

IBM Db2 Automation for z/OS

Db2 Space Monitoring using Db2 Automation Tool

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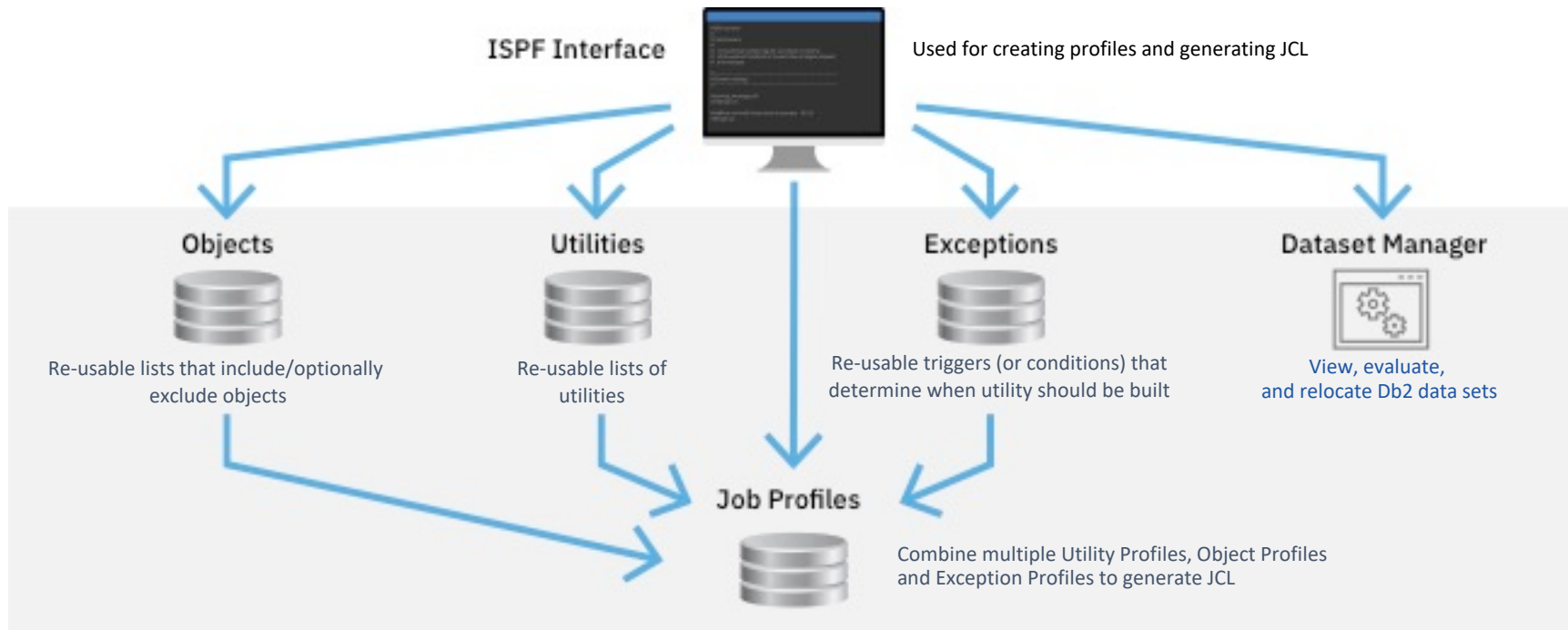
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Space Monitoring

- Why ?
 - Customers are looking for ways to better monitor and control data set growth of Db2 objects
- How ?
 - Db2 Automation Tool Can Help
 - define objects to be monitored
 - define what conditions to watch
 - MVS
 - RTS
 - define the actions to be taken
 - Reallocate / resize
 - create a JCL to run regularly

