

ORACLE

Oracle Database In-Memory

AskTOM Office Hours, External Tables

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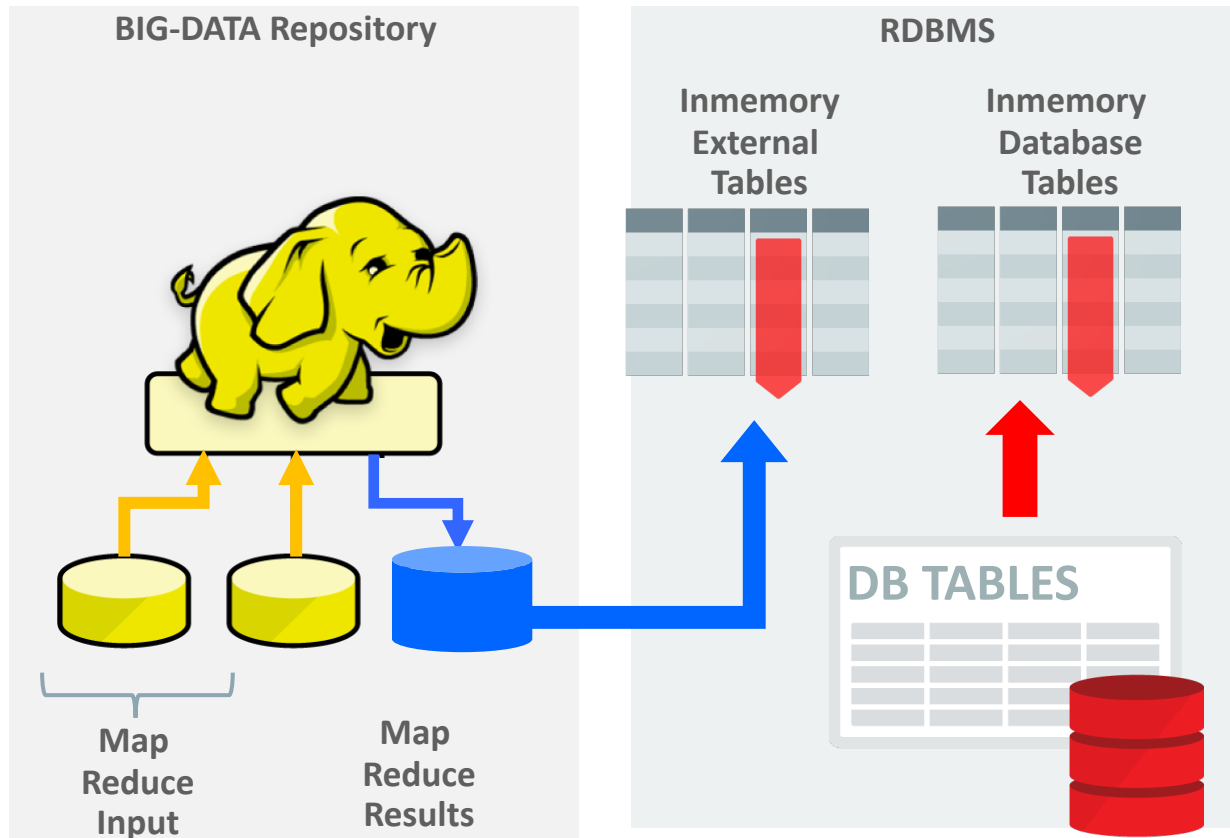


Additional Database In-Memory External Table Information

- Previous Ask TOM Sessions:
 - Database In-Memory 21c New Features
- Database In-Memory blog posts:
 - 18c
 - 21c
- Database In-Memory Documentation
 - In-Memory Guide

