Monitor and Manage IBM i with SQL Services

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Db2 for i development

IBM i Anywhere
IBM i Everywhere

SEMIUG

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What are IBM i Services

- SQL views, functions, and procedures
- Provide SQL access to system information
  - Similar to what CL commands provide
  - Similar to what APIs provide
- The data is accessed at the time the request is made
- Almost all services are shipped in the QSYS2 library
- The SYSTOOLS library contains working examples that can be studied and copied

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Performance Consideration

- Whenever possible, use predicates to limit the amount of data that needs to be extracted

  - Slow

```
SELECT * FROM QSYS2.OBJECT_PRIVILEGES
  WHERE AUTHORIZATION_NAME = '*PUBLIC' AND
        OBJECT_AUTHORITY   = '*ALL';
```

  - Faster

```
SELECT * FROM QSYS2.OBJECT_PRIVILEGES
  WHERE SYSTEM_OBJECT_SCHEMA = 'TOYSTORE' AND
        AUTHORIZATION_NAME   = '*PUBLIC'  AND
        OBJECT_AUTHORITY     = '*ALL';
```


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Documentation for IBM i Services

- Access directly in IBM Documentation

IBM i Services

There are many system services that can be accessed through system-provided SQL views, procedures, and functions. These provide an SQL interface to access, transform, order, and subset the information without needing to code to a system API.

- **Application Services**
  These procedures, functions, and views provide interface information that can be used by applications.
- **Backup, Recovery, and Media Services (BRMS) Services**
  These table functions and views provide information about BRMS.
- **Communication Services**
  These services provide communication information.
- **IFS Services**
  These services provide information about the integrated file system.
- **Java Services**
  This view and procedure provide Java information and JVM management options.
- **Journal Services**
  These services provide information about audit journals and data journals.
- **Librarian Services**
  These services provide object and library list information.
- **Message Handling Services**
  These views and functions provide system message information.

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Documentation for IBM i Services

- Access through the Db2 for i Technology Updates wiki
  - ibm.biz/Db2foriServices

IBM i Service	Type of Service	IBM i 7.4	IBM i 7.3	IBM i 7.2
Application Services				
QSYS2.BOUND_MODULE_INFO	View	SF99704 Level 4	SF99703 Level 16	Not Supported
QSYS2.BOUND_SRVPGM_INFO	View	SF99704 Level 4	SF99703 Level 16	Not Supported
QSYS2.CLEAR_DATA_QUEUE()	Procedure	SF99704 Level 4	SF99703 Level 16	Not Supported
QSYS2.DATA_AREA_INFO()	Table function	Base	SF99703 Level 15	Not Supported

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Many examples available

Db2 for i SQL Tutor

You are in: IBM i Tutorials, Demos, and SQL examples

List of all of the Db2 for i SQL Gists by Scott Forstie
List of all of the IBM i COMMON Tutorials by Scott Forstie & Tim Rowe

Categories
Access Client Solutions (ACS)
Database Engineering Topics
Db2 for i Services
IBM i Services

- Aggregation of all Gist Examples
- Aggregation of all iSee video blogs
- Different perspectives to easily find what you want

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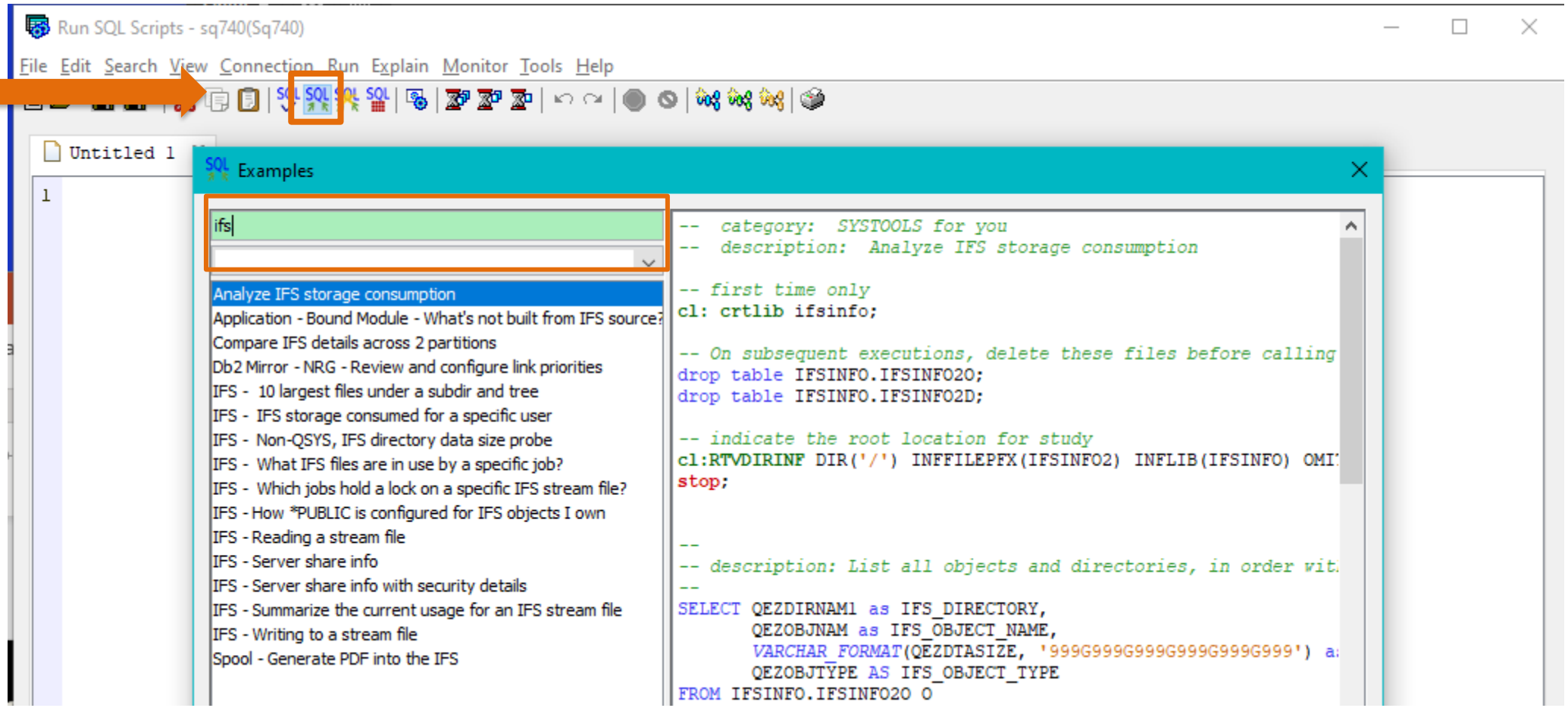
IBM i Access Client Solutions – Insert from examples



