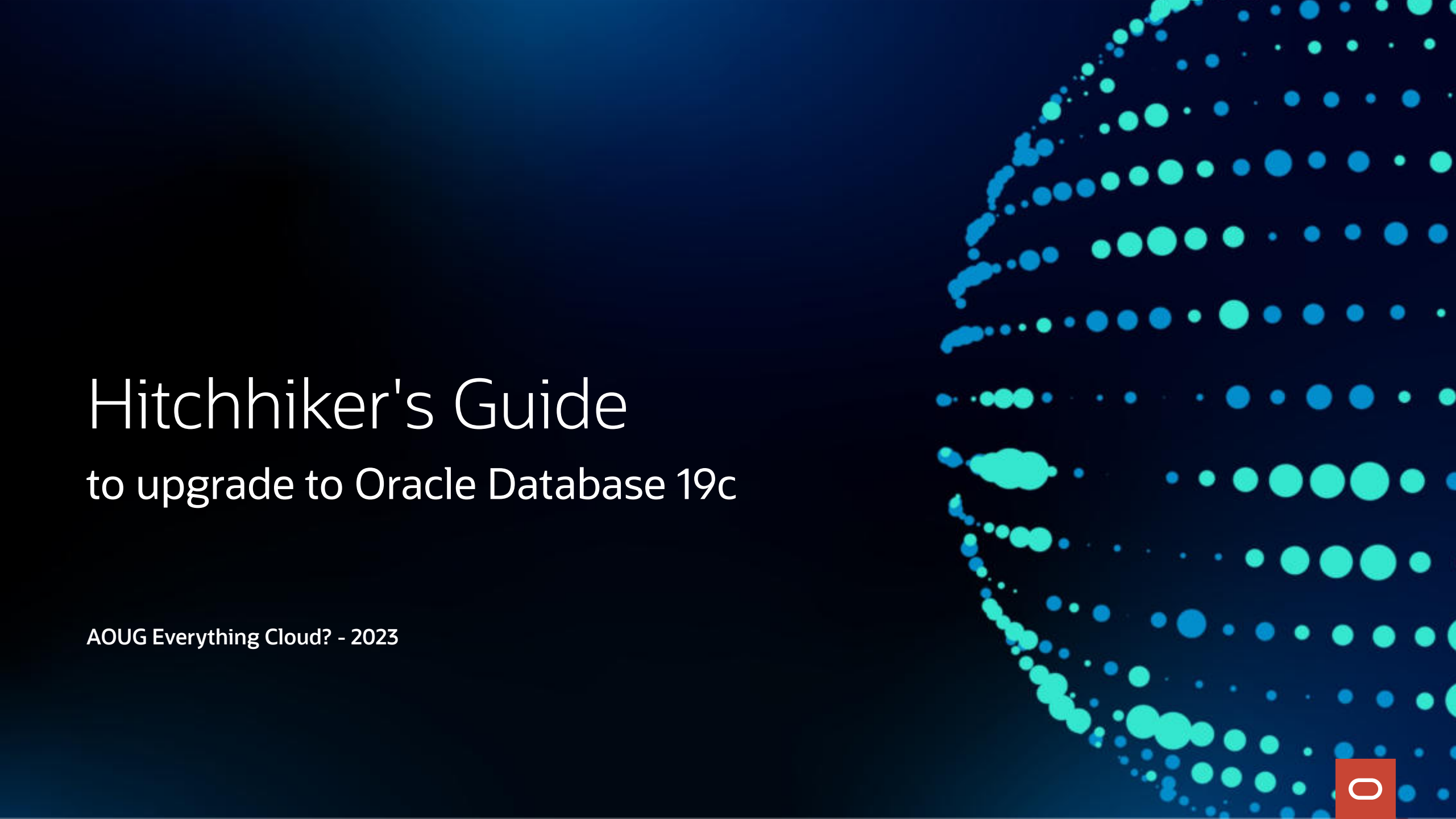
Hitchhiker's Guide

to upgrade to Oracle Database 19c

AOUG Everything Cloud? - 2023



Daniel Overby Hansen

Senior Principal Product Manager
Cloud Migration

dohdatabase

@dohdatabase

https://dohdatabase.com

Mike Dietrich

Senior Director Product Management

Database Upgrade, Migration and Patching

MikeDietrich

@MikeDietrichDE

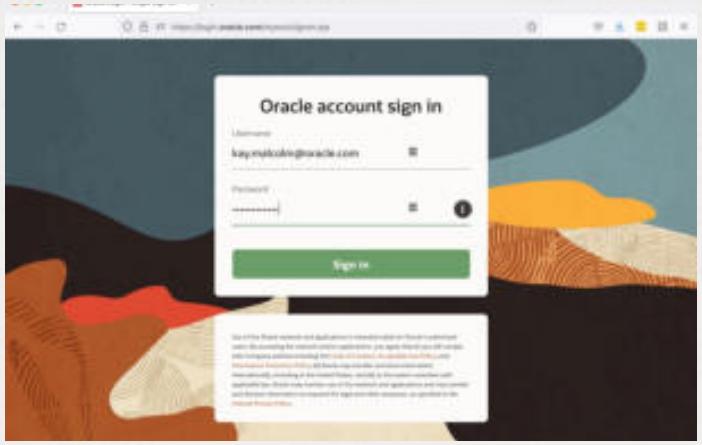
https://MikeDietrichDE.com

AGENDA

09:30	Intro and labs provisioning
09:45	Upgrade to Oracle Database 19c
10:15	Labs - part 1
11:00	Performance Stability Prescription
11:30	Labs - part 2
11:55	Wrap-up

Requirements for running this HOL

Laptop / Tablet



Oracle Account

Lab Provisioning

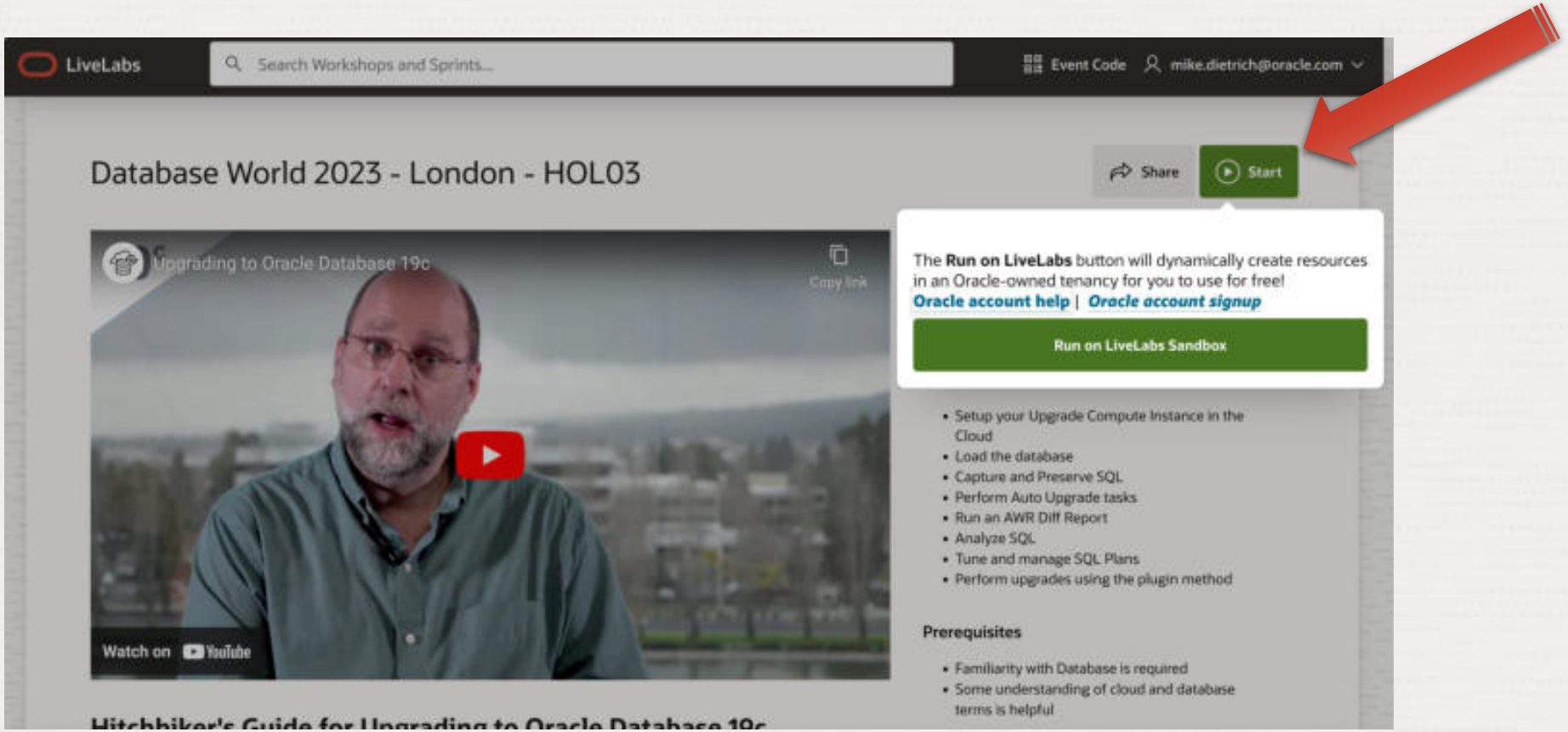
➔ Open a web browser

➔ Type in this link below to get access to the workshop page

https://tinyurl.com/aoug2023hol

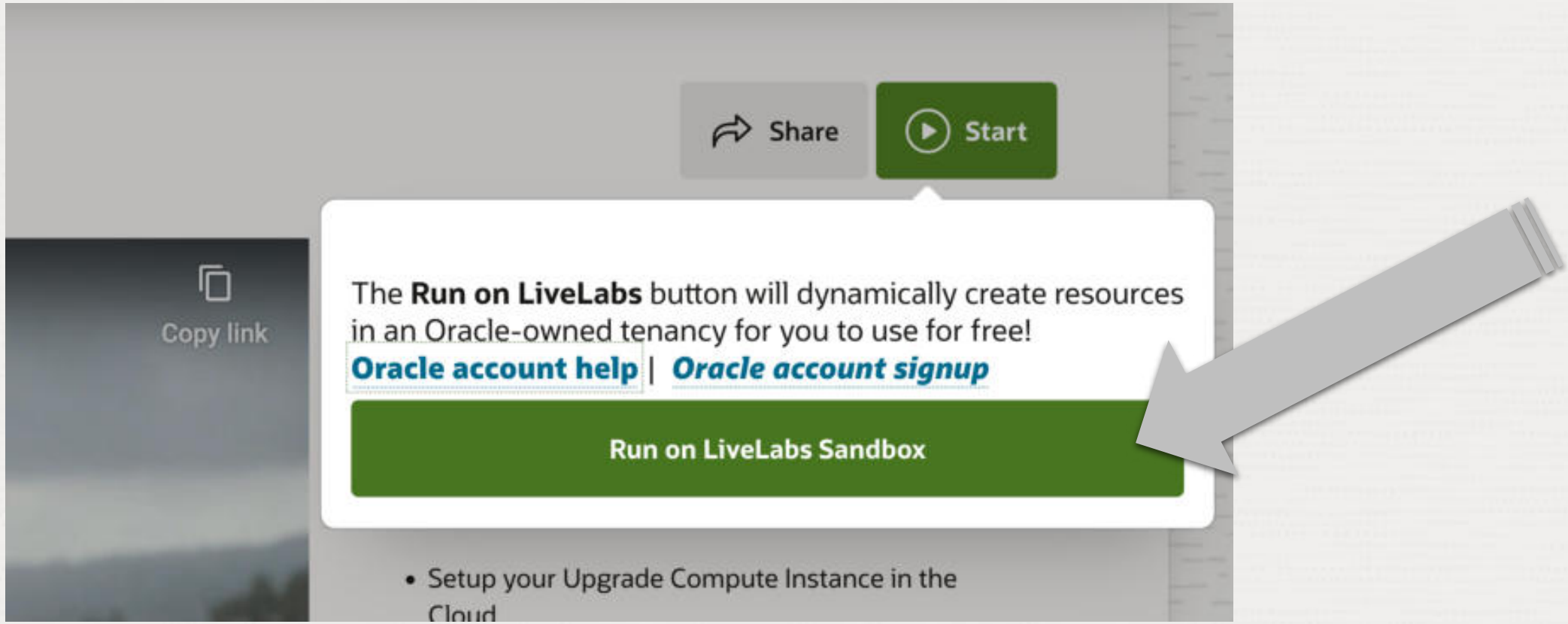
Lab Provisioning

Click on the Green Button "Start"



