Applied Databases

Lecture 17
XPath

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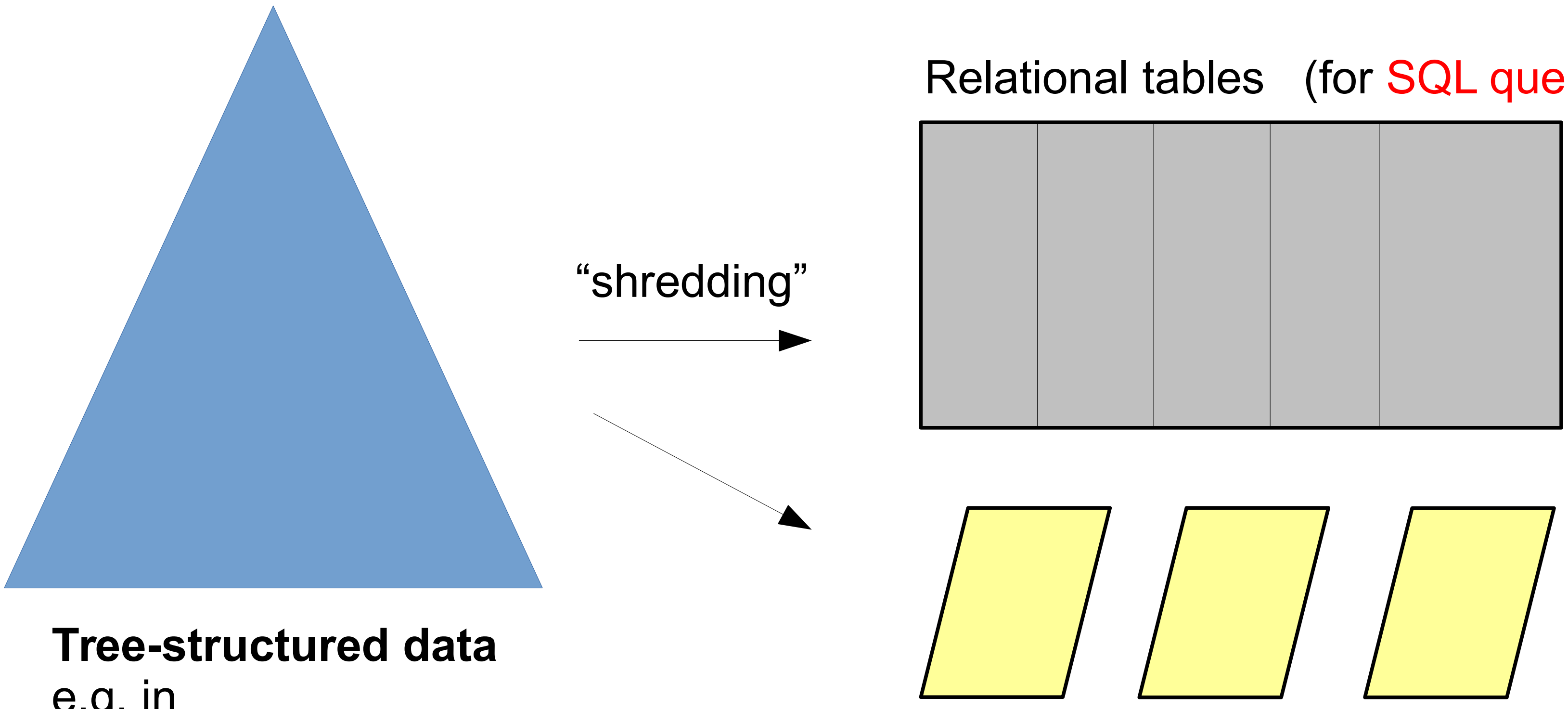
University of Edinburgh - March 14th, 2016

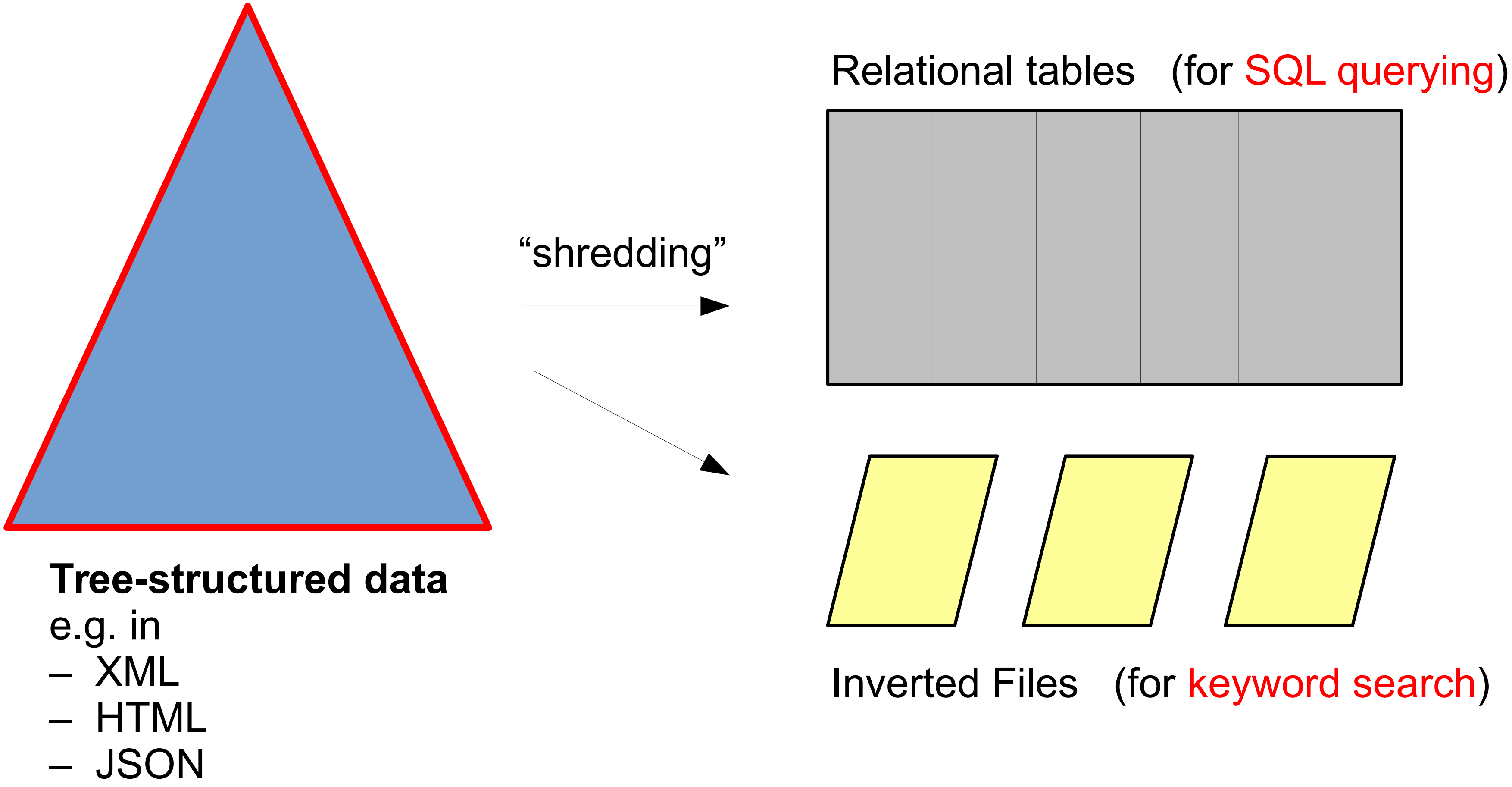


Relational tables (for SQL querying)

“shredding”

Tree-structured data
e.g. in
- XML
- HTML
- JSON

Inverted Files (for keyword search)



Tree-structured data
e.g. in

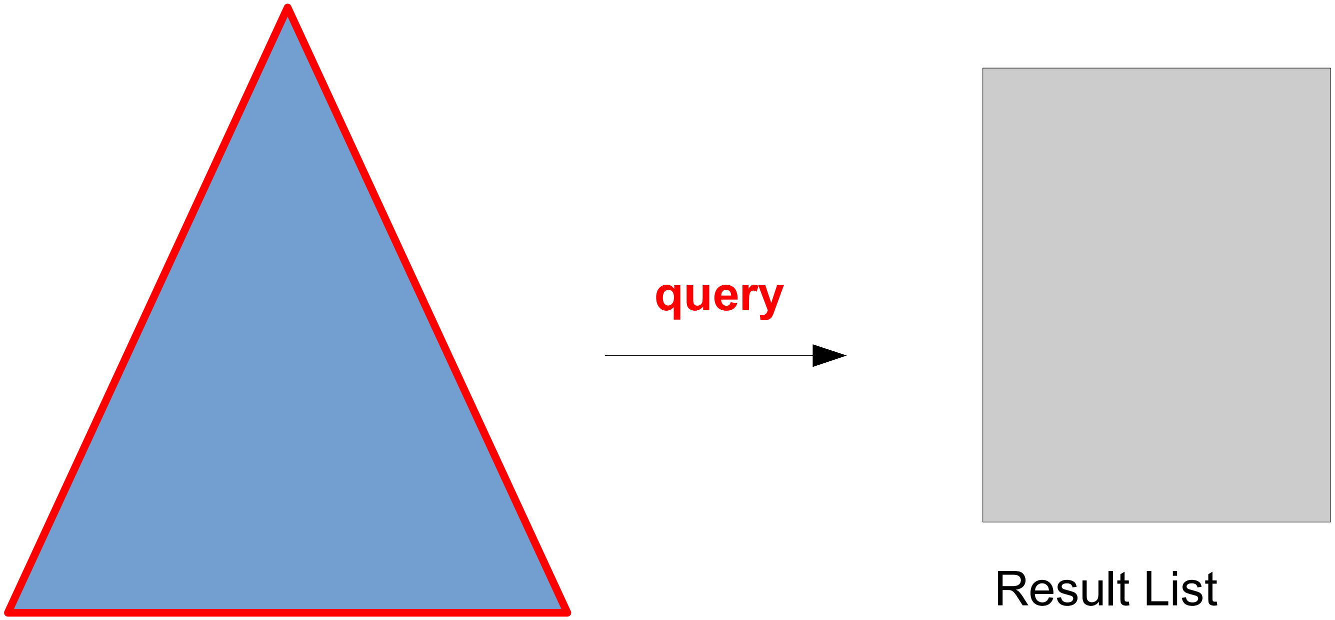
- XML
- HTML
- JSON

“shredding”

Relational tables (for SQL querying)

Inverted Files (for keyword search)

Sometimes: more intuitive / natural to query the tree directly



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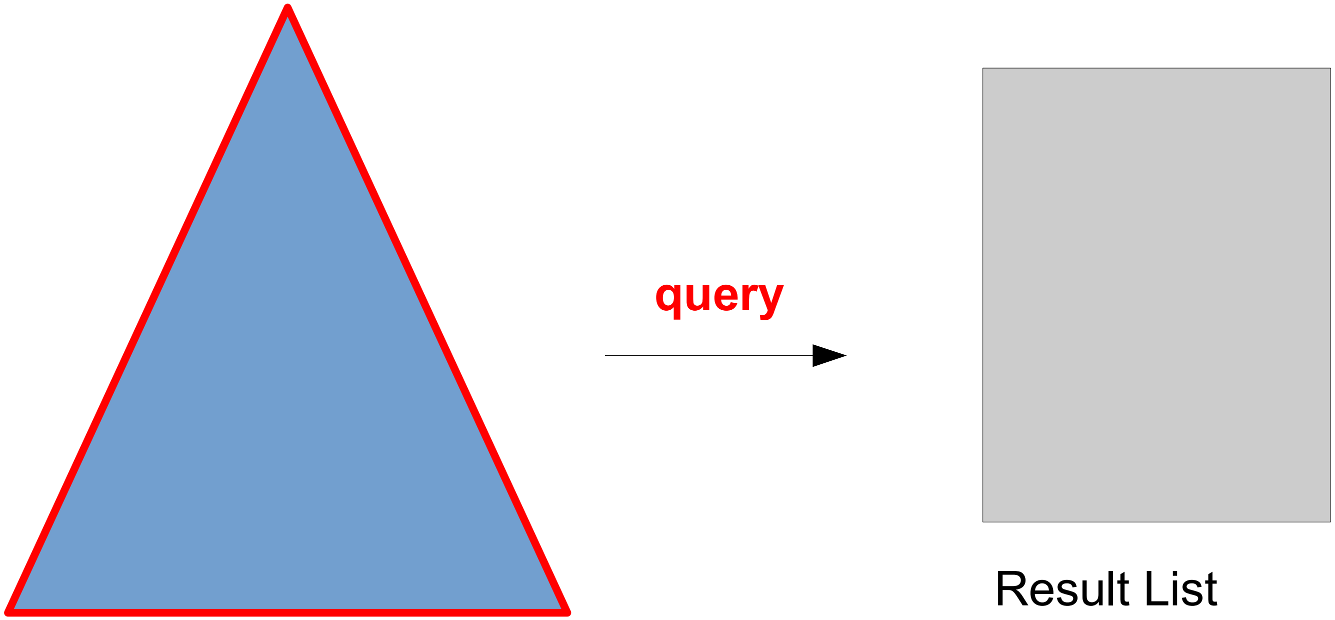

Tree-structured data
e.g. in
– XML
– HTML
– JSON

→ need a **query language for trees / XML**!

Sometimes: more intuitive / natural to **query the tree directly**

XPath

→ low-level query language to select nodes of an XML document

→ W3C Standard (1999)

→ **most important XML query language**: used in many technologies such as XQuery,
XSLT,
XPointer,
XLink,
Javascript, ...

→ Cave: newer versions are more expressive than 1.0
We study XPath 1.0 [current version: 3.0 (2014)]

Terminology: instead of "query" we often say *XPath expression*.

→ an expression is the primary construction of the XPath grammar;
it matches the production Expr of the XPath grammar.

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→ W3C Standard (1999)

→ **most important XML query language**: used in many technologies such as XQuery,
XSLT,
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Every web browser supports XPath

→ Cave: newer versions are more expressive than 1.0
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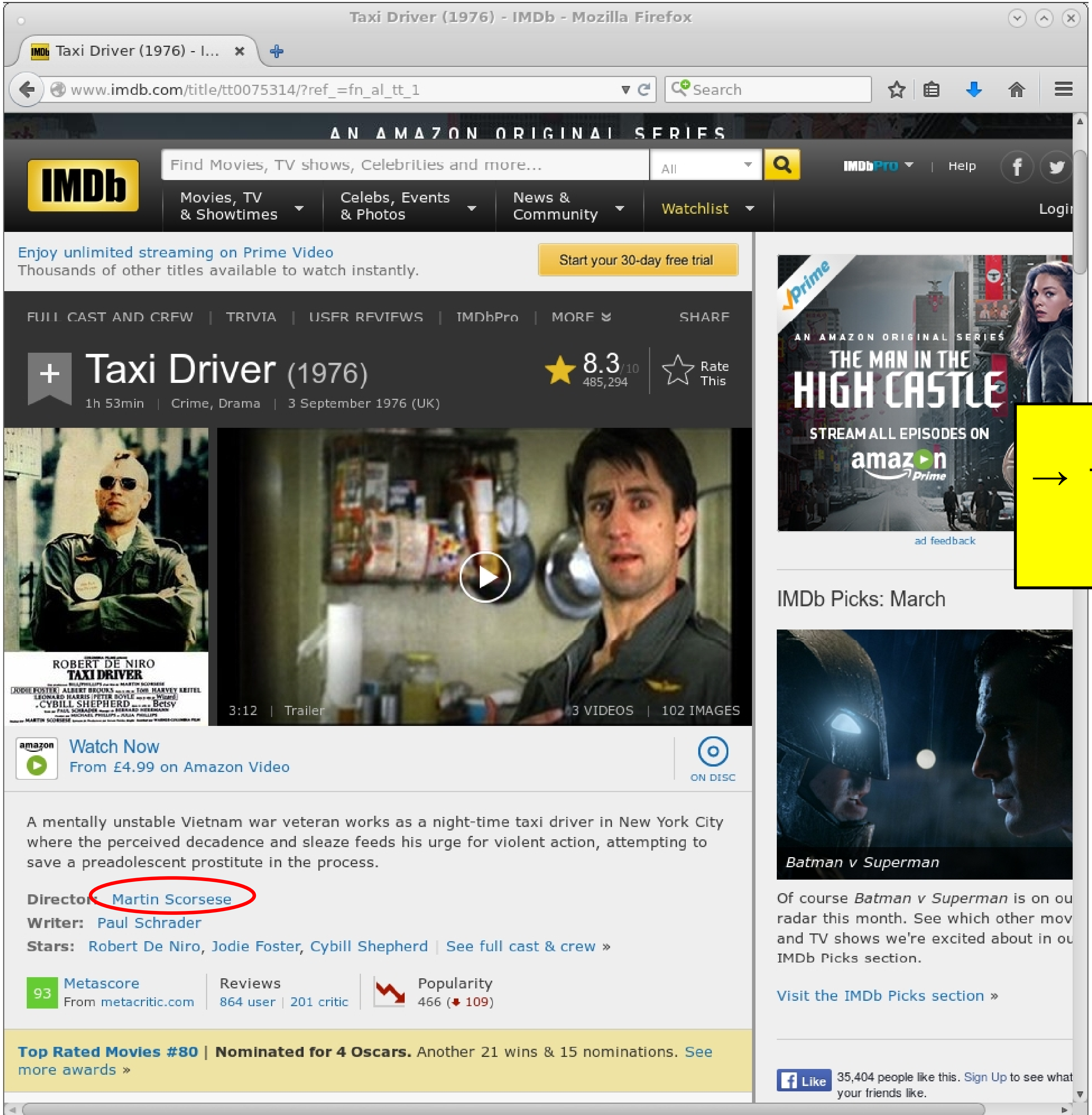

Taxi Driver (1976) - IMDb - Mozilla Firefox

Taxi Driver (1976) - I...

www.imdb.com/title/tt0075314/?ref_=fn_al_tt_1

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Taxi Driver (1976)

8.3/10
485,294

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1h 53min | Crime, Drama | 3 September 1976 (UK)

3:12 | Trailer

3 VIDEOS | 102 IMAGES

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ON DISC

A mentally unstable Vietnam war veteran works as a night-time taxi driver in New York City where the perceived decadence and sleaze feeds his urge for violent action, attempting to save a preadolescent prostitute in the process.

