XML and Databases
XPath evaluation (3)

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Week 10

Recap from last week

1. Using automata to run queries in streaming

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2. Handling filters with upward axes

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Today

- How to add preceding-sibling/following-sibling ?
- What data structures to use for automata ?

Following-sibling

Fundamentally, not very different from `child`!

In a pre-order traversal:

`child` : From a node, go `firstChild` then `nextSibling`, . . . , `nextSibling` until `NULL` is found

`following-sibling` : From a node, go `nextSibling`, . . . , `nextSibling` until `NULL` is found

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What does it mean in terms of automata?

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What does it mean in terms of automata?

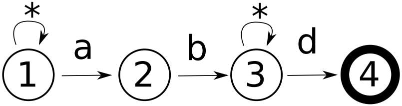
Add a new *kind* of transition

Example

```
//a/b//d
```

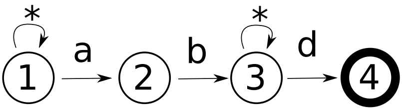
Example

`//a/b//d`



Example

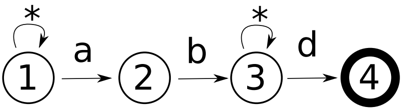
`//a/b//d`



`//a/following-sibling::b//d`?

Example

`//a/b//d`



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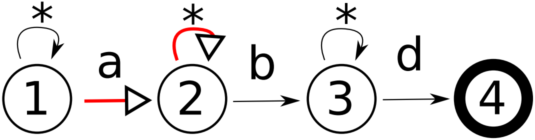

Example

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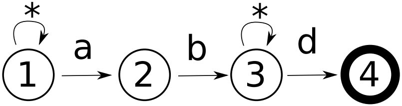
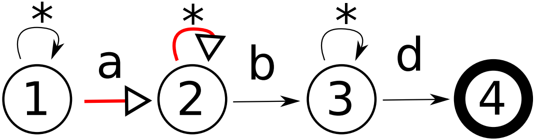


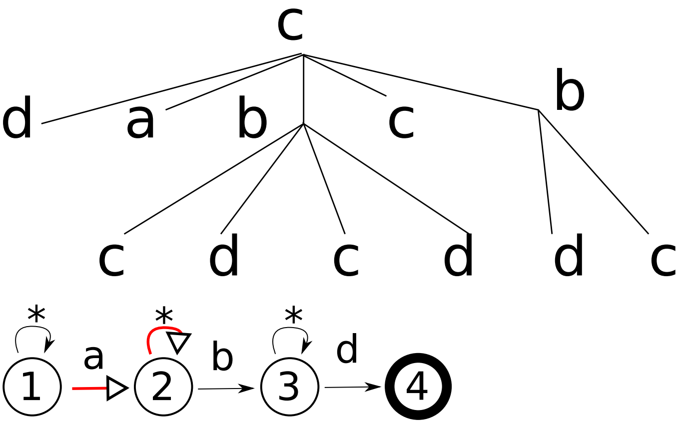
`//a/following-sibling::b//d`?

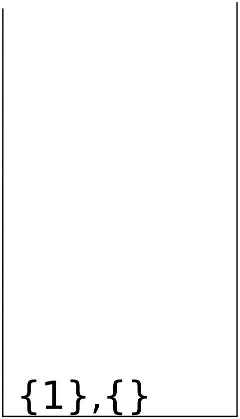


When we evaluate an automaton we can perform two kinds of transitions:

- When doing a "first child" move, we take black transitions (`Down`)
- When doing a "next sibling" move, we take red transitions (`Right`)

