DBMS_SCHEDULER 12.2

New Features

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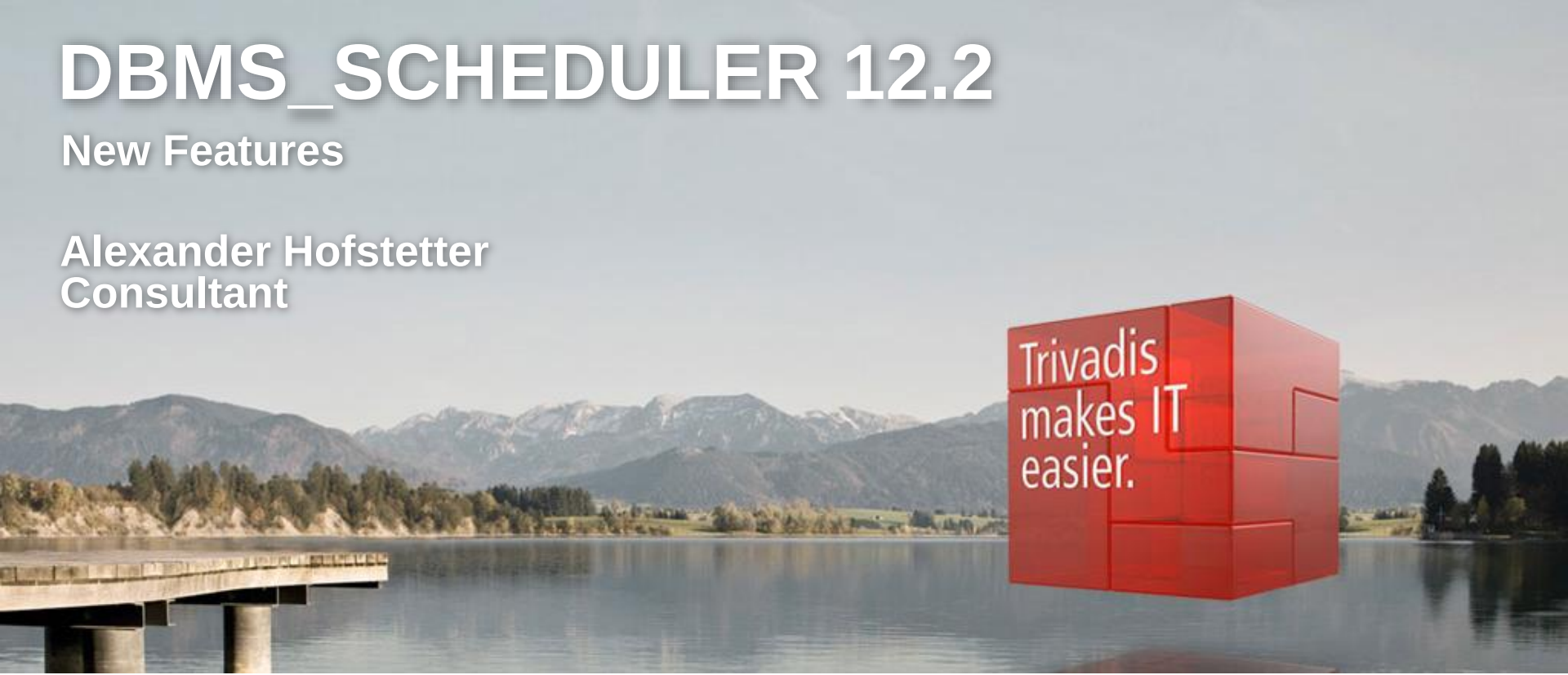

About me

- Consultant, Trivadis GmbH, Munich
- Since 2008 Oracle DBA
- Working with Oracle since 2005
- Latest Projects
  - High Availability
  - Automation
  - Migration & Upgrades

