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#IDUGDB2

Advanced Performance Diagnostics for SQL

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Session Code: D03
Monday May 23rd, 3:45 – 4:45pm
Platform: DB2 for Linux, Unix, Windows

Objectives

- Learn how to pinpoint your most expensive SQL statements using the package cache table functions
- Learn how to analyze where a problem query is spending its time using time spent metrics
- Learn how to monitor query sort memory usage and spilling
- Learn how to use the runtime explain capabilities and activity event monitor to capture both the actual cardinalities and the new object metrics for a problem query.
- Take away practical examples you can try out in your own environment.

Agenda

- A quick review of the core DB2 monitoring capabilities
- Identifying high impact SQL statements
- Analyzing queries using Time Spent
- Monitoring query sort memory usage and spilling
- Advanced diagnostics using Runtime Explain and Section Actuals

A Quick Review of the Core DB2 Monitoring Capabilities

DB2 Monitoring Basics

- How do I monitor what DB2 is doing?
  - Real-time in-memory metrics using SQL functions
  - Historical data captured using event monitors
- Also of note
  - Snapshot monitoring
  - db2pd
- For this session we'll focus on the latest generation of monitoring capabilities introduced starting in DB2 9.7

Lightweight Monitoring Functions

- MON_* SQL functions introduced starting in DB2 9.7
- Less impact / more efficient then snapshot functions
  - Direct in-memory access through trusted routines (not fenced wrappers over snapshot apis)
  - Much less latch contention
    - Uses new infrastructure that pushes data up to accumulation points rather than forcing monitor queries to do extensive drilldown
  - Lower CPU consumption
  - Significantly faster response time
  - Less FCM resource usage / internode traffic
- Monitoring data collection carries low overhead – is enabled by default on new databases

Monitoring Perspectives and Dimensions

- DB2 allows monitoring metrics to be accessed through a number of different reporting dimensions
- Allows more effective drilldown, and different perspectives on the data to help isolate problems
- Three main dimensions, each consisting of a number of reporting points with corresponding routines
- System / Request
  - Provide total perspective of application work being done by database system
  - Aggregated through the WLM infrastructure
- Data objects
  - Provide perspective of impact of all activity occurring with the scope of data objects
  - Aggregated through data storage infrastructure
- **Activity / Query**
  - **Provide perspective of work being done by specific SQL statements**
  - **Aggregated through the package cache infrastructure**

In this session we will spend our time here

Access Points: Activity Perspective

- MON_GET_PKG_CACHE_STMT
  - Both static and dynamic SQL (historical)
- MON_GET_PKG_CACHE_STMT_DETAILS
  - XML based output
- MON_GET_ACTIVITY
  - Information on current executing activities / queries
- MON_GET_ACTIVITY_DETAILS
  - XML based output

Some Additional Tips

- Monitoring data is accumulated and maintained in-memory from point of database activation until de-activation
  - Explicitly activate your database to ensure consistent availability of monitoring metrics
- Monitoring metrics are incremented globally at each of the reporting levels and do not reset
  - To compute changes in metrics over a specific period of time take an initial baseline sample and compute deltas from that (eg. compute I/O a particular SQL statement has driven over the past 5 mins)
- Event monitors can be utilized to capture and persist event based data for historical analysis
  - Package cache event monitor for aggregate statement data
  - Activity event monitor for individual statement executions

Identifying High Impact SQL Statements

MON_GET_PKG_CACHE_STMT()

- Ideal entry point for analyzing query problems
- Query a wealth of metrics for any statement that is active in the package cache
  - Rank and order by any of these metric
  - Aggregate metrics accumulated after each statement execution
  - Both static and dynamic SQL
  - Metrics collected by default
  - Low overhead
- Retains significant workload information with a modest PCKCACHESZ
- Package Cache Event Monitor can be configured in cases where cache evictions are causing information to be lost
- Only limitation is that it doesn't track individual executions

Finding High Impact Queries

Top 5 queries by statement execution time in server

```
select stmt_exec_time, num_executions, stmt_text
from table(mon_get_pkg_cache_stmt(null,null,null,-2)) as s
order by stmt_exec_time desc fetch first 5 rows only
```

Statement with most execution time in the server

```
STMT_EXEC_TIME       NUM_EXECUTIONS       STMT
-------------------- -------------------- ------------------------------------------------------------
             3951764              2218111 SELECT s_quantity, s_dist_01, s_dist_02,                 …
              902078               195866 SELECT c_balance, c_delivery_cnt                         …
              619547               212999 DECLARE CUST_CURSOR1 CURSOR FOR SELEC                    …
              480681               221873 SELECT w_tax, c_discount, c_last, c_credit               …
              441494                20124 SELECT count(distinct S_I_ID) INTO :H                    …
```