Director: Martin Scorsese

Writer: Paul Schrader

Stars: Robert De Niro, Jodie Foster, Cybill Shepherd | See full cast & crew »

93 Metascore
From metacritic.com

Reviews
864 user | 201 critic

Popularity
466 (↓ 109)

Top Rated Movies #80 | **Nominated for 4 Oscars.** Another 21 wins & 15 nominations. See more awards »

Prime

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THE MAN IN THE HIGH CASTLE
STREAM ALL EPISODES ON
amazon Prime

ad feedback

IMDb Picks: March

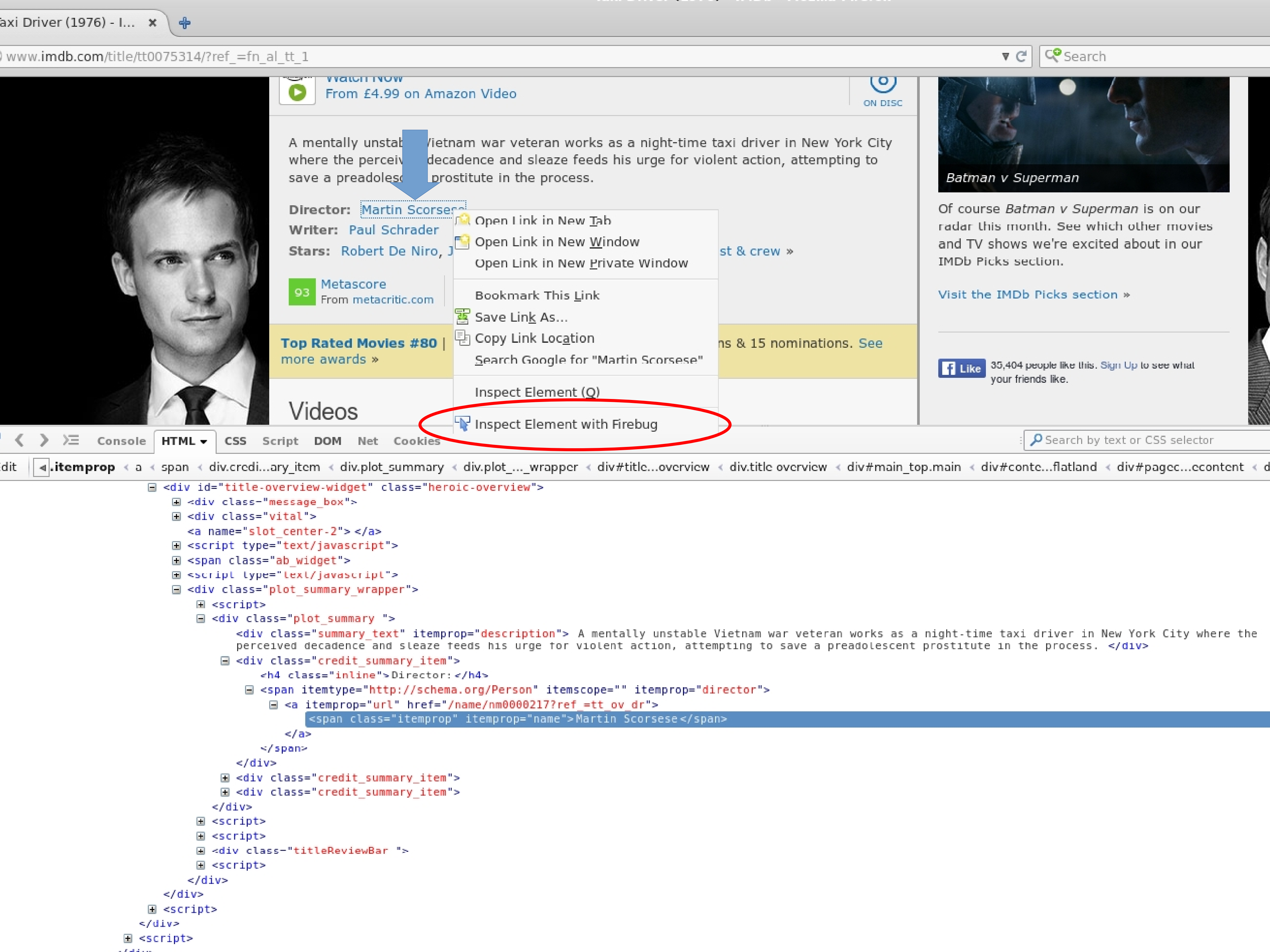
Batman v Superman

Of course *Batman v Superman* is on ou radar this month. See which other mov and TV shows we're excited about in ou IMDb Picks section.

Visit the IMDb Picks section »

Like 35,404 people like this. Sign Up to see what your friends like.

→ find Director's name in the HTML



A mentally unstab[le V]ietnam war veteran works as a night-time taxi driver in New York City where the percei[ved] decadence and sleaze feeds his urge for violent action, attempting to save a preadoles[cent] prostitute in the process.

Director: Martin Scorsese

Writer: Paul Schrader

Stars: Robert De Niro, J... st & crew »

93 Metascore From metacritic.com

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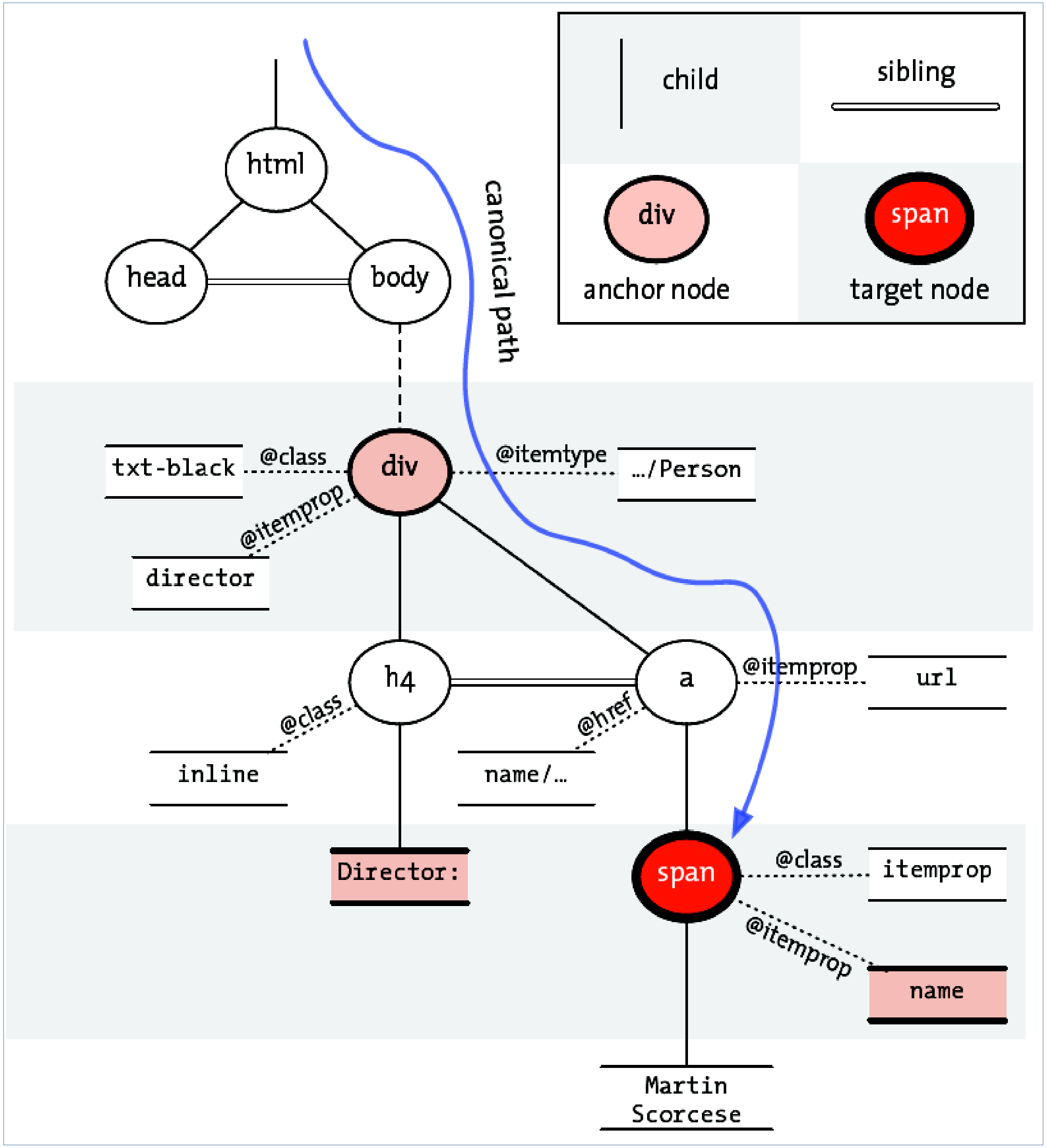
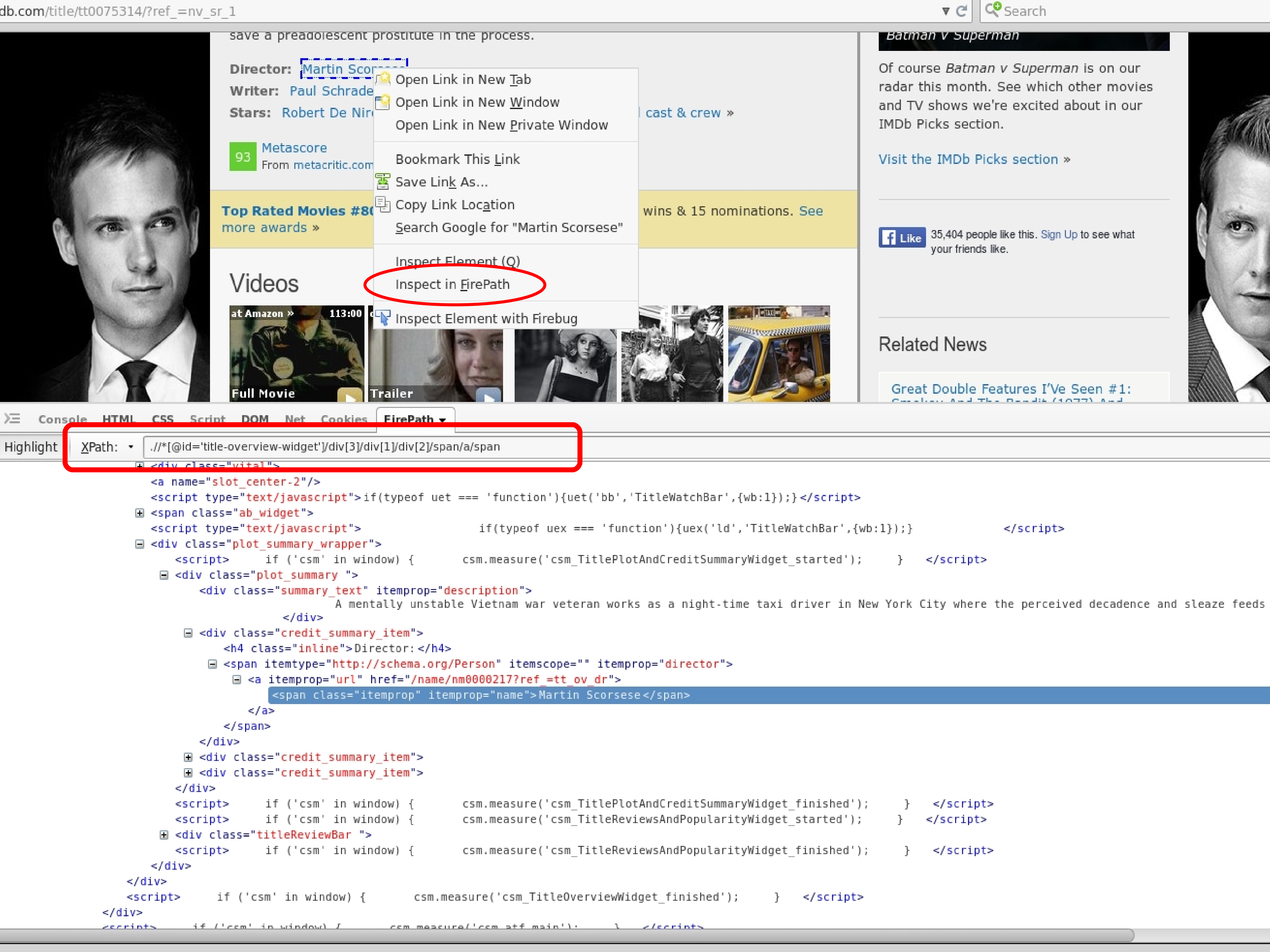
```
<div id="title-overview-widget" class="heroic-overview">
  <div class="message_box">
  <div class="vital">
  <a name="slot_center-2"> </a>
  <script type="text/javascript">
  <span class="ab_widget">
  <script type="text/javascript">
  <div class="plot_summary_wrapper">
    <script>
    <div class="plot_summary ">
      <div class="summary_text" itemprop="description"> A mentally unstable Vietnam war veteran works as a night-time taxi driver in New York City where the
      perceived decadence and sleaze feeds his urge for violent action, attempting to save a preadolescent prostitute in the process. </div>
      <div class="credit_summary_item">
        <h4 class="inline">Director:</h4>
        <span itemtype="http://schema.org/Person" itemscope="" itemprop="director">
          <a itemprop="url" href="/name/nm0000217?ref_=tt_ov_dr">
            <span class="itemprop" itemprop="name">Martin Scorsese</span>
          </a>
        </span>
      </div>
      <div class="credit_summary_item">
      <div class="credit_summary_item">
    </div>
    <script>
    <script>
    <div class="titleReviewBar ">
    <script>
  </div>
</div>
<script>
</div>
<script>
```



Tree structure of an IMDB movie page (HTML)

→ deep tree structure

→ **span-node** of Director’s name at depth > 50



save a preadolescent prostitute in the process.

Director: Martin Scorsese

Writer: Paul Schrade

Stars: Robert De Nir

cast & crew »

93 Metascore
From metacritic.com

Top Rated Movies #8 ... wins & 15 nominations. See more awards »

Of course *Batman v Superman* is on our radar this month. See which other movies and TV shows we're excited about in our IMDb Picks section.