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Oracle Database 11*g*
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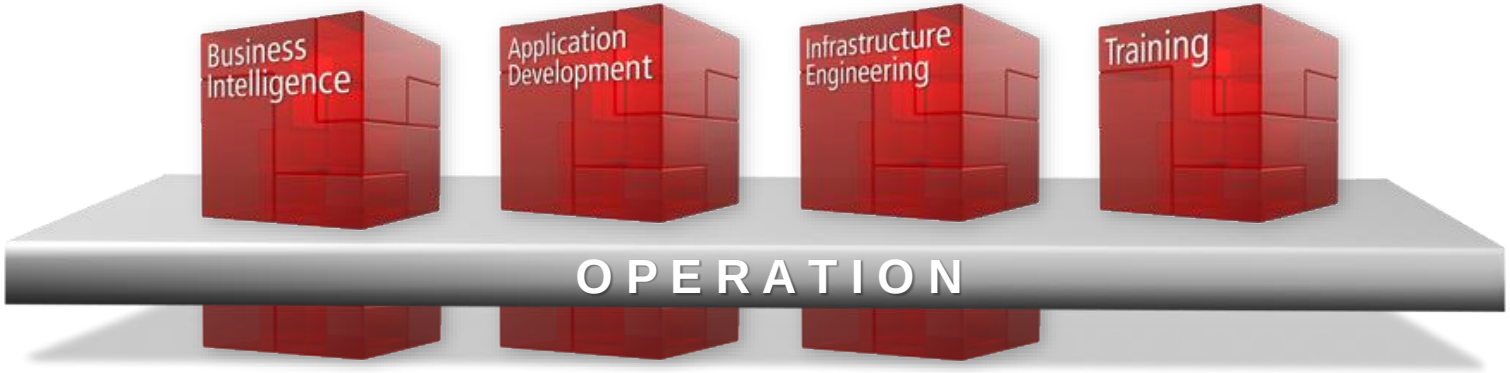

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Agenda

1. Scheduler Basics
2. Resource Management
3. Scheduling
4. New Features 12.2
5. Conclusion

Scheduler Basics

Introduction

- Implemented in 10gR1
- Time- and event-based scheduling
- Monitoring, logging and reporting possibilities
- Resource management

Architecture

- sys.scheduler$_job Table

- The job coordinator (cjqNNN process) controls the jobs
  - Queries the job table
  - Spawns and cleanup slave processes if needed
  - Switches to sleep mode and wake up
  - There is one coordinator per instance in a RAC environment

Architecture II

- Job Execution by Job Slave
  - Gathers all required information about the job
  - Starts a database session
  - Opens a transaction and starts the job
  - After completion transaction is commited and closed
  - Closes the the database session

Architecture III

- After completion
  - Run Count
  - Logging
  - Rescheduling if required
  - Look for new work or go to sleep

Job Categories

- **Database Job**
  - PL/SQL Block
  - Stored Procedure
- **External Job**
  - Executable
- **Script Job**
  - SQL Script
  - External Script
  - Backup Script

Job Categories II

- Chain Job
- Lightweight Job
- Multiple-destination Job
- Detached Job
- In-Memory-Job

Resource Management

Resource management

- **Resource Manager**
  - Provides more control over hardware resources
  - Limits the amount of CPU usage
  - Limit the degree of parallelism and priority
  - Limit the amount of active sessions
  - Move session to another group

Resource management II

- **Job Classes**
  - Assign Consumer Group
  - Assign Service
  - Define logging level
  - Created in SYS schema
  - MANAGE SCHEDULER privilege is necessary

Resource management III

- Windows
  - Assign Resource Plan
  - Only one Window can be active
  - Overlapping is possible (not recommended)
  - Manage Scheduler privilege is necessary

Scheduling

Scheduling

- **Time-based scheduling**
  - Start at a particular date and time
  - Once or repeating, even complex intervals
- **Event-based scheduling**
  - Job starts based on an event
  - There a two kindes of event

Time-based Scheduling

- start_date, repeat_interval, end_date
- repeat_interval can be Calender Expression or PL/SQL Expression
  - Calendar: `FREQ=MINUTELY; INTERVAL=5;`
  - PL/SQL: `SYSTIMESTAMP + INTERVAL '5' MINUTE`
- **FREQ, INTERVAL**, BYMONTH, BYWEEKNO, BYYEARDAY, BYDATE,BYMONTHDAY,BYDAY,BYHOUR,BYMINUTE,BYSECOND,BYSETPOS, INCLUDE,EXCLUDE,INTERSECT,PERIODS,BYPERIOD

- Syntax available at:

http://tinyurl.com/jo4645n

Scheduling Examples

- Every 2nd Thursday

```
FREQ=Weekly; INTERVAL=2; BYDAY=THU
```

- Last workday of a month

```
FREQ=MONTHLY; BYDAY=MON,TUE,WED,THU,FRI; BYSETPOS=-1;
```

- Every 2nd hour every 5 minutes from Monday to Friday

```
FREQ=MINUTELY;INTERVAL=5;BYDAY=MON,TUE,WED,THU,FRI;
BYHOUR=0,2,4,6,8,10,12,14,16,18,20,22
```

New Features 12.2

Job Incompatibilities

- You can define an incompability between two or more jobs
- Only one of the group can be running at a time
- Incompatibility can be defined at job or program level

Job Incompatibilities – Job Level

- Only one Job in the definition can run at the time
- All other jobs in the same group have to wait until first jobs finishes

Example: you have got one Incompatible Group with JOB A, B und C

while JOB A runs, you can‘t start JOB B or C.