More High Impact Queries

Top 5 most CPU intensive queries

```
select stmt_exec_time, num_executions,
       (total_cpu_time / 1000) as cpu_time,
       stmt_text
from table(mon_get_pkg_cache_stmt(null,null,null,-2)) as s
order by cpu_time desc fetch first 5 rows only
```

```
select stmt_exec_time, num_executions,
       (pool_read_time + pool_write_time +
       direct_read_time + direct_write_time) as io_time
 from table(mon_get_pkg_cache_stmt(null,null,null,-2)) as t
order by io_time desc fetch first 5 rows only
```

Top 5 most I/O intensive queries

Queries with the Worst Relative Velocity

```
select total_act_time, total_act_wait_time,
   (case when total_act_time > 0
    then ((total_act_time - total_act_wait_time) * 100
          / total_act_time)
    else 100
    end) as relvelocity,
    stmt_text
from table (mon_get_pkg_cache_stmt(null,null,null,-2)) as t
order by relvelocity fetch first 5 rows only
```

Compute percentage of query time where we're processing

Relative velocity shows the degree to which progress of the query is impacted by waits

Majority of query time spent in waits!

TOTAL_ACT_TIME	TOTAL_ACT_WAIT_TIME	RELVELOCITY	STMT_TEXT
1481597	1457690	1	DECLARE READ_ORDERLI …
228	223	2	create view dbtimeme …
28	27	3	alter table activity …
30	29	3	create event monitor …
35	33	5	create event monitor …

Queries with the Least Efficient Plans

```
select rows_returned, rows_read,
       (case when rows_returned > 0
        then rows_read / rows_returned
        else 0
       end) as ratio,
       stmt_text as stmt
from table(mon_get_pkg_cache_stmt(null,null,null,-2)) as p
order by ratio desc
fetch first 10 rows only
```

Ratio of rows read to rows returned

This query shows us how much data we processed to produce a single row of results

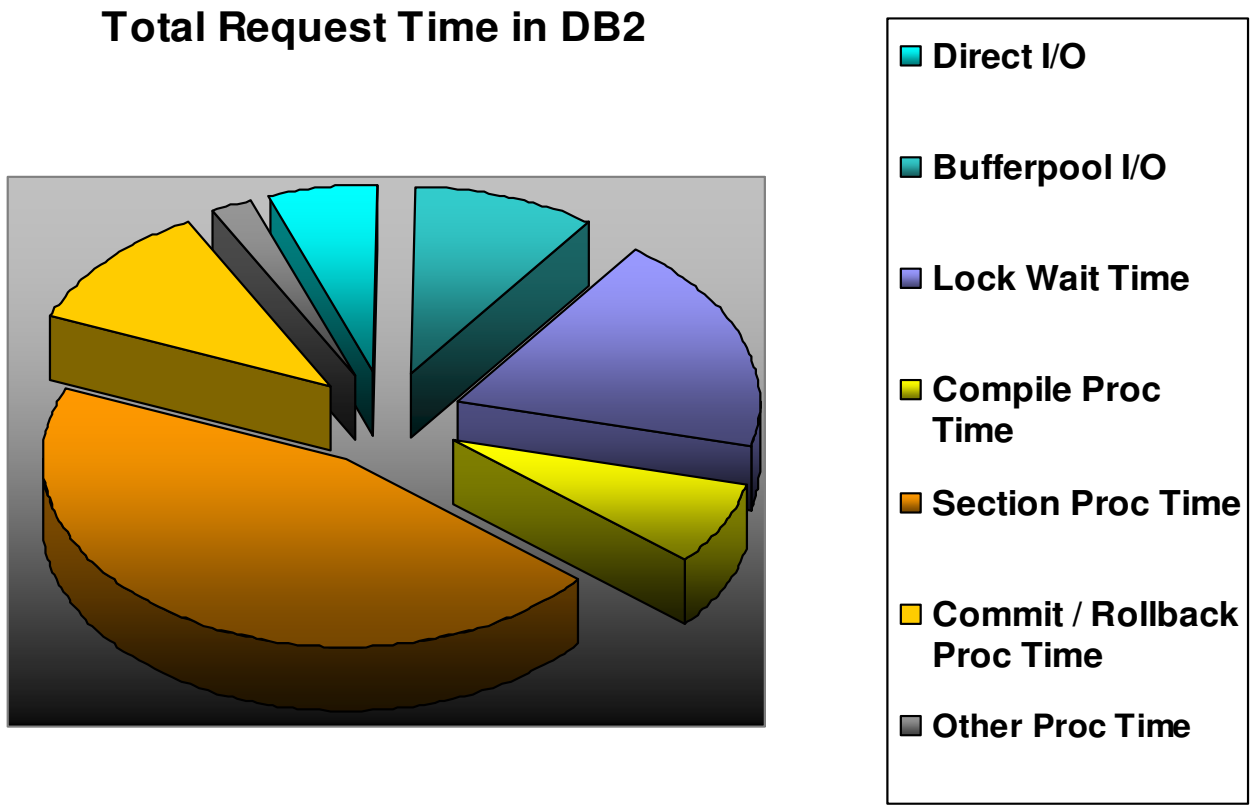
ROWS_RETURNED	ROWS_READ	RATIO	STMT
2	11137814	5568907	select count(*) from acti…
1	5568907	5568907	select min(time_completed
3	9	3	select * from syscat.WORK…
9	9	1	select substr(serviceclas…
9	9	1	select * from dbtimedelta…
2843729	2843729	1	DECLARE CUST_CURSOR1 CURS…
2843729	2843729	1	SELECT w_street_1, w_stre…
29599464	29599528	1	SELECT s_quantity, s_dist…
0	14	0	alter table control drop…
0	13	0	create view dbtimemetrics…