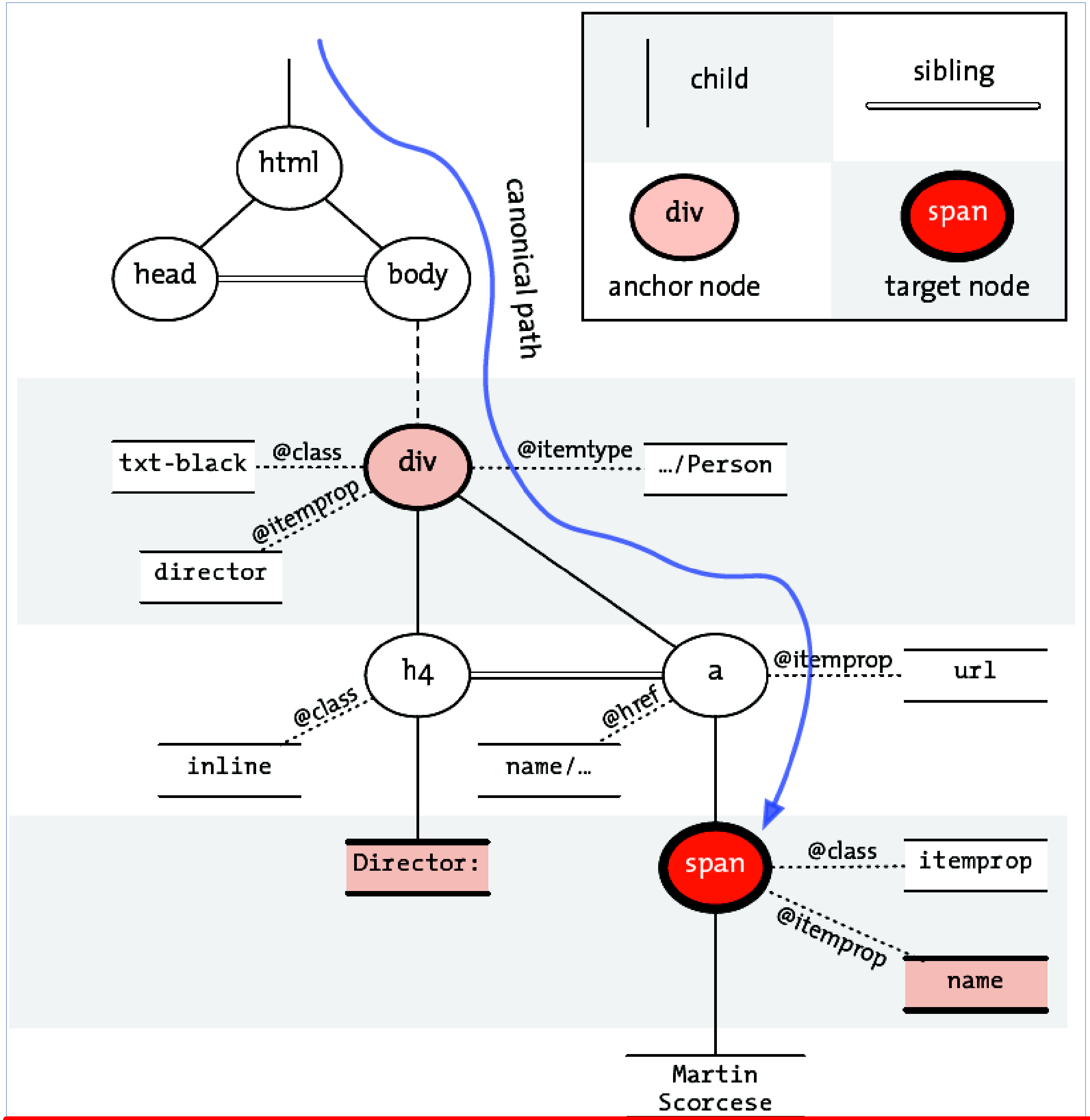
Visit the IMDb Picks section »

35,404 people like this. Sign Up to see what your friends like.

Great Double Features I've Seen #1:

XPath: .//*[@id='title-overview-widget']/div[3]/div[1]/div[2]/span/a/span

```
    <div class="vital">
      <a name="slot_center-2"/>
      <script type="text/javascript">if(typeof uet === 'function'){uet('bb','TitleWatchBar',{wb:1});}</script>
    <span class="ab_widget">
      <script type="text/javascript">            if(typeof uex === 'function'){uex('ld','TitleWatchBar',{wb:1});}            </script>
    <div class="plot_summary_wrapper">
        <script>     if ('csm' in window) {       csm.measure('csm_TitlePlotAndCreditSummaryWidget_started');     }   </script>
      <div class="plot_summary ">
          <div class="summary_text" itemprop="description">
                        A mentally unstable Vietnam war veteran works as a night-time taxi driver in New York City where the perceived decadence and sleaze feeds
                    </div>
        <div class="credit_summary_item">
              <h4 class="inline">Director:</h4>
          <span itemtype="http://schema.org/Person" itemscope="" itemprop="director">
            <a itemprop="url" href="/name/nm0000217?ref_=tt_ov_dr">
                <span class="itemprop" itemprop="name">Martin Scorsese</span>
              </a>
            </span>
          </div>
        <div class="credit_summary_item">
        <div class="credit_summary_item">
        </div>
        <script>     if ('csm' in window) {       csm.measure('csm_TitlePlotAndCreditSummaryWidget_finished');     }   </script>
        <script>     if ('csm' in window) {       csm.measure('csm_TitleReviewsAndPopularityWidget_started');     }   </script>
      <div class="titleReviewBar ">
        <script>     if ('csm' in window) {       csm.measure('csm_TitleReviewsAndPopularityWidget_finished');     }   </script>
      </div>
    </div>
    <script>     if ('csm' in window) {       csm.measure('csm_TitleOverviewWidget_finished');     }   </script>
  </div>
  <script>     if ('csm' in window) {       csm.measure('csm_atf_main');     }   </script>
```



Tree structure of
an IMDB movie page
(HTML)

→ deep tree structure
→ **span-node** for director’s name at depth > 50

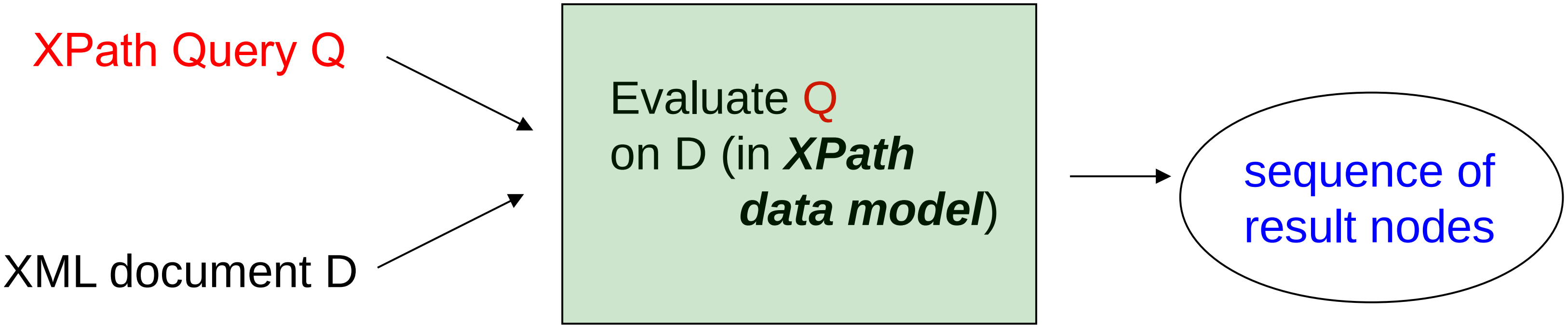
XPath query selecting the **span-node**

```
.//*[@id='title-overview-widget']/div[3]/div[1]/div[2]/span/a/span
```

Outline

1. XPath Data Model: **7 types of nodes**
2. Simple Examples
3. Location Steps and Paths
4. Value Comparison, and other Functions

XPath Data Model



XPath Query Q

XML document D

Evaluate Q on D (in ***XPath data model***)

sequence of result nodes

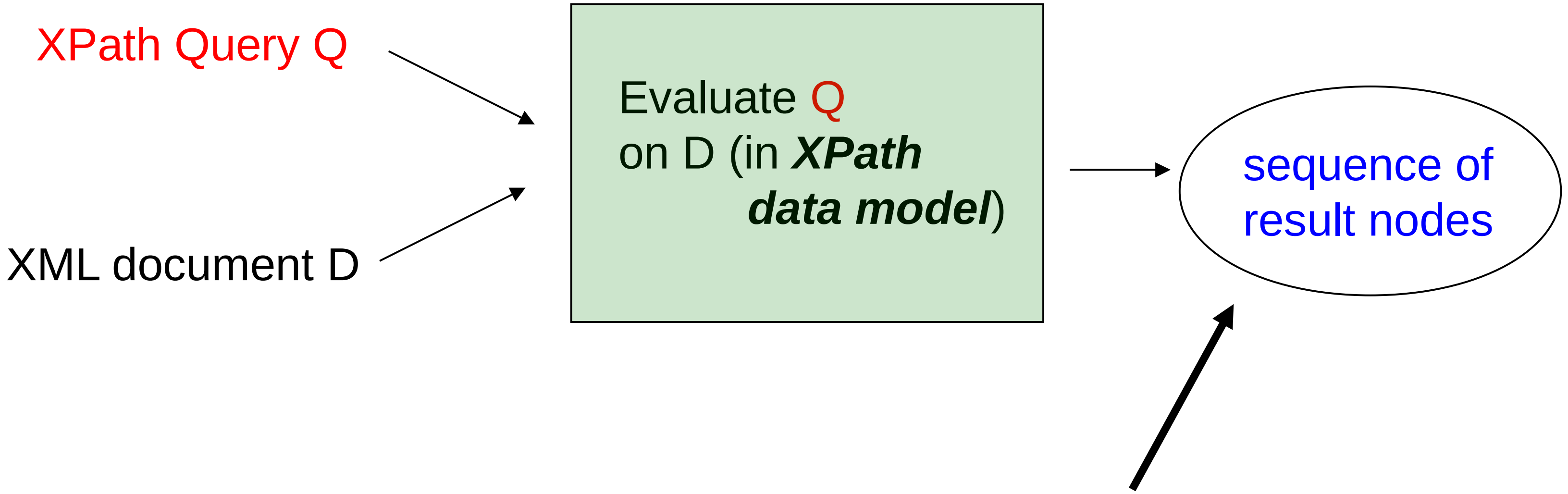
Document D is modeled as a **tree**.

THERE ARE SEVEN TYPES OF NODES in the XPath Data Model:

7 node types

→ root nodes
→ element nodes
→ text nodes
→ attribute nodes
→ namespace nodes
→ processing instruction nodes
→ comment nodes

Result Sequences



XPath Query Q

XML document D

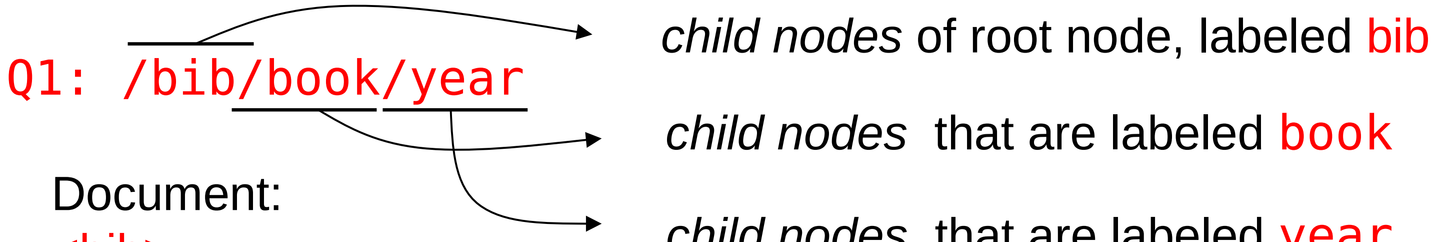
Evaluate Q on D (in ***XPath data model***)

sequence of result nodes

→ ordered in **document order**
→ contains **no duplicates**

Simple Examples

In abbreviated syntax.



Q1: /bib/book/year

child nodes of root node, labeled bib

child nodes that are labeled book

child nodes that are labeled year

Document:

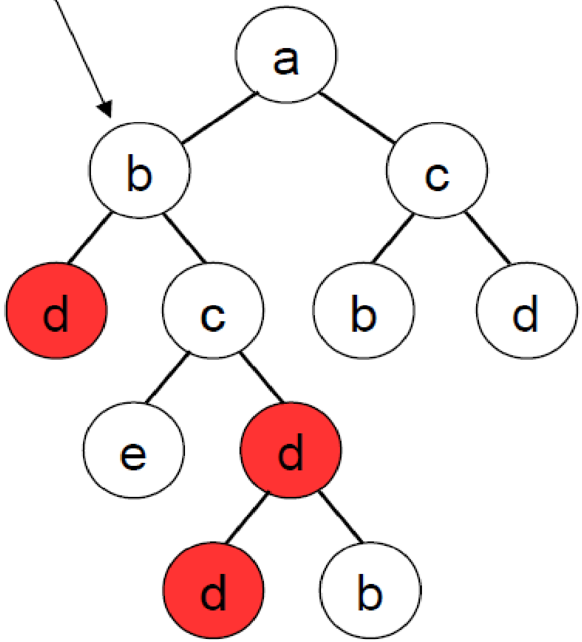
```
<bib>
 <book>
   <author>Abiteboul</author>
   <author>Hull</author>
   <author>Vianu</author>
   <title>Foundations of Databases</title>
   <year>1995</year>
 </book>
 <book>
   <author>Ullmann</author>
   <title>Principles of Database and Knowledge Base Systems</title>
   <year>1998</year>
 </book>
</bib>
```

Simple Examples

In abbreviated syntax.

`Q3: /a/b//d`

“b-child of a-doc. element”

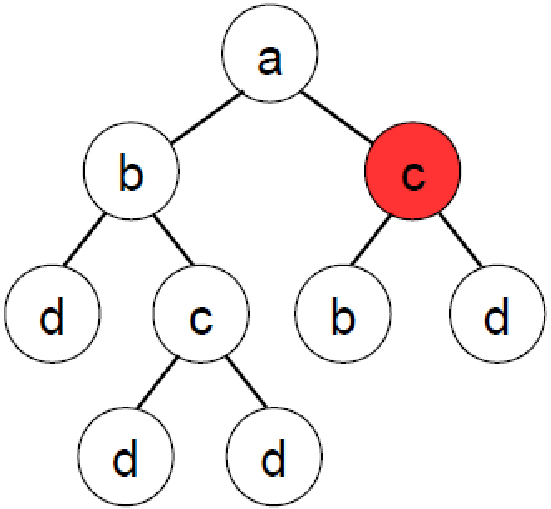


ALL d-nodes
in this subtree

Simple Examples

In abbreviated syntax.

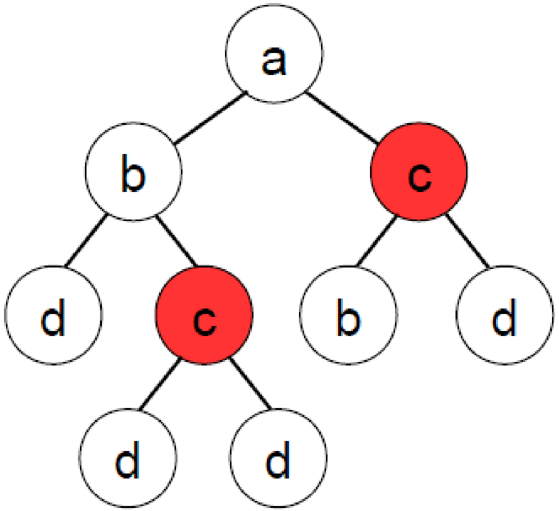
```
Q4: /*/c
```



Simple Examples

In abbreviated syntax.

