RADICAL 2010

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Wiki
Everyone can use to
Store,
Organize,
Manage and
Exchange data

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Joint work with
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Michael Benedikt (Oxford)

Or:

How to train your database wiki

Or:

~~*How to train your database wiki*~~

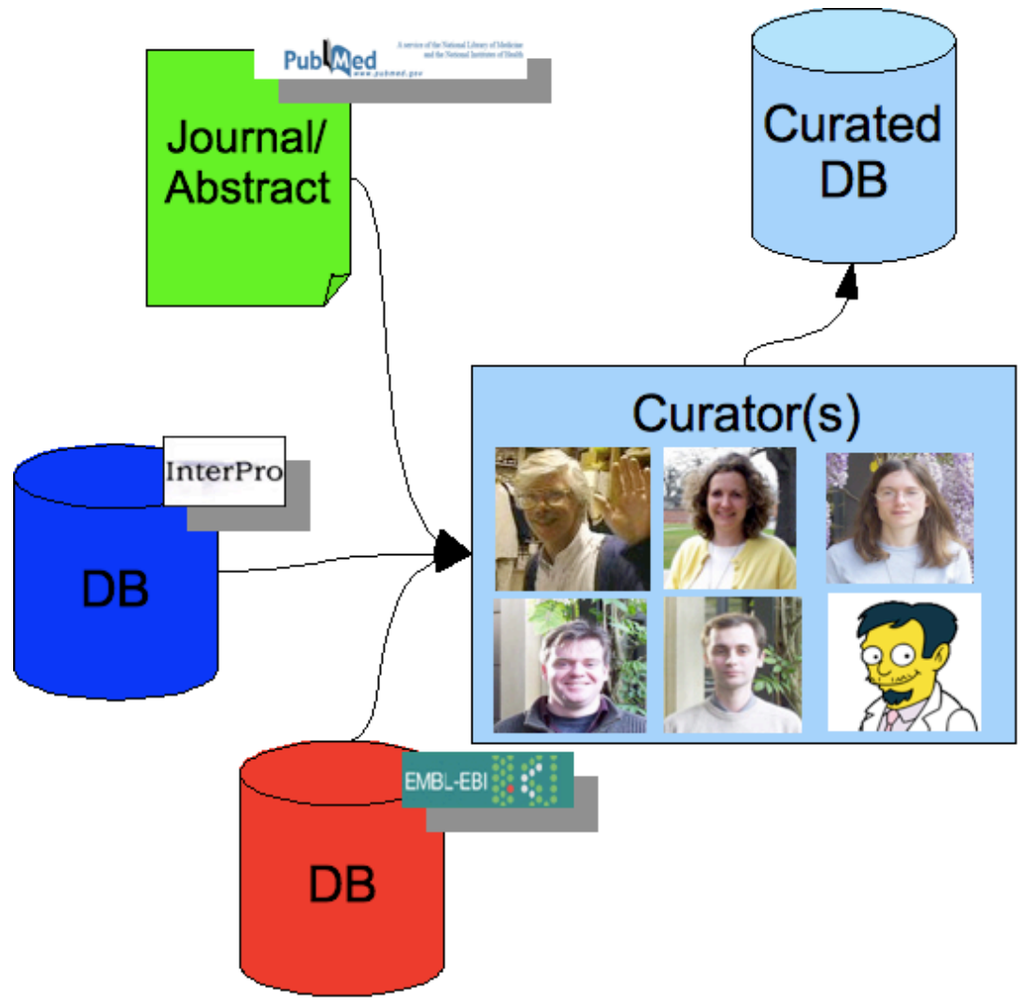
Or:

~~*How to train your database wiki*~~

This is what happens when
James has too much coffee

Curated databases

- Created by manual effort
- Curators copy data from papers, other DBs
- Some sources unreliable
  - some curators too



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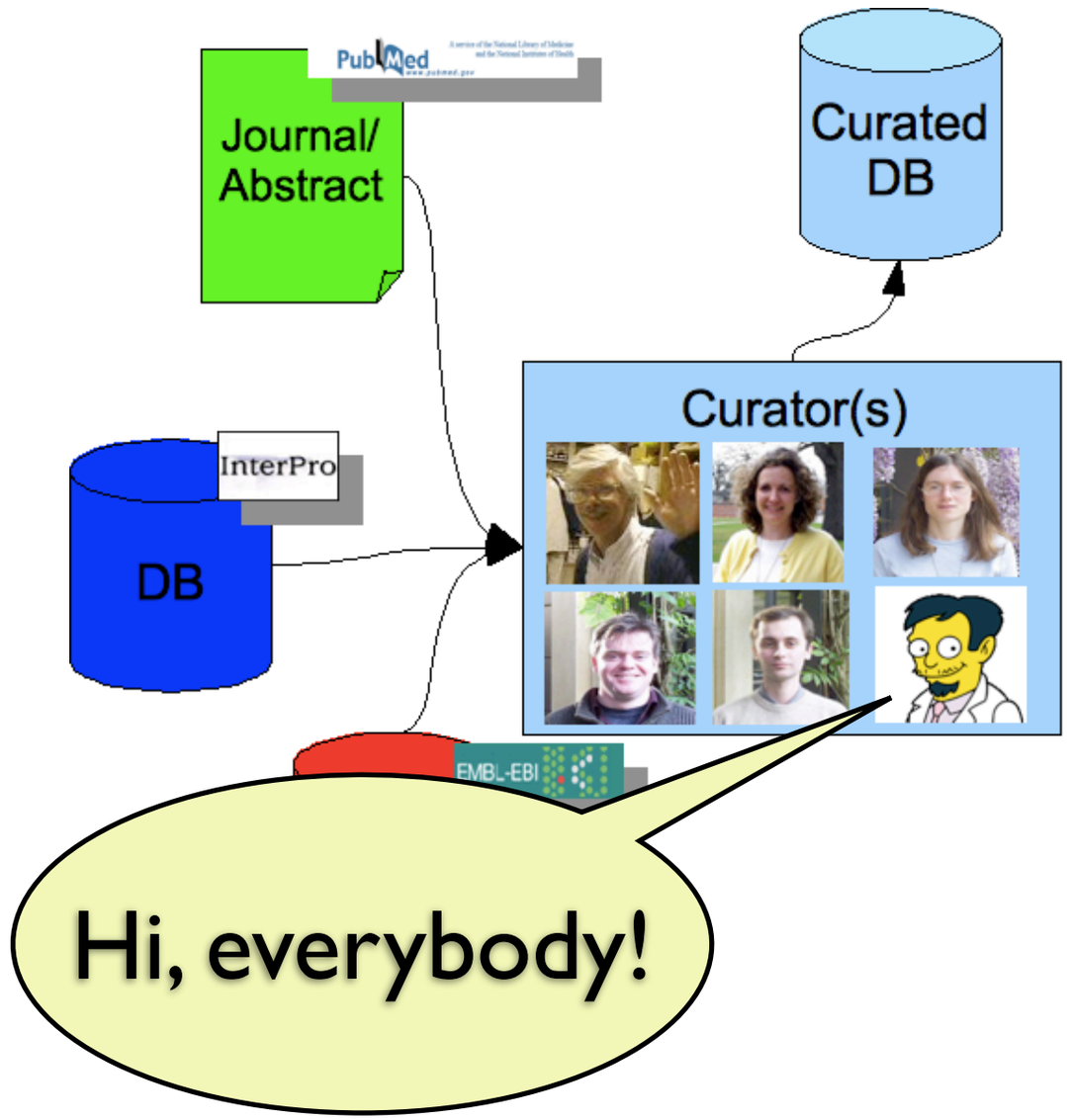


Problem

- We know basically what to do
- "Curated databases" should provide built-in:
  - archiving [Buneman et al. 04, 08, ...]
  - provenance [Buneman et al. 01, 06, 07, 08, ...]
  - annotation [Geerts et al. 06, ...]
- But hard to convince users to do the right thing

Solution:
A database wiki

- Standard wiki stuff
  - WikiLinks, editable pages, brain-dead syntax, page history
- New: editable, (semi)structured data with
  - Transclusion (via queries embedded in pages)
  - Annotation (discuss data, propose changes)
  - Stable citation, copy/paste for wiki data
  - Archiving - record all past versions
  - Provenance - automagical (?)