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IBM® Db2® for i Catalogs

Catalogs

SYSCATALOGS

INFORMATION_SCHEMA_CATALOG_NAME

Schemas

SYSSCHEMAS

SQLSCHEMAS

SCHEMATA

Database Support

SQL_FEATURES
SQL_LANGUAGES
SQL_SIZING
CHARACTER_SETS

Tables Views Indexes

SYSCOLUMNS
SYSCOLUMNS2
SYSCOLUMNS2_SESSION
SYSFILES
SYSFIELDS
SYSINDEXES
SYSKEYS
SYSTABLEDEP
SYSTABLES
SYSVIEWDEP
SYSVIEWS

SQLCOLUMNS
SQLSPECIALCOLUMNS
SQLTABLES

COLUMNS
TABLES
VIEWS

Constraints

SYSCHKCST
SYSCST
SYSCSTCOL
SYSCSTDEP
SYSKEYCST
SYSREFCST

SQLFOREIGNKEYS
SQLPRIMARYKEYS

CHECK_CONSTRAINTS
REFERENTIAL_CONSTRAINTS
TABLE_CONSTRAINTS

Privileges

SYSCOLAUTH
SYSCONTROLS
SYSCONTROLSDEP
SYSPACKAGEAUTH
SYSROUTINEAUTH
SYSSCHEMAAUTH
SYSSEQUENCEAUTH
SYSTABAUTH
SYSUDTAUTH
SYSVARIABLEAUTH
SYSXSROBJECTAUTH

SQLCOLPRIVILEGES
SQLTABLEPRIVILEGES

AUTHORIZATIONS
ROUTINE_PRIVILEGES
UDT_PRIVILEGES
USAGE_PRIVILEGES
VARIABLE_PRIVILEGES

Triggers

SYSTRIGCOL
SYSTRIGDEP
SYSTRIGGERS
SYSTRIGUPD

Routines

SYSFUNCS
SYSJARCONTENTS
SYSJAROBJECTS
SYSPARMS
SYSPROCS
SYSROUTINEDEP
SYSROUTINES

SQLFUNCTIONCOLS
SQLFUNCTIONS
SQLPROCEDURECOLS
SQLPROCEDURES

PARAMETERS
ROUTINES

XML Schemas

XSRANNOTATIONINFO
XSROBJECTCOMPONENTS
XSROBJECTHIERARCHIES
XSROBJECTS

Statistics

SYSCOLUMNSTAT
SYSINDEXSTAT
SYSMQTSTAT
SYSPACKAGESTAT
SYSPACKAGESTMTSTAT
SYSPARTITIONDISK
SYSPARTITIONINDEXES
SYSPARTITIONINDEXDISK
SYSPARTITIONINDEXSTAT
SYSPARTITIONMQTS
SYSPARTITIONSTAT
SYSPROGRAMSTAT
SYSPROGRAMSTMTSTAT
SYSTABLEINDEXSTAT
SYSTABLESTAT

SQLSTATISTICS

Miscellaneous Objects

SYSPACKAGE
SYSSEQUENCES
SYSTYPES
SYSVARIABLEDEP
SYSVARIABLES

SQLTYPEINFO
SQLUDTS

USER_DEFINED_TYPES
SEQUENCES

Db2 for i catalog views (QSYS2)
ODBC and JDBC™ catalog views (SYSIBM)
ANS and ISO catalog views (QSYS2)

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Health Center Procedures

QSYS2.HEALTH_ACTIVITY
QSYS2.HEALTH_DATABASE_OVERVIEW
QSYS2.HEALTH_DESIGN_LIMITS
QSYS2.HEALTH_ENVIRONMENTAL_LIMITS
QSYS2.HEALTH_SIZE_LIMITS
QSYS2.RESET_ENVIRONMENTAL_LIMITS

Utility Services

QSYS2.ANALYZE_CATALOG – UDTF
QSYS2.CANCEL_SQL – PROCEDURE
QSYS2.COMPARE_FILE – UDTF
QSYS2.DUMP_SQL_CURSORS – PROCEDURE
QSYS2.END_IDLE_SQE_THREADS – PROCEDURE
QSYS2.EXTRACT_STATEMENTS – PROCEDURE
QSYS2.FIND_AND_CANCEL_QSQSRVR_SQL – PROCEDURE
QSYS2.FIND_QSQSRVR_JOBS – PROCEDURE
QSYS2.GENERATE_SQL – PROCEDURE
QSYS2.GENERATE_SQL_OBJECTS – PROCEDURE
QSYS2.RESTART_IDENTITY – PROCEDURE
QSYS2.SWAP_DYNUSRPRF – PROCEDURE
SYSTOOLS.CHECK_SYSCST – PROCEDURE
SYSTOOLS.CHECK_SYSROUTINE – PROCEDURE
SYSTOOLS.RELATED_OBJECTS – UDTF
SYSTOOLS.VALIDATE_DATA – UDTF

Application Services

QSYS2.DELIMIT_NAME – UDF
QSYS2.OVERRIDE_QAQQINI – PROCEDURE
QSYS2.OVERRIDE_TABLE – PROCEDURE
QSYS2.PARSE_STATEMENT – UDTF
SYSPROC.WLM_SET_CLIENT_INFO – PROCEDURE

Performance Services

QSYS2.ACTIVE_QUERY_INFO – UDTF
QSYS2.ADD_QUERY_THRESHOLD – PROCEDURE
QSYS2.CONDENSEDINDEXADVICE – VIEW
QSYS2.DATABASE_MONITOR_INFO – VIEW
QSYS2.QUERY_SUPERVISOR – VIEW
QSYS2.REMOVE_QUERY_THRESHOLD – PROCEDURE
QSYS2.RESET_TABLE_INDEX_STATISTICS – PROCEDURE
QSYS2.SYSIXADV – TABLE
SYSTOOLS.ACT_ON_INDEX_ADVICE – PROCEDURE
SYSTOOLS.HARVEST_INDEX_ADVICE – PROCEDURE
SYSTOOLS.REMOVE_INDEXES – PROCEDURE

Plan Cache Procedures

QSYS2.CHANGE_PLAN_CACHE_SIZE
QSYS2.CLEAR_PLAN_CACHE
QSYS2.DUMP_PLAN_CACHE
QSYS2.DUMP_PLAN_CACHE_PROPERTIES
QSYS2.DUMP_PLAN_CACHE_TOPN
QSYS2.DUMP_SNAP_SHOT_PROPERTIES
QSYS2.END_ALL_PLAN_CACHE_EVENT_MONITORS
QSYS2.END_PLAN_CACHE_EVENT_MONITOR
QSYS2.IMPORT_PC_EVENT_MONITOR
QSYS2.IMPORT_PC_SNAPSHOT
QSYS2.REMOVE_PC_EVENT_MONITOR
QSYS2.REMOVE_PC_SNAPSHOT
QSYS2.REMOVE_PERFORMANCE_MONITOR
QSYS2.START_PLAN_CACHE_EVENT_MONITOR