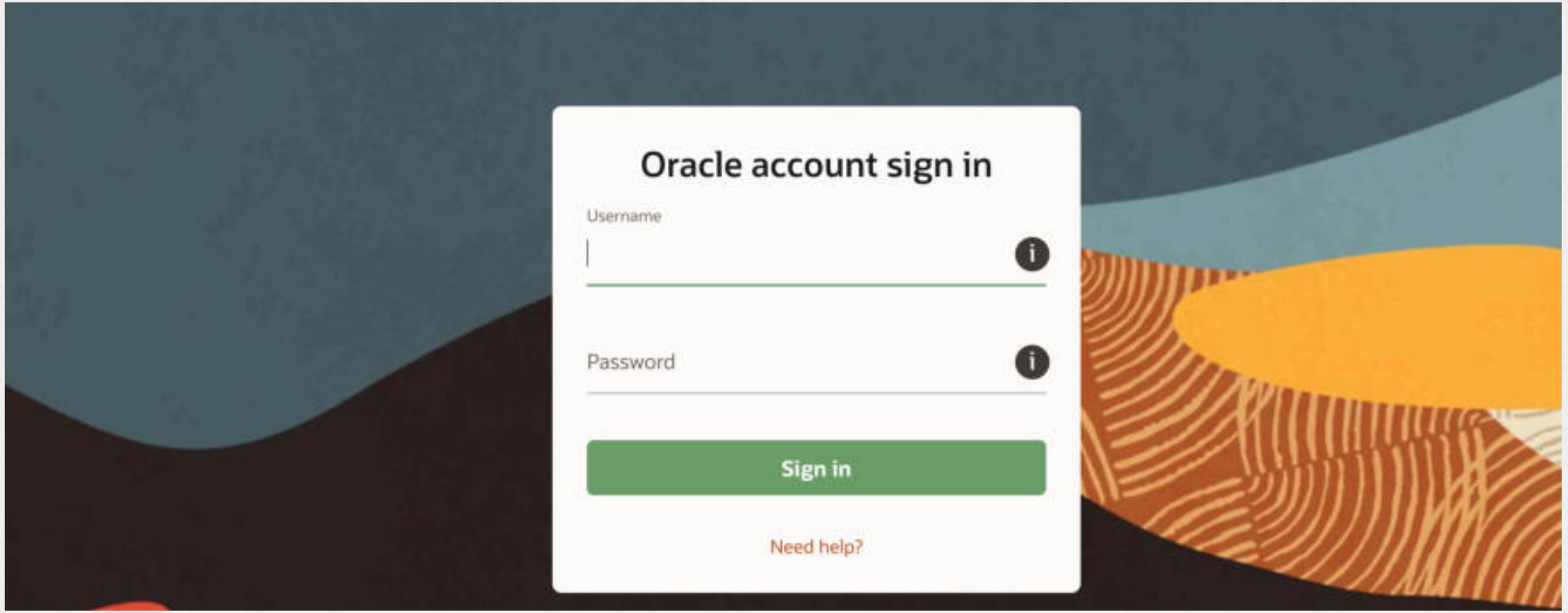
Lab Provisioning

Click on the next Green Button "Run on LiveLabs Sandbox"



Lab Provisioning

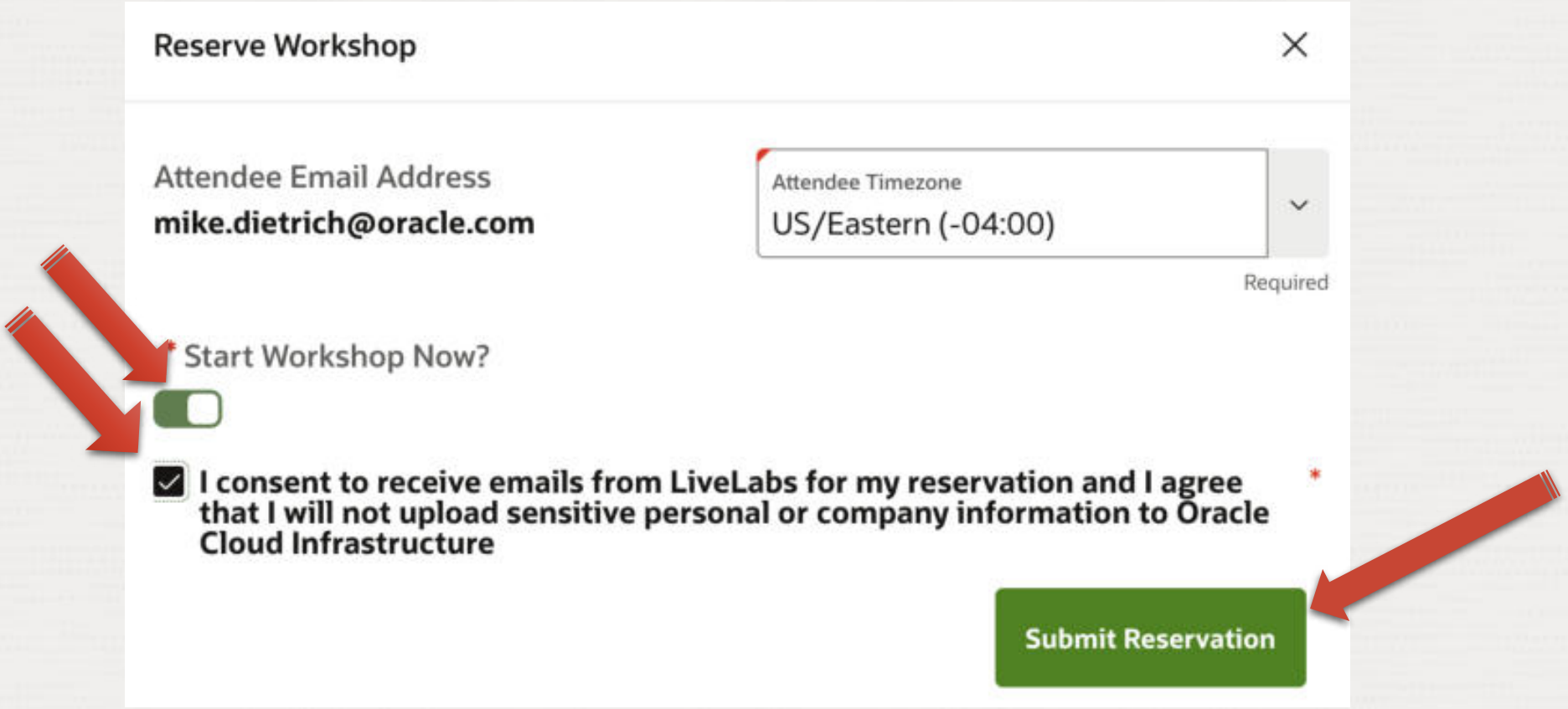
Logon with your Oracle SSO user



- If you don't have an Oracle SSO User yet, please create one: `https://tinyurl.com/OracleSSO`

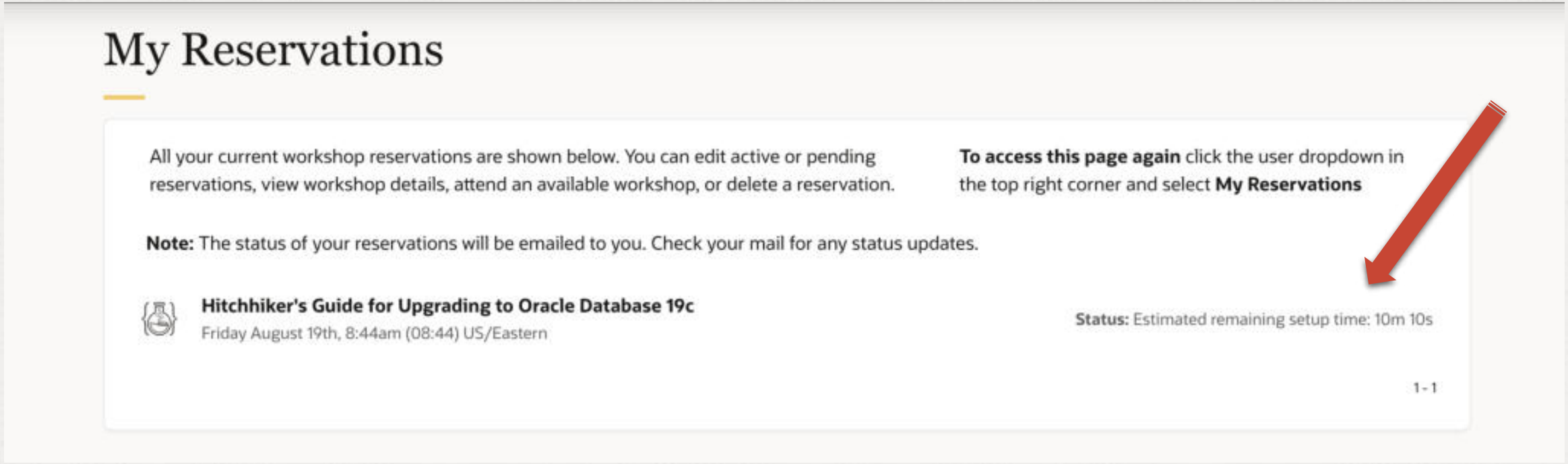
Lab Provisioning

Click on "Start Workshop Now", on the CONSENT checkbox, and then "Submit Reservation"



Lab Provisioning

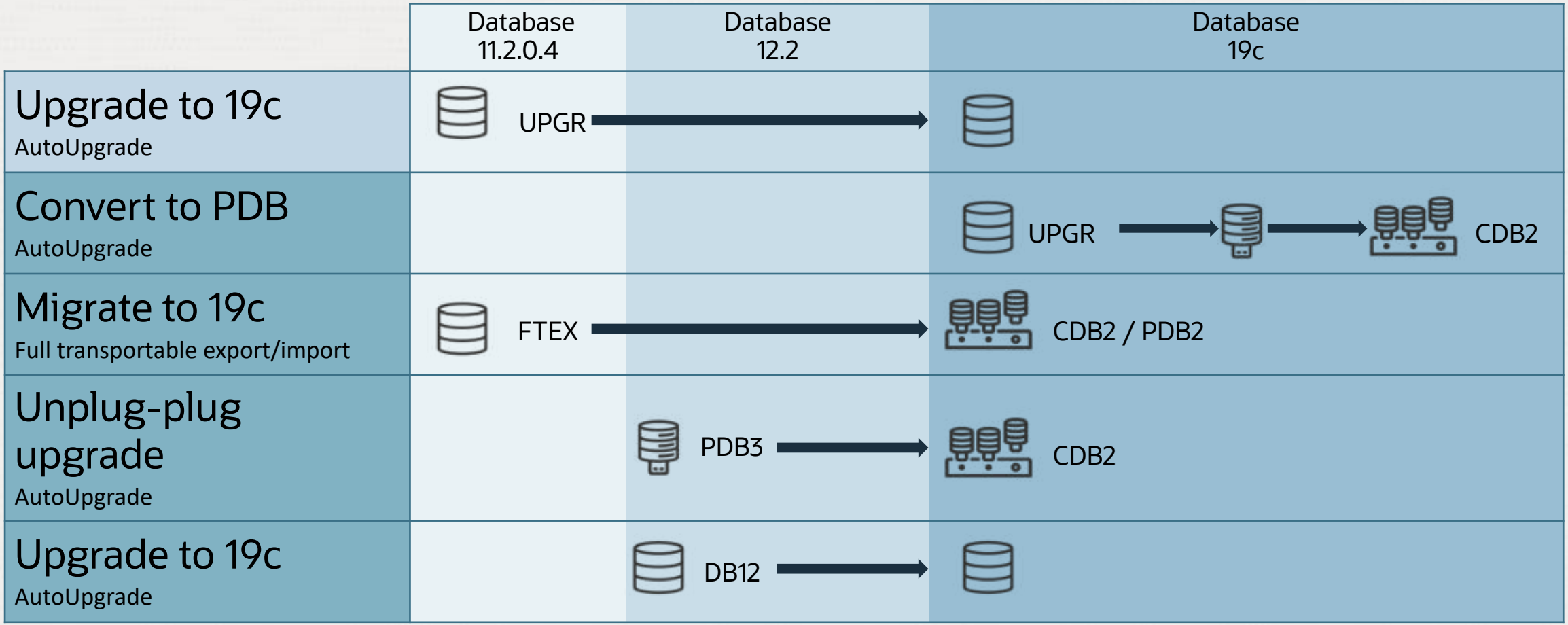
This will take you to "My Reservations" – now we have 11 mins to explain the exercises