Analyzing Queries Using Time Spent

Time Spent Metrics

- A set of metrics in DB2 that represent a breakdown of where time is spent within the server
  - Represents sum of time spent by each agent thread in the system (foreground processing)
  - Provides user with a *relative* breakdown of time spent, showing which areas are the most expensive during request / query processing
  - Available in both the system and activity perspectives
    - This presentation will focus on analysis from the activity perspective
  - Can be used for rapid identification and diagnosis of performance problems
- Times are divided into:
  - Wait times
    - Time agent threads spend blocking on I/O, network communications, etc
  - Processing times
    - Time spent processing in different component areas when the agent was not stuck on a wait
  - Summary / total times
    - Total time spent in a particular component area including both processing + wait times

"Time Spent" Metrics: Breakdown of Wait + Processing Times in DB2

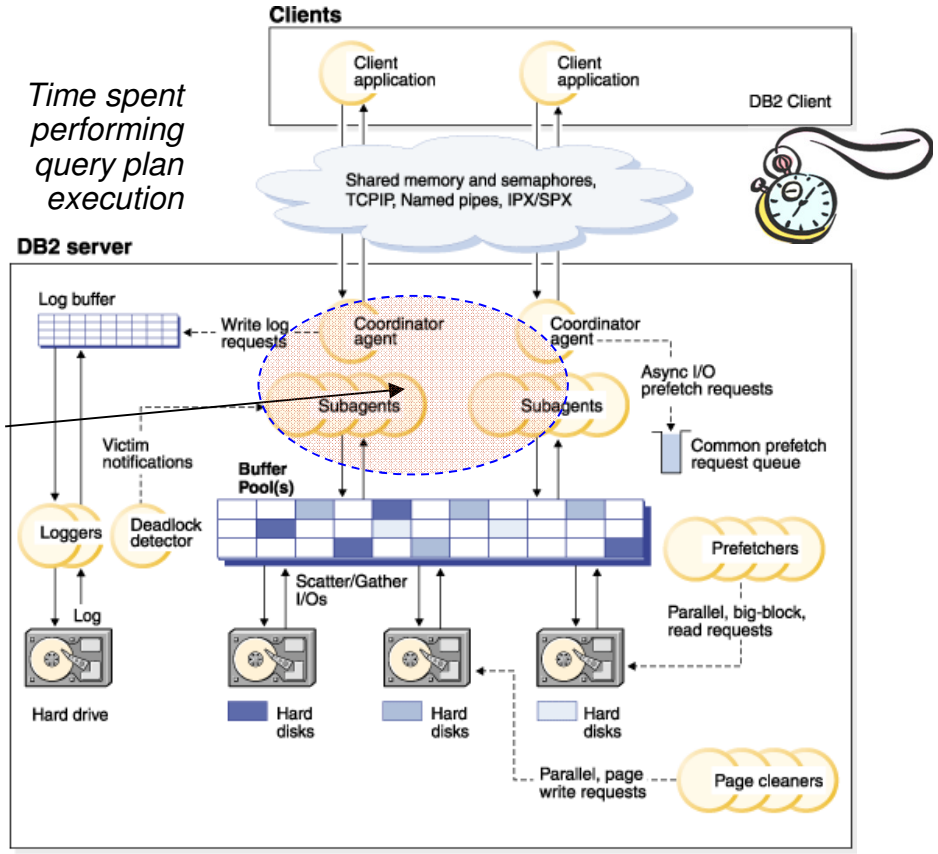


Activity Time Spent Hierarchy

"Time spent" metrics are mutually exclusive and in aggregate form a hierarchy (shown below) that breaks down the time spent executing queries in the database server on behalf of the client. Below we show the hierarchy for the activity perspective.