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Security Services

QSYS2.AUTHORITY_COLLECTION – VIEW
QSYS2.AUTHORITY_COLLECTION_DLO – VIEW
QSYS2.AUTHORITY_COLLECTION_FSOBJ – VIEW
QSYS2.AUTHORITY_COLLECTION_LIBRARIES – VIEW
QSYS2.AUTHORITY_COLLECTION_OBJECT – VIEW
QSYS2.AUTHORIZATION_LIST_INFO – VIEW
QSYS2.AUTHORIZATION_LIST_USER_INFO – VIEW
QSYS2.CERTIFICATE_INFO – UDTF
QSYS2.DRDA_AUTHENTICATION_ENTRY_INFO – VIEW
QSYS2.FUNCTION_INFO – VIEW
QSYS2.FUNCTION_USAGE – VIEW
QSYS2.GROUP_PROFILE_ENTRIES – VIEW
QSYS2.OBJECT_OWNERSHIP – VIEW
QSYS2.OBJECT_PRIVILEGES – UDTF & VIEW
QSYS2.SECURITY_INFO – VIEW
QSYS2.SQL_CHECK_AUTHORITY – UDF
QSYS2.USER_INFO – VIEW
QSYS2.USER_INFO_BASIC – VIEW
SYSPROC.SET_COLUMN_ATTRIBUTE – PROCEDURE
SYSTOOLS.CHANGE_USER_PROFILE – UDTF

Spool Services

QSYS2.OUTPUT_QUEUE_ENTRIES – UDTF & VIEW
QSYS2.OUTPUT_QUEUE_ENTRIES_BASIC – VIEW
QSYS2.OUTPUT_QUEUE_INFO – VIEW
SYSTOOLS.DELETE_OLD_SPOOLED_FILES – PROCEDURE
SYSTOOLS.GENERATE_PDF – UDF
SYSTOOLS.SPOOLED_FILE_DATA – UDTF

Storage Services

QSYS2.ASP_INFO – VIEW
QSYS2.ASP_JOB_INFO – VIEW
QSYS2.ASP_VARY_INFO – VIEW
QSYS2.MEDIA_LIBRARY_INFO – VIEW
QSYS2.NVME_INFO – VIEW
QSYS2.SYSDISKSTAT – UDTF & VIEW
QSYS2.SYSTMPSTG – VIEW
QSYS2.USER_STORAGE – VIEW

Journal Services

QSYS2.DISPLAY_JOURNAL – UDTF
QSYS2.JOURNAL_INFO – VIEW
QSYS2.JOURNALED_OBJECTS – VIEW
SYSTOOLS.AUDIT_JOURNAL_nn – UDTFs

Java Services

QSYS2.JVM_INFO – VIEW
QSYS2.SET_JVM – PROCEDURE

Librarian Services

QSYS2.JOURNAL_INHERIT_RULES – VIEW
QSYS2.LIBRARY_INFO – UDTF
QSYS2.LIBRARY_LIST_INFO – VIEW
QSYS2.OBJECT_STATISTICS – UDTF

System Health Services

QSYS2.SYSLIMITS – VIEW
QSYS2.SYSLIMITS_BASIC – VIEW
QSYS2.SYSLIMTBL – TABLE

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Product Services

QSYS2.LICENSE_INFO – VIEW
QSYS2.SOFTWARE_PRODUCT_INFO – VIEW
SYSTOOLS.LICENSE_EXPIRATION_CHECK – PROCEDURE

IFS Services

QSYS2.IFS_JOB_INFO – UDTF
QSYS2.IFS_OBJECT_LOCK_INFO – UDTF
QSYS2.IFS_OBJECT_PRIVILEGES – UDTF
QSYS2.IFS_OBJECT_REFERENCES_INFO – UDTF
QSYS2.IFS_OBJECT_STATISTICS – UDTF
QSYS2.IFS_READ – UDTF
QSYS2.IFS_WRITE – PROCEDURE
QSYS2.SERVER_SHARE_INFO – VIEW

Communication Services

QSYS2.ACTIVE_DB_CONNECTIONS – UDTF
QSYS2.ADD_TIME_SERVER – PROCEDURE
QSYS2.HTTP_SERVER_INFO – VIEW
QSYS2.NETSTAT_INFO – VIEW
QSYS2.NETSTAT_INTERFACE_INFO – VIEW
QSYS2.NETSTAT_JOB_INFO – VIEW
QSYS2.NETSTAT_ROUTE_INFO – VIEW
QSYS2.REMOVE_TIME_SERVER – PROCEDURE
QSYS2.SERVER_SBS_CONFIGURATION – VIEW
QSYS2.SERVER_SBS_ROUTING – VIEW
QSYS2.SET_SERVER_SBS_ROUTING – PROCEDURE
QSYS2.TCPIP_INFO – VIEW
QSYS2.TIME_PROTOCOL_INFO – VIEW
SYSIBMADM.ENV_SYS_INFO – VIEW

Work Management Services

QSYS2.ACTIVE_JOB_INFO – UDTF
QSYS2.AUTOSTART_JOB_INFO – VIEW
QSYS2.COMMUNICATIONS_ENTRY_INFO – VIEW
QSYS2.GET_JOB_INFO – UDTF
QSYS2.JOB_DESCRIPTION_INFO – VIEW
QSYS2.JOB_INFO – UDTF
QSYS2.JOB_LOCK_INFO – UDTF
QSYS2.JOB_QUEUE_INFO – VIEW
QSYS2.MEMORY_POOL – UDTF
QSYS2.MEMORY_POOL_INFO – VIEW
QSYS2.OBJECT_LOCK_INFO – VIEW
QSYS2.OPEN_FILES – UDTF
QSYS2.PRESTART_JOB_INFO – VIEW
QSYS2.PRESTART_JOB_STATISTICS – UDTF
QSYS2.RECORD_LOCK_INFO – VIEW
QSYS2.ROUTING_ENTRY_INFO – VIEW
QSYS2.SCHEDULED_JOB_INFO – VIEW
QSYS2.SUBSYSTEM_INFO – VIEW
QSYS2.SUBSYSTEM_POOL_INFO – VIEW
QSYS2.SYSTEM_STATUS – UDTF
QSYS2.SYSTEM_STATUS_INFO – VIEW
QSYS2.SYSTEM_STATUS_INFO_BASIC – VIEW
QSYS2.SYSTEM_VALUE_INFO – VIEW
QSYS2.WORKLOAD_GROUP_INFO – VIEW
QSYS2.WORKSTATION_INFO – VIEW

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Application Services

QSYS2.BOUND_MODULE_INFO – VIEW
QSYS2.BOUND_SRVPGM_INFO – VIEW
QSYS2.CLEAR_DATA_QUEUE – PROCEDURE
QSYS2.DATA_AREA_INFO – UDTF & VIEW
QSYS2.DATA_QUEUE_ENTRIES – UDTF
QSYS2.DATA_QUEUE_INFO – VIEW
QSYS2.DB_TRANSACTION_INFO – VIEW
QSYS2.ENVIRONMENT_VARIABLE_INFO – VIEW
QSYS2.EXIT_POINT_INFO – VIEW
QSYS2.EXIT_PROGRAM_INFO – VIEW
QSYS2.PROGRAM_EXPORT_IMPORT_INFO – VIEW
QSYS2.PROGRAM_INFO – VIEW
QSYS2.QCMDEXC – PROCEDURE
QSYS2.QCMDEXC – UDF
QSYS2.RECEIVE_DATA_QUEUE – UDTF
QSYS2.SEND_DATA_QUEUE – PROCEDURE
QSYS2.SERVICES_INFO – TABLE
QSYS2.SET_PASE_SHELL_INFO – PROCEDURE
QSYS2.STACK_INFO – UDTF
QSYS2.USER_INDEX_ENTRIES – UDTF
QSYS2.USER_INDEX_INFO – VIEW
QSYS2.USER_SPACE – UDTF
QSYS2.USER_SPACE_INFO – VIEW
QSYS2.WATCH_DETAIL – UDTF
QSYS2.WATCH_INFO – VIEW
SYSTOOLS.LPRINTF – PROCEDURE
SYSTOOLS.SPLIT – UDTF