Introduction into the Lab: Hitchhikers Guide to Oracle Database 19c

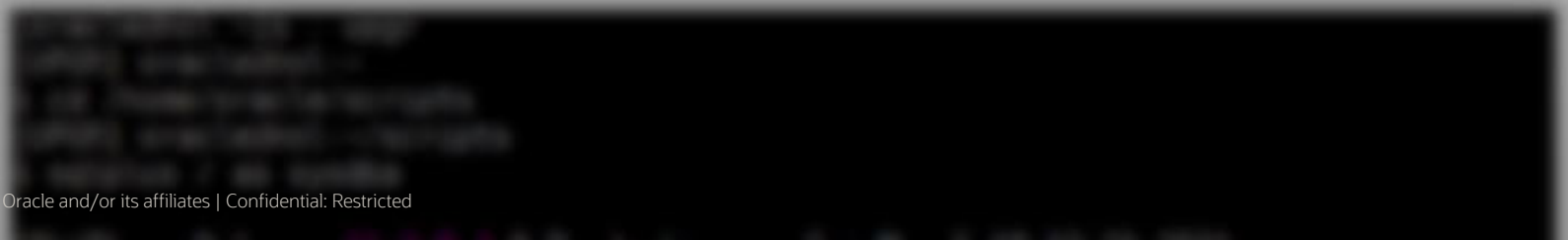
Upgrade to Oracle Database 19c and ensure performance stability

Lab Overview

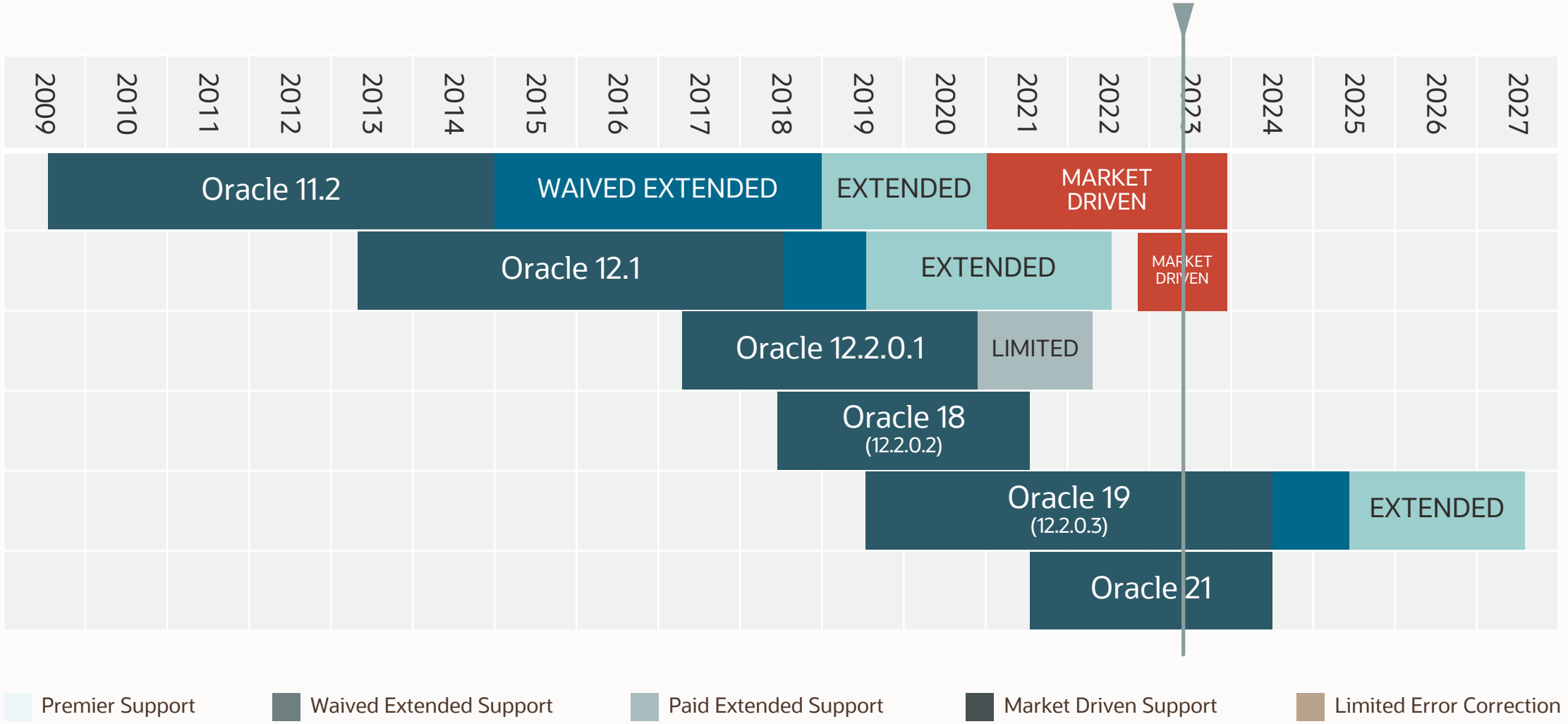


AutoUpgrade

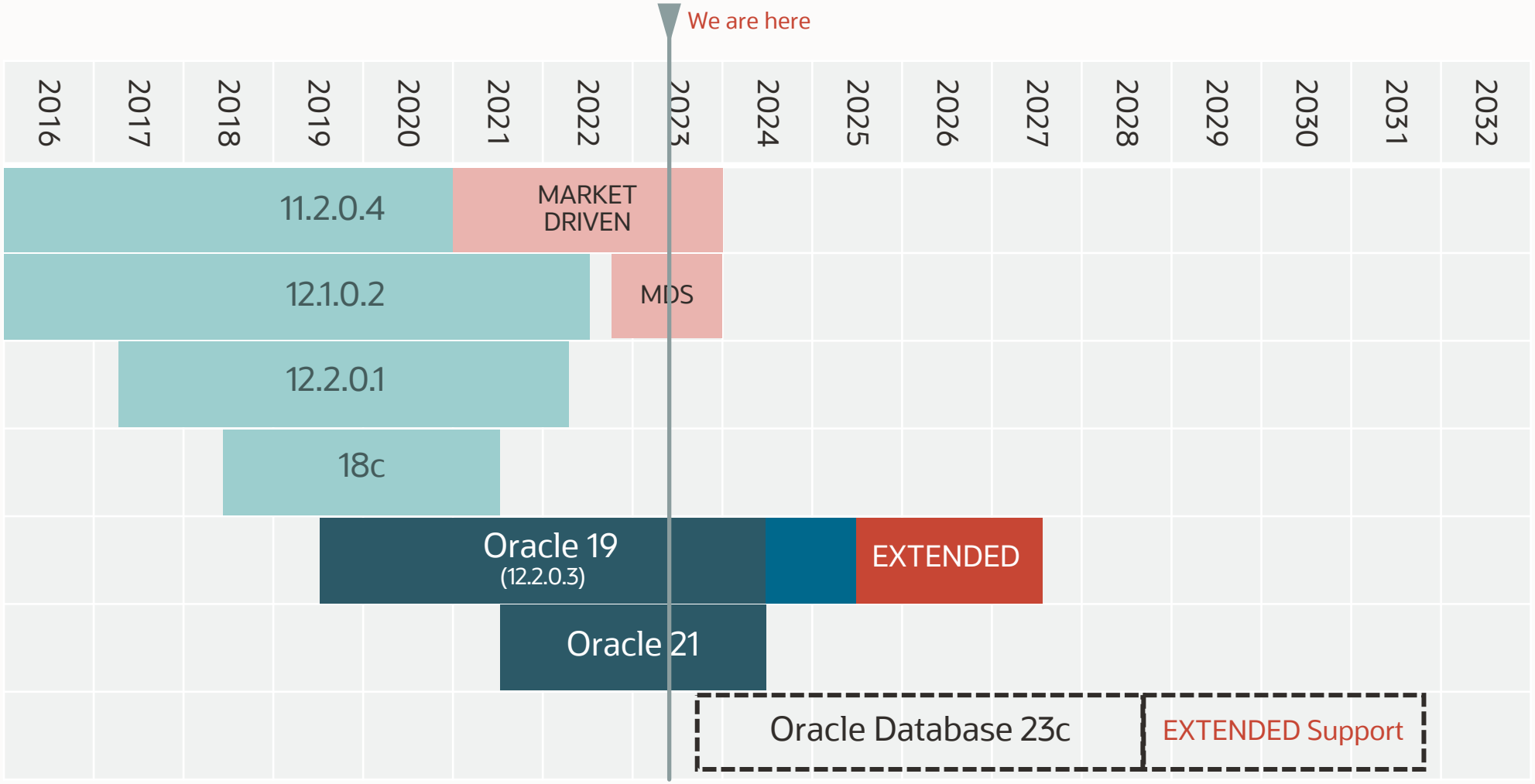
Upgrade to Oracle Database 19c and ensure performance stability



Lifetime Support Policy



Release Strategy | Make Your Plan



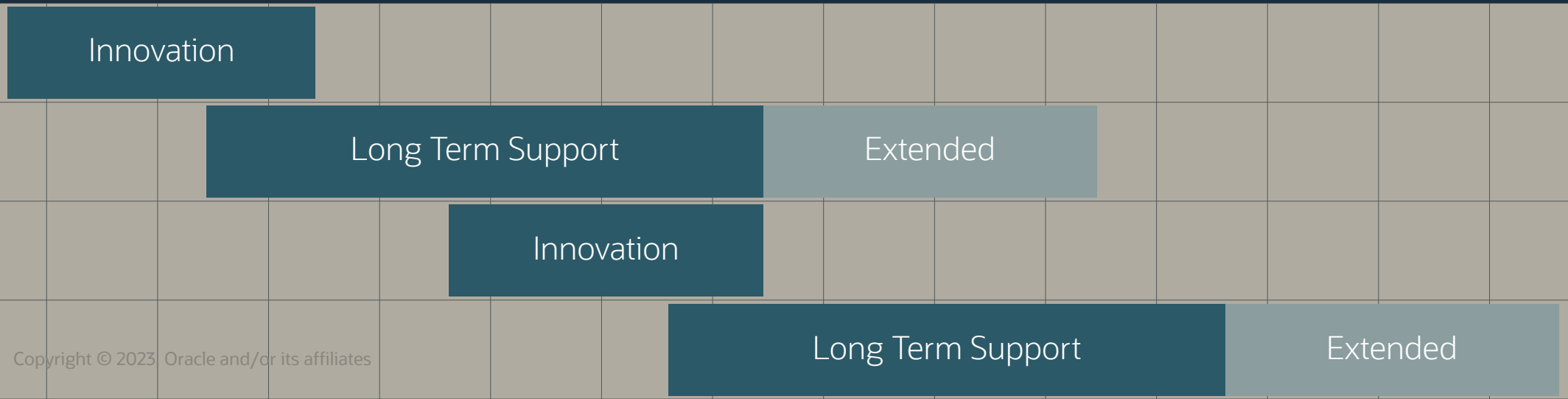
Release Types

LONG TERM SUPPORT

5+ years of Premier Support followed by
3+ years of Extended Support

INNOVATION

2 years of Premier Support
No Extended Support



Move production databases from one Long Term Support release to the next

Next Long Term Support release

Oracle Database 23c

Upgrade possible only from:

- Oracle Database 19c
- Oracle Database 21c

Do you want to upgrade?

