <xsl:value-of select="."/>
</xsl:template>
```

- Returns ?xml processing instructions: <?xml version="1.0"?>
  - Not all parser return the <?xml …?> element

# Node Functions - comment()

- Matches comments in the XML document
- This:

```
<xsl:template match="//comment()">
    <xsl:value-of select="."/>
</xsl:template>
```

- Returns all the comments in the XML document:

```
<!-- A single order -->
```

- Parsers are not required to return comments so your XSLT may never get a comment to process.

# Node Functions - text()

- Text lets you select the PCDATA content of a node
- When you match a node, you generally get back the node and all of its descendents.
- Example XML fragment:

```
<outerlayer> This is text for the outer layer
    <middlelayer> This is text for the middle layer
        <innerlayer> This is text for the inner layer
          </innerlayer>
    </middlelayer>
</outerlayer>
```

# Node Functions - text() - (cont.)

- Applying this:

```
<xsl:output method="text“/>
<xsl:template match=“outerlayer”>
    <xsl:value-of select=“.”/>
</xsl:template >
```

- Yields all outerlayer, middlelayer, and innerlayer text

```
This is text for the outer layer
    This is text for the middle layer
        This is text for the inner layer
```

# Node Functions - text() - (cont.)

- To get just the outerlayer text, apply this:

```
<xsl:output method="text“/>
<xsl:template match=“outerlayer”>
      <xsl:value-of select=“text()”/>
</xsl:template >
```

- This yields only:

```
This is text for the outer layer
```

# Positional Functions - position()

- When you want the position of a node within a node-set
- Using customer.xml, get the position of William Tell

```
<xsl:template match="//name[. = 'Tell, William']">
    <xsl:value-of select="position()"/>
</xsl:template >
<xsl:template match="//name"/>
```

- Yields:

  2

- Because:

  Node set is: text - <name> - text - <name> - text

  "Tell, William" is the first element of <bad> customers

# Positional Functions - position() - (cont.)

- When you want to search for a node at a specific position
- To look for the second name, apply the template:

```
<xsl:template match="//name[position() = 2]">
    <xsl:value-of select="."/>
</xsl:template >
<xsl:template match="//name"/>
```

- Which yields:

```
Li, Sue
Carr, Sam
```

- Shorthand notation

```
<xsl:template match= "//name[2]" >
    <xsl:value-of select="."/>
</xsl:template >
```

# Positional Functions - last()

- Use last() to find the last position in a node set.

```
<xsl:template match="//name[position() = last()]">
    <xsl:value-of select="."/>
</xsl:template >
<xsl:template match="//name"/>
```

- Which yields:

```
Carnot, John
Carr, Sam
```

# Positional Functions - last()-1

- Use last() to find the next to last position in a node set.

```
<xsl:template match="//name[position() = last()-1]">
    <xsl:value-of select="."/>
</xsl:template >
<xsl:template match="//name"/>
```

- Which yields:

Li, Sue
Tell, William

# Positional Functions - count()

- Use count() to find the number of elements in a node set.

```
<xsl:template match="/">
    <xsl:value-of select="count(//name)"/>
</xsl:template >
```

- Which yields:

```
5
```

# Numeric Functions - number()

- The number function converts PCDATA from a character string to a number
- To get a numeric count of the number of items ordered:

```
<xsl:template match="/">
    <xsl:value-of select="number(/order/item/qty)"/>
</xsl:template >
```

- This yields the number:

```
2
```

# Numeric Functions - sum()

- Produces the sum of a node-set
- Given an XML document:

```
<employee id="111-11-1111">
    <hours day="1">7</hours>
    <hours day="2">10</hours>
    <hours day="3">7</hours>
    <hours day="4">8</hours>
    <hours day="5">8</hours>
</employee>
```

- Apply to get the total hours worked for the week (40):

```
<xsl:template match="/">
    <xsl:value-of select="sum(employee/hours)"/>
</xsl:template>
```

# Boolean Functions - boolean()

- Used for boolean math
- boolean()
  - Evaluates to either *true* or *false*
  - If value is number, it is *false* if value is 0 and *true* otherwise
  - If value is string, it is *true* if the length > 0 and *false* otherwise
  - If value is node-set, it is *false* if empty and *true* otherwise
- Applied to customers.xml

```
<xsl:template match="/">
    <xsl:if test="boolean(//name)">
        <p>We have some customers :-)</p>
    </xsl:if>
</xsl:template>
```

# Boolean Functions - not()

- Test the opposite condition of boolean statement
- Applied to customers.xml

```
<xsl:template match="/">
    <xsl:if test="not(boolean(//name))">
        <p>We do not have any customers :-(</p>
    </xsl:if>
</xsl:template>
```

# Boolean Functions - true() and false()

- true() and false() always evaluate to *true* and *false*, respectively.
- Useful for debugging

```
<xsl:template match="/">
    <xsl:if test="true()">
        <p>Always print this line.</p>
    </xsl:if>
</xsl:template>
```

# String Functions - string()

- Converts any value to a string
- Useful for converting from string to numbers, performing calculations, and converting back to string.

```
<xsl:template match="/">
    <p>
    The number of hours worked this week is:
    <xsl:value-of select="string(sum(employee/hours))"/>
    </p>
</xsl:template>
```

# String Functions - string-length()

- Finds the length of the string
- To length of each customer name

```
<xsl:template match="//name">
    <xsl:value-of select="string-length()"/>
</xsl:template >
```

# String Functions - contains()

- Determines if a substring is contained in a string
- Prints all customers with the string ‘William’ in their names

```
<xsl:template match=“//name”>
    <xsl:if test=“contains(., ‘William’)”>
      <xsl:value-of select=“.”/>
    </xsl:if>
</xsl:template >
```

- This yields:

  Tell, William

- contains() is case-sensitive, like all string functions.

# String Functions - starts-with()

- Determines if a string starts with a certain string.
- Prints all customers with last names that start with ‘L’

```
<xsl:template match=“//name”>
    <xsl:if test=“starts-with(text(), ‘L’)”>
      <xsl:value-of select=“.”/>
    </xsl:if>
</xsl:template >
```

- Yields:

  Li, Sue

# String Functions - substring()

- Finds a substring of a string
- Applying to customer.xml:

```
<xsl:template match="//name[1]">
    <xsl:value-of select="substring(., 8)"/>
</xsl:template >
<xsl:template match="//name"/>
```

- Yields:

```
Fred
illiam
```

- This works as well:

```
<xsl:template match="//name[1]">
    <xsl:value-of select="substring(.,  8, 4)"/>
</xsl:template >
<xsl:template match="//name"/>
```

# String Functions - substring-after()

- Finds substring after a string
- Applying to customer.xml:

```
<xsl:template match="//name[1]">
        <xsl:value-of select="substring-after(. , ',')"/>
</xsl:template >
<xsl:template match="//name"/>
```

- Yields:

```
Fred
William
```

# String Functions - substring-before()

- Finds substring before a string
- Applying to customer.xml:

```
<xsl:template match="//name[1]">
    <xsl:value-of select="substring-before(. , ',')"/>
</xsl:template >
<xsl:template match="//name">
```

- Yields:

```
Jones
Tell
```

# String Functions - concat()

- Puts multiple strings together
- Applying to customer.xml:

```
<xsl:template match="//name[1]">
    <xsl:value-of select="concat(substring-after(. , ','), ' ',
      substring-before(. , ','))"/>
</xsl:template >
<xsl:template match="//name">
```

- Yields:

Fred Jones

William Tell

# String Functions - translate()

- Translates one character set to another
- translate(string-to-translate,  match-string, translate-string)
- Applying to customer.xml:

```
<xsl:template match="//name">
    <xsl:value-of select="translate(. , 'abcdefghijklmnopqrstuvwxyz',
        'bcdefghijklmnopqrstuvwxyza')"/>
</xsl:template >
```

- Yields

Jpoft, Fsfe

Lf, Svf

Cbsopu, Jpio

Temm, Wjmmjbn

Cbss, Sbn

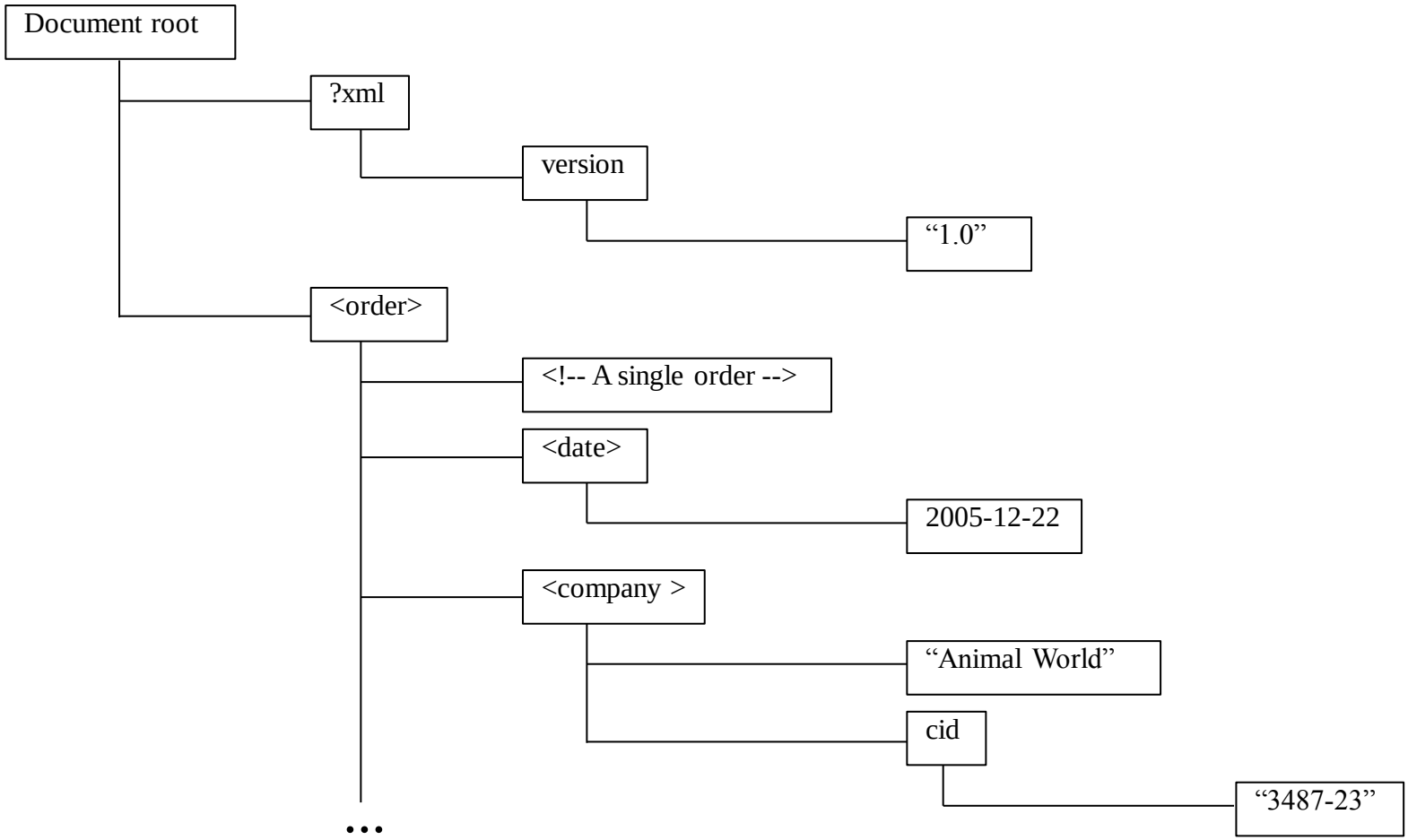
# String Functions - translate() - (cont.)

- Remember that translate is case-sensitive
- If the second string is longer than the third string, the extra character is stripped out of the result
- translate(‘abcd’, ‘bcd’, ‘BC’)
- Yields: aBC

# Axis Names

- Axis names are a way to specify any node of a document with respect to any other node (or itself)
- Up until now, we dealt with parents and children.
- Now, we can use axis names to deal with other node relationships.

# Remember supplier.xml?



# Some Axis Commands

- **self**
  - The self axis refers to the node at the current context
  - “.” is equal to “self::node()”
  - <xsl:for-each select=“.”> =
    <xsl:for-each select=“self::node()”>
  - If current context is the <order> tag, then both produce <order>
- **child**
  - Child is used most often so it is the default
  - “date” is equal to “child::date”
  - <xsl:for-each select=“date”> =
    <xsl:for-each select=“child::date”>
  - If our current context is the <order> tag, then both produce <date>

# More on Children

- **child**
  - "child::*" produces all children elements of the current context
  - <xsl:for-each select="*"> =

    <xsl:for-each select="child::*">
  - If current node is <order>, this produces <date>, <company>, etc.

  - "child::@*" produces all children attributes of the current context
  - <xsl:for-each select="@*"> =

    <xsl:for-each select="child::@*"> =

    <xsl:for-each select="attribute::*">
  - If current node is <company>, this produces "cid"

# Descendants

- **descendent**
  - “descendent::date” produces all elements <date> which are children, childrens’ children, etc. elements of the current context
  - <xsl:for-each select=“descendent::date”>
  - If current node is <order> or the document root (/), this produces <date>

- **descendent-or-self**
  - “descendent-or-self::date” produces all elements <date> which are the same, children, childrens’ children, etc. elements of the current context
  - <xsl:for-each select=“descendent-or-self::date”> =

    <xsl:for-each select=“.//date”>
  - If current node is <date>, <order>, or the document root (/), this produces <date>

# Ancestors

- **parent**
  - “parent::order” produces the element <order> which is a parent of the current context
  - <xsl:for-each select=“parent::order”> =

    <xsl:for-each select=“../order”>
  - If current node is <date>, this produces <order>
  - <xsl:for-each select=“date/parent::order”> =

    <xsl:for-each select=“date/../order”>

# Ancestors (cont.)

- **ancestor**
  - “ancestor::order” produces the element <order> which is an ancestor of the current node
  - <xsl:for-each select=“ancestor::order”>
  - If current node is <date>, <company>, “cid”, etc., this produces <order>
- **ancestor-or-self**
  - “ancestor-or-self::order” produces the element <order> which is an ancestor of the current node or the current node itself
  - <xsl:for-each select=“ancestor-or-self::order”>
  - If current node is <date>, <company>, “cid”, etc., this produces <order>

# Siblings

- **following-sibling**
  - “following-sibling::company” produces the next element <company> which is the sibling following the current node
  - <xsl:for-each select=“/order/date/following-sibling::company”>
  - This produces <company>, etc.
  - Does not work for attributes
- **preceding-sibling**
  - “preceding-sibling::date” produces the previous element <date> which is the sibling preceding the current node
  - <xsl:for-each select=“/order/date/company/preceding-sibling::date”>
  - This produces the previous element: <date>
  - Does not work for attributes

# Siblings (cont.)

- **following**
  - “following::*” produces the next elements (including descendents) which follow the current node
  - <xsl:for-each select=“/following::*”> produces all the next elements of the root node: <order>, <date>, <company>, etc.
- **preceding**
  - “preceding::*” produces the preceding elements of the current node
  - <xsl:for-each select=“/order/date/company/preceding::*”>
  - This produces all the previous elements: <date>, <order>, and root

# Τέλος Ενότητας