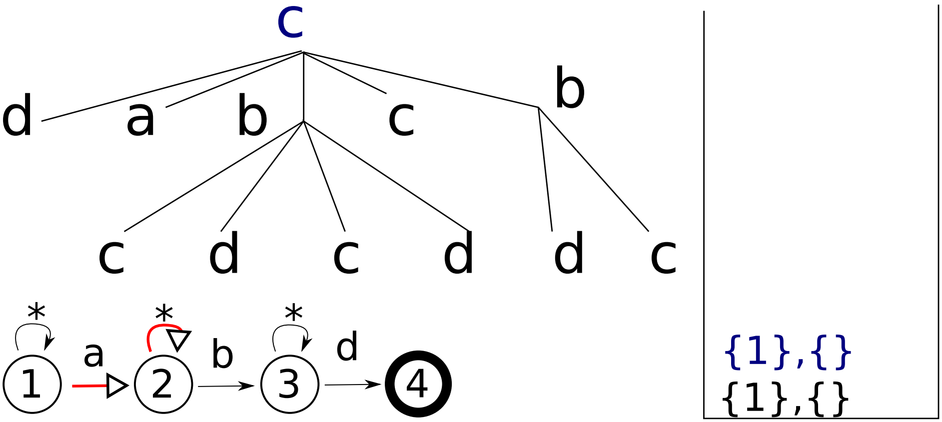
Example





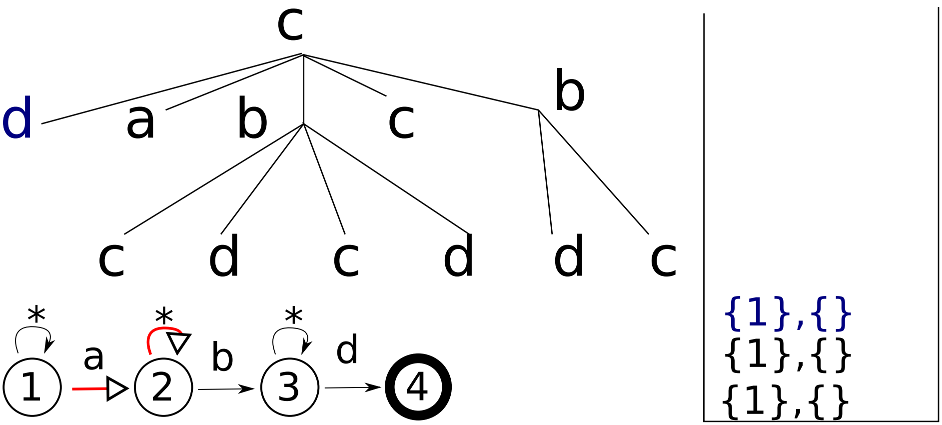
Initially, the stack contains the initial state

Example



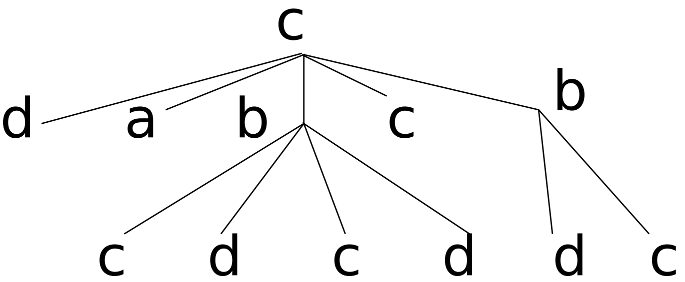
`startElement("c")`, one `Down` transition, no `Right` transition