SQL Statement Execution

- WLM_QUEUE_TIME_TOTAL
- STMT_EXEC_TIME
  - TOTAL_ACT_WAIT_TIME
    - LOCK_WAIT_TIME
    - LOG_BUFFER_WAIT_TIME
    - LOG_DISK_WAIT_TIME
    - FCM_SEND/RECV_WAIT_TIME
    - DIAGLOG_WRITE_WAIT_TIME
    - POOL_READ/WRITE_TIME
    - DIRECT_READ/WRITE_TIME
    - (…)
  - TOTAL_SECTION_PROC_TIME
    - TOTAL_SECTION_SORT_PROC_TIME
    - **TOTAL_COL_PROC_TIME [new]**
  - TOTAL_ROUTINE_NON_SECT_PROC_TIME
    - TOTAL_ROUTINE_USER_CODE_PROC_TIME
  - **TOTAL_INDEX_BUILD_PROC_TIME [new]**
  - *(Any nested query processing)*



Analyzing Individual Queries Using Time Spent

- Once we have pinpointed our statements of interest, our next step is to drill down into these individual statements to understand where they are spending their time
- By understanding where the time is being spent in the query we can identify where the database server is spending effort, and look for opportunities for tuning
- We can use the `EXECUTABLE_ID` value from problem statements identified via examples in the previous section to lookup detailed time metrics for statements of interest and perform more in depth analysis
  - Uniquely identifies each query plan in the package cache

"Where is my time being spent?"

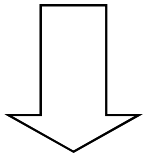
Show me the full hierarchy of waits + processing times for a particular statement

```
select p.executable_id, r.metric_name, r.parent_metric_name,
       r.total_time_value as time, r.count, p.member
from
(select stmt_exec_time, executable_id
from table(mon_get_pkg_cache_stmt(null,null,null,-2)) as s
order by stmt_exec_time desc fetch first row only) as stmts,
table(mon_get_pkg_cache_stmt_details(null,
                                     stmts.executable_id,
                                     null,
                                     -2)) as p,
table(mon_format_xml_times_by_row(p.details)) as r
order by stmts.executable_id, total_time_value desc
```

Find statement with most time in server

Executable ID for our statement(s) of interest

Format XML details to produce row based format for time spent metrics



(continued)

EXEC_ID	METRIC_NAME	PARENT_METRIC_NAME	TIME	COUNT	MEMBER
x'00000001…'	STMT_EXEC_TIME	-	6676617	110191	0
x'00000001…'	TOTAL_ROUTINE_NON_SECT_PROC_TIME	STMT_EXEC_TIME	6008956	110191	0
x'00000001…'	TOTAL_ROUTINE_USER_CODE_PROC_TIME	TOTAL_ROUTINE_NON_S	6008956	110191	0
x'00000001…'	POOL_READ_TIME	TOTAL_ACT_WAIT_TIME	372754	52135	0
x'00000001…'	TOTAL_ACT_WAIT_TIME	STMT_EXEC_TIME	372754	-	0
x'00000001…'	TOTAL_SECTION_PROC_TIME	STMT_EXEC_TIME	294907	0	0
x'00000001…'	WLM_QUEUE_TIME_TOTAL	-	0	0	0
x'00000001…'	FCM_TQ_RECV_WAIT_TIME	FCM_RECV_WAIT_TIME	0	0	0
x'00000001…'	FCM_MESSAGE_RECV_WAIT_TIME	FCM_RECV_WAIT_TIME	0	0	0
x'00000001…'	FCM_TQ_SEND_WAIT_TIME	FCM_SEND_WAIT_TIME	0	0	0
x'00000001…'	FCM_MESSAGE_SEND_WAIT	FCM_SEND_WAIT_TIME	0	0	0
x'00000001…'	LOCK_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	DIRECT_READ_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	DIRECT_WRITE_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	LOG_BUFFER_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	LOG_DISK_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	POOL_WRITE_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	AUDIT_FILE_WRITE_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	AUDIT_SUBSYSTEM_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	DIAGLOG_WRITE_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	FCM_SEND_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	FCM_RECV_WAIT_TIME	TOTAL_ACT_WAIT_TIME	0	0	0
x'00000001…'	TOTAL_SECTION_SORT_PRO	TOTAL_SECTION_PROC_T	0	0	0

…

Common Statement Bottlenecks

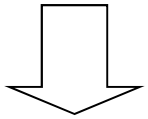
- I/O bottlenecks
  - Large bufferpool read / write times may indicate excessive table scans occurring, spilling to temps, or a poorly tuned I/O subsystem
  - Unexpected direct read / write times may indicate lobs that aren't inlined properly, or unexpected usage of temps in query plan
- Locking bottlenecks
  - Large lock wait times indicate contention problems in your workload are affecting your query performance
- Routine bottlenecks
  - Large routine times may indicate inefficiencies or problems with procedures or user defined functions
- Reclaim wait bottlenecks [PureScale]
  - Large reclaim wait times indicate cross member page contention is impacting your query execution
- Diagnostic or audit bottlenecks
  - Diag log or audit wait times may indicate cases where diagnostic or audit related logging is unexpectedly impacting query performance