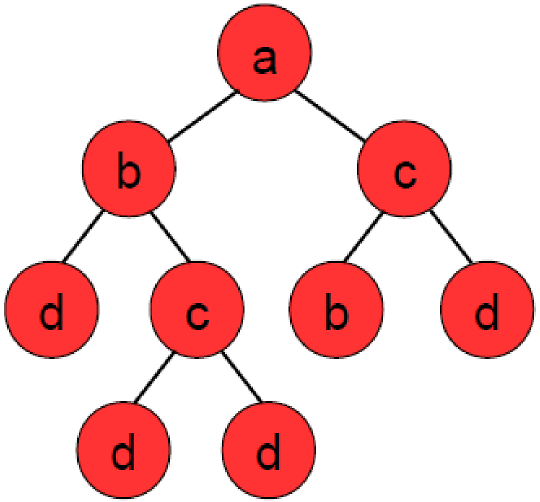
```
Q5: //c
```



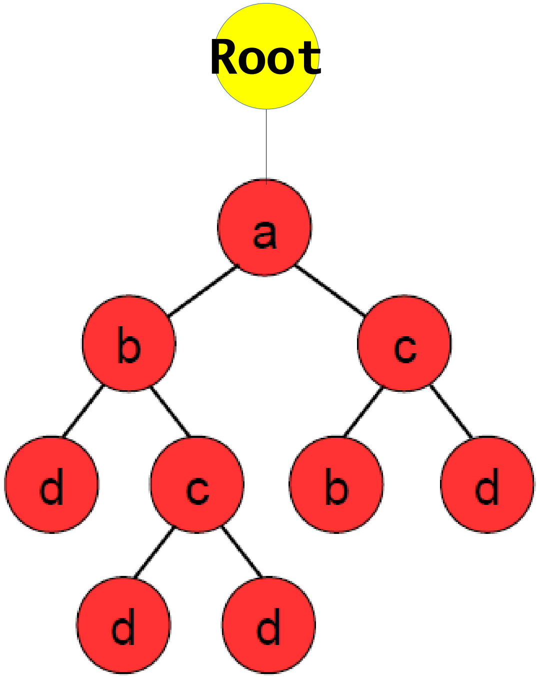
Simple Examples

In abbreviated syntax.

```
Q6: //*
```



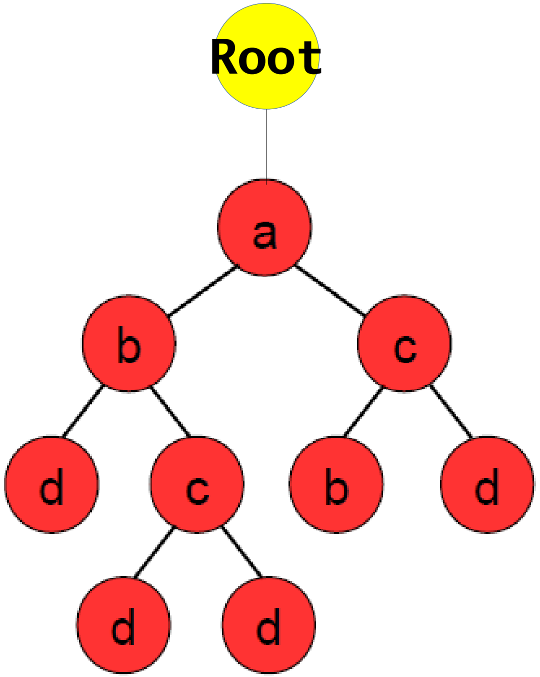
→ important: there is always a (virtual) **Root-node**!
even if <?xml … > is missing.



`/a` = a-child of Root-node

`/a/../*` = same node

→ important: there is always a (virtual) **Root-node**!
even if <?xml … > is missing.



`/a` = a-child of Root-node

`/a/../*` = same node

`/a/../..//a` = "*No Match*"

→ important: there is always a (virtual) **Root-node**!
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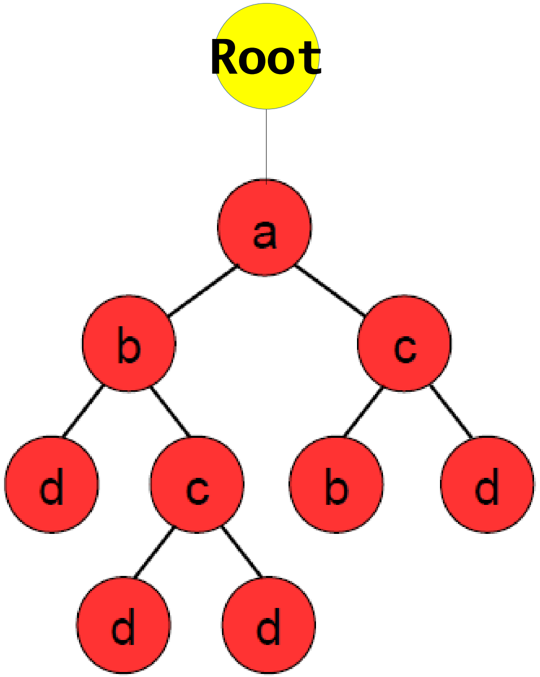


`/a` = a-child of Root-node

`/a/../*` = same node

`/a/../..//a` = *"No Match"*

`/a/..` = *"No DOCTYPE Declaration,*
Root is [Element :<a/>]"

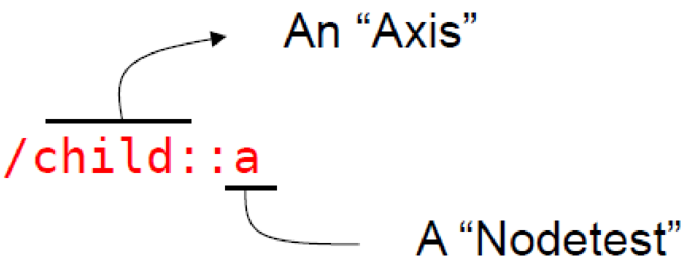
↑

Implementation-dependent

Abbreviations

In **abbreviated syntax**.

`/a` is abbreviation for `/child::a`



An “Axis”

A “Nodetest”

`//a` is abbreviation for `/descendant-or-self::node()/child::a`

`.` is abbreviation for `self::node()`

`..` is abbreviation for `parent::node()`

→ Child and descendant-or-self are only 2 out of **12 possible axes**.

An “Axis” is a sequence of nodes. It is evaluated relative to a context-node.

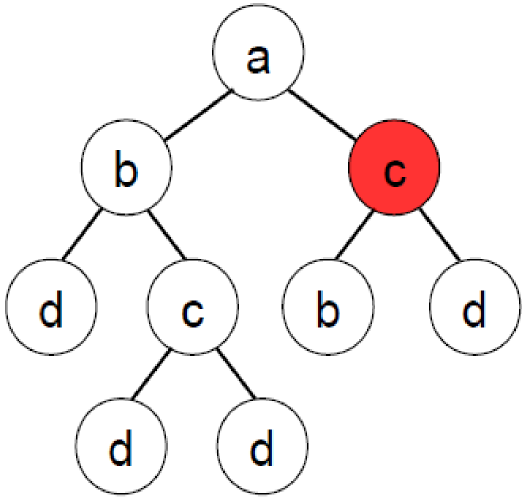
Other axes:

- → `descendant`
- → `parent`
- → `ancestor-or-self`
- → `ancestor`
- → `following-sibling`
- → `preceding-sibling`
- → `attribute`
- → `following`
- → `preceding`
- → `self`

Predicates (aka "Filters")

In abbreviated syntax.

`Q7: //c[./b]` → "*has b-child*" (context-nodes are all c-nodes…)



Filters [..] have

→ *existential semantics*

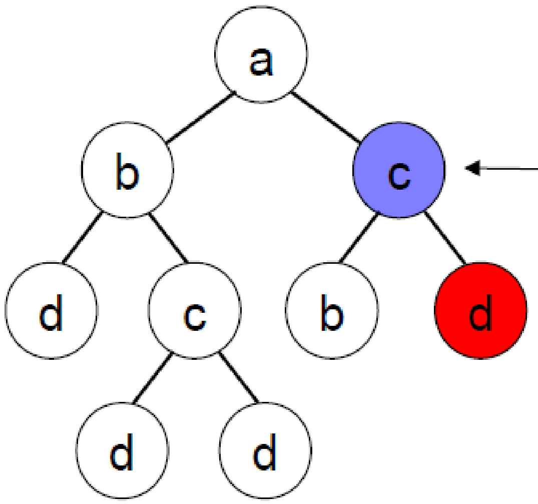
→ [./b] = "*there exists a* b-child"

Predicates (aka “Filters”)

In abbreviated syntax.

```
Q8: //c[./b]/d
```

“*has b-child*”



All d-children of the context-node(s)

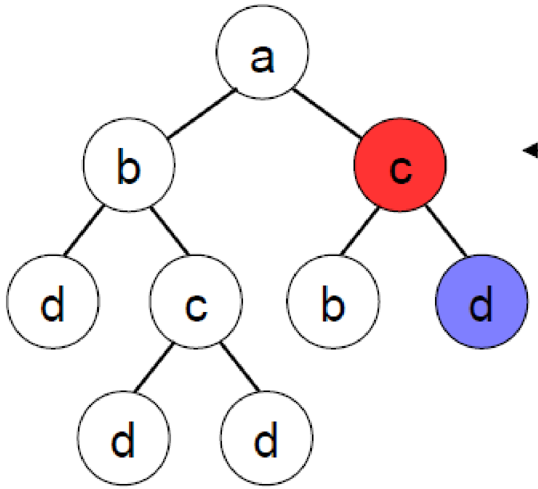
Predicates (aka “Filters”)

In abbreviated syntax.

```
Q9: //c[./b]/d/..
```

“*has b-child*”

select **parent(s)** of context-node(s)



parent(s) of the context-node(s)

Q9 selects c-nodes that “*have a b-child AND a d-child*”

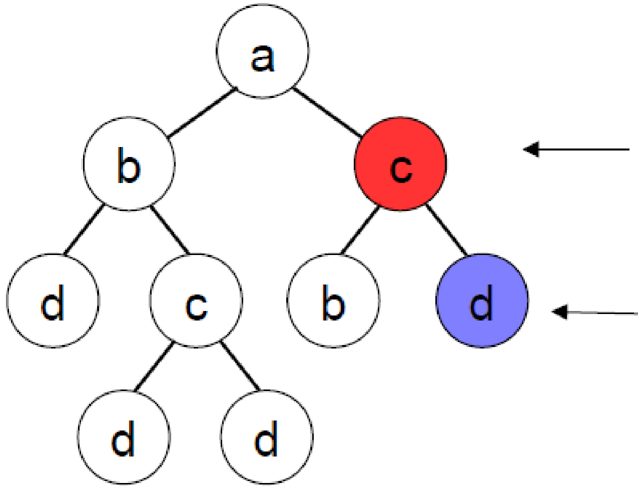
Predicates (aka “Filters”)

In abbreviated syntax.

`Q9: //c[./b]/d/..`

“has b-child”

select **parent(s)** of context-node(s)



parent(s) of the context-node(s)

`Q9` selects c-nodes that *“have a b-child AND a d-child”*

More direct way: `//c[./b and ./d]`

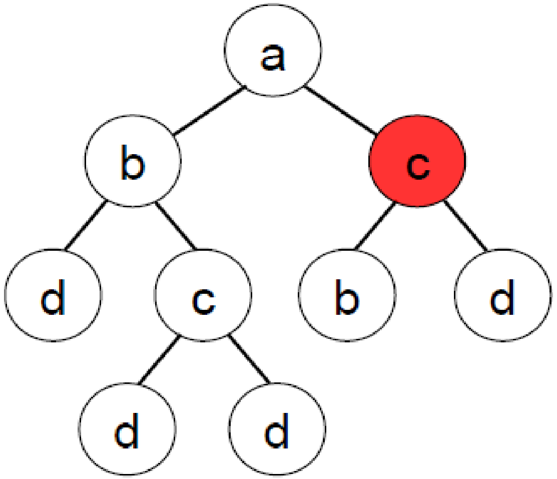
Predicates (aka “Filters”)

In abbreviated syntax.

```
//c[b and d]
```

evaluates to **true/false**

A “*Filter*”



c-nodes that “*have a b-child AND a d-child*”

Predicates (aka "Filters")

In abbreviated syntax.

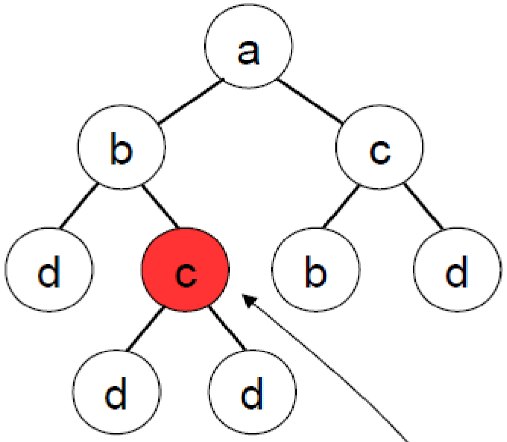
`//c[b and d]`

evaluates to **true/false**

A "*Filter*"

Question

How to only select the other c-node?



Can use "`not( … )`" in a filter!

`//c[not(b)]`

"does not have a b-child"

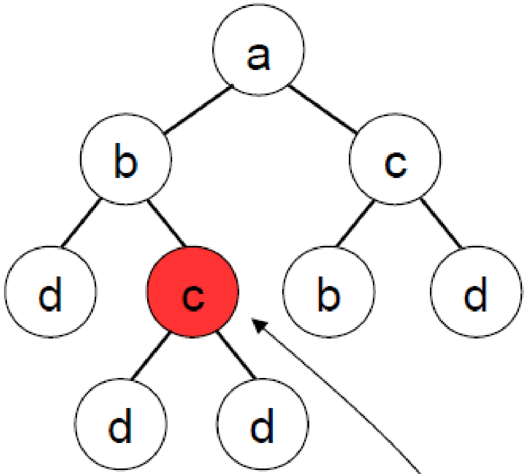
Examples: Predicates

In abbreviated syntax.

```
//c[b and d]
```

evaluates to **true/false**

A “*Filter*”



Can use “`not( … )`” in a filter!

```
//c[not(b)]
```

Question

How to only select the other c-node?

Many more possibilities, of course:

```
//c[parent::b]
//c[../../b]
//c[../d]
```

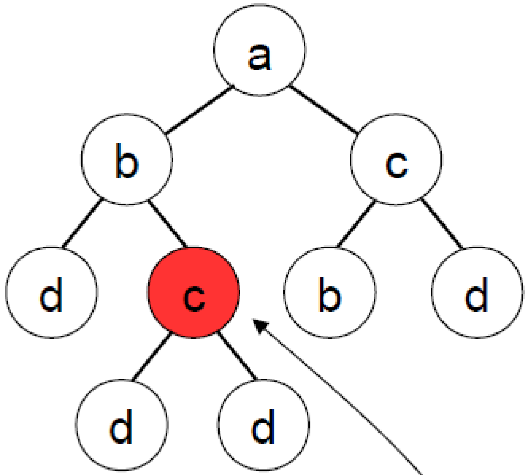
Examples: Predicates

In abbreviated syntax.

```
//c[b and d]
```

evaluates to **true/false**

A "*Filter*"



Question

How to only select
the other c-node?

Many more
possibilities, of course:

```
//c[parent::b]
//c[../../b]
//c[../d]
```

Can use "`not( … )`" in a filter!

```
//c[not(b)]
```

➔ can you say
"c-node that has only d-children"?

Examples: Predicates

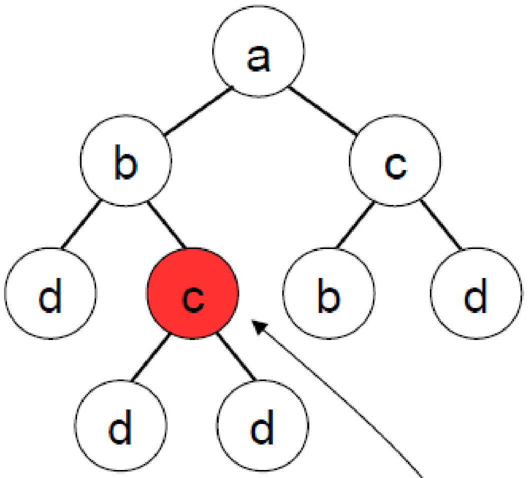
In abbreviated syntax.

```
//c[b and d]
```

$\underbrace{\texttt{b and d}}_{\text{A “}\textit{Filter}\text{”}}$ evaluates to **true/false**

Question

How to only select
the other c-node?



Many more
possibilities, of course:

```
//c[parent::b]
//c[../../b]
//c[../d]
```

Can use “`not( … )`” in a filter!

```
//c[not(b)]
```

➔ can you say
“c-node that has only d-children”?

YES! needs a bit of logic… `//c[not(child::*[not(self::d)])]`

Location Steps & Paths

→ A Location Path is a sequence of Location Steps

→ A Location Step is of the form

axis :: nodetest [Filter_1] [Filter_2] … [Filter_n]

Filters (aka predicates, (filter) expressions)

→ evaluate to **true/false**

→ XPath queries, evaluated with
context-node = current node

Boolean operators: **and, or**

Empty string/sequence are converted to **false**

Location Steps & Paths

→ A Location Path is a sequence of Location Steps

→ A Location Step is of the form

axis :: nodetest [Filter_1] [Filter_2] … [Filter_n]

Filters (aka predicates, (filter) expressions) evaluate to **true/false**

nodetest: * or node-name (could be expanded →namespaces) or

→ text()
→ comment()
→ processing-instruction(ln)
→ node()

Example `child::text()` “*select all text node children of the context node*”

→ the nodetest node() is true for any node.