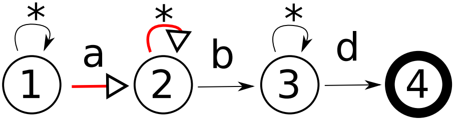
Example



`startElement("d")`, one `Down` transition, no `Right` transition

Example

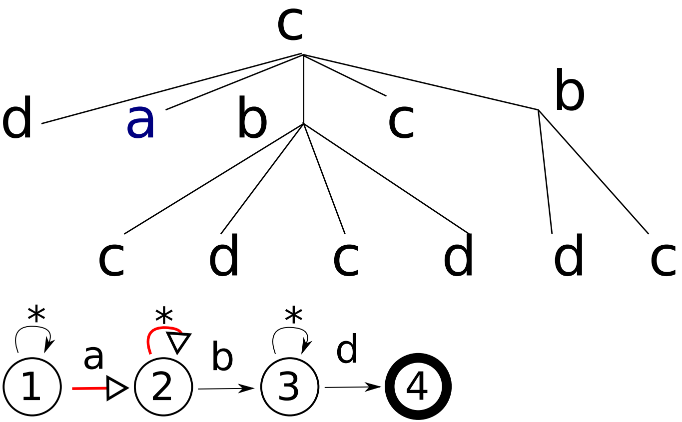


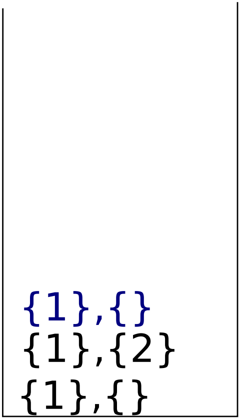


{1},{}
{1},{}

endElement("d"), replace last-sibling with the top of the stack

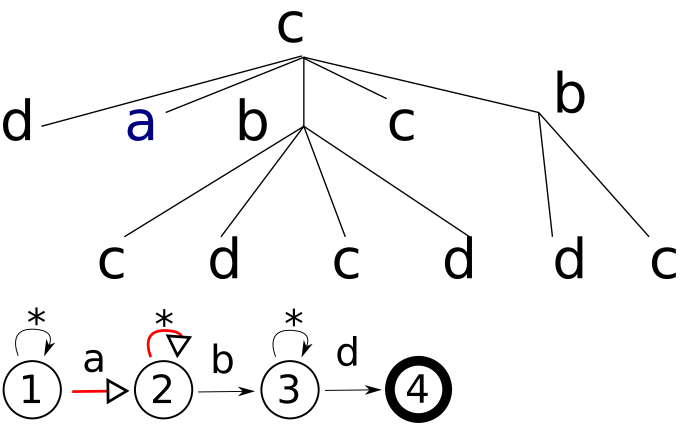
Example

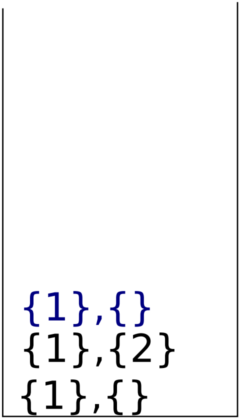




`startElement("a")`, one `Down` transition, one `Right` transition

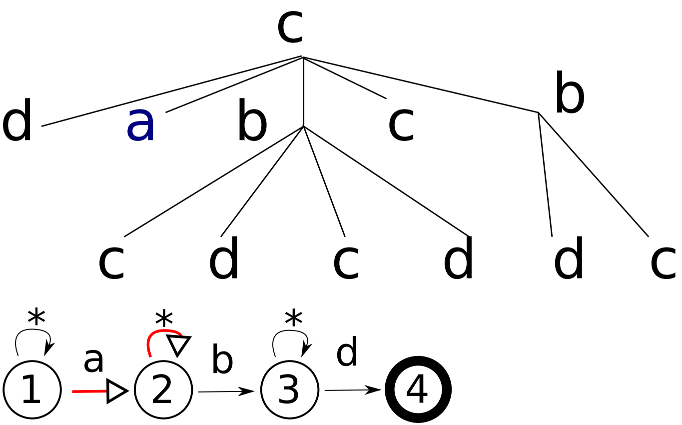
Example