PTF Services

QSYS2.GROUP_PTF_INFO – VIEW
QSYS2.PTF_INFO – VIEW
SYSTOOLS.FIRMWARE_CURRENCY – VIEW
SYSTOOLS.GROUP_PTF_CURRENCY – VIEW
SYSTOOLS.GROUP_PTF_DETAILS – VIEW

Message Handling Services

QSYS2.HISTORY_LOG_INFO – UDTF
QSYS2.JOBLOG_INFO – UDTF
QSYS2.MESSAGE_FILE_DATA – VIEW
QSYS2.MESSAGE_QUEUE_INFO – UDTF
QSYS2.MESSAGE_QUEUE_INFO – VIEW
QSYS2.REPLY_LIST_INFO – VIEW
QSYS2.SEND_MESSAGE – PROCEDURE

Performance Services

QSYS2.COLLECTION_SERVICES_INFO – VIEW

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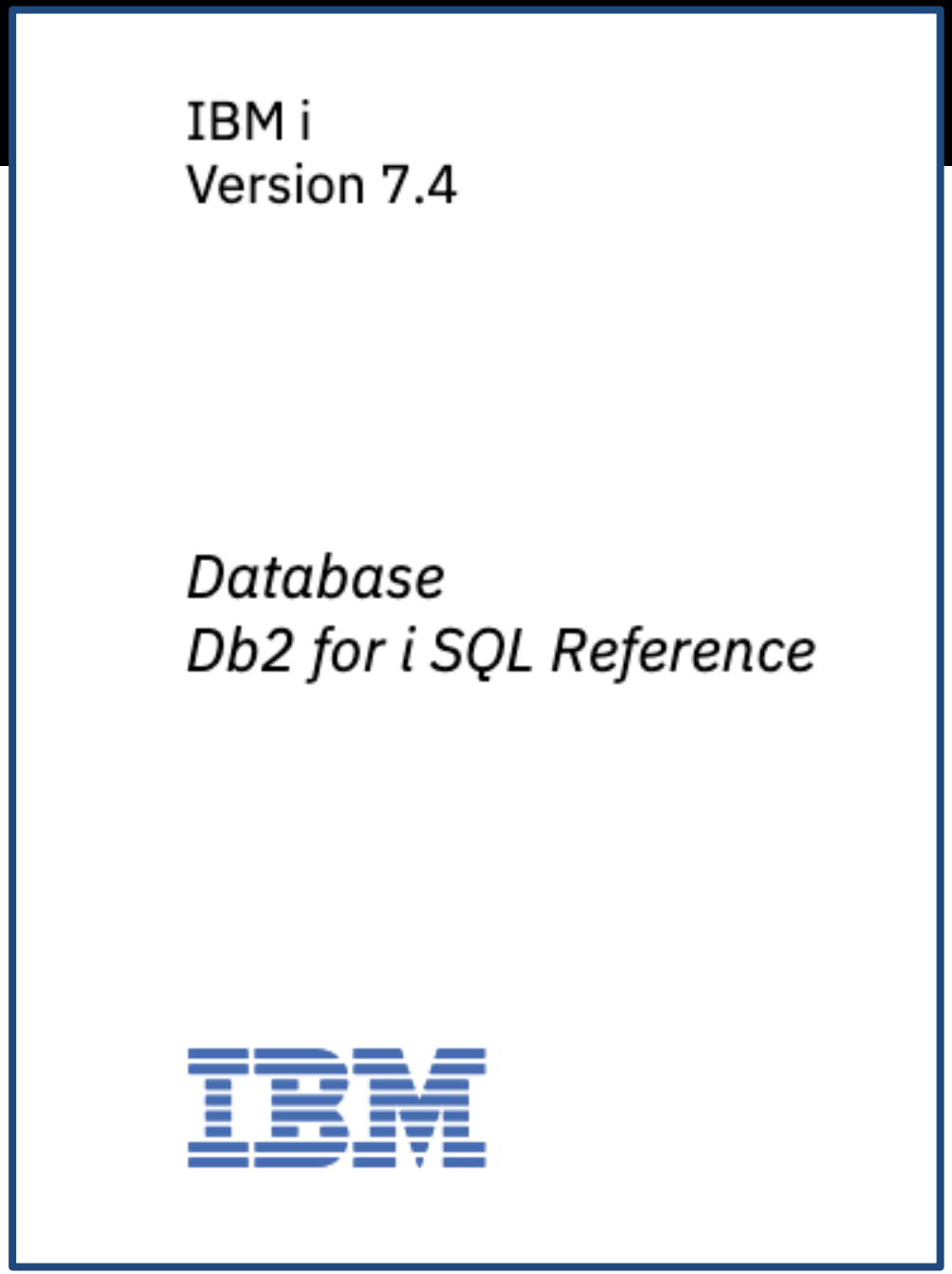
SQL Reference

- 2000+ pages
- All the technical details
- Updated twice each year



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OUTPUT_QUEUE_ENTRIES_BASIC


```
select * from qsys2.output_queue_entries_basic
  where output_queue_library_name = 'QUSRSYS' and
        output_queue_name = 'PRT01'
order by size desc
limit 5;
```

ORDER BY DESC returns the largest value first

CREATE_TIMESTAMP	SPOOLED_FILE_NAME	USER_NAME	SIZE	TOTAL_PAGES	USER_DATA
2020-02-26 11:39:44.627389	QPSRVTRCJ	SBURRICH	10308	1711	T000000001
2020-02-26 11:35:47.354857	QPSRVTRCJ	SBURRICH	8260	1454	T000000001
2020-02-29 13:17:35.401442	QSQSYSIBM	SLROMANO	4164	566	CRTCMOD
2020-03-04 16:57:20.195250	QPSRVTRCJ	POIRIER	836	138	T000000002
2020-03-05 15:00:29.200888	QPSRVTRCJ	SBURRICH	836	121	T000000002

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Read a spooled file


```
select * from table (systools.spooled_file_data(
       job_name =>'424630/SLROMANO/QPADEV000G',
       spooled_file_name => 'RPGDTAQ'))
  order by ordinal_position;
```

ORDINAL_POSITION	SPOOLED_DATA
1	5770WDS V7R4M0 190419 RN IBM ILE RPG SLR/RPGDTAQ SQ740 03/07/2
2	Command . . . . . : CRTBNDRPG
3	Issued by . . . . . : SLROMANO
4	Program . . . . . : RPGDTAQ
5	Library . . . . . : SLR
6	Text 'description' . . . . . : *SRCMBRTXT
7	Source Member . . . . . : RPGDTAQ
8	Source File . . . . . : QSQLTEMP1
9	Library . . . . . : QTEMP
10	CCSID . . . . . : 37
11	Text 'description' . . . . . : SQL data queue - send
12	Last Change . . . . . : 03/07/20 08:55:00

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DELETE_OLD_SPOOLED_FILES

- Manage spooled files by age
- Older than the specified timestamp?
  The spooled file is deleted

```
-- Preview removal of any spooled file older than 30 days
call systools.delete_old_spooled_files(
    delete_older_than => current date - 30 days,
    preview => 'YES');
```

The => notation connects the name of a parameter with its value

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DELETE_OLD_SPOOLED_FILES

- Time range customizable
- Schedulable
- Changeable

RUNSQL lets you add SQL into existing CL processing

```
-- Use the RUNSQL command to initiate the CALL
cl: runsql sql('call SYSTOOLS.DELETE_OLD_SPOOLED_FILES(
    current timestamp - 30 days)') commit(*NONE);


-- Run it in a batch job
cl: SBMJOB CMD(RUNSQL
   SQL('CALL SYSTOOLS.DELETE_OLD_SPOOLED_FILES()')
   COMMIT(*NONE)) JOB(DLTSPOOL);
```


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SUBSYSTEM_INFO

- Returns one row for every subsystem description

```
select * from qsys2.subsystem_info
  order by maximum_active_jobs desc, current_active_jobs desc;
```

SUBSYSTEM_DESCRIPTION_LIBRARY	SUBSYSTEM_DESCRIPTION	STATUS	MAXIMUM_ACTIVE_JOBS	CURRENT_ACTIVE_JOBS	TEXT_DESCRIPTION
QSYS	QSYSWRK	ACTIVE	-	150	System subsystem
QSYS	QUSRWRK	ACTIVE	-	95	User subsystem
QSHTOOLS	QSHELL	ACTIVE	-	22	Shell server subsystem
QSYS	QSERVER	ACTIVE	-	18	File Server Subsystem
QSYS	QBATCH	ACTIVE	-	14	Batch Subsystem
QHTTPSVR	QHTTPSVR	ACTIVE	-	10	HTTP SERVER SUBSYSTEM

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Subsystem Management

- Use STRSBS to start inactive subsystems

```
SELECT sbsd_lib, sbsd,
  qsys2.qcmdexc('QSYS/STRSBS SBSD(' concat sbsd_lib
    concat '/' concat sbsd concat ')') as STRSBS_RESULT
  FROM QSYS2.SUBSYSTEM_INFO
  WHERE status = 'INACTIVE'
  and sbsd in ('PAYROLLSBS', 'BACKUPSBS');
```

SBSD_LIB	SBSD	STRSBS_RESULT
QGPL	PAYROLLSBS	1

The QCMDEXC scalar function allows you to run a CL command from within SQL

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OBJECT_STATISTICS

- List details about objects in libraries, like DSPOBJD
- 69 columns of information
- List all the objects in the TOYSTORE library that were created at least 2 years ago

```
select *
   from table(qsys2.object_statistics('TOYSTORE', '*ALL'))
   where objcreated < current date - 2 years;
```


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OBJECT_STATISTICS

- Return only file names, no extended details, for all files in TOYSTORE

```
select *
  from table(qsys2.object_statistics('TOYSTORE','*FILE',
                '*ALLSIMPLE'));
```

- Return a list of all libraries with no extended details

```
select *
  from table(qsys2.object_statistics('*ALLSIMPLE','*LIB'));
```

- Return all the information for a specific file in TOYSTORE

```
select *
  from table(qsys2.object_statistics('TOYSTORE', '*FILE',
                'EMP'));
```


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OBJECT_STATISTICS

- Which IBM CL commands have had their command parameter defaults changed using CHGCMDDFT
- Identify commands that should have CHGCMDDFT added to QSTRUP

```
select *
  from table(qsys2.object_statistics('QSYS', '*CMD'))
  where APAR_ID = 'CHGDFT';
```

OBJNAME	OBJTYPE	OBJOWNER	OBJTEXT	CHANGE_TIMESTAMP
CRTUSRPRF	*CMD	QSYS	Create User Profile	2019-09-13 02:30:13.000000
STRDBG	*CMD	QSYS	Start Debug	2019-09-13 03:22:15.000000

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IFS_OBJECT_STATISTICS

- SQL Alternative to RTVDIRINF and WRKLNK
- 87 columns of data returned

- Return object identified by a path name
  - OR –
- Return all objects that can be accessed starting with a path name

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Search an IFS tree

- Find objects based on a partial name

```
select * from table(qsys2.ifs_object_statistics('/usr'))
  where path_name like '%.txt'
  order by path_name;
```

For the LIKE predicate, the % means "match any number of characters"

PATH_NAME	OBJECT_TYPE	CREATE_TIMESTAMP
/usr/install_out.txt	*STMF	2016-08-30 13:46:45
/usr/scottf/dlyjob CL source.txt	*STMF	2018-03-01 08:17:30
/usr/scottf/dlyjobCLsource.txt	*STMF	2018-03-01 08:35:08
/usr/local/guardium/install_out.txt	*STMF	2017-05-30 16:31:07
/usr/local/guardium/guard_itap.stderr.1.txt	*STMF	2017-05-30 16:31:27
/usr/local/guardium/guard_itap.stderr.2.txt	*STMF	2017-06-07 20:40:19

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GET_JOB_INFO

- Returns information about a single job
- 22 columns of information
- Argument is either a fully qualified job name, or * to indicate the current job

```
select * from table
(qsys2.get_job_info('399133/QUSER/QSQSRVR'));
```

V_JOB_STATUS	V_ACTIVE_JOB_STATUS	V_ACTIVE_JOB_TYPE	V_AUTHORIZATION_NAME	V_SBS_NAME	V_CPU_USED
*ACTIVE	CNDW	PJ	JAVA	QSYSWRK	116572

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ACTIVE_JOB_INFO

- Returns information about active jobs (WRKACTJOB)
- Filtering criteria by job name, subsystem, and user
- 123 columns of information

```
select * from table
   (qsys2.active_job_info(job_name_filter=>'QSQSRVR',
                          detailed_info=>'ALL'));
```

JOB_NAME	JOB_ACTIVE_TIME	SERVER_MODE_CONNECTING_JOB
399050/QUSER/QSQSRVR	2020-03-06 04:18:22	399005/QDIRSRV/QUSRDIR
399133/QUSER/QSQSRVR	2020-03-06 04:20:40	399418/JAVA/QP0ZSPWP
399420/QUSER/QSQSRVR	2020-03-06 05:00:03	399459/JAVA/QJVAEXEC
399991/QUSER/QSQSRVR	2020-03-06 06:00:08	399418/JAVA/QP0ZSPWP
399992/QUSER/QSQSRVR	2020-03-06 06:00:10	-