Oracle Database 11.2.0.4
Oracle Database 12.1.0.2
Oracle Database 12.2.0.1
Oracle Database 18c

Oracle Database 11.2.0.4
Oracle Database 12.1.0.2
Oracle Database 12.2.0.1
Oracle Database 18c

Oracle Database 19c

Oracle Database 23c

Everybody must upgrade to Oracle Database 19c

- With or without Multitenant

```
--As of Oracle Database 19c you can create up to 3 PDBs without
--having the multitenant license. Applies to SE2 as well

SQL> alter system set max_pdbs=3;
```


Have at least a few environments in Oracle Database 19c using Oracle Multitenant

Your path to successful database upgrades

1

Install Oracle Home including RU and MRP

MOS Note: 2118136.2
MOS Note: 555.1
MOS Note: 2781612.2

2

Download and deploy the most recent AutoUpgrade

MOS Note: 2485457.1

3

Collect performance information from current source and test thoroughly

AutoUpgrade | Overview

11.2.0.4
12.1.0.2
12.2.0.1
18c
19c

ONE BUTTON APPROACH

12.2.0.1
18c
19c
21c

1. CONFIG FILE

2. ANALYZE

3. UPGRADE

Optionally,
convert to PDB

AutoUpgrade Overview

Supported source releases

- 11.2.0.4
- 12.1.0.2
- 12.2.0.1
- 18
- 19

All architectures (CDB and non-CDB)
All supported operating systems
All editions (SE2, EE)
All types (single instance and RAC)

AutoUpgrade Overview

Always download the newest edition from MOS Note: 2485457.1

AutoUpgrade Overview

Shortest possible config text file

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
```

AutoUpgrade Overview

One command

```
$ java -jar autoupgrade.jar -config cdb1.cfg -mode deploy
```

Advanced monitoring and logging

AutoUpgrade Overview

Supported target releases

- 12.2.0.1
- 18
- 19
- 21
- Any future release

AutoUpgrade Essentials

Photo by Daniel Cheung on Unsplash

AutoUpgrade | Essentials

Download

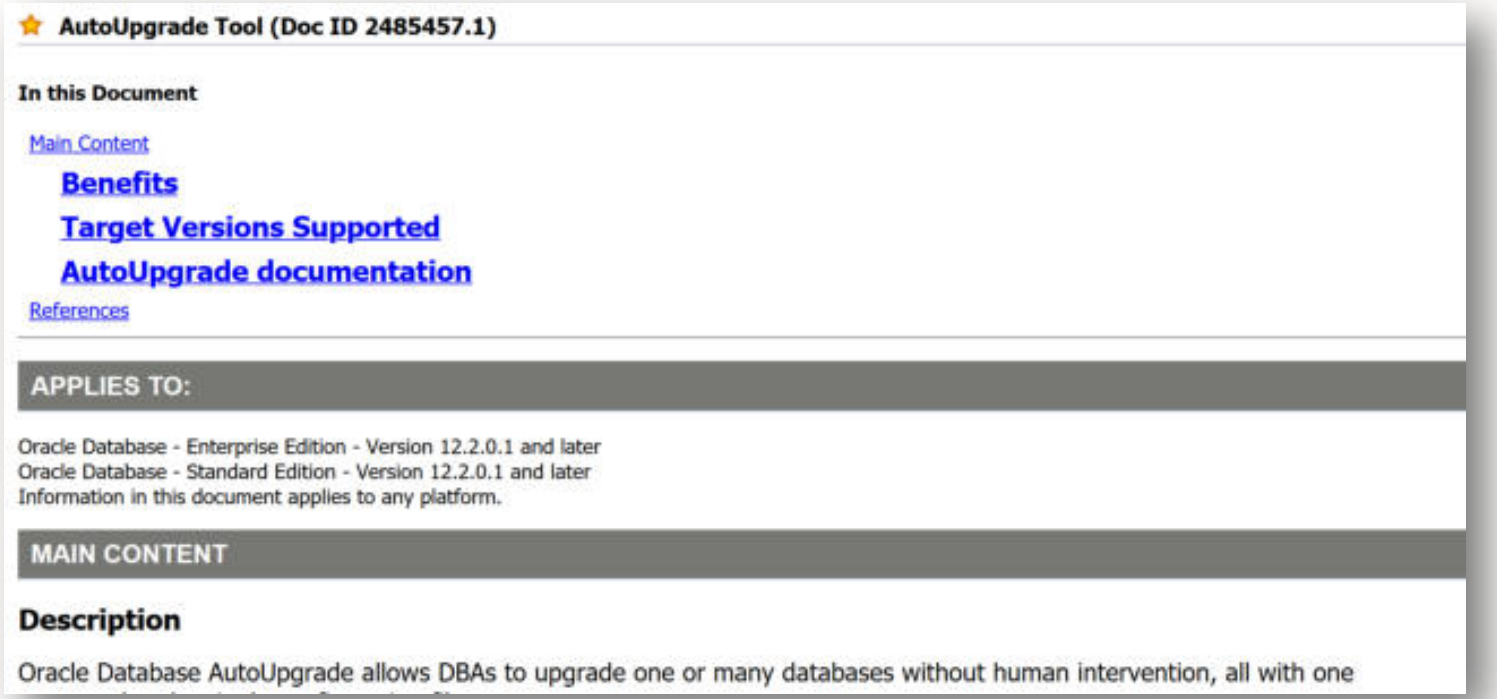
Configure

Analyze

Check

Upgrade

Always download latest version from MOS



AutoUpgrade Tool (Doc ID 2485457.1)

In this Document

Main Content

Benefits

Target Versions Supported

AutoUpgrade documentation

References

APPLIES TO:

Oracle Database - Enterprise Edition - Version 12.2.0.1 and later
Oracle Database - Standard Edition - Version 12.2.0.1 and later
Information in this document applies to any platform.

MAIN CONTENT

Description

Oracle Database AutoUpgrade allows DBAs to upgrade one or many databases without human intervention, all with one

AutoUpgrade | Essentials

Download
Configure
Analyze
Check
Upgrade

Check your version

```
$ java -jar autoupgrade.jar -version

build.version 22.5.221011
build.date 2022/10/11 14:23:59 -0400
build.hash e9428661
build.hash_date 2022/10/11 12:55:45 -0400
build.supported_target_versions 12.2,18,19,21
build.type production
```

AutoUpgrade | Essentials

Download

Configure

Analyze

Check

Upgrade

AutoUpgrade handles older releases as well

```
$ java -jar autoupgrade.jar -version

build.version 22.5.221011
build.date 2022/10/11 14:23:59 -0400
build.hash e9428661
build.hash_date 2022/10/11 12:55:45 -0400
build.supported_target_versions 12.2,18,19,21
build.type production
```

AutoUpgrade | Essentials

- Download
- **Configure**
- Analyze
- Check
- Upgrade

Shortest possible config file version

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
```

Or, generate a sample config file

```
$ java -jar autoupgrade.jar -create_sample_file config

Created sample configuration file /home/oracle/sample_config.cfg
```

Pro tip: *upg1* is a prefix that you decide. Use it to define multiple databases

AutoUpgrade | Essentials

- Download
- Configure
- **Analyze**
- Check
- Upgrade

Analyze your database

```
$ java -jar autoupgrade.jar -config CDB1.cfg -mode analyze

...

upg> Job 100 completed

Please check the summary report at:
/u01/app/oracle/cfgtoollogs/autoupgrade/cfgtoollogs/upgrade/auto/status/status.html
/u01/app/oracle/cfgtoollogs/autoupgrade/cfgtoollogs/upgrade/auto/status/status.log
```

Pro tip: Analyze is similar to running `preupgrade.jar`

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- **Check**
- Upgrade

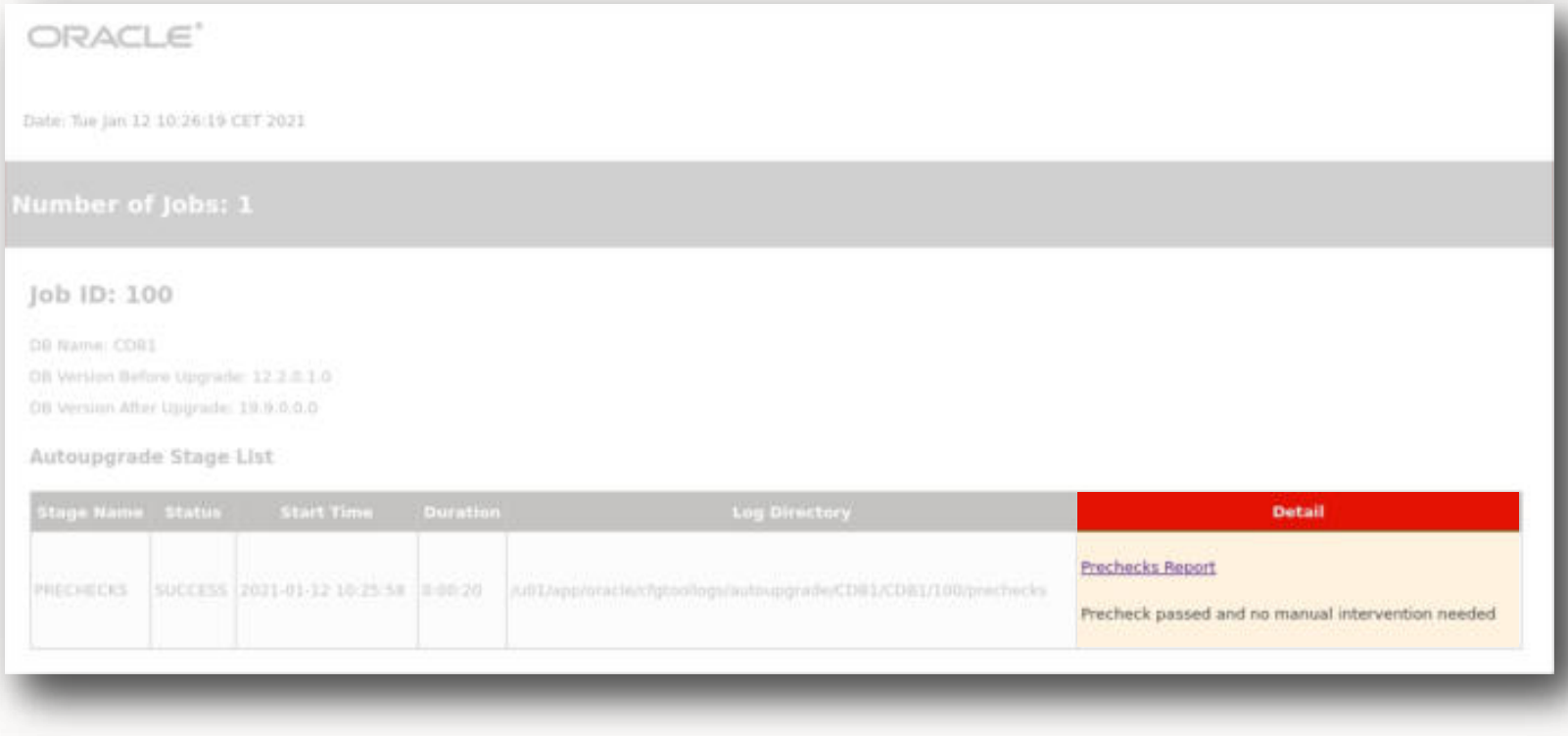
Summary report - text

```
=============================================
          Autoupgrade Summary Report
=============================================
[Date]           Tue Jan 12 10:26:19 CET 2021
[Number of Jobs] 1
=============================================
[Job ID] 100
=============================================
[DB Name]                   CDB1
[Version Before Upgrade]  12.2.0.1.0
[Version After Upgrade]   19.9.0.0.0
---------------------------------------------
[Stage Name]    PRECHECKS
[Status]        SUCCESS
[Start Time]    2021-01-12 10:25:58
[Duration]      0:00:20
[Log Directory] /u01/app/oracle/upg/CDB1/100/prechecks
[Detail]        /u01/app/oracle/upg/CDB1/100/prechecks/cdb1_preupgrade.log
                Precheck passed and no manual intervention needed
---------------------------------------------
```