`attribute::*` “*select all attributes of the context node*”

Location Steps & Paths

→ A Location Path is a sequence of Location Steps

→ A Location Step is of the form

axis :: nodetest [Filter_1] [Filter_2] … [Filter_n]

Filters (aka predicates, (filter) expressions) evaluate to **true/false**

nodetest: * or node-name (could be expanded →namespaces) or

→ text()
→ comment()
→ processing-instruction(ln)
→ node()

12 Axes

Forward Axes:

→ self
→ child
→ descendant-or-self
→ descendant
→ following
→ following-sibling

In doc order

Backward Axes:

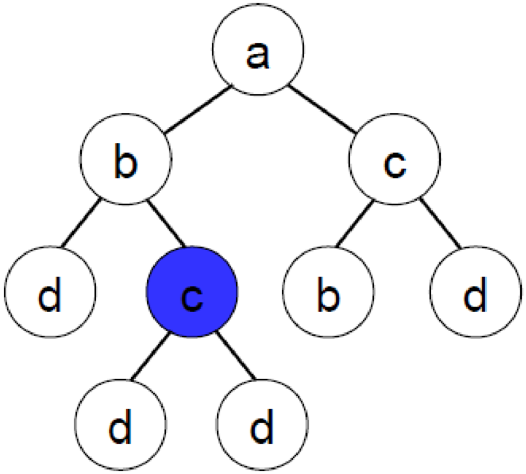
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling

reverse doc order

→ attribute

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

```
→ self
→ child
→ descendant-or-self
→ descendant
→ following
→ following-sibling
```

In doc order

Backward Axes:

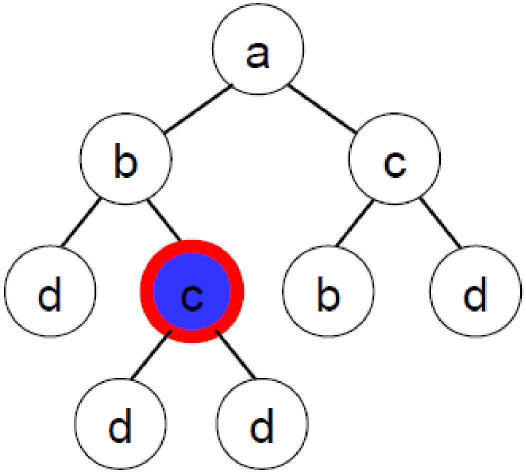
```
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling
```

reverse doc order

```
→ attribute
```

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



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Forward Axes:

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In doc order

Backward Axes:

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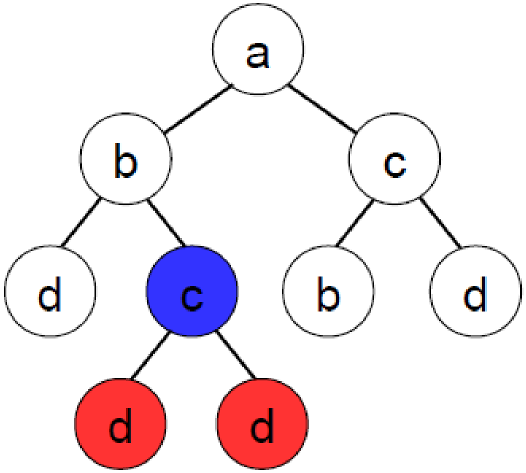
→ attribute

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

- → self
- → child
- → descendant-or-self
- → descendant
- → following
- → following-sibling

In doc order

Backward Axes:

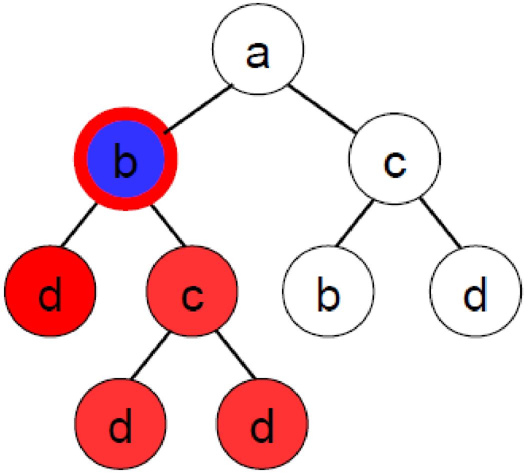
- → parent
- → ancestor
- → ancestor-or-self
- → preceding
- → preceding-sibling

reverse doc order

→ attribute

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

→ `self`
→ `child`
→ **`descendant-or-self`**
→ `descendant`
→ `following`
→ `following-sibling`

In doc order

Backward Axes:

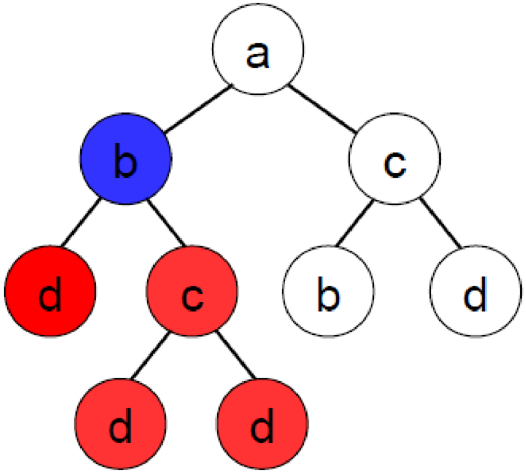
→ `parent`
→ `ancestor`
→ `ancestor-or-self`
→ `preceding`
→ `preceding-sibling`

reverse doc order

→ `attribute`

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

```
→ self
→ child
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→ descendant
→ following
→ following-sibling
```

In doc order

Backward Axes:

```
→ parent
→ ancestor
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→ preceding
→ preceding-sibling
```
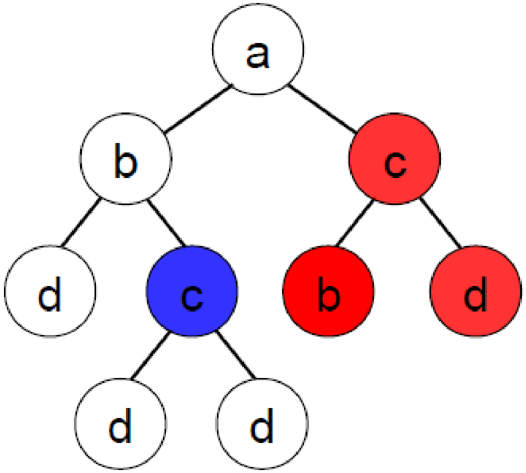

```
→ attribute
```

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

→ self
→ child
→ descendant-or-self
→ descendant
→ following
→ following-sibling

In doc order

Backward Axes:

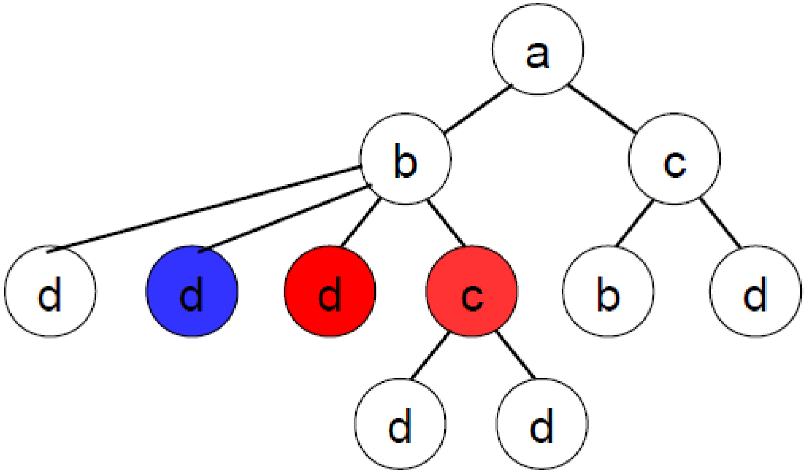
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling

→ attribute

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

- → `self`
- → `child`
- → `descendant-or-self`
- → `descendant`
- → `following`
- → **`following-sibling`**

In doc order

Backward Axes:

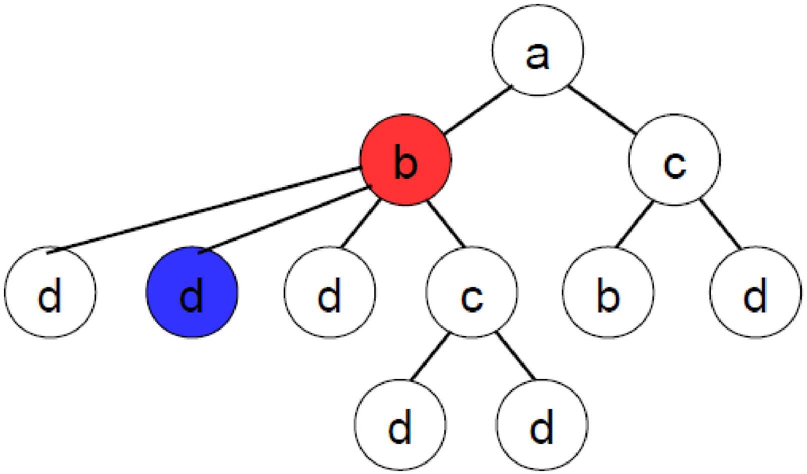
- → `parent`
- → `ancestor`
- → `ancestor-or-self`
- → `preceding`
- → `preceding-sibling`

→ `attribute`

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

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Forward Axes:

→ `self`
→ `child`
→ `descendant-or-self`
→ `descendant`
→ `following`
→ `following-sibling`

In doc order

Backward Axes:

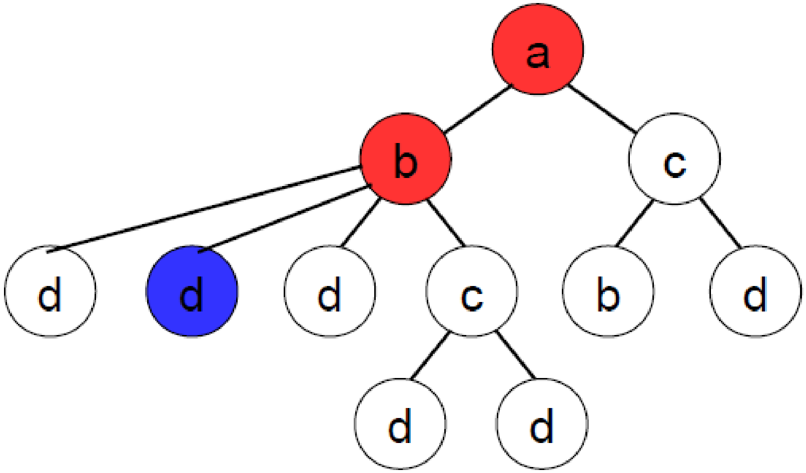
→ **`parent`**
→ `ancestor`
→ `ancestor-or-self`
→ `preceding`
→ `preceding-sibling`

reverse doc order

→ `attribute`

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

```
→ self
→ child
→ descendant-or-self
→ descendant
→ following
→ following-sibling
```

In doc order

Backward Axes:

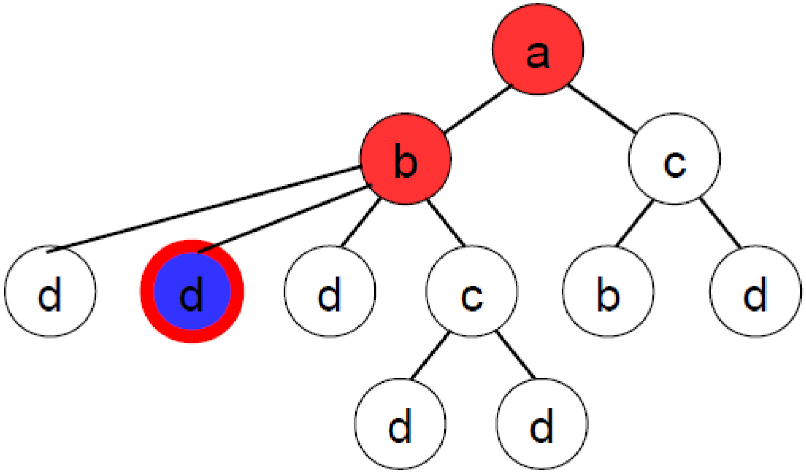
```
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling
```

```
→ attribute
```

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



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```
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→ child
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→ descendant
→ following
→ following-sibling
```

In doc order

Backward Axes:

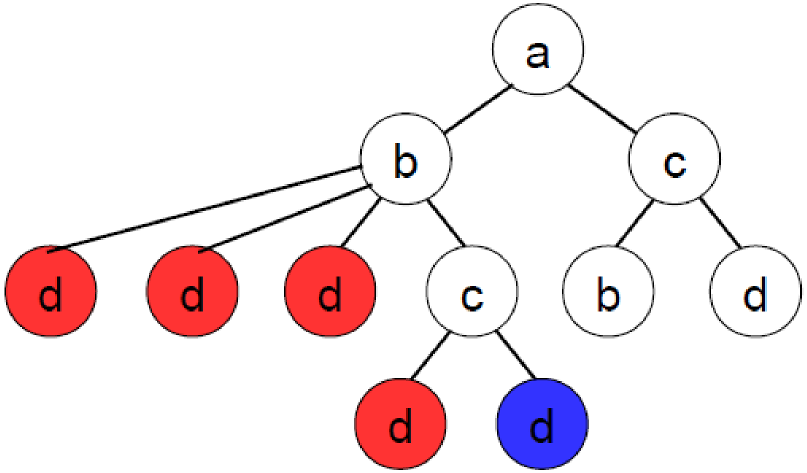
```
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling
```

```
→ attribute
```

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

```
→ self
→ child
→ descendant-or-self
→ descendant
→ following
→ following-sibling
```

In doc order

Backward Axes:

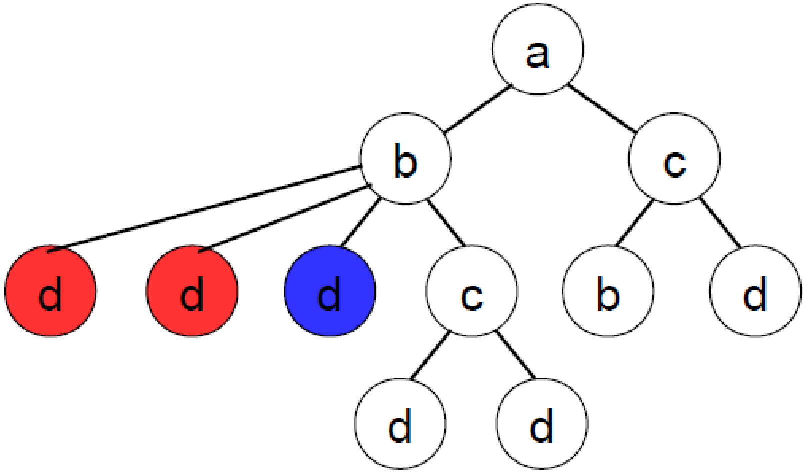
```
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling
```

```
→ attribute
```

reverse doc order

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



→ from context node, execute query:

`axis::*`

Forward Axes:

- → `self`
- → `child`
- → `descendant-or-self`
- → `descendant`
- → `following`
- → `following-sibling`

In doc order

Backward Axes:

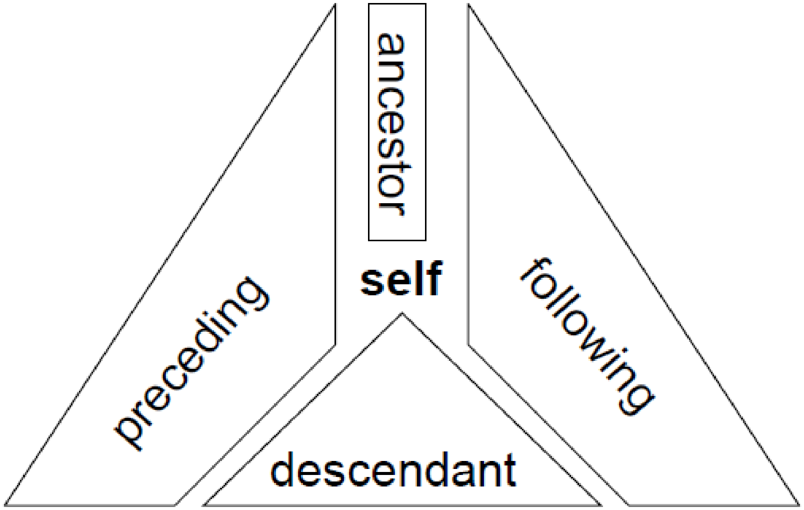
- → `parent`
- → `ancestor`
- → `ancestor-or-self`
- → `preceding`
- → **`preceding-sibling`**

reverse doc order

→ `attribute`

Location Steps & Paths

Axis = a sequence of nodes (is evaluated relative to context-node)



Forward Axes:

```
→ self
→ child
→ descendant-or-self
→ descendant
→ following
→ following-sibling
```

In doc order

Backward Axes:

```
→ parent
→ ancestor
→ ancestor-or-self
→ preceding
→ preceding-sibling
```

reverse doc order

```
→ attribute
```

Location Path Semantics

→ A Location Path **P** is a sequence of Location Steps

a_1 :: n_1 [F_1_1] [F_1_2] … [F_1_n1]
/ **a_2** :: n_2 [F_2_1] [F_2_2] … [F_2_n2]

/ **a_m** :: n_m [F_m_1] [F_m_2] … [F_m_nm]

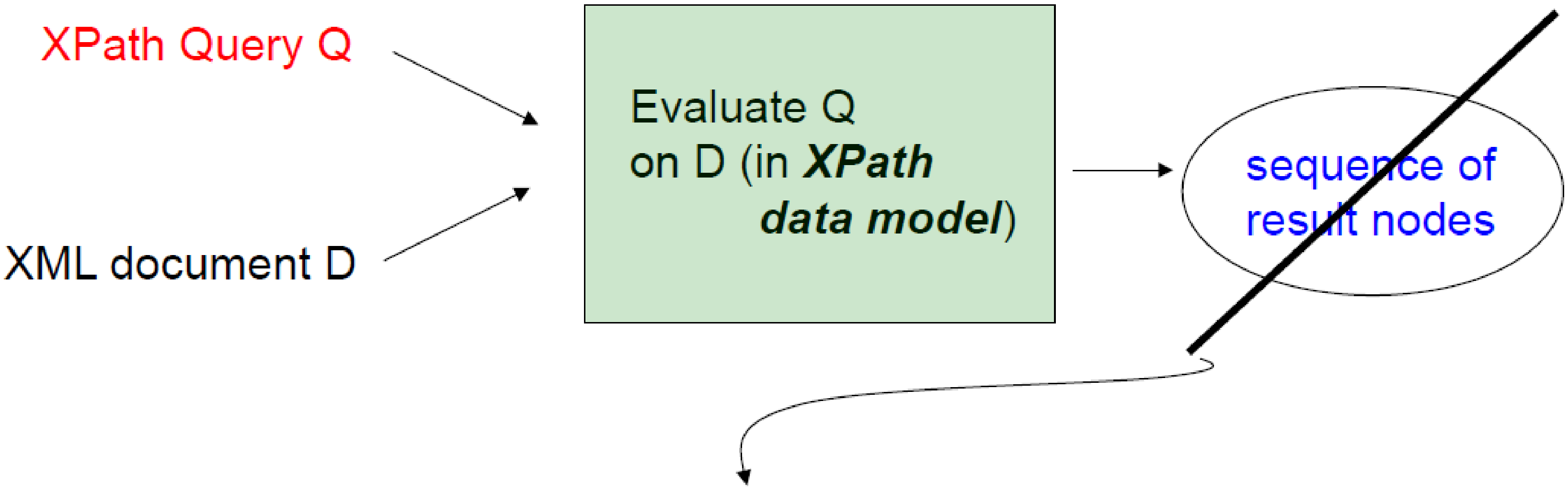
S0 = initial sequence of context-nodes

(1) (to each) context-node N in S0, apply axis **a_1**: gives sequence S1 of nodes
(2) remove from S1 any node M for which
→ test n_1 evaluates to false
→ any of filters F_1_1,…,F_1_n1 evaluate to false.

Proceed similarly for S1 and **a_2**, et cetera

Finally, obtain Sm = result sequence of query **P**.

More Details



XPath Query Q

XML document D

Evaluate Q on D (in ***XPath data model***)

~~sequence of result nodes~~

NOT correct (at least not for intermediate expr's)

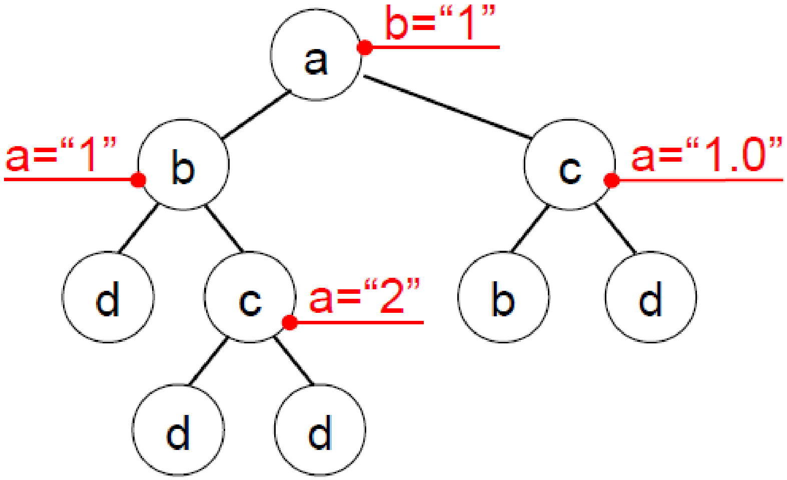
An expression evaluates to an object, which has one of the following **four basic types**

- node-set (an unordered collection of nodes w/o duplicates)
- boolean (true or false)
- number (a floating-point number)
- string (a sequence of UCS characters)

Attribute Axis

How to

→ test attribute nodes



Examples

`//attribute::*`

Result:
b="1"
a="1"
a="2"
a="1.0"

Remember, these are just NODEs.

//attribute::*/. gives same result

And //attribute::a/.. gives

<b a="1"><d/><c a="2"><d/><d/></c></b>
<c a="2"><d/><d/></c>
<c a="1.0"><b/><d/></c>

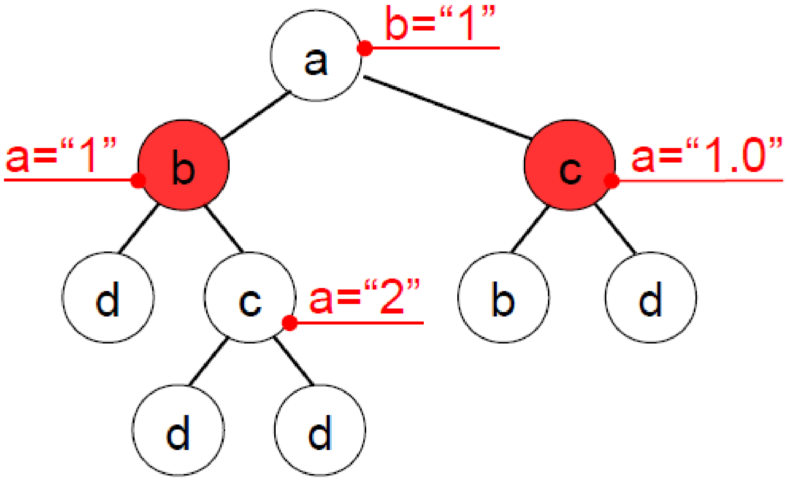
Attribute Axis & Value Tests

How to
→ test attribute **values**

Examples

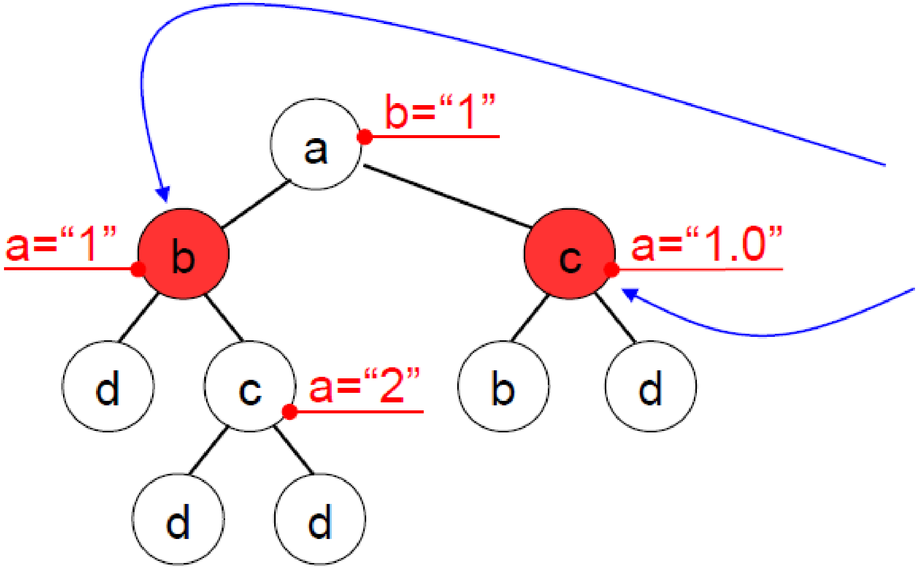
`//*[attribute::a=1]`

(selects the two red nodes)



Attribute Axis & Value Tests

How to
→ test attribute **values**



Examples

number (float) comparison

`//*[attribute::a=1]`

(selects the two red nodes)

Watch out

//*[attribute::a="1"]

//*[attribute::a="1.0"]

string comparison

Attribute Axis & Value Tests

How to
→ test attribute **values**

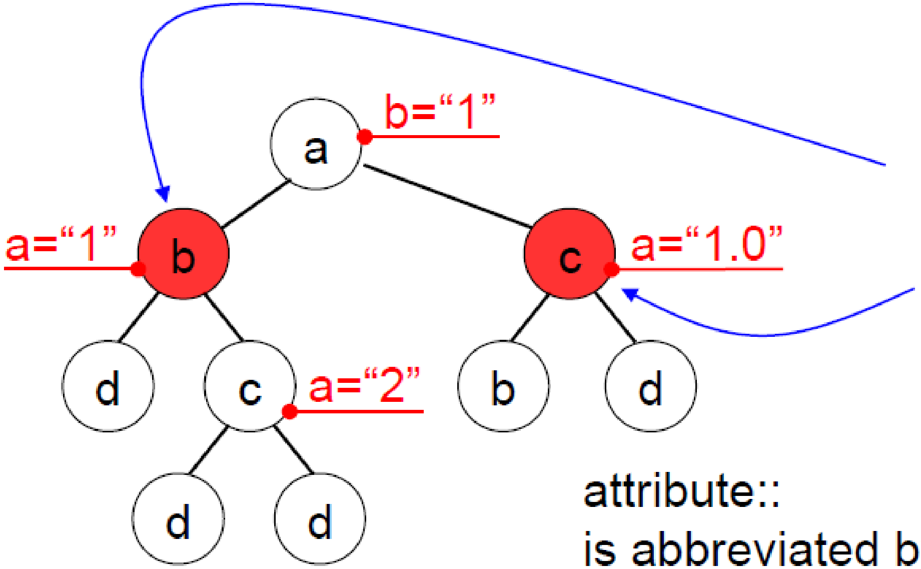
Examples

number (float) comparison

`//*[attribute::a=1]`

(selects the two red nodes)

Watch out



//*[attribute::a="1"]

//*[~~attribute::~~a="1.0"]
@

string comparison

attribute::
is abbreviated by @

//*[@a!="1"]	selects both c-nodes
//*[@a>1]	selects only left c-node
//*[@a=//@b]	selects what?? (hint: "=" is string comp. here)

Tests in Filters

- or
- and
- =, !=
- <=, <, >=, >

Boolean **true**
coerced to a float 1.0

The operators are all left associative.
For example, 3 > 2 > 1 is equivalent to (3 > 2) > 1, which evaluates to **false**.

But, 3 > 2 > 0.9 evaluates to **true**.

For two strings u,v

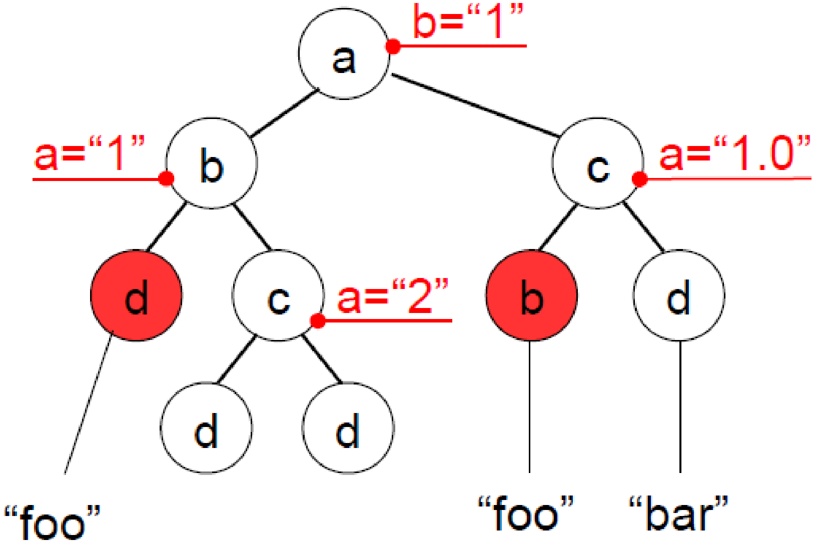
u<=v
u<v
u>=v
u>v

Always return **false**!
→ Unless both u and v are numbers.

["1.0">="1"] evaluates to **true**.

Text Nodes

How
→ test text nodes & values



//text()

Result:
foo
foo
Bar

`//*[text()="foo"]`

Result: the two red nodes

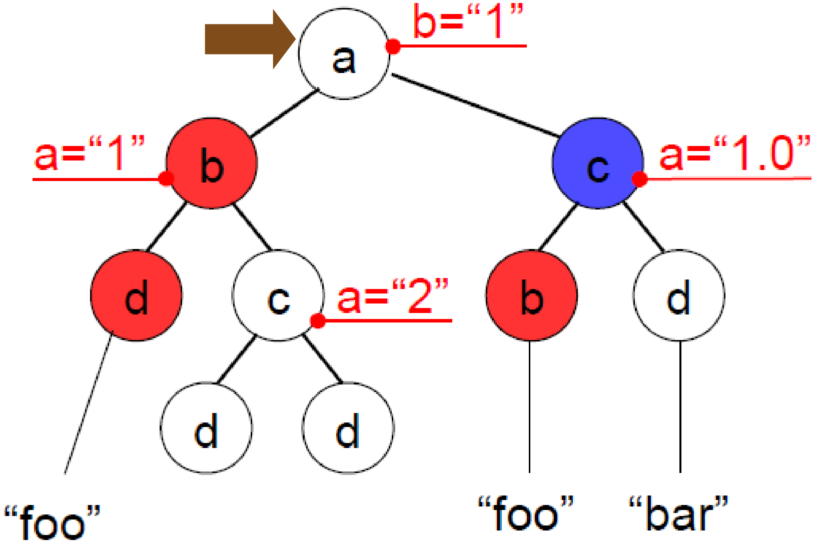
Question:

What is the result for
`//*[text()=//b/text()]`

Useful Functions (Strings)

The string-value of an element node is the concatenation of the string-values of all text node descendants in document order.

```
//*[.="foo"]
//*[.=“foobar”]
```

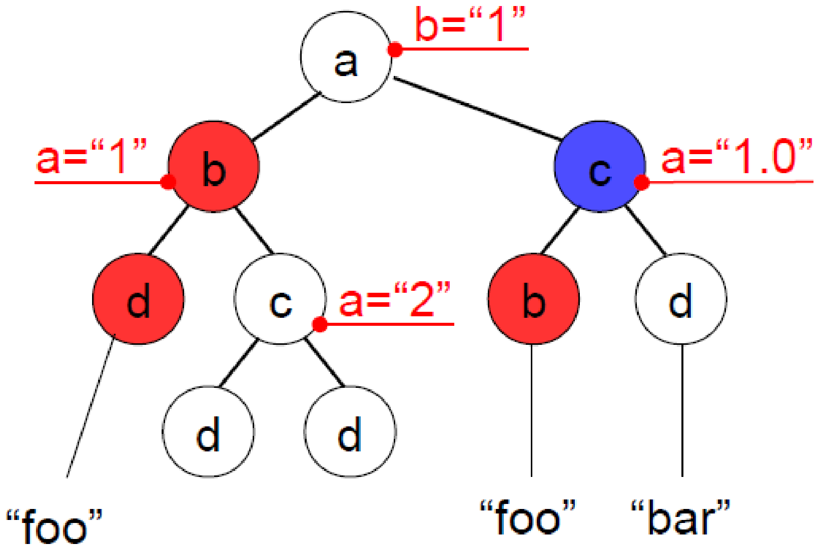


```
//*[.=”foofoobar”]
```

Useful Functions (Strings)

The string-value of an element node is the concatenation of the string-values of all text node descendants in document order.