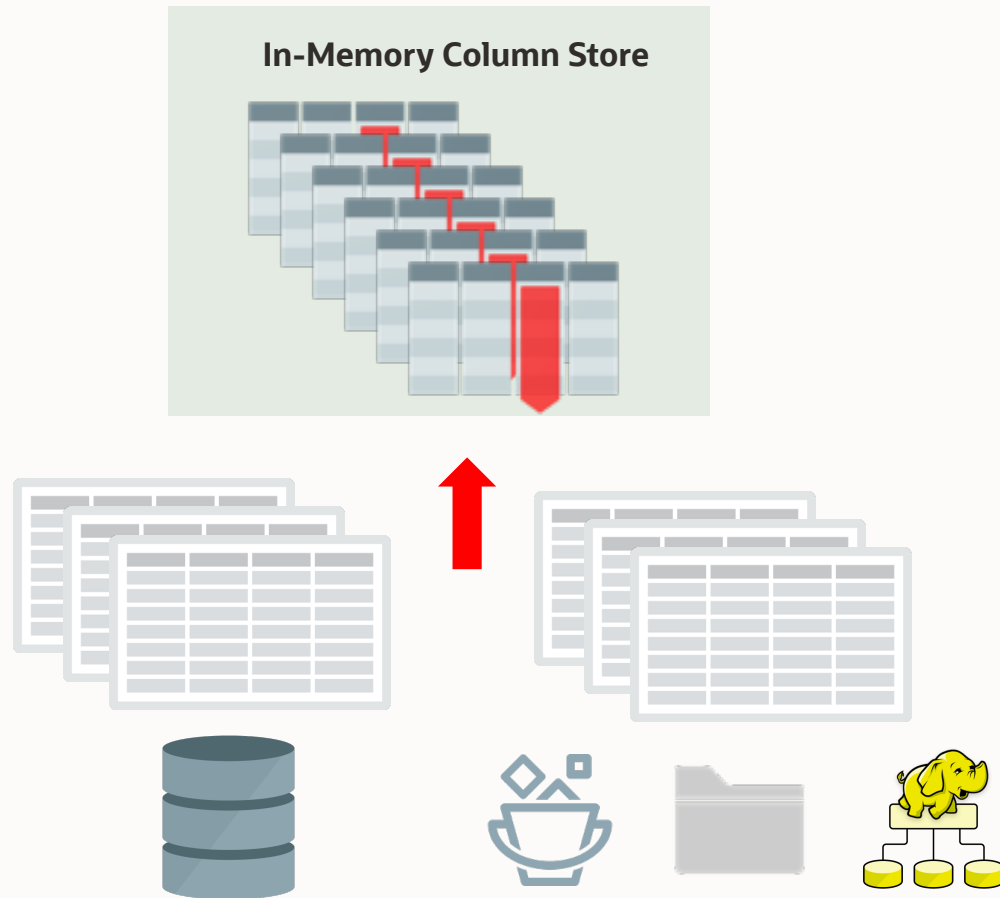
In-Memory For External Tables

Fast Analytics on External Data



- Introduced in Oracle Database 18c
- External Tables allow transparent access to external file data
 - In-Memory For External Tables will allow fast analytics on external data without having to import it into the database
- **All In-Memory Optimizations** apply
 - e.g. vector processing, JSON
- Up to **100X** faster

Enhanced In-Memory External Table Support



- Introduced in Oracle Database 21c
- Now supports population for partitioned external tables or hybrid external tables
 - INMEMORY clause at the top-level is inherited by every partition
 - INMEMORY attribute can also be specified for individual partitions
- Flexibility to only populate selected external and/or internal partitions

External Table Example

```
create table ext_cust
( custkey number, name varchar2(25), address varchar2(26), city varchar2(24), nation varchar2(19) )
organization external
(
  type oracle_loader
  default directory ext_dir
  access parameters (
    records delimited by newline
    fields terminated by '%'
    missing field values are null
    ( custkey, name, address, city, nation ) )
  location ('ext_cust.csv')
)
reject limit unlimited
```

Partition External Table Example

```
create table ext_cust_part
( custkey number, name varchar2(25), address varchar2(26), city varchar2(24), nation varchar2(19) )
organization external
(
  type oracle_loader
  default directory ext_dir
  access parameters (
    records delimited by newline
    fields terminated by '%'
    missing field values are null
    ( custkey, name, address, city, nation ) )
)
reject limit unlimited
partition by list (nation)
(
  partition n1 values('RUSSIA') location ('ext_cust_russia.csv'),
  partition n2 values('JAPAN') location ('ext_cust_japan.csv'),
  partition n3 values('VIETNAM') location ('ext_cust_vietnam.csv'),
  partition n4 values('ALGERIA') location ('ext_cust_algeria.csv'),
  partition n5 values('CHINA') location ('ext_cust_china.csv') )
```

