DOAG 2013

How to avoid a salted Banana

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A Joke that highlights an issue

The concept of throw away in performance tuning

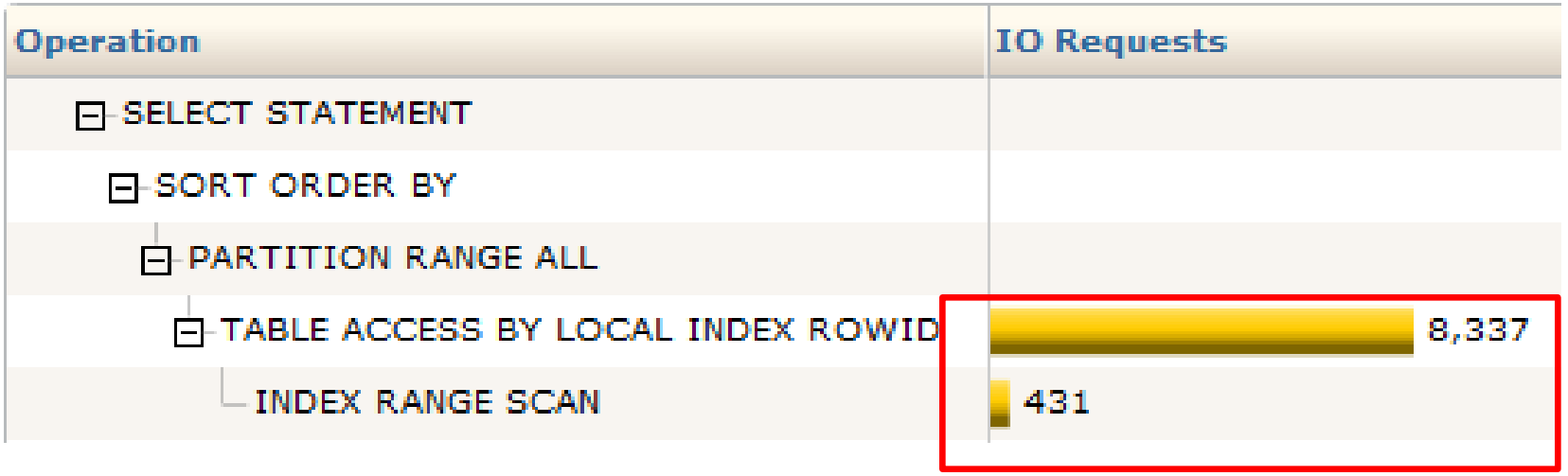
- commonly used in Performance tuning
- usually in the context of Join Sequence optimization
- or index optimization

Operation	Actual Rows
SELECT STATEMENT	1
SORT ORDER BY	1
PARTITION RANGE ALL	1
TABLE ACCESS BY LOCAL INDEX ROWID	1
INDEX RANGE SCAN	175K

- all but one row thrown away

To cache an (B-tree) index versus a table

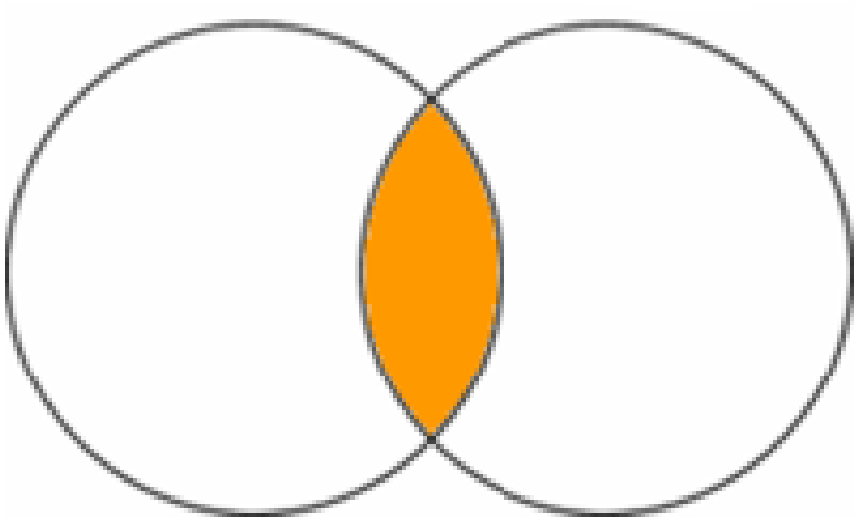
- generally indexes are cached better than underlying tables
- index blocks are likely to have a better hit ration than table blocks
  - index entries are usually smaller than underlying rows
  - indexes are clustered by definition