```
//*[.="foo"]
//*[.=“foobar”]
```



- → concat(st_1, st_2,…, st_n) = st_1 st_2 … st_n
- → startswith(“abcd”,”ab”) = true
- → contains(“bar”,”a”) = true
- → substring-before("1999/04/01","/") = 1999.
- → substring-after("1999/04/01","19") = 99/04/01
- → substring("12345",2,3) = “234”
- → string-length(“foo”) = 3

What is the result to this: `//*[contains(.,"bar")]`

Useful Functions (Strings)

The string-value of an element node is the concatenation of the string-values of all text node descendants in document order.

```
//*[.="foo"]
//*[.=“foobar”]
```

→ normalize-space(“   foo   bar a “) = “foo bar a”

→ translate(“bar","abc","ABC") = BAr

returns the first argument string with occurrences of characters in the second argument string replaced by the character at the corresponding position in the third argument string

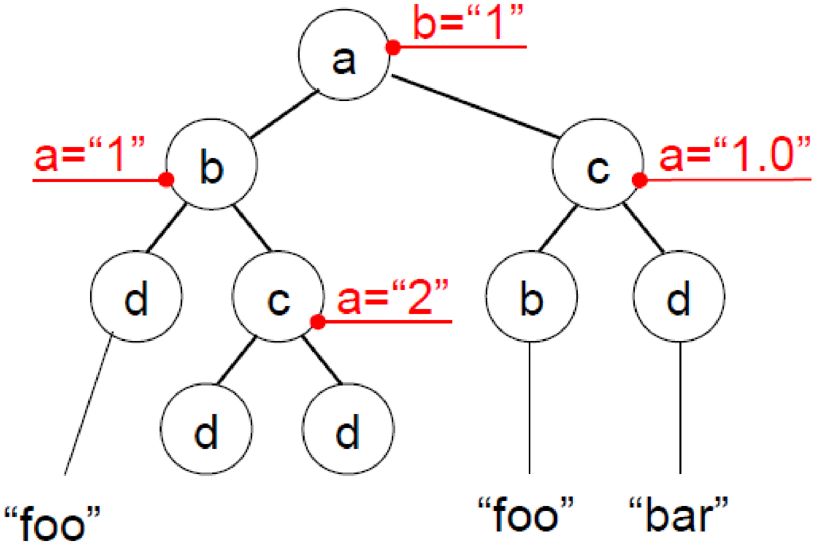
Useful Functions (on Node Sets)

→ `count`

Counts number or results

```
/a[count(//*[text()=//b/text()])=2]
```

What is the result?



Useful Functions (on Node Sets)

→ count

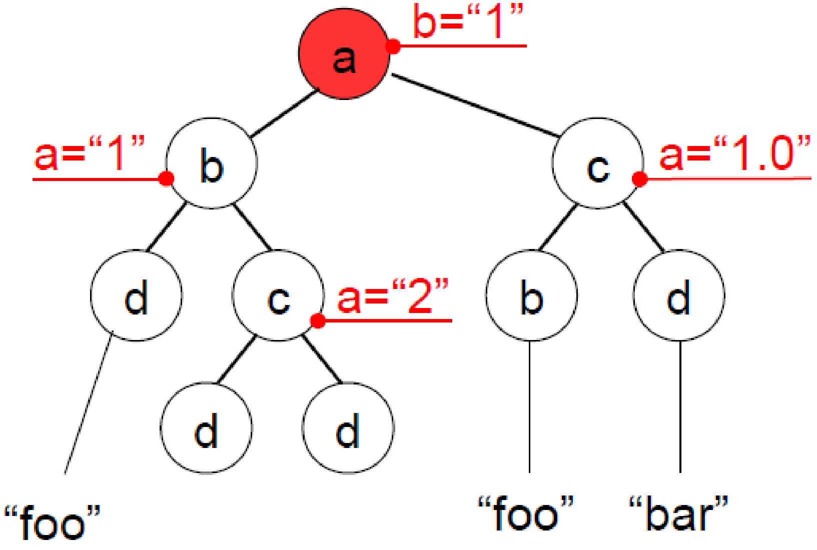
Counts number or results

```
/a[count(//*[text()=//b/text()])=2]
```

What is the result?

Same result as:

```
/a[count(//*[text()="foo"])
  > count(//*[text()="bar"])]
```



Useful Functions (on Node Sets)

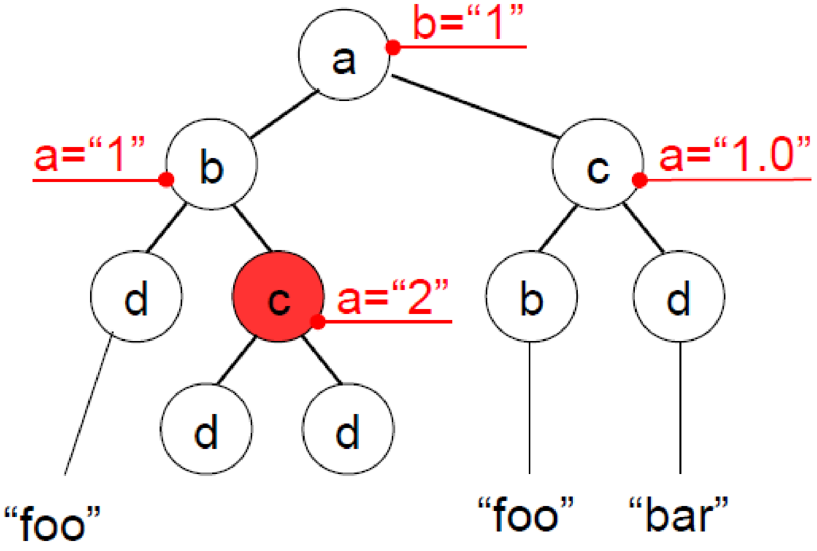
→ `count`
Counts number or results

```
/a[count(//*[text()=//b/text()])=2]
```

What is the result?

Same result as:

```
/a[count(//*[text()="foo"])
  > count(//*[text()="bar"])]
```



What is the result for:

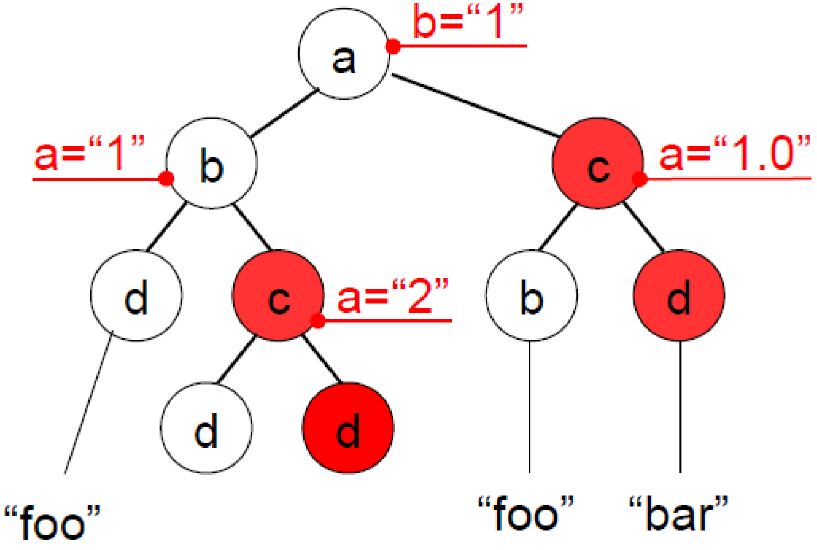
```
//c[count(b)=0]
```

(same as `//c[not(b)]`)

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context



`//*[position()=2]`

`//a` is abbreviation for `descendant-or-self::node()/child::a`

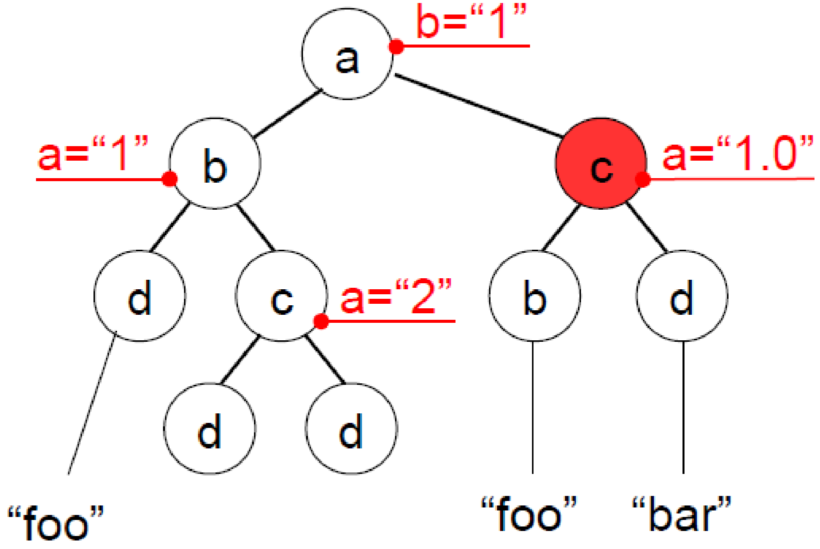
Useful Functions (on Node Sets)

→ `last()`

returns contex-size from the evaluation context

→ `position()`

Returns context-position from the eval. context



```
//*[position()=2]
```

```
//*[position()=2 and ../../a]
```

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

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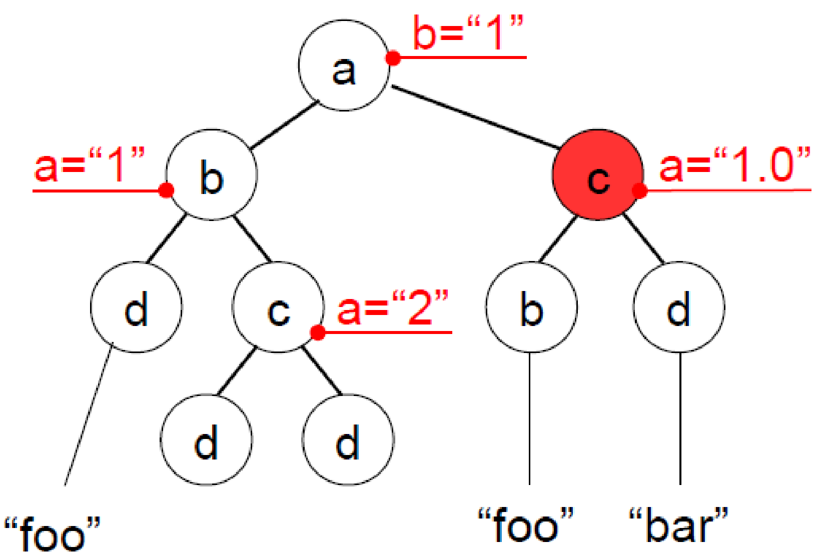
Returns context-position from the eval. context



```
//*[position()=2]
```

```
//*[position()=2 and ../../a]
```

Which nodes?

`//*[position()=2 and ../../../a]`

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returns contex-size from the evaluation context

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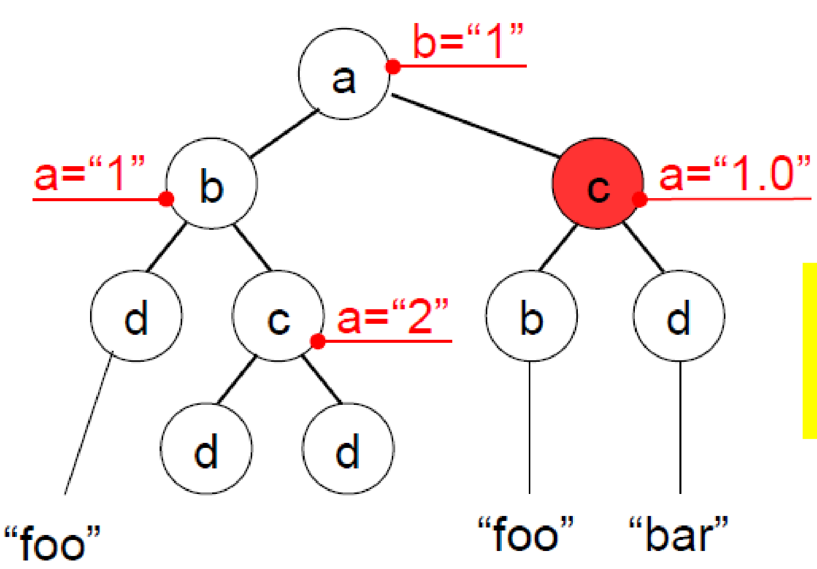
Returns context-position from the eval. context



```
//*[position()=2]
```

```
//*[position()=2 and ../../a]
```

Which node?

```
//*[position()=2 and ../../../../a]
```

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returns contex-size from the evaluation context

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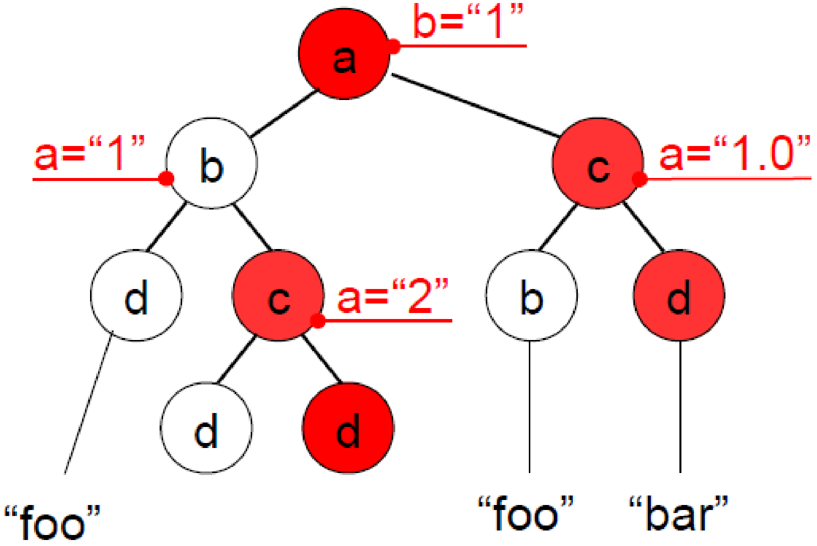
Returns context-position from the eval. context

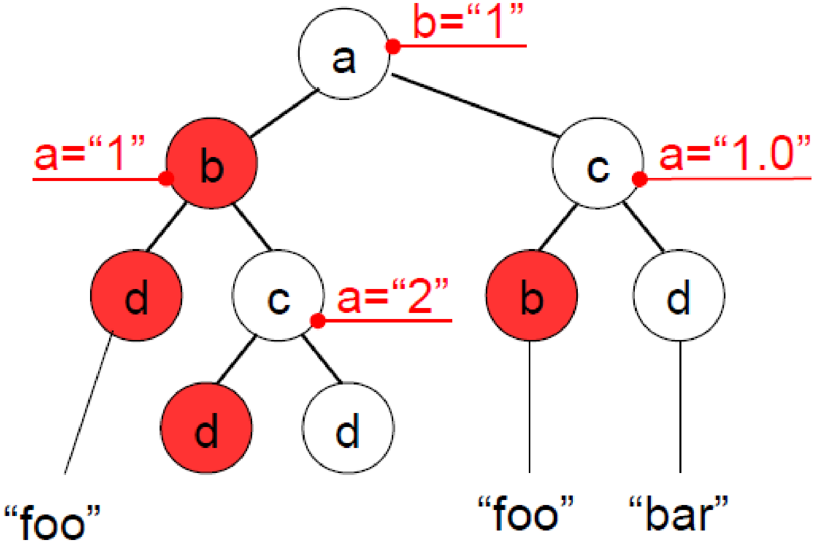


```
//*[position()=2]

//*[position()=2 and ../../a]