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OBJECT_LOCK_INFO

- Returns one row for every lock on every object
- Use a WHERE clause to limit the result set or you will get every lock on every object on the system!

```
select * from qsys2.object_lock_info
where object_schema = 'TOYSTORE' and object_name ='SALES';
```

MEMBER_LOCK_TYPE	LOCK_STATE	LOCK_STATUS	JOB_NAME
-	*SHRRD	HELD	509329/SLROMANO/QPADEV000X
MEMBER	*SHRRD	HELD	509329/SLROMANO/QPADEV000X
DATA	*EXCL	HELD	509329/SLROMANO/QPADEV000X

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JOB_LOCK_INFO

- Returns a list of locks held by a job
- Similar to DSPJOB option 12 (Display locks, if active)
- Argument is either a fully qualified job name, or * to indicate the current job

```
select * from table(qsys2.job_lock_info('*'))
  order by object_type;
```

OBJECT_LIBRARY	OBJECT_NAME	OBJECT_TYPE	OBJECT_ATTRIBUTE	LOCK_STATE	LOCK_STATUS	LOCK_COUNT	LOCK_SCOP
QSYS	QIWS	*LIB	PROD	*SHRRD	HELD	1	JOB
QSYS	QSYS	*LIB	PROD	*SHRRD	HELD	1	JOB
QSYS	QSYS2	*LIB	PROD	*SHRRD	HELD	1	JOB
QSYS	QUSRSYS	*LIB	PROD	*SHRRD	HELD	1	JOB

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SYSTEM_STATUS_INFO

- WRKSYSSTS, but better!
  - System statistical information
  - Storage information
  - Partition information
  - Machine type, model, attention light

TOTAL_JOBS_IN_SYSTEM	ACTIVE_JOBS_IN_SYSTEM	MAIN_STORAGE_SIZE	HOST_NAME	PARTITION_ID	ATTENTION_LIGHT
62865	787	12566528	UT30P14	14	OFF

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SYSTEM_STATUS_INFO

- Save status at regular intervals to understand what "normal" looks like
- One time set up step:

```
create table mylib.sys_status_tracker as
(select current server, s.*
from qsys2.system_status_info s) with no data;
```

- Add rows on a regular cadence

```
insert into mylib.sys_status_tracker
  (select current server, s.*
      from qsys2.system_status_info s);
```


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Remote database access

- Execute SQL statements against a remote database
- Three-part names: **<database-name>**.<schema-name>.<object-name>

```
CL: ADDRDBDIRE RDB(X1423P2) RMTLOCNAME(X1423P2 *IP);
CL: ADDSVRAUTE USRPRF(SLROMANO) SERVER(X1423P2)
    USRID(SLROMANO) PASSWORD(xxxxxx);

CREATE TABLE X1423P2.TOYSTORE.EMPLOYEE (EMPNO CHAR(6),
                                        FIRSTNME CHAR(10),
                                        LASTNAME CHAR(15));
INSERT INTO X1423P2.TOYSTORE.EMPLOYEE
  VALUES ('000002', 'Michael', 'Thompson');
SELECT * FROM X1423P2.TOYSTORE.EMPLOYEE;
```


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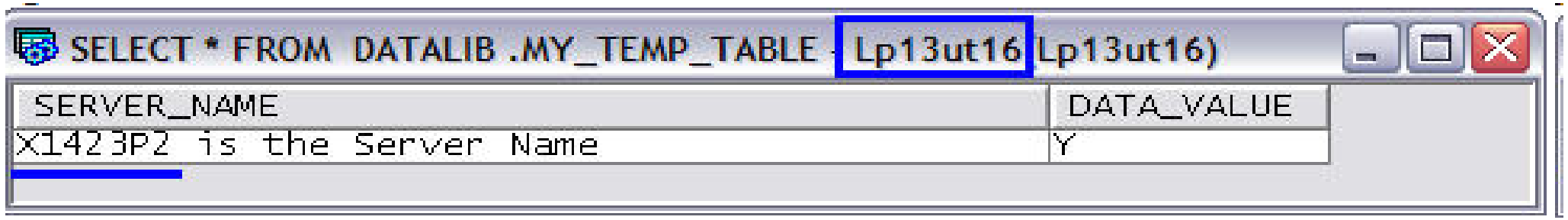
INSERT with remote SUBSELECT

- INSERT can reference a single remote database in its subselect

```
INSERT INTO DATALIB.MY_TEMP_TABLE
     (SELECT CURRENT_SERVER CONCAT ' is the Server Name',
             IBMREQD
      FROM X1423P2.SYSIBM.SYSDUMMY1);

SELECT * FROM DATALIB.MY_TEMP_TABLE;
```



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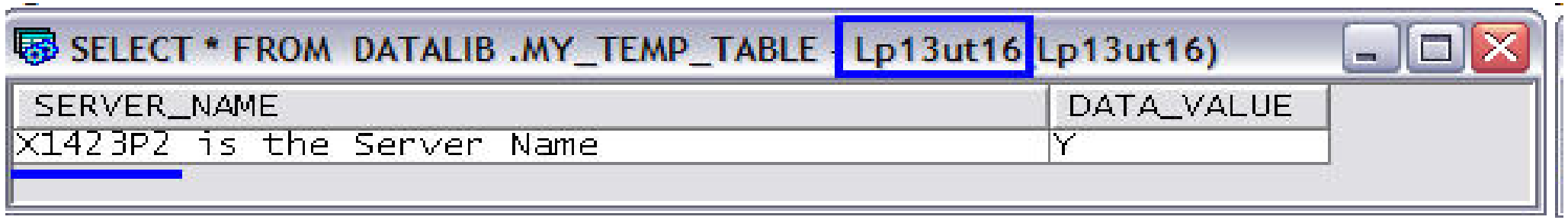
CREATE TABLE with remote SUBSELECT

- CREATE TABLE AS can reference a single remote database

```
CREATE TABLE DATALIB.MY_TEMP_TABLE (SERVER_NAME, DATA_VALUE)
  AS (SELECT CURRENT_SERVER CONCAT ' is the Server Name',
             IBMREQD
       FROM X1423P2.SYSIBM.SYSDUMMY1) WITH DATA;

SELECT * FROM DATALIB.MY_TEMP_TABLE;
```



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ALIAS for remote database access

- An SQL ALIAS can be used to implement database transparency

```
CREATE OR REPLACE ALIAS DATALIB.TARGET_TABLE
  FOR RDB1.MYLIB.TABLE1;

INSERT INTO DATALIB.DATAMART
  (SELECT * FROM DATALIB.TARGET_TABLE);

CREATE OR REPLACE ALIAS DATALIB.TARGET_TABLE
  FOR RDB2.MYLIB.TABLE1;

INSERT INTO DATALIB.DATAMART
  (SELECT * FROM DATALIB.TARGET_TABLE);
```


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Table functions and 3-part names