Job Incompatibilities – Program Level

- Only Jobs running the same Program can run at a time
- All other jobs, using other programs in the same group have to wait until all jobs finish.

Example: you have got one Incompatible Group with Program A, B und C

Job 1+2 run Program A ; Job 3+4 run Program B; Job 5+6+7+8 run Program C

While a Job 5 with Program C is running, only Job 6, 7 and 8 would run

Job 1,2,3 and 4 can‘t start as long a job with Program C is running

Job Incompatibilities Procedures

- CREATE_INCOMPATIBILITY
- ADD_TO_INCOMPATIBILITY
- REMOVE_FROM_INCOMPATIBILITY
- DROP_INCOMPATIBILITY

Job Incompatibilities: CREATE_INCOMPATIBILITY

```
DBMS_SCHEDULER.CREATE_INCOMPATIBILITY (
   incompatibility_name     IN VARCHAR2,
   object_name              IN VARCHAR2,
   constraint_level         IN VARCHAR2 DEFAULT 'JOB_LEVEL',
   enabled                  IN BOOLEAN DEFAULT TRUE,
   comments                 IN VARCHAR2 DEFAULT NULL);
```

```
BEGIN
dbms_scheduler.create_incompatibility(
  incompatibility_name => 'incompatible1',
  object_name => 'job1,job2,job3',
  enabled => true );
END;
/
```

Job Incompatibilities ADD_TO_INCOMPATIBILITY

```
DBMS_SCHEDULER.ADD_TO_INCOMPATIBILITY (
   incompatibility_name    IN VARCHAR2,
   object_name             IN VARCHAR2);
```

```
BEGIN
dbms_scheduler.add_to_incompatibility(
  incompatibility_name => 'incompatible1',
  object_name => 'job4');
END;
/
```

Job Incompatibilities REMOVE_FROM_INCOMPATIBILITY

```
DBMS_SCHEDULER.REMOVE_FROM_INCOMPATIBILITY (
   incompatibility_name    IN VARCHAR2,
   object_name             IN VARCHAR2);
```

```
BEGIN
dbms_scheduler.remove_from_incompatibility(
  incompatibility_name => 'incompatible1',
  object_name => 'job2');
END;
/
```

Job Incompatibilities DROP_INCOMPATIBILITY

```
DBMS_SCHEDULER.DROP_INCOMPATIBILITY (
   incompatibility_name     IN VARCHAR2);
```

```
BEGIN
dbms_scheduler.drop_incompatibility(
  incompatibility_name => 'incompatible1');
END;
/
```

Job Incompatibilities Views

- USER_SCHEDULER_INCOMPATS
- USER_SCHEDUER_INCOMPAT_MEMBER

```
USER_SCHEDULER_INCOMPATS
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------
 INCOMPATIBILITY_NAME                      NOT NULL VARCHAR2(128)
 CONSTRAINT_LEVEL                                   VARCHAR2(13)
 ENABLED                                            VARCHAR2(5)
 JOBS_RUNNING_COUNT                                 NUMBER
 COMMENTS                                           VARCHAR2(256)
```

Job Incompatibilities Views

```
USER_SCHEDULER_INCOMPAT_MEMBER
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------
 INCOMPATIBILITY_OWNER                     NOT NULL VARCHAR2(128)
 INCOMPATIBILITY_NAME                      NOT NULL VARCHAR2(128)
 OBJECT_OWNER                              NOT NULL VARCHAR2(128)
 OBJECT_NAME                               NOT NULL VARCHAR2(128)
```

Resource Queues

Resource Queues

- Specifies how many resources are required to execute a Job
- Resource can be specified by name and count
- At execution time Scheduler ensures that available resources are not exceeded
- Jobs can‘t run until required resources are available