//*[position()=last()]
```

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context

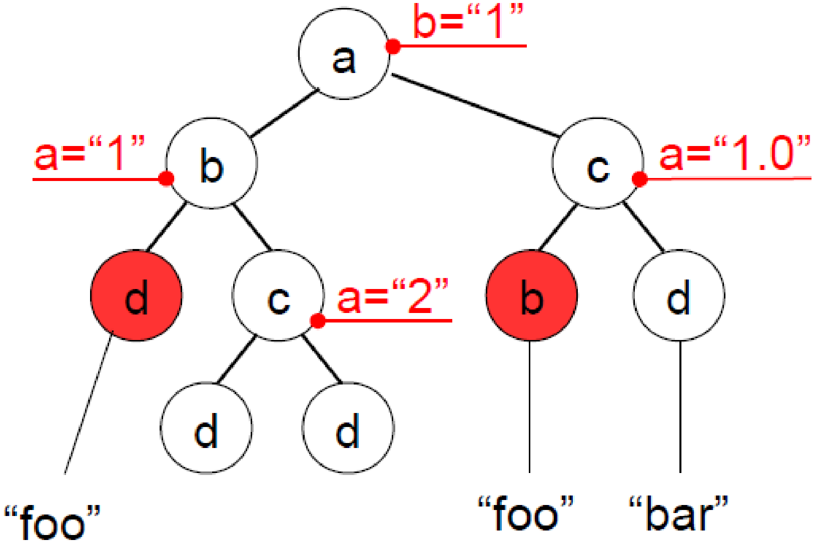


```
//*[position()=2]

//*[position()=2 and ../../a]

//*[position()=last()-1]
```

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context

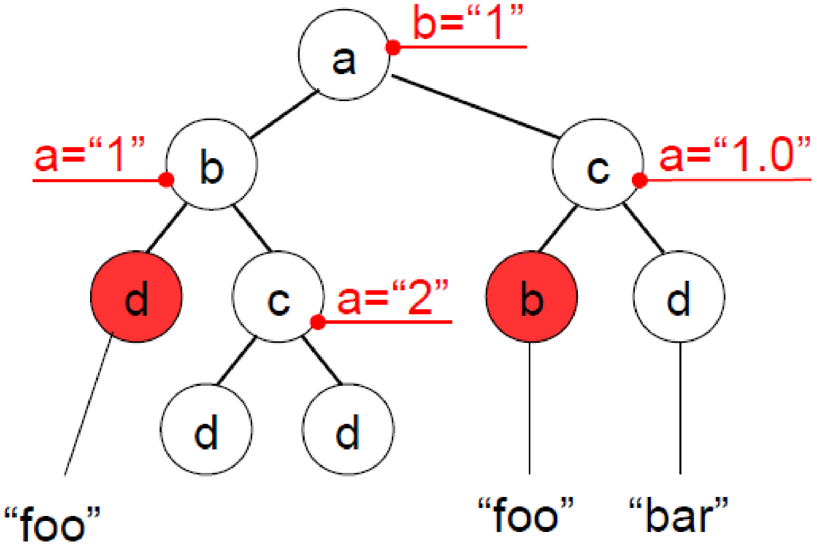


```
//*[position()=2]

//*[position()=2 and ../../a]

//*[position()=last()-1
     and ./text()="foo"]
```

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context



```
//*[position()=2]

//*[position()=2 and ../../a]

//*[position()=last()-1
     and ./text()="foo"]
```

Useful:

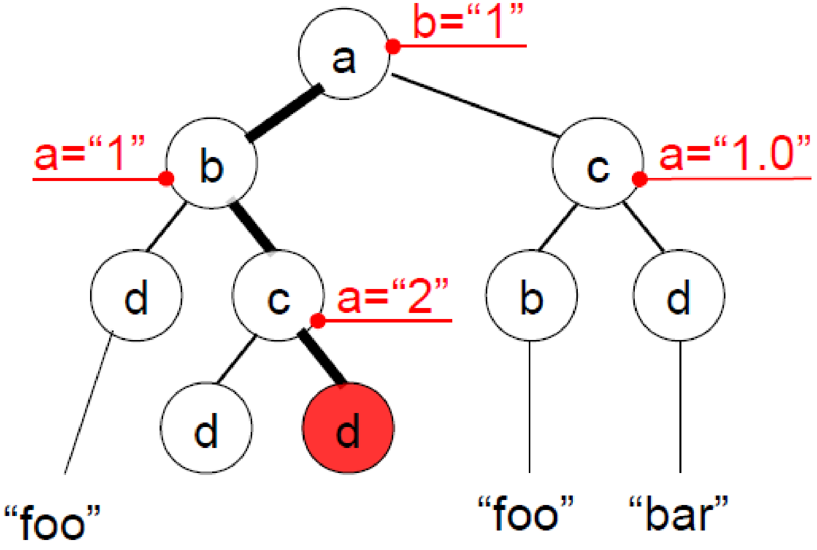
`child::*[self::chapter or self::appendix][position()=last()]`

selects the last chapter or appendix child of the context node

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context



```
//*[position()=2]
```

```
//*[position()=2 and ../../a]
```

```
//*[position()=last()-1
     and ./text()="foo"]
```

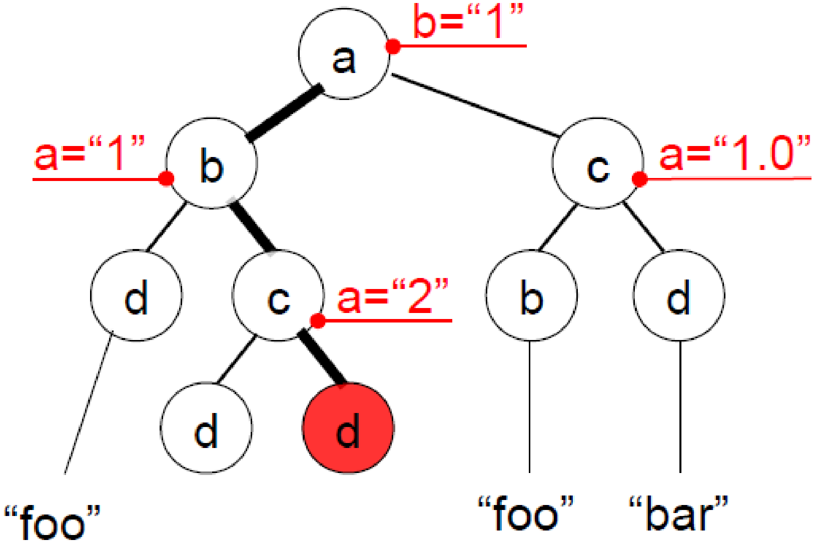
```
*/*[position()=1]/*[position()=2]/*[position()=2]
```

→ allows absolute location of any node (a la Dewey)

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context



```
//*[position()=2]

//*[position()=2 and ../../a]

//*[position()=last()-1
     and ./text()="foo"]
```

```
*/*[position()=1]/*[position()=2]/*[position()=2]
```

Abbreviation: `*/*[1]/*[2]/*[2]`

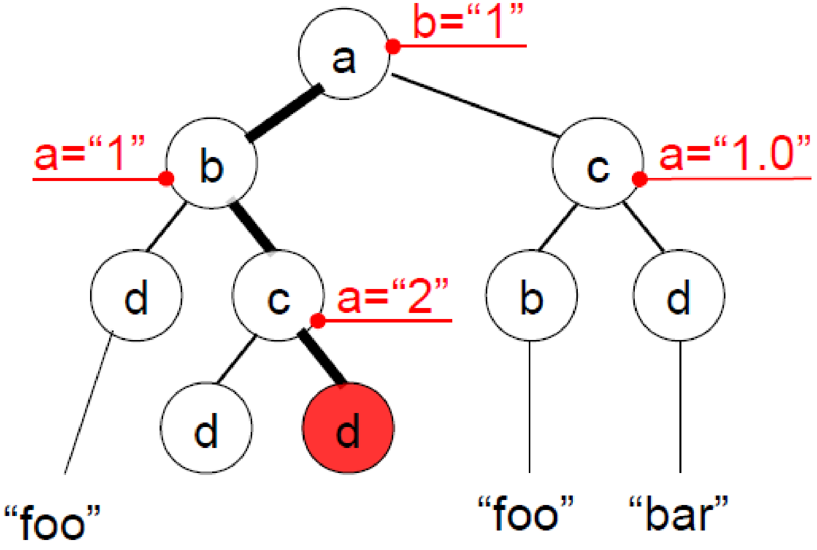
Useful Functions (on Node Sets)

→ `last()`

returns contex-size from the evaluation context

→ `position()`

Returns context-position from the eval. context



```
//*[position()=2]

//*[position()=2 and ../../a]

//*[position()=last()-1
     and ./text()="foo"]
```

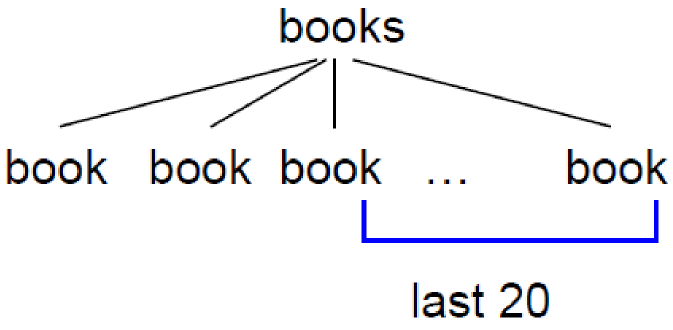
```
*/*[position()=1]/*[position()=2]/*[position()=2]
```

Abbreviation: `*/*[1]/*[2]/*[2]` **→What is result for** `//*[./*[2]/*[2]]`

Useful Functions (on Node Sets)

→ `last()`
returns contex-size from the evaluation context

→ `position()`
Returns context-position from the eval. context



How do you select the
last 20 book-children of books?

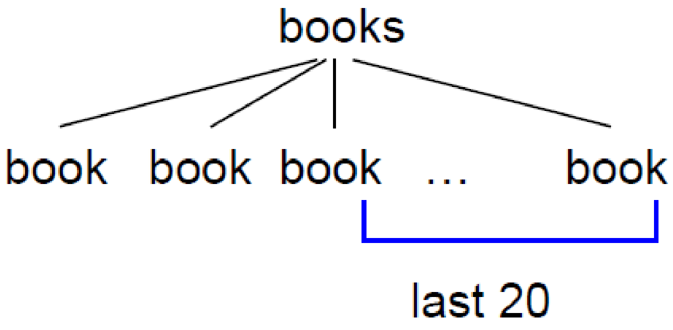
Useful Functions (on Node Sets)

→ `last()`

returns contex-size from the evaluation context

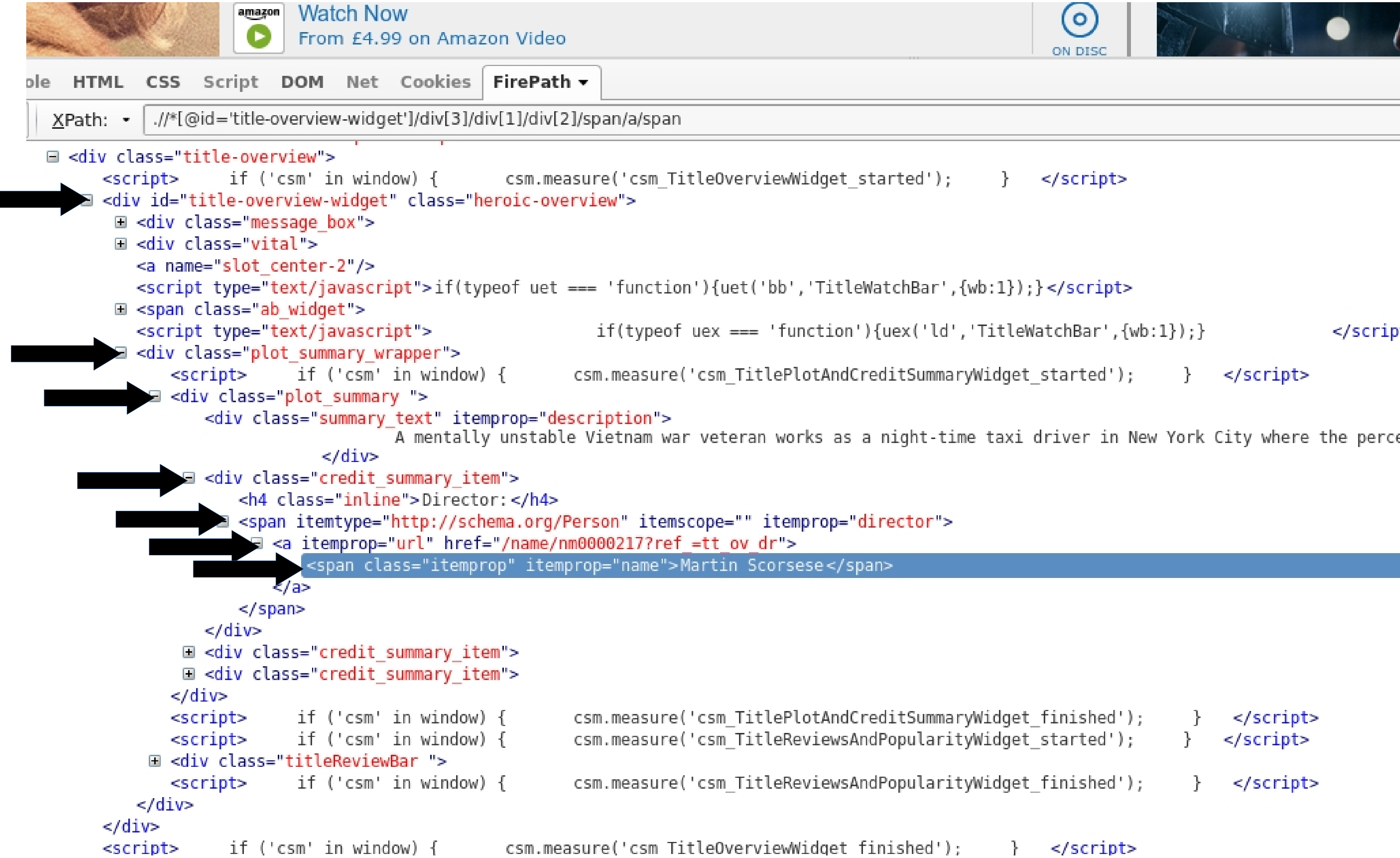
→ `position()`

Returns context-position from the eval. context



How do you select the last 20 book-children of books?

```
/books/book[position()>last()-20]
```



XPath: .//*[@id='title-overview-widget']/div[3]/div[1]/div[2]/span/a/span

```
⊟ <div class="title-overview">
      <script>     if ('csm' in window) {       csm.measure('csm_TitleOverviewWidget_started');     }    </script>
    ⊟ <div id="title-overview-widget" class="heroic-overview">
        ⊞ <div class="message_box">
        ⊞ <div class="vital">
          <a name="slot_center-2"/>
          <script type="text/javascript">if(typeof uet === 'function'){uet('bb','TitleWatchBar',{wb:1});}</script>
        ⊞ <span class="ab_widget">
          <script type="text/javascript">                 if(typeof uex === 'function'){uex('ld','TitleWatchBar',{wb:1});}             </scrip
        ⊟ <div class="plot_summary_wrapper">
              <script>     if ('csm' in window) {       csm.measure('csm_TitlePlotAndCreditSummaryWidget_started');     }    </script>
            ⊟ <div class="plot_summary ">
                  <div class="summary_text" itemprop="description">
                                      A mentally unstable Vietnam war veteran works as a night-time taxi driver in New York City where the perce
                               </div>
                ⊟ <div class="credit_summary_item">
                      <h4 class="inline">Director:</h4>
                    ⊟ <span itemtype="http://schema.org/Person" itemscope="" itemprop="director">
                        ⊟ <a itemprop="url" href="/name/nm0000217?ref_=tt_ov_dr">
                              <span class="itemprop" itemprop="name">Martin Scorsese</span>
                          </a>
                      </span>
                  </div>
                ⊞ <div class="credit_summary_item">
                ⊞ <div class="credit_summary_item">
              </div>
              <script>     if ('csm' in window) {       csm.measure('csm_TitlePlotAndCreditSummaryWidget_finished');     }    </script>
              <script>     if ('csm' in window) {       csm.measure('csm_TitleReviewsAndPopularityWidget_started');     }    </script>
            ⊞ <div class="titleReviewBar ">
              <script>     if ('csm' in window) {       csm.measure('csm_TitleReviewsAndPopularityWidget_finished');     }    </script>
          </div>
      </div>
      <script>     if ('csm' in window) {       csm.measure('csm_TitleOverviewWidget_finished');     }    </script>
```

XPath Query Evaluation

How to implement?

How expensive? complexity?

What are the most difficult queries?

END

Lecture 17