New Time Spent Metrics in DB2 10.5

- TOTAL_BACKUP_TIME / TOTAL_BACKUP_PROC_TIME / TOTAL_BACKUPS *[DB2 10.5 Cancun]*
  - New time spent category for online backups
- TOTAL_INDEX_BUILD_TIME / TOTAL_INDEX_BUILD_PROC_TIME / TOTAL_INDEXES_BUILT *[DB2 10.5 Cancun]*
  - New time spent category for index creation / recreations
- TOTAL_COL_TIME / TOTAL_COL_PROC_TIME
  - Time spent in the columnar runtime

Example: Assessing Efficiency of Columnar Query

```
SELECT TOTAL_SECTION_TIME, TOTAL_COL_TIME,
       DEC((FLOAT(TOTAL_COL_TIME)/
            FLOAT(NULLIF(TOTAL_SECTION_TIME,0)))*100,5,2)
       AS PCT_COL_TIME
FROM TABLE(MON_GET_PKG_CACHE_STMT(NULL,NULL,NULL,-1)) AS T
WHERE STMT_TEXT = 'SELECT * FROM TEST.COLTAB A, TEST.ROWTAB B WHERE A.ONE = B.ONE'
```



```
 TOTAL_SECTION_TIME   TOTAL_COL_TIME        PCT_COL_TIME
 -------------------- -------------------- ------------
                    5                    4        80.00
```

Compute the ratio of columnar processing time to overall section processing time to see how much we're leveraging the columnar runtime

Majority of processing occurred in the highly optimized columnar runtime

Monitoring Query Sort Memory Usage and Spilling

Monitoring Sort Memory Usage

- Sort memory can be monitoring through the following metrics
  - SORT_SHRHEAP_ALLOCATED (current)
  - SORT_SHRHEAP_TOP (high watermark)
  - SORT_CONSUMER_SHRHEAP_TOP (per consumer hwm) (DB2 10.5 Cancun+)
- Accessible at multiple levels of reporting
  - MON_GET_DATABASE (Database level)
  - MON_GET_PKG_CACHE_STMT (Query level) (DB2 10.5 Cancun+)
  - MON_GET_SERVICE_SUBCLASS_STATS (Subclass level) (DB2 10.5 Cancun+)
  - Others (DB2 10.5 Cancun+)
- Example:

```
SELECT SORT_SHRHEAP_ALLOCATED,
       SORT_SHRHEAP_TOP
FROM TABLE(MON_GET_DATABASE(-1))
```

Obtain current and maximum sort usage for the database

Monitoring Sort Consumers

- Total individual sort consumer counts including
  - TOTAL_SORT_CONSUMERS (overall total) (DB2 10.5 Cancun+)
  - TOTAL_HASH_GRPBYS
  - TOTAL_HASH_JOINS
  - TOTAL_OLAP_FUNCS
  - TOTAL_SORTS
  - TOTAL_COL_VECTORS_CONSUMERS (DB2 10.5 Cancun+)

- Memory throttling and overflow / spill counts
  - POST_THRESHOLD_HASH_GRPBYS / HASH_GRPBY_OVERFLOWS
  - POST_THRESHOLD_HASH_JOINS / HASH_JOIN_OVERFLOWS
  - POST_THRESHOLD_OLAP_FUNCS / OLAP_FUNC_OVERFLOWS
  - POST_THRESHOLD_SORTS / SORT_OVERFLOWS
  - POST_THRESHOLD_COL_VECTOR_CONSUMERS

Monitoring Sort Consumers

- Active sort consumer counts and high watermarks
  - ACTIVE_SORT_CONSUMERS / ACTIVE_SORT_CONSUMERS_TOP (DB2 10.5 Cancun+)
  - ACTIVE_HASH_GRPBYS / ACTIVE_HASH_GRPBYS_TOP
  - ACTIVE_HASH_JOINS / ACTIVE_HASH_JOINS_TOP
  - ACTIVE_OLAP_FUNCS / ACTIVE_OLAP_FUNCS_TOP
  - ACTIVE_SORTS / ACTIVE_SORTS_TOP
  - ACTIVE_COL_VECTORS_CONSUMERS / ACTIVE_COL_VECTOR_CONSUMERS_TOP (DB2 10.5 Cancun+)
- Also accessible at multiple levels of reporting
  - MON_GET_DATABASE (Database level)
  - MON_GET_PKG_CACHE_STMT (Query level)
    MON_GET_SERVICE_SUBCLASS_STATS (Subclass level)
  - Others

Monitoring for Spilling

```
with ops as
( select
  (total_sorts + total_hash_joins + total_hash_grpbys)
   as sort_ops,
  (sort_overflows + hash_join_overflows + hash_grpby_overflows)
   as overflows,
   sort_shrheap_top as sort_heap_top
from table(mon_get_database(-2)))
select sort_ops,
       overflows,
       (overflows * 100) / nullif(sort_ops,0) as pctoverflow,
       sort_heap_top
from ops;
```

Extract percentage of sort operations that have spilled and high watermark sort usage