- User Defined Table Functions (UDTFs) cannot directly use 3-part names
- However… a 3-part name can be used in the WHERE clause

```
SELECT CURRENT SERVER, h.*
  FROM TABLE(qsys2.history_log_info()) h
WHERE EXISTS
(SELECT 1 FROM rmtdb.sysibm.sysdummy1);
```


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Table functions and 3-part names

- Query the partition history

```
SELECT CURRENT SERVER AS "IBM i partition", h.*
  FROM TABLE(qsys2.history_log_info()) h;
```

IBM i partition	MESSAGE_ID	MESSAGE_TYPE	MESSAGE_TEXT
LP02UT28	CPC1602	INFORMATIONAL	Subsystem description MDDLIB31CK in library MDDLIB310 changed
LP02UT28	CPF1804	INFORMATIONAL	Subsystem MDDLIB31CK in library MDDLIB310 starting.
LP02UT28	CPC1612	INFORMATIONAL	Job description MDDLIB31CK in library MDDLIB310 changed.
LP02UT28	CPC1612	INFORMATIONAL	Job description MDDLIB31CK in library MDDLIB310 changed.
LP02UT28	CPC0961	COMPLETION	Class MDDLIB31CK in library MDDLIB310 changed.
LP02UT28	CPF1124	INFORMATIONAL	Job 884969/QSYS/MDDLIB31CK started on 11/27/18 at 01:41:23 ir
LP02UT28	CPF1103	INFORMATIONAL	Subsystem MDDLIB31CK started.
LP02UT28	CPF1124	INFORMATIONAL	Job 884970/SLICTEST/$DBRTRI043 started on 11/27/18 at 01:41:2

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Table functions and 3-part names

- Query the partition history…**on a different IBM i partition**

```
SELECT CURRENT SERVER AS "IBM i partition", h.*
  FROM TABLE(qsys2.history_log_info()) h
  WHERE EXISTS (SELECT 1 FROM GT73P1.sysibm.sysdummy1);
```

IBM i partition	MESSAGE_ID	MESSAGE_TYPE	MESSAGE_TEXT
GT73P1	CPC1236	COMPLETION	Job 226153/SCOTTF/US0000FA7F submitted for job sch
GT73P1	CPF1124	INFORMATIONAL	Job 226153/SCOTTF/US0000FA7F started on 11/27/18 a
GT73P1	CPF1164	COMPLETION	Job 226153/SCOTTF/US0000FA7F ended on 11/27/18 at
GT73P1	CPF1124	INFORMATIONAL	Job 226154/SCOTTF/QDFTJOBD started on 11/27/18 at
GT73P1	CPIAD0B	INFORMATIONAL	*SIGNON server job 226132/QUSER/QZSOSIGN processin
GT73P1	CPIAD0B	INFORMATIONAL	*SIGNON server job 226132/QUSER/QZSOSIGN processin
GT73P1	CPIAD0B	INFORMATIONAL	*SIGNON server job 226132/QUSER/QZSOSIGN processin
GT73P1	CPIAD0B	INFORMATIONAL	*SIGNON server job 226132/QUSER/QZSOSIGN processin

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SYSTEM_STATUS_INFO

- Add rows from a different system:

```
insert into mylib.sys_status_tracker
  (select current server, s.*
      from rmtsys.qsys2.system_status_info s);
```


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Storage management

- Review the top 10 storage consumers

```
select authorization_name,
 sum(storage_used) as storage_used
from qsys2.user_storage
where authorization_name in
                    (select user_name
                       from qsys2.user_info
                       where user_creator <> '*IBM')
group by authorization_name
order by 2 desc
limit 10;
```

GROUP BY combines rows with the same value. SUM adds the values for all the rows in the group.

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IFS storage management

- Review the IFS storage consumed by a specific user

```
with ifsobjs (path, type) as (
select path_name, object_type
 from table (qsys2.object_ownership('SLROMANO'))
 where path_name is not null -- only IFS objects
)
select i.*, data_size, z.*
from ifsobjs i, table (qsys2.ifs_object_statistics(
  start_path_name => path, subtree_directories => 'NO')) z
order by data_size desc;
```

PATH	TYPE	DATA_SIZE
/This/Catalog/On/Larrys/System/COMMON1	*STMF	1048576000
/QOpenSys/pkgs/lib/ibmichroot/config/loc.tar	*STMF	885166080
/tmp/bootstrap.tar	*STMF	268380160
/QOpenSys/pkgs/lib/ibmichroot/config/icu4c.tar	*STMF	121733120
/home/ACS	*DTR	112182126

WITH defines a common table expression. This is like a temporary table available to this query.

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REPLY_LIST_INFO

- Compare system reply lists between a local and a remote IBM i

1. Get information from a remote IBM i

```
create table qtemp.sq740_reply_list as
  (select current_server as server_name, r.*
     from sq740.qsys2.reply_list_info r)
  with data;
```

A three-part name consists of the RDB name, the schema name, and the table name.

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REPLY_LIST_INFO

2. Compare remote values with local values

```
select r.server_name as remote_server, r.sequence_number,
  r.message_id, current_server as local_server, l.sequence_number,
  l.message_id
from qtemp.sq740_reply_list r full outer join qsys2.reply_list_info l
 on r.message_id = l.message_id and
    r.sequence_number = l.sequence_number;
```

A full outer join returns
- all the matching rows
- all the rows from the left table without a match
- all the rows from the right table without a match

The match criteria is specified in the ON clause.

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REPLY_LIST_INFO

matched

not matched

REMOTE_SERVER	SEQUENCE_NUMBER	MESSAGE_ID	LOCAL_SERVER	SEQUENCE_NUMBER	MESSAGE_ID
SQ740	10	CPA0700	SQ730	10	CPA0700
SQ740	20	RPG0000	SQ730	20	RPG0000
SQ740	30	CBE0000	SQ730	30	CBE0000
SQ740	40	PLI0000	SQ730	40	PLI0000
SQ740	3200	CPA32B2	SQ730	3200	CPA32B2
SQ740	4072	CPA4072	SQ730	4072	CPA4072
SQ740	7025	CPA7025	SQ730	7025	CPA7025
-	-	-	SQ730	15	CPA7025
-	-	-	SQ730	955	CPA5737
-	-	-	SQ730	2224	CPA32B2
-	-	-	SQ730	3283	CPA32B2

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PTF Groups

- What PTF Groups are on your IBM i?

```
select ptf_group_name,
 max(ptf_group_description) as ptf_group_description,
 max(ptf_group_level) as ptf_group_level
from qsys2.group_ptf_info
where ptf_group_status = 'INSTALLED'
group by ptf_group_name;
```

PTF_GROUP_NAME	PTF_GROUP_DESCRIPTION	PTF_GROUP_LEVEL
SF99666	HIGH AVAILABILITY FOR IBM I	7
SF99665	JAVA	11
SF99653	DB2 WEB QUERY FOR I V2.2.1	10
SF99652	CONTENT MANAGER ONDEMAND FOR I - 5770-RD1 7.4	6
SF99675	HARDWARE AND RELATED PTFS	2
SF99663	PERFORMANCE TOOLS	7

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PTF Groups

- Are your PTF Groups the most current versions?

```
select * from systools.group_ptf_currency;
```

- GROUP_PTF_CURRENCY accesses a live XML stream from the PSP site. It compares the currently available version from IBM with the version installed on your IBM i.