Component Overview



Component Overview - Product main menu

```
AUTOTOOL V4R3 --- IBM DB2 Automation Tool for z/OS --- 2021/04/08 13:39:47
```

```
-----  
Options: 0 - Setup                      7 - DB2 Command Processor  
         1 - Object Profiles             8 - Dataset Manager  
         2 - Utility Profiles            9 - Stand Alone Utilities  
         3 - Exception Profiles          10 - DB2 Admin Scheduler  
         4 - Job Profiles                11 - Autonomic Console  
         5 - Quick Build                 12 - Reorganization Avoidance  
         6 - Execution Reports           X - Exit  
-----
```

```
DB2 Subsystem ID: PB1A
```

```
(1-4 Character Subsystem ID or ? for list)
```

```
Current SQLID: _____
```

```
User: TS6771 - Configuration ID: HAA  
-----
```

*new ? - Notepad++ [Administrator]

Component Overview – Object Profile create screen

```

AUTOTOOL V4R3  ----- Objects Profile Display ----- 2021/04/08 13:30:45
-----
Line Commands: C - Create  D - Delete  E - Export  I - Import
                Q - Quick   V - View    U - Update  J - Jobs    R - Rename
Profile Like   *
Creator Like   TS6771   Recent Profiles 00          Row 1 of 2
DB2 Subsystem: PB1A
Enter Tablespaces Like to Display

Database Like. . *_____ wildcard  N (Yes/No)
Tablespace Like. *_____ Exclude  I (E - Exclude, I - Include)
Creator Like . . *_____ >

Process Dependent Indexes . . . . . N (Yes/No)
Process Referentially Dependent Tablespaces . N (Y - Yes, N - No,
                                                B - Build time Expansion,
                                                R - Run time Expansion)

Process Cloned Tables . . . . . N (Yes/No)
Process AUX Tablespaces . . . . . N (L - LOB, X - XML,
                                                A - All, N - No)

Process History objects . . . . . N (Yes/No)
Advanced SQL . . . . . N (Yes/No) Update SQL N (Yes/No)
  
```

- Object selection
 - Wildcard
 - exclude/include

Component Overview – Object Profile screen

```

AUTOTOOL V4R3      ---- Update Object Profile Display      --- 2021/04/08  13:32:11
-----
Commands: Explode - View all objects.
Line Commands: A - Add      D - Delete      E - Explode    U - Update    R - Repeat
                V - View Advanced SQL
Creator: TS6771      Profile: WTK_SPCMON      User: TS6771
Description: TEST SPACE MONITORING BOBDEMO      DB2 Subsystem: PB1A
Share Option U      (U - Update, V - View, N - No)      Row 1 of 5      >
-----
      TS/
      IX/ wild ----- Process ----- Inc/ IX DB Name/ Volume /
Cmd  VL  Card  IX RI Clone Util  AUX  HST  Exc  TS Crtr  IX Crtr/ IX Name/
-----
  1  TS  N    N  N  N    N    N  N  INC  PDBOB  BOBDEMO  GLWSDPT  ALL
    TS  N    N  N  N    N    N  N  INC  PDBOB  BOBDEMO  GLWSEMP  ALL
    TS  N    N  N  N    N    N  N  INC  PDBOB  BOBDEMO  GLWSEPA  ALL
    TS  N    N  N  N    N    N  N  INC  PDBOB  BOBDEMO  GLWSPJA  ALL
    TS  N    N  N  N    N    N  N  INC  PDBOB  BOBDEMO  GLWSPRJ  ALL
***** Bottom of Data *****