SORT_OPS	OVERFLOWS	PCTOVERFLOW	SORT_HEAP_TOP
1200	300	25	12777216

If SORT_HEAP_TOP is near the configured SHEAPTHRES_SHR it indicates that our SORTHEAP is overconfigured relative to our concurrency limits

About 25% of our sort operations overflowed and spilled indicating some tuning may be worthwhile

Monitoring Query Sort Usage and Consumers

```
SELECT SORT_SHRHEAP_TOP,
       SORT_CONSUMER_SHRHEAP_TOP,
       ACTIVE_SORT_CONSUMERS_TOP,
       NUM_EXECUTIONS,
       (TOTAL_SORTS +
        TOTAL_HASH_JOINS +
        TOTAL_HASH_GRPBYS +
        TOTAL_COL_VECTOR_CONSUMERS) AS SORT_OPS,
       (SORT_OVERFLOWS +
        HASH_JOIN_OVERFLOWS +
        HASH_GRPBY_OVERFLOWS) AS SORT_OVERFLOWS,
       (POST_THRESHOLD_SORTS +
        POST_THRESHOLD_HASH_JOINS +
        POST_THRESHOLD_HASH_GRPBYS +
        POST_THRESHOLD_COL_VECTOR_CONSUMERS) AS THROTTLED_SORT_OPS,
       SUBSTR(STMT_TEXT,1,255) AS STMT_TEXT
FROM TABLE(MON_GET_PKG_CACHE_STMT(NULL,NULL,NULL,-2))
```

Sort usage + biggest individual consumer + active consumers

Aggregate sort operators

Aggregate sort overflows / spills

Aggregate throttled sort operators

Total memory usage

Biggest single operator

4 distinct sort consumers in this query

```
SORT_SHRHEAP_TOP SORT_CONSUMER_SHRTHEAP_TOP ACTIVE_SORT_CONSUMERS_TOP … STMT_TEXT
---------------- --------------------------- -------------------------- ------------------------
          262144                      131072                          4 WITH OPS AS (SELECT …
```

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Advanced Diagnostics using Runtime Explain and Section Actuals

Introducing Runtime Explain

- There may be cases when a more detailed analysis of query execution is required than can be provided with basic monitoring metrics such as time spent
- In these cases the tool we typically turn to is the EXPLAIN feature of DB2 – which we will refer to herein as the "SQL Compiler EXPLAIN"
  - This capability compiles an input SQL statement and allows you to format and view the query plan
  - Expected to be a generally accurate approximation of the query you actually ran
  - May differ due to differences in compilation environment and/or table statistics from when your query was compiled
- In DB2 9.7 we also introduced the ability to perform a "Runtime EXPLAIN" (otherwise known as an explain from section) which produces output directly from a compiled query plan in the engine.
- Allows you to generate plan output from the actual section you were executing
- Enables additional diagnostic features like section actuals and object metrics

Explain from Section Procedures

- A set of stored procedures provided that allow you to format a runtime section into the explain tables
  - EXPLAIN_FROM_CATALOG
  - EXPLAIN_FROM_SECTION
  - EXPLAIN_FROM_ACTIVITY
  - EXPLAIN_FROM_DATA
- Explain table content can then be processed using the standard explain tools (eg. db2exfmt)
- Explain output can be generated from any of the following sources:
  - Static or dynamic statement entries in the package cache
  - Any cache entry captured by the new package cache event monitor
  - Static statement from the catalog tables
  - Statement execution captured with section by the activity event monitor

Section Actuals + Object Metrics

- One of the key benefits of the explain from section capability is the ability to capture and format "section actuals" and "object metrics"
  - All EXPLAIN output will contain cardinality estimates for individual operators in the plan
  - Explains generated from captured activity data (EXPLAIN_FROM_ACTIVITY) will also contain actual cardinalities and metrics per-data object within the query

- Examining this output gives you a detailed indication of what actually happened during the query execution
  - How closely actual cardinalities matched estimates
  - What activity occurred on individual data objects (in DB2 10.1+)
- In order to examine these metrics we will need to capture an execution of our SQL statement of interest using the activity event monitor

Capturing Activities to Obtain Detailed Explain Metrics

- The **activity event monitor** in DB2 allows the capture of execution details for individual SQL statements as well as several other recognized activities (eg. Load)
- It can be configured to capture a variety of different metrics as well as the section data which includes actual cardinalities and object metrics
- Since the capture of individual activities is quite granular we offer a fair degree of flexibility allowing the following data capture options:
  - Capture data for all activities running in a particular WLM workload
  - Capture data for all activities running in a particular WLM service class
  - Capture data for activities that violate a particular WLM threshold
- We can also enable the capture of activities run by a specific application using the WLM_SET_CONN_ENV procedure
- Our final example will demonstrate how to capture a statement of interest using the activity event monitor and then obtain the detailed explain metrics

Step I: Prereq Setup Steps

```
call sysproc.sysinstallobjects('EXPLAIN','C',null,null)
```