Resource Queues Procedures

- CREATE_RESOURCE
- SET_ATTRIBUTE / _NULL
- SET_RESOURCE_CONSTRAINT
- DROP_RESOURCE

Resource Queues CREATE_RESOURCE

```
DBMS_SCHEDULER.CREATE_RESOURCE (
  resource_name     IN VARCHAR2,
  units             IN PLS_INTEGER,
  status            IN VARCHAR2 DEFAULT 'ENFORCE_CONSTRAINTS',
  constraint_level  IN VARCHAR2 DEFAULT 'JOB_LEVEL',
  comments          IN VARCHAR2 DEFAULT NULL);
```

```
BEGIN
   DBMS_SCHEDULER.CREATE_RESOURCE(
      resource_name => 'app_resource1',
      units => 2,
      status => 'ENFORCE_CONSTRAINTS',
      comments => 'Resource1');
END;
/
```

Resource Queues SET_RESOURCE_CONSTRAINT

```
DBMS_SCHEDULER.SET_RESOURCE_CONSTRAINT (
   object_name         IN VARCHAR2,
   resource_name       IN VARCHAR2,
   units               IN NUMBER DEFAULT 1);
```

```
BEGIN
    DBME_SCHEDULER.SET_RESOURCE_CONSTRAINT(
         OBJECT_NAME   => 'job1',
         RESOURCE_NAME => 'app_resource1',
         UNITS         =>1);
END;
/
```

Resource Queues DROP_RESOURCE

```
BEGIN
   DBMS_SCHEDULER.DROP_RESOURCE(
      resource_name => 'app_resource1',
      force         => true
   )
END;
/
```

Resource Queues Views

- USER_SCHEDULER_RESOURCES

```
USER_SCHEDULER_RESOURCES
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------
 RESOURCE_NAME                             NOT NULL VARCHAR2(128)
 STATUS                                             VARCHAR2(19)
 RESOURCE_UNITS                                     NUMBER
 UNITS_USED                                         NUMBER
 JOBS_RUNNING_COUNT                                 NUMBER
 COMMENTS                                           VARCHAR2(256)
```

Resource Queues Views

- USER_SCHEDULER_RSC_CONSTRAINTS

```
USER_SCHEDULER_RSC_CONSTRAINTS
 Name                                      Null?    Type
 ----------------------------------------- -------- ----------------------
 OBJECT_OWNER                              NOT NULL VARCHAR2(128)
 OBJECT_NAME                               NOT NULL VARCHAR2(128)
 RESOURCE_OWNER                            NOT NULL VARCHAR2(128)
 RESOURCE_NAME                             NOT NULL VARCHAR2(128)
 UNITS_USED                                         NUMBER
```

In-Memory Jobs

In-Memory Jobs

- Should be created and run during a short period of time
- In-memory jobs have a larger memory footprint
- There are 2 types of in-memory jobs:
  - IN_MEMOR_RUNTIME
  - IN_MEMORY_FULL

IN_MEMORY_RUNTIME

- Based on Lightweight Jobs (persistent)
- Repeatable
- Run with DEFAULT_IN_MEMORY_JOB_CLASS
  - Logging level = none
  - No information in scheduler views

IN_MEMORY_FULL

- Not persistent, only in memory
- Must be associated to a program
- Not repeatable, supposed to run once
- Do not generate Redo at create or during runtime
- On RAC job is only present where created
- They are not propagated to physical or logical standby