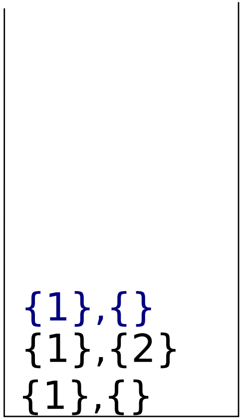




the Right transition goes to state 2, update the right of the stack

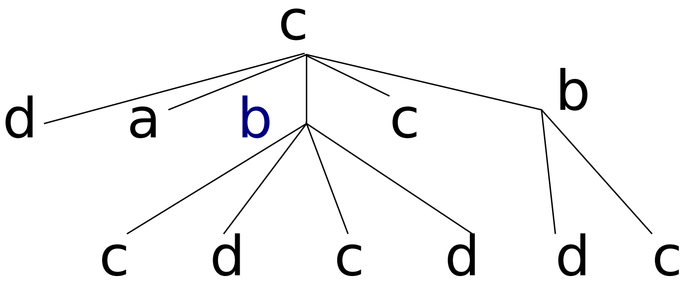
Example

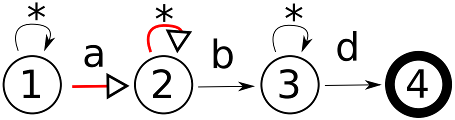




the `Down` transition goes to state 1, pushed on the stack

Example

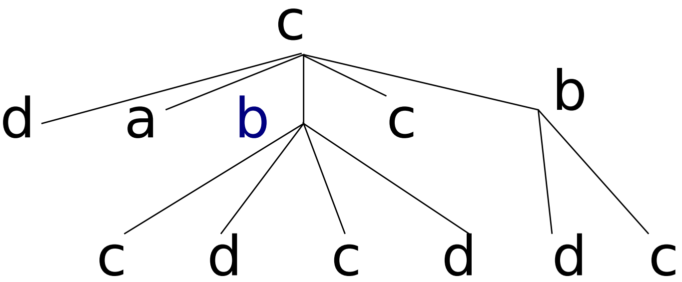


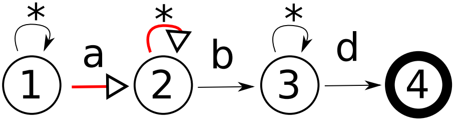


{1,3},{}
{1},{2}
{1},{}

`endElement("a")`

Example

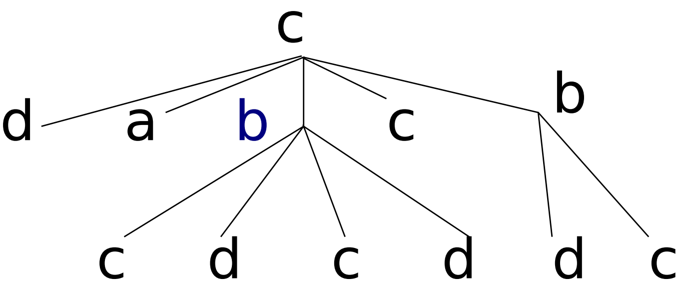


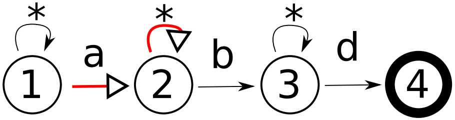


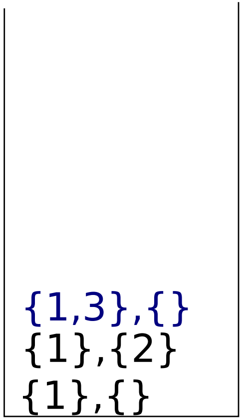
{1,3},{}
{1},{2}
{1},{}

From $\{1\} \cup \{2\}$ compute the b transition

Example

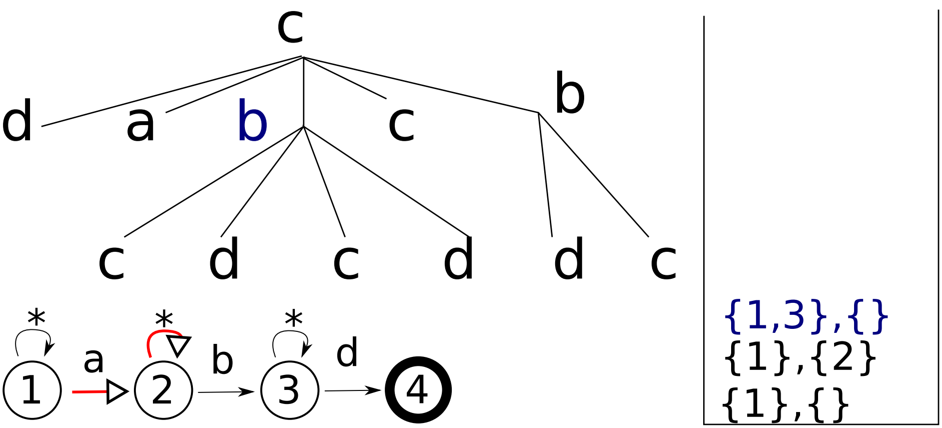






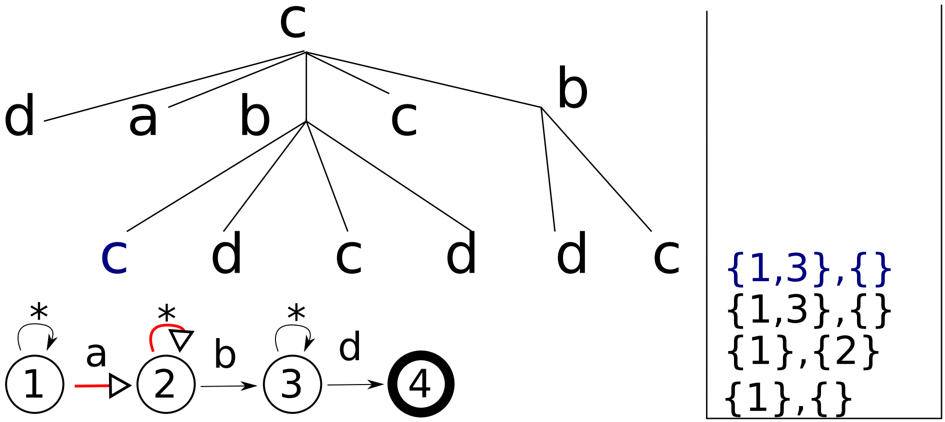
One Right (stay in state 2), replace right part of stack

Example



Two `Down` (stay ins state 1, go to state 3), push on the stack

Example



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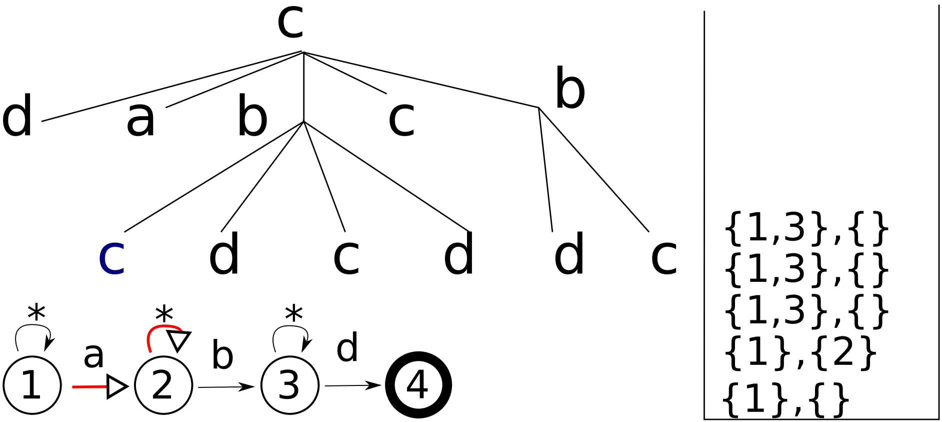
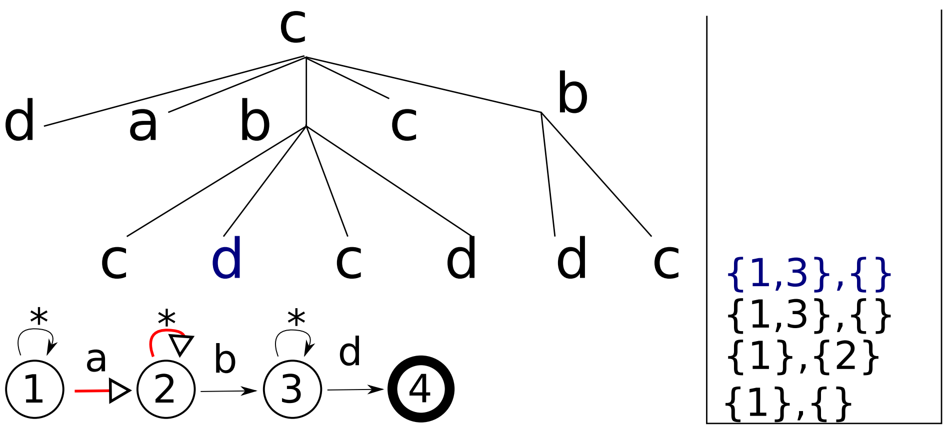
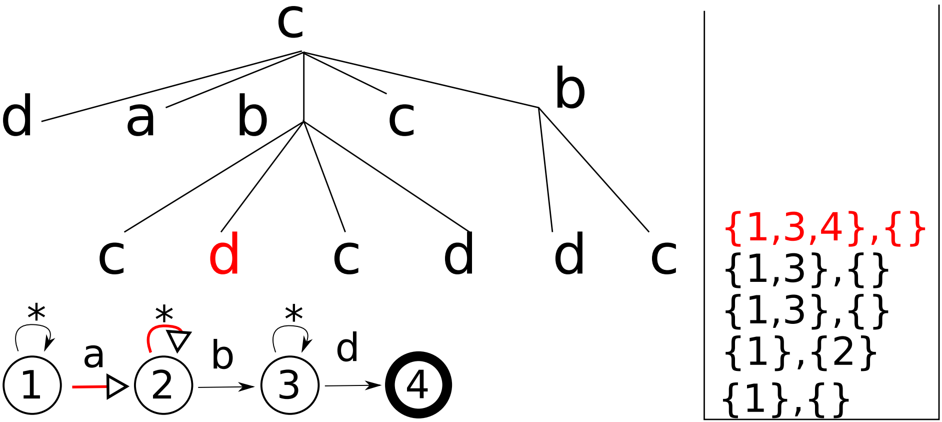


Example



Example



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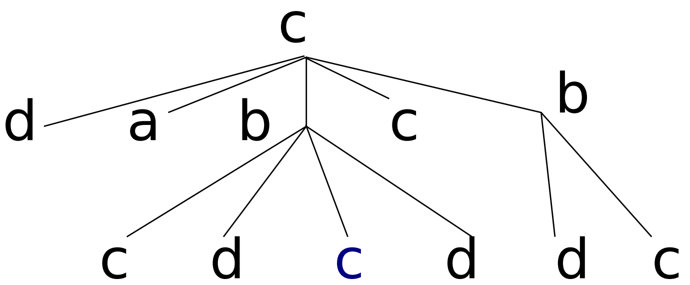
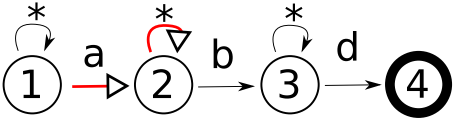
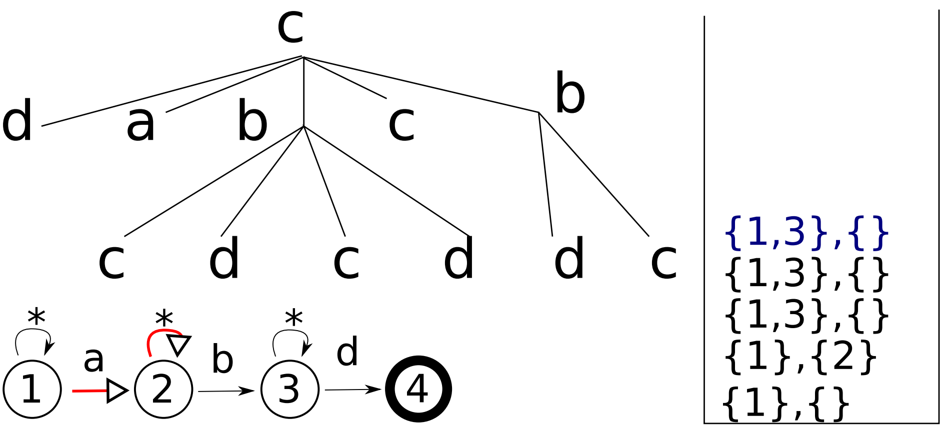




{1,3},{}
{1,3},{}
{1},{2}
{1},{}

Example



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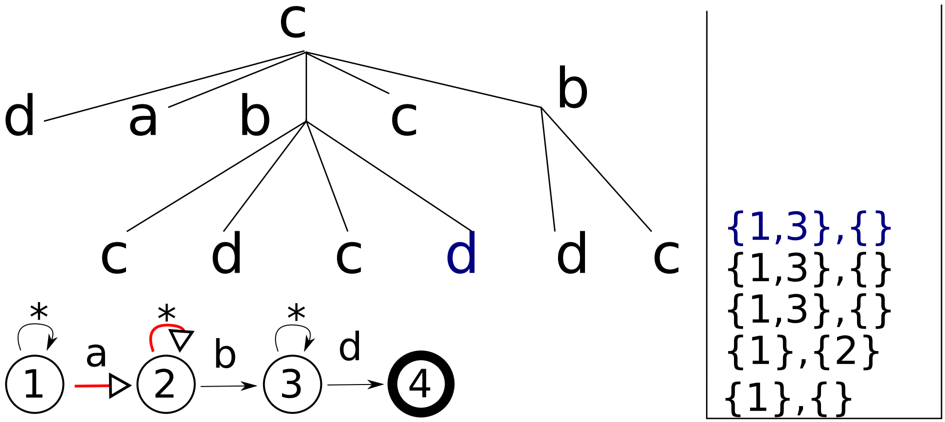