Create the explain tables…

```
create event monitor actEvmon for activities write to table
activity ( table activity, in monitorTBS ),
activityvals ( table activityvals, in monitorTBS ),
activitystmt ( table activitystmt, in monitorTBS ),
activitymetrics ( table activitymetrics, in monitorTBS ),
control ( table control, in monitorTBS )
manualstart
```

Create the activity event monitor

Step II: Capturing the Activity Data

```
set event monitor actEvmon state 1
call wlm_set_conn_env(null,
    '<collectactdata>WITH DETAILS, SECTION</collectactdata>
     <collectactpartition>ALL</collectactpartition>
     <collectsectionactuals>BASE</collectsectionactuals>')
```

Enable the event monitor and setup to capture a statement on my connection

```
select t1.ident, sum(t1.data) as data,
       sum(t2.moredata) as moredata
from t1,t2
where t1.ident=t2.ident
group by t1.ident
```

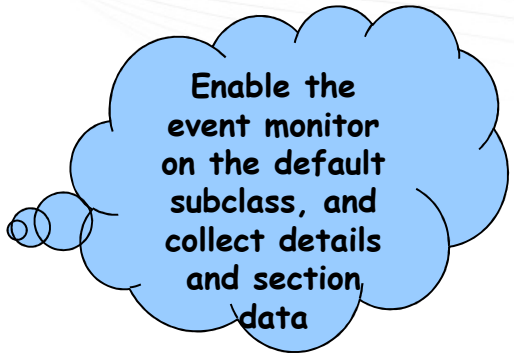
Execute the statement I'm interested in

```
call wlm_set_conn_env(null,
   '<collectactdata>NONE</collectactdata>
    <collectsectionactuals>BASE</collectsectionactuals>')
set event monitor actEvmon state=0
```

Disable collection and the event monitoring once I am done

Step II: Another approach

```
set event monitor actEvmon state 1
update db cfg using section_actuals base
alter service class sysdefaultsubclass under
   sysdefaultuserclass
     collect activity data on all database partitions with
   details,section
```

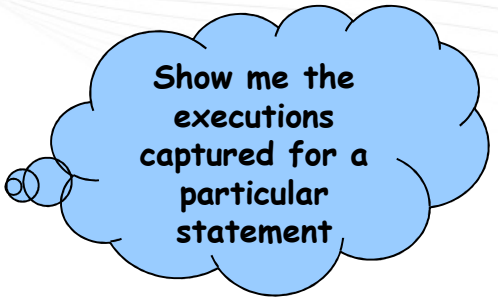


(Queries of interest run and are captured…)

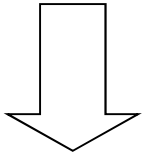
```
alter service class sysdefaultsubclass under
   sysdefaultuserclass
     collect activity data none
update db cfg using section_actuals none
set event monitor actEvmon state 0
```

Step III: Locating the activity of interest

```
select a.appl_id, a.uow_id, a.activity_id, a.appl_name,
       s.executable_id, s.stmt_text
from activity as a,
     activitystmt as s
     where a.appl_id = s.appl_id and
           a.uow_id = s.uow_id and
           a.activity_id = s.activity_id and
           s.stmt_text like 'select * from t1%'
```



Identifiers for the activity



```
APPL_ID                    UOW_ID ACTIVITY_ID  EXECUTABLE_ID   STMT_TEXT                  APPL_NAME
-------------------------- ------ ------------ --------------- -------------------------- ----------
*LOCAL.davek.100917004844 62     1            x'010000…1E00' select * from t1,t2 where…  db2bp
```

Step III: An alternate approach

```
select a.appl_id, a.uow_id, a.activity_id, a.appl_name,
       m.total_cpu_time, s.executable_id, s.stmt_text
from
       activity as a,
       activitystmt as s,
       activitymetrics as m
where a.appl_id = s.appl_id and
      a.uow_id = s.uow_id and
      a.activity_id = s.activity_id
and
      a.appl_id = m.appl_id and
      a.uow_id = m.uow_id and
      a.activity_id = m.activity_id
order by total_cpu_time desc fetch first 5 rows only
```

Find the captured activities with the largest CPU time

Statement executable id

Identifiers for the activity

APPL_ID	UOW_ID	ACTIVITY_ID	APPL_NAME	TOTAL_CPU_TIME	EXECUTABLE_ID	STMT_TEXT
*LOCAL.davek.100917004844	62	1	db2bp	30500	x'0100…01E00'	select t1.ident, sum(t1.d …
*LOCAL.davek.100917004844	64	1	db2bp	5360	x'0100…00900'	CALL wlm_set_conn_env(?,? …
*LOCAL.davek.100917001050	105	1	db2bp	4603	x'0100…04A00'	CALL wlm_set_conn_env(?,? …
*LOCAL.davek.100919015109	20	1	db2bp	444	x'0100…05000'	SELECT TABNAME, TABSCHEMA …
*LOCAL.davek.100919015109	25	1	db2bp	406	x'0100…05000'	SELECT TABNAME, TABSCHEMA …