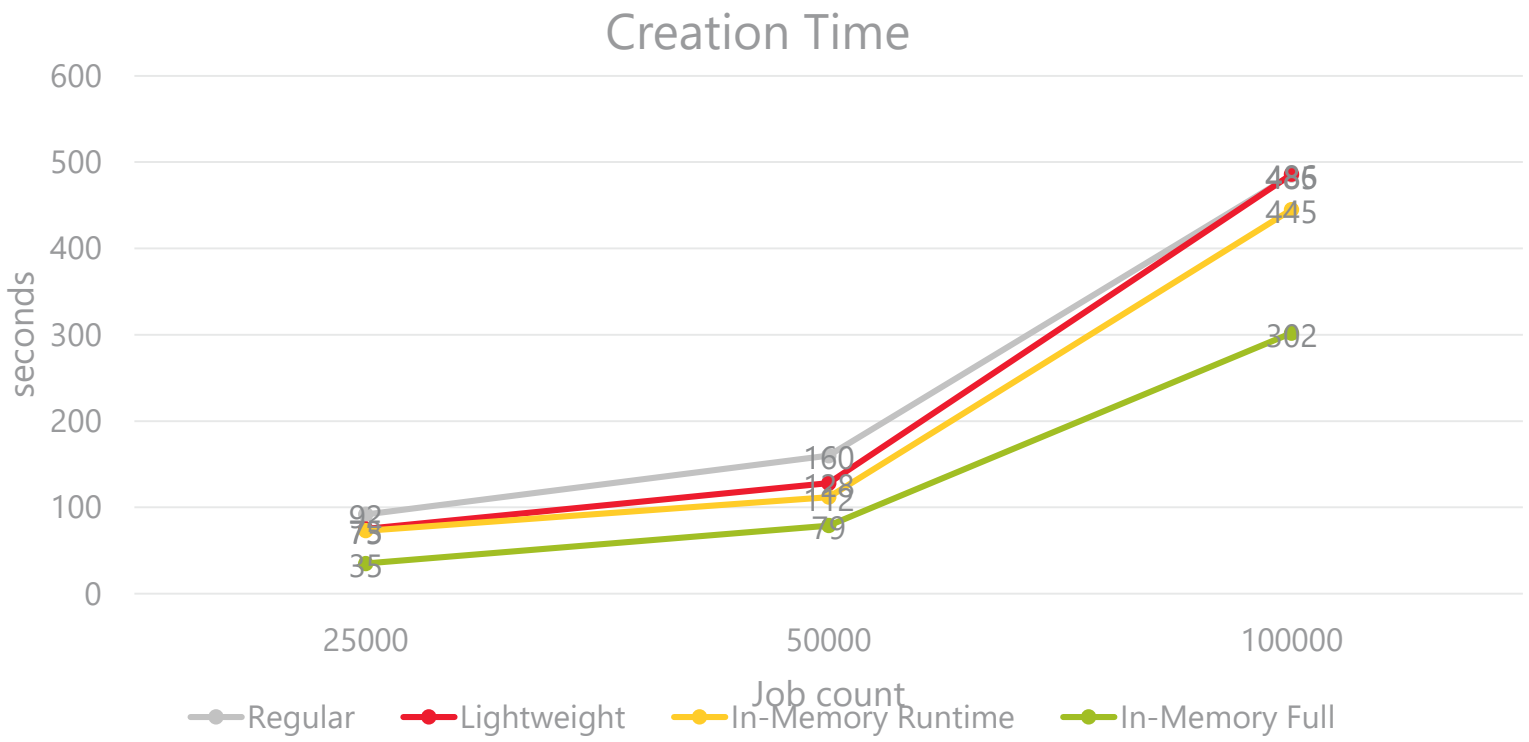
In-Memory Runtime Job Example

```
BEGIN
  DBMS_SCHEDULER.CREATE_JOB (
    job_name => 'my_repeat_job',
    program_name => 'repeat_prog',
    start_date => systimestamp,
    repeat_interval => 'freq=secondly;interval=10',
    job_style => 'IN_MEMORY_RUNTIME',
    enabled => true);
END;
/
```

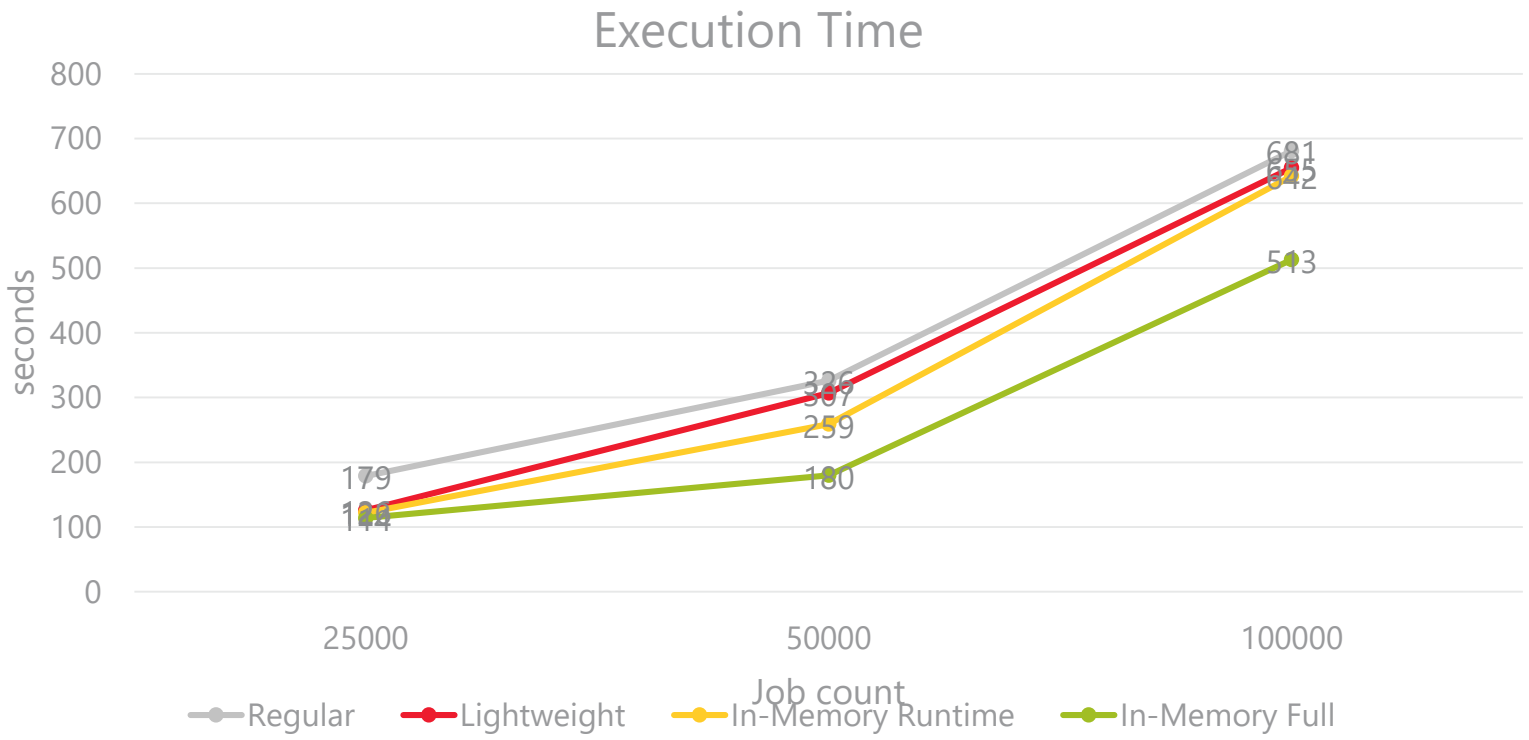
In-Memory Full Job Example

```
BEGIN
  DBMS_SCHEDULER.CREATE_JOB (
    job_name => 'my_immediate_job',
    program_name => 'fast_op',
    job_style => 'IN_MEMORY_FULL',
    enabled => true);
END;
/
```

Job Type Comparison



Job Type Comparison



In-Memory Views

- V$SCHEDULER_INMEM_MDINFO

Name	Null?	Type
OBJID		NUMBER
PRGOID		NUMBER
LAST_ENABLED_TIME		TIMESTAMP(3) WITH TIME ZONE
CLSOID		NUMBER
INSTANCE_ID		NUMBER
FLAGS		NUMBER
CREATOR		VARCHAR2(128)
CLIENT_ID		VARCHAR2(65)
GUID		VARCHAR2(33)
CON_ID		NUMBER

In-Memory Views

- V$SCHEDULER_INMEM_RTINFO

```
Name                                      Null?    Type
----------------------------------------- -------- --------------------
USERID                                             NUMBER
OBJID                                              NUMBER
ID_TYPE                                            NUMBER
NAME                                               VARCHAR2(128)
NEXT_RUN_DATE                                      TIMESTAMP(3) WITH TIME ZONE
LAST_START_DATE                                    TIMESTAMP(3) WITH TIME ZONE
LAST_END_DATE                                      TIMESTAMP(3) WITH TIME ZONE
RUN_COUNT                                          NUMBER
FAILURE_COUNT                                      NUMBER
RUNNING_INSTANCE                                   NUMBER
RUNNING_SLAVE                                      NUMBER
JOB_STATUS                                         NUMBER
CON_ID                                             NUMBER
```

Conclusion

Conclusion

- New Possibilites to regulate jobs
  - Job Incompatibilities defines jobs / programs which can‘t run parallel
  - Resource Queues defines a number of resource which can‘t be exceeded

- New Possibilities for extra fast jobs
  - In-Memory Runtime job for a persistent, repeatable jobs
  - In-Memory Full job for an extra fast one time executable job

Any questions…?

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