```

- Object selection sample
 - bobdemo db
 - only tablespaces

Component Overview – Utility Profile screen

```

AUTOTOOL V4R3 ----- Utility Profile Options ----- 2021/04/08 13:32:46

Creator: TS6771      Profile: WTK_SPCMON_RELOCATE      User: TS6771
Description RELOCATE      DB2 Subsystem: PB1A
Share Option U (U - Update, V - View, N - No)

More:      +

                                Include      Update
                                Utility      Utility
Reallocation . . . . . N (Yes/No) N (Yes/No)
Recover . . . . . N (Yes/No) N (Yes/No)
Rebuild Index . . . . . N (Yes/No) N (Yes/No)
Image Copy . . . . . N (Yes/No) N (Yes/No)
Recovery Expert Image Copy . . . N (Yes/No) N (Yes/No)
Copy to Copy . . . . . N (Yes/No) N (Yes/No)
Merge Copy . . . . . N (Yes/No) N (Yes/No)
Runstats . . . . . N (Yes/No) N (Yes/No)
TS Reorg . . . . . N (Yes/No) N (Yes/No)
IX Reorg . . . . . N (Yes/No) N (Yes/No)
Quiesce . . . . . N (Yes/No) N (Yes/No)
Modify . . . . . N (Yes/No) N (Yes/No)

Option  ===>
*HAA$UOP HAA$DXDS SDSE -DSL TST SUPERC
  
```

- for Space Monitoring, Reallocation would be the main option
 - Reorg also could be used but requires more manual intervention

Reallocation Options

```
AUTOTOOL V4R3 ----- Reallocate options ----- 2021/04/08 13:26:42
Creator: TS6771      Name: WTK_SPCMON_RELOCATE      User: TS6771
                                           DB2 Subsystem: PB1A
                                           More:      +

Use RT Stats in addition to MVS Catalog N   (Yes/No)
Use ONLY Exception Profile Criteria . . N   (Yes/No)
Reallocate when
  Extents in space greater than . . . . 90   (1 - 255)
  Percentage used greater than . . . . 90 . 00 (.01 - 100%)
Reallocate Space Parameters
  Hash Sp = HASHSPACE plus x percent      20   (1 - 100%)
    or    DATASIZE plus x percent          10   (1 - 100%)
  Primary = Allocated plus x percent       10   (1 - 100%)
    or    Used plus x percent              5    (1 - 100%)
  Secondary = x percent of Primary . . . 5    (1 - 100%)
  DB2 Percent Free per Page . . . . .    (0 - 99%)
  DB2 Free Pages . . . . .                (0 - 255)
Allow Reallocation to Decrease Size . . Y   (Yes/No)
Use Dataset Manager to Reallocate . . . N   (Yes/No)
Apply MAXPRIME rules to Reallocation      Y   (Yes/No)
Round Allocations to the Cylinder level N   (Yes/No)
```

- conditions to be evaluated (Reallocate when)
- reallocation parameters (increase percentage)
- Use Dataset Manager x Db2 Alter command

Job Profile for Reallocation

```
AUTOTOOL V4R3  ----- Jobs Profile Display ----- 2021/04/16 09:35:33
-----
Line Commands: B - Build  C - Create  D - Delete  E - Export
                I - Import R - Rename  U - Update  V - View
-----
Profile Like  *                               DB2 Subsystem: PB1A
Creator Like  TS6771   Recent Profiles 00          Row 1 of 5  >
-----

Cmd  Name      Enter New Jobs Profile Data
C    QUIC
     SPAC
     WTK_
     WTK_
     WTK_
*****
Creator . . . . TS6771
Profile Name . . reallocate
Description . . . reallocate when
Update Option . U  (U - Update, V - View only, N - No access)

*HAA$JPR
```

- Creating new Job Profile

Job Profile for Reallocation

```
AUTOTOOL V4R3 ----- Jobs Profile Display ----- 2021/04/16 09:35:33
-----
Line Commands: B - Build C - Create D - Delete E - Export
               I - Import R - Rename U - Update V - View
-----
Profile Like *                               DB2 Subsystem: PB1A
Creator Like TS6771 Recent Profiles 00        Row 1 of 5  >
-----

Cmd  Name                Creator  Updt
C    QUICKBUILD          TS6771   N
    SPACEMON             TS6771   U
    WTK_SPC
    WTK_SPC
    WTK_SPC
*****
```