Step III: Notes on DPF and PureScale

- In DPF, statement execution is distributed across multiple partitions
  - Activity data must be collected on all partitions to capture all the work done by the query
  - Each partition involved in the query will generate an activity record and separate section actuals corresponding to that partition's contribution
  - The explain process will amalgamate information across partitions automatically
- In PureScale statement execution is local to a particular member
  - Only the coordinator member will execute the query plan and generate section actuals
  - Note that the statement execution may still involve contention on global resources that are being contended for by other members

Step IV: Performing and Formatting the Explain from Section

Identifiers for the activity

```
call explain_from_activity('*LOCAL.davek.100715194643',
                           85,1, 'ACTEVMON', null,
                           ?,?,?,?,?)
```

Perform an explain on the activity of interest…

```
db2exfmt -d sample -w -1 -n %% -# 0 -s %% -o explain.txt
```

Now format the most recent data in the explain tables to a readable text file

Step V: Examining the Explain Output (Cardinalities)

Estimated Cardinality
(vs)
Actual Cardinality

```
Access Plan:
-----------
Total Cost:        30.8779
Query Degree:      1

          Rows
      Rows Actual
        RETURN
        (   1)
         Cost
          I/O
          |
           6
           30
        GRPBY
        (   2)
        30.8423
          NA
          |
          |
           16
           90
        HSJOIN
        (   3)
        30.7964
          NA
     /-----+------\
    60              2.66667
    50               NA
  TBSCAN           FILTER
  (   4)           (   7)
  9.4529           2.69976
    NA               NA
    |                |
    60              16
    50              16
   SORT            IXSCAN
  (   5)           (   8)
  9.40141          2.69976
    NA               NA
    |                |
    |                |
     |                |
     60              16
     50              16
    SORT            IXSCAN
   (   5)           (   8)
   9.40141          2.69976
     NA               NA
     |                |
     60               -1
     60               NA
   TBSCAN     INDEX: DAVEK
   (   6)          IDX1
   9.27088         Q2
     NA
     |
     60
     NA
TABLE: DAVEK
     T2
     Q1
```

Step V: Examining the Explain Output (Object Metrics)

```
Runtime statistics for objects used in Access Plan:
---------------------------------------------------

Schema: DAVEK
Name:     IDX1
Type:     Index

          Metrics
          --------------------
          object_index_l_reads:5
          object_index_lbp_pages_found:5
          object_index_gbp_indep_pages_found_in_lbp:5

Schema: DAVEK
Name:     T2
Type:     Table

          Metrics
          --------------------
          rows_reads:60
          object_data_l_reads:10
          object_data_lbp_pages_found:10
          object_data_gbp_indep_pages_found_in_lbp:10
```

Index Object

Index I/O metrics

Table Object

Table activity + I/O

Per-object metrics available through EXPLAIN (10.1+)

- Tables
  - Rows inserted / updated / deleted / read
  - Overflow creates / accesses
  - Lock wait time + lock escalations
  - Direct reads / writes
  - Bufferpool metrics for data, xda, columnar storage(10.5)
- Indexes
  - Bufferpool metrics for index storage

Questions?

DB2 Monitoring Resources

- Tuning and Monitoring Database System Performance
  - https://www.ibm.com/developerworks/community/wikis/form/anonymous/api/wiki/0fc2f498-7b3e-4285-8881-2b6c0490ceb9/page/24f2e298-60e3-4a19-8da8-0d92b775ed66/attachment/2a8df9be-3958-47b1-b92c-11d66745176e/media/DB2BP_System_Performance_0813.pdf
- DB2 Monitoring Enhancements for BLU Acceleration
  - http://www.ibm.com/developerworks/data/library/techarticle/dm-1407monitor-bluaccel/index.html

How Can You Get Started with Data Server Manager?

DB2 ADVANCED EDITIONS

Included as part of DB2 Advanced Editions

Target: Existing and New Customers

BUSINESS VALUE OFFERING- PERFORMANCE MANAGEMENT OFFERING

Purchase in support of non-advanced DB2 editions

Target Customers: DB2 customers expanding their footprint incrementally

LICENSE EXCHANGE O… FROM EXISTING TOOLS T… PERFORMANCE MANAGEMENT OFFERING

Move existing customers(OPM, OQWT, OCM) to DB2 Advanced Editions(via trade-up part number) or Performance Management Offering (via license exchange)

Target Customers: Existing DB2 customers who are already using the tools

DB2 NON-ADVANCED EDITION CUSTOMERS

Included in DB2 (basic database administration and performance mgmt.)

Target Customers: DB2 customers who just want base functionality

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IBM

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D01

Advanced Performance Diagnostics for SQL

Please fill out your session evaluation before leaving!