Hybrid Partition Table Example

```
create table ext_cust_hybrid_part
( custkey number, name varchar2(25), address varchar2(26), city varchar2(24), nation varchar2(19) )
external partition attributes
(
  type oracle_loader
  default directory ext_dir
  access parameters (
    records delimited by newline
    fields terminated by '%'
    missing field values are null
    ( custkey, name, address, city, nation ) )
  reject limit unlimited
)
partition by list (nation)
( partition n1 values('RUSSIA')   external location ('ext_cust_russia.csv'),
  partition n2 values('JAPAN')   external location ('ext_cust_japan.csv'),
  partition n3 values('BULGARIA'),
  partition n4 values('NORWAY') )
```


Housekeeping

Setup

- Directory(s) to support external tables

```
create directory ext_dir as '/home/user/ext_tables'
```

- Hybrid partitioned tables were introduced in 19c

```
create table ext_cust_hybrid_part
```

```
*
```

```
ERROR at line 1:
```

```
ORA-00406: COMPATIBLE parameter needs to be 19.0.0.0.0 or greater
```

```
ORA-00722: Feature "hybrid partitioned tables"
```

- In-Memory hybrid partitioned tables were introduced in 21c
- In-Memory external table access requires:

```
ALTER SESSION SET QUERY_REWRITE_INTEGRITY=stale_tolerated;
```

- Two different views for partitions:

```
user_tab_partitions
```

```
user_external_tab_partitions
```

Cautions

- External files must honor the partition key
 - Oracle does not check the external files for validity
 - Invalid external table formats may cause wrong results
- External table are not automatically re-populated if they change
 - External tables must always be populated/re-populate with `DBMS_INMEMORY.(RE)POPULATE`
- Results are also undefined if a partition is altered (by dropping or adding values)

External Table Demos

External Table Query Example

Required for IM External Table queries

```
alter session set QUERY_REWRITE_INTEGRITY = stale_tolerated;
```

```
SQL> select nation, count(*) from EXT_CUST group by nation;
```

NATION	COUNT (*)
ALGERIA	2360
CHINA	2427
JAPAN	2413
RUSSIA	2463
VIETNAM	2344

```
SQL>
```

External Table Execution Plan Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT				30 (100)	
1	HASH GROUP BY		5	80	30 (4)	00:00:01
2	EXTERNAL TABLE ACCESS INMEMORY FULL	EXT_CUST	12007	187K	29 (0)	00:00:01

External Table Access



External Partition Table Query Example

```
alter session set QUERY_REWRITE_INTEGRITY = stale_tolerated;
```

```
SQL> select nation, count(*) from EXT_CUST_PART group by nation;
```

NATION	COUNT (*)
RUSSIA	2463
JAPAN	2413
VIETNAM	2344
ALGERIA	2360
CHINA	2427

```
SQL>
```

External Partition Table Execution Plan Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	Pstart	Pstop
0	SELECT STATEMENT				30 (100)			
1	PARTITION LIST ALL		5	80	30 (4)	00:00:01	1	5
2	HASH GROUP BY		5	80	30 (4)	00:00:01		
3	EXTERNAL TABLE ACCESS INMEMORY FULL	EXT_CUST_PART	12007	187K	29 (0)	00:00:01	1	5

External Partition Table Access



Hybrid Partition Table Query Example

```
alter session set QUERY_REWRITE_INTEGRITY = stale_tolerated;
```

```
SQL> select nation, count(*) from EXT_CUST_HYBRID_PART group by nation;
```

NATION	COUNT (*)
RUSSIA	2463
JAPAN	2413
BULGARIA	2360
NORWAY	2360

```
SQL>
```

Hybrid Partition Table Execution Plan Example

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time	Pstart	Pstop
0	SELECT STATEMENT				15 (100)			
1	PARTITION LIST ALL		4	52	15 (7)	00:00:01	1	4
2	HASH GROUP BY		4	52	15 (7)	00:00:01		
3	TABLE ACCESS HYBRID PART INMEMORY FULL	EXT_CUST_HYBRID_PART	9596	121K	14 (0)	00:00:01	1	4
4	TABLE ACCESS INMEMORY FULL	EXT_CUST_HYBRID_PART					1	4

New HYBRID PART access method



Where Can You Get More Information?

https://blogs.oracle.com/in-memory/dbim-resources