Adding Profiles to the Job Profile

Add Objects Profiles y (Yes/No)

Add Exception Profiles N (Yes/No)

Add Utilities Profiles y (Yes/No)

Add a Group N (Yes/No)

```
*****
```

- add the newly created profiles

Job Profile for Reallocation

```

AUTOTOOL V4R3 ----- Objects Profile Display ----- 2021/04/16 09:41:46
-----
Line Commands: C - Create D - Delete E - Export I - Import S - Select
               Q - Quick V - View U - Update
Profile Like *
Creator Like TS6771 Recent Profiles 00 DB2 Subsystem: PB1A
Row 1 of 2 >
-----

Cmd  Name AUTOTOOL V4R3 ----- Utilities Profile Display ----- 2021/04/16 09:42:29
-----
S QUICKBUILD
S WTK_SPCMON
*****
Line Commands: C - Create D - Delete E - Export I - Import S - Select
               Q - Quick U - Update V - View
Profile Like *
Creator Like TS6771 Recent Profiles 00 DB2 Subsystem: PB1A
Row 1 of 2 >
-----

Cmd  Name Creator Updt
S QUICKBUILD TS6771 N
S WTK_SPCMON_RELOCATE TS6771 U
***** Bottom of Data *****

```

- add the newly created profiles

Job Profile for Reallocation

```
AUTOTOOL V4R3 ----- Jobs Profile Display ----- 2021/04/16 09:50:23
-----
Line Commands: B - Build  C - Create  D - Delete  E - Export
               I - Import  R - Rename  U - Update  V - View
-----
Profile Like   *
Creator Like   TS6771  Recent Profiles 00          DB2 Subsystem: PB1A
Row 1 of 6    >
-----
HAAM090I - Profile "TS6771.REALLOCATE" saved.
-----
Cmd  Name
--  --
b   QUICKBUILD          TS6771      N
   REALLOCATE           TS6771      U
   SPACEMON             TS6771      U
   WTK_SPCMON_EXCP      TS6771      U
   WTK_SPCMON_ITAU      TS6771      U
   WTK_SPCMON_JOB       TS6771      U
***** Bottom of Data *****
```

- Build job to evaluate conditions x objects

Job Profile for Reallocation

```
AUTOTOOL V4R3 ----- Jobs Profile Display ----- 2021/04/16 09:50:23
-----
Line Commands: B - Build  C - Create  D - Delete  E - Export
                I - Import R - Rename  U - Update  V - View
-----
                  Build Job for TS6771.REALLOCATE
-----
- Build Online or Batch. . b (O - Online, B - Batch)
C Schedule Job . . . . . N (Yes/No)  Update options . . N (Yes/No)
-
JCL Output Options:
  Edit Generated Job . . . Y (Yes/No)
  Build job in Data set. . RSTEST.HAA.GEN.JCL
                        Member . . TS6771SM
*
Job Cards:
==> //TS6771D JOB CLASS=A,NOTIFY=SYSUID,MSGCLASS=H
==> //*
==> //*
==> /*
```

- batch x online
- Schedule option
 - Db2 Administration Task Manager

Job Profile for Reallocation

```
AUTOTOOL V4R3 ----- Jobs Profile Display ----- 2021/04/16 09:50:23
-----
Line Commands: B - Build C - Create D - Delete E - Export
                  Build Job for TS6771.REALLOCATE
-
- You have selected your job to be built in a batch mode. The
- batch generation JCL will be stored in data set
- RSTEST.HAA.GEN.JCL(TS6771SM).
C Please specify in the data set and member below where you want the
  JCL built by the batch module to be placed.

Schedule Job . . . . N (Yes/No)  Update options . . N (Yes/No)

Build job in Data set . RSTEST.HAA.GEN.JCL
Member . . ts6771j0

* Jobcard data to be used on the generated job:
==> //TS6771D JOB CLASS=A,NOTIFY=SYSUID,MSGCLASS=H
==> //*
==> //*
==> //*
```