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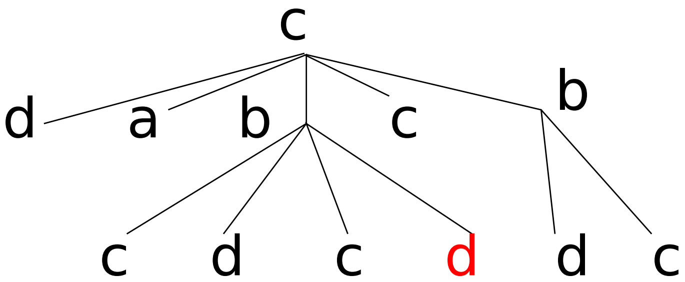

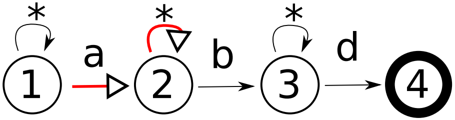

{1,3,4},{}
{1,3},{}
{1,3},{}
{1},{2}
{1},{}

Path with `following-sibling` and no filters

Adapt last week's algorithm:

- keep a stack of pairs of sets of states
- the first set of states represents the states of the parent
- the second set of states represents the states of the previous-sibling

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More precisely, on `startElement`

1. Take the top of the stack $S_{\text{parent}}, S_{\text{presib}}$;
2. Compute the union $S = S_{\text{parent}} \cup S_{\text{presib}}$
3. Compute two new sets S'_{parent} and S'_{presib}
4. S'_{parent} is the set of states that can be reached from S with a `Down` transition S'_{presib} is the set of states that can be reached by a `Right` transition
5. At the top of the stack, replace S_{presib} with S'_{presib}
6. Push $S'_{\text{parent}}, \{\}$ at the top of the stack

Adding preceding-sibling in filters

Consider `//a//b[./parent::c/preceding-sibling::d]/c`.
What can we say about the `b` nodes ?

- They must have a parent `c`
- The parent must have a preceding-sibling `d`

This is true for all the nodes which are:

- below a `c`
- which is a following sibling of a `d`
- which can occur anywhere

$\Rightarrow$ `//d/following-sibling::c/*`
Only need to adapt last week's algorithm to following-sibling

Some more examples of rewriting of filters

`[./ancestor::d/preceding-sibling::e/parent::f]`
becomes
`//f/e/following-sibling::d//*`

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[./ancestor::d/preceding-sibling::e/parent::f]
```
becomes
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//f/e/following-sibling::d//*
```

```
[./preceding-sibling::e/ancestor::d/preceding-sibling::f]
```
becomes
```
//f/following-sibling::d//e/folowing-sibling::*
```

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What is the general rule ?

Rewriting backward filters

Let `[ f ]` be a filter with backward axes. We rewrite it into a path d. d and f do *NOT* compute the same results but, for every node selected by d, `[ f ]` is `true`. Let:

$$f = ./a_0\texttt{::}t_0/a_1\texttt{::}t_1/\ldots/a_n\texttt{::}t_n$$

where $a_i \in \{\texttt{parent}, \texttt{ancestor}, \texttt{preceding-sibling}\}$ andn t_i is a label or $*$.

$$//t_n/\bar{a}_n\texttt{::}t_{n-1}/\ldots/\bar{a}_0\texttt{::}*$$

where $\bar{a}_i$ is the inverse axis of a_i (`parent` is the inverse of `child`, `descendant` the inverse of `ancestor` and `preceding-sibling` the inverse of `following-sibling`)