和高水位线相关的性能问题主要有：

- SQL查询全表扫描；
- 直接路径加载；

本篇主要演示高水位线产生以及如何消除。

1 高水位线演示

1.1 创建测试数据

SQL> create table t_hwm segment creation immediate tablespace users as select * from dba_objects where 1=2;

Table created.
SQL> col segment_name for a30
SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
------------------------------ ---------- ------------------------------ ---------- ---------
T_HWM ASSM USERS 8 1

SQL> show parameter db_block_size

NAME TYPE VALUE
------------------------------------ ----------- ------------------------------
db_block_size integer 8192

> 此时表没有分析，是原始数据，即8个数据块（因为db_block_size默认是8K，创建一个表默认的初始化段是64K）。

```
SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t
WHERE t.table_name='T_HWM';

TABLE_NAME                     NUM_ROWS     BLOCKS EMPTY_BLOCKS
------------------------------ ---------- ---------- ------------
T_HWM
```

> BLOCKS：代表该表中曾经使用过的数据块的数目，即水线；
> EMPTY_BLOCKS：代表分配给该表，但在水线以上的数据库块，即从来没有使用的数据块。

1.2 插入测试数据

```
SQL> insert into t_hwm select * from dba_objects;

91592 rows created.

SQL> commit;

Commit complete.
```

1.3 查看数据字典信息

```
SQL> SELECT
t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM
Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME                   SEGMENT_SU TABLESPACE_NAME                BLOCKS
EXTENTS
------------------------------ ---------- ------------------------------ ----------
---------
T_HWM                          ASSM       USERS                                1664
28

SQL> SELECT COUNT(1) FROM Dba_Extents t WHERE t.segment_name='T_HWM';

  COUNT(1)
```

```
----------
        28
```

```
SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t
WHERE t.table_name='T_HWM';

TABLE_NAME                     NUM_ROWS     BLOCKS EMPTY_BLOCKS
------------------------------ ---------- ---------- ------------
T_HWM
```

> 可以看到，分配的数据块是1664，区为28，表为空，是因为没有经过分析；

1.4 收集统计信息

```
SQL> exec dbms_stats.gather_table_stats(USER,'T_HWM');

PL/SQL procedure successfully completed.

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t
WHERE t.table_name='T_HWM';

TABLE_NAME                     NUM_ROWS     BLOCKS EMPTY_BLOCKS
------------------------------ ---------- ---------- ------------
T_HWM                           91592  1630            0
```

> 收集完统计信息Dba_Tables有数据，显示使用了1630个数据块，但EMPTY_BLOCKS为0，这个字段需要使用analyze分析后才会有数据。

```
SQL>  analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t
WHERE t.table_name='T_HWM';

TABLE_NAME                     NUM_ROWS     BLOCKS EMPTY_BLOCKS
```

---------- ---------- ---------- ----------
T_HWM 91592 1630 34

> BLOCKS+EMPTY_BLOCKS=1664，和Dba_Segments.blocks相等。Dba_Segments.blocks表示分配给这个表的所有的数据块的数目，user_tables.blocks表示已经使用过的数据库块的数目。

1.5 Delete不会降低HWM

SQL> delete from t_hwm;

91592 rows deleted.

SQL> commit;

Commit complete.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
---------- ---------- ---------- ---------- ----------
T_HWM ASSM USERS 1664 28

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t WHERE t.table_name='T_HWM';

TABLE_NAME NUM_ROWS BLOCKS EMPTY_BLOCKS
---------- ---------- ---------- ----------

```
T_HWM                          0      1630            34

SQL> select count(distinct
dbms_rowid.rowid_block_number(rowid)||dbms_rowid.rowid_relative_fno(rowid))
used from T_HWM;

      USED
----------
         0
```

> 表里没有任何数据块容纳数据，即表里无数据。

1.6 Append方式insert会使用HWM之上的数据块

```
SQL> insert /*+ append */ into t_hwm select *from dba_objects;

91592 rows created.

SQL> commit;

Commit complete.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT
t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM
Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME                   SEGMENT_SU TABLESPACE_NAME            BLOCKS
EXTENTS
------------------------------ ---------- ------------------------------ ---------- ---------
-
T_HWM                          ASSM       USERS                        3328     41
```

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t WHERE t.table_name='T_HWM';

TABLE_NAME NUM_ROWS BLOCKS EMPTY_BLOCKS
---------- ---------- ---------- ------------
T_HWM 91592 3227 101

> append方式插入数据，只会使用HWM之上的数据块，导致HWM增大。

1.7 Normal方式Insert插入，可使用HWM之下的数据块

SQL> insert into t_hwm select *from dba_objects;

91592 rows created.

SQL> commit;

Commit complete.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
---------- ---------- ---------- ---------- ---------
T_HWM ASSM USERS 3328 41

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t WHERE t.table_name='T_HWM';

TABLE_NAME NUM_ROWS BLOCKS EMPTY_BLOCKS
------------------------------ ---------- ---------- ------------
T_HWM 183184 3227 101

2 高水位线消除

消除高水位线的方法有：

- TRUNCATE语句；
- ALTER table ... Shrink Space ；
- ALTER table ... Move；

2.1 TRUNCATE语句消除HWM

SQL> truncate table t_hwm;

Table truncated.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
------------------------------ ---------- ------------------------------ ---------- ----------
T_HWM ASSM USERS 8 1

2.2 Shrink表

SQL> insert into t_hwm select *from dba_objects;

91592 rows created.

SQL> commit;

Commit complete.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> delete from t_hwm;

91592 rows deleted.

SQL> commit;

Commit complete.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
---------- ---------- ---------- ---------- ---------
T_HWM ASSM USERS 1664 28

SQL> alter table t_hwm enable row movement;

Table altered.

SQL> alter table t_hwm shrink space;

Table altered.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
---------- ---------- ---------- ---------- ---------
T_HWM ASSM USERS 8 1

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t WHERE t.table_name='T_HWM';

TABLE_NAME NUM_ROWS BLOCKS EMPTY_BLOCKS
---------- ---------- ---------- ------------
T_HWM 0 1 7

> 必须启用行迁移，并且表空间为自动段空间管理，通过收缩表，高水位线下移。如果有索引，可以使用alter table t_hwm shrink space cascade语句。

2.3 Move表

移动表可以是在当前表空间重建表，或者在另一个表空间重建表。

SQL> insert into t_hwm select *from dba_objects;

91592 rows created.

SQL> commit;

Commit complete.

SQL> delete from t_hwm;

91592 rows deleted.

SQL> commit;

Commit complete.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
------------------------------ ---------- ------------------------------ ---------- ---------
T_HWM ASSM USERS 1664 28

SQL> alter table t_hwm move;

Table altered.

SQL> analyze table t_hwm compute statistics;

Table analyzed.

SQL> SELECT t.segment_name,t.segment_subtype,t.tablespace_name,t.blocks,t.extents FROM

Dba_Segments t WHERE t.segment_name='T_HWM';

SEGMENT_NAME SEGMENT_SU TABLESPACE_NAME BLOCKS EXTENTS
------------------------------ ---------- ------------------------------ ---------- ---------
T_HWM ASSM USERS 8 1

SQL> SELECT t.table_name,t.num_rows,t.blocks,t.empty_blocks FROM Dba_Tables t WHERE t.table_name='T_HWM';

TABLE_NAME NUM_ROWS BLOCKS EMPTY_BLOCKS
------------------------------ ---------- ---------- ------------
T_HWM 0 0 8