SQL5

Verson 19.3

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Current standards

1. SQL Standard - SQL/XML Functionality. ISO/IEC JTC1/SC32 #1293, 2005-04-22. http://jtc1sc32.org/doc/N1251-1300/32N1293-WG3-Presentation-for-SC32-20050418.pdf
2. K.Kulkarni. Overview of SQL:2003, part 14 "SQL/XML", p. 65. Silicon Valley Laboratory, IBM Corporation, San Jose, 2003-11-06. http://www.wiscorp.com/SQL2003Features.pdf
3. N.Mattos, H.Darwen, P.Cotton, P.Pistor, K.Kulkarni, S.Dessloch, K.Zeidenstein. SQL99, SQL/MM, and SQLJ: An Overview of the SQL standards. http://www.wiscorp.com/sql1999_c3.zip
4. How to add style to XML. //W3C papers. http://www.w3.org/Style/styling-XML
5. CSS vs. XSL. //W3C papers. http://www.w3.org/Style/CSS-vs-XSL
6. XML Path Language (XPath). Version 1.0. //W3C Recommendation, 16 November 1999. http://www.w3.org/TR/xpath
7. XML submission. //Web Forms 2.0, Working Draft, 12 October 2006. http://www.whatwg.org/specs/web-forms/current-work/#x-www-form-xml
8. P.Scarponcini. SQL Multimedia and Application Packages - Part 3: Spatial. Bentley Transportation, 2000-03-26. http://www.wiscorp.com/sqlspat.zip

Proposals

Hierarchical input-output
Concept for output
SQL/XLang output
Conditions
Compositions of determinations,
compositions of refinements
Portion of sorted data
Aggregates vs. recursion
Wave algorithm (on examples)
Output, optionally
Concept for input
Manually
Manually into content
Input, optionally
Concept for processing
SQL, XML just over TCP

Distributed query
Concept for dQ
Implementation
Examples of replication
dQ, optionally
BLOB
Nested schemas like former folders
Repairing of dQ, optionally

Different
Whole control
Controllable and usable FTS
Freezing
Timer
Interval table constraints

Model - Window System
Concept for 3D
2D-grid in 3D
3D-triggers
Mouse triggers
Operations
3D-contour, optionally
Concept for 2D
2D-triggers
Mouse triggers
1D, optionally
Window format, optionally
Mixture of dimensions
Fielders, tablers

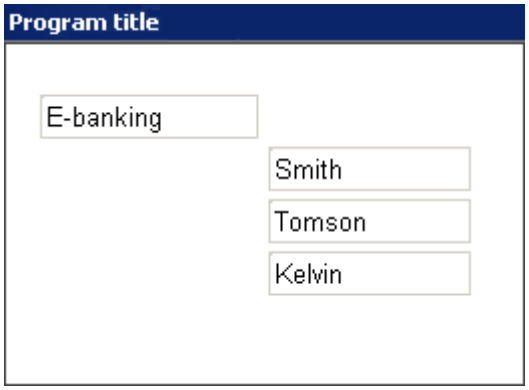
Hierarchical input-output (hIO)

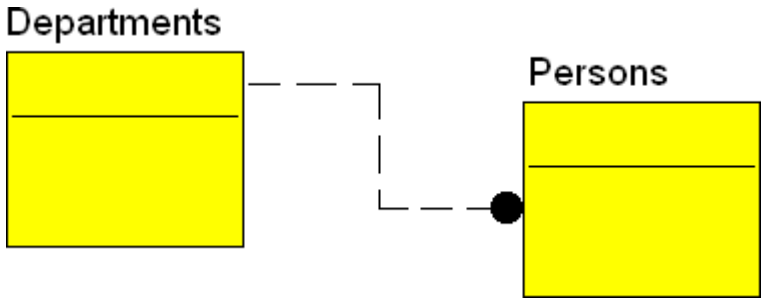
Attention: XML is used instead of binary format only to represent hierarchical data from communication channel onto slides

Concept for output

Screen schema=database schema

Output fields are bound by relations IDEF1. Screen of program has schema, and this schema completely repeats schema of database



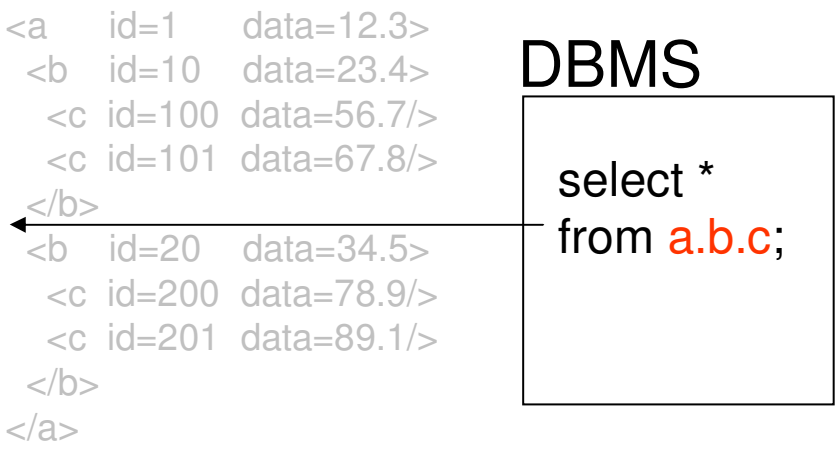


Syntax, expressing hierarchy, e.g. "Departments.Persons" is absent in SQL at all. Client cannot separate in Cartesian products, what fields belong to one table, or another. So taking information from database, we lose a part of information!

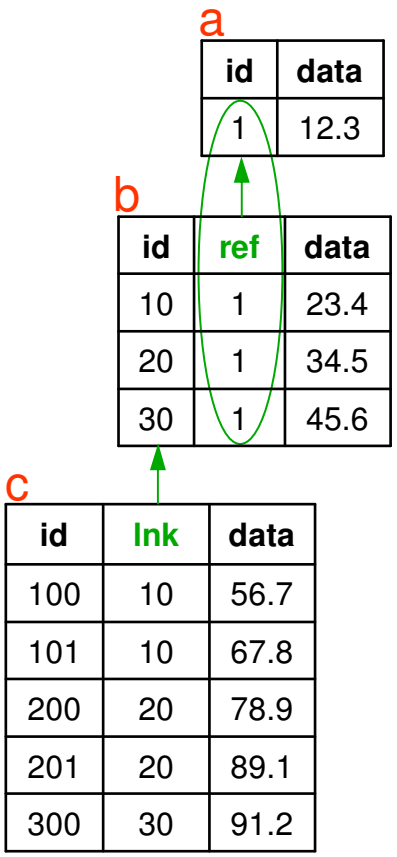
Tree notation vs. LOOP/FETCH

Instead of inserting lost information by machine, we try to make it manually, forcing user to trace work of computer. It occupies up to 50% of working time. Tracing is written in notation LOOP/FETCH. We take one record at a time to find records, bound with it.

Strong decision exists. It is expressions like 'select * from a.b.c' to select data from tables 'a', 'b', 'c', already bound by foreign keys. Let's name this by term 'XTree' (in analogy with 'XPath').



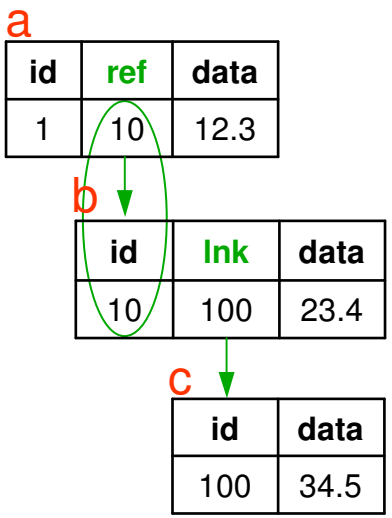
Selecting set



select * from a.b.c;

```
<a    id=1    data=12.3>
 <b   id=10   data=23.4>
  <c id=100 data=56.7/>
  <c id=101 data=67.8/>
 </b>
 <b   id=20   data=34.5>
  <c id=200 data=78.9/>
  <c id=201 data=89.1/>
 </b>
 <b   id=30   data=45.6>
  <c id=200 data=91.2/>
 </b>
</a>
<!-- used refering fields are not extracted -->
```

Selecting relay-race



select * from a.b.c;

```
<a    id=1    data=12.3>
  <b  id=10   data=23.4>
    <c id=100 data=34.5/>
  </b>
</a>
<!-- used refering fields are not extracted -->
```

Postulates

- FK of table to itself is always means list, instead of nesting (transforming list to nesting is archived by special statement, slide 29)
- Previous element of list refers to next element (instead of next element refers to previous)

Restriction to obtain particular list instead of all lists may be:

- tree, in which list is (e.g. “select b from a.b.c;”), or
- predicate for element of list (e.g. “select * from b where first(b)/@b1=5;”)

Selecting list

a

id	lnk	data
88	1	77.7

b

id	ref	lnk	data
1	**10**	3	12.3
10	**100**	4	23.4
100	null	5	34.5

c

id	ref	data
3	**30**	3.1
30	**300**	3.2
300	null	3.3
4	**40**	4.1
40	**400**	4.2
400	null	4.3
5	**50**	5.1
50	**500**	5.2
500	null	5.3

select * from a.b.c;

```
<a     id=88   data=77.7>
 <b    id=1    data=12.3>
  <c   id=3    data=3.1/>
  <c   id=30   data=3.2/>
  <c   id=300  data=3.3/>
 </b>
 <b    id=10   data=23.4>
  <c   id=4    data=4.1/>
  <c   id=40   data=4.2/>
  <c   id=400  data=4.3/>
 </b>
 <b    id=100  data=34.5>
  <c   id=5    data=5.1/>
  <c   id=50   data=5.2/>
  <c   id=500  data=5.3/>
 </b>
</a>
<!-- used refering fields are not extracted -->
```

Refinement for set and relay-race

If two tables refer to each other, or one table refers to another by several foreign keys, than this ambiguity is solved in query: Sign '#' and name of necessary referring field (not name of constraint, i.e. name of foreign key) are specified after strictly name of table, containing necessary foreign key. It looks like new table name with symbol '#' in the middle of the name. We shall name this specifying of referring field by term 'refinement'.

Refinement for set

a

id	data
1	12.3
2	23.4

b

id	ref1	ref2	data
10	1	2	34.5
20	1	2	45.6
30	1	2	56.7
40	1	2	67.8

c

id	lnk1	lnk2	data
100	**10**	20	78.9
101	**10**	20	89.1
200	**30**	40	91.2
201	**30**	40	88.8

select * from a.b#ref1.c#lnk1;

```
<a          id=1              data=12.3>
  <b#ref1   id=10   ref2=2    data=34.5>
    <c#lnk1 id=100 lnk2=20 data=78.9/>
    <c#lnk1 id=101 lnk2=20 data=89.1/>
  </b>
  <b#ref1   id=30   ref2=2    data=56.7>
    <c#lnk1 id=200 lnk2=40 data=91.2/>
    <c#lnk1 id=201 lnk2=40 data=88.8/>
  </b>
</a>
<!-- un-used refering fields are extracted -->
```

Refinement for relay-race

a

id	ref1	ref2	data
1	**10**	20	12.3

b

id	lnk1	lnk2	data
20	200	201	34.5
10	**100**	101	23.4

c

id	data
201	78.9
200	67.8
101	56.7
100	45.6

select * from a#ref1.b#lnk1.c;

```
<a#ref1    id=1    ref2=20   data=12.3>
  <b#lnk1  id=10   lnk2=101 data=23.4>
    <c       id=100            data=45.6/>
  </b>
</a>
<!-- un-used refering fields are extracted -->
```

Refinement for list

Similarly, if table contains a list and refers to self by several foreign keys, than this ambiguity is also solved in query: Sign '$' and name of necessary referring field (not name of constraint, i.e. name of foreign key) are specified after strictly name of table, containing necessary foreign key. It also looks like new table name with symbol '$' in the middle of the name. We shall name this specifying of referring field by term 'refinement' too.

Different signs - '#' and '$' - are used in two different types of refinement, that it would possible to use both types of refinement simultaneously: 'table#field1$field2'

Refinement for list

a

id	lnk	data
88	1	77.7

b

id	ref1	ref2	lnk	data
1	**10**	20	3	12.3
10	null	200	4	23.4

c

id	ref3	ref4	data
3	**30**	70	3.1
30	**300**	700	3.2
300	null	null	3.3
4	**40**	80	4.1
40	**400**	800	4.2
400	null	null	4.3

select * from a.b$ref1.c$ref3;

```
<a          id=88              data=77.7>
  <b$ref1   id=1    ref2=20    data=12.3>
    <c$ref3 id=3    ref4=70    data=3.1/>
    <c$ref3 id=30   ref4=700   data=3.2/>
    <c$ref3 id=300             data=3.3/>
  </b>
  <b$ref1   id=10   ref2=200   data=23.4>
    <c$ref3 id=4    ref4=80    data=4.1/>
    <c$ref3 id=40   ref4=800   data=4.2/>
    <c$ref3 id=400             data=4.3/>
  </b>
</a>
 <!-- un-used refering fields are extracted -->
```

Another output

```
select tab2/@data2, tab1/@data1
from   tab1, tab2  -- tab1 is first
where tab2/@fld2=tab1/@fld1;
```

```
<tab1  data2=3   data1=12.3 />
<tab1  data2=7   data1=23.4 />
<tab1  data2=10 data1=34.5 />
<tab1  data2=25 data1=45.6 />
```

Switching designations

select a.a1 , b.b1	select a/@a1·b/@b1
from schema.tab	from schema§tab
where b.b1=5	where b/@b1=5
group by x1, y1	group @c by @x1, @y1
	group @c by x1, y1 --exists
update d set d1=5	update d set @d1=5
	update d set d1/@e1=5 --exists
insert into b	insert into b (@)
delete from	delete * from
create procedure p(v type1)	create procedure p (@v type1)
references tab(@fld1)	refers tab/@fld1
references tab(@fld1, @fld2)	refers (tab[@fld1, @fld2])
foreign key	foreign
not null	notnull

Switching and enquiring session parameter

```
set dialect sql5;          -- SQL5

set dialect sql4;          -- SQL:2003

show dialect;  ⟶  <?res code=0 dialect=sql4 /?>
```

SQL/XLang output

XLang

XPath

a/(b | k)/c

a/b*/c

a/b+/c

a/b?/c

a/b[@b1]/c

a/b[@b1=5]/c

a/b[0]/c

a/(b | k)[0]/c

a//b

XTree

a.(b | k).c

a.b*.c

a.b+.c

a.b?.c

a.b[@b1].c

a.b[@b1=5].c

a.b[0].c

a.(b | k)[0].c

a..b

tab[!=5] -- level of nesting

E.g.

‘*’ means repetition of section (of table) from 0 to infinity times

a.b*.c means all following trees

a.c

a.b.c

a.b.b.c

a.b.b.b.c

etc

‘+’ means repetition of section (of table) from 1 to infinity times

a.b+.c means all following trees

a.b.c

a.b.b.c

a.b.b.b.c

a.b.b.b.b.c

etc

‘..’ means any intermediate sections (tables) in any quantity

a..c means all following trees

a.c

a.m.c

a.n.c

a.n.n.c

a.n.k.c

a.n.k.k.c

etc

‘?’ means presence or absent of section (of table)

a.b?.c means both following trees

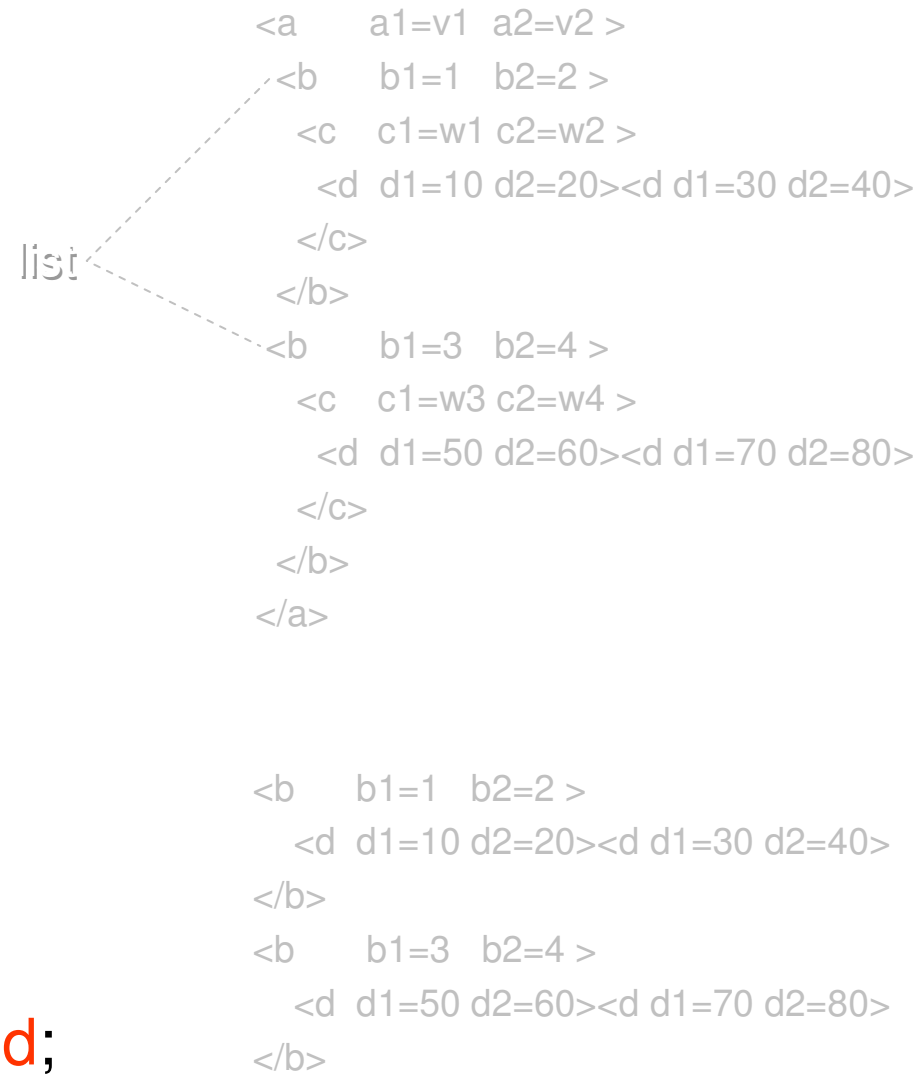
a.c

a.b.c

p/q/a.b.c.d means the same as p.q.a.b.c.d but p.q are not extracted

Extracted tables

```
select *
from   p/q/a.b.c.d;

select *
from   p/q/a.b[3,5].c.d;

select b.d
from   p/q/a.b.c.d;

select b.d
from   p/q/a.b[3,5].c.d;

select b[3,5].d
from   p/q/a.b[11-18].c.d;
-- b[13,15] to output
```



Extracted fields

```
select b [@b1].d[@d1]
from   p/q/a.b.c.d;
-- only these fields
```

```
<b     b1=1>
   <d  d1=10><d d1=30>
</b>
<b     b1=3>
   <d  d1=50><d d1=70>
</b>
```

```
select b [@b1 as m].d[@d1 as n]
from   p/q/a.b.c.d;
-- only these fields, but with renaming
```

```
<b     m=1>
   <d  n=10><d n=30>
</b>
<b     m=3>
   <d   n=50><d n=70>
</b>
```

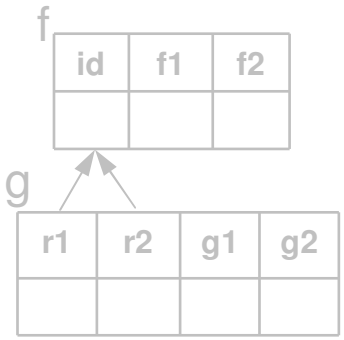
Binding two trees (BTT)

```
select a.b.k.m
from   p/q/a.b ,s/t/k.m
where b/@b1=k/@k1;
```

Aliases for section

```
select f.g.x
from   f x,    -- it's impossible 'f.g.x' from 'f' and 'x'
       f.g.x;
```

```
<f     f1=  f2= >
 <g    g1=  g2= >
  <x   f1=  f2= />
 </g>
</f>
```



Aliases for whole tree

```
select *
from   f.g     k.m; -- rename tree

select f.g as k.m  -- rename tree
from   f.g     k.m;
```

```
<k     f1=  f2= >
 <m    g1=  g2= />
</k>
```

Aliases and BTT

```
select k.m.n
  from p/q/c k m n
where k/@c2=m/@c3 and m/@c4=n/@c5;

select k.m.n
  from p/q/a k, r/s/b m, t/u/c n,
where k/@a2=m/@b2 and m/@b3=n/@c3;

select k.m.n.v
  from p/q/a.b k.m, r/s/c.d n.v  -- renaming trees
where m/@b2=n/@c2;
```

Re-alignment tree to list (only for non-branching tree)

```
select a    from   p/q/a*;
select a    from   p/q/(a.b)*;
```

```
<a   a1=v1  a2=v2 />
<a   a1=v3  a2=v4 />
<a   a1=v5  a2=v6 />
```

```
select a.b from   p/q/(a.b)*;
```

```
<a   a1=v1  a2=v2 >
 <b  b1=w1>
 <b  b1=w2>
</a>
<a   a1=v3  a2=v4 >
 <b  b1=w3>
 <b  b1=w4>
</a>
<a   a1=v5  a2=v6 >
 <b  b1=w5>
 <b  b1=w6>
</a>
```

Realignment list to tree

select a* from p/q/a;

select a* from p/q/a.b;

```
<a    a1=v1  a2=v2 >
 <a   a1=v3  a2=v4 >
  <a  a1=v5  a2=v6 />
 </a>
</a>
```

select (a.b)* from p/q/a.b;

```
<a        a1=v1  a2=v2 >
 <b       b1=w1>
  <a      a1=v3  a2=v4 >
   <b     b1=w3>
    <a    a1=v5  a2=v6 >
     <b   b1=w5>
     <b   b1=w6>
    </a>
   </b>
   <b     b1=w4>
  </a>
 </b>
</a>
```

Constant as section

select a.<u u1=8>.b
from p/q/a.b;

```
<a    a1=v1 a2=v2 >
 <u   u1=8>
  <b  b1=1  b2=2 />
  <b  b1=3  b2=4 />
 </u>
</a>
<a    a1=w1 a2=w2 >
 <u   u1=8>
  <b  b1=1  b2=2 />
  <b  b1=3  b2=4 />
 </u>
</a>
```

select a.<u u1=8 >||b||</u>
from p/q/a.b;

```
<a    a1=v1 a2=v2 >
 <u   u1=8>
  <b  b1=1  b2=2 />
 </u>
 <u   u1=8>
  <b  b1=3  b2=4 />
 </u>
</a>
<a    a1=w1 a2=w2 >
 <u   u1=8>
  <b  b1=1  b2=2 />
 </u>
 <u   u1=8>
  <b  b1=3  b2=4 />
 </u>
</a>
```

XPath continues XTree

```
select * from p/q/a.b.c
  where       q/t/u/@u1=7              -- 'p/q/t/u/@u1'
    and       b/t/u/@u1=8;             -- 'p/q/a/b/t/u/@u1'

insert into   p/q (
              q/n/k/a.b(@b1).c         -- 'p/q/n/k/a.b.c'
) values (1)
 where        q/t/u/@u1=7              -- 'p/q/t/u/@u1'
    and       b/t/u/@u1=8;             -- 'p/q/n/k/a/b/t/u/@u1'

update        p/q/a.b.c                -- similarly 'p/q/a/b.c'
  set         q/n/k/@k1=1,             -- 'p/q/n/k/@k1‘
              b/n/k/@k1=2,             -- 'p/q/a/b/n/k/@k1'
 where        q/t/u/@u1=7              -- 'p/q/t/u/@u1'
    and       b/t/u/@u1=8;             -- 'p/q/a/b/t/u/@u1'

delete        b, d
  from        p/q/a.b.c.d
 where        q/t/u/@u1=7              -- 'p/q/t/u/@u1'
    and       b/t/u/@u1=8;             -- 'p/q/a/b/t/u/@u1'
```

Refinement in any place

(in XPath too)

```
select * from p#ref1/q#lnk1/a.b#k.c#m.d;

insert into     p#ref1/q#lnk1/a      (@data) values (88);

update          p#ref1/q#lnk1/a set @data=88;
update          p#ref1/q#lnk1/a      (@data) select 88;

delete * from p#ref1/q#lnk1/a.b#k.c#m.d;
```

Conditions

Restriction only for set and relay-race

```
select * from a.b*.c
    where  parent(b)/@b2=child(b)/@b1;
```

-- functions ‘parent’ and ‘child’ are used only for set and relay-race,
must be used always simultaneously

```
<a>
 <b          b2=1>
  <b  b1=1 b2=2>
   <b b1=2 >
    <c/>
   </b>
  </b>
 </b>
</a>
```

Only for set and relay-race

```
select * from a.b*.c.b*
    where  root(b)/@b2=3;
```

-- restriction for first ‘b’ in whole tree

```
select * from a.b*.c.b*
    where  terminator(b)/@b2=4;
```

-- cut tree on last ‘b’ in each branch, field ‘b2’ of which is equal 4

P.S. ‘select terminator(b) from b* ’ is possible too

```
<a>
  <b       b2=3>
    <b     b2=4>
      <c>
        <b  b2=4>
          <b b2=5 />
        </b>
      </c>
    </b>
  </b>
</a>

<a>
  <b       b2=3>
    <b     b2=4>
      <c>
        <b  b2=4 />
      </c>
    </b>
  </b>
</a>
```

Conditions for fields

XPath

a.b[@b1=5]

a.b[@b1]

a.b.c[@c1=../@a1]

a.b[position()=1 and @b1=5]*.c

a.b[last() and @b1=5]*.c

XTree

from …/a.b where @b1=5

from …/a.b where @b1 is not null

from …/a.b.c where a/@a1=c/@c1

from …/a.b*.c where first(b)/@b1=5
-- first in each list

from …/a.b*.c where last(b)/@b1=5
-- last in each list

from …/a.b*.c where @a1 in ...

Restriction only for list

```
select * from a.b.c
    where  previous(b)/@b2=next(b)/@b1;
```

-- functions ‘previous’ and ‘next’ are used only for list,
and must be used always simultaneously

```
<a>
  <b        b2=1><c/></b>
  <b b1=1 b2=2><c/></b>
  <b b1=2      ><c/></b>
</a>
```

Only for list

```
select * from a.b*.c.b*
    where  first(b)/@b2=3;

    -- restriction for first ‘b’ in each list
```

```
<a>
  <b b2=3><c/></b>
  <b b2=4><c/></b>
  <b b2=5><c/></b>
</a>
<a>
  <b b2=3><c/></b>
  <b b2=4><c/></b>
  <b b2=6><c/></b>
</a>
```

```
select * from a.b*.c.b*
    where  last(b)/@b2=4;

    -- cut tree on last ‘b’ in each list, field ‘b2’ of which is equal 4
```

```
<a>
  <b b2=7><c/></b>
  <b b2=4><c/></b>
</a>
<a>
  <b b2=8><c/></b>
  <b b2=4><c/></b>
</a>
```

Compositions of determinations, compositions of refinements

Nog

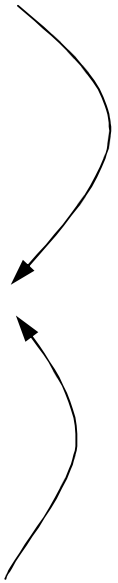
```
create table a (
  id     num     primary key,
  data float
);
create table b (
  id     num     primary key,
  ref1 num       references a(id),   -- important
  ref2 num       references a(id),   -- ballast
  ref3 num       references c(id),   -- important
  ref4 num       references c(id),   -- ballast
  data float
);
create table c (
  id   num       primary key,
  data float
);
```

```
<a>
  <b#ref1:ref3>
    <c>
  </b>
</a>
```

.a.b#ref1:ref3.c.
/a/b#ref1:ref3/c/

Buckle

```
create table a (
  id   num       primary key,
  ref1 num       references b(id),   -- important
  ref2 num       references b(id),   -- ballast
  data float
);
create table b (
  id   num       primary key,
  data float
);
create table c (
  id   num       primary key,
  ref1 num       references b(id),   -- important
  ref2 num       references b(id),   -- ballast
  data float
)
```

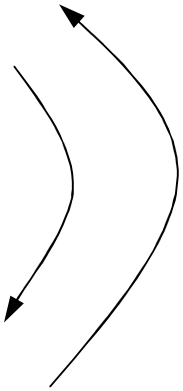


<a#ref1>
****
<c#ref3>
****
****

.a#ref1.b.c#ref3.
/a#ref1/b/c#ref3/

Crossroad

```
create table a (
  id   num      primary key,
  ref  num      references b(id),
  data float
);
create table b (
  id   num      primary key,
  lnk  num      references a(id),
  data float
);
```



<a#ref>
** <b>**
****

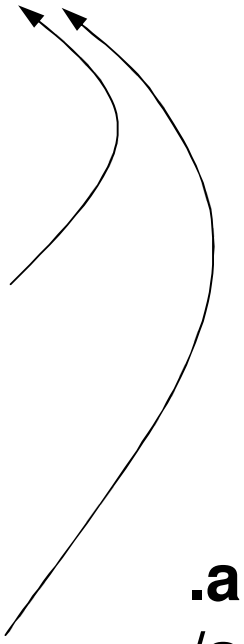
<a>
** <b#lnk>**
****

.a#ref.b.
/a#ref/b/

.a.b#lnk.
/a/b#lnk/

Branching-1

```
create table a (
  id   num       primary key,
  data float
);
create table b (
  id   num       primary key,
  ref1 num       references a(id),   -- important
  ref2 num       references a(id),   -- ballast
  data float
);
create table c (
  id   num       primary key,
  ref1 num       references a(id),   -- important
  ref2 num       references a(id),   -- ballast
  data float
);
```



<a>
** <b#ref1>**
** <c#ref1>**
****

.a.(b#ref1 c#ref1).

/a/(b#ref1 c#ref1)/

-- both branches simultaneously

.a.(b#ref1 | c#ref1).

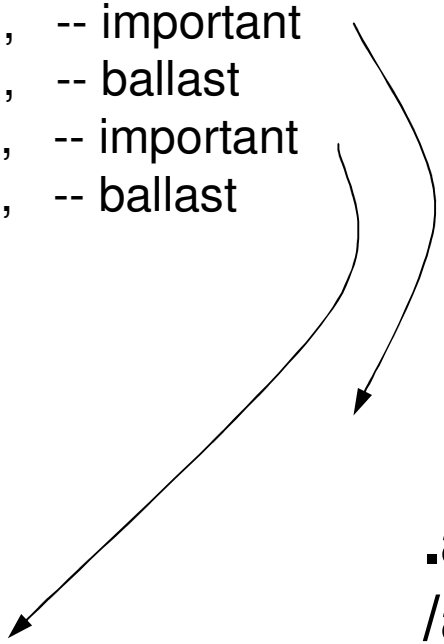
-- any branch

~~**/a/(b#ref1 | c#ref1)/**~~

-- path must be specified exactly

Branching-2

```
create table a (
  id   num       primary key,
  ref1 num       references b(id),   -- important
  ref2 num       references b(id),   -- ballast
  ref3 num       references c(id),   -- important
  ref4 num       references c(id),   -- ballast
  data float
);
create table b (
  id   num       primary key,
  data float
);
create table c (
  id   num       primary key,
  data float
);
```



<a#ref1+ref3>
<b>
<c>
****

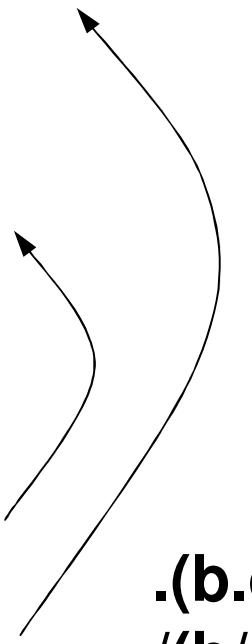
.a#ref1+ref3.(b c).
/a#ref1+ref3/(b c)/
-- both branches simultaneously

.a#ref1^ref3.(b | c).
-- any branch

~~**/a#ref1^ref3/(b | c)/**~~
-- path must be specified exactly

Continuation-1

```
create table b (
  id   num       primary key,
  data float
);
create table c (
  id   num       primary key,
  data float
);
create table d (
  id   num       primary key,
  ref1 num       references b(id),   -- important
  ref2 num       references b(id),   -- ballast
  ref3 num       references c(id),   -- important
  ref4 num       references c(id),   -- ballast
  data float
);
```



Sament can't be inside 2 saments

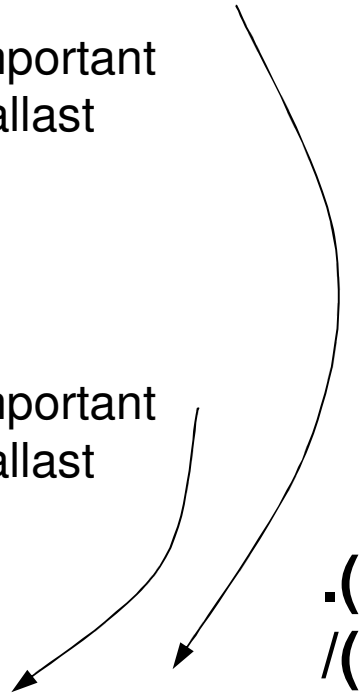
.(b.d#ref1 c.d#ref3).
/(b/d#ref1 c/d#ref3)/
-- both branches simultaneously

.(b.d#ref1 | c.d#ref3).
-- any branch

~~**/(b/d#ref1 | c/d#ref3)/**~~
-- path must be specified exactly

Continuation-2

```
create table b (
  id   num       primary key,
  ref1 num       references d(id),   -- important
  ref2 num       references d(id),   -- ballast
  data float
);
create table c (
  id   num       primary key,
  ref1 num       references d(id),   -- important
  ref2 num       references d(id),   -- ballast
  data float
);
create table d (
  id   num       primary key,
  data float
);
```



Sament can't be inside 2 saments

.(b#ref1 c#ref3).d.

/(b#ref1 c#ref3)/d/

-- both branches simultaneously

.(b#ref1 | c#ref3).d.

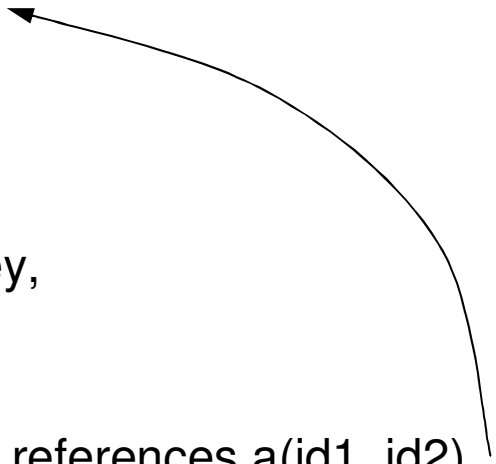
-- any branch

~~**/(b#ref1 | c#ref3)/d/**~~

-- path must be specified exactly

Combined key

```
create table a (
  id1 num,
  id2 num,
  primary key (id1, id2),
  data float
);
create table b (
  id     num     primary key,
  lnk1 num,
  lnk2 num,
  foreign key (lnk1, lnk2) references a(id1, id2),
  data float
);
```



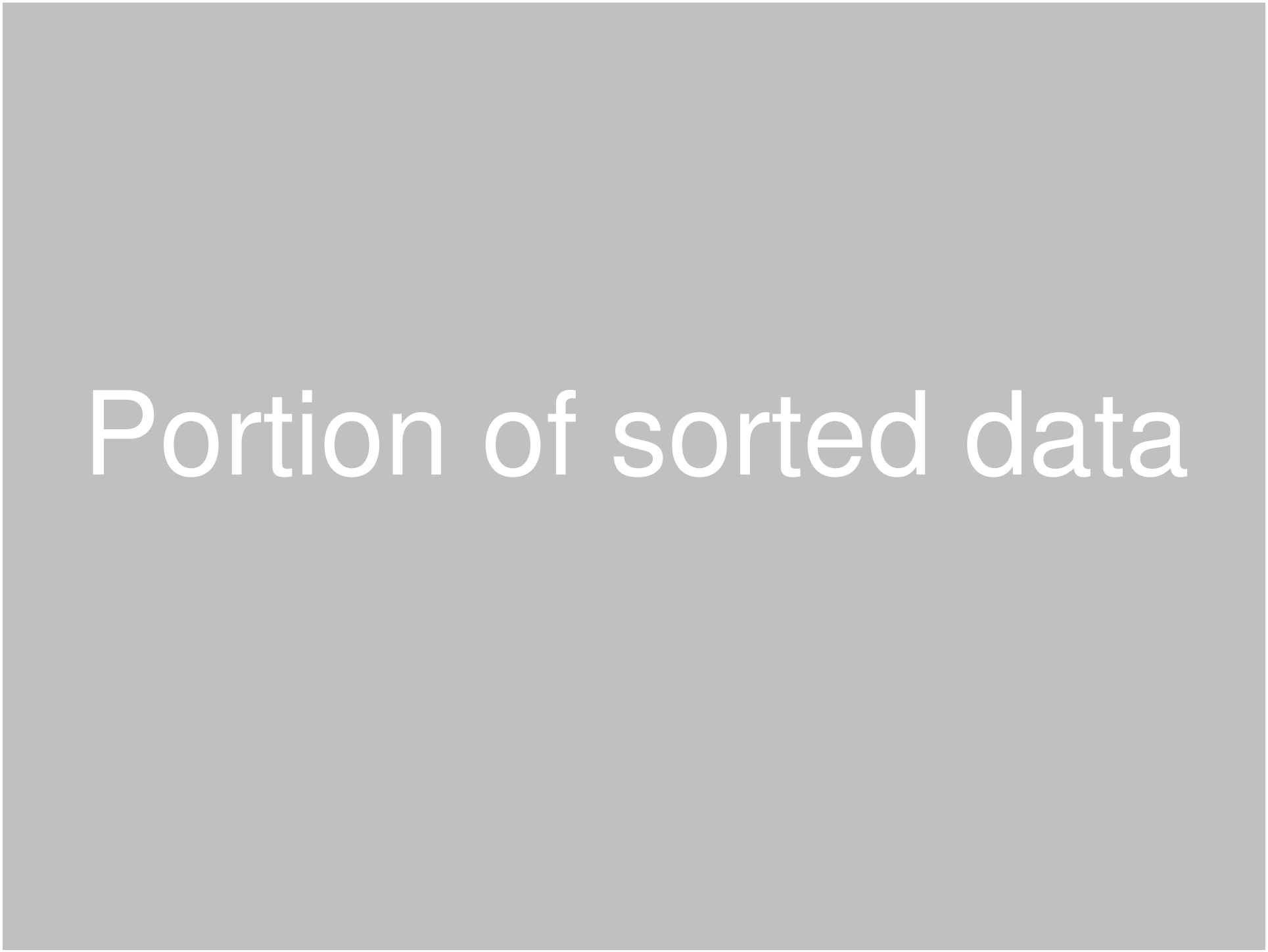
<a>
** <b#lnk1*lnk2>**
****

.a.b#lnk1*lnk2.
/a/b#lnk1*lnk2/

Refinement creates Determination

```
insert into a select * from a.b#lnk;
insert into a select * from a#ref.b;
insert into a select * from a.b$lnk;
```

--“select” with refinement creates xml-output with determination,
“insert” uses this determination for correct entering


Portion of sorted data

Next portion

```
select * from a.* where ...
order by    @a2 asc,  @a3 desc, @a1 asc
downward @a1=100  @a2=null   @a3="string“
limit 20;
 -- start from record @a1=100 @a2=null @a3="string“,
     and select next 20 records
```

```
select * from a.* where ...
order by    @a2 asc,  @a3 desc, @a1 asc
downward (select * from a.* where ... limit 1 )
limit 20;
 -- start from record, returned by “select * from a.* where ... limit 1”,
     and select next 20 records
```

Previous portion

```
select * from a.* where ...
order by    @a2 asc,  @a3 desc, @a1 asc
upward @a1=100  @a2=null   @a3="string“
limit 20;
 -- start from so record, and select next 20 records,
    that last selected record would be @a1=100 @a2=null @a3="string“
```

```
select * from a.* where ...
order by    @a2 asc,  @a3 desc, @a1 asc
upward (select * from a.* where ... limit 1 )
limit 20;
 -- start from so record, and select next 20 records,
    that last selected record would be equal to
    returned by “select * from a.* where ... limit 1”
```

Aggregates vs. recursion

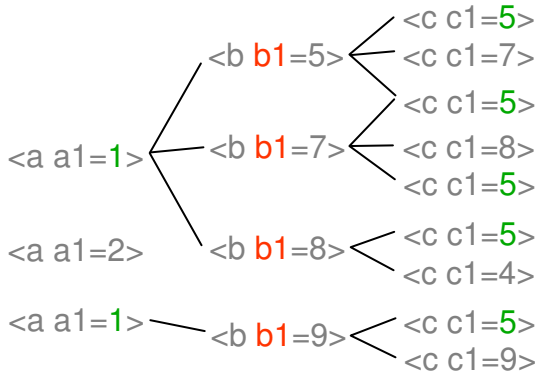
Grouping by non-list for extraction

select sum(@b1) from p/q/a.b.c
-- summurizing @b1, which are only in tree

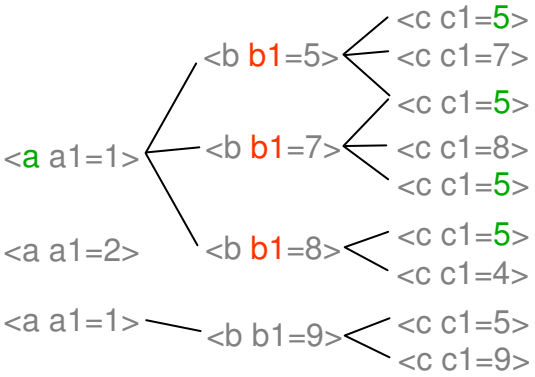
<b b1= >
<b b1= >
<b b1= >

if 'c' has no self-refering FK (i.e. cannot contain list), else <?res code=1 /?>

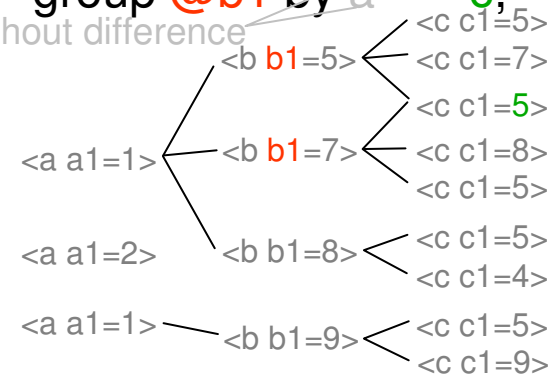
group @b1 by @a1 @c1;



group @b1 by a @c1;

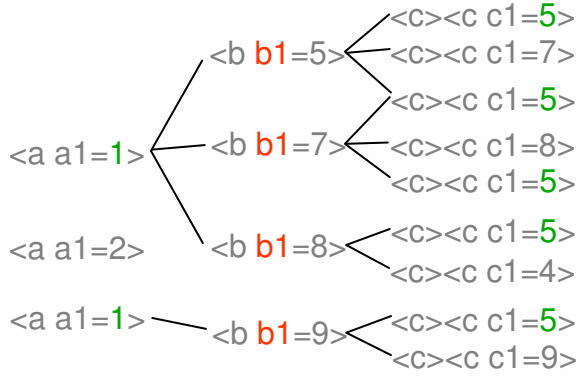


group @b1 by @a1 c;
group @b1 by a c;
without difference

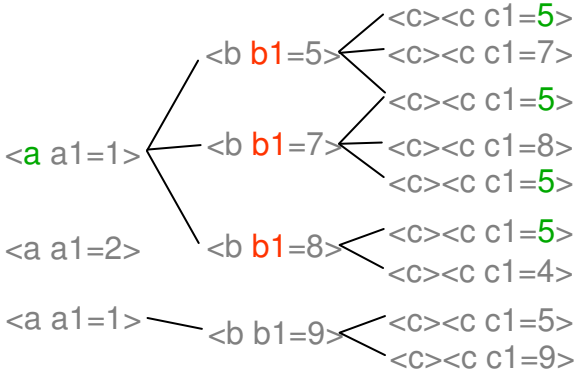


if 'c' has self-refering FK (i.e. can contain list)

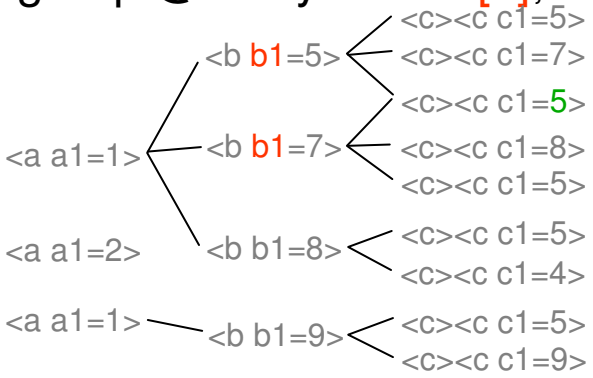
group @b1 by @a1 c[2]/@c1;



group @b1 by a c[2]/@c1;

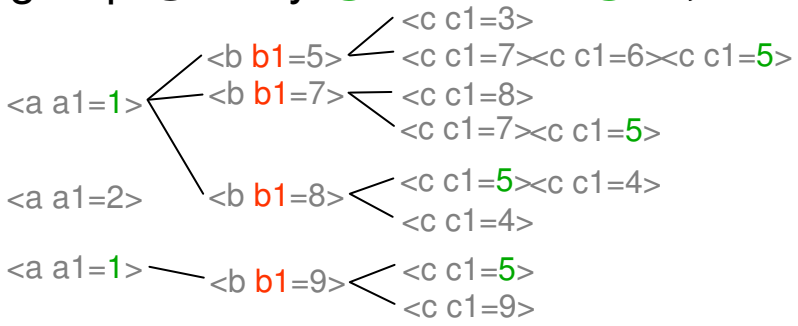


group @b1 by @a1 c[2];
group @b1 by a c[2];



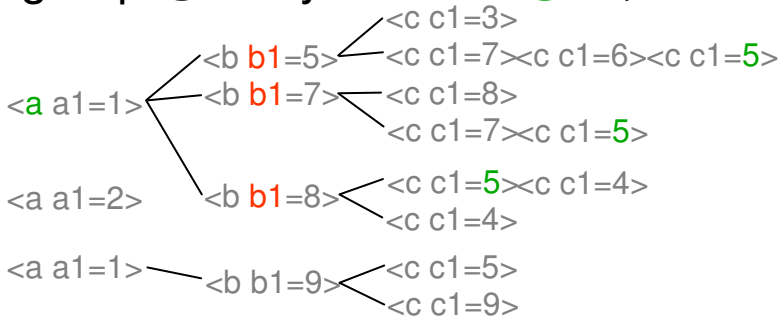
Group by list for extraction

group @b1 by @a1 some @c1;

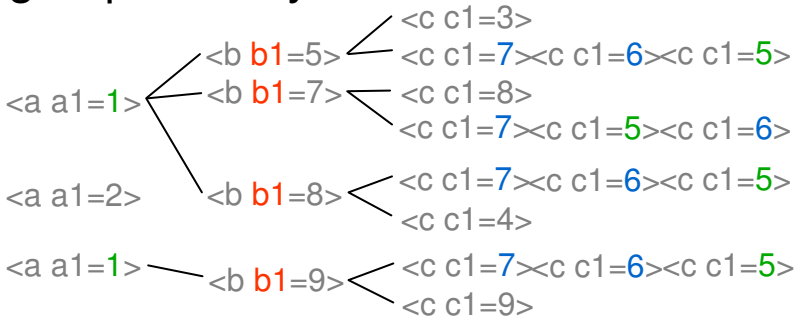


-- by any list element

group @b1 by a some @c1;

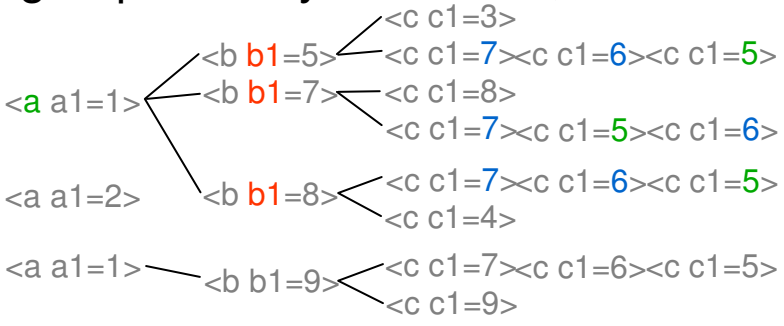


group @b1 by @a1 all @c1;

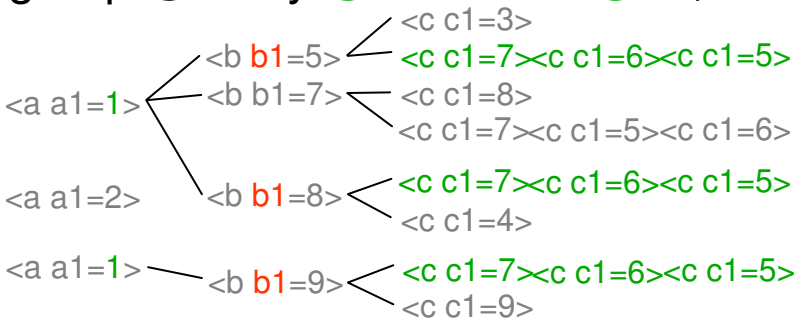


-- by all list elements

group @b1 by a all @c1;

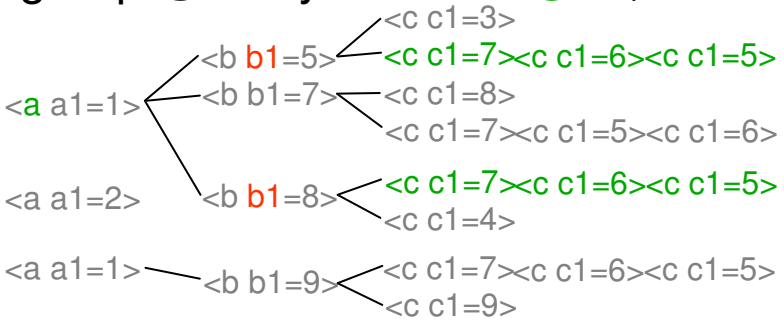


group @b1 by @a1 whole @c1;



-- by whole list

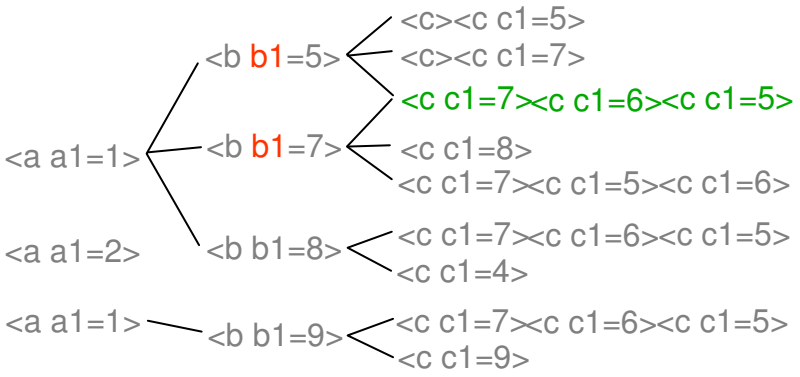
group @b1 by a whole @c1;



Group by list for extraction (continuation)

select sum(@b1) from p/q/a.b.c

group @b1 by a some c;
group @b1 by a all c;
group @b1 by a whole c;



Grouping for further operations

update a.b.c.d.e ⟹ <?res code=0 ?>

set @b1=sum(@d1)

-- assignment or comparison must obtain only one meaning from aggregate

group @d1 by b;

-- so group only by section of assignment or comparison (i.e. 'b'),

group @d1 by a;

-- or by any section, preceding it (i.e. 'a')

group @d1 by @b2; group @d1 by @a2;

-- or by their fields

set @b1=5
where sum(@d1)>10

for 'select', 'insert', 'delete' too

set @b1=sum(@c1)+sum(@d1)

-- left operand of arithmetical (e.g. '+') or comparison (e.g. '<>')
must correspond with only one right operand, and vice versa

group @c1, @d1 by b; group @c1, @d1 by a;
group @c1, @d1 by @b2; group @c1, @d1 by @a2;

-- so both aggregates in operation must have identical grouping

set @b1=5
where sum(@c1)<>sum(@d1)

as well as 'some(sum())', 'all(sum())'

set @b1=max(sum(@d1) as @x)

group @x by b, @d1 by e; group @x by a, @d1 by e;
group @x by @b2,@d1 by e; group @x by @a2, @d1 by e;

-- only first aggregate (i.e. 'max') has restriction above,
all next aggregates (i.e. 'sum') have no restrictions

set @b1=5
where max(sum(@d1) as @x)>10

Aggregate processes all sections with identical name

```
update a.b.c.b.c
update a.b.b.c.c
update a.(b.c)*
update a.b*.c*
```

⟹ <?res code=0 ?>

```
set @a1=sum(@c1)
```

```
set @a1=5
where sum(@c1)>10
```

-- aggregate always processes (e.g. summarizes)
all sections with identical name (i.e. all ‘c’ of different level ‘!’)

```
group @c1 by @b;
```

```
group @c1 by @b1;
```

-- grouping is always by first section with identical names (i.e. by ‘b’ with level !=2)

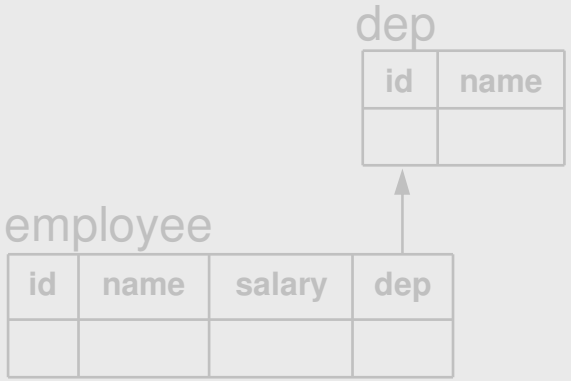
Default grouping

If aggregate is used, but ‘group by’ is absent,
than grouping is executed
by first section (record) in tree

```
select   *
  from   city.(flight.city)*
  where sum(flight/@price) = (select min(sum(@price) as @x)
                                  from   city.(flight.city)*
                                  group @price, @x by city)
  group @price city;
```

Wave algorithm (on examples)

Select employee




```
select *
  from dep.employee
  where @salary > (
    select avg(@salary)
    from   employee e
    where  e/@dep=dep/@id
  ) order by @salary desc;
```

Output:

```
<dep            id="1"  name="Technical">
  <employee id="54" name="Fraud"    salary="3200“/>
  <employee id="72" name="Kitter"     salary="3100“/>
  <employee id="31" name="Tomson" salary="3000“/>
</dep>
<dep            id="2"  name="Marketting">
  <employee id="25" name="Johnson" salary="4100“/>
  <employee id="64" name="Smith"      salary="4000“/>
</dep>
```

Select direct flights


```
select flight
  from city[@name="a"].flight#c1:c2.city[@name="b"];
```

Output:

```
<flight t1="5.30"   t2="8.30"   day="sunday“       price=“12”/>
<flight t1="7.30"   t2="10.30" day="monday"      price=“11”/>
<flight t1="9.30"   t2="12.30" day="tuesday"      price=“10”/>
<flight t1="15.30" t2="18.30" day=“wednesday” price=“13”/>
<flight t1="17.30" t2="20.30" day="thursday"     price=“9”/>
<flight t1="19.30" t2="22.30" day="friday“         price=“11”/>
<flight t1="7.30"   t2="10.30" day="saturday"     price=“10”/>
```

Select in-direct pathes

```
select  (flight[@t1 @t2 @price].city)*.flight
  from   city[@name="a"].(flight#c1:c2[@day="monday"].city)*.flight.city
    -- expression under ‘select’ clause must be substring of expression under ‘from’ clause
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
    -- (flight.city)*.flight.cify is equal (flight.city)* for ‘where’ clause
     and terminator(city)/@name="b";
```

how to reach city "b"
from city "a" on Monday,
time for change flight is
not less 30 minutes

Output:

```
<flight   t1="5.30"  t2="5.50“ price=“2”>
 <city    name="C">
  <flight t1="7.00"  t2="11.00“ price=“7”/>
 </city>
</flight>
<flight   t1="5.10"  t2="12.10“ price=“11”>
 ...
</flight>
```

Select most cheap path as tree

```
select   city*
  from   city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="b“
      and sum(@price) =
        -- specifing ‘flight’ before ‘@price’ is redundant, because other tables dont contain ‘@price’
select   min(sum(@price))
  from   city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="b";
```

what is the most chip path
from city "a" to city "b",
time for change flight is
not less 30 minutes

Output:

```
<city    name="C">
  <city  name=“D">
    <city name=“B">
  </city>
</city>
```

Select most cheap path as list

```
select   town
  from   city town,                                   -- to align tree to list
         city[@name="a"].(flight#c1:c2.town)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="b“
      and sum(@price) =
select   min(sum(@price))
  from   city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="b";
```

not safisfy

satisfies

what is the most chip path
from city "a" to city "b",
time for change flight is
not less 30 minutes

Output:

```
<town  name=“C“/>
<town  name=“D“/>
<town  name=“B“/>
```

Select cost of most cheap path

```
select   sum(@price) as @cost
  from   city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="b“
      and sum(@price) =
select   min(sum(@price))
  from   city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="b";
```

what is cost of the most chip path
from city "a" to city "b",
time for change flight is
not less 30 minutes

Output:

<flight cost=“8”/>

Select less bumpy path

```
select   town
  from   city town,
         city[@name="a"].(flight#c1:c2.town)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
     and terminator(city)/@name="b“
     and sum(@t2-@t1) =
select    min(sum(@t2-@t1))
  from    city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
     and terminator(city)/@name="b";
```

what is the less bumpy path
from city "a" to city "b",
time for change flight is
not less 30 minutes

Output:

```
<town  name=“G“/>
<town  name=“H“/>
<town  name=“K“/>
<town  name=“B“/>
```

Select less boring path

```
select   town
  from   city town,
         city[@name="a"].(flight#c1:c2.town)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
     and terminator(city)/@name="b“
     and sum(next(flight)/@t1 - previous(flight)/@t2) =
select    min(sum(next(flight)/@t1 - previous(flight)/@t2)
  from    city[@name="a"].(flight#c1:c2.city)*
  where parent(flight)/@t1 - child(flight)/@t2 > 0/00.30
     and terminator (city)/@name="b";
```

what is the less boring path
from city "a" to city "b",
time for change flight is
not less 30 minutes