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- **Check**
- Upgrade

Summary report - HTML


ORACLE

Date: Tue Jan 12 10:26:19 CET 2021

Number of Jobs: 1

Job ID: 100

DB Name: CDB1

DB Version Before Upgrade: 12.2.0.1.0

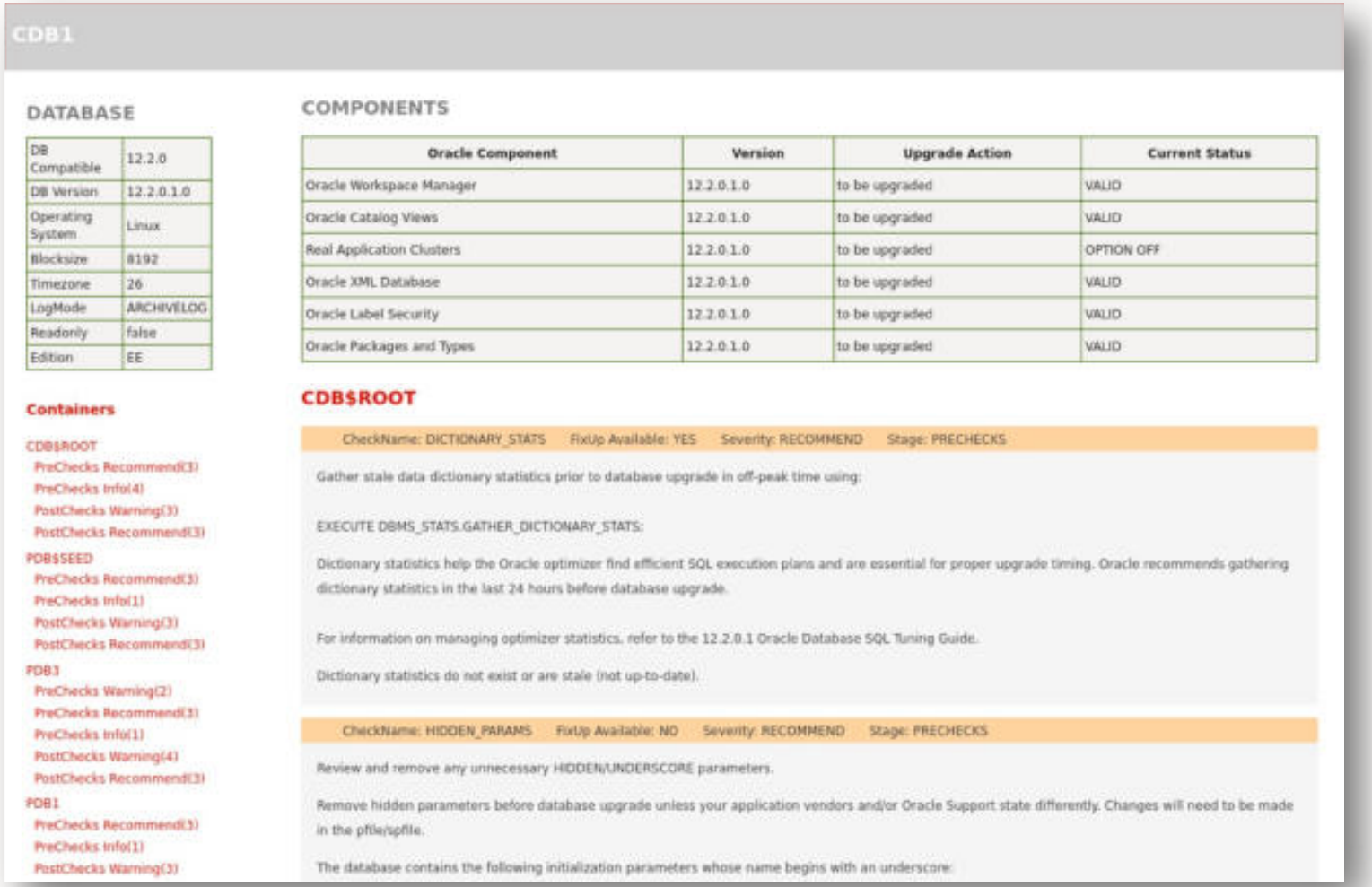
DB Version After Upgrade: 19.9.0.0.0

Autoupgrade Stage List

Stage Name	Status	Start Time	Duration	Log Directory	Detail
PRECHECKS	SUCCESS	2021-01-12 10:25:58	0:00:20	/u01/app/oracle/cfgtoollogs/autoupgrade/CDB1/CDB1/100/prechecks	Prechecks Report Precheck passed and no manual intervention needed

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- **Check**
- Upgrade



CDB1

DATABASE

DB Compatible	12.2.0
DB Version	12.2.0.1.0
Operating System	Linux
Blocksize	8192
Timezone	26
LogMode	ARCHIVELOG
Readonly	false
Edition	EE

Containers

CDB$ROOT
PreChecks Recommend(3)
PreChecks Info(4)
PostChecks Warning(3)
PostChecks Recommend(3)
PDB$SEED
PreChecks Recommend(3)
PreChecks Info(1)
PostChecks Warning(3)
PostChecks Recommend(3)
PDB3
PreChecks Warning(2)
PreChecks Recommend(3)
PreChecks Info(1)
PostChecks Warning(4)
PostChecks Recommend(3)
PDB1
PreChecks Recommend(3)
PreChecks Info(1)
PostChecks Warning(3)

COMPONENTS

Oracle Component	Version	Upgrade Action	Current Status
Oracle Workspace Manager	12.2.0.1.0	to be upgraded	VALID
Oracle Catalog Views	12.2.0.1.0	to be upgraded	VALID
Real Application Clusters	12.2.0.1.0	to be upgraded	OPTION OFF
Oracle XML Database	12.2.0.1.0	to be upgraded	VALID
Oracle Label Security	12.2.0.1.0	to be upgraded	VALID
Oracle Packages and Types	12.2.0.1.0	to be upgraded	VALID

CDB$ROOT

CheckName: DICTIONARY_STATS FixUp Available: YES Severity: RECOMMEND Stage: PRECHECKS

Gather stale data dictionary statistics prior to database upgrade in off-peak time using:

EXECUTE DBMS_STATS.GATHER_DICTIONARY_STATS;

Dictionary statistics help the Oracle optimizer find efficient SQL execution plans and are essential for proper upgrade timing. Oracle recommends gathering dictionary statistics in the last 24 hours before database upgrade.

For information on managing optimizer statistics, refer to the 12.2.0.1 Oracle Database SQL Tuning Guide.

Dictionary statistics do not exist or are stale (not up-to-date).

CheckName: HIDDEN_PARAMS FixUp Available: NO Severity: RECOMMEND Stage: PRECHECKS

Review and remove any unnecessary HIDDEN/UNDERSCORE parameters.

Remove hidden parameters before database upgrade unless your application vendors and/or Oracle Support state differently. Changes will need to be made in the pfile/spfile.

The database contains the following initialization parameters whose name begins with an underscore:

AutoUpgrade | Essentials

Download
Configure
Analyze
Check
Upgrade

Preupgrade report comes in:

- HTML
- Text
- JSON

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- Check
- **Upgrade**

Upgrade

```
$ java -jar autoupgrade.jar -config CDB1.cfg -mode deploy
```

Have a cup of coffee and wait, or …

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- Check
- **Upgrade**

Monitor

```
upg> lsj

+----+-------+---------+---------+-------+--------------+--------+---------------+
|Job#|DB_NAME|    STAGE|OPERATION| STATUS|    START_TIME| UPDATED|        MESSAGE|
+----+-------+---------+---------+-------+--------------+--------+---------------+
| 101|   CDB1|PREFIXUPS|EXECUTING|RUNNING|20/11/24 13:38|13:39:26|Remaining 12/13|
+----+-------+---------+---------+-------+--------------+--------+---------------+
```

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- Check
- **Upgrade**

All the details

```
upg> status -job 101

Progress
-----------------------------------
Start time:      20/11/24 13:38
Elapsed (min):   13
Last update:     2020-11-24T13:48:52.139
Stage:           DBUPGRADE
Operation:       EXECUTING
Status:          RUNNING
Stage summary:
    SETUP             <1 min
    GRP               <1 min
    PREUPGRADE        <1 min
    PRECHECKS         <1 min
    PREFIXUPS         8 min
    DRAIN             <1 min
    DBUPGRADE         3 min (IN PROGRESS)

Job Logs Locations
-----------------------------------
Logs Base:    /home/oracle/autoupg_default/CDB1/CDB1
Job logs:     /home/oracle/autoupg_default/CDB1/CDB1/101
Stage logs:   /home/oracle/autoupg_default/CDB1/CDB1/101/dbupgrade
TimeZone:     /home/oracle/autoupg_default/CDB1/CDB1/temp
```

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- Check
- **Upgrade**

All the details - continued

```
...

Additional information
----------------------------------
Details:
[Upgrading] is [0%] completed for [cdb1-cdb$root]
                 +---------+---------------+
                 |CONTAINER|     PERCENTAGE|
                 +---------+---------------+
                 | CDB$ROOT|   UPGRADE[12%]|
                 | PDB$SEED|UPGRADE PENDING|
                 |     PDB3|UPGRADE PENDING|
                 +---------+---------------+

Error Details:
None
```

AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- Check
- **Upgrade**

Success

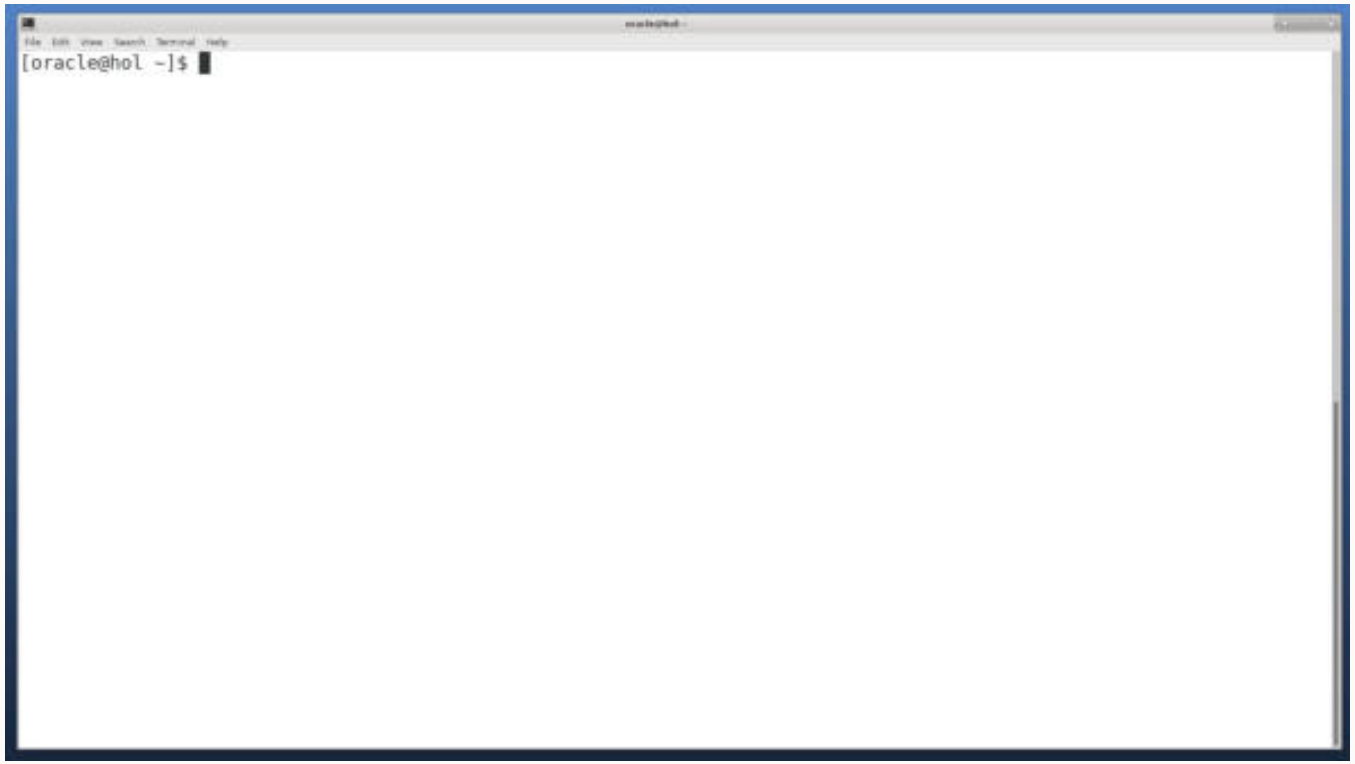
```
upg> Job 101 completed
------------------- Final Summary --------------------
Number of databases            [ 1 ]

Jobs finished successfully     [1]
Jobs failed                    [0]
Jobs pending                   [0]
------------- JOBS FINISHED SUCCESSFULLY -------------
Job 101 for CDB1

---- Drop GRP at your convenience once you consider it is no longer needed ----
Drop GRP from CDB1: drop restore point AUTOUPGRADE_9212_CDB1122010
```

And it includes:

- Recompilation (utlrp.sql)
- Time zone file upgrade
- Postupgrade fixups
- … and so much more

AutoUpgrade | Essentials

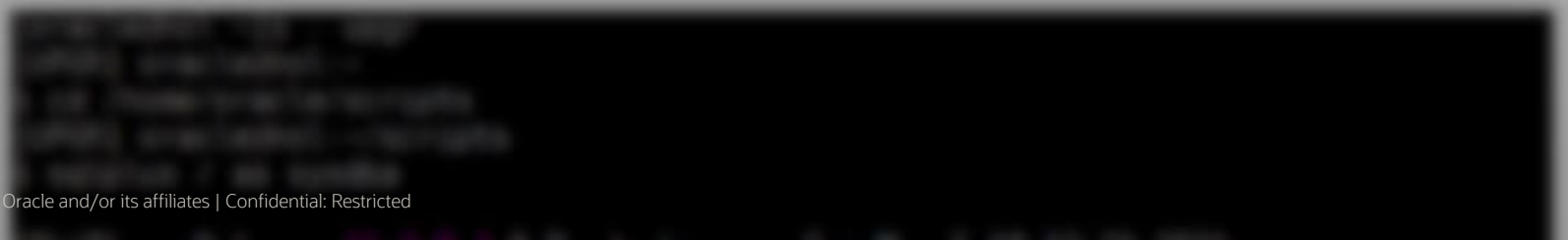
Download
Configure
Analyze
Check
Upgrade



Watch on YouTube

Lab Exercises

Upgrade to Oracle Database 19c and ensure performance stability



Lab Exercises

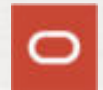
Eleven units covering multiple use cases

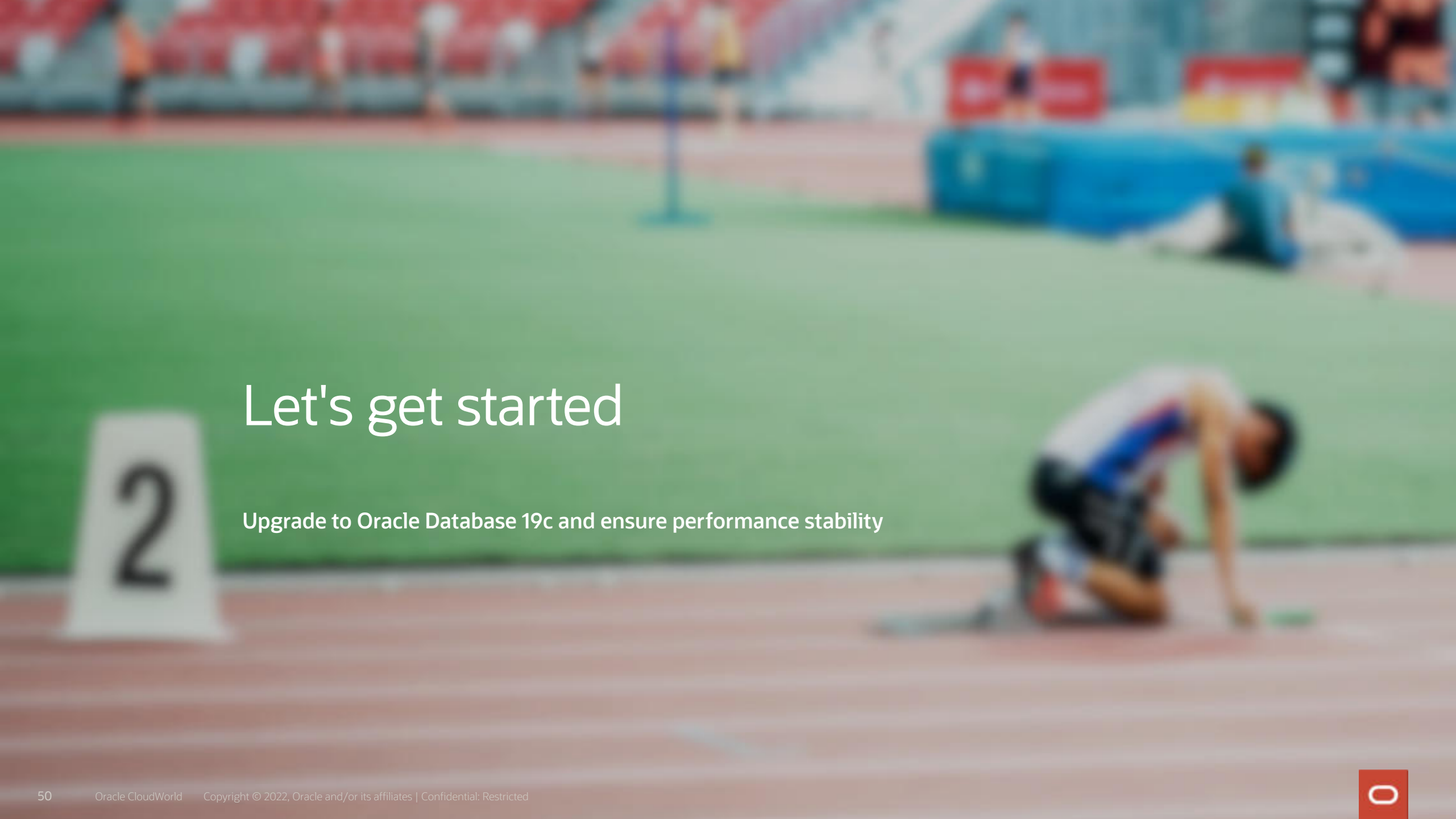
1. Initialize Environment

2. Pre-upgrade: Generate AWR Snapshot
3. Pre-upgrade: Capture and Preserve SQL

4. Upgrade: AutoUpgrade

5. Post-Upgrade: AWR Compare Report
6. Post-Upgrade: SQL Performance Analyzer
7. Post-Upgrade: SQL Plan Management
8. Post-Upgrade: SQL Tuning Advisor
9. Use Case: Plugin UPGR into CDB2
10. Alternative: Transportable Export/Import
11. Use Case: Unplug Plug Upgrade



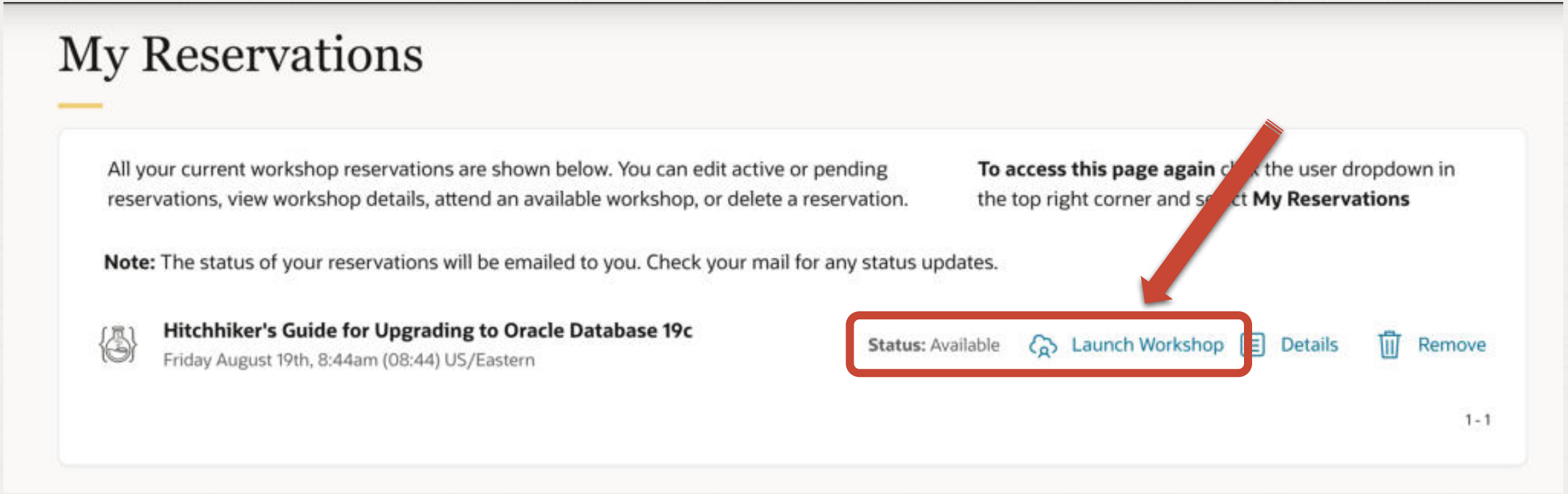


Let's get started

Upgrade to Oracle Database 19c and ensure performance stability

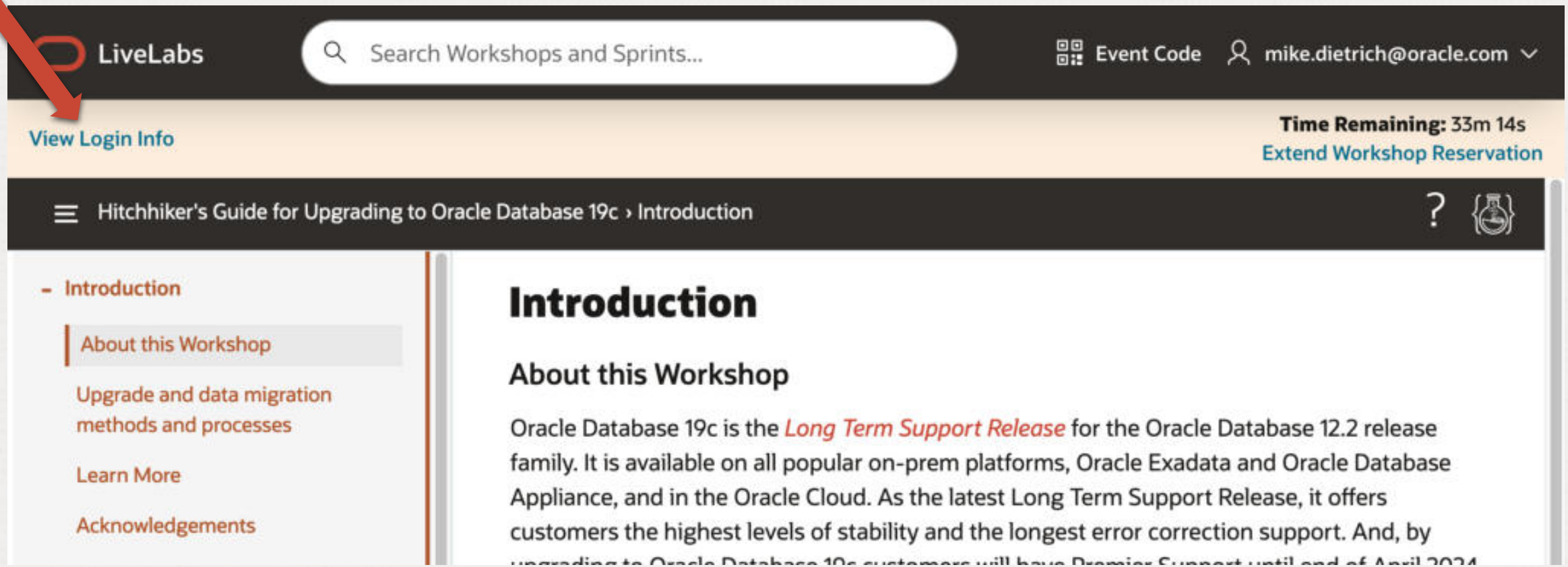
Lab Provisioning

Now you start - click "Launch Workshop"



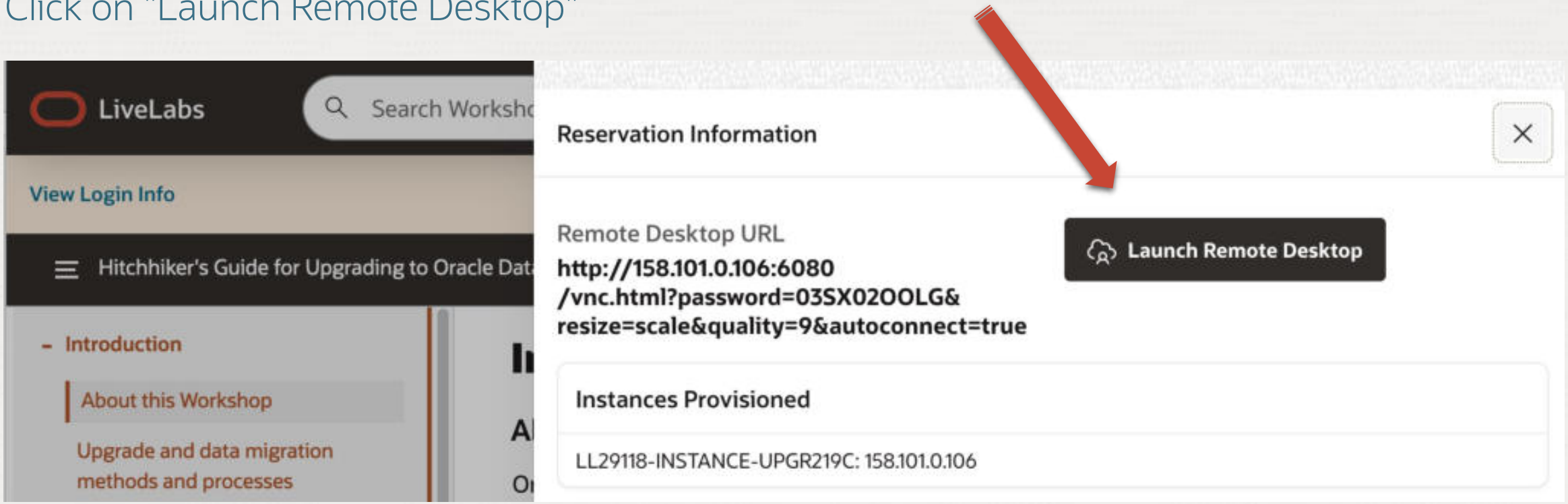
Lab Provisioning

Click on "View Login Info"



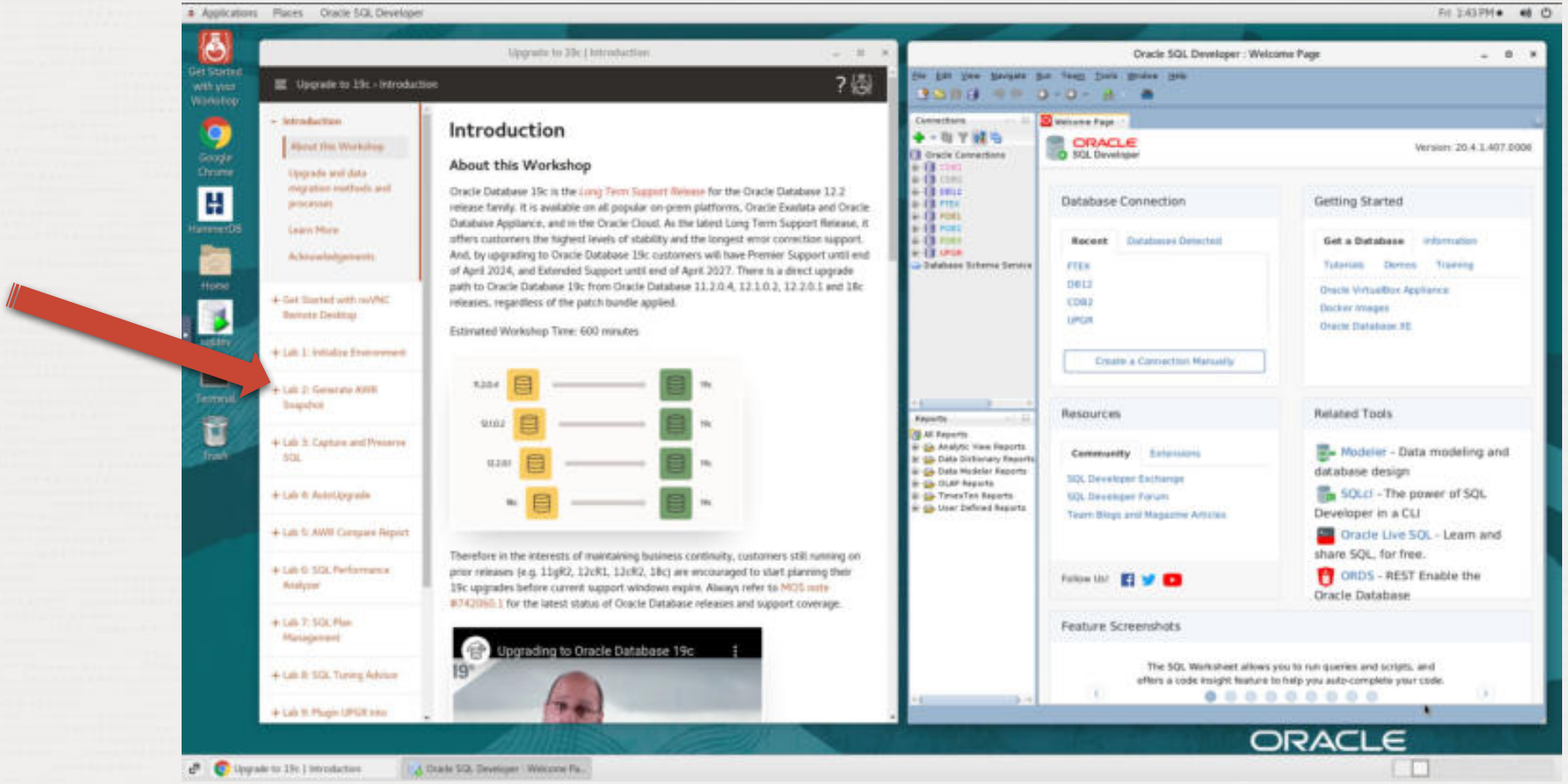
Lab Provisioning

Click on "Launch Remote Desktop"



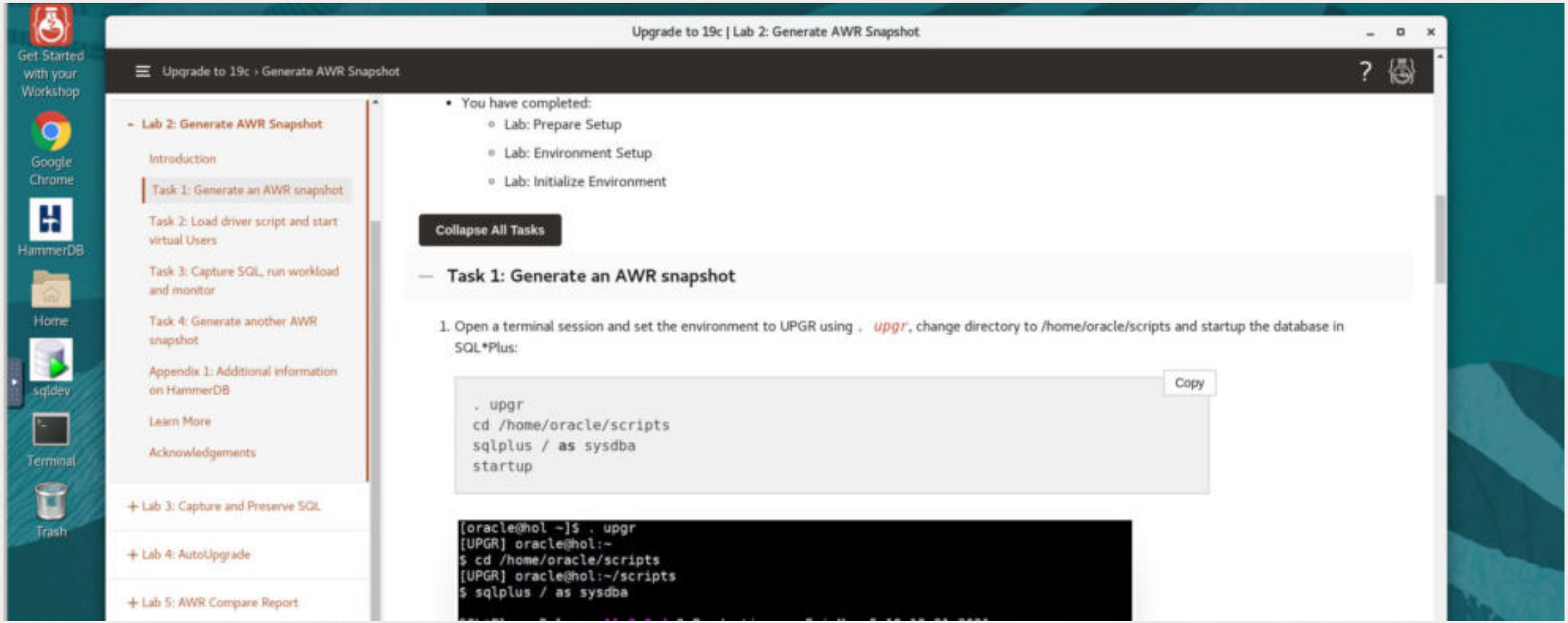
Lab Provisioning

Start with LAB #2 "Generate AWR Snapshot"



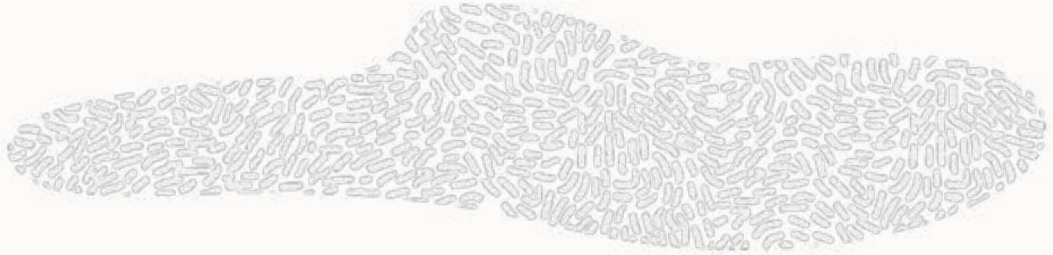
Lab Provisioning

You may want to close SQL Developer – then you have more space to work



Performance Stability Prescription

SQL Tuning Set | Definition

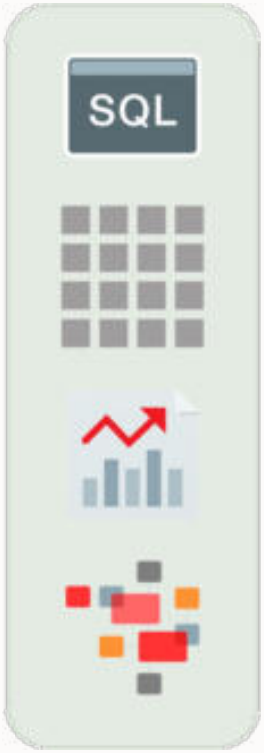


SQL statement

Context

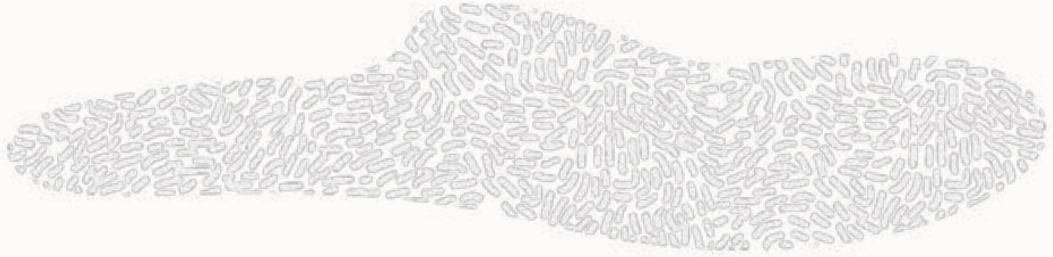
Statistics

Plans



Collect at least
one full month of workload data
before any upgrade or migration

Workload Information



AWR – Automatic Workload Repository

Change the retention to a minimum of 40 days

```
exec
dbms_workload_repository.modify_snapshot_settings(
retention=>57600, interval=>30);
```

Collect SQL statements and plans

Use AWR as main source

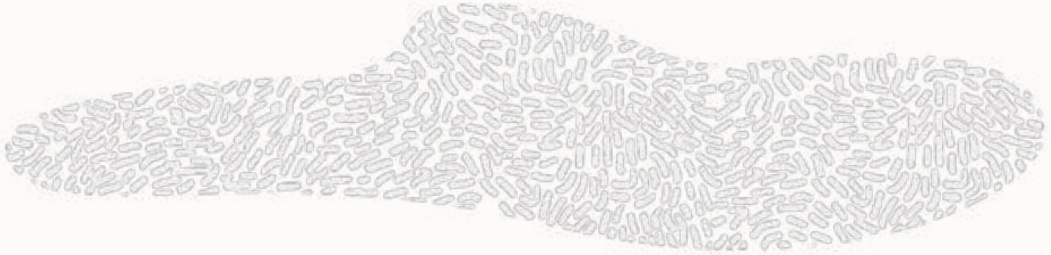
Capture from Cursor Cache for OLTP

Collect statements, plans and stats in SQL Tuning Sets

Performance Stability Prescription

1. Collect
3. Analyze
5. Manage
2. Compare
4. Tune
6. Test

AWR | Diff Report



Use script `awrddrpt.sql`

Top Timed Events

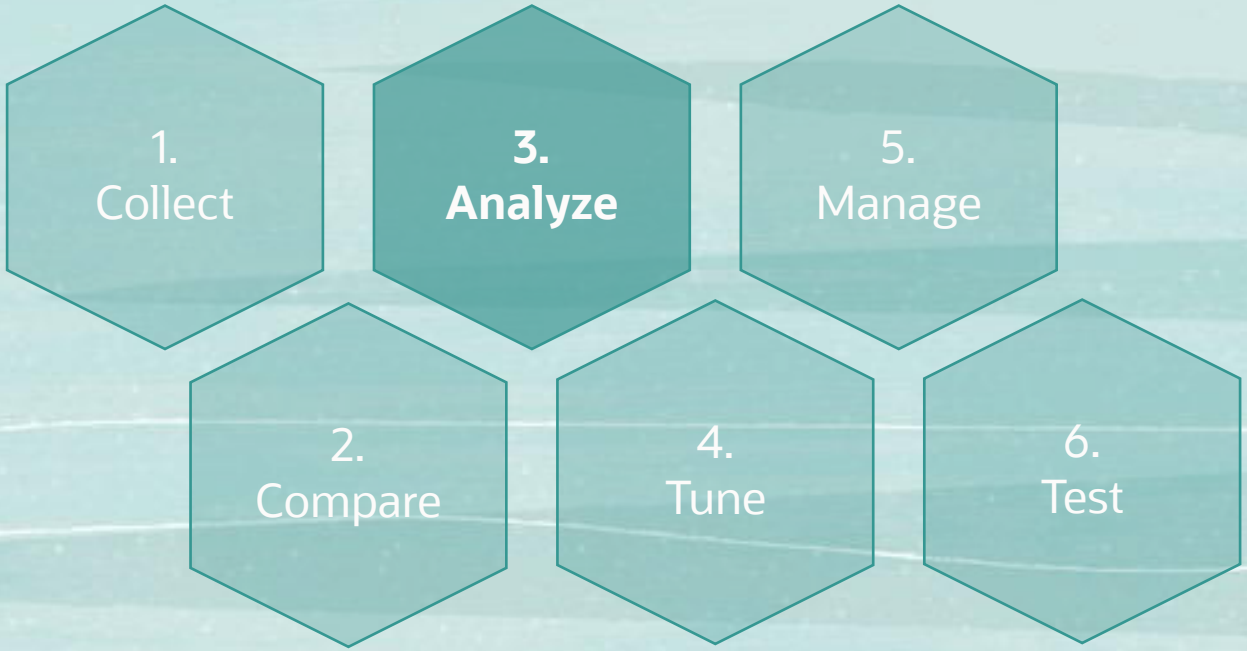
- Events with a "-" did not make the Top list in this set of snapshots, but are displayed for comparison purposes

1st						2nd					
Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time	Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time
CPU time			68,289.05		43.73	db file sequential read	User I/O	22,193,998	114,919.21	5.18	23.17
db file sequential read	User I/O	6,686,953	37,737.81	5.64	24.17	enq: SS - contention	Configuration	3,913	98,997.90	25,299.74	19.96
gc buffer busy	Cluster	12,508,244	23,886.55	1.91	15.30	CPU time			73,786.55		14.88
TCP Socket (KGAS)	Network	680,629	12,514.65	18.39	8.01	row cache lock	Concurrency	73,940	48,472.30	655.56	9.77
db file scattered read	User I/O	1,572,296	4,271.68	2.72	2.74	reliable message	Other	41,148	47,600.87	1,156.82	9.60

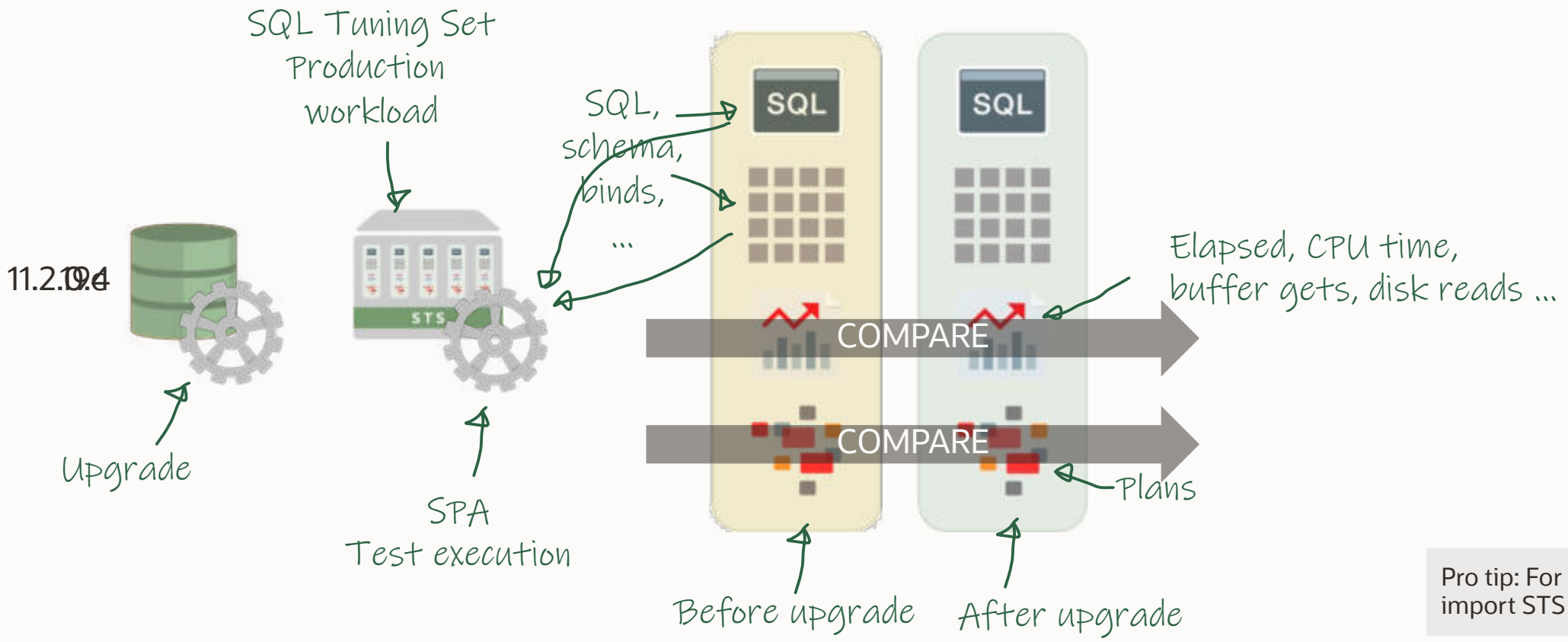
Requires Enterprise Edition + Diagnostic pack

Pro tip: For migrations, you can transport AWR data

Performance Stability Prescription

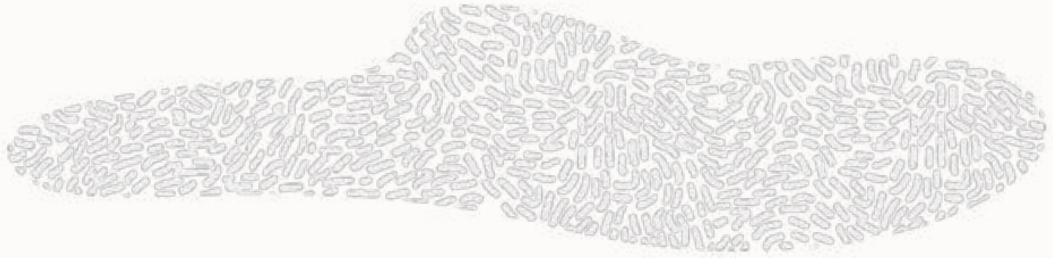


SPA | Concept



Pro tip: For migrations,
import STS into target database

SPA | Regressed Report



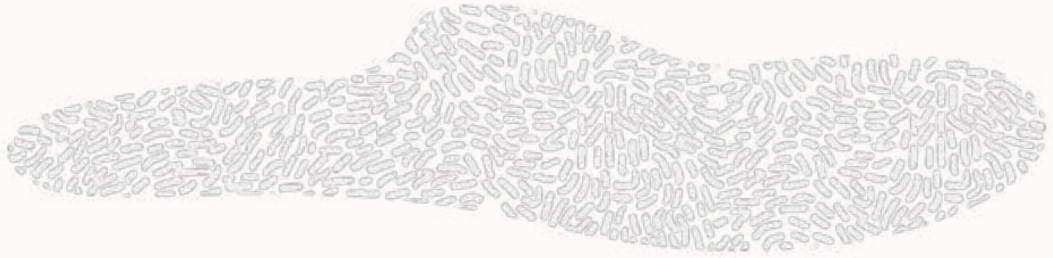
Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

From production workload

From test execution

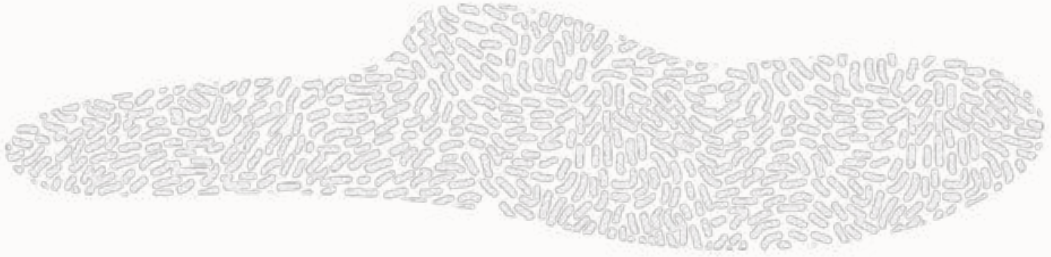
SPA | Regressed Report



Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

SPA | Regressed Report



Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0ag	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

SