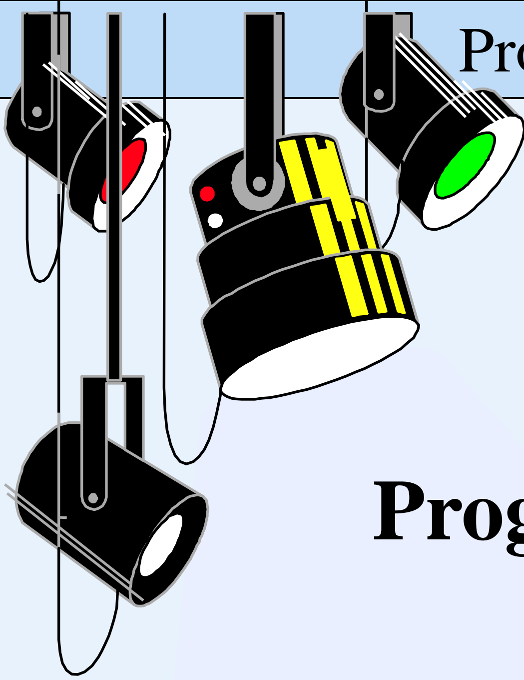


Programming Languages for XML

- XPath
- XQuery
- Extensible StyleSheets Language (XSLT)

XPath

XPath is a simple language for describing sets of similar paths in a graph of semistrucured data.

The XPath Data Model

Sequence of items corresponds to a set of tuples in the relational algebra.

An item is either:

1. A value of primitive type: integer, real, boolean, or string.
2. A node (three kinds of nodes)

Three kinds of nodes:

(a) Documents. These are files containing an XML document, perhaps denoted by their local path name or URL.
(b) Elements. These are XML elements, including their opening tags, their matching closing tags if there is one, and everything in between (i.e., below them in the tree of semistructured data that an XML document represents).
(c) Attributes. These are found inside opening tags.

The items in a sequence needn't be all of the same type although often they will be.

A sequence of five items:

```
10
“ten”
10.0
<Number base = “8”>
        <Digit>1</Digit>
        <Digit>2</Digit>
</Number>
@val=“10”
```

Document Nodes

It is common to apply XPath to documents that are files. We can make a document node from a file by applying the function:

doc(*file name*)

The named file should be an XML document. We can name a file either by giving its local name or a URL if it is remote.

doc(*“movie.xml”*)
doc(*“/usr/slly/data/movies.xml”*)
doc(*“infolab.stanford.edu/~hector/movies.xml”*)

Path Expressions

An XPath expression starts at the root of a document and gives a sequence of tags and slashes (/).

doc(*file name*)/T_1/T_2/…/T_n

doc(*"movie.xml"*)/StarMoviedata/Star/Name

Evaluation of XPath expressions:

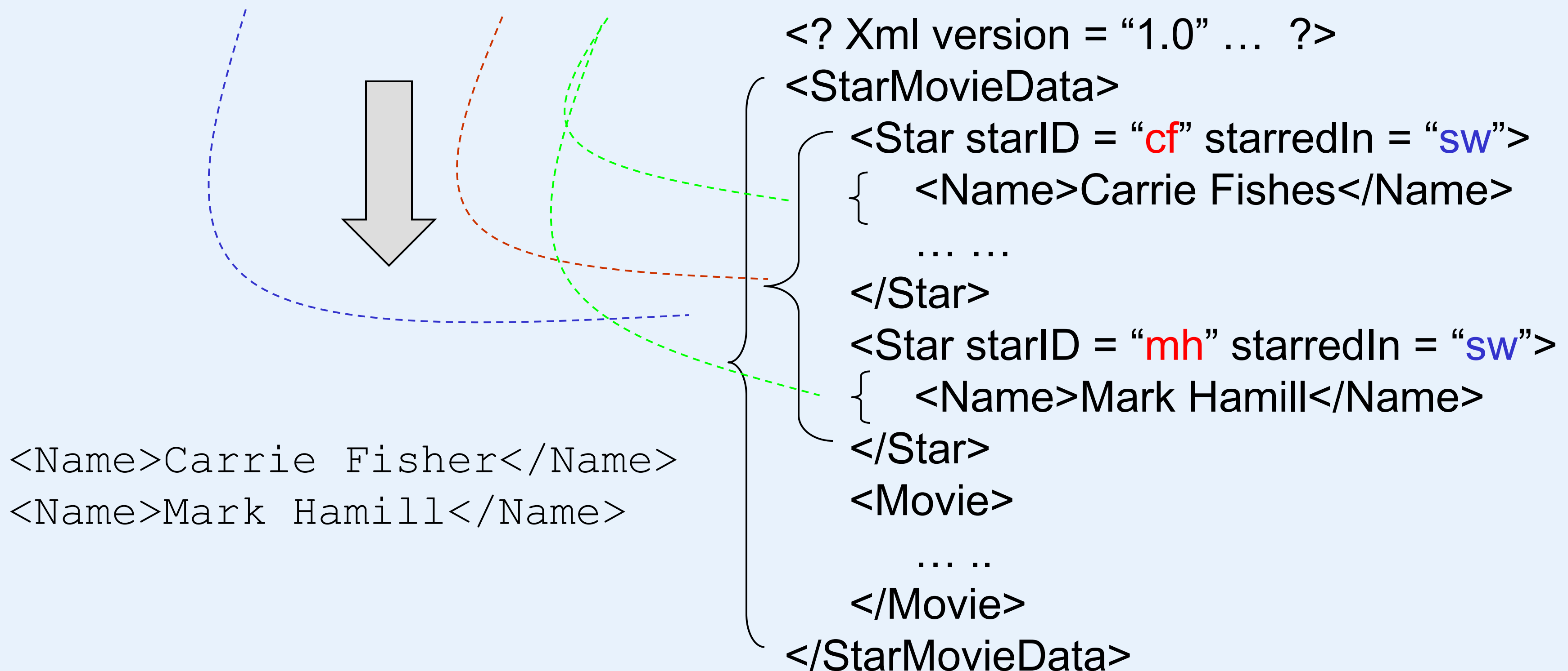
1. Start with a sequence of items consisting of one node: the document node.
2. Then, process each of T_1, T_2, …, T_n in turn.
3. To process T_i, consider the sequence of items that results from processing the previous tag, if any. Examine those items, in order, and find each of all its subelements whose tag is T_i.

Programming Language for XML

```
<? Xml version = “1.0” encoding = “utf-8” standalone = “yes” ?>
<StarMovieData>
    <Star starID = “cf” starredIn = “sw”>
        <Name>Carrie Fishes</Name>
        <Address>
            <Street>123 Maple St.</Street><City>Hollywood</City>
        </Address>
        <Address>
            <Street>5 Locust Ln.</Street><City>Malibu</City>
        <Address>
    </Star>
    <Star starID = “mh” starredIn = “sw”>
        <Name>Mark Hamill</Name><Street>456 Oak Rd.</Street>
        <City>Brentwood</City>
    </Star>
    <Movie movieID = “sw” starOf = “cf mh”>
        <Title>Star Wars</title><Year>1977</Year>
    </Movie>
</StarMovieData>
```

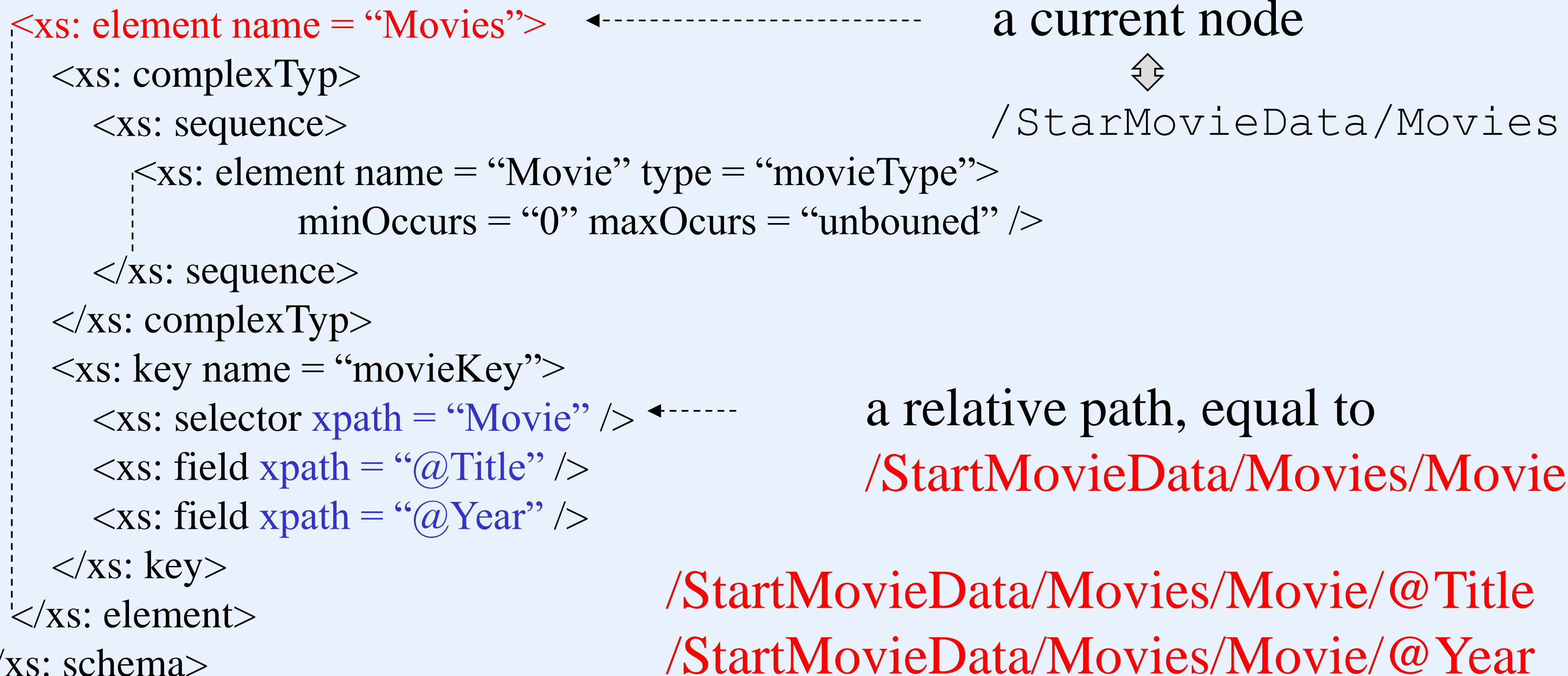
```
doc(“movie.xml”)/StarMoviedata/Star/Name
```

In the following discussion, the document node is not included in an XPath for simplicity.



Relative Path Expressions

In several contexts, we shall use XPath expressions that are relative to the *current node* or sequence of nodes.



Attribute in Path Expressions

- Path expressions allow us to find all the elements within a document that are reached from the root along a particular path.

$$/T_1/T_2/\ldots/T_n$$

- We can also end a path by an attribute name preceded by an *at-sign*.

$$/T_1/T_2/\ldots/T_n/@A$$

```
/StarMovieData/Star/@starID
```

Axes

So far, we have only navigated though semistructured-data graphs in two ways: from a node to its children or to an attribute. In fact, XPath provides several axes to navigate a graph in different ways. Two of these axes are *child* (the default axis) and *attribute*, for which @ is really a shorthand.

Axes used in Xpath expressions: /axis::

Self	/self::	/next-sibling::
Parent	/parent::	/following::
descendant	/descendant::	/preceding::
Ancestor	/ancestor::	/child::
Next-sibling		/attribute::
Following		
Preceding		

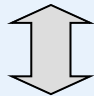
/child::StarMovieData/descentend::Star/attribute::starID

Abbreviated axes

/ - stands for *child*
@ – stands for *attribute*

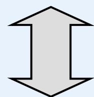
. - stands for *self*
.. – stands for *parent*
// - stands for *descendant*

/child::StarMovieData/descentend::Star/attribute::starID



/StarMovieData//Star/@starID

/descendant::City



//City

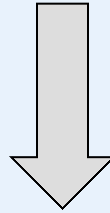
/StarMovieData//Star//City
produces the same results as //City.

Context of Expression

- By "context", we mean an element in a document, working as a reference point (current node).
- So it makes sense to apply axes like *parent*, *ancestor*, or *next-sibling* to a current node.
- Two functions: text(), node()

  - /child::text() – select all those children of the current node, which are text nodes
  - /child::node() – select the all the children of the current node, whatever their node type
  - /self::node() – select the current node

/StarMovieData//Star/self::node()



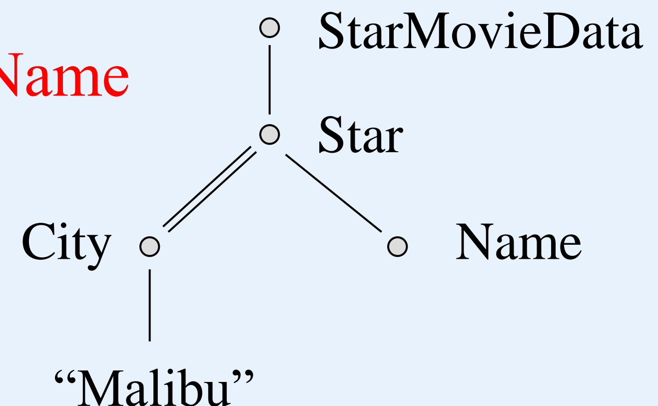
/StarMovieData//Star

Conditions in Path Expressions

As we evaluate a path expression, we can restrict ourselves to follow only a subset of the paths whose tags match the tags in the expression. To do so, we follow a tag by a condition, surrounded by square brackets. Such a condition can be anything that has a boolean value. Values can be compared by comparison operators: = , >=, !=. A compound condition can be constructed by connecting comparisons with logic operations: ∨, ∧.

/StarMovieData/Star[.//City = “Malibu”]/Name

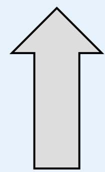
<Name>Carrie Fisher</Name>



Programming Language for XML

```
<? Xml version = "1.0" encoding = "utf-8" standalone = "yes" ?>
<StarMovieData>
    <Star starID = "cf" starredIn = "sw">
        <Name>Carrie Fishes</Name>
        <Address>
            <Street>123 Maple St.</Street><City>Hollywood</City>
        </Address>
        <Address>
            <Street>5 Locust Ln.</Street><City>Malibu</City>
        <Address>
    </Star>
    <Star starID = "mh" starredIn = "sw">
        <Name>Mark Hamill</Name><Street>456 Oak Rd.</Street>
        <City>Brentwood</City>
    </Star>
    <Movie movieID = "sw" starOf = "cf mh">
        <Title>Star Wars</title><Year>1977</Year>
    </Movie>
</StarMovieData>
```

```
<Name>Carrie Fisher</Name>
```

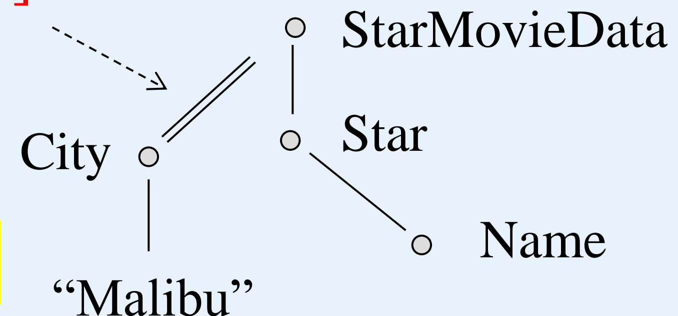


/StarMovieData/Star[.//City = “Malibu”]/Name

Conditions in Path Expressions

As we evaluate a path expression, we can restrict ourselves to follow only a subset of the paths whose tags match the tags in the expression. To do so, we follow a tag by a condition, surrounded by square brackets. Such a condition can be anything that has a boolean value. Values can be compared by comparison operators: = , >=, !=. A compound condition can be constructed by connecting comparisons with operations: ∨, ∧.

/StarMovieData/Star[..//City = “Malibu”]/Name



/StarMovieData/Star[.//City = “Malibu”]/Name

Conditions in Path Expressions

Several other useful forms of condition are:

- An integer [*i*] by itself is true only when applied the *i*th child of its parent.

  /StarMovieData/Stars/Star[2]

- A tag [*T*] by itself is true only for elements that have one or more subelements with tag *T*.

  /StarMovieData/Stars/Star[Address]

- An attribute [*A*] by itself is true only for elements that have an attribute *A*.

  /StarMovieData/Stars/Star[@startID]

Programming Language for XML

```
<? Xml version = "1.0" encoding = "utf-8" standalone = "yes" ?>
<Movies>
    <Movie title = "King Kong" >
        <Version year = "1933">
            <Star>Fay Wray</Star>
        </Version>
        <Version year = "1976">
            <Star>Jeff Bridegs</Star>
            <Star>Jessica Lange</Star>
        </Version>
    </Movie>
    <Movie title = "Footloose">
        <Version year = "1984">
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

/Movies/Movie/Version[1]/@year

/Movies/Movie/Version[Star] ?

/Movies/Movie/Version/Star?

Wildcards

In an XPath expression, we can use * to say “any tag”. Likewise, @* says “any attribute.”

```
/StarMovieData/*/@*
```

Results: “cf”, “sw”, “mh”, “sw”, “sw”, “cf mh”

```
<StarMovieData>
    <Star starID = “cf” starredIn = “sw”>
        … …
    </Star>
    <Star starID = “mh” starredIn = “sw”>
        … …
    </Star>
    <Movie movieID = “sw” starOf = “cf mh”>
        … …
    </Movie>
</StarMovieData>
```

XQuery

- XQuery is an extension of XPath that has become a standard for high-level querying of databases containing XML data.

- XQuery is designed to take data from multiple databases, from XML files, from remote Web documents, even from CGI (common gate interface) scripts, and to produce XML results that you can process with XSLT.

XQuery Basics

All values produced by XQuery expressions are sequences of items.

Items:

primitive values

nodes: document, element, attribute nodes

XQuery is a *functional language*, which implies that any XQuery expression can be used in any place that an expression is expected.

FLWR Expressions

FLWR (pronounced “flower”) expressions are in some sense analogous to SQL select-from-where expressions.
An XQuery expression may involve clauses of four types, called for-, let-, where-, and return-clauses (FLWR).

1. The query begins with zero or more for- and let-clauses. There can be more than one of each kind, and they can be interlaced in any order, e.g., for, for, let, for, let.
2. Then comes an optional where-clause.
3. Finally, there is exactly one return-clause.

Return <Greeting>Hello World</Greeting>

Let Clause

let *variable* := *expression*

- The intent of this clause is that the expression is evaluated and assigned to the variable for the remainder of the FLWR expression.
- Variables in XQuery must begin with a dollar-sign.
- More generally, a comma-separated list of assignments to variables can appear.

```
let $stars := doc(“stars.xml”)
```

```
let   $movies := doc(“movies.xml”)
      $stars := doc(“stars.xml”)
```

for Clause

for *variable* in *expression*

```
let $movies := doc(“movies.xml”)
for $m in $movies/Movies/Movie
```

Stars.xml

```
<? Xml version = “1.0” encoding = “utf-8” standalone = “yes” ?>
<Stars>
    <Star>
        <Name>Carrie Fisher</Name>
        <Address>
            <Street>123 Maples St.</street>
            <City>Hollywood</City>
        </Address>
        <Address>
            <Street>5 Locust Ave.</Street>
            <City>Malibu</City>
        </Address>
    </Star>
            … more stars
</Stars>
```

Movies.xml

```
<? Xml version = “1.0” encoding = “utf-8” standalone = “yes” ?>
<Movies>
    <Movie title = “King Kong”>
        <Version year = “1993”>
            <Star>Fay Wray</Star>
        </Version>
        <Version year = “1976”>
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = “Footloose”>
        <Version year = “1984”>
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

Where Clause

where *condition*

where $s/Address/Street = "123 Maple St." and $s/Address/City = "Malibu"

This clause is applied to an item, and the condition, which is an expression, evaluates to true or false.

return Clause

return *expression*

This clause returns the values obtained by evaluating *expression*.

```
let $movies := doc("movies.xml")
for $m in $movies/Movies/Movie
return $m/Version/Star
```

```
<Star>Fay Wray</Star>
<Star>Jeff Brideges</Star>
<Star>Jessica Lange</Star>
<Star>Kevin Bacon</Star>
<Star>John Lithgow</Star>
<Star>Sarah Jessica Parker</Star>
… …
```

Programming Language for XML

```
let $movies := doc("movies.xml")
for $m in $movies/Movies/Movie
return $m/Version/Star
```

```
<? Xml version = "1.0" encoding = "utf-8" … ?>
<Movies>
    <Movie title = "King Kong">
        <Version year = "1993">
            <Star>Fay Wray</Star>
        </Version>
        <Version year = "1976">
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = "Footloose">
        <Version year = "1984">
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

```
<Star>Fay Wray</Star>
<Star>Jeff Brideges</Star>
<Star>Jessica Lange</Star>
<Star>Kevin Bacon</Star>
<Star>John Lithgow</Star>
<Star>Sarah Jessica Parker</Star>
        … …
```

Replacement of variables by their Values

Here the XPaths will be handled as part of a string.

```
let $movies := doc("movies.xml")
for $m in $movies/Movies/Movie
return <Movie title = $m/@title>$m/Version/Star</Movie>
```

Not correct! The variable will not be replaced by its values.

```
<Movie title = $m/@title>$m/Version/Star</Movie>
<Movie title = $m/@title>$m/Version/Star</Movie>
<Movie title = $m/@title>$m/Version/Star</Movie>
   … …
```

Programming Language for XML

```
let $movies := doc("movies.xml")
for $m in $movies/Movies/Movie
return <Movie title = {$m/@title}>{$m/Version/Star}</Movie>
```

```
<Movie title = "King Kong"><Star>Fay Wray</Star></Movie>
<Movie title = "King Kong"><Star>Jeff Brideges</Star></Movie>
<Movie title = "King Kong"><Star>Jessica Lange</Star></Movie>
<Movie title = "Footloose"><Star>Kevin Bacon</Star></Movie>
<Movie title = "Footloose"><Star>John Lithgow</Star></Movie>
<Movie title = "Footloose"><Star>Sarah Jessica Parker</Star></Movie>
        … …
```

Joins in XQuery

We can join two or more documents in XQuery in much the same way as in SQL. In each case, we need variables, each of which ranges over elements of one of the documents or tuples of one of the relations, respectively.

1. In SQL, we use a from-clause to introduce the needed tuple variables
2. In XQuery, we use a for-clause.

```
let   $movies := doc("movies.xml")
      $stars := doc("stars.xml")
for   $s1 in $movies/Movies/Movie/Version/Star
      $s2 in $Stars/Stars/Star
where data($s1) = data($s2/Name)
return $s2/Address/City
```

```
Select ssn, lname, Dname
From employees s1, departments s2
Where s1.dno = s2. Dnumber
```

Programming Language for XML

```
let    $movies := doc("movies.xml")
       $stars := doc("stars.xml")
for    $s1 in $movies/Movies/Movie/Version/Star
       $s2 in $Stars/Stars/Star
where data($s1) = data($s2/Name)
return $s2/Address/City
```

```
<? Xml version = "1.0" …. … ?>
<Movies>
    <Movie title = "King Kong">
        <Version year = "1993">
            <Star>Fay Wray</Star>
        </Version>
        <Version year = "1976">
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = "Footloose">
        <Version year = "1984">
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

```
<? Xml version = "1.0" encoding = "utf-8" … ?>
<Stars>
    <Star>
        <Name>Fay Wray</Name>
        <Address>
            <Street>123 Maples St.</street>
            <City>Hollywood</City>
        </Address>
        <Address>
            <Street>5 Locust Ln.</Street>
            <City>Mallibu</City>
        </Address>
    </Star>
            … more stars
</Stars>
```

XQuery Comparison Operators

A query: find all the stars that live at 123 Maple St., Malibu.

The following FLWR seems correct. But it does not work.

```
let     $stars := doc(“stars.xml”)
for     $s in $stars/Stars/Star
where $s/Address/Street = “123 Maple S
        and $s/Address/City = “Malibu”
return $s/Name
```

Correct query:

```
let     $stars := doc(“stars.xml”)
for     $s in $stars/Stars/Star,
        $s1 in $s/Address
where $s1/Street = “123 Maple St.” and
        $s1//City = “Malibu”
return $s/Name
```

```
<? Xml version = “1.0” encoding = “utf-8” … ?>
<Stars>
    <Star>
        <Name>Fay Wray</Name>
        <Address>
            <Street>123 Maples St.</street>
            <City>Hollywood</City>
        </Address>
        <Address>
            <Street>5 Locust Ave.</Street>
            <City>Mallibu</City>
        </Address>
    </Star>
            … more stars
</Stars>
```

Elimination of Duplicates

XQuery allows us to eliminate duplicates in sequences of any kind, by applying the built-in distinct values.

Example. The result obtained by executing the following first query may contain duplicates. But the second not.

```
let     $starsSeq := (
        let $movies := doc("movies.xml")
        for $m in $movies/Movies/Movie
        return $m/Version/Star
)
return <Stars>{$starSeq}</Stars>
```

```
let     $starsSeq := distinct-values(
        let $movies := doc("movies.xml")
        for $m in $movies/Movies/Movie
        return $m/Version/Star
)
return <Stars>{$starSeq}</Stars>
```

Select average(distinct *salary)* **from** *employee*;

Quantification in XQuery

There are expressions that say, in effect, *for all* (∀), and *there exists* (∃):

every *variable* in *expression1* satisfies *expression2*
some *variable* in *expression1* satisfies *expression2*

```
let      $stars := doc("stars.xml")
for      $s in $stars/Stars/Star
where    every $c in $s/Address/City
         satisfies $c = "Hollywood"
return $s/Name
```

Find the stars who have houses only in Hollywood.

```
let      $stars := doc("stars.xml")
for      $s in $stars/Stars/Star
where    $c in $s/Address/City satisfies
         $c = "Hollywood"
return $s/Name
```

Find the stars with a home in Hollywood. (Key word *some* is not used.)

Select *ssn, fname, salary* **from** *employee* ***where*** *salary*

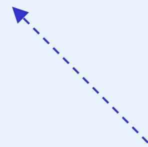
> all (***select*** *salary* ***from*** *employee* ***where*** *dno = 4);*

```
Select fname, lname
from employee
where
        exists (select *
                from dependent
                where essn = ssn);
```

Aggregation

XQuery provides built-in functions to compute the usual aggregations such as count, average, sum, min, or max. They take any sequence as argument. That is, they can be applied to the result of any XPath expression.

```
let     $movies := doc("movies.xml")
for     $m in $movies/Movies/Movie
where   count($m/Version) > 1
return $m
```



Find the movies with multiple versions.

```
Select s.ssn, s.lname, count(r.lname)
from employee s, employee r
where s.ssn = r.superssn
group by s.ssn, s.lname;
having count(name) < 3;
```

Branching in XQuery Expressions

There is an *if-then* expression in Xquery of the form:

if (*expression1*) then (*expression2*)

```
let      $kk := doc("movies.xml")/Movies/Movie/Movie[@title = "King Kong"]
for      $v in $kk/Version
return      if ($v/@year = max($kk/Version/@year))
            then <Latest>{$v}</Latest>
            else <Old>{$v}</Old>
```

```
<? Xml version = "1.0" …. … ?>
<Movies>
    <Movie title = "King Kong">
        <Version year = "1993">
            <Star>Fay Wray</Star>
        </Version>
        <Version year = "1976">
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = "Footloose">
        <Version year = "1984">
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

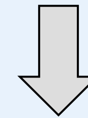
Tag the version of *King Kong*.

Programming Language for XML

Movies.xml

```
<? Xml version = "1.0" encoding = "utf-8" standalone = "yes" ?>
<Movies>
    <Movie title = "King Kong">
        <Version year = "1993">
            <Star>Fay Wray</Star>
        </Version>
        <Version year = "1976">
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = "Footloose">
        <Version year = "1984">
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

```
Let $kk :=
   doc("movies.xml")/Movies/Movie/Movie
   [@title = "King Kong"]
For $v in $kk/Version
Return if ($v/@year =
   max($kk/Version/@year))
        then <Latest>{$v}</Latest>
        else <Old>{$v}</Old>
```



```
<Latest><Version year = "1993"> … </Latest>
<Old><Version year = "1976"> … </Old>
```

Ordering the Result of a Query

It is possible to sort the result as part of a FLWR query

order *list of expressions*

```
let     $movies := doc("movies.xml")
for     $m in $movies/Movies/Movie,
        $v in $m/Version
order   $v/@year
return  <Movie title = "{$m/@title}" year = "{$v/@year}" />
```

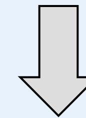
```
Select *
From employees
order by ssn
```

Construct the sequence of *title-year* pairs, ordered by *year*.

Movies.xml

```
<? Xml version = "1.0" encoding = "utf-8" standalone = "yes" ?>
<Movies>
    <Movie title = "King Kong">
        <Version year = "1993">
            <Star>Fay Wray</Star>
        </Version>
        <Version year = "1976">
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = "Footloose">
        <Version year = "1984">
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

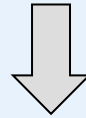
```
let     $movies := doc("movies.xml")
for     $m in $movies/Movies/Movie,
        $v in $m/Version
order   $v/@year
return <Movie title = "{$m/@title}"
year = "{$v/@year}" />
```



```
<Movie title = "King Kong" year = "1976" />
<Movie title = "King Kong" year = "1993" />
<Movie title = "Footloose" year = "1984" />
```

Programming Language for XML

```
let     $movies := doc("movies.xml")
for     $m in $movies/Movies/Movie,
        $v in $m/Version
order   $m/@title, $v/@year
return  <Movie title = "{$m/@title}" year = "{$v/@year}" />
```



```
<Movie title = "Footloose" year = "1984" />
<Movie title = "King Kong" year = "1976" />
<Movie title = "King Kong" year = "1993" />
```

Extensible Stylesheet Language

XSLT (Extensible Stylesheet Language for Transformation) is a standard of the World-Wide-Web Consortium.

- Its original purpose was to allow XML documents to be transformed into HTML or similar forms that allowed the document to be viewed or printed.
- In practice, XSLT is another query language for XML to extract data from documents or turn one document form into another form.

XSLT Basics

Like XML schema, XSLT specifications are XML documents, called *stylsheet*. The tag used in XSLT are found in a name-space: http://www.w3.org/1999/XSL/Transform.

At the highest level, a stylesheet looks like:

```
<? Xml version = '1.0" encoding = "utf-8" ?>
<xsl:stylesheet xmlns:xsl =
            http://www.w3.org/1999/XSL/Transform>
… …
</xsl:stylesheet>
```

Templates

A stylesheet will have one or more templates. To apply a stylesheet to an XML document, we go down the list of templates until we find one that matches the root.

```
<xsl:template match = "XPath expression">
```

Templates

<xsl:template match = "*XPath expression*">

XPath expression can be either rooted (beginning with a slash) or relative. It describes the elements of XML documents to which this template is applied.

Rooted expression – the template is applied to every element of the document that matches the path (absolute path).

Relative expression – part of an Xpath, evaluated relative to a reference point (the current node).

Programming Language for XML

```
<? Xml version = “1.0” encoding = “utf-8” ?>
<xsl:stylesheet xmlns:xsl =
                http://www.w3.org/1999/XSL/Transform>
        <xsl:template match = “/”>
             <HTML>
                 <BODY>
                    <B>This is a document</B>
                 </BODY>
             </HTML>
        </xsl:template >
</xsl:stylesheet>
```

Applying the template, an XML document is transformed to a HTML file:

```
<HTML>
    <BODY>
        <B>This is a document</B>
    </BODY>
</HTML>
```

Obtaining Values from XML Data

<xsl:value-of select = “*expression*” />

```
<? Xml version = “1.0” encoding = “utf-8” standalone = “yes” ?>
<Movies>
    <Movie title = “King Kong”>
        <Version year = “1993”>
            <Star>Fay Wray</Star>
        </Version>
        <Version year = “1976”>
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        <version year = “2005” />
    </Movie>
    <Movie title = “Footloose”>
        <Version year = “1984”>
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

```
<? Xml version = “1.0” encoding = “utf-8” ?>
<xsl:stylesheet xmlns:xsl =
        http://www.w3.org/1999/XSL/Transform>
    <xsl:template match = “/Movies/Movie”>
        <xsl:value-of select = “@title” />
        <BR/>
    </xsl:template >
</xsl:stylesheet>
```

“King Kong”

“Footloose”

This ability makes XSTL a query language.

Recursive Use of Templates

Powerful transformations require recursive application of templates at various elements of the input.

<xsl:apply-template select = "*expression*" />

Programming Language for XML

```
<? Xml version = “1.0” encoding = “utf-8” ?>
<xsl:stylesheet xmlns:xsl = http://www.w3.org/1999/XSL/Transform>

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

    <xsl:template match = “Movie”>
        <Movie title = “<xsl:value-of select = “@title” />
            <xsl:apply-templates />
        </Movie>
    </xsl:template>
    <xsl:template match = “Version”>
        <xsl:apply-template />
    </xsl:template>
    <xsl:template match = “Star”>
        <Star name = “<xsl:value-of select = “.” />”/>
    </xsl:template>
</xsl:stylesheet>
```

use this template

use this template

use this template

```
<? Xml version = “1.0” encoding = “utf-8”
    standalone = “yes” ?>
<Movies>
    <Movie title = “King Kong”>
        <Version year = “1993”>
            <Star>Fay Wray</Star>
        </Version>
        <Version year = “1976”>
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = “Footloose”>
        <Version year = “1984”>
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr
            </Star>
        </Version>
    </Movie>
</Movies>
```

Programming Language for XML

```
<? Xml version = “1.0” encoding = “utf-8”
    standalone = “yes” ?>
<Movies>
    <Movie title = “King Kong”>
        <Version year = “1993”>
            <Star>Fay Wray</Star>
        </Version>
        <Version year = “1976”>
            <Star>Jeff Brideges</Star>
            <Star>Jessica Lange</Star>
        </version>
    </Movie>
    <Movie title = “Footloose”>
        <Version year = “1984”>
            <Star>Kevin Bacon</Star>
            <Star>John Lithgow</Star>
            <Star>Sarah Jessica Parkr</Star>
        </Version>
    </Movie>
</Movies>
```

```
<? Xml version = “1.0” encoding = “utf-8”
                    standalone = “yes” ?>
<Movies>
    <Movie title = “King Kong”>
        <Star name = “Fay Wray” />
        <Star name = “Jeff Brideges” />
        <Star name = “Jessica Lange” />
    </Movie>
    <Movie title = “Footloose”>
        <Star name = “Kevin Bacon” />
        <Star name = “John Lithgow” />
        <Star name = “Sarah Jessica Parkr” />
    </Movie>
</Movies>
```

Iteration in XSLT

We can put a loop within a template that gives us freedom over the order in which we visit certain subelements of the element to which the template is being applied.

```
<xsl:for-each select = "expression" >
```

The expression is an XPath expression whose value is a sequence of items. Whatever is between the opening <for-each> tag and its matching closing tag is executed for each item, in turn.

Programming Language for XML

```
<? Xml version = “1.0” encoding = “utf-8” standalone = “yes” ?>
<Stars>
    <Star>
        <Name>Carrie Fisher</Name>
        <Address>
            <Street>123 Maples St.</street>
            <City>Hollywood</City>
        </Address>
        <Address>
            <Street>5 Locust Ln.</Street>
            <City>Mallibu</City>
        </Address>
    </Star>
        … more stars
</Stars>
```

```
<? Xml version = “1.0” encoding = “utf-8” ?>
<xsl:stylesheet xmlns:xsl =
    http://www.w3.org/1999/XSL/Transform >
    <xsl:template match = “/”>
        <0L>
            <xsl:for-each select = “Stars/Star” >
                <LI>
                    <xsl:value-of select = “Name”>
                </LI>
            </xsl:for-each>
        </0L><P />
        <0L>
            <xsl:for-each select =
                    “Stars/Star/Address”>
                <LI>
                    <xsl:value-of select = “City”>
                </LI>
            </xsl:for-each>
        </0L>
    </xsl:template >
</xsl:stylesheet>
```

1. Carrie Fishes
2. Mark Hamill

… …

1. Hollywood
2. Malibu

… …

Programming Language for XML

```
<Stars>
      <Star>
            <Name>Carrie Fisher</Name>
            <Address>
                <Street>123 Maples
St.</street>
                <City>Hollywood</City>
            </Address>
            <Address>
                <Street>5 Locust Ln.</Street>
                <City>Mallibu</City>
            </Address>
      </Star>
                … more stars
</Stars>
```

```
<0L>
      <LI>
            Carrie Fishe
      </LI>
      … more stars

</0L><P/>
<0L>
      <LI>
            Hollywood
      </LI>
      <LI>
            Mallibu
      </LI>
      … more stars

</0L>
```

```
<? Xml version = "1.0" encoding = "utf-8" ?>
<xsl:stylesheet xmlns:xsl =
http://www.w3.org/1999/XSL/Transform>
            <xsl:template match = "/">
                <0L>
                    <xsl:for-each select =
                                "Stars/Star" >
                        <LI>
                            <xsl:value-of select =
                                "Name">
                        </LI>
                    </xsl:for-each>
                </0L><P/>
                <0L>
                    <xsl:for-each select =
                            "Stars/Star/Address">
                        <LI>
                            <xsl:value-of select =
                            "City">
                        </LI>
                    </xsl:for-each>
                </0L>
            </xsl:template >
</xsl:stylesheet>
```

1. Carrie Fishes
2. Mark Hamill

… …

1. Hollywood
2. Malibu

… …

Conditions in XSLT

We can introduce branching into our templates by using an **if** tag.

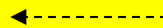
<xsl:if test = “*boolean expression*” >

Whatever appears between its tag and its matched closing tag is executed if and only if the boolean expression is *true*.

```
<? Xml version = “1.0” encoding = “utf-8” ?>
<xsl:stylesheet xmlns:xsl = http://www.w3.org/1999/XSL/Transform>
        <xsl:template match = “/”>
          <TABLE border = “5”><TR><TH>Stars</TH><TR>
            <xsl:for-each select = “Stars/Star” >
              <xsl:if test = “Address/City = ‘Hollywood’”>
                  <TR><TD>
                          <xsl:value-of select = “Name” />
                  </TD></TR>
              </xsl:if>
            </xsl:for-each>
          </TABLE>
        </xsl:template >
</xsl:stylesheet>
```

Stars
Carrie Fishes
⋮

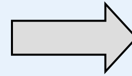
```
<TABLE border =
"5"><TR><TH>Stars</TH><TR>
        <TR>
                <TD>
                        Carrie Fishes
                </TD>
        </TR>
        <TR>
                <TD>
                        … …
                </TD>
        </TR>
                … …
</TABLE>
```



Each star has a house in Hollywood.

Stars
Carrie Fishes
⋮

```
<html>
<body>
        <table border="1">
        <tr>
        <th>Month</th>
        <th>Savings</th>
         </tr>
        <tr>
        <td>January</td>
        <td>$100</td>
        </tr>
        </table>
</body>
</html>
```



Month	Savings
January	$100

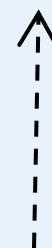
How to use XSTL to make document transformation?

(in Java)

```
XslTransform xslTran = new XslTransform();
xslTran.Load("transform.xsl");
XmlTextWriter writer = new XmlTextWriter("xslt_output.html",
System.Text.Encoding.UTF8);
xslTran.Transform(xmlDoc, null, writer);
```

an XSTL sheet

create a file to store the output



a file containing an XML document to be transformed