- the table access generates 19 times more I/O than the index access

A challenging query

- common query in call centers
- No matter where you start you always get a high number of rows
- the intersection of the two criteria is small
- query is throw away dominated



City = 'Bern' last name = 'Müller'

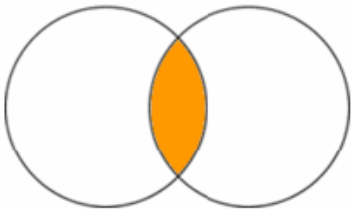
try to combine the criteria

- natural approach is combined search
- main issue is that the search criteria are on different tables
- No easy way to create combined search

different traditional approaches

- fast refresh materialized view
  - need rights and additional space
  - fast refresh very critical in OLTP
- bitmap join index
  - locking implications
  - fast refresh very critical in OLTP
- text index
  - “exotic” solution
  - requires purchase of text option
  - program change required for search operators

Why read the table if you are going to throw it away?



City = 'Bern' last name = 'Müller'

+

Operation	IO Requests
SELECT STATEMENT	
SORT ORDER BY	
PARTITION RANGE ALL	
TABLE ACCESS BY LOCAL INDEX ROWID	8,337
INDEX RANGE SCAN	431

=

example code

```
Create table address (city_name      varchar2(30) not null,
             person_id               number(7) not null,
             data                    varchar2(200))
/
create Table person (person_id number(7) not null,
                    last_name varchar2(15) not null,
                    data         varchar2(200))
/
create Index city_idx1 on address (city_name, person_id)
compress;
create Index city_idx2 on address (person_id, city_name)
compress;
create Index person_idx1  on person(last_name, person_id)
compress;
create Index person_idx2  on person(person_id, last_name)
compress;
```

example code continued

```
select * from (
select a.city_name, p.last_name, substr(p.data,1,1) p_data,
substr(a.data,1,1) a_data
  from ibj.address a,
       ibj.person p
where p.person_id = a.person_id
  and a.city_name = 'Bern'
  and p.last_name = 'Müller')
where rownum < 11
/
```

Oracle Optimizations for inner Table access

Randolf Geist (http://oracle-randolf.blogspot.ch/2011/07/logical-io-evolution-part-2-9i-10g.html):

Oracle introduced in recent releases various enhancements in that area - in particular in 9i the "Table Prefetching" and in 11g the Nested Loop Join Batching using "Vector/Batched I/O".

The intention of Prefetching and Batching seems to be the same - they both are targeted towards the usually most expensive part of the Nested Loop Join: The random table lookup as part of the inner row source. By trying to "prefetch" or "batch" physical I/O operations caused by this random block access Oracle attempts to minimize the I/O waits.

table prefetching (9i)

- access to inner table outside of the nested loop
- rowids are collected and buffered inside the nested loop
- access by rowid is done by a small vector I/O

Id	Operation	Name
0	SELECT STATEMENT	
* 1	COUNT STOPKEY	
2	TABLE ACCESS BY INDEX ROWID	PERSON
3	NESTED LOOPS	
4	TABLE ACCESS BY INDEX ROWID	ADDRESS
* 5	INDEX RANGE SCAN	CITY_IDX1
* 6	INDEX RANGE SCAN	PERSON_IDX2

nested loop batching (11g)

- extra nested loop introduced
- rowids are collected and buffered inside the nested loop
- access by rowid is done by a big vector I/O

```
-------------------------------------------------------------------
| Id  | Operation                              | Name             |
-------------------------------------------------------------------
|   0 | SELECT STATEMENT                       |                  |
|*  1 |  COUNT STOPKEY                         |                  |
|   2 |   NESTED LOOPS                         |                  |
|   3 |    NESTED LOOPS                        |                  |
|   4 |     TABLE ACCESS BY INDEX ROWID        | ADDRESS          |
|*  5 |      INDEX RANGE SCAN                  | CITY_IDX1        |
|*  6 |     INDEX RANGE SCAN                   | PERSON_IDX2      |
|   7 |    TABLE ACCESS BY INDEX ROWID         | PERSON           |
-------------------------------------------------------------------
```

example code rewritten for Index Backbone Join

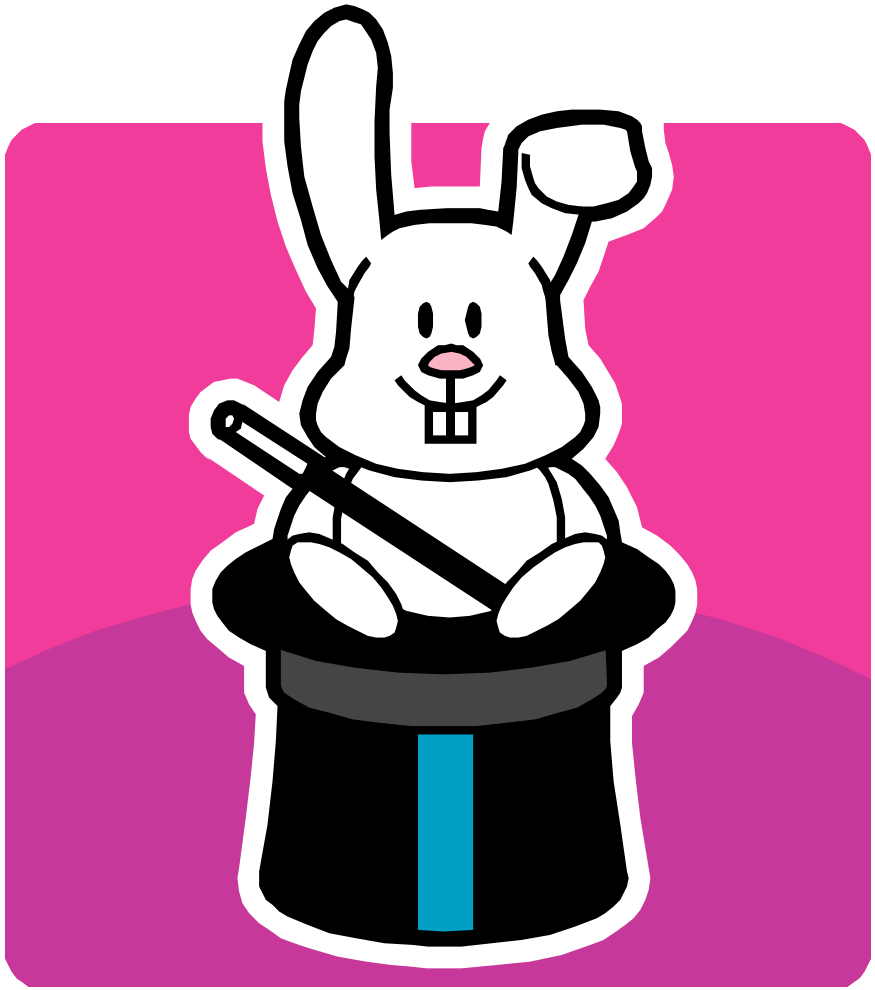
```
select * from (
select a.city_name, p.last_name, substr(p.data,1,1) p_data,
       substr(a.data,1,1) a_data
  from ibj.person p,
       ibj.address a,
       (select /*+ NO_MERGE  */ p.rowid p_rowid,
               a.rowid a_rowid
          from ibj.address a,
               ibj.person p
         where p.person_id = a.person_id
           and a.city_name = 'Bern'
           and p.last_name = 'Müller'
        ) i
where i.p_rowid = p.rowid
  and i.a_rowid = a.rowid)
where rownum < 11
/
```

Index Backbone Join

- extra nested loop programmed
- all filtering in the indexes
- rowids are cached in the intermediate resultset
- access to the tables is delayed for the last possible moment

```
-----------------------------------------------------------------------
| Id  | Operation                           | Name                    |
-----------------------------------------------------------------------
|   0 | SELECT STATEMENT                    |                         |
|*  1 |  COUNT STOPKEY                      |                         |
|   2 |   NESTED LOOPS                      |                         |
|   3 |    NESTED LOOPS                     |                         |
|   4 |     VIEW                            |                         |
|*  5 |      HASH JOIN                      |                         |
|*  6 |       INDEX RANGE SCAN              | PERSON_IDX1             |
|*  7 |       INDEX RANGE SCAN              | CITY_IDX1               |
|   8 |     TABLE ACCESS BY USER ROWID      | PERSON                  |
|   9 |    TABLE ACCESS BY USER ROWID       | ADDRESS                 |
-----------------------------------------------------------------------
```

Demo



Timings – native 11G

- Optimizer decides for nexted loop batching
- table access for Address almost 2 minutes
- batched access to person table Person fast

Id	Operation	Name	Starts	E-Rows	A-Rows	A-Time	Buffers	Reads
0	SELECT STATEMENT		1		10	00:03:24.42	44271	29509
* 1	COUNT STOPKEY		1		10	00:03:24.42	44271	29509
2	NESTED LOOPS		1		10	00:03:24.42	44271	29509
3	NESTED LOOPS		1	11	10	00:03:24.31	44261	29499
4	TABLE ACCESS BY INDEX ROWID	ADDRESS	1	12	14731	00:01:55.73	14793	14792
* 5	INDEX RANGE SCAN	CITY_IDX1	1	44244	14731	00:00:00.93	62	61
* 6	INDEX RANGE SCAN	PERSON_IDX2	14731	1	10	00:01:28.51	29468	14707
7	TABLE ACCESS BY INDEX ROWID	PERSON	10	1	10	00:00:00.11	10	10

Timings – Index Backbone Join

- no_merge hint necessary or query gets rewritten to previous result
- non optimized view allows for hash join
- very efficient
- buffer cache was flashed for fair comparison

Id	Operation	Name	Starts	E-Rows	A-Rows	A-Time	Buffers	Reads
0	SELECT STATEMENT		1		10	00:00:00.40	150	149
* 1	COUNT STOPKEY		1		10	00:00:00.40	150	149
2	NESTED LOOPS		1	10	10	00:00:00.40	150	149
3	NESTED LOOPS		1	10	10	00:00:00.26	140	139
4	VIEW		1	42105	10	00:00:00.14	130	129
* 5	HASH JOIN		1	42105	10	00:00:00.14	130	129
* 6	INDEX RANGE SCAN	PERSON_IDX1	1	42105	15445	00:00:00.01	68	68
* 7	INDEX RANGE SCAN	CITY_IDX1	1	44244	14731	00:00:00.11	62	61
8	TABLE ACCESS BY USER ROWID	PERSON	10	1	10	00:00:00.13	10	10
9	TABLE ACCESS BY USER ROWID	ADDRESS	10	1	10	00:00:00.14	10	10

Conclusions

- completely different look on queries

```
select * from (
select a.city_name, p.last_name,
       substr(p.data,1,1) p_data,
       substr(a.data,1,1) a_data
  from ibj.person p,
       ibj.address a,
       (select /*+ NO_MERGE  */ p.rowid p_rowid,
               a.rowid a_rowid
          from ibj.address a,
               ibj.person p
         where p.person_id = a.person_id
          and a.city_name = 'Bern'
          and p.last_name = 'Müller'
       ) i
where i.p_rowid = p.rowid
  and i.a_rowid = a.rowid)
where rownum < 11
```

Ballast

essential columns

Quo vadis ?