Implementation

- Using Links
  - Other web programming languages would probably also work (but we have in-house expertise)
- Currently:
  - basic wiki stuff
  - "data tree" - editable via browser & persistent
  - path transclusions and type-based selection queries

Demo

and now for something completely different:

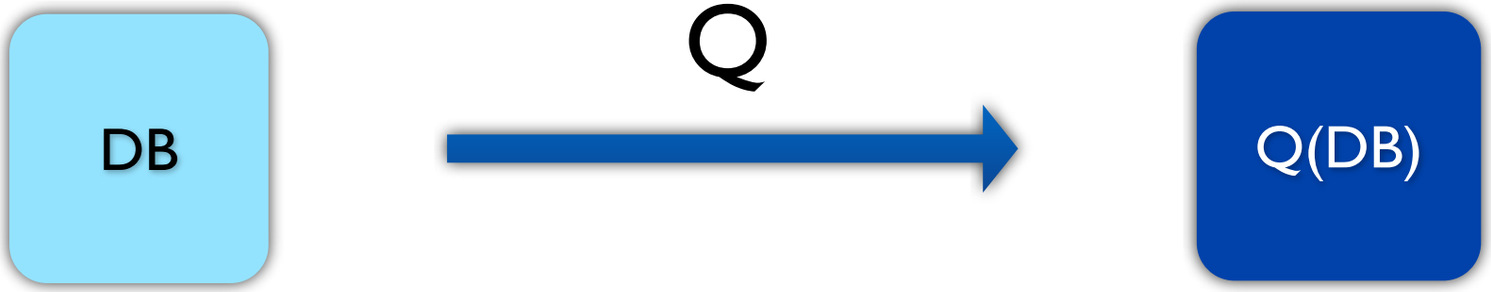
Independence Analysis for semistructured data

Motivation

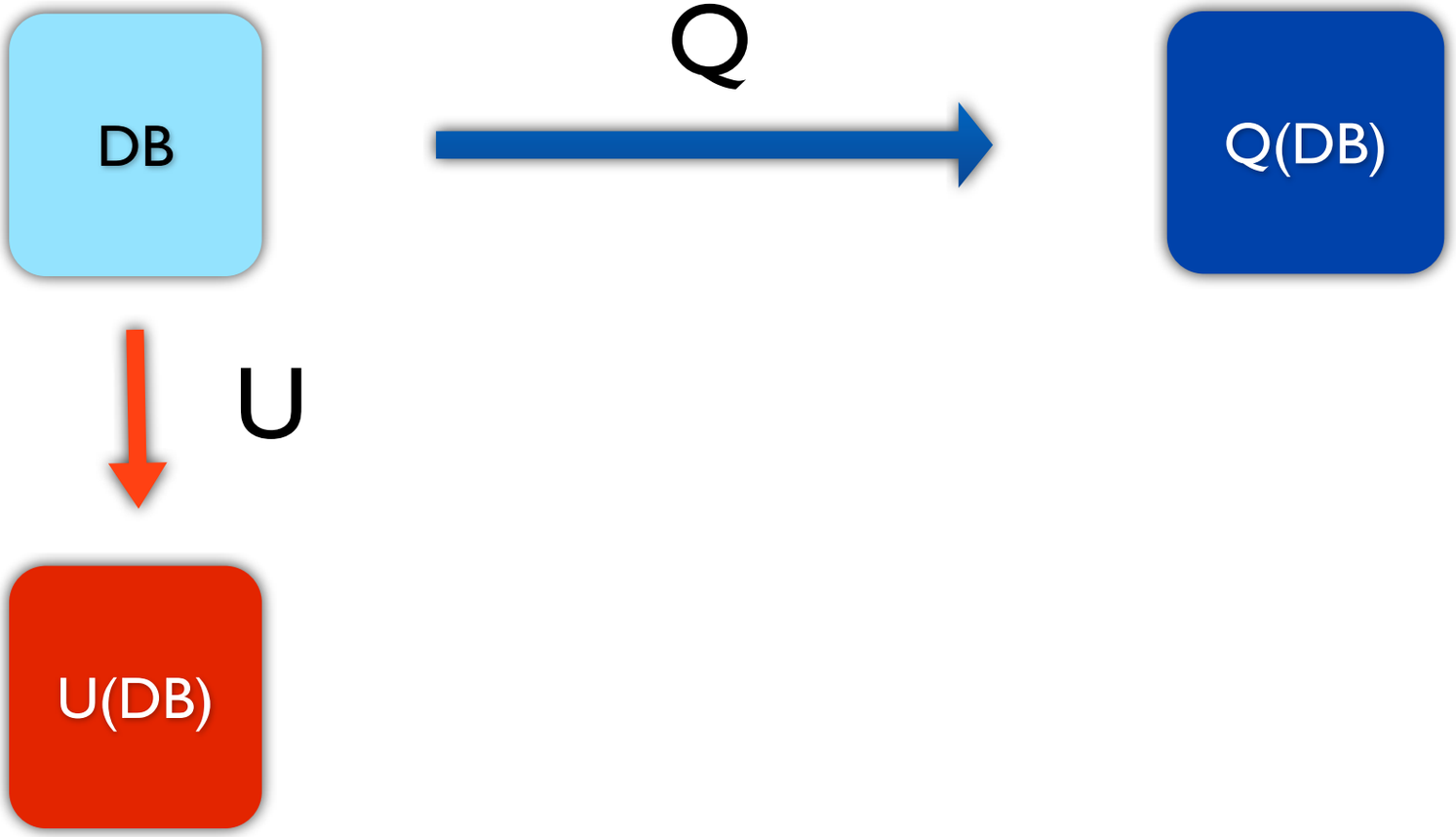
- Suppose we have multiple (cached) pages
  - expressed by (XQuery/XPath) queries Q_1, Q_2, ...
- When the database wiki is updated:
  - Which queries may be affected?
  - If we can determine (quickly) that queries and updates are *independent*
  - then can keep using cached version of unchanged pages

Query-update independence

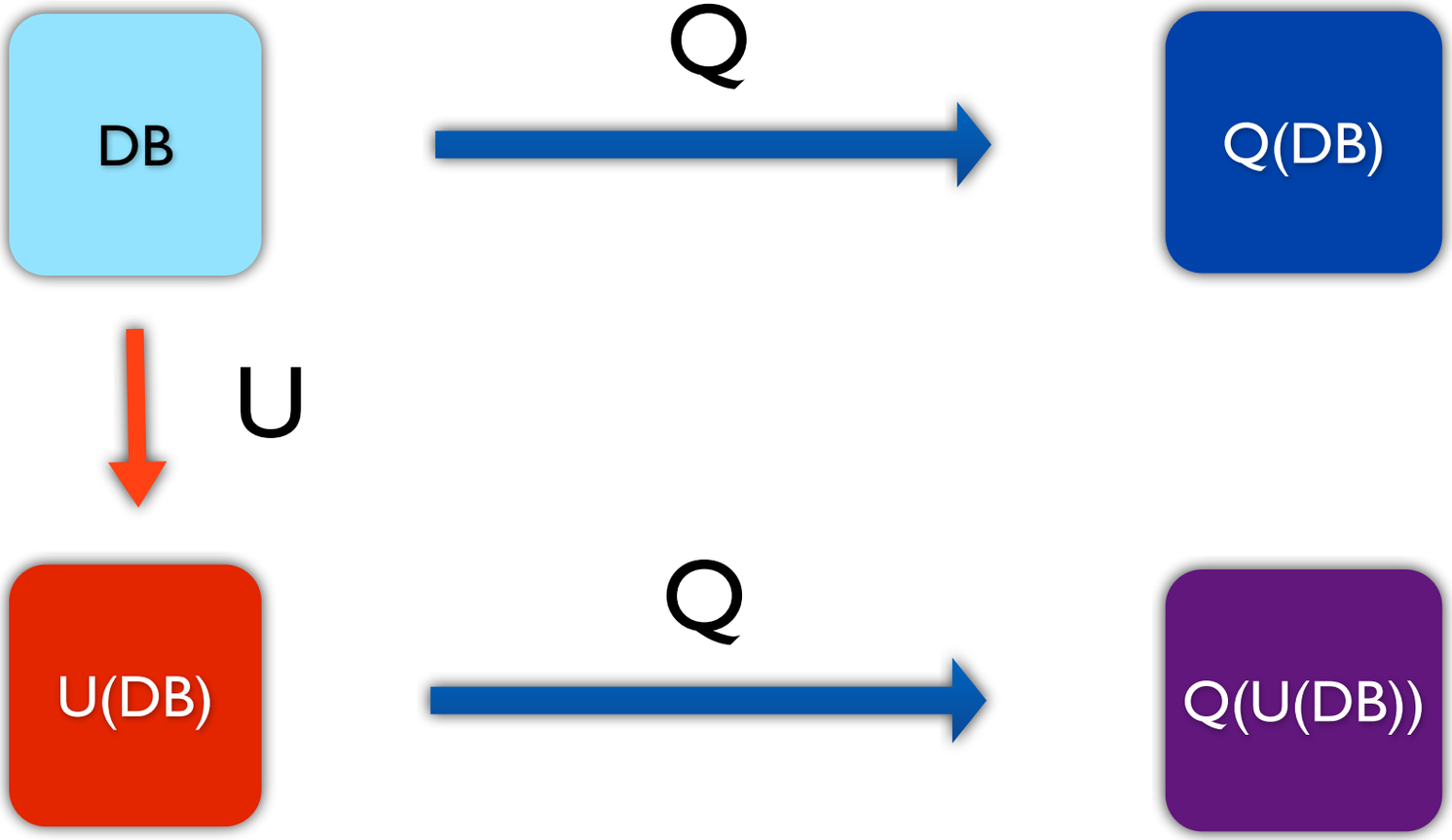
Query-update independence



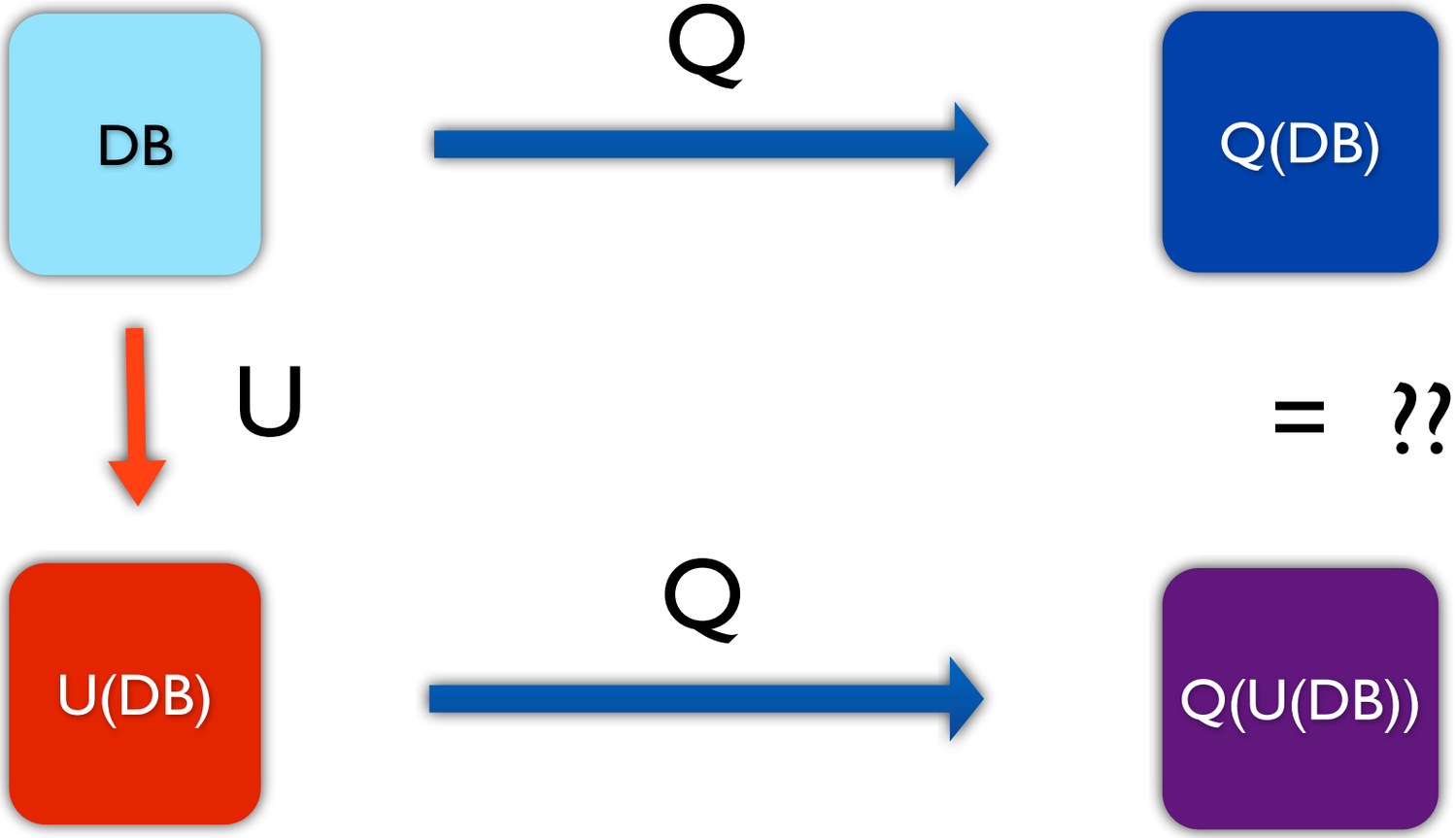
Query-update independence



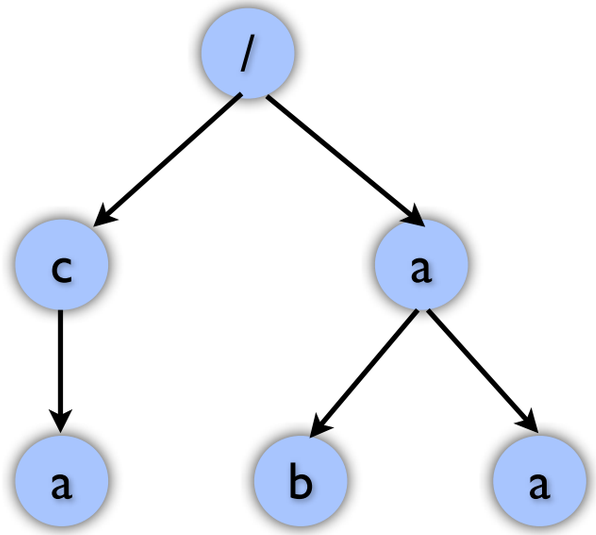
Query-update independence



Query-update independence

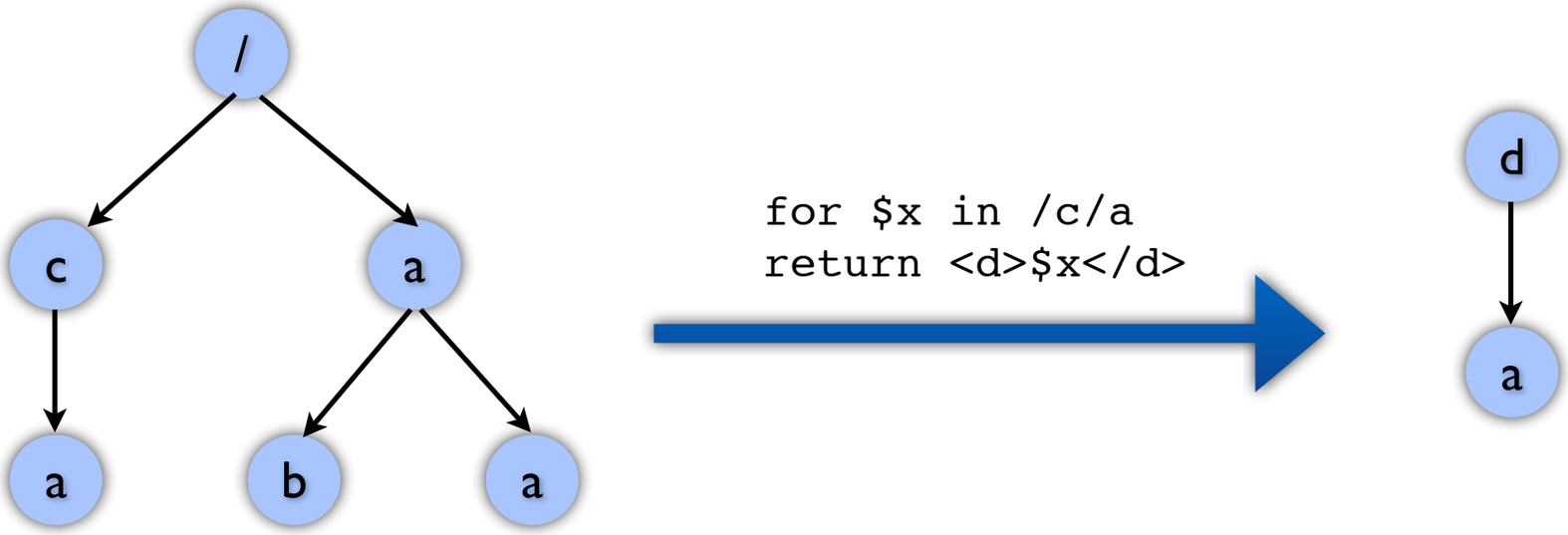


Independence example




```
for $x in /c/a
return <d>$x</d>
```

Independence example



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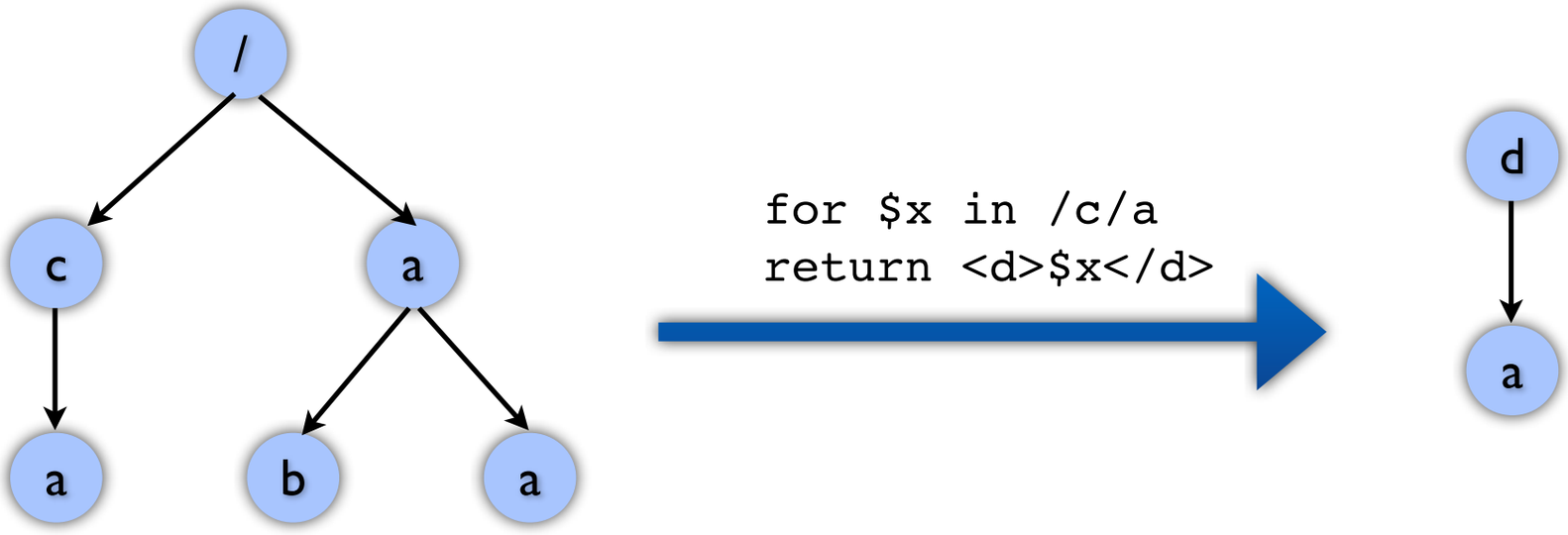

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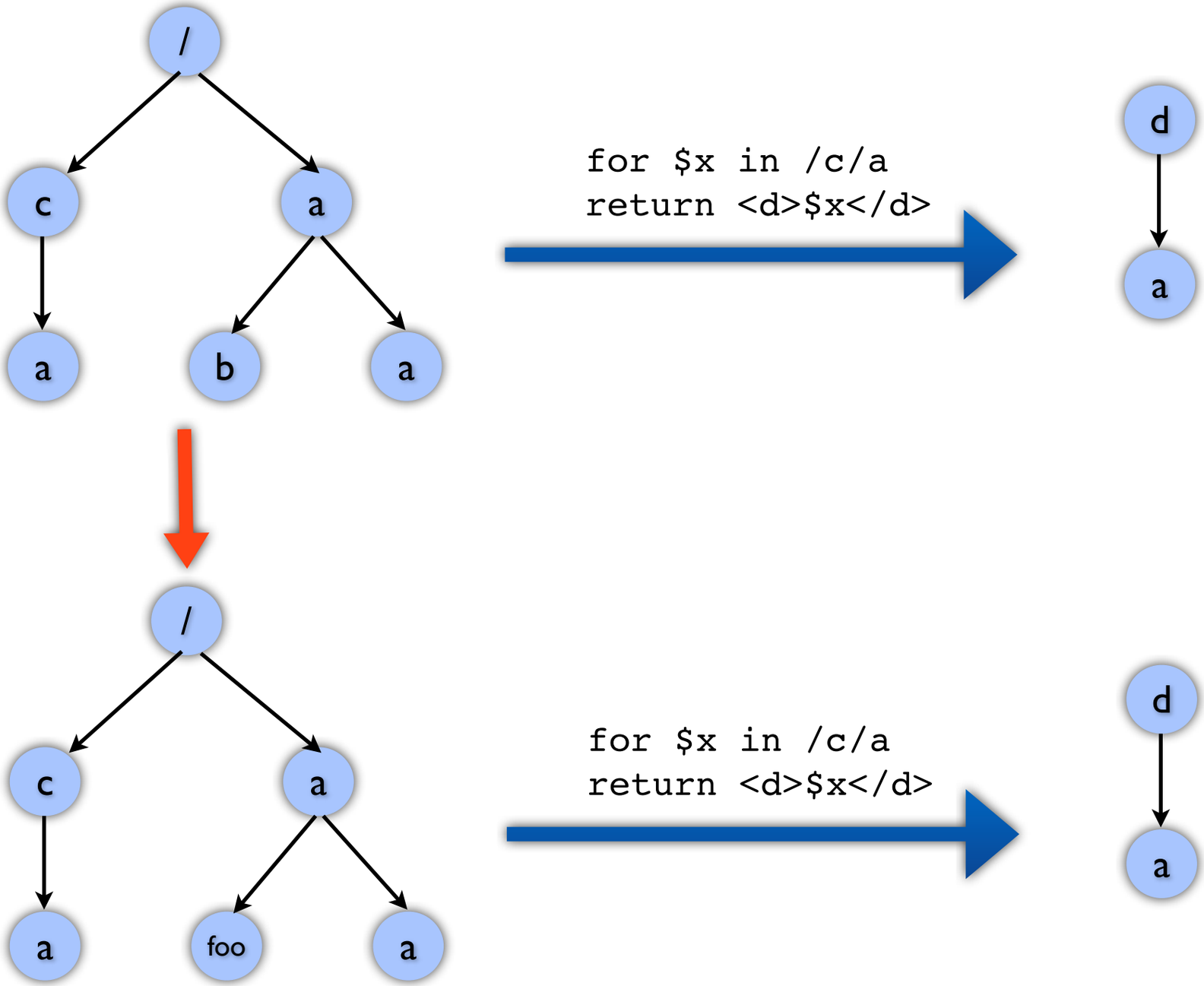

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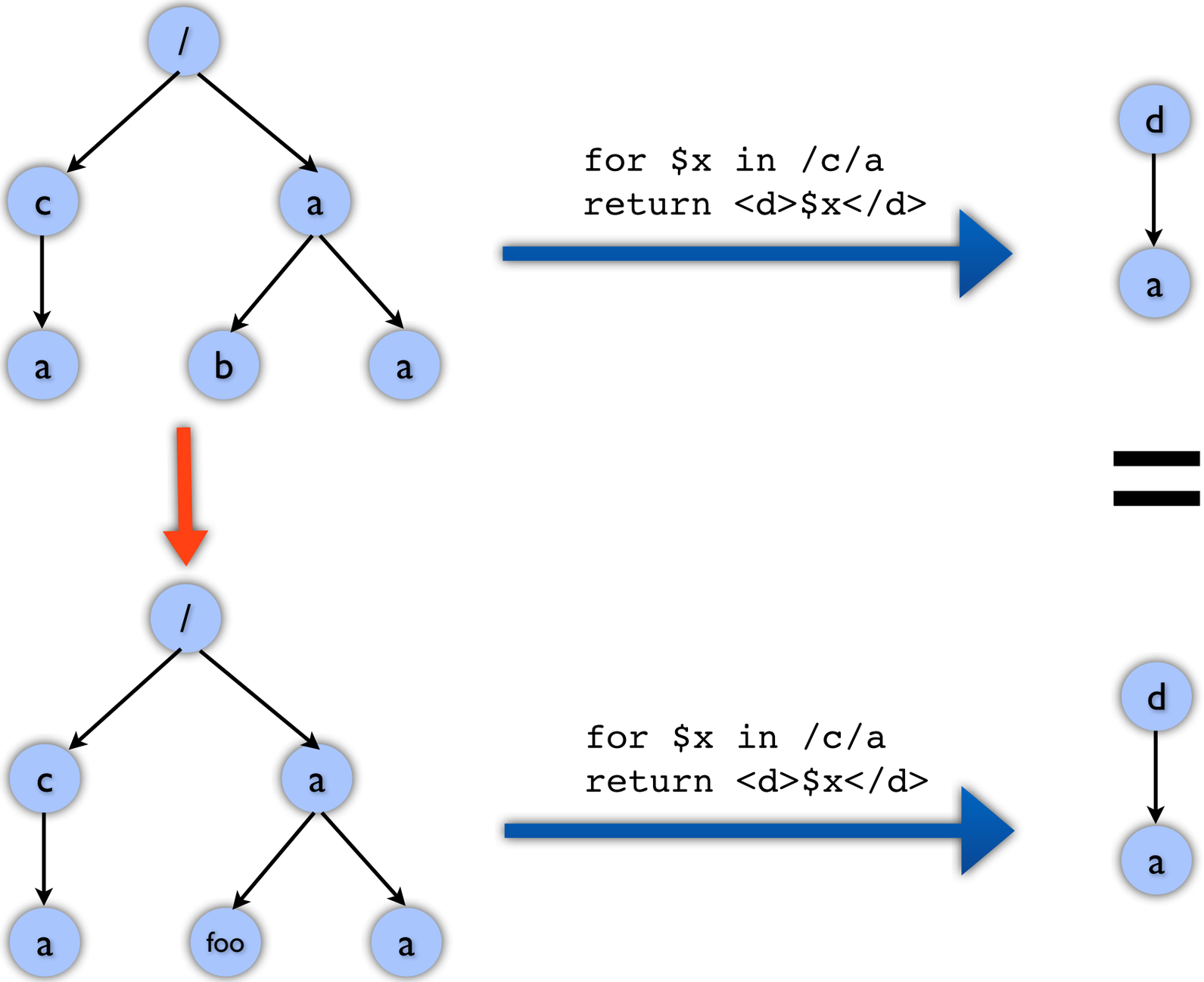
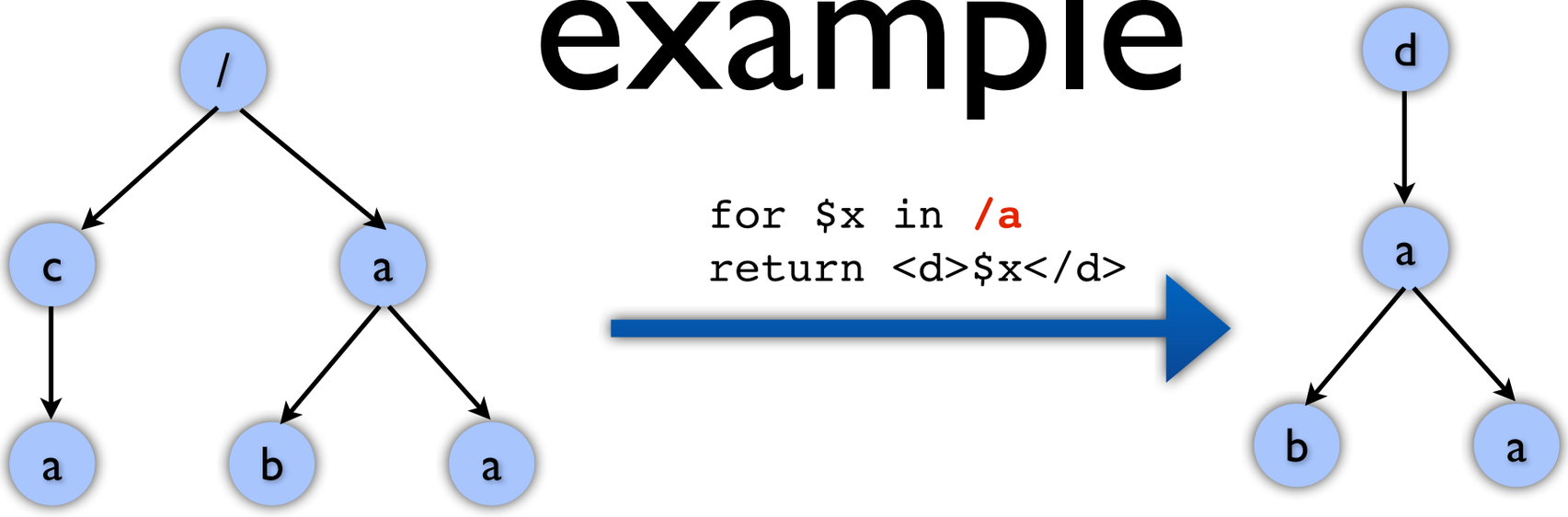


Independence **non-**example



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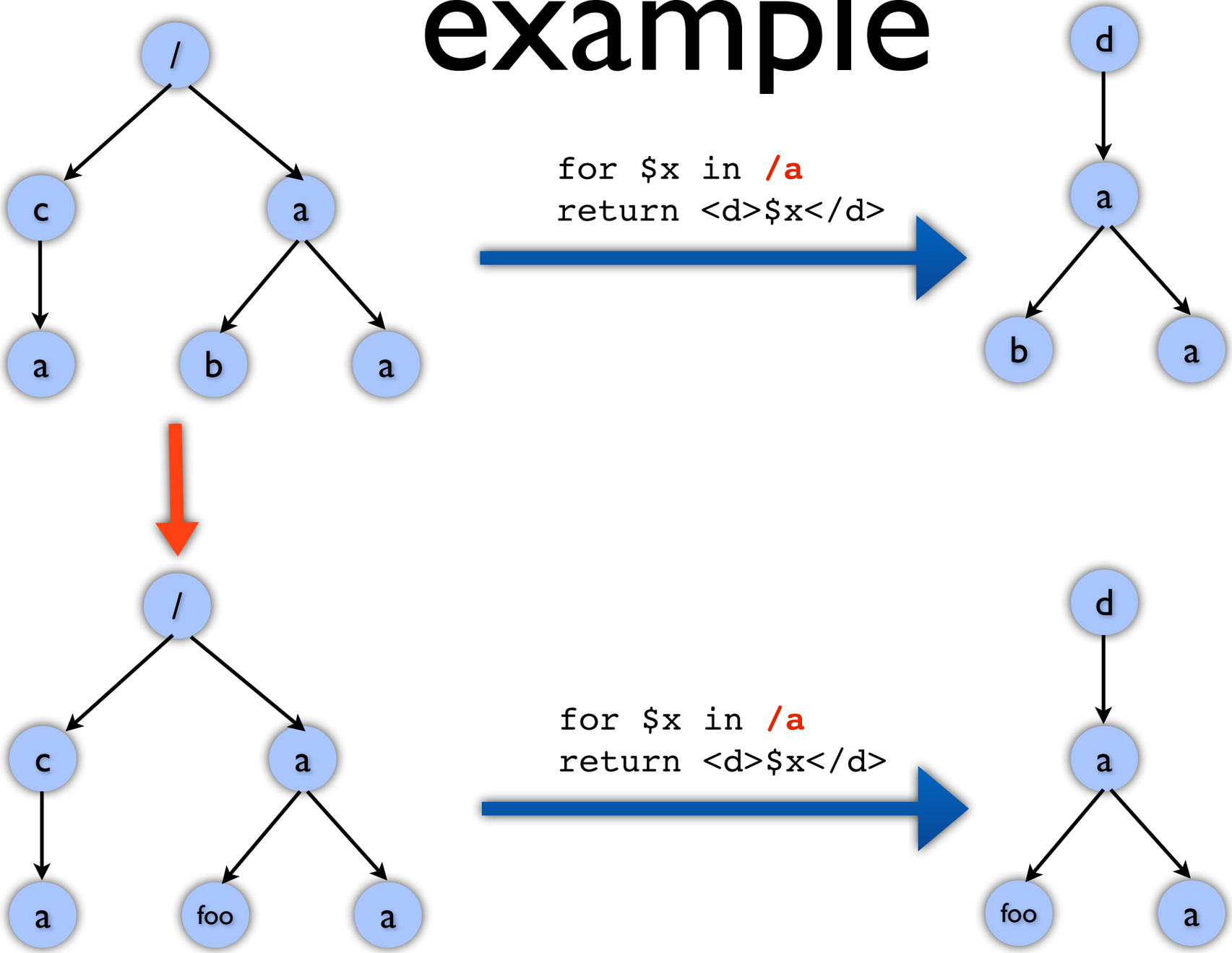

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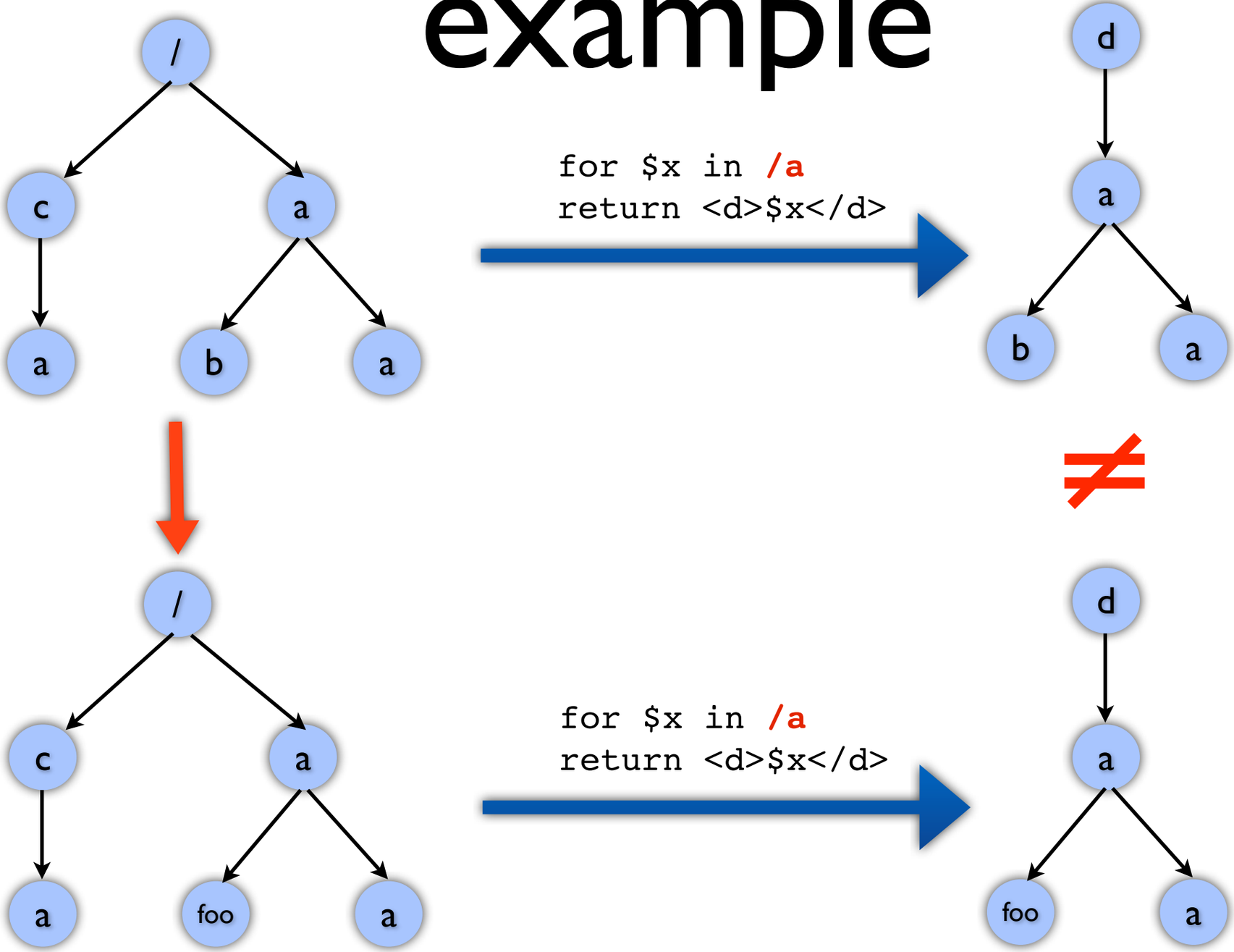


Prior work

- [Benedikt and C 09]: static independence analysis based on schema (reg. exp. types)
  - Showed effective for avoiding view maintenance
- Problem: Useless if you don't have a schema
  - Some prior work on path-based "XML projection" [Marian & Simeon 03,...], "commutativity analysis" [Ghelli et al. 08]
  - But doesn't quite solve independence problem

Current work

- [Benedikt and C 2010]: Use **queries** to statically describe the set of updates that "may destabilize" the query
  - Call this $\Delta(Q)$, the **destabilizer** (or **antiprovenance**) of Q
- *Targets(U)* disjoint from $\Delta(Q)$ implies Q independent of U
- Can be just as effective, without a schema

Key subproblem: XPath intersection analysis

- In the absence of schema, use **paths** to statically describe sets of nodes
  - cf. [Ghelli, Simeon & Rose 2008], others
  - Intersection of **downward** paths is $O(n^2)$
  - But general problem is NP-hard

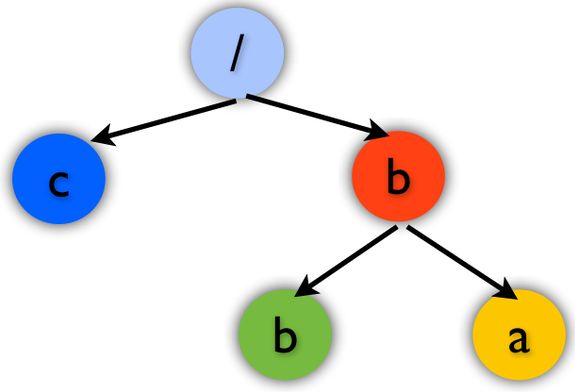
Solvers to the rescue?

- There are solvers for decidable tree logics
- `MONA` (decides MSO(Tree))
  - Somewhat unpredictable, needs tuning
- [Geneves et al. 07]: Modal mu-calc solver
  - Source not available
  - Optimized version not yet available

A special case

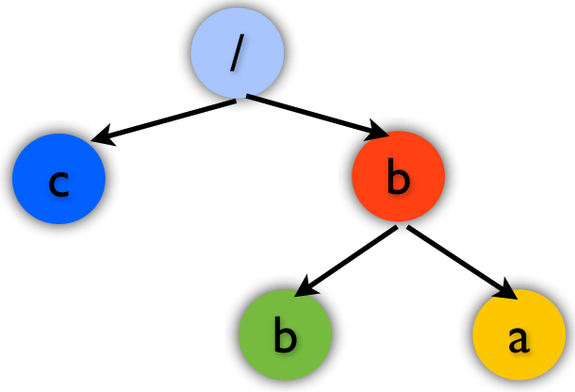
- Our approach: novel (apparently) reduction from EFO(Tree) to EFO(N, <).
- Most SMT solvers are **very** good at EFO(N,<)-SAT (typically complete)
- Typically faster than `MONA` or Geneves solver on our path intersection/ independence benchmark
  - but handles a much weaker theory

Idea



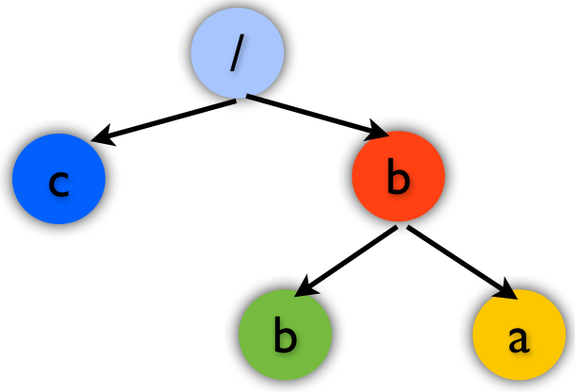
- `Sibling(x,y)`
- `=>`
- `x.post < y.pre`