Output:

```
<town  name=“J“/>
<town  name=“K“/>
<town  name=“B“/>
```

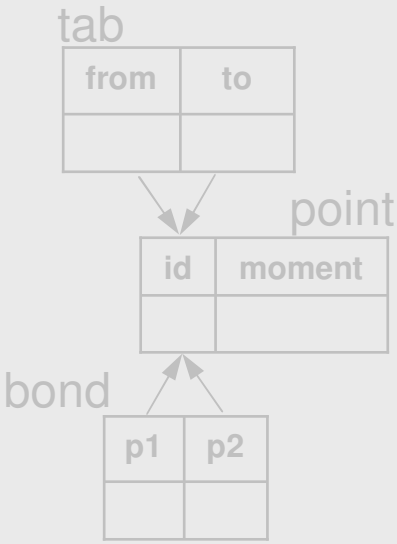
Visit all cities

```
select  (flight[@t1 @t2 @price].city)*
  from   city[@name="a"].(flight#c1:c2.city[@name as @n])*
  where root(flight)/@day="monday"
      and terminator(flight)/@day="friday"
      and @n~=("b", "c", "d", "a")
      and parent(flight)/@t1 –
            child(flight)/@t2 > 0/00.30
      and terminator(city)/@name="a“
      and terminator(city)/!=9
```

from city "a" on Monday,
back into "a" on Friday,
through "b", "c", "d",
not more than one flight per day

```
<flight      t1="5.30"   t2="5.50“   price=“2”>
 <city       n="C">
  <flight    t1="7.00"   t2="11.00“ price=“7”>
   <city     n=“D“>
    <flight  t1=“12.00" t2="13.20“ price=“4”>
     <city   n=“B“>
      <flight t1=“14.00" t2="15.10“ price=“4”>
       <city  n=“A“/>
      </flight>
     </city>
    </flight>
   </city>
  </flight>
 </city>
</flight>
<flight   t1="5.10"  t2="12.10“ price=“11”>
 ...
      <city  n=“A“/>
 ...
</flight>
```

Find shortest path

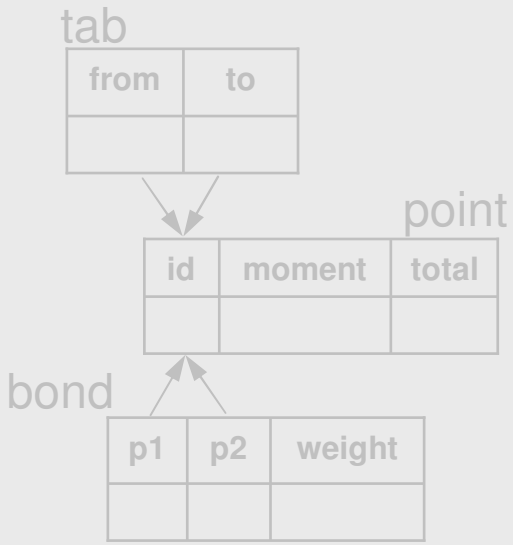


Output:

```
<point    id="3">
 <point   id="4“>
  ...
   <point id="11“/>
  ...
 </point>
</point>
```

```
update point set @moment=null;
update tab#from.point.(bond#p1:p2.point[@moment=null])*.tab#to
  set     @moment=!; -- wave of culculation runs from root to ends of branches
if tab#to.point/@moment is not null then
  select point.(point)*
    from tab#from.point.(bond#p1:p2.point[@moment=!])*.tab#to;
else select ‘<p>Pass does not exist</p>’;
end if;
```

Find weighted shortest path



Output:

```
<point    id="3">
 <point   id="4“>
  ...
   <point id="11“/>
  ...
 </point>
</point>
```

```
update point set @moment=null, @total=null;
update tab#from.point.(bond#p1:p2.point[@moment=null or @total>../../@total+./@weight])*.tab#to
  set     @moment=!, @total=../../@total+./@weight;
if tab#to.point/@moment is not null then
  select point.(point)*
    from tab#from.point.(bond#p1:p2.point[@moment=! and @total=../../@total+./@weight])*.tab#to;
else select ‘<p>Pass does not exist</p>’;
end if;
```

Output, optionally

Title

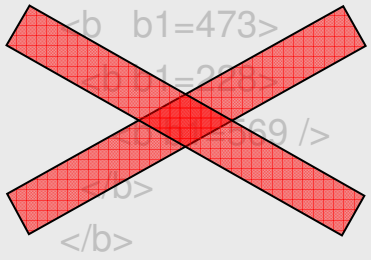
comment on column a/@data is “title”;
comment on column b/@data is “caption”;
comment on column c/@data is “desc”;

select *
from a.b.c
commenting a, c
-- extracts comments as first xml-element,
-- appending service attribute _=comment

```
<a     id=null  data=title _=comment>
<a     id=1     data=12.3>
  <b   id=10    data=23.4>
    <c id=null  data=desc _=comment/>
    <c id=100   data=56.7/>
    <c id=101   data=67.8/>
  </b>
  <b   id=20    data=34.5>
    <c id=null  data=desc _=comment/>
    <c id=200   data=78.9/>
    <c id=201   data=89.1/>
  </b>
</a>
```

Cartesian product without ‘where’

```
select @b1 from p/q/a.b*.c;
```



```
<b b1=473 />
<b b1=228 />
<b b1=569 />
```

```
select @b1·@a1 from p/q/a.b.c;
-- only specified fields
```

```
<a b1=1 a1=v1 />
<a b1=3 a1=v1 />
```

```
select @ from p/q/a.b.c;
-- all fields
```

```
<a a1=v1 a2=v2 b1=1 b2=2 c1=w1 c2=w2>
<a a1=v1 a2=v2 b1=3 b2=4 c1=w3 c2=w4>
```

Selecting field as element

```
select ^b1.^d1
from   p/q/a.b.c.d;
-- ^b1, ^d1 are fields
```

```
<b1>1</b1 >
   <d1>10</d1> <d1>30</d1>
<!-- </b> -->
<b1>3</b1>
   <d1>50</d1> <d1>70</d1>
<!-- </b> -->
```

```
select ^b1.<e>.^d1.</e>
from   p/q/a.b.c.d;
```

```
<b1>1</b1 >
   <e> <d1>10</d1> <d1>30</d1> </e>
<b1>3</b1>
   <e> <d1>50</d1> <d1>70</d1> </e>
```

```
select ^b1.<e>||^d1||</e>
from   p/q/a.b.c.d;
```

```
<b1>1</b1 >
   <e><d1>10</d1></e> <e><d1>30</d1></e>
<b1>3</b1>
   <e><d1>50</d1></e> <e><d1>70</d1></e>
```

View

create view vname as select a.b.c;

Concept for input

No adjustment

It's necessary to provide possibility to install DBMS and immediately use it, like user install and use programs "Teleport", "FlashGet", browser, etc. DBMS itself must accept XML, and place data from it into tables under some agreements:

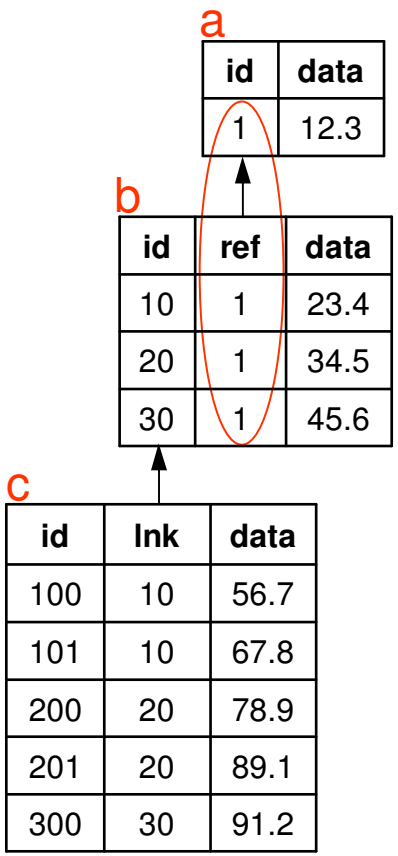
- xml-element is saved in a table with *identical name* (i.e. tag name coincides with table name), xml-attribute is saved in field with *identical name* (i.e. attribute name coincides with field name). Primary key of new record is filled by trigger

- during creating two records, corresponding to surrounding xml-element and directly enclosed into it, primary key of one record *is copies into foreign key* of another record

- during creating two records, corresponding to two consecutively located xml-elements with the same names, *also* primary key of one record *is copied into foreign key* of another record

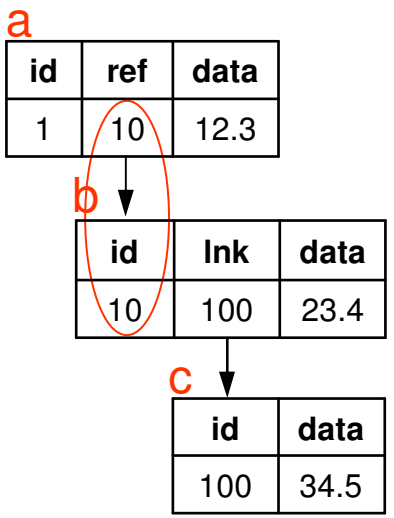
Auto-inserting as set

```
<a    data=12.3>
  <b  data=23.4>
    <c data=56.7/>
    <c data=67.8/>
  </b>
  <b  data=34.5>
    <c data=78.9/>
    <c data=89.1/>
  </b>
  <b  data=45.6>
    <c data=91.2/>
  </b>
</a>
```



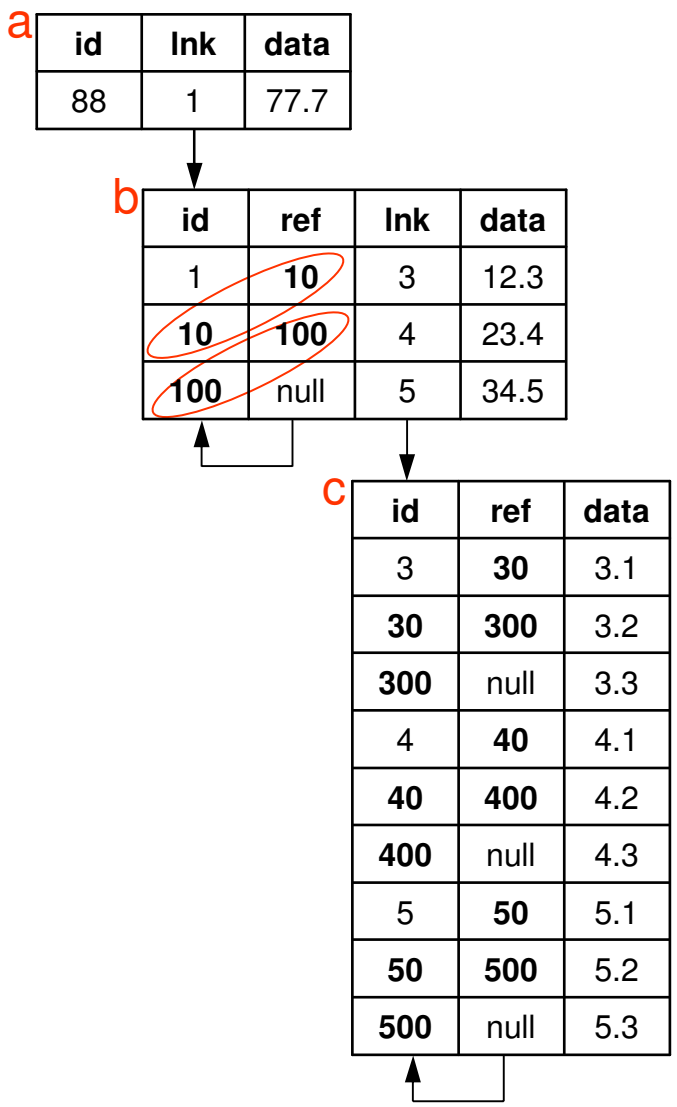
Auto-inserting as relay-race

```
<a    data=12.3>
  <b  data=23.4>
    <c data=34.5/>
  </b>
</a>
```



Auto-inserting as list

```
<a      data=77.7>
  <b    data=12.3>
    <c  data=3.1/>
    <c  data=3.2/>
    <c  data=3.3/>
  </b>
  <b    data=23.4>
    <c  data=4.1/>
    <c  data=4.2/>
    <c  data=4.3/>
  </b>
  <b    data=34.5>
    <c  data=5.1/>
    <c  data=5.2/>
    <c  data=5.3/>
  </b>
</a>
```

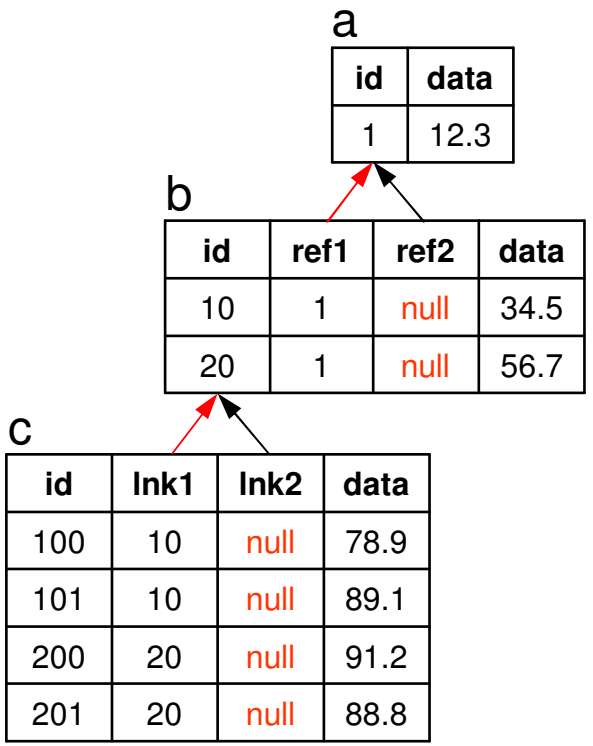


Determination

If two tables refer to each other, or one table refers to another by several foreign keys, than this ambiguity is solved in name of opening xml-tag: Sign '#' and name of necessary referring field (not name of constraint, i.e. name of foreign key) are specified after strictly name of table, containing necessary foreign key. It looks like new tag name with symbol '#' in the middle of the name. We shall name this specifying of referring field by term 'determination'.

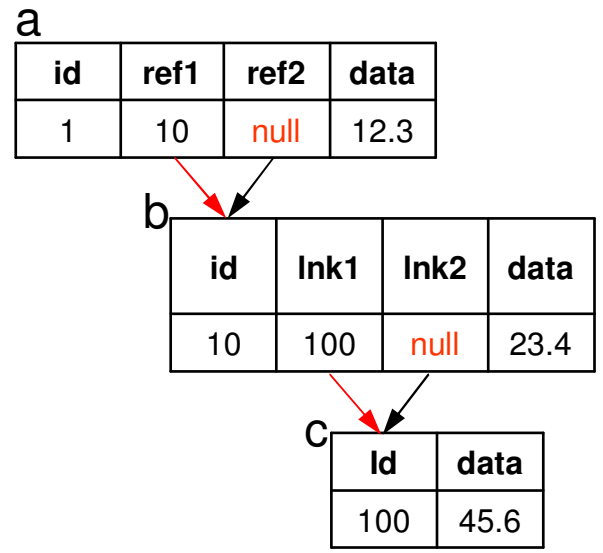
Determination for set

```
<a          data=12.3>
  <b#ref1   data=34.5>
    <c#lnk1 data=78.9/>
    <c#lnk1 data=89.1/>
  </b>
  <b#ref1   data=56.7>
    <c#lnk1 data=91.2/>
    <c#lnk1 data=88.8/>
  </b>
</a>
```



Determination for relay-race

```
<a#ref1     data=12.3>
  <b#lnk1   data=23.4>
    <c      data=45.6/>
  </b>
</a>
```



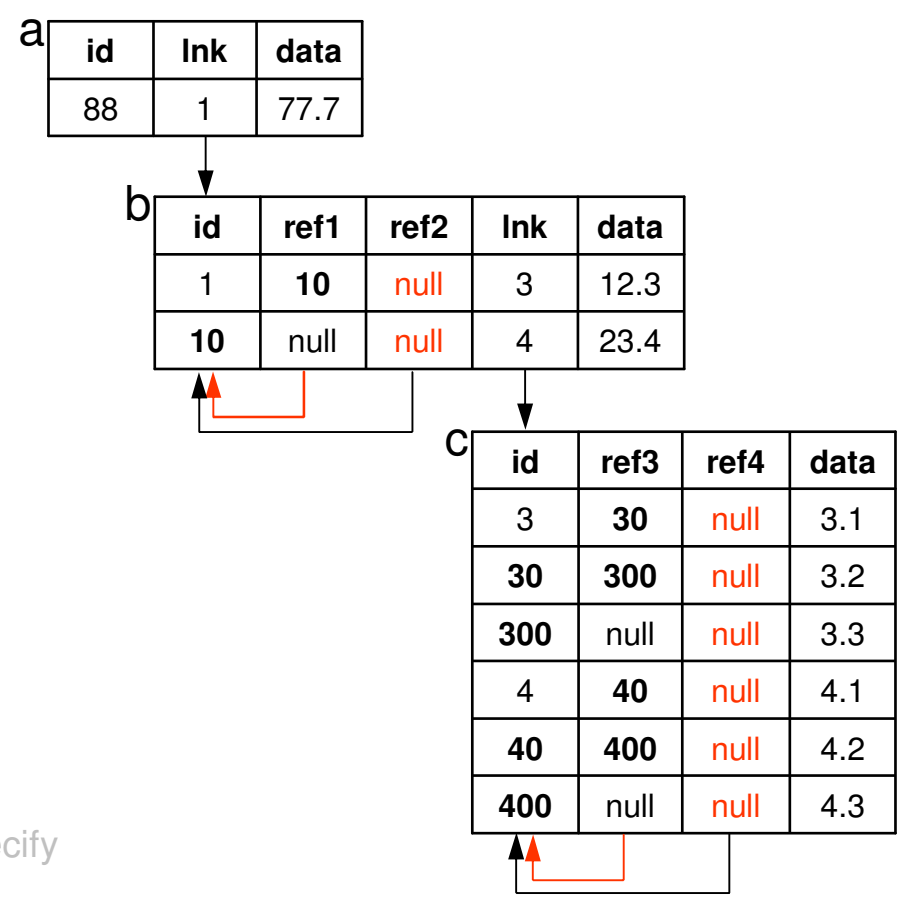
Determination too

If table refers to self by several foreign keys, than this ambiguity is also solved in name of opening xml-tag: Sign '$' and name of necessary referring field (not name of constraint, i.e. name of foreign key) are specified after strictly name of table, containing necessary foreign key. It also looks like new tag name with symbol '$' in the middle of the name. We shall name this specifying of referring field by term 'determination' too. Determination must be specified in each of consecutively located xml-elements with the same name - including in the first element (that user think less).

Different signs - '#' and '$' - are used in two different types of determination, that it would possible to use both types of determination simultaneously: 'tag#field1$field2‘.

Determination for list

```
<a            data=77.7>
  <b$ref1     data=12.3>
    <c$ref3   data=3.1/>
    <c$ref3   data=3.2/>
    <c$ref3   data=3.3/>
  </b>
  <b$ref1     data=23.4>
    <c$ref3   data=4.1/>
    <c$ref3   data=4.2/>
    <c$ref3   data=4.3/>
  </b>
</a>
-- '$' instead of '#', that it will possible to specify
-- list and set simultaneously, as well as
-- list and relay-race simultaneously
```



Presence of PK attribute

means update instead of insert

a

pk	data
1	12.3

<a pk=1 data=45.7 />

a

pk	data
1	45.7

Selection into LAN & WAN stops transaction

Client (e.g. browser) submits XML, DBMS enters it into tables, triggers react on it. When DBMS sends XML by 'select ... ;‘ ('select ... union ... select ... ;'), client can use it as definition of new screen.
To all screens can be built by one stored procedure (instead of each next trigger for each next answer), extraction stops transaction, until client submits new XML or command 'prolong;'.

Manually

Manually inserting as Set

```
insert into * values
  <a     data=12.3>
    <b   data=23.4/>
    <b   data=34.5/>
    <b   data=45.6/>
  </a>
   <a     data=0.7>
    <b   data=56.7/>
    <b   data=67.8/>
    <b   data=78.9/>
  </a>
;
```

a

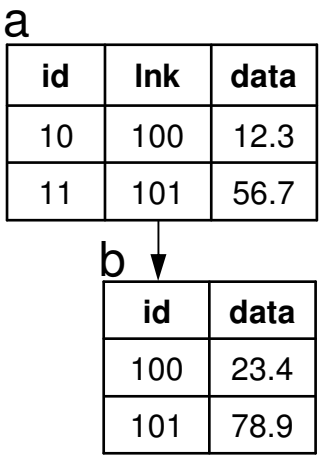
id	data
10	12.3
11	0.7

b

id	lnk	data
100	10	23.4
101	10	34.5
103	10	45.6
104	**11**	56.7
105	**11**	67.8
106	**11**	78.9

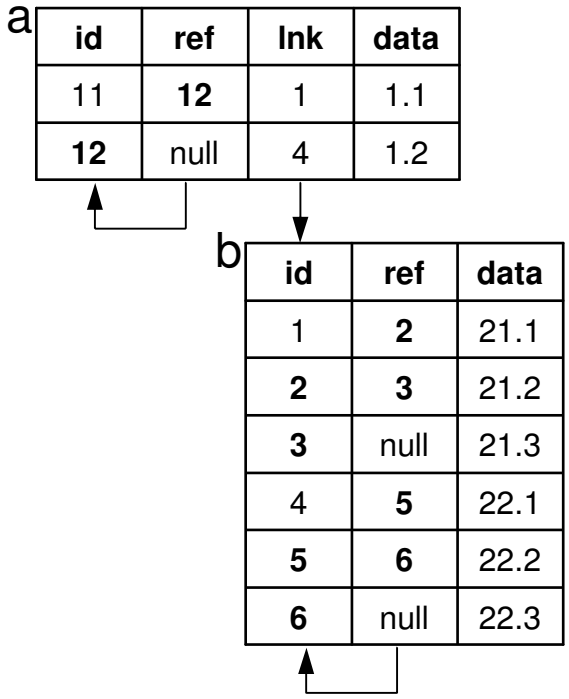
Manually inserting as Relay-race

```
insert into * values
  <a     data=12.3>
    <b   data=23.4/>
  </a>
  <a      data=56.7>
    <b   data=78.9/>
  </a>
;
```



Manually inserting as List

```
insert into * values
  <a     data=1.1>
    <b   data=21.1/>
    <b   data=21.2/>
    <b   data=21.3/>
  </a>
  <a     data=1.2>
    <b   data=22.1/>
    <b   data=22.2/>
    <b   data=22.3/>
  </a>
;
```



Manually: Determination

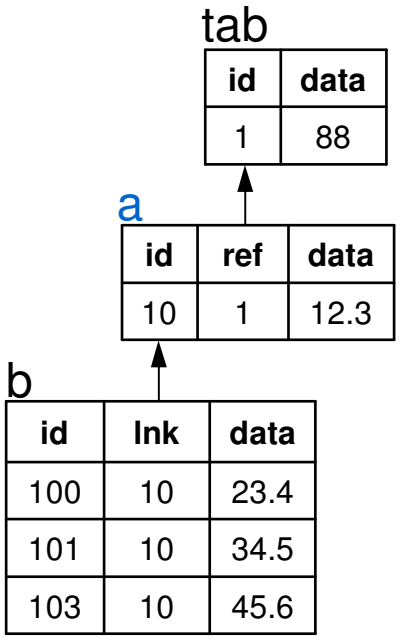
```
insert into * values
  <a#ref  data=12.3>
    <b      data=23.4/>
    <b      data=34.5/>
    <b      data=45.6/>
  </a>
;
```

```
insert into * values
  <a          data=12.3>
    <b#lnk  data=23.4/>
    <b#lnk  data=34.5/>
    <b#lnk  data=45.6/>
  </a>
;
```

Manually into content

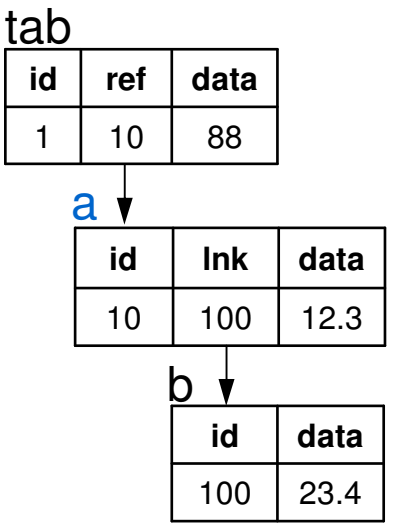
Manually into content: Set

```
insert into tab (@data, @μ) values (88,
  <a       data=12.3>
    <b     data=23.4/>
    <b     data=34.5/>
    <b     data=45.6/>
  </a>
);
```



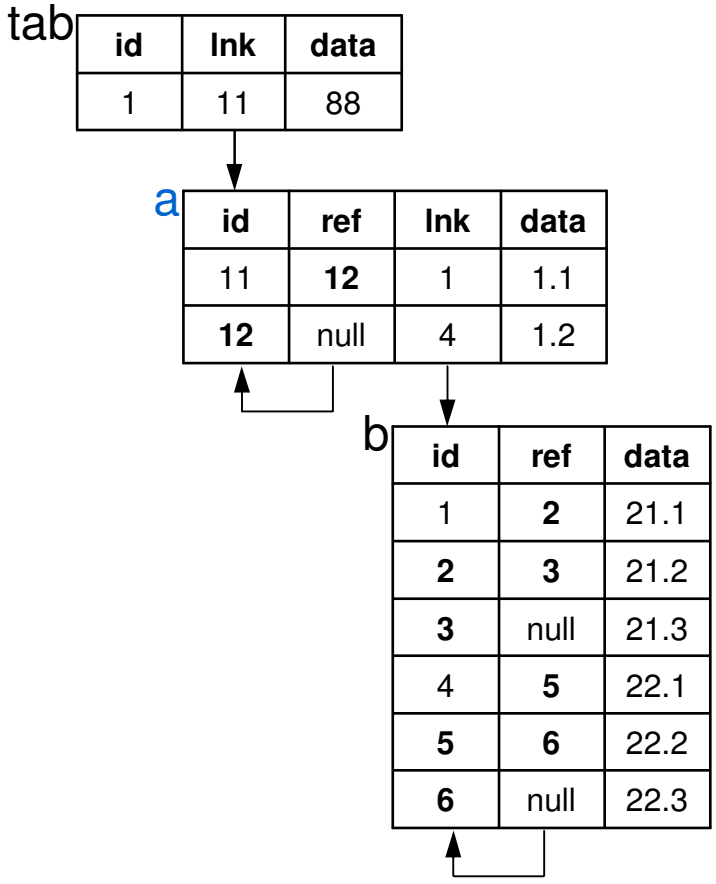
Manually into content: Relay-race

```
insert into tab (@data, @μ) values (88,
  <a       data=12.3>
    <b     data=23.4/>
  </a>
);
```



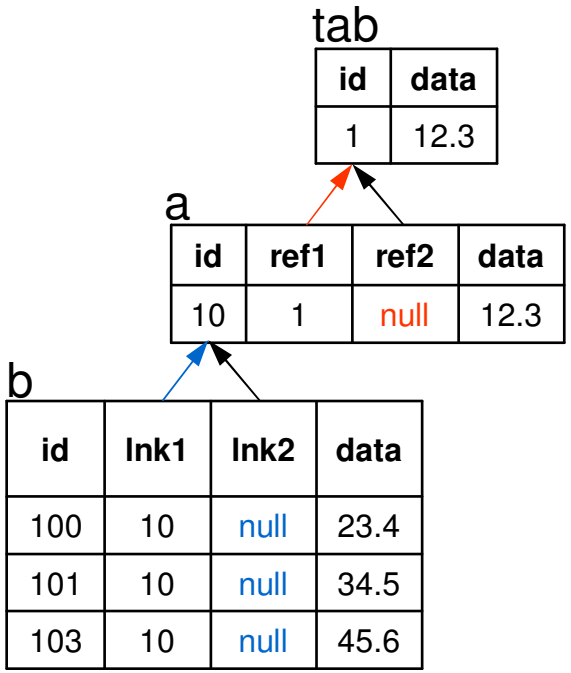
Manually into content: List

```
insert into tab (@data, @µ) values (88,
  <a     data=1.1  >
    <b   data=21.1/>
    <b   data=21.2/>
    <b   data=21.3/>
  </a>
  <a     data=1.2  >
    <b   data=22.1/>
    <b   data=22.2/>
    <b   data=22.3/>
  </a>
);
```



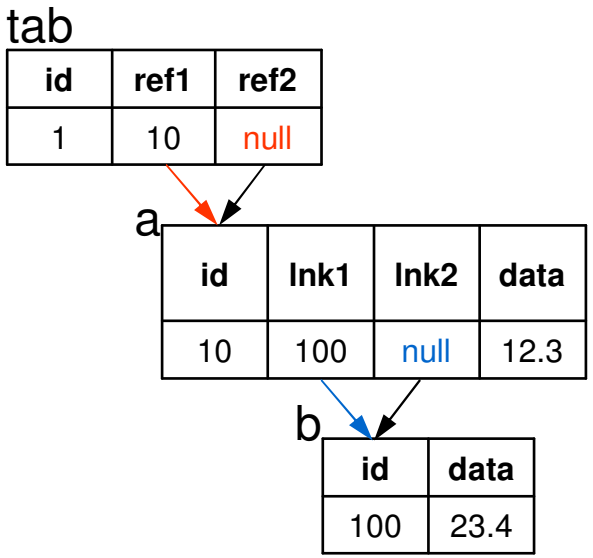
Set: determination

```
insert into tab (@μ) values (
  <a#ref1   data=12.3>
    <b#lnk1 data=23.4/>
    <b#lnk1 data=34.5/>
    <b#lnk1 data=45.6/>
  </a>
);
```



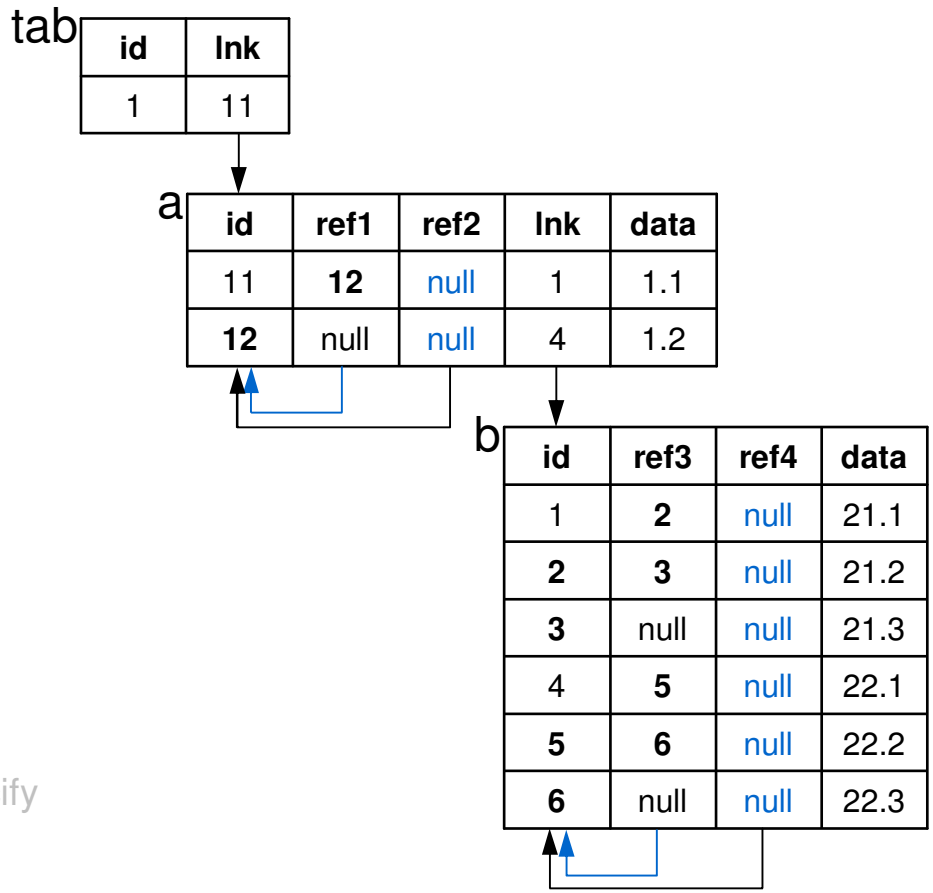
Relay-race: Determination

```
insert  into tab#ref1 (@μ) values (
  <a#lnk1 data=12.3>
    <b       data=23.4/>
  </a>
);
```



List: Determination

```
insert into tab (@μ) values (
  <a$ref1     data=1.1  >
    <b$ref3   data=21.1/>
    <b$ref3   data=21.2/>
    <b$ref3   data=21.3/>
  </a>
  <a$ref1     data=1.2  >
    <b$ref3   data=22.1/>
    <b$ref3   data=22.2/>
    <b$ref3   data=22.3/>
  </a>
);
-- '$' instead of '#', that it will possible to specify
-- list and set simultaneously,
-- list and relay-race simultaneously
```



Inserting into tree

Into set or relay-race

insert into p/q/a.b(@μ).c.d

-- if ‘b’ is list, inserting under first element of list 'b‘

insert into p/q/a.b[3,5](@μ).c.d

-- inserting under 3th and 5th elements of list 'b‘

…values <c c1=10><k k1=20/></c>;

…select * from c.k;

-- once more nested 'c.k' - in addition to existing 'c.d'

Into list

insert into p/q/a.b(@b1, @b2).c …

insert into p/q/a.b(@).c …

-- inserting after first element of list 'b‘

insert into p/q/a.b[3,5](@b1, @b2).c[7,8] …

insert into p/q/a.b[3,5](@).c[7,8] …

-- inserting after 3th and 5th elements of list 'b‘ – only if list ‘c’ has 7th and 8th elements

… values (1, 2);

… select @b1, @b2, @c1, @c2 from b, c where @b1=@c1;

Separation

Select only inserted by outside agent

select … outside;

Permission depends of activity of trigger

grant … depends TriggerName;

Saved at break of connection

savewhole; -- by default

```
<a    data=12.3>
  <b  data=23.4>
    <c data=56.7/>
    <c data=67.8/>
  </b>
  <b  data=34.5>
    <c data=78.9/>
    <c data=89.1/>
  </b>
  <b  data=45.6>
    <c data=91.2/>
  </b>
</a>
```

-- nothing is saved
-- '' is necessary

savepart;

```
<a    data=12.3>
  <b  data=23.4>
    <c data=56.7/>
    <c data=67.8/>
  </b>
  <b  data=34.5>
    <c data=78.9/>
    <c data=89.1/>
  </b>
  <b  data=45.6>
    <c data=91.2/>
  </b>
</a>
```

-- 'a', two 'b', two 'c'
-- are saved

Concept for processing

Partly deleting of tree

(refering fields obtain ‘null’)

```
delete b, d          from   p/q/a.b.c.d;

delete b             from   p/q/a.*;      -- in all places

delete b.*           from   p/q/a.b.c.d;

delete *             from   p/q/a.b.c.d;

delete a.b.c.d       from   p/q/*;

delete a.b*.c*.d     from   p/q/*;
```

Partly deleting of list

(refering fields obtain new values)

delete b[3,5].* from p/q/a.b.c;

delete b[3,5].* from p/q/a.b[11-18].c;

-- deleting 13th and 15th elements

Insertion of tree

insert into p/q/a.b(@μ).c …

insert into p/q/a.b[3,5](t/u/@μ).c[7,8] …

…values <n n1=10><k k1=20/></n>;

Replace operator ‘merge’

by separate ‘update’
and separate ‘insert’

```
update a (@a1, @a2) select @a1, @a2 from k
                    where @a3=@k3;

update a (@a1, @a2) select @k1 as @a1, @k2 as @a2 from k
                    where @a3=@k3;
```

Replace ‘merge’ for list

update p/q/a.b(@b1, @b2).c(@c1, @c2) …
update p/q/a.b(@).c(@) …

update p/q/a.b[3,5](@b1, @b2).c[7,8](@c1, @c2) …
update p/q/a.b[3,5](@).c[7,8](@) …

… select @b1, @b2, @c1, @c2 from b, c where @b1=@c1;

Updating = deleting + insertion

```
update tab set @data=88, @μ = <a        data=12.3>…</a>;
update tab set @data=88, @μ = <a#ref1 data=12.3>…</a>;
update tab set @data=88, @μ = <a$ref1 data=12.3>…</a>;
```

```
-- delete all trees, nested into table “tab“,
-- insert specified tree(s) as nested into “tab”
```

Update several tables at once

```
update p/q/v.w*.z*                          set @w1=5, @z1=10;
update p/q/v.w*.z* (@w1=5, @z1) select 5, 10;
```

Sub-tree like field

```
update p/q   set a.*     = <k k1=3><m m1=4></k>;
update p/q   set a.b.c = <k k1=3><m m1=4></k>;
update p/q   set a.*     = (select * from k.m.n);
update p/q   set a.b.c = (select * from k.m.n);
```

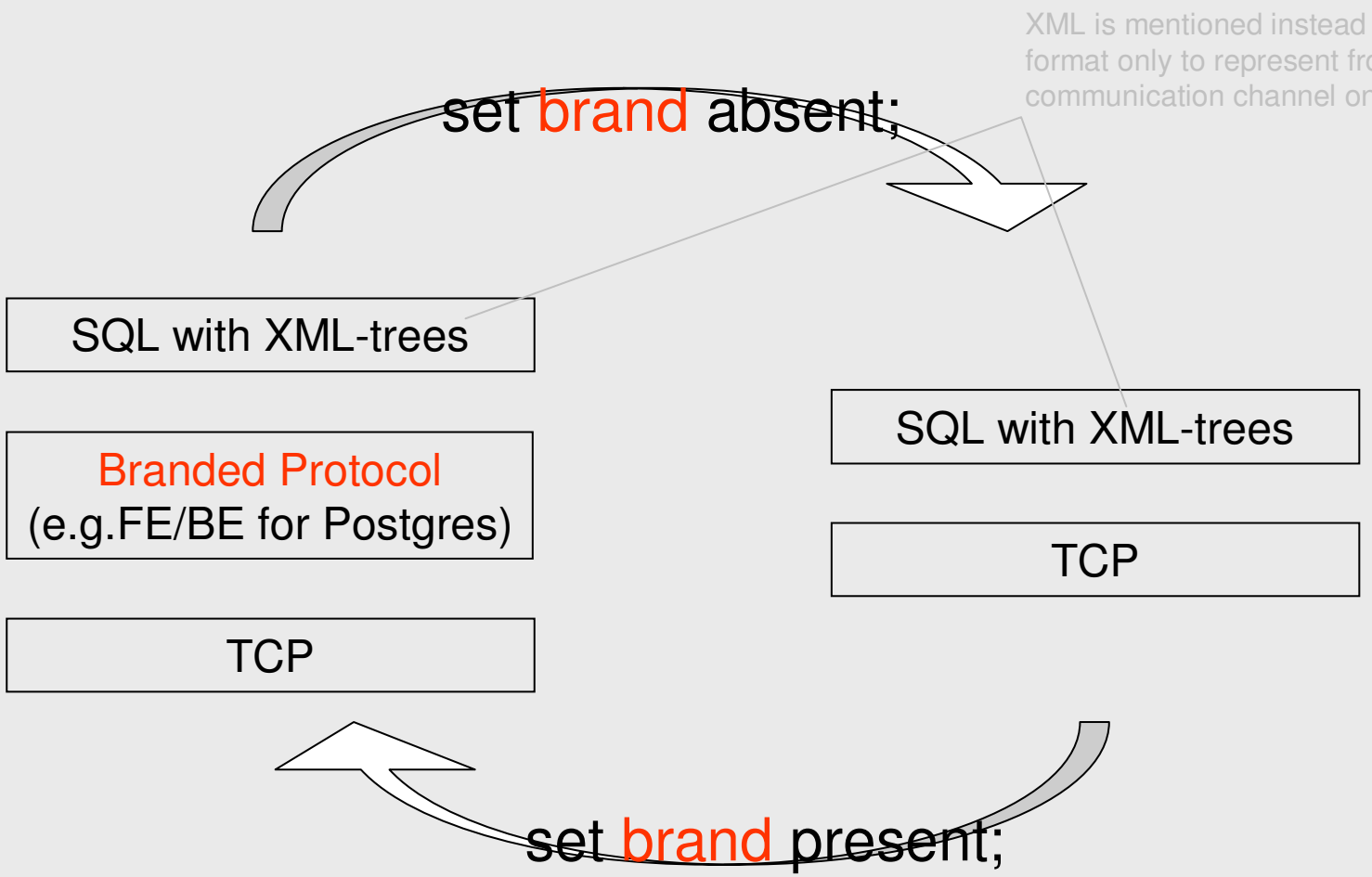
‘where’ for tree

```
select * from      p/q/a.b.c                 …
insert into        p/q (
                   q/n/k/a.b(@b1).c          …
update             p/q/a.b.c                 …
delete b, d from p/q/a.b.c.d                 …
```

```
where   q/t/u/@μ   =    <n  n1=10><k k1=20/></n>
  and   b/t/u/@μ   in   <m m1=30><v v1=40/></m>
```

XML just over TCP, optionally

Switching protocol stack



Switching and enquiring session parameter

set brand present; -- to enter Branded Protocol

set brand absent; -- to withdraw Branded Protocol

show brand; ⟹ <?res code=0 pb=absent /?>

Distributed query

Concept for dQ

SQL vs. branded programs

It's necessary to note, that SQL would be more flexible and convenient for distributed query (gathering data from several databases and scattering them into several databases), than branded programs; including more convenient for replication, than branded programs. But there is no necessary syntax:

- database has 'nickname' (nickname is specified in query before table name through colon)
- group of databases is named 'society' (society is also specified before table name through colon, and means nicknames of all databases of group)
- 'default' database is database, in which all nicknames and societies are stored

Nickname, ‘all’, restriction

```
connect          address=remote.bz;
create nick db1  address=site.com;
create nick db2  address=data.net;
create nick db3  address=store.org;
create nick db4  address=place.ws;
```

default database

target database
≠
source database

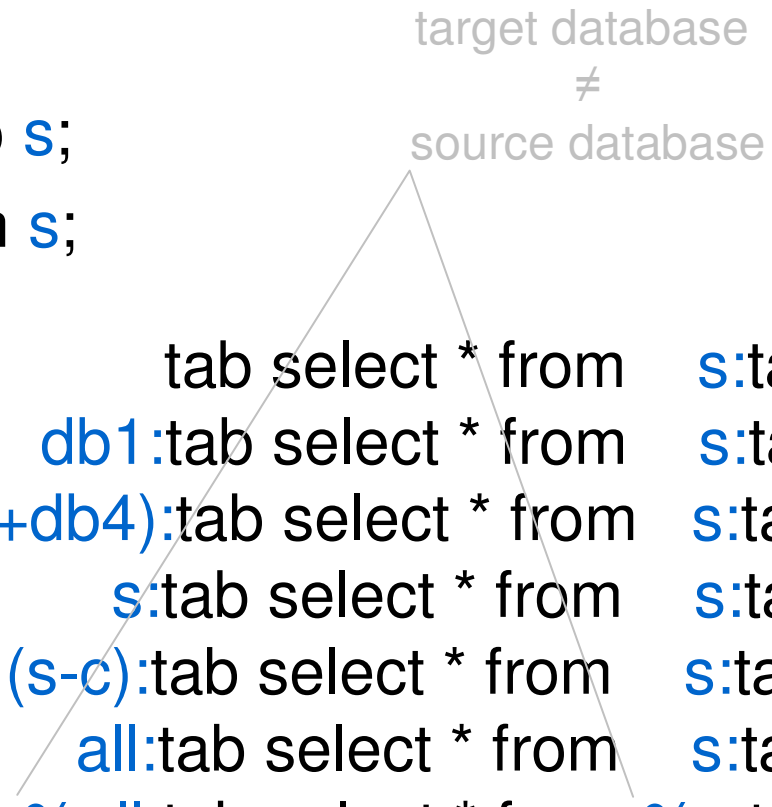
```
insert into          tab select * from    db1:tab;
insert into       db3:tab select * from    db1:tab;
insert into       all:tab select * from    db1:tab;
insert into      %all:tab select * from %db1:tab;
insert into %default:tab select * from   %all:tab;
```

The same or different

One sql-statement with society means a great number of sql-statements with nicknames. Besides this, that nicknames, several societies or several mentions of one society don't specify the same database simultaneously, we place symbol '%' before them; and that several mentions of one society always synchronously specify the same database, we place any word (identical) and symbol '%' before this mentions.

Society, ‘all’, restriction

```
create society s;
create society c;
append db1, c, default  to s;
refuse   db2, c          from s;
```

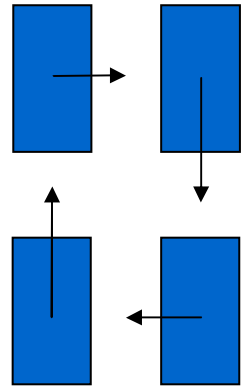



```
insert into                tab select * from    s:tab;
insert into          db1:tab select * from    s:tab;
insert into (db1+db4):tab select * from    s:tab;
insert into            s:tab select * from    s:tab;
insert into      (s-c):tab select * from    s:tab;
insert into        all:tab select * from    s:tab;
insert into       %all:tab select * from %s:tab;
insert into         %c:tab select * from %s:tab;
insert into   %default:tab select * from %c:tab;
```

Society as oriented graph

```
create society s;
append db1 [ into db7 ] , db2 [ into db8 ] to     s;
refuse   db1 [ into db7 ] , db2 [ into db8 ] from s;
append (db1, db2) [ into (db7,db8) ]         to     s;
refuse   (db1, db2) [ into (db7,db8) ]       from s;
refuse   all                                 from s;
```

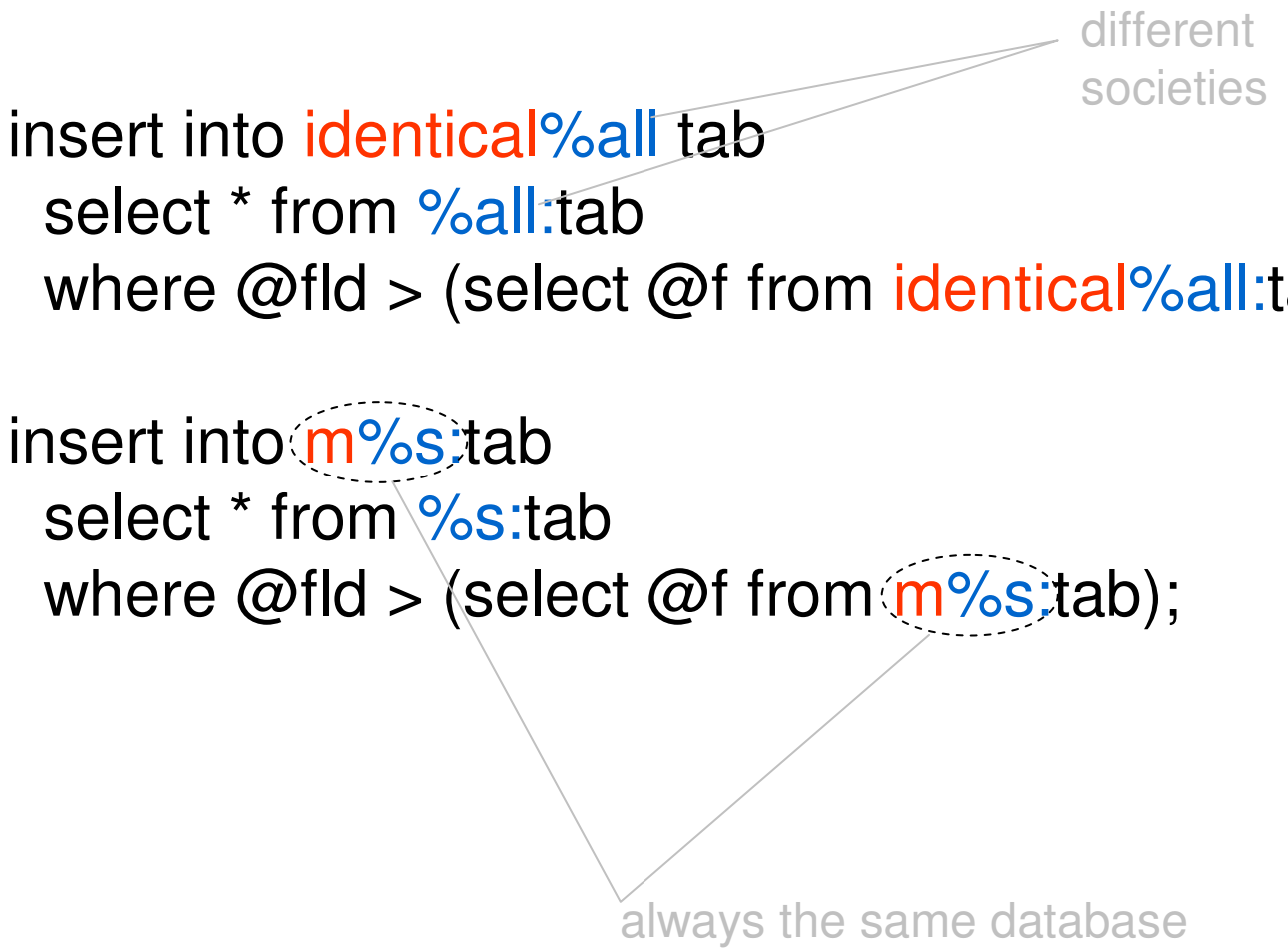
```
create society c;
append db1 into db2, db2 into db3,
            db3 into db4, db4 into db1 to c;
insert into c:tab select * from c:tab;
```



Control of societies

```
create society s, c;
drop   society s, c;
drop   society all;      -- drop all societies
set    society none;  -- forbid all societies
set    society s, c;    -- allow two societies
set    society all;      -- allow  all societies
set    society all except s, c;

grant  append on society s to u;
grant  refuse  on society s to u;
revoke drop    on society s to u;
revoke set     on society s to u;
```

Marker


different
societies
insert into identical%all tab
select * from %all:tab
where @fld > (select @f from identical%all:tab);
insert into m%s:tab
select * from %s:tab
where @fld > (select @f from m%s:tab);
always the same database

Prefix terms

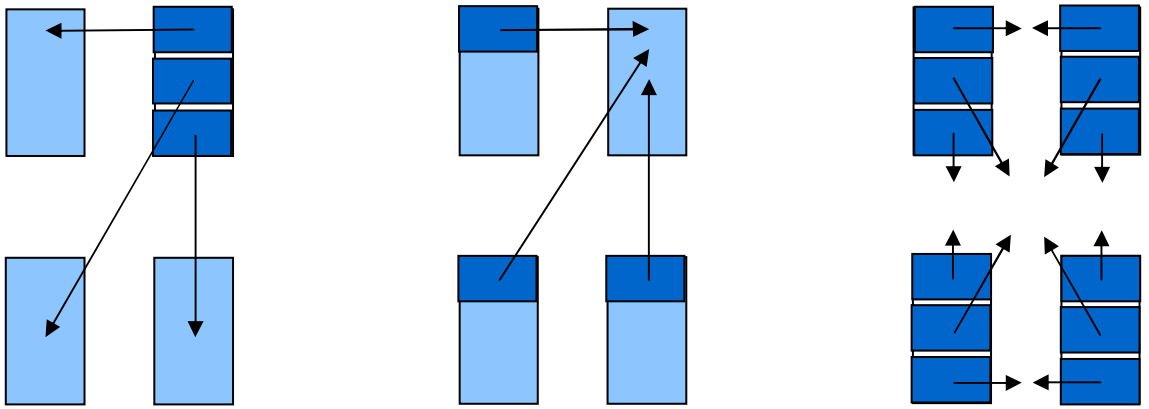
prefix		restricted prefix		marked prefix	
nick	db	restricted nick	%db		
society	s	restricted society	%s	marked society	i%s
all	all	restricted all	%all	marked all	i%all
		restricted default	%default		
		restricted you	%you		

Nick identifier (NID)

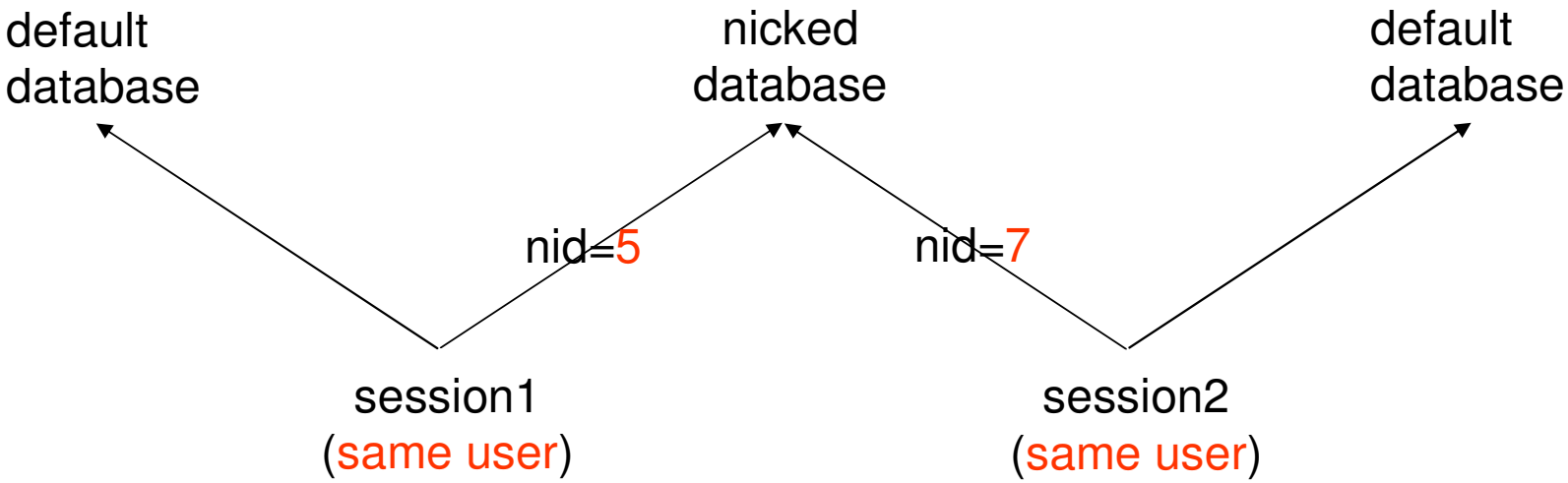
```
create nick [ db1 ] address=www.ws   [ nid=7 ];
alter    nick   db1 [ address=site.com ] [ nid=1 ];
drop     nick   db1;
drop     nick     all; -- of one user
```

NID

```
insert into    all:t  (@d, @s) select @d, %% from db1:t where @x=all:%%;
insert into  db1:t (@d, @s) select @d, %% from    all:t where @x=db1:%%;
insert into i%all:t (@d, @s) select @d, %% from %all:t where @x=i%all:%%;
```



NID is session-specific



Crossing FK (cFK)

```
connect address=www.site.com user=Smith;
create table b (
  b1 xml,
  b2 number,
  b3 xml
);

connect address=www.remote.bz user=Rothschild;
create nick db1 address=site.com;
create table a (
  a1 number                                  references db1:b(@b1/k/m/@m1),
  a2 xml,  foreign key (@a2/p/q/@q1) references db1:b(@b2),
  a3 xml,  foreign key (@a3/p/q/@q1) references db1:b(@b3/k/m/@m1)
);
```

Implementation

Mistrust & simplicity

In purpose of security, distributed query must satisfy some requirements - concept of whole mistrust of one database to another:

- database does not store login of other database (not to give foreign login at unauthorized access)
- database does not edit (update, insert, delete) data of other database (temporary access to one database, obtained at unauthorized access, can't destroy other database)
- if it's possible, database does not obtain data from other database (data from another database does not become accessible at unauthorized access)

And concept of client simplicity:

- client does not know SQL (can't simplify or decompose SQL)

Isolation

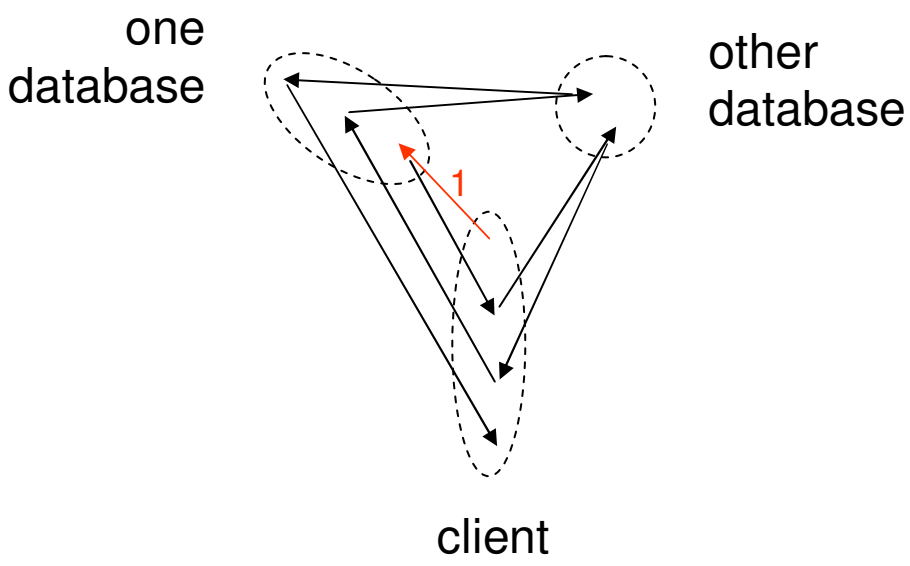
So one database can't create and enter sql-command into other database neither directly, nor indirectly (asking client to forward command). And client can't construct new sql-command on base of parsing of entered sql-command.

First database sends special command to client, which force client to make substitution inside last sql-command, sent to first database and memorized in client stack, and to send result of transformation into second database. Special commands must be so limited, that to not allow appearance of sql-command, harm for second database.

- <?ry/?>
- <?finish/?>
- <?iiv/?>
- <?reader/?>

Participation of user

User submits only first (1) query, all next parcels are sent by client and DBMS-es automatically, independently of user.



Select distributed union (dU)

1. select * from all:tab;

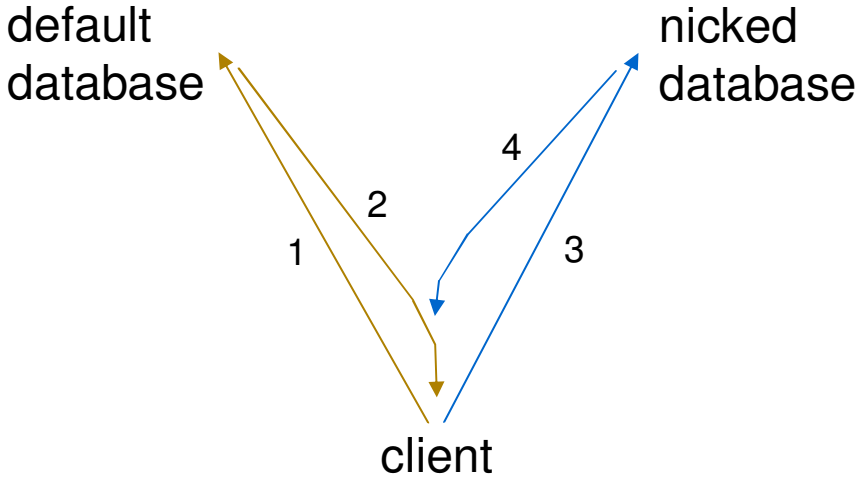
1. select * from s:tab;

1. select * from tab
   union
   select * from db1:tab;

2. <?ry addr=site.com /?>
   <?ry addr=data.net /?>
   <?ry addr=store.org /?>
   <tab id=3 data1=12.3 data2=aaa>
   <tab id=7 data1=23.4 data2=bbb>
   <tab id=10 data1=34.5 data2=ccc>
   <tab id=25 data1=45.6 data2=ddd>

Bag
Baribute

3. connect addr=site.com;
   select * from %you:tab;
   connect addr=data.net;
   select * from %you:tab;
   connect addr=store.org;
   select * from %you:tab;



Exactly '%you' is used in all similar cases, reasons are on the slides 155, 158

Insert/update/delete dU

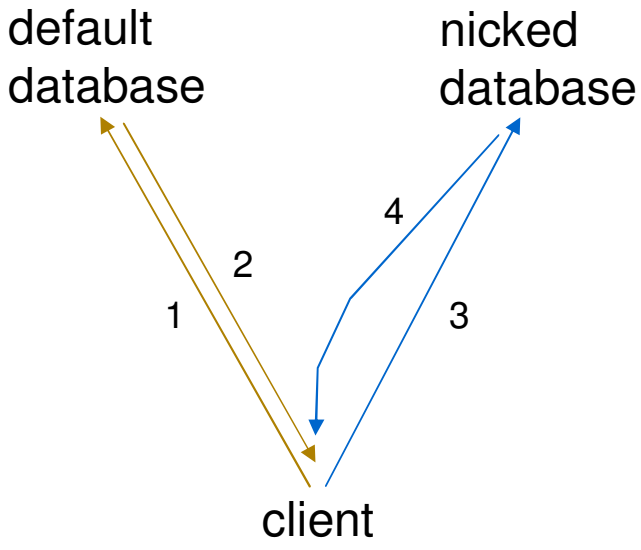
1. insert into all:tab values (3, 5);
   insert into s:tab values (3, 5);

1. insert into db1:tab values (3, 5);

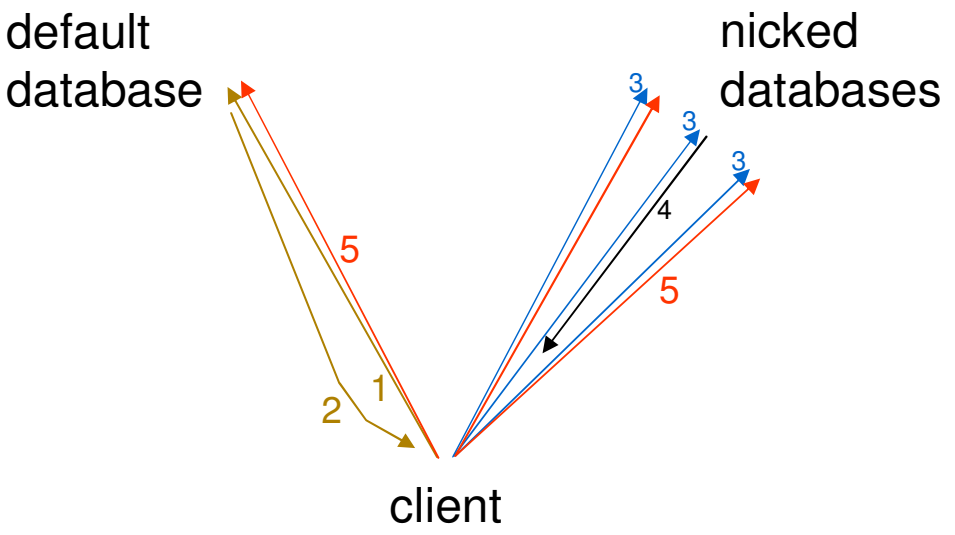
3. connect addr=site.com;
   insert into %you:tab values (3,5);
   connect addr=data.net;
   insert into %you:tab values (3,5);
   connect addr=store.org;
   insert into %you:tab values (3,5);

2. <?ry addr=site.com /?>
   <?ry addr=data.net /?>
   <?ry addr=store.org /?>

2. <?ry addr=site.com /?>

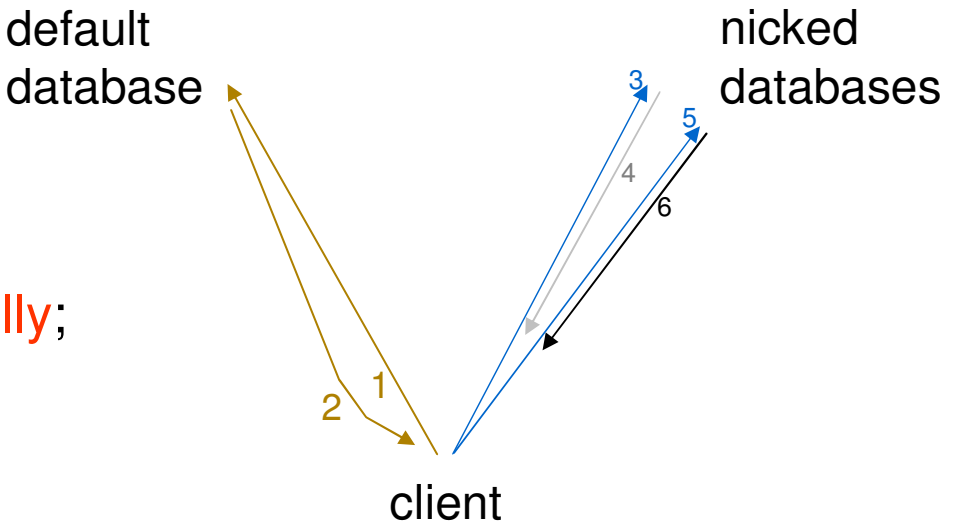


Search parallelly



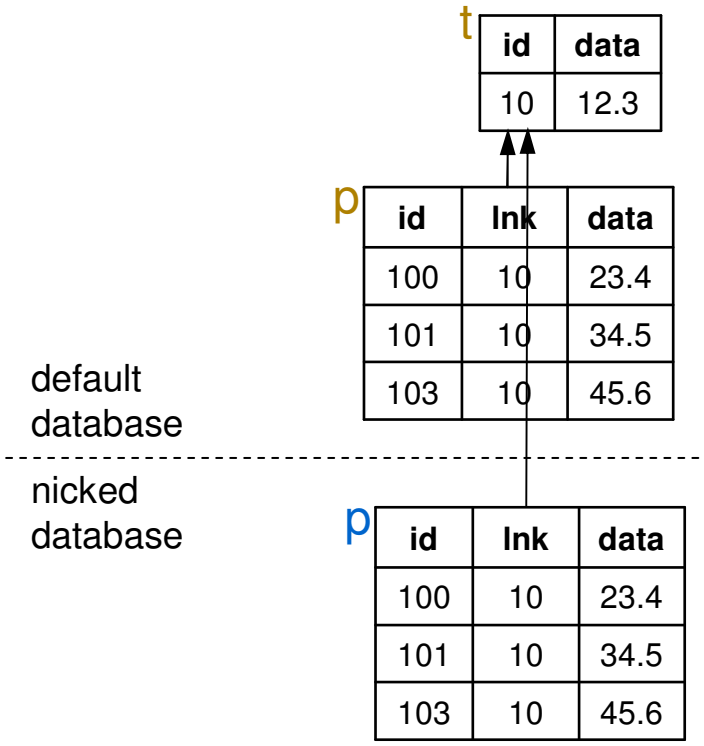
1. select all:func() parallelly;
2. <?ry addr=site.com /?>
   <?ry addr=data.net /?>
   <?ry addr=store.org /?>
3. connect addr=site.com;
   select %you:func();
   connect addr=data.net;
   select %you:func();
   connect addr=store.org;
   select %you:func();
4. <tab data1=12.3 data2=aaa>
5. cancel;

Search consecutively



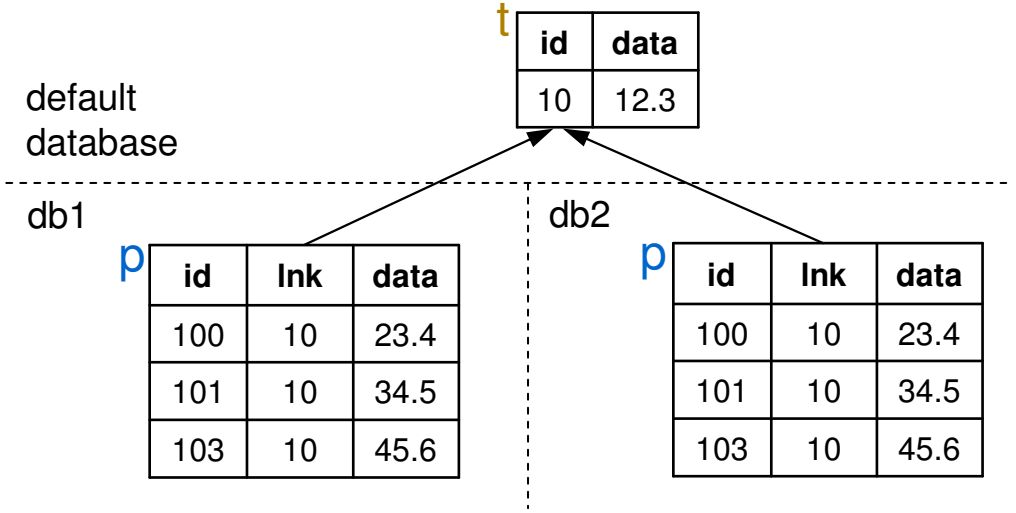
1. select all:func() sequentially;
2. <?ry addr=site.com /?>
   <?ry addr=data.net /?>
   <?ry addr=store.org /?>
3. connect addr=site.com;
   select %you:func();
4. <?res code=2 /?> -- absense
5. connect addr=data.net;
   select %you:func();
6. <tab data1=12.3 data2=aaa> -- store.org will be not used

Ambiguity of cFK for Set

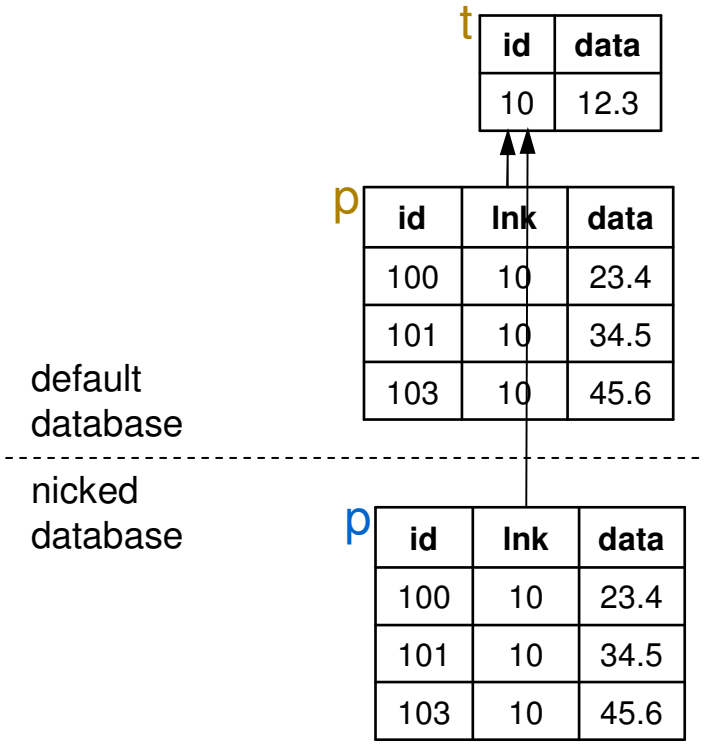


1. select * from t.*;
1. insert into t(@μ) values (<q/>);
1. update t set p/q/r/@fld=5;
1. delete * from t/p/q;

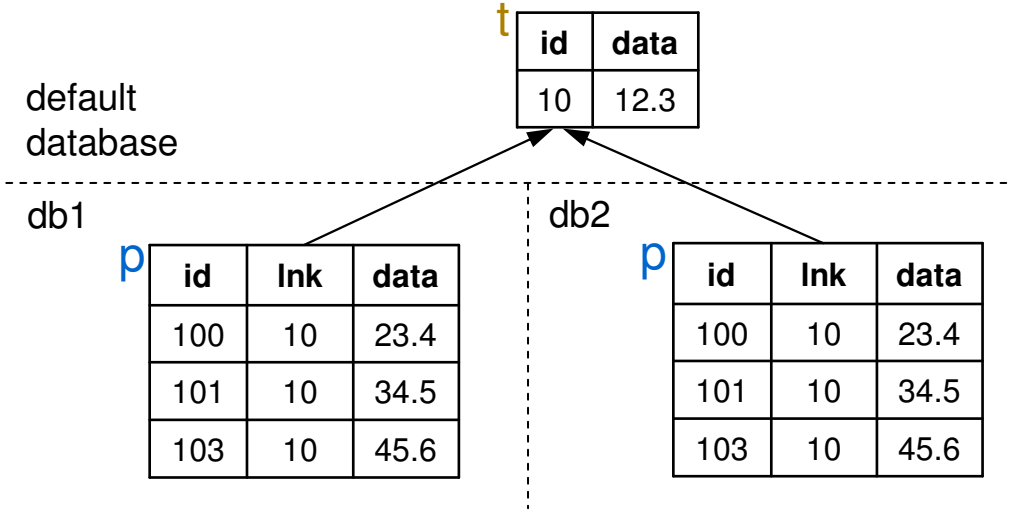
2. <?res code=3 /?> <!--mistake-->



Constraint also does not work

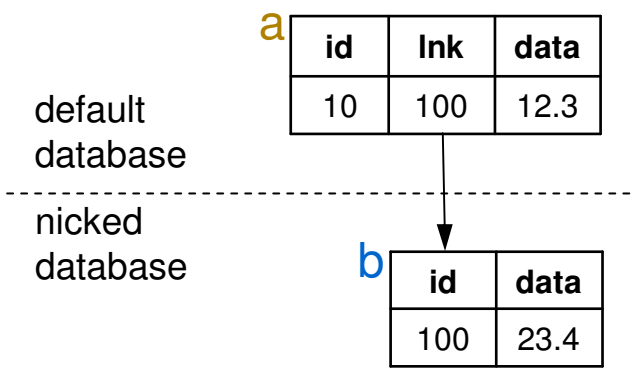


1. create table db1:p (
   id num,
   lnk num references default:t(id)
   on delete cascade,
   -- on update cascade
   -- on update set null
   data num
   );



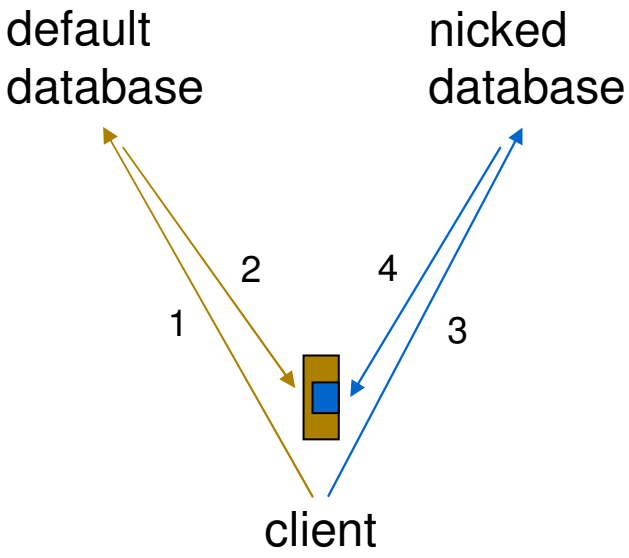
2. <?res code=3 /?>
   <!--mistake-->

Select cFK of Relay-race & BTT



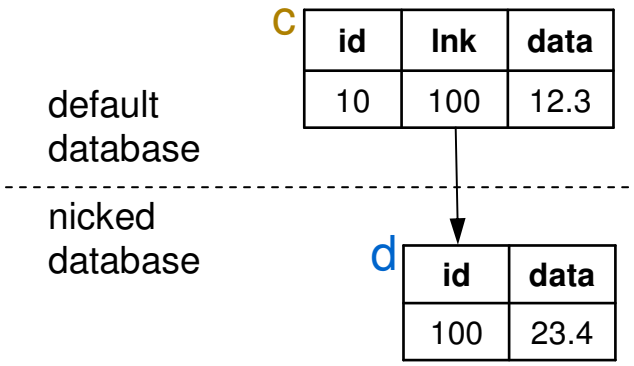
1. select * from a.*;

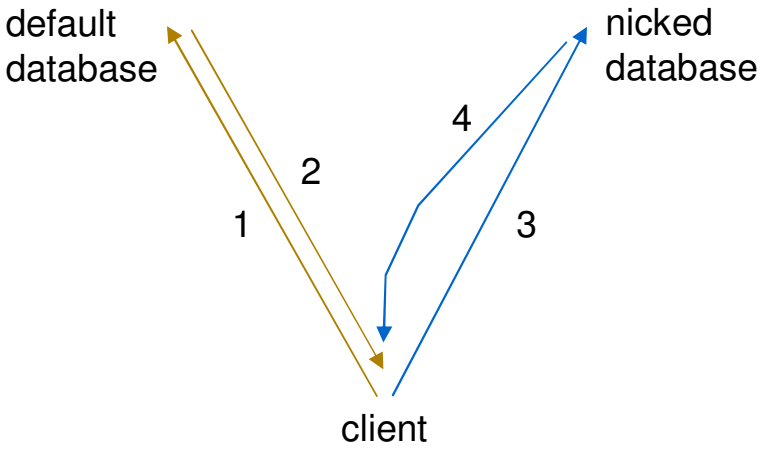
2. <?finish addr=site.com
ques="select * from b.* where @b2=" /?>
<a a1=3 a2=23.4> <?f b2=453 /?>
<a a1=7 a2=23.4> <?f b2=748 /?>
<a a1=10 a2=34.5> <?f b2=295 /?>
<a a1=25 a2=45.6> <?f b2=817 /?>



3. connect addr=site.com;
select * from b.* where @b2=453;
select * from b.* where @b2=748;
select * from b.* where @b2=295;
select * from b.* where @b2=817;

Sel/ins/upd/del via cFK:Relay-race





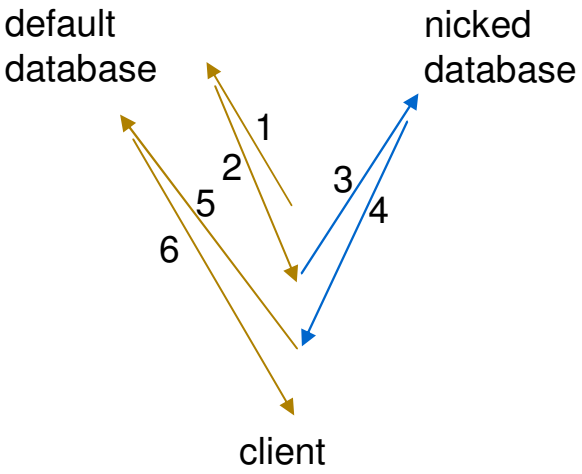
1. select %db1:b/c/d/e where @b1=3 and @d1=5;
1. insert into %db1:b/c/d/e values (10,20) where @b1=3 and @d1=5;
1. update %db1:a set b/c/d/e/@e1=5 where @b1=3 and @d1=5;
1. delete * from %db1:b/c/d/e where @b1=3 and @d1=5;

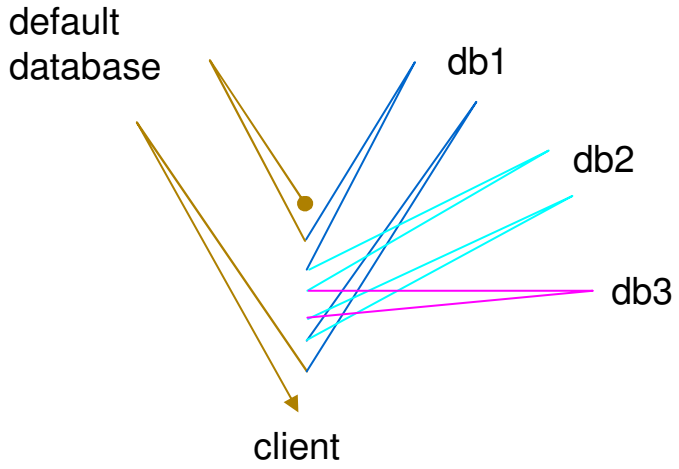
2. <?ry shift="b/c" addr=site.com /?>

3. select %you:d/e where @b1=3 and @d1=5;
3. insert into %you:d/e values (10,20) where @b1=3 and @d1=5;
3. update d set e/@e1=5 where @b1=3 and @d1=5;
3. delete * from d/e where @b1=3 and @d1=5;

desirable
1. ... where b/@b1=3 and @d1=5;
3. ... where @d1=5;

Insert Relay-race: fractal

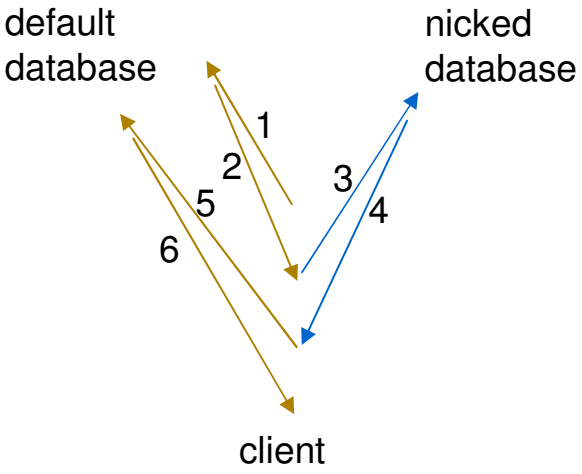


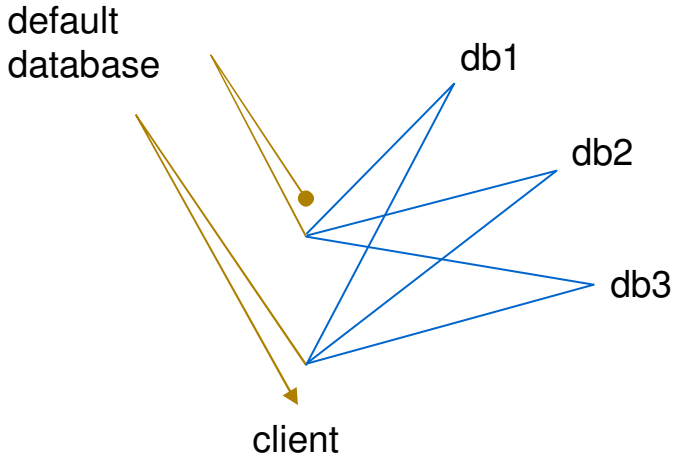


4

1. insert into a values <a> <c><d></d></c> ;
2. <?iiv place="4" addr=nicked.com /?>
3. insert into b values <c><d></d></c>;
4. <?res code=0 pk=100 /?> <!-- OK -->
5. insert into a values <a><? b 100 /?>; -- from stack
6. <?res code=0 pk=10 /?> <!-- OK -->

Insert Relay-race: neighbour

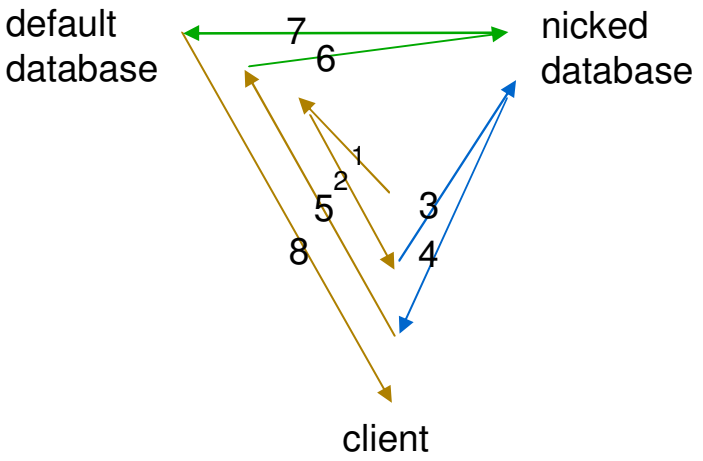


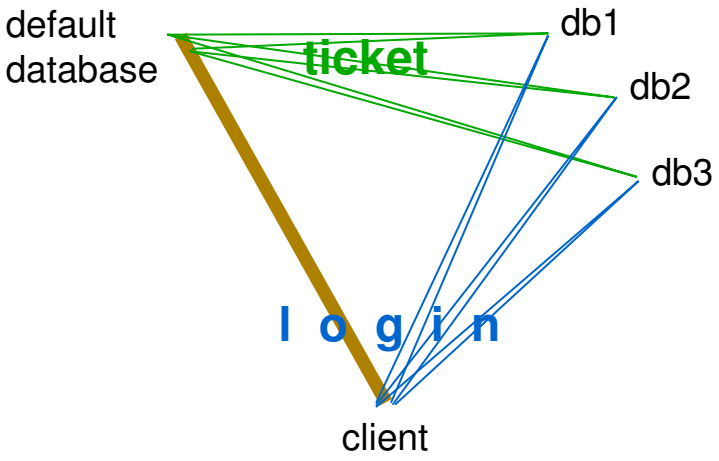


4 11 18

1. insert into a values <a> <c></c> <d></d> ;
2. <?iiv place="4" addr=site.com /?>
   <?iiv place="11" addr=data.net /?>
   <?iiv place="18" addr=store.org /?>
3. insert into b values ;
   insert into c values <c></c>;
   insert into d values <d></d>;
4. <?res code=0 pk=100/?> <?res code=0 pk=200/?> <?res code=0 pk=300/?>
5. insert into a values <a><? b 100 /?><? c 200 /?><? d 300 /?>;
6. <?res code=0 pk=10 /?>

Select distributed joining (dJ)






```
1.      select * from all:tab as ta, all:tab as tb where ta/@t1= tb/@t2;
2.      <?reader addr=default.edu ?>
          <?store nick=db1 addr=nicked.com /?>
        <?/reader?>
3.      ticket default.edu
          template select * from all:tab as ta, all:tab as tb where ta/@t1= tb/@t2;
4.      <?res code=0 ticket=xbwid ?>
5.      upon db1=xbwid
          select * from all:tab as ta, all:tab as tb where ta/@t1= tb/@t2;
6.      select …                                    -- particular ‘select’
7.      <tab t1=88 t2=99 data=12.3>                 <!-- particular data -->
8.      <ta data1=3 data2=12.3>                     <!-- final data -->
```

Ticket

Ticket is temporary Username/Password, which

- only for *'select'* operations
- only for concrete address of reader
- has *timeout* to connect
- *auto-removed* after disconnect (disposable)
- *disconnected and auto-removed* at first 'select', not derived from template
- under *privileges* of asking login (some records will be invisible like for asking login – slide 185)

```
ticket reader.com
template select *
  from all:tab as ta, all:tab as tb
  where ta/@t1= tb/@t2;
```

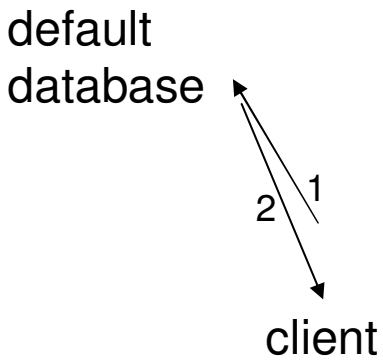
```
<?res code=0 ticket=xbwid /?>
```

Insert/update/delete dJ

1. insert into x values (1, 2, 3);

2. <?dup view="@a1, @b1, @c1 from db1:a, db2:b, db3:c"?>
   <?to nick=db1 addr=www.com?>
   <?to nick=db2 addr=data.net?>
   <?to nick=db3 addr=store.org?>
   <?/dup?>

2. <?res code=4 /?> <!--mistake-->



Insertion, updating, deleting of Distributed Joining are forbidden, because default DBMS must tell definition of view and can cheat about names of tables and fields, and condition of joining

Select distributed intersection or exception (dI, dE)

Like select dJ:

```
1.  select * from tab intersect select select * from db1:tab;
2.  <?reader addr=default.edu /?>
      <?store nick=db1 addr=nicked.com /?>
    <?/reader?>
3.  ticket default.edu
      template select * from tab intersect select select * from db1:tab;
4.  <?res code=0 ticket=xbwid /?>
5.  upon db1=xbwid
      select * from tab intersect select select * from db1:tab;
6.  select …                                    -- particular ‘select’
7.  <tab t1=88 t2=99 data=12.3>                 <!-- particular data -->
8.  <ta data1=3 data2=12.3>                     <!-- final data -->
```

Communication service info

select/insert/update/delete

```
<?ry shift="b/c" addr=more.com /?>
<?res  code=2 /?>
```

select

```
<?cancel /?>

<?finish addr=more.com ques="select …" /?>
  <a> <?f b2=453 ?> </a>

<?reader addr=default.edu ?>
  <?store nick=db1 addr=nicked.com /?>
<?/reader?>
```

Bag "more"

insert

```
<?iiv  place="5" addr=nicked.com /?>
```

insert/update/delete

```
<?res  code=0 pk=10 /?>
<?res  code=3 /?>
```

```
insert … values (
   '… <? tab 100 ?> …'
);
```

Kag "more"

```
<?res  code=0 pk=10 /?>
```

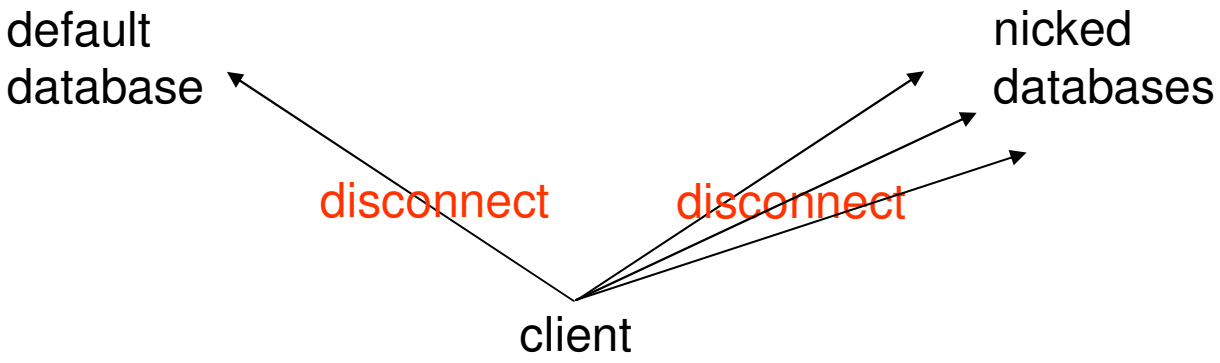
Baribute

Bag

Terms for XML and its analogue

	in document	in traffic
<element>	Element	Sament (SAg eleMENT)
	Tag	Sag (Sent tAG)
	Attribute	Saribute (SAg attRIBUTE)
<?element/?>	Kament	Bament
	Kag	Bag
	Karibute	Baribute

Disconnect default database implyies disconnect all nicked databases



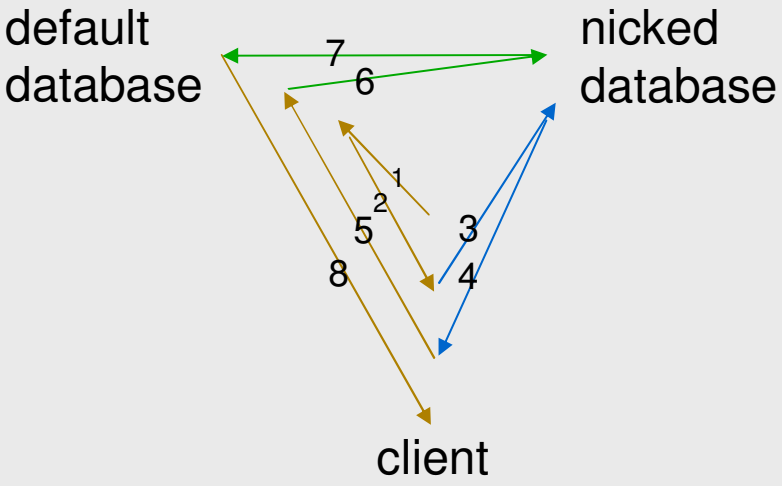
Sub-array

```
insert into i%all:t ( @fld )
  select sum( @arr[ i%all:%% ] ) from %all:tab;
select @arr[1] from tab;   -- particular ‘select’ from db1:
select @arr[1] from tab;   -- particular ‘select’ from db2:
select @arr[1] from tab;   -- particular ‘select’ from db3:
        <tab arr[1]=5 />          <!-- particular data from db1: -->
        <tab arr[1]=7 />          <!-- particular data from db2: -->
        <tab arr[1]=8 />          <!-- particular data from db3: -->
```

```
select @arr[ i=2:6:2, 2:i:2  ] from t;      <t arr[ i=2:6:2, 2:i:2 ]="1 2 3 4 5 6" />
select @arr[    2:6:2, 2:6:2 ] from t;      <t arr[    2:6:2,2:6:2 ]=“1 2 3 0 4 5 0 0 6” />
select @arr[  (1,6,4),(2,3)  ] from t;      <t arr[  (1,6,4),(2,3) ]=“0 3 2 0 0 0” />
select @arr[      1    ,    :    ] from t;  <t arr[      1    ,    :   ]=“0 0 0 0 0 0” />
```

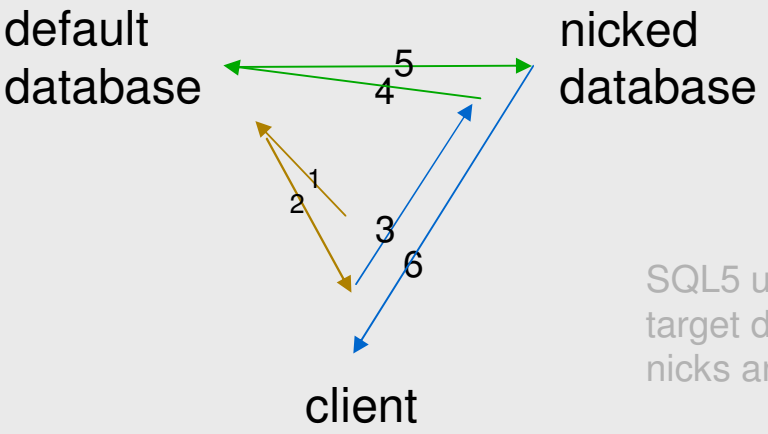
Examples of replication

Insert-select-1



1. insert into tab select * from db1:tab;
2. <?reader addr=default.edu ?>
   <?store nick=db1 addr=nicked.com ?>
   <?/reader?>
3. ticket default.edu
   template insert into tab select * from db1:tab;
4. <?res code=0 ticket=xbwid ?>
5. upon db1=xbwid
   insert into tab select * from db1:tab;
6. select …
7. <tab t1=88 t2=99 data=12.3>
8. <?res code=0 done=15 ?>

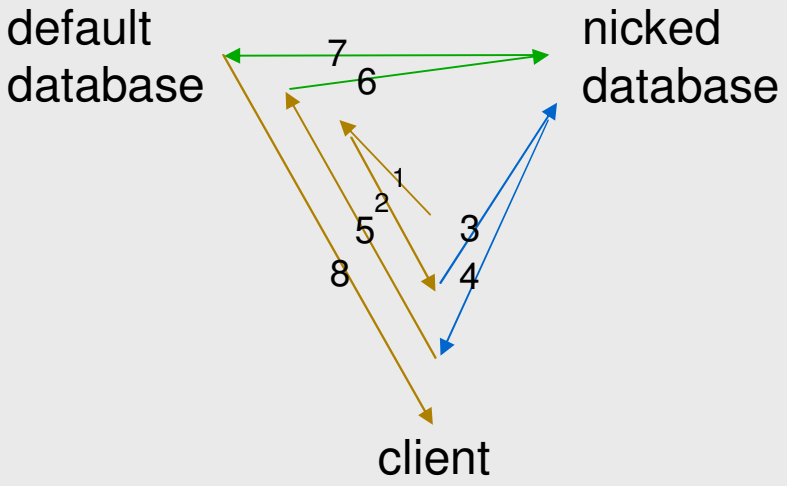
Insert-select-2: reason of ‘YOU’

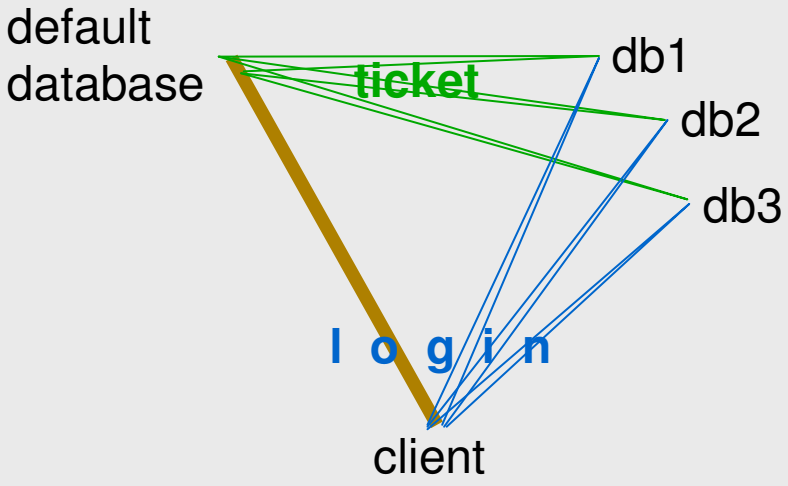


SQL5 uses prefix ‘YOU’ to say target database to not use own nicks and societies

1. insert into db1:tab select * from tab;
2. <?res code=0 ticket=xbwid ?>
   <?ry addr=nicked.com ?>
3. upon default=xbwid
   insert into %you:tab select * from tab;
4. select …
5. <tab t1=88 t2=99 data=12.3>
6. <?res code=0 done=15 ?>

Update-select

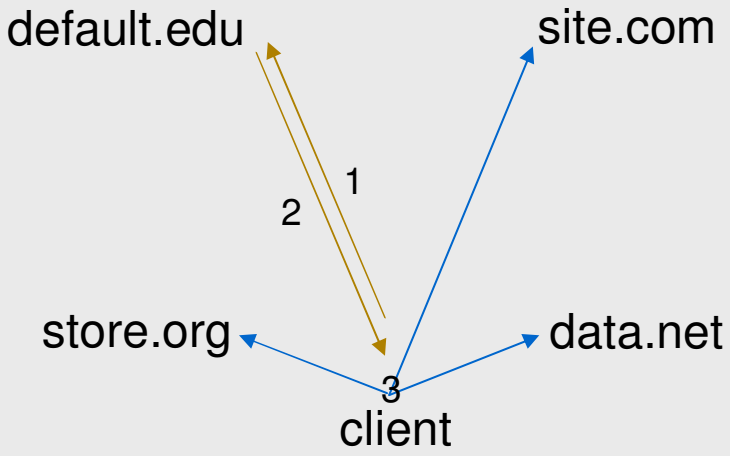




1. update tab set @fld= (select @a1 from db1:a);
2. <?reader addr=default.edu ?>
   <?store nick=db1 addr=nicked.com ?>
   <?/reader?>
3. ticket default.edu
   template update tab set @fld= (select @a1 from db1:a);
4. <?res code=0 ticket=xbwid ?>
5. upon db=xbwid
   update tab set @fld= (select @a1 from db1:a);
6. select … -- particular ‘select’
7. <a a1=88 > <!-- particular data -->
8. <?res code=0 done=15 ?>

All-to-all and its traffic

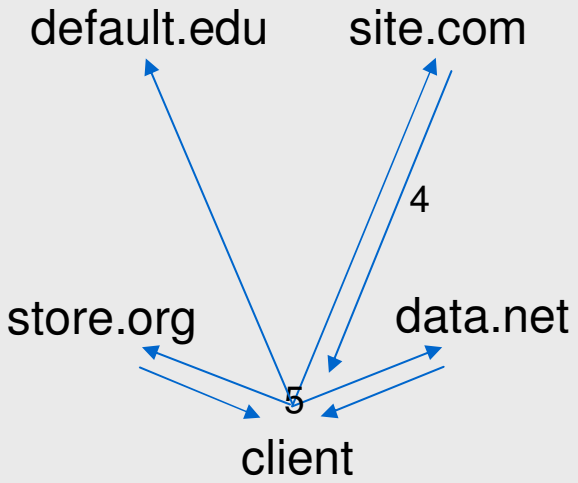
1. insert into %all:tab select * from %all:tab;
2. <?reader addr=default.edu ?>
   <?store nick=db1 addr=site.com ?>
   <?store nick=db2 addr=data.net ?>
   <?store nick=db3 addr=store.org ?>
   <?/reader?>
   <?reader addr=site.com ?>
   <?ticket it=ccc ?>
   <?store nick=db2 addr=data.net ?>
   <?store nick=db3 addr=store.org ?>
   <?/reader?>
   <?reader addr=data.net ?>
   <?store nick=db1 addr=site.com ?>
   <?ticket it=nnn ?>
   <?store nick=db3 addr=store.org ?>
   <?/reader?>
   <?reader addr=store.org ?>
   <?store nick=db1 addr=site.com ?>
   <?store nick=db2 addr=data.net ?>
   <?ticket it=ooo ?>
   <?/reader?>

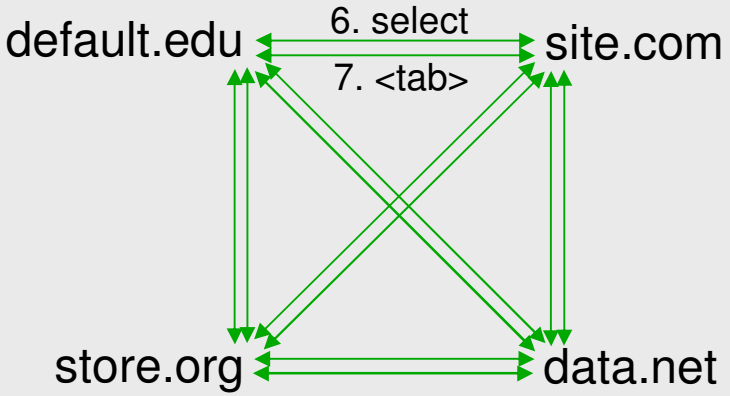


3. connect data.net;
   ticket site.com
   template insert into %all:tab
   select * from %all:tab;
   connect store.org;
   ticket site.com
   template insert into %all:tab
   select * from %all:tab;

Reason of restriction of ‘YOU’

4. <?res ticket=222 ?><?res ticket=333 ?>
   ...
5. upon db1= and db2= and db3=
   insert into %you:tab select * from %all:tab;
   upon default=ccc and db2=222 and db3=333
   insert into %you:tab select * from %all:tab;
   upon db1= and default=nnn and db3=
   insert into %you:tab select * from %all:tab;
   upon db1= and db2= and default=ooo
   insert into %you:tab select * from %all:tab;
6. select … ; select … ; select … ;
   ...
7. <tab t1= t2= data= >
   <tab t1= t2= data= >
   <tab t1= t2= data= >
   ...





SQL5 uses RESTRICTED prefix ‘YOU’ to exclude target database from source database-s

NID: whole <?ry?>, <?reader?>

```
select @fld, %% from all:a/b/tab;
insert into     all:a/b/tab (@d, @s) values (10, %%);
update          all:a/b/tab    set @s=%%;
delete * from all:a/b     where @s=%%;
```

```
<?ry shift=b/c addr=site.com  nid=1 ?>
<?ry shift=b/c addr=data.net  nid=2 ?>
<?ry shift=b/c addr=store.org nid=3 ?>
```

```
insert into i%all:tab (d,s) select d,%% from s%all:tab where i%all:%%=s%all:%% +1;
```

```
<?reader addr=reader.com ?>
  <?store nick=db addr=library.com       ?>    <!-- library.com  to reader.com -->
  <?ticket                          it=ccc ?>    <!-- default.com to reader.com -->
  <?sys nick=db1 addr=site.com  nid=1 ?>
  <?sys nick=db2 addr=data.net  nid=2 ?>
  <?sys nick=db3 addr=store.org nid=3 ?>
<?/reader?>
```

dQ, optionally

Forward insertion & updating from default database into nicked databases

```
create predicate a/x/y/@y1=s:%% [and …or …]
  [for UserName]
  [parallelly | consecutively];    -- only for select


 -- only first proper predicate will be executed
```

DBMS automatically repeats query at break of connection

```
timein;
insert into a
  select *
  from db1:a.*


timeout;
```

```
repeat
  insert into a
  select *
  from db1:a.*
  where db1:a/@pk<>a/@pk
until TIMEOUT='false';
```

DBMS continues shapshot at break of connection

```
insert into db1:* select * from *  -- snapshot
controlling a;                     -- 'a' is snapshot mark

insert into db1:* select * from *  -- after break of connection
continuing a;                      -- submit tail of snapshot 'a'
```

Manually into nicked database

```
insert into s:* values
  <a     data=12.3>
    <b   data=23.4/>
    <b   data=34.5/>
    <b   data=45.6/>
  </a>
   <a     data=0.7>
    <b   data=56.7/>
    <b   data=67.8/>
    <b   data=78.9/>
  </a>
;
```

BLOB

Downloading BLOB

Connection can be broken, computer with DBMS can be rebooted or switched off (e.g. notebook). So it is necessary to save in field:

- address of BLOB on remote computer to continue
- downloaded parts of BLOB
- offsets of beginning and of end for each part to continue

And we need operators, returning:

- BLOB
- percents of completeness of downloading
- address of BLOB on remote computer (to inform, downloading is not finished, and where it is possible to obtain BLOB, if DBMS will be destroyed)
- starting downloading in background mode

Accepting client submission

If anybody selects BLOB during accepting, what must DBMS respond? Answering NULL, it notes, that it knows nothing about BLOB, what is false, because accepting is only matter of time. Thus field must save:

- accepted parts of BLOB
- meaning "ACCEPTING", similar to NULL, but not equal to it

Obtaining "ACCEPTING“ during replication, may third database save it in own BLOB-field? No, because it disinforms users of third database, that it itself is accepting BLOB. Thus once more meaning, similar to NULL, into which "ACCEPTING" is turned during replication.

- meaning “NOTGOT", similar to NULL, but not equal to it

It is still a file

To choose routine to process BLOB, which does not contain filetype in own content, we need to save filetype in BLOB-field. If filetype is in the content, and DBMS understands this format, than must copy filetype from content into BLOB-field at each operation of coping BLOB

- file type

BLOB-field contains

- meaning “NULL"
    - meaning "ACCEPTING“
    - file type
    - beginning of BLOB
        - file type
        - whole BLOB
            - meaning “NOTGOT“
                - address on remote computer
                - file type
                - parts of BLOB
                - offsets of borders of parts

Operators

SELECT fld ...

to extract BLOB

SELECT PERCENT(fld) ...

completeness of downloading

SELECT TYPE(fld) ...

to extract file type of BLOB

SELECT DOWNLOAD(fld) ...

in background mode, returns boolean

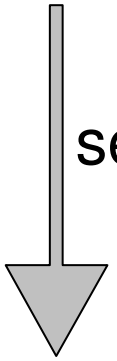
SELECT STOP(fld) FROM * WHERE fld=542

to stop downloading BLOB

BLOBs are after all attributes

d

d1	d2
4	3652435
5	accepting
7	data.net/7254843
8	null



select @d1, @d2 from d;

<d d1=4 d2="3652435"/>
<d d1=5 d2="accepting"/>
<d d1=7 d2="data.net/7254843"/>
<d d1=8 d2="null"/>
<?file id="3652435" type="mpg" size="3">Y29</?file>

BLOBs are transfered not in xml-attributes, but after all xml-elements. Otherwise they would block reaction of acceptor at fast transfered nonBLOB attributes

If transfer of BLOB is broken

d

d1	d2
5	3652
7	accepting
8	data.net/7254843
9	null

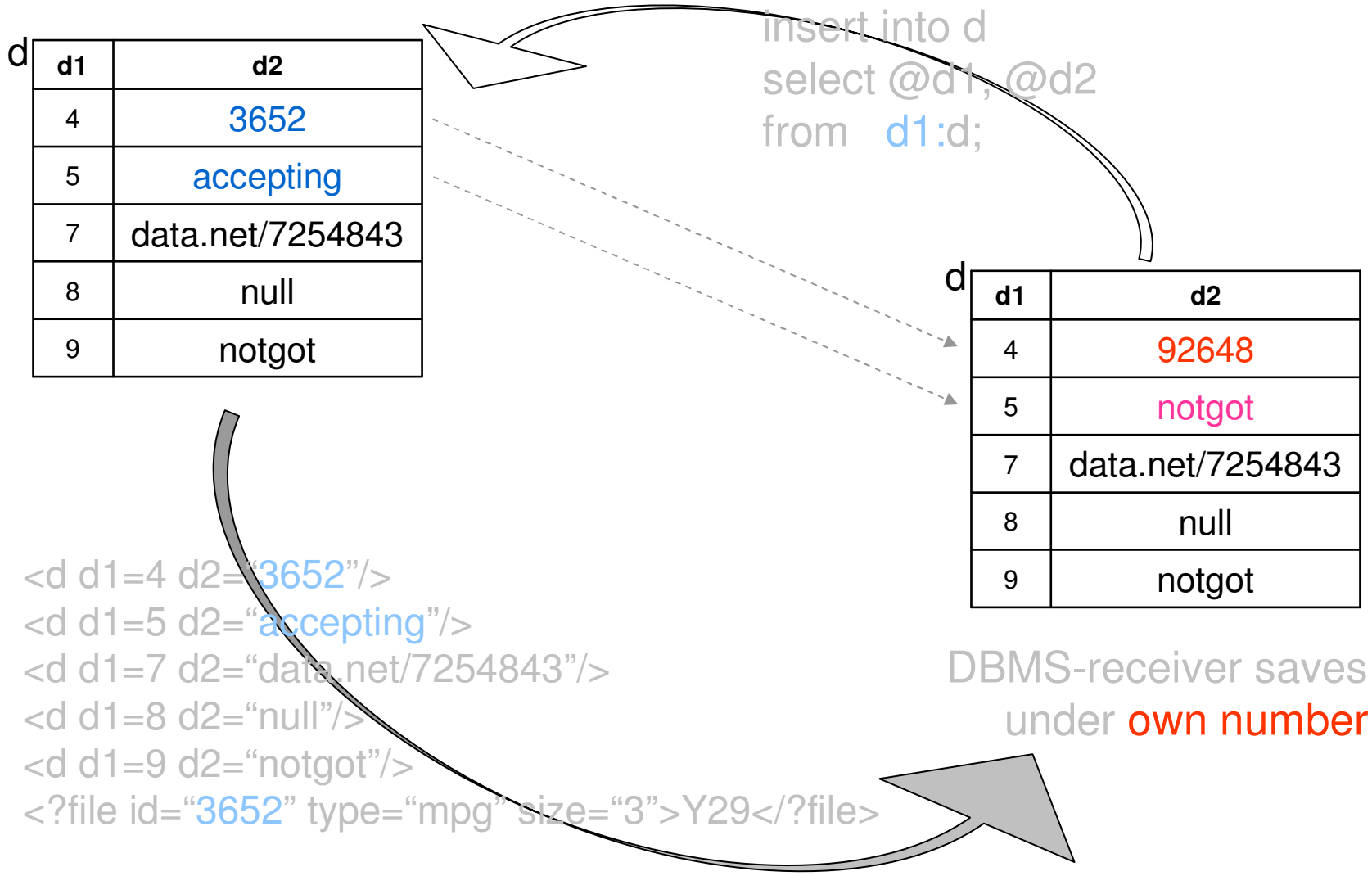
```
select @d1, @d2
from   db1:d;
```

If transfer of BLOB is broken at 1000nd byte, then client automatically repeats query for the tail of BLOB

```
select @d2[1000:]
from   db1:d
where @d2=3652;
```

```
<d d2[1000:]="3652"/>
<?file id="3652" size="3">udG</?file>
```

Copying BLOB from DB to DB



Nested schemas like former folders

Instead of many databases

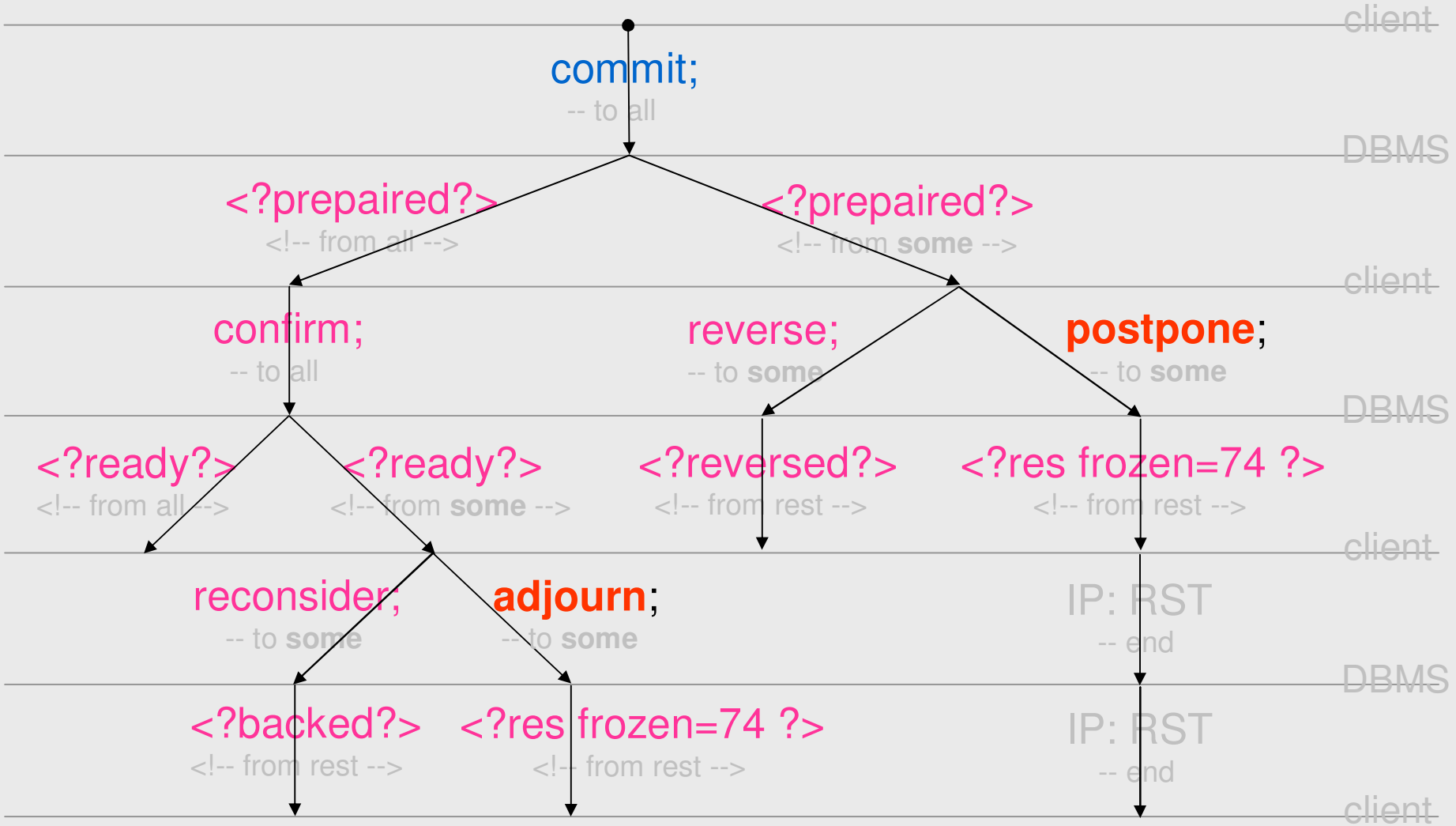
```
connect address=site.com schema=sn1/sn2;
create schema sn5          inside     sn3/sn4                uni=goods; -- uni is UNIque name
connect address=site.com schema=sn1/sn2/sn3/sn4/sn5;
connect address=site.com                                    uni=goods;
connect                  schema=../..;                                 -- go two schemes above
connect                  schema=./sn3/sn4;                             -- go into sub-schema
-- root schemas with name of one letter are external storage like DVD/BluRay


alter    schema sn1/sn2/sn3/sn4/sn5   rename       to sn7;
alter    schema sn1/sn2/sn3/sn4/sn7   [copy|move] to [address=data.net] uni=my;
alter    schema sn1/sn2/sn3/sn4/sn7   [copy|move] to [address=data.net] schema=sn1/sn2;


-- after move
alter    schema sn1/sn2/sn3/sn7         uni to chernobyl;
create nick db1   address=data.net      uni=my;
alter    nick db1   address=site.com     uni=chernobyl;                 -- only uni, never schema
```

Repairing of dQ, optionally

2PC, 3PC

Operator 'POSTPONE' to freeze 2- and 3-phase 'COMMIT' (2PC and 3PC) on second phase, and operator 'ADJOURN' to freeze 3-phase 'COMMIT' (3PC) on third phase – to repair only failed databases after from their log-files

Freezing stages of 2PC and 3PC



Different

Permutation

Permutation for fields

```
from a, x
where @a1~=@x1 and  @a2~=@x1 and  @a3~=@x1;
```

```
where @a1<>@a2 and @a2<>@a3 and @a1<>@a3
  and @a1 in (select @x1 from x)
  and @a2 in (select @x1 from x)
  and @a3 in (select @x1 from x)
```

Permutation for cartesian product or tree

```
from a, b, c, x  -- cartesian product of ‘a’, ‘b’, ‘c’
where @a1~=@x1 and  @b1~=@x1 and  @c1~=@x1;

from a.b.c, x    -- tree ‘a.b.c’
where @a1~=@x1 and  @b1~=@x1 and  @c1~=@x1;
```

```
where @a1<>@b1 and @b1<>@c1 and @a1<>@c1
  and @a1 in (select @x1 from x)
  and @b1 in (select @x1 from x)
  and @c1 in (select @x1 from x)
```

Permutation for ‘*’, ‘+’

from a.b*.c, x where @b1~=@x1;

```
from a.b[@b1 as k1].b[@b1 as m1].b[@b1 as n1].b[@b1 as
                p1].b[@b1 as q1].b[@b1 as r1].b[@b1 as s1]. ...  .c
where @k1<>@m1 and @k1<>@n1 and @k1<>@p1 and @k1<>@q1 and @k1<>@r1 and @k1<>@s1 and ...
  and              @m1<>@n1 and @m1<>@p1 and @m1<>@q1 and @m1<>@r1 and @m1<>@s1 and ...
  and                           @n1<>@p1 and @n1<>@q1 and @n1<>@r1 and @n1<>@s1 and ...
  and                                        @p1<>@q1 and @p1<>@r1 and @p1<>@s1 and ...
  and                                                     @q1<>@r1 and @q1<>@s1 and ...
  and                                                                  @r1<>@s1 and ...
  and @k1 in (select @x1 from x)
  and @m1 in (select @x1 from x)
  and @n1 in (select @x1 from x)
  and @p1 in (select @x1 from x)
  and @q1 in (select @x1 from x)
  and @r1 in (select @x1 from x)
  and @s1 in (select @x1 from x)
  and ... ;
```

Whole control

Rights for each record

User enters not separate records into database, but whole graphs. Graphs of different users (different roles) are cross little, so all records of database are decomposed into little interacting classes (departments).

```
create department dp;
```

It is reasonable to give identical rights on all records of one department to user (to role), and to specify department name in records themselves in fields of special datatype “legal”

```
create table a          (... , a5 legal, ...);
insert  into   a values (... , dp,           ...);

bestow select   on dp for usr;
bestow update on dp for rolename;
```

Hiding and protection

We shall withdraw rights on department by following operator

VANISH select ON dp FOR usr;
VANISH update ON dp FOR rolename;

- if user has no rights to some operation with record, than record does not exist for this user (he does not see it in this operation)
- if record has no field of datatype legal, or this field is equal NULL, than user has all rights on this record
- field legal is accessible for updating on the same basis, as whole record

Use case

We shall specify for user convenient (and for administrating database too) at creating user, by which department he marks all inserted or updated records by default. We shall specify this department in parameter trace.

```
create user     u1
       identified by p1
       trace    dp;
```

Controllable and usable full text search (cuFTS)

Table, nested in textual field

S

pk	s1	s2
1	10	In the morning, dog comes, cat comes home too. Continue in the NEXT issue

@token	@sn	@beginning	@end
In	1	1	2
the	2	4	6
morning	3	8	14
dog	4	17	19
comes	5	21	24
cat	6	27	29
comes	7	31	34
home	8	36	39
too	9	41	43
Continue	10	46	53
in	11	55	56
the	12	58	60
NEXT	13	62	65
issue	14	67	71

Syntactical access:

@s2/@token
@s2/@sn
@s2/@beginning
@s2/@end

```
insert into s (@s2/@token, @s2/@sn) values ("new", 15)
update s SET @s2/@token = "<b>" || @s2/@token || "</b>";
delete from s where @s2/@beginning >= 100;
```

Solution of collisions

S

pk	s1	s2
1	10	In the morning, dog comes, cat comes home too. Continue in the NEXT issue

```
select @s1, @s2/@token
from     s
where @s2/@sn in (
    select distinct @s2/@sn
    from     s, (
       select @s2/@sn as fn
       from     s
       where @s2/@token in "comes next“
                    )
    where abs(@sn-fn)  <=  1
                              );
```

propagated group

s1	s2	sys_clue
10	dog comes, cat ... the NEXT issue	1
10	cat comes home ... the NEXT issue	2

Operations with nested column

Concatenation of two nested columns
is
UNION for them,
and gives new nested table

Surrounding by tags

pk	s1	s2
1	10	In the morning, dog comes, cat comes home too. Continue in the NEXT issue

```
select   @s1, ("<b>"     ||  @s2/@token as @f1 ||  "</b>")    ||
              ("<em>“  ||  @s2/@token as @f2 ||  "</em>")
from     s
where  @f1 in "comes next“
  and   @f2 in (
          select distinct(@s2/@token, @s2/@sn) @s2/@token
          from   s, (
              select @s2/@sn as fn
              from    s
              where @s2/@token in "comes next“
                    )
          where abs(@s2/@sn-fn)=1
                );
```

concatenation

alias for function argument

s1	s2	SYS_CLUE
10	dog comes, cat ... the NEXT issue	1
10	cat comes home ... the NEXT issue	2

Table of tokens

```
tokenize s(@s2) into tokens delimiting delimiters;
copy tokens( @idlexeme, @token ) from c:/lexeme.txt
```

Table with
blank, tab,
/n, /r,
marks of punctuation

leaves 'idlexeme' equal null

tokens

idtoken	token	idlexeme
1	in	1
2	the	2
3	morning	3
4	dog	4
5	comes	5
12	come	5
6	cat	6
7	home	7
8	too	8
9	continue	9
10	next	10
11	issue	11

all grammatical forms

```
create index i1 on tokens( @idtoken  );
create index i2 on tokens( @token    );
create index i3 on tokens( @idlexeme );
```

Table of items

itemize s(@s2) into items delimiting delimiters tokenizing tokens;
set nomenclarute items; -- for operations 'in', etc

items

idfield	pk	idtoken	own name	abbr	sn	beginning	end
505	1	1	yes		1	1	2
505	1	1			11	55	56
505	1	2			2	4	6
505	1	2			12	58	60
505	1	3			3	8	14
505	1	4			4	17	19
505	1	5			5	21	24
505	1	5			7	31	34
505	1	6			6	27	29
505	1	7			8	36	39
505	1	8			9	41	43
505	1	9	yes		10	46	53
505	1	10		yes	13	62	65
505	1	11			14	67	71

Side positive effect –
new sub-fields:

@s2/@idtoken
@s2/@idlexeme
@s2/@idfield

id of table column (unique in whole database)

create index i4 on items(@idfield, @pk, @idtoken);
create index i5 on items(@idfield, @pk, @sn);

Freeezing

Frozen transaction

```
create user u identified by p waited 1.0/0; -- yy.mm.dd/hh.mm.ss;
freeze;
```

```
<?res code=0 frozen=7482 ?> <!-- from 'default.edu' -->
<?res code=0 frozen=8726 ?> <!-- from 'site.com' -->
<?res code=0 frozen=9278 ?> <!-- from 'data.net' -->
<?res code=0 frozen=3825 ?> <!-- from 'data.net': second transaction -->
<?res code=0 frozen=6384 ?> <!-- from 'store.org' -->
<?res code=5 ?>             <!-- from 'place.ws': database is broken -->
```

```
unfreeze address=site.com user=Smith  pwd=ncwhif safe=8726;
unfreeze address=data.net user=Darvin pwd=qxuwb safe=9278;
```

To switch-on and switch-off notebook several times during one long transaction, lasting days or even weeks, it's enough to enter operator 'FREEZE (similar to 'DISCONNECT'), which saves transaction in current state; and operator 'UNFREEZE (similar to 'CONNECT'), which continues transaction from frozen state (instead starts new transaction, as 'CONNECT'). 'FREEZE' returns identifier of frozen transaction, which should be specified in 'UNFREEZE'

Useful before freeze

```
commit savepoint a;
freeze;
```

Timer

Timer is

procedure, which is actual from moment, specified in parameter 'start', and to moment, specified in parameter 'end'. Whole gap of time from 'start' to 'end' is divided into equal intervals of time, duration of which is specified in parameter 'per‘ (quantity of intervals 'per' can be not integer of gap from ‘start' to ‘end'). On each this interval (including last and not equal 'per' itself), function is automatically executed in moments, lagging from beginning of interval to distance, specified in parameter ‘schedule'.

Syntax

```
create timer TimerName
  start        yy.mm.dd/hh.mm.ss
  end          yy.mm.dd/hh.mm.ss
  schedule (yy.mm.dd/hh.mm.ss, yy.mm.dd/hh.mm.ss, …)
  per          yy.mm.dd/hh.mm.ss
  as begin … end;
```

```
create timer t1 schedule (01/0, 03/0, 10/0) per 01.00/0 as … ;
                                        -- 1st , 3rd, 10th days of each month
create timer t2 schedule (0/0.05, 0/0.10, 0/0.20) per 0/01 as … ;
                                        -- 5th, 10th, 20th minutes of each hour
create timer t3 schedule (0) per 1/0 as … ;
                                        -- each day
```

Interval table constraints

Notrift, Notcross, Sole

Either for array[2], or for data types,
composed of only two elements of the same data type

- only one array or composed data type under constraint
- first element must be less or equal second element
- only data types
  natural, enum, UUID, integer, float, money, or datetime

Notrift, Notcross

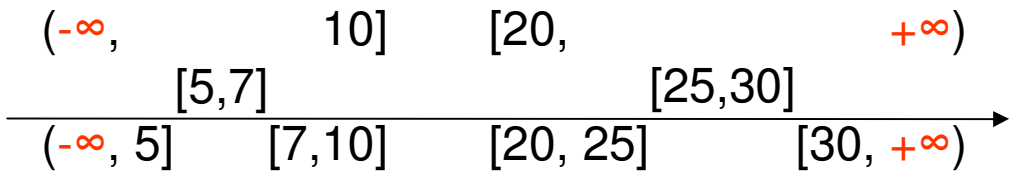
```
create type  t as (beg datetime, end datetime);

create table a (                -- for intervals [@a1/@beg, @a1/@eng]
  a1   t,
  notcross (a1),                -- must not cross in whole table
  notrift      (a1)             -- must be continuous line without gaps
);
create table aa (               -- for intervals [@aa1[1], @aa1[2]]
  aa1 datetime array[2],
  notcross (aa1),               -- must not cross in whole table
  notrift     (aa1)             -- and must be continuous line without gaps
);

create table b (                -- for intervals [@b1/@beg, @b1/@eng]
  b1   t,
  b2   number,
  b3   number,
  notcross (b1, b2, b3),        -- must not cross within records with identical '@b2, @b3'
  notrift     (b1, b2, b3)      -- must be continuous line within records with identical '@b2, @b3'
);
create table bb (               -- for intervals [@bb1[1], @bb1[2]]
  bb1  datetime array[2],
  bb2  number,
  bb3  number,
  notcross (bb1, bb2, bb3),     -- must not cross within records with identical '@b2, @b3'
  notrift     (bb1, bb2, bb3)   -- must be continuous line within records with identical '@b2, @b3'
);
```

Sole

```
create type  t as (beg datetime, end datetime);

create table c (              -- for intervals [@c1/@beg, @c1/@eng]
  c1   t,
  sole (c1)                   -- must be sole in whole table
);
create table cc (             -- for intervals [@cc1[1], @cc1[2]]
  cc1  datetime array[2],
  sole (cc1)                  -- must be sole in whole table
);

create table d (              -- for intervals [@d1/@beg, @d1/@eng]
  d1  t,
  d2  number,
  d3  number,
  sole (d1, d2, d3)           -- must be sole within records with identical '@d2, @d3'
);
create table dd (             -- for intervals [@dd1[1], @dd1[2]]
  dd1 datetime array[2],
  dd2 number,
  dd3 number,
  sole (dd1, dd2, dd3)        -- must be sole within records with identical '@d2, @d3'
);
```

‘Notcross’ changes values ‘eternity’ (-∞), ‘infinity’ (+∞)

necessary for arithmetic calculations




```
create table g (
  g1 number
  g2 number array[2],
  notcross (g2)
);
insert into g values (1, array[eternity,      10] );
insert into g values (2, array[       20, infinity] );

insert into g values (3, array[        5,       7] );
insert into g values (4, array[       25,      30] );
select * from g;
```

```
1, [eternity, 5]
3, [  5,        7]
1, [  7,       10]
2, [20,        25]
4, [25,        30]
2, [30, infinity]
```

Model into Window System

Concept for 3D

Office technologies stopped

It has occurred because user, capable to write primitive programs, can't:

- display 3-dimensional data in window of own program
- move 3-dimensional objects by commands

There is a need for:

- 3D-objects, written as triangles (which are understandable for users) instead of constructor of objects in SQL, because user does not master formulating and considering of own problems via constructors

Figure by triangles

```
create table concourse (id        number,
                        color     number array[3] color,
                        offset    number array[3] shift,    -- displacement of concourse
                        turn      number array[3] krylov, -- rotation of figure in e.g. Krylov angles
                        distance number array[2]  span, -- around geom.center of  concourse
                        note      varchar);
create table figure    (id        number,
                        conc      number          references concorse(@id),
                        color     number array[3] color,
                        disp      number array[3] shift,  -- displacement of figure
                        rot       number array[3] euler, -- rotation of figure in e.g. Euler angles
                        range     number array[2]  span, -- around geometric center of  figure
                        note      varchar);
create table triangle  (fig       number          references figure(@id),
                        vertex    number array[3] references point(@id),
                        more      varchar);
create table point     (id        number,
                        coord     number array[3] dot,        -- coordinates of point
                        time      datetime array[2] period, -- more usable than 'select…period'
                        note      varchar);
```

on 2 or more levels higher bottom 'dot'

data type

visual type

New step in tech: DBMS

And a need for:

- DBMS, returning result of operator SELECT in format X11, that program could send obtained data to the X-server without any own calculations or changes (without referencing to OpenGL, DirectX, which user never will masters!)

```
select * from concouse.* UNION select * from gathering.*
PROJECTING [perspectively|planarly]
[ camera    (0, 0, 0) ]  -- location of camera
[ width (3, 4) ]         -- width of camera
[ look   (1, 1, 1) ]     -- direction of camera
;
```

Usability

3D-construction is presented as hierarchy of points, triangles, figures (groups of triangles), *groups of figures, groups of groups, etc*. Record, containing these objects, must be bound by foreign key. To extract all triangles of a figure or a group, it's necessary to select by operator 'SELECT' not only record, being this figure or group, but also all records, located below it in hierarchy - up to records, which present 3D-points. For this, tables of these records are listed through point - ”SELECT * FROM group3.group2.group1.triangle.point PROJECTING” - as this is accepted in classical object-oriented languages. Names of tables are *not important, because points are always expected to be located on the most lower level* of hierarchy of each branch of tree, triangles - on one level above, and records of other levels are not visualized. Before transformation into format X11, invisible triangles will be removed from result of query, and partly visible triangles will be cut to their visible parts. So any program displays contents of a database on screen by function 'printg(“SELECT * FROM group3.group2.group1.triangle.point PROJECTING")'.

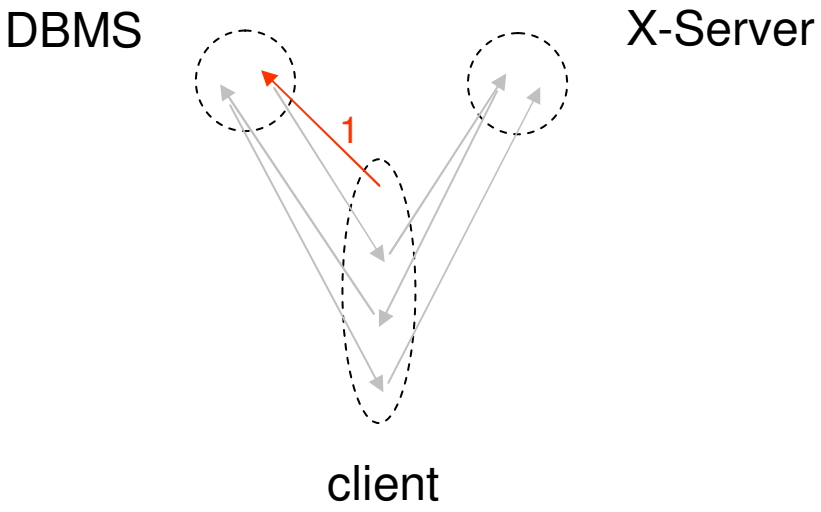
Driven scene

It will be enough for user to call one function in OS, we shall name it as 'printg', in which user specify what 3D-objects from database must appear on a screen (this function being called, automatically forwards all mouse motion commands of objects and motion of camera into DBMS; all messages about motion of objects, obtained from DBMS, automatically forwarded into X-server).

It will be also enough to call this function, i.e. ‘printg', to send order to change coordinates on SQL (change immediately is displayed on screen, because messages from DBMS are automatically forwarded to X-server after first call of 'printg'). And 'printg‘ will be in library of standard input/output, and can be called in any program.

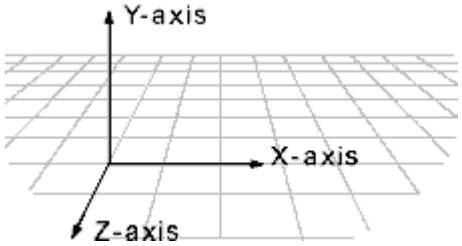
Participation of user

User submits only first (1) query, all next parcels
(mouse motion commands of objects and of camera,
correction X11-data because UPDATE in DBMS)
are sent by client library, DBMS, X-Server
automatically, independently of user.



Example: Overview of all figures

```
create function geodia (arg table) returns (
  @geocenter num array[3],
  @diameter   num array[3]
) as begin
  select (@mi+@ma)/2 as @geocenter, @ma-@mi as @diameter
  from (
    select min(@coord) as @mi, max(@coord) as @ma
    from arg.*.point
  );
end;

select * from a.*
  projecting
  eye (
    select @geocenter + [0,0, @diameter[3]/2+max(@diameter[1],@diameter[2]) ]
    from   geodia (a)
  ) look   (0,0,-1);
```



New step in tech: Ways

And also a need for:

- two ways to change the coordinates (in field of numeric datatype, marked by visual type “dot”), both ways create commands in format X11 to control X-Server, which are immediately forwarded to the X-server:
  - by operator UPDATE (that allow a program to change coordinates)
  - accepting events in format X11, which are also commands to change coordinates, but are send by mouse (that allows to change coordinates by mouse)

```
update a.* shift    (5, 5, 5);
update a.* krylov (45, 45, 45) center (0, 0, 0); -- rotate
update a.* euler  (45, 45, 45) center (0, 0, 0); -- rotate
update a.* sprain (5, 5, 5)      center (0, 0, 0);
```

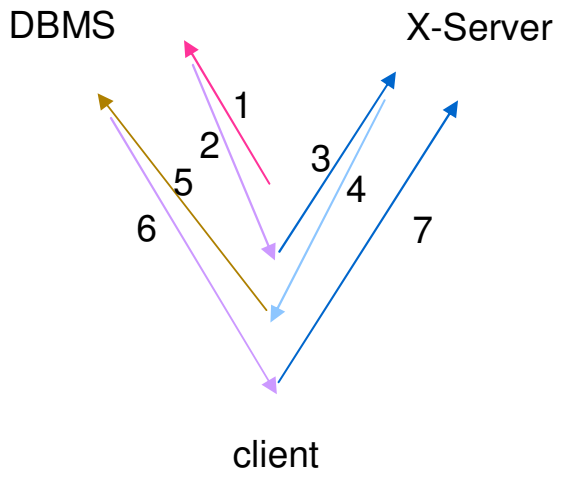
Commands from program

Similarly it's also possible to specify whole hierarchy of records from figure or group to 3D-points in operator UPDATE – ”update group3.group2.group1.triangle.point set ...”. So any program changes position of an object in database and on screen by function ‘printg ("update group3.group2.group1.triangle.point set ...")'.

```
update point set @coord=mouse; -- value for array[3]
-- point is always in place, where mouse is

update point set @coord=default;
-- see ‘create table point (coord number array[3] default ... )’
```

DBMS as Visualization server

Functionality of OpenGL
must be implemented in DBMS



1. query:
   - select … PROJECTING …
   - insert, update, delete

2, 6 <?xd size=345>…</?xd> <!-- data for X11-server, wrapped in XML -->

3, 7 … <!-- data itself for X11-server-->

4 … <!-- event itself from X11-server -->

5 <?xe size=345>…</?xe> <!-- event from X11-server, wrapped in XML -->

Shift and rotation on levels to refer to the same figure several times

```
create table concourse (id       number,
                        color    number array[3] color,
                        offset   number array[3] shift,    -- displacement of concourse
                        turn     number array[3] krylov, -- rotation of figure in e.g. Krylov angles
                        distance number array[2]  span, -- around geom.center of  concourse
                        note     varchar);
create table figure    (id       number,
                        conc     number          references concorse(@id),
                        color    number array[3] color,
                        disp     number array[3] shift,  -- displacement of figure
                        rot      number array[3] euler, -- rotation of figure in e.g. Euler angles
                        range    number array[2]  span, -- around geometric center of  figure
                        note     varchar);
create table triangle  (fig      number          references figure(@id),
                        vertex   number array[3] references point(@id),
                        more     varchar);
create table point     (id       number,
                        coord    number array[3] dot,       -- coordinates of point
                        time     datetime array[2] period, -- more usable than 'select…period'
                        note     varchar);
```

on 2 or more levels higher bottom 'dot'

Time and distance constraints

Movie

```
create table concourse (id        number,
                        color     number array[3] color,
                        offset    number array[3] shift,    -- displacement of concourse
                        turn      number array[3] krylov, -- rotation of figure in e.g. Krylov angles
                        distance  number array[2]  span, -- around geom.center of  concourse
                        note      varchar);
create table figure    (id        number,
                        conc      number          references concorse(@id),
                        color     number array[3] color,
                        disp      number array[3] shift,   -- displacement of figure
                        rot       number array[3] euler, -- rotation of figure in e.g. Euler angles
                        range     number array[2]  span, -- around geometric center of  figure
                        note      varchar);
create table triangle  (fig       number          references figure(@id),
                        vertex    number array[3] references point(@id),
                        more      varchar);
create table point     (id        number,
                        coord     number array[3] dot,       -- coordinates of point
                        time      datetime array[2] period, -- more usable than 'select…period'
                        note      varchar);
```

on 2 or more levels higher bottom 'dot'

'update' creates new record and thus line by this point in 4D space

Part of movie in real time scale

```
select * from concouse.*
where  -- all time without ‘where’ for time

point/@time & -- ‘&’ is operator of intersection of intervals
[09.01.01/05.00, 09.01.01/10.00]
-- select [@time1,@time2] from …
-- select @timeinterval      from …
PROJECTING [cycled|not cycled];
```

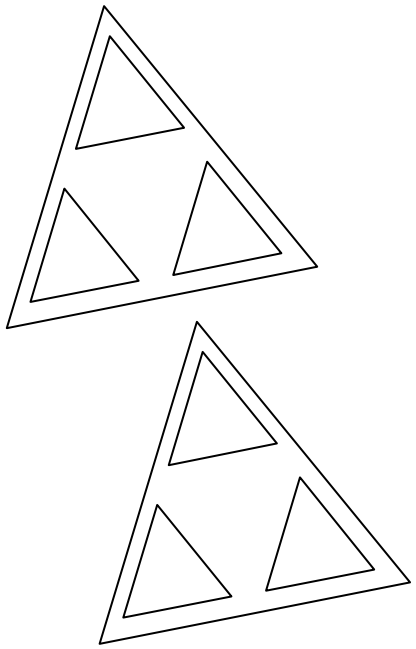
```
point/@time & 09.01.01/05.00
point/@time & now
-- one movie’s frame
PROJECTING;
```

Distance

```
create table concourse (id        number,
                        color     number array[3] color,
                        offset    number array[3] shift,    -- displacement of concourse
                        turn      number array[3] krylov, -- rotation of figure in e.g. Krylov angles
                        distance number array[2]  span, -- around geom.center of  concourse
                        note      varchar);
create table figure    (id        number,
                        conc      number          references concorse(@id),
                        color     number array[3] color,
                        disp      number array[3] shift,  -- displacement of figure
                        rot       number array[3] euler, -- rotation of figure in e.g. Euler angles
                        range     number array[2]  span, -- around geometric center of  figure
                        note      varchar);
create table triangle  (fig       number          references figure(@id),
                        vertex    number array[3] references point(@id),
                        more      varchar);
create table point     (id        number,
                        coord     number array[3] dot,       -- coordinates of point
                        time      datetime array[2] period, -- more usable than 'select…period'
                        note      varchar);
```

on 2 or more levels higher bottom 'dot'

Visibility of details depends



If figure contains
6 small triangles with value of span field inside [10, 100], and
2 big triangles with value of span field inside [100, 9999], than

- geometrical center of all 8 triangles is calculated
- the following is shown at distance between camera and geometrical center:
  - nothing, at distance less 10
  - only 6 small triangles, at distance from 10 to 100
  - only 2 big triangles, at distance from 100 to 9999
  - nothing, at distance farther 9999

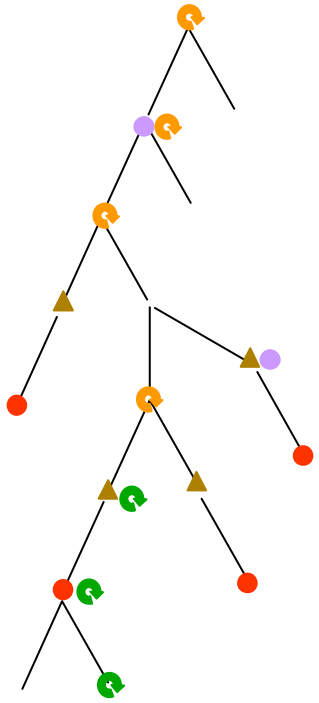
Session parameters

```
set 3Dcamera (0, 0, 0) ;  -- move camera
set 3Dlook   (1, 1, 1) ;  -- turn camera
set 3Dwidth   (3, 4) ;    -- change width of camera
```

Particularities

Branches:

- operation *ignores* branches, not specified in query
- operation *ignores* branches, not satisfied to conditions for sections and fields



Sections:

- table names (section names) are *un-important*
- bottom ‘dot’ of each branch contains point
- one section above of each branch contains triangles
- other sections are *invisible*

Fields:

- ‘dot’ is *ignored*: if not 3 elements in array, if not sole ‘array[3] dot’, if is above other ‘array[3] dot’
- ‘color, shift, euler/krylov, span’ are *ignored*: in triangles, in points, in sections below, if not sole in record
- triangle is *ignored*, if ambiguity because no refinement (slide 13)
- all other fields are *ignored*

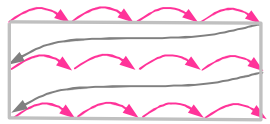
2D-grid in 3D-space

Grid with texture

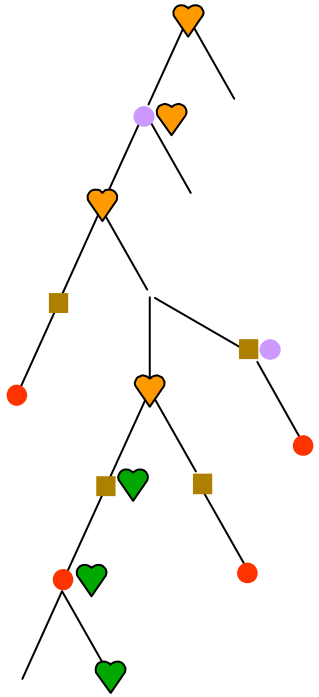
```
create table concourse (id      number, ...);
create table figure    (id      number,
                        cc      number           references concorse(@id),
                        color   number array[3] color, -- ignored, if texture is not null
                        disp    number array[3] shift,  -- displacement of figure
                        rot     number array[3] euler, -- rotation of figure in e.g Euler angles
                        range   number array[2]  span, -- around geometric center of  figure
                        side    number           references quadrangle(@id),
                        pic     blob             texture, -- rectangular picture for whole grid
                        d       number           diffuse,
                        rf      number           reflect,
                        rd      number           radiate,
                        note    varchar);
create table quadrangle(id      number,          -- 2D grid in 3D space
                        next    number           references quadrangle(@id),
                        vertex  number  array[4] references point(@id),
                        note    varchar);
create table point     (id      number,
                        coord   number  array[3] dot,      -- coordinates of point
                        time    datetime array[2] period, -- more usable than 'select…period'
                        note    varchar);
```

on 2 or more levels higher bottom 'dot'

also on 2 or more levels higher bottom 'dot'



Difference in Particularities



Sections:

- one section above ‘dot’ of each branch contains quadrangles

Fields:

- ‘texture, diffuse, reflect, radiate’ are *ignored*: in quadrangles,
- in points, in sections below, if not sole in record
- quadrangle is *ignored*, if ambiguity because no refinement (slide 13)

3D-triggers

Trigger for shift, sprain

```
create trigger t on tab
after      shift
when @offset.x=          -- distance of shift
  and @distab=           -- table name, on which 'tab' is dropped
  and @dispk=            -- value of primary key, on which 'tab' occurs
as begin …
   … where @fld=@offset.z;
```

```
create trigger t on tab
after      sprain
when @coef.x=  -- is normalized
  and @center.x=
  and @distab=
  and @dispk=
as begin …
   … where @fld=@coef.z;
   … where @fld=@center.z;
```

Trigger for rotation

```
create trigger t on tab
after      rotation
when @krylov.x=          -- Krylov angle of rotation
  [or    @euler.x=   ]    -- Euler  angle of rotation
  and @center.x=
  and @distab=            -- table name, on which 'tab' is dropped
  and @dispk=             -- value of primary key of object,
                                  -- on which 'tab' is dropped

as begin …
   … where @fld=@krylov.z;
   … where @fld=@euler.z;
```

Mouse triggers

Mouse operations terms

worker – object, obtained focus. Always point (first point of two ends of contour segment or triangle or quadrangle border, at clicking on them), triangle, or quadrangle (at clicking in empty space between them)

focus – event; first click on object, accepting click (object becomes ***worker***)

shift, rotation – event; motion on screen by mouse, taking object itself

sprain – event; motion on screen by mouse, taking dotted square around object

destiner – object, lost focus

First accepting object obtains focus

```
create table a (
  id   number,
 focus – figure ‘a’ does not obtain focus
);
create table b (
  id   number,
  lnk number              references a(@id),
  focus – figure ‘b’ does not obtain focus
);
create table c (
  id   number,
  ref number              references b(@id),
  v    number array[3] references d(@id)
 focus – triangle does not obtain focus
);
create table d ( -- click is here
  id   number,
  x    number array[3] dot
  focus -- point obtains focus
);
```

```
create table a (
  id   number,
 focus – figure ‘a’ does not obtain focus
);
create table b (
  id  number,
  lnk number              references a(@id),
  focus – figure ‘b’ obtains focus
);
create table c (
  id   number,
  ref number              references b(@id),
  v    number array[3] references d(@id)
         – triangle does not obtain focus
);
create table d ( -- click is here
  id   number,
  x    number array[3] dot
         – point does not obtain focus
);
```

Focus

```
create table figure (
  id              number,
  footnote        varchar,
  [constraint c] focus [accept|reject]'
);
```

Trigger

create trigger t on a
after focus

Programmably

```
select focus (tabname)
  where @pk=3;
```

Trigger for click, double-click

```
create trigger t on tab
after      click                -- other meaning is 'double'
when @self=yes                  -- i.e. worker=distiner; other is 'no'
  and @distab=                  -- table name of 'distiner'
  and @dispk=                   -- value of primary key of 'distiner'
as begin …
```

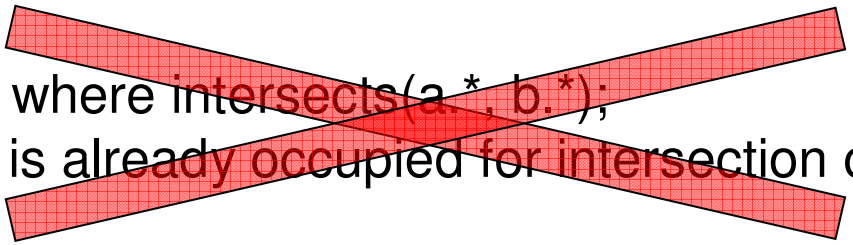
Programmably

```
select click     (tabname) where @pk=3;
select double (tabname) where @pk=3;
```

Operations

Operations: 3D-comparisons

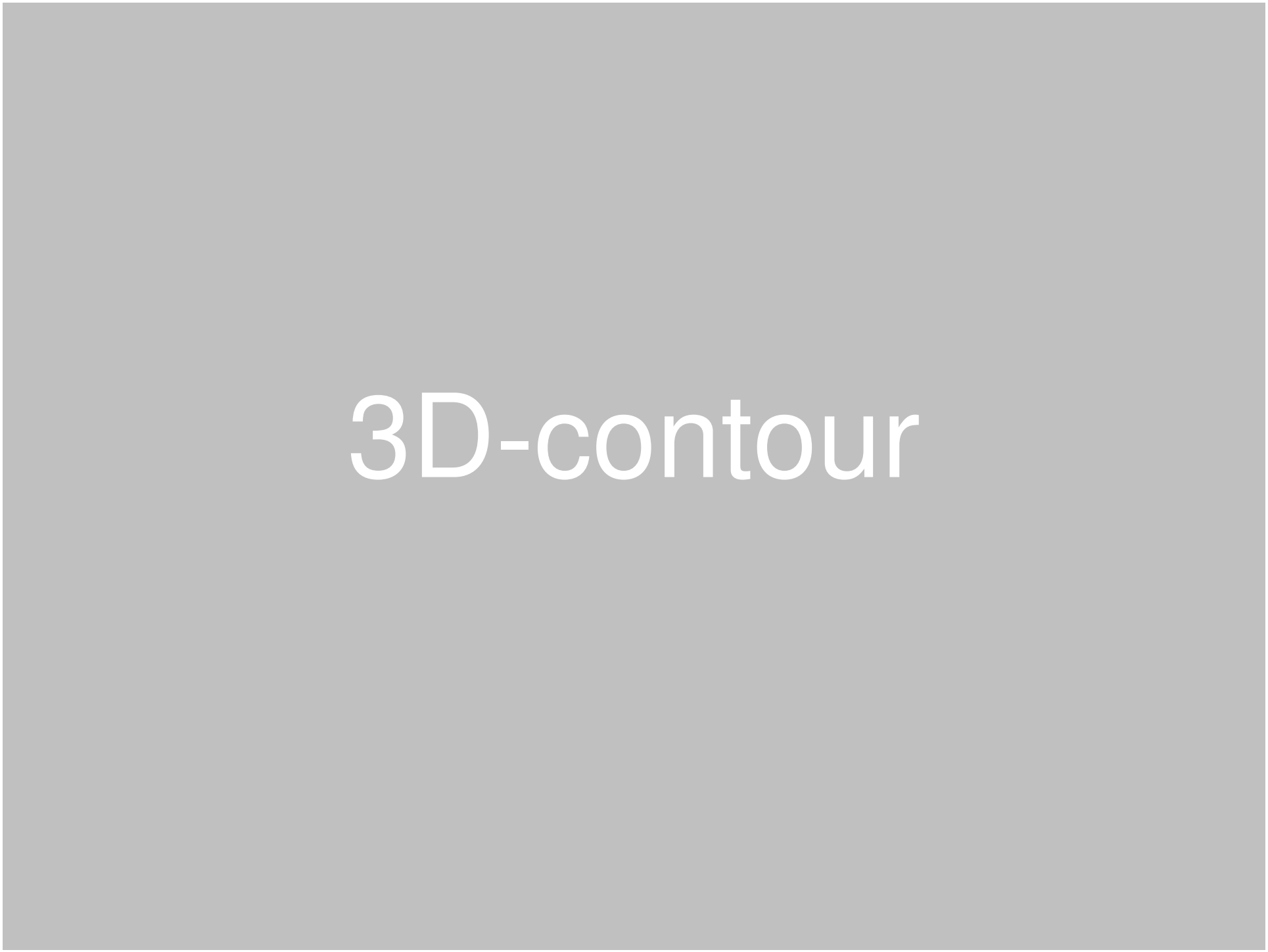
```
-- return boolean
… where a.*    =        b.*;        -- the same dots
… where a.*  ~=         b.*;        -- the same volume and shape
… where a.*       in    b.*;        -- b.* contains a.*
… where a.*       in=   b.*;        -- (a.* in  b.*) or (a.* = b.*)
… where a.*       in^   b.*;        -- a.* in  b.* and touch b.*
… where a.* out^        b.*;        -- a.* not in  b.* and touch b.*

… where a.* back in   b.*;          -- b.* in a.*
… where a.* back in=  b.*;          -- b.* in= a.*
… where a.* back in^  b.*;          -- b.* in^ a.*
```



… where intersects(a.*, b.*);
-- is already occupied for intersection of ‘select’

Operations: 3D-calculations

```
… where measure(a.*)=5;  -- volume

 -- return new triangles and points under 3rd level figures of left tree (a.*)
… where a.*  &   b.*;     -- comman records (triangles, points) in 2 low levels
… where a.*  ~&  b.*;     -- geometrical overlap of figures (3rd level from bottom)
… where a.*  ^   b.*;     -- geometrical place of touch of triangles (but not cross)
… where a.*  -|  b.*;     -- geometrical place of cross of triangles (but not touch)
… where a.*  ^-| b.*;     -- (a.* ^  b.*) union (a.* -| b.*)
… where a.*  <|  b.*;     -- closest point of left tree (a.*) to right tree (b.*)
… where a.*  |>  b.*;     -- b.* |>  a.*
… where a.*  <-> b.*;     -- distance between figures
```


3D-contour

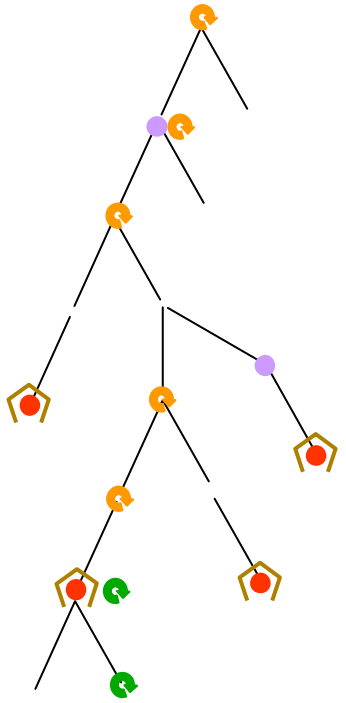
Broken line

```
create table concourse (id        number,
                        color     number array[3] color,
                        offset    number array[3] shift,    -- displacement of concourse
                        turn      number array[3] krylov, -- rotation of figure in e.g. Krylov angles
                        distance  number array[2]  span, -- around geom.center of  concourse
                        note      varchar);
create table figure     (id        number,
                        conc      number          references concorse(@id),
                        color     number array[3] color,
                        disp      number array[3] shift,  -- displacement of figure
                        rot       number array[3] euler, -- rotation of figure in e.g. Euler angles
                        range     number array[2]  span, -- around geometric center of  figure
                        line      number          references point(@id),
                        note      varchar);
create table point      (id        number,
                        next      number          references point(@id),
                        coord     number array[3] dot,       -- coordinates of point
                        time      datetime array[2] period, -- more usable than 'select…period'
                        note      varchar);
```

on 1 or more levels higher bottom 'dot'

- contour is broken line, which first and last points coincide
- surface is never described by any contour

Difference in Particularities



Sections:

- same section, where is ‘dot’, of each branch
- contains lines
- section refers to itself

Fields:

- ‘color, shift, euler/krylov, span’ are *ignored*:
- in points (lines), in sections below, if not sole in record
- line is *ignored*, if ambiguity because no refinement (slide 13)

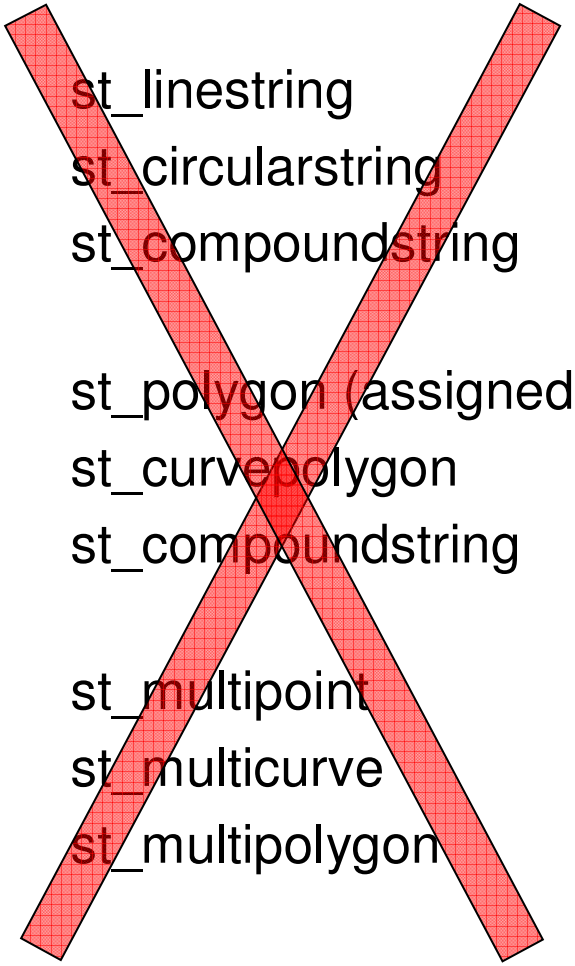
Operations: calculations

… where measure(a.*)=5; -- length, perimiter

-- return new lines under 2nd level figures of left tree (a.*)
… where a.* &   b.*;   -- comman records (lines) in 1st low levels
… where a.* ~& b.*;   -- geometrical overlap of figures (2nd level from bottom)
… where a.* ^   b.*;   -- geometrical place of touch of lines (but not cross)
… where a.* -| b.*;   -- geometrical place of cross of lines (but not touch)
… where a.* ^-| b.*;   -- (a.* ^ b.*) union (a.* -| b.*)

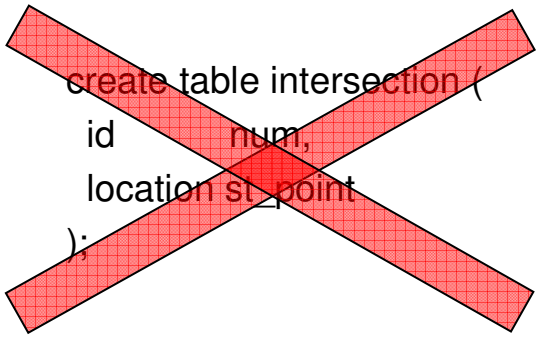
Concept for 2D

Current way is not usable



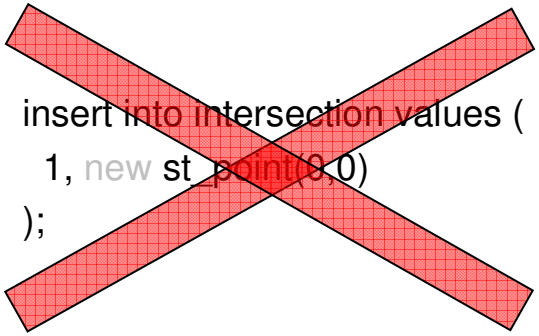
We are forced to learn
sophisticated SQL
to use redundant datatypes,
where we can use
usual schema of data

Array instead of new datatype



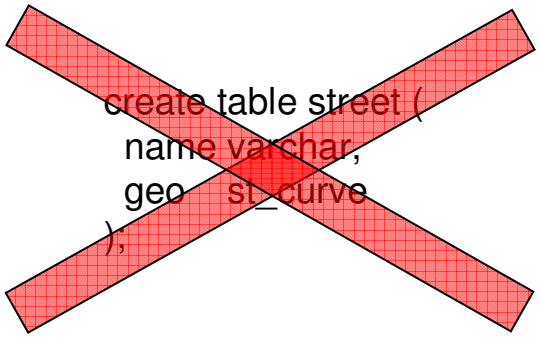

```
create table intersection (
  id           num,
  location num array[2] dot
);
```

Array instead of them



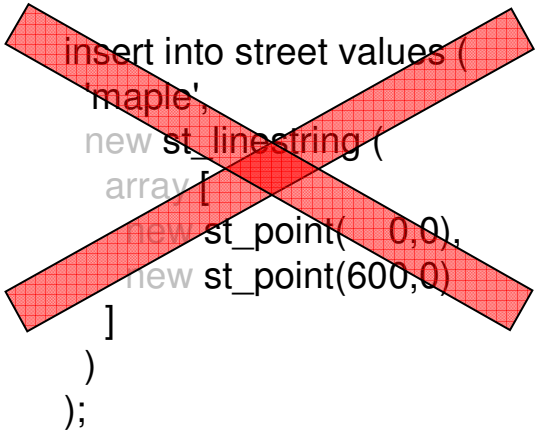

```
<intersection id="1" location="0 0">;
```

Schema instead of new datatypes



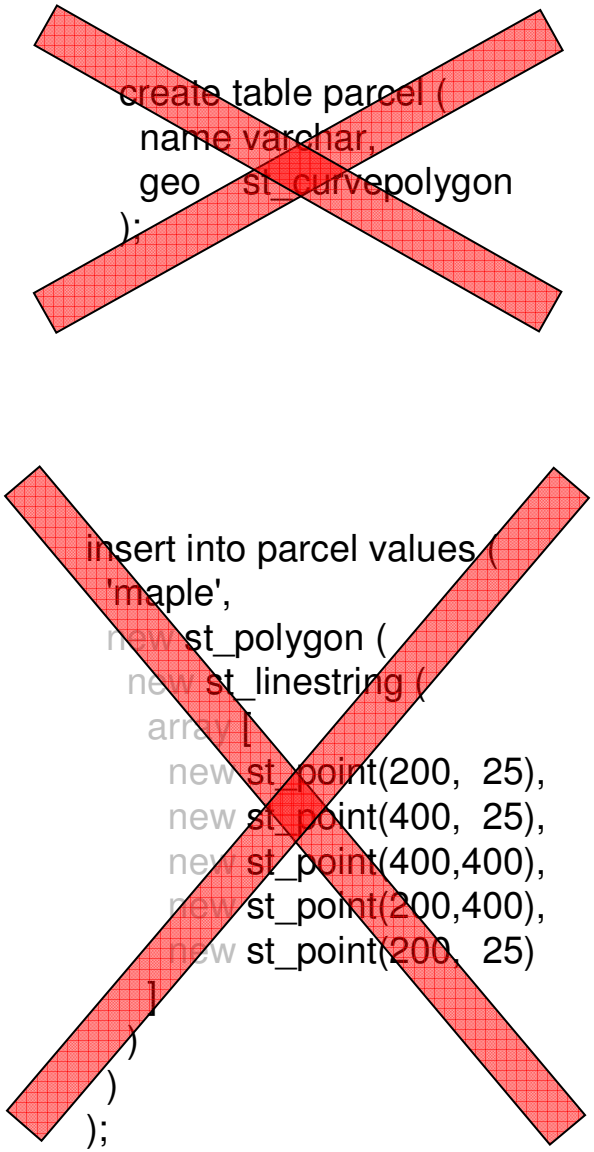

```
create table street (
  name varchar,
  first    num references segment(id)
);
create table segment (
  id       num,
  next   num references segment(id),
  point  num array[2] dot
);
```

Hierarchical data instead of them




```
<street          name="maple">
    <segment point="    0 0">
    <segment point="660 0">
</street>
;
```

Once again, schema instead




```
create table parcel (
  name varchar,
  first    num references segment(id)
);
create table segment (
  id       num,
  next   num references segment(id),
  point  num array[2] dot
);
```

```
<parcel          name="maple">
    <segment point="200   25">
    <segment point="400   25">
    <segment point="400 400">
    <segment point="200 400">
    <segment point="200   25">
</parcel>
;
```

Instead of pretentious datatypes

```
create table concourse (id        number,
                        depth     int         layer,
                        color     number array[3] color, -- both for border and for surface
                        offset    number array[2] shift,  -- displacement of concourse
                        turn      number          rotation, -- rotation of concourse
                        distance  number array[2]  span, -- around geom.center of  concourse
                        note      varchar);
create table figure     (id       number,
                        conc      number          references concorse(@id),
                        depth     int         layer,
                        color     number array[3] color,  -- both for border and for surface
                        disp      number array[2] shift,    -- displacement of figure
                        rot       number          rotation, -- rotation of figure
                        range     number array[2]  span,  -- around geometric center of  figure
                        line      number          references point(@id),
                        note      varchar);
create table point      (id       number,
                        next      number          references point(@id),
                        coord     number array[2] dot,      -- coordinates of point
                        time      datetime array[2] period, -- more usable than 'select…period
                        note      varchar);
```

on 1 or more levels higher bottom 'dot'

-- contour and surface are not differ in operations
-- contour is broken line, which first, last points coincide

Operations: Projection

```
select * from concouse.* UNION select * from gathering.*
where point/@time & [09.01.01, 09.01.01]
PROJECTING
[ eye    (0, 0) ]                    -- location of camera
[ width (3, 4) ]                     -- width of camera
[cycled|not cycled];

                -- un-visible surfaces and broken lines are ignored
                -- partly un-visible surfaces and broken lines are cut
                   before putting into output
                -- wholly visible surfaces and broken lines are put into output
```

Session parameters

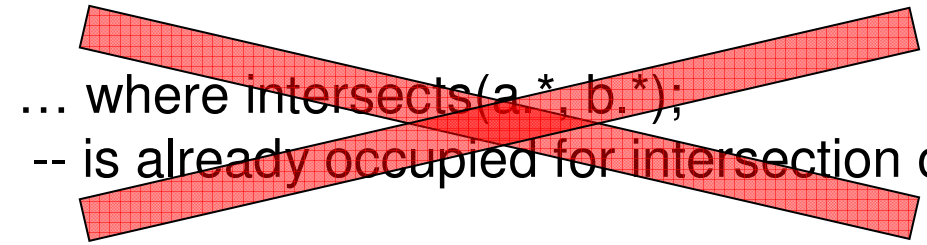
```
set 2Dcamera (0, 0) ;  -- move camera
set 2Dwidth    (3, 4) ;   -- change width of camera
```

Operations: Motion, deformation

```
update a.* shift   (5, 5);
update a.* rotate (45)     center (0, 0);
update a.* sprain (5, 5)   center (0, 0);

update a.* shift   (select …);
update a.* rotate (select …) center (select …);
update a.* sprain (select …) center (select …);
```

Operations: 2D-comparisons

```
-- return boolean
… where a.*    =        b.*;        -- the same dots
… where a.*  ~=         b.*;        -- the same area and shape
… where a.*       in    b.*;        -- b.* contains a.*
… where a.*       in=   b.*;        -- (a.* in  b.*) or (a.* = b.*)
… where a.*       in^   b.*;        -- a.* in  b.* and touch b.*
… where a.* out^        b.*;        -- a.* not in  b.* and touch b.*

… where a.* back in   b.*;          -- b.* in a.*
… where a.* back in=  b.*;          -- b.* in= a.*
… where a.* back in^  b.*;          -- b.* in^ a.*
```



… where intersects(a.*, b.*);
-- is already occupied for intersection of ‘select’

Operations: 2D-calculations

… where measure(a.*)=5; -- area

-- return new lines under 2nd level figures of left tree (a.*)
… where a.* &   b.*;   -- comman records (lines) in 1st low levels
… where a.* ~& b.*;   -- geometrical overlap of figures (2nd level from bottom)
… where a.* ^   b.*;   -- geometrical place of touch of lines (but not cross)
… where a.* -| b.*;   -- geometrical place of cross of lines (but not touch)
… where a.* ^-| b.*;   -- (a.* ^ b.*) union (a.* -| b.*)
… where a.* <| b.*;   -- closest point of left tree (a.*) to right tree (b.*)
… where a.* |> b.*;   -- b.* |> a.*
… where a.* <-> b.*;   -- distance between figures

Special value ‘mouse’

```
update point set @coord=mouse; -- value for array[2]
-- end of line is always in place, where mouse is

update point set @coord=default;
-- see ‘create table point (coord number array[3] default ... )’
```

2D-triggers

Trigger for shift, spain

```
create trigger t on tab
after      shift
when @offset.x=          -- distance of motion
  and @distab=           -- table name, on which 'tab' is dropped
  and @dispk=            -- value of primary key, on which 'tab' occurs
as begin …
   … where @fld=@offset.y;
```

```
create trigger t on tab
after      sprain
when @coef.x=  -- is normalized
  and @center.x=
  and @distab=
  and @dispk=
as begin …
   … where @fld=@coef.y;
   … where @fld=@center.y;
```

Trigger for rotation

```
create trigger t on tab
after      rotation
when @angle=              -- angle of rotation
  and @center.x=
  and @distab=            -- table name, on which 'tab' is dropped
  and @dispk=             -- value of primary key, on which 'tab' occurs
as begin …
   … where @fld=@angle;
   … where @fld=@center.y;
```

First object obtains mouse focus

```
create table a (
  id   number,
 focus – figure ‘a’ does not obtain focus
);
create table b (
  id   number,
  lnk number references a(@id),
  focus – figure ‘b’ does not obtain focus
);
create table c (
  id   number,
  ref number  references b(@id),
  v    number references d(@id)
 focus – figure ‘c’ does not obtain focus
);
create table d ( -- click is here
  id   number,
  r    number  references d(@id),
  x    number array[2] dot
  focus -- point obtains focus
);
```

```
create table a (
  id   number,
 focus – figure ‘a’ does not obtain focus
);
create table b (
  id  number,
  lnk number references a(@id),
  focus – figure ‘b’ obtains focus
);
create table c (
  id   number,
  ref number  references b(@id),
  v    number references d(@id)
          – figure ‘c’ does not obtain focus
);
create table d ( -- click is here
  id   number,
  r    number  references d(@id),
  x    number array[2] dot
          – point does not obtain focus
);
```

Window format, optionally

Switching and enquiring session parameter

set ws microsoft; -- to Microsoft window system

set ws x11; -- to X11 window system

show ws; ⟹ <?res code=0 ws=x11 /?>

Mixture of dimensions

3D point with 2D object

If 3D point refers to 2D figure (including 2D line itself), than 2D figure is always displayed in plane, perpendicular to look from camera

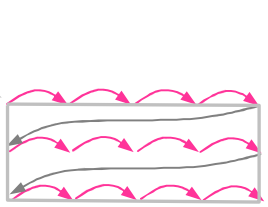
```
create table 3Dpoint (coord number  array[3] dot,
                      fig    number  references 2Dfig(@id),
                      note   varchar);
create table 2Dfig    (id     number,
                       line   number  references 2Dline(@id),
                       note   varchar);
create table 2Dline   (id     number,
                       next   number references 2Dline(@id),
                       coord number array[2] dot,
                       note   varchar);
```

The same is for ***text or blob*** field, marked by 'incamera', in 3D point

```
create table 3Dpoint (coord number  array[3] dot,
                      note   varchar  incamera);
```

3D triangle/quadrangle with 2D object

If 3D triangle (or quadrangle, i.e. left top angle of quadrangle) refers to 2D figure (including 2D line itself), than 2D figure is displayed in plane, perpendicular to look from camera (if refering field is marked by 'incamera'), or in plane of triangle/quadrangle (if is marked by 'infacet')



```
create table 3Dtriangle (vertex number  array[3] references 3Dpoint(@id),
                         fig    number  infacet   references 2Dfig(@id) );
create table 3Dpoint    (id     number,
                         coord  number  array[3] dot);
create table 2Dfig      (id     number,
                         line   number           references 2Dline(@id) );
create table 2Dline     (id     number,
                         next   number           references 2Dline(@id),
                         coord  number  array[2] dot);
```

3D triangle/quadrangle with text

The same is for ***text or blob*** field, marked by 'incamera' or by 'infacet', in 3D triangle/quadrangle

```
create table 3Dtriangle (vertex number  array[3] references 3Dpoint(@id),
                         note   varchar  infacet);
create table 3Dpoint    (id     number,
                         coord  number  array[3] dot);
```

Fielders, tablers

Fielders mark columns

```
create table fig      (id      num,
                       color   num array[3] color,
                       offset  num array[3] shift,
                       turn    num array[3] euler,
                       dist    num array[2] span);

create table fig4     (fg      num          references fig(@id),
                       range   num array[2] span,
                       time    time array[2] period,
                       side    num          references quadr(@id),
                       pic     blob         texture,
                       d       num          diffuse,
                       rf      num          reflect,
                       rd      num          radiate,
                       focus);
create table quadr    (id      num,
                       next    num          references quadr(@id),
                       vertex  num array[4] references point(@id) );

create table fig3     (id      num,
                       conc    num          references fig(@id),
                       range   num array[2] span,
                       focus);
create table tri      (fig     num          references fig3(@id),
                       vertex  num array[3] references point(@id) );

create table point    (id      num,
                       coord   num array[3] dot,
                       time    time array[2] period);
```

-- where dot(@fld) and ...

-- where user_fielder(@fld) and ...

string fielder

fielder name	example of value
constraint	somename
varchar	(30)
default	5
array	[5,10]
refers	tab/@fld
check	(@fld < 5)

may be followed

phrase in brackets, or only one word

boolean fielder

fielder name	example of value
serial, unique, notnull, notrift, notcross, sole, dot, shift, krylov, euler, rotation, span, period, color, texture, diffuse, reflect, radiate, infacet, incamera, user_fielder	true (if present) false (if absent)

Field constraint = domain = fielder

```
create fielder name    as … ;
create fielder primary as unique notnull;      -- fielder is a group of fielders

create fielder n       as float10 diffuse;
create fielder k       as float4 n;        -- error: fielder must not contain collisions
alter table tab alter fld set|drop n;      -- set|drop fielder


create table tab (fld int4 fieldername);  -- elementary boolean fielder
select * from tab where fieldername(@fld);
```

Tablers mark tables

```
create table fig      (id      num,
                       color   num array[3] color,
                       offset  num array[3] shift,
                       turn    num array[3] euler,
                       dist    num array[2] span);

create table fig4     (fg      num          references fig(@id),
                       range   num array[2] span,
                       time    time array[2] period,
                       side    num          references quadr(@id),
                       pic     blob         texture,
                       d       num          diffuse,
                       rf      num          reflect,
                       rd      num          radiate,
                       focus);
create table quadr    (id      num,
                       next    num          references quadr(@id),
                       vertex  num array[4] references point(@id) );

create table fig3     (id      num,
                       conc    num          references fig(@id),
                       range   num array[2] span,
                       focus);
create table tri      (fig     num          references fig3(@id),
                       vertex  num array[3] references point(@id) );

create table point    (id      num,
                       coord   num array[3] dot,
                       time    time array[2] period);
```

-- where user_tabler(tab) and ...

-- where focus(tab) and ...

string tabler

tabler name	example of value
constraint	somename
unique	(@fld1, @fld2)
foreign	(@fld1, @fld2)
refers	(tab[@fld1, @fld2])
check	(@fld+@fld2<10)

phrase in brackets, or only one word

boolean tabler

tabler name	example of value
focus, user_tabler	true (if present) false (if absent)

Table constraint = tabler
≠ composed data type

```
create tabler name as … ;
create tabler f       as focus check(@fld1+@fld2<10); -- tabler is a group of tablers

create tabler n       as check(@fld1>7 and @fld2>9);
create tabler k       as f n;                  -- error: tabler must not contain collisions
alter table tab set|drop n;                    -- set|drop tabler


create table tab (fld1 int4, tablername);  -- elementary boolean tabler
select * from tab where tablername(tab);
```