- location to place generated reallocation job

Job Profile for Reallocation

```
File Edit Edit_Settings Menu Utilities Compilers Test Help
EDIT      RSTEST.HAA.GEN.JCL(TS6771SM) - 01.00      Columns 00001 00072
000107 //HAA#DATA DD *
000108     GENERATE_UTILITY_JOB (                      -
000109     DB2_SUBSYSTEM      PB1A                      -
000110     USER_INDICATOR     HAA                        -
000111     PROFILE_NAME       'REALLOCATE'               -
000112     PROFILE_CREATOR    TS6771                     -
000113     PROFILE_DESCRIPTION 'REALLOCATE WHEN'          -
000114     EXECUTION_LIB_1    RSDEMO.ABP220.IBMTAPE.SABPLOAD -
000115     EXECUTION_LIB_2    RSDEMO.HAA430.IBMTAPE.SHAALOAD -
000116     EXECUTION_LIB_4    RSDEMO.HAA430.IBMTAPE.SFECLOAD -
000117     DEBUG_MODE         OFF                        -
000118     PREVIEW_EXCP_REPORT NO                       -
000119     GEN_TO_DATASET     RSTEST.HAA.GEN.JCL          -
000120     GEN_TO_MEMBER      TS6771J0                   -
000121     JOB_CARD_1_1       '//TS6771D JOB CLASS=A,NOTIFY=SYSUID,MSGC' -
000122     JOB_CARD_1_2       'LASS=H'                   -
000123     JOB_CARD_2_1       '//*'                      -
000124     JOB_CARD_3_1       '//*'                      -
000125     JOB_CARD_4_1       '//*'                      -
```

- Db2 Automation Tool command

Job Profile for Reallocation

```
IRR010I  USERID TS6771  IS ASSIGNED TO THIS JOB.
ICH70001I TS6771  LAST ACCESS AT 11:03:13 ON THURSDAY, APRIL
$HASP373 TS6771D  STARTED - INIT 6      - CLASS A      - SYS
IEF403I  TS6771D - STARTED - TIME=11.03.59
RKTsw01I
RKTsw01I  JOBNAME  STEPNAME PROCSTEP STEP    RC    CPU (Total)
RKTsw01I  TS6771D  PROFILE          1     00    00:00:00.01
RKTsw01I          HAA@BULD          2     06    00:00:00.18
IEF404I  TS6771D - ENDED - TIME=11.04.00
RKTsw01I  TS6771D  JOB TOTALS:                00:00:00.19
$HASP395 TS6771D  ENDED - RC=0006
```

- If no object selected, job ends with return code 6
- could be used for further automation
 - additional steps to be run depending on RC

Job Profile for Reallocation

Following are the objects included in generated JCL based on the Utility Profile EXCEPTION Rule. If there is no Exception Profile in the Job, All objects default PART Level statistics are displayed for all objects.

Number of Accepted Objects.....5

Number of Rejected Objects.....0

Total Number of Objects Included in Generated JCL.....5

Jobname-	TS	IndexSpc	Database	Part	Index-TS	DS-	DS-	--Current-	--Current-	Cur	Ma
	or	TableSpc			--Name--	Ext	Num	Allocation	---Used---	Usd	-G
	IX							----KB----	----KB----	-%-	
TS6771D	TS	GLWSEMP	BOBDEMO	1		2	1	1584	1524	96	
	TS	GLWSEMP	BOBDEMO	2		2	1	1584	1500	95	
	TS	GLWSEMP	BOBDEMO	3		2	1	1584	1504	95	
	TS	GLWSEMP	BOBDEMO	4		2	1	1584	1324	84	
	TS	GLWSEPA	BOBDEMO	1		3	1	31824	31068	98	
	TS	GLWSPJA	BOBDEMO	1		4	1	14544	13092	90	

***** ***** END OF OBJECTS *****

- Objects included on the reallocation job

Job Profile for Reallocation

```
BROWSE      RSTEST.HAA.GEN.JCL(TS6771J0) - 01.00      Line 0000000085 Col 001 080
//SQL#IN DD *
--
--      Reallocate Tablespace: "BOBDEMO"."GLWSEMP"
--      - Current Allocation is 33 Tracks
--
--      ALTER TABLESPACE "BOBDEMO"."GLWSEMP"
--      ALTER PARTITION 1
--      PRIQTY      1742
--      SECQTY      88
--      ;
--
--      COMMIT;
--
--      Reallocate Tablespace: "BOBDEMO"."GLWSEMP"
--      - Current Allocation is 33 Tracks
--
--      ALTER TABLESPACE "BOBDEMO"."GLWSEMP"
--      ALTER PARTITION 2
```

- Reallocation command

Space Monitoring

- Another alternative using exception profiles
- Additional conditions to be checked
- Optionally send a WTO message
 - further automation with your System Automation solution
 - Tivoli System Automation

Component Overview – Exception Profile screen

```
AUTOTOOL V4R3  ---- Update Exceptions Profile Display --- 2021/04/08 13:34:35
Commands: View B - View Boolean View S - View Selected View C - View Category
Options - Panel display options Group - Toggle Groups Save - Save Profile
Db2 Subsystem: PB1A
----- Row 1 of 18 ----- +>
S Statistics Type--- *Column----- Cond -----Exception Value-----
| Limit Exception Processing by Day of the Week/Month and/or Time of Day
| Select these conditions to limit the types of Objects that are processed
| Query Monitor performance recommendations
| RUNSTATS recommendation for missing or conflicting catalog statistics
| Select these conditions to specify various types of User Exits
| IBM Db2 Analytics Accelerator Exception Conditions
| DSNACCOX-like Recommendations
| Real Time TableSpace Statistics
| Real Time IndexSpace Statistics
| Real Time Image Copy related Thresholds...since last COPY
| Real Time Reorg Tablespace related Thresholds...since last REORG
| Real Time Reorg Index related Thresholds...since last REORG
| Real Time Runstats related Thresholds...since last RUNSTATS
| MVS Catalog exception conditions
| Db2 Catalog Image Copy related Thresholds
```

- For space monitoring, 2 groups could be used
 - Real Time Tablespace statistics
 - MVS Catalog Exception

Exception Profiles – Options for Space Monitoring

- Real Time Tablespace statistics SPACEUSED_PCT
 - The amount of space used as a percentage of the size limit for the table space.
Table space statistics table: $(NPAGES * PAGE SIZE * 100) / DSSIZE$

```

- Real Time TableSpace Statistics
- TABLESPACESTATS  TOTALROWS      -- _____
-                   SPACE           -- _____
-                   EXTENTS         -- _____
-                   NACTIVE         -- _____
-                   NPAGES          -- _____
-                   DATASIZE        -- _____
-                   *SPACE_DATA_RATIO
-                   *SPACEUSED_PCT  > 75
0

```

- MVS Catalog exception conditions PERCENT_USED
 - PERCENT_USED The percentage of space used for each individual object partition;
calculated as $(\text{total used space} / \text{total allocated space}) \times 100$.

```

- MVS Catalog exception conditions
- MVS Catalog stats are processed at the Partition level
- MVS CATALOG      *DSNUM          -- _____
-                  *EXTENTS        -- _____
-                  *ALLOCATED_TRACKS
-                  *PERCENT_USED    > 75
0                  *PERCENT_MAXUSED -- _____
-                  *PERCENT_MAXALLOC
-                  *PQTY           -- _____
-                  *SQTY           -- _____