Idea



- `Desc(x,y)`
- `=>`
- `x.pre < y.pre & x.post > y.post`

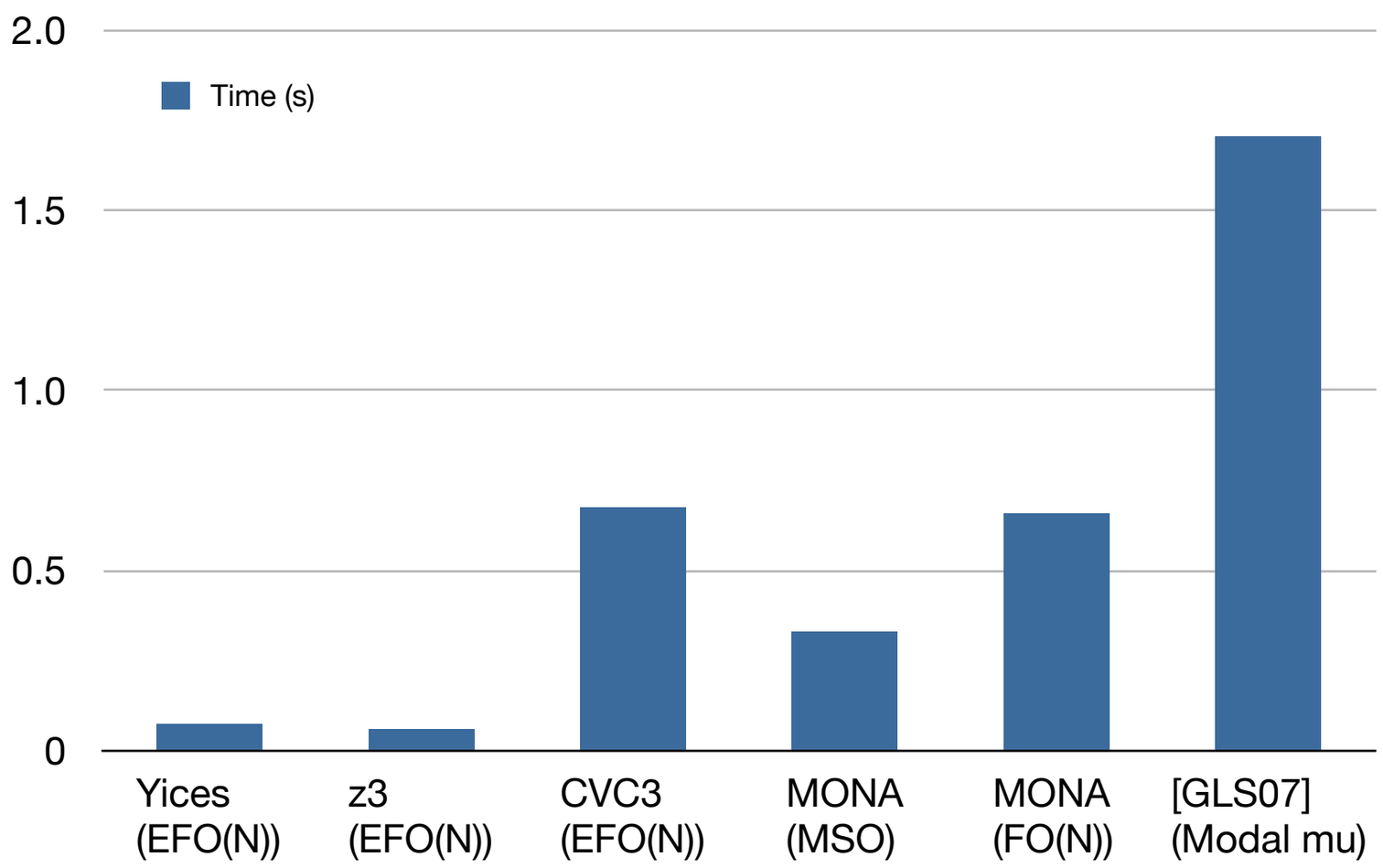
Idea



1 2 3 4 5 6 7 8 9 10

```
Child(x,y) =>
Desc(x,y) & not (Desc(x,x1) & Desc(x1,y)
          & ...
          & not (Desc(x,xn) & Desc(xn,y)
```

Comaprison for one typical problem



(not a comprehensive experiment!)

Experimental results

- Destabilizer-based independence analysis is just as effective as schema-based
  - succeeds/fails on different queries
  - fast enough (using yices) to yield savings
- Close to exact
  - < 1% false positives on benchmark of over 500 problems
  - (hand classified)

Respectable charts and figures

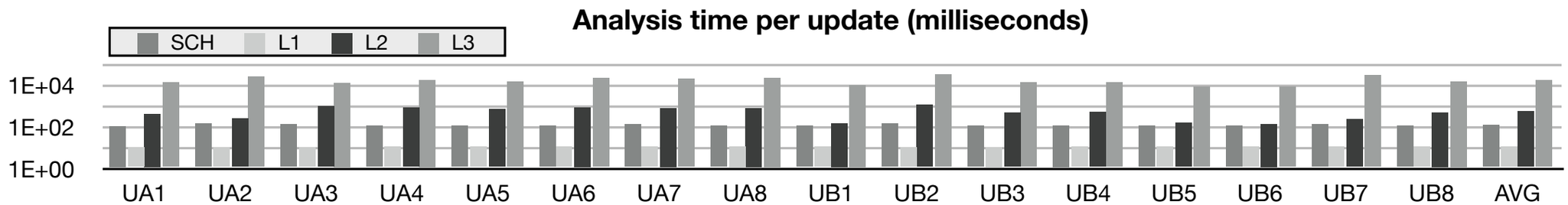


Figure 5: Running times for the generic analysis, in milliseconds (logarithmic scale), broken down by update and analysis level.

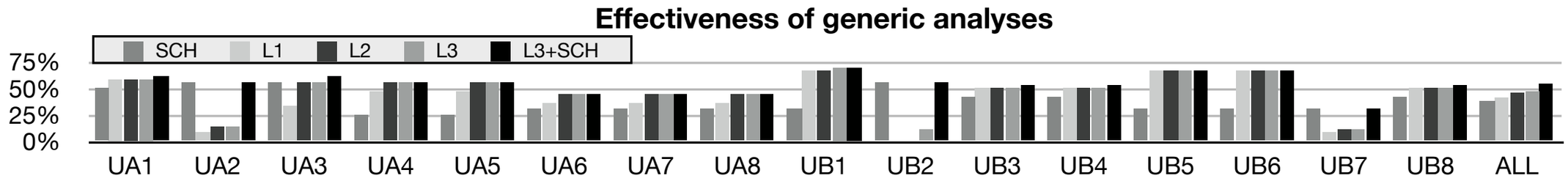
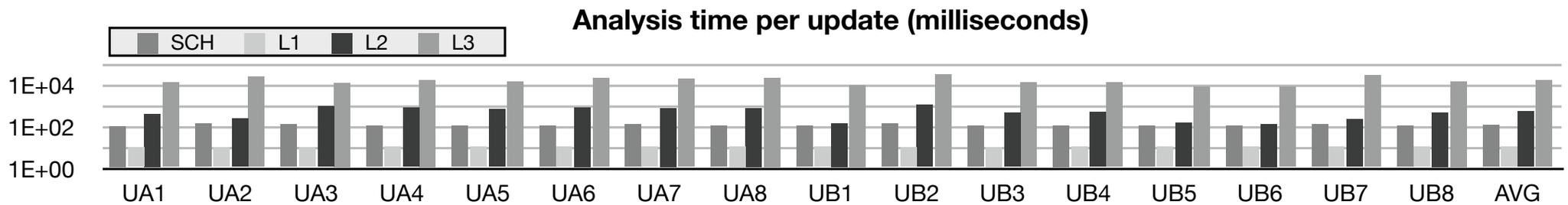


Figure 6: Effectiveness of the generic analysis, expressed as a percentage of query-update pairs determined independent, broken down by update and by analysis level.

	SCH	L_1	L_2	$L_2 + SCH$
1.1MB	8.3%	10.5%	8.3%	10.9%
2.3MB	11.0%	14.5%	14.9%	20.1%

Table 1: Maintenance time savings across whole benchmark

Respectable charts and figures



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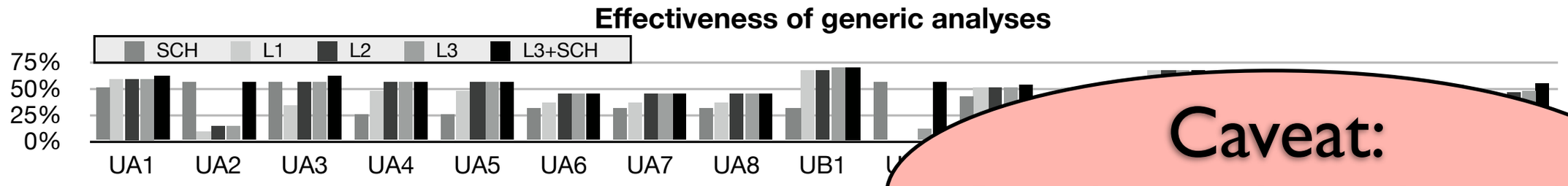

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Caveat:
Synthetic benchmark

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Table 1: Maintenance time savings across whole benchmark

Limitations/future work

- What if you do have a schema?
  - Naive joint path and schema analysis works OK
  - Smarter: destabilizer intersection modulo schema
- Schemas not expressible exactly in EFO(N)
  - Can SMT approach be extended to handle schemas?
- What about incremental maintenance?
  - ideally, want to combine static and dynamic approaches

Conclusions

- Database wikis will be A.W.E.S.O.M.E.
- and will need good high-level web, XML and constraint programming tools
- Need to solve tree constraints quickly using SMT solvers (or other decision procedures?)
- in order to make R.A.D.I.C.A.L. advances in techniques for database curation