PTF_GROUP_CURRENCY	PTF_GROUP_ID	PTF_GROUP_TITLE	PTF_GROUP_LEVEL_INSTALLED	PTF_GROUP_LEVEL_AVAILABLE
INSTALLED LEVEL IS CURRENT	SF99663	SF99663 740 Performance Tools	7	7
INSTALLED LEVEL IS CURRENT	SF99664	SF99664 740 Backup Recovery Solutions	24	24
INSTALLED LEVEL IS CURRENT	SF99665	SF99665 740 Java	11	11
INSTALLED LEVEL IS CURRENT	SF99666	SF99666 740 High Availability for I...	7	7
INSTALLED LEVEL IS CURRENT	SF99668	SF99668 740 IBM Db2 Mirror for i	13	13
INSTALLED LEVEL IS CURRENT	SF99675	SF99675 740 Hardware and Related PTFs	2	2
INSTALLED LEVEL IS CURRENT	SF99704	SF99704 740 DB2 for IBM i	15	15
UPDATE AVAILABLE	SF99738	SF99738 740 Group Security	22	23
UPDATE AVAILABLE	SF99739	SF99739 740 Group Hiper	60	61

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Review upcoming license expirations

- Do any licenses expire in the next 45 days?

```
call systools.license_expiration_check(45);
```

- Then check if any messages were sent to QSYSOPR

```
select message_text
 from qsys2.message_queue_info
  where message_queue_name = 'QSYSOPR' and
        message_text like '%EXPIRE%';
```

```
MESSAGE_TEXT
PRODUCT LICENSE WILL EXPIRE ON 06/15/18 - 5770SS1 5051 IBM i
PRODUCT LICENSE WILL EXPIRE ON 07/15/18 - 5770BR1 5050 Backup Recovery and Media Services for IBM i
```


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Security dashboard

SECURITY_INFO – View

One stop service for system-level security information

- Display Security Attributes (DSPSECA)
- Display Security Auditing (DSPSECAUD)
- Work with System Value (WRKSYSVAL) – SYSVAL(*SEC)

```
select * from qsys2.security_info;
```

SECURITY_LEVEL	PASSWORD_LEVEL	AUDIT_JOURNAL_EXISTS	AUDIT_JOURNAL_RECEIVER	PASSWORD_EXPIRATION_INTERVAL	PASSWORD_MAXIMUM_LENGTH	INACTIVE_JOB_TIMEOUT	ALLOW_SECURITY_SYSVAL_CHANGE
50	2	YES	ZLHREV0151	186	128	180	YES

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CERTIFICATE_INFO

- Are any certificates expiring in the next 2 months?

```
SELECT * FROM TABLE(QSYS2.CERTIFICATE_INFO(
            CERTIFICATE_STORE_PASSWORD => '*NOPWD',
            CERTIFICATE_STORE => '*OBJECTSIGNING' ))
WHERE VALIDITY_END < CURRENT DATE + 2 MONTHS;
```

CERTIFICATE_LABEL	SERIAL_NUMBER	VALIDITY_START	VALIDITY_END	TRUSTED
CL_T3	5DCA24A2082140	2019-11-10 21:18:58	2020-11-10 21:18:58	YES

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Display User Profile

- Is anyone using a password that is identical to their user name?

```
select count(*) from qsys2.user_info_basic
where status = '*ENABLED'
 and user_default_password = '*YES';
```

- Are we in good shape to change the password level (QPWDLVL) system value?

```
select user_name  from qsys2.user_info_basic
where password_level_2_3 = 'NO';
```


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OBJECT_PRIVILEGES

- The SQL version of DSPOBJAUT
- What public authorities have been granted to objects in TOYSTORE?

```
select * from qsys2.object_privileges
where object_schema = 'TOYSTORE' and
 authorization_name = '*PUBLIC';
```

OBJECT_NAME	OBJECT_TYPE	OBJECT_AUTHORITY	OBJECT_OPERATIONAL	OBJECT_MANAGEMENT
EMPLOYEE	*FILE	*CHANGE	YES	NO
PROJACT	*FILE	*EXCLUDE	NO	NO
PROJECT	*FILE	*EXCLUDE	NO	NO
SALES	*FILE	*EXCLUDE	NO	NO
STAFF	*FILE	*EXCLUDE	NO	NO

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IFS_OBJECT_PRIVILEGES

- One row returned for an IFS object's public and private privileges
- Similar to OBJECT_PRIVILEGES for QSYS objects

```
select * from table (
  qsys2.ifs_object_privileges(
    path_name => '/usr/local/tap.ini'));
```

OWNER	AUTHORIZATION_NAME	DATA_AUTHORITY	OBJECT_OPERATIONAL	OBJECT_MANAGEMENT	OBJECT_EXISTENCE
SCOTTF	*PUBLIC	*RWX	YES	NO	NO
SCOTTF	SCOTTF	*RWX	YES	YES	YES

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IFS Security - Object Ownership


```
--
-- IFS Object Ownership
--
select path_name, OBJECT_TYPE, OBJECT_OWNER
  from table (
      qsys2.ifs_object_statistics(
        START_PATH_NAME => '/home/SCOTTF',
        SUBTREE_DIRECTORIES => 'YES', IGNORE_ERRORS => 'YES'))
where OBJECT_OWNER <> 'SCOTTF';
```

PATH_NAME	OBJECT_TYPE	OBJECT_OWNER
/home/SCOTTF/capture dawns object info.sql	*STMF	TIMMR
/home/SCOTTF/hello.cpp	*STMF	TIMMR
/home/SCOTTF/bookstore.file	*STMF	TIMMR
/home/SCOTTF/hello2.cpp	*STMF	TIMMR
/home/SCOTTF/lug.xlsx	*STMF	TIMMR
/home/SCOTTF/ALLOBJusers09172019.xlsx	*STMF	TIMMR

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IFS Security - Object Ownership


```
select path_name,
  qsys2.qcmdexc('QSYS/CHGOWN OBJ(''' concat path_name concat''')
                    NEWOWN(SCOTTF) RVKOLDAUT(*NO)') as chgown_result
  from table (
      qsys2.ifs_object_statistics(
        START_PATH_NAME => '/home/SCOTTF',
        SUBTREE_DIRECTORIES => 'YES', IGNORE_ERRORS => 'YES')
)    where OBJECT_OWNER <> 'SCOTTF';
```

PATH_NAME	CHGOWN_RESULT
/home/SCOTTF/capture dawns object info.sql	1
/home/SCOTTF/hello.cpp	1
/home/SCOTTF/bookstore.file	1
/home/SCOTTF/hello2.cpp	1
/home/SCOTTF/lug.xlsx	1

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The “*IBM Did it For You*” Approach

Compliance Automation Reporting Tool (CART)

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  - A data mart is created with the information, enhanced with timestamp info for historical perspective
    - You decide how much history data you want to keep
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Contact Doug Mack
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Thank you!

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