```

Exception Profile – WTO option

```

AUTOTOOL V4R3      ---- Update Exceptions Profile Display --- 2021/04/08 13:14:11
Commands: View B - View Boolean View S - View Selected View C - View Category
Options - Panel display options Group - Toggle Groups Save - Save Profile
Line Cmds: A - And O - Or S - Select D - Deselect R - Repeat U - Update
Group Line Commands: G - Toggle + - Expand - - Contract
CONDITIONS: LT|<|LE|<=|EQ|=|GT|>|GE|>=|NE|~|=|<>  "*" indicates an HAA stat
-----
Creator: TS6771      Profile: WTK_EXCP_ITAU      User: TS6771
                                           Db2 Subsystem: PB1A
-----
Share Option U (U - Update, V - View, N - No)
Description TESTING EXCEPTIONS FOR ITAU      Scroll Right for Column Help
Use Stats From: R (R - Repository,      Update Runstats Options: N (Yes/No)
                  C - Catalog,      Save Triggers in Repository: N (Yes/No)
                  U - Runstats,      WTO number of triggered Objects: Y (Yes/No)
                  S - Shadow,      Combine IX/TS Exceptions when
                  H - History)      evaluating an IX triggering a TS: N (Yes/No)
-----
----- Row 1 of 18      +>
S Statistics Type--- *Column----- Cond -----Exception Value-----
_ Limit Exception Processing by Day of the Week/Month and/or Time of Day

```

- Option to send WTO message

Component Overview – Job Profile screen

```

AUTOTOOL V4R3  ----- Update Jobs Profile Display ----- 2021/04/08 13:38:15
-----
Commands: Build - Build job profile.
Line Commands: V - View  A - Add  D - Delete  U - Update  R - Repeat
                G - show/hide Group
-----
Creator: TS6771      Profile: SPACEMON      User: TS6771
                DB2 Subsystem: PB1A
-----
Share Option U  (U - Update,      Description SPACE MONITORING
                V - View,
                N - No)
Update Job Generation Options N  (Yes/No)  Row 1 of 4      >
-----
  Cmd  Order  Excp Rule  Type  Name  Creator
  ---  ---  ---  ---  ---  ---
   -    1    -    -    GRP  DEFAULT GROUP #1  HAA
   -    1    -    -    OBJS  WTK_SPCMON  TS6771
   -    2    -    -    EXCP  WTK_EXCP  TS6771
   -    3    -    -    UTIL  WTK_SPCMON_RELOCATE  TS6771
***** Bottom of Data *****

```

- Create a Job profile with 3 profiles
 - Objects, Exception and Utility

Exception Profile – WTO option result

```
IRR010I  USERID TS6771  IS ASSIGNED TO THIS JOB.
ICH70001I TS6771  LAST ACCESS AT 10:53:19 ON THURSDAY, APRIL 8, 2021
$HASP373 TS6771D  STARTED - INIT 6    - CLASS A          - SYS RS01
IEF403I TS6771D - STARTED - TIME=10.59.33
RKTSW01I
RKTSW01I  JOBNAME  STEPNAME PROCSTEP STEP    RC  CPU (Total)  CPU (TCB)  CPU
RKTSW01I  TS6771D  PROFILE          1     00  00:00:00.01  00:00:00.00  00:0
+HAA$BULD: 00002 Objects were triggered by Exception Processing
RKTSW01I          HAA@BULD          2     00  00:00:00.19  00:00:00.15  00:0
IEF404I TS6771D - ENDED - TIME=10.59.34
RKTSW01I  TS6771D  JOB TOTALS:          00:00:00.20  00:00:00.15  00:0
$HASP395 TS6771D  ENDED - RC=0000
```

Message could be used by Automation Solution (e.g. Tivoli Workload Scheduler) to take additional actions (e.g. run the generated jobs)

Space Monitoring

- Summary
 - Db2 Automation offers good alternatives for Space Monitoring
 - Have options to further automate the process
 - return code
 - wto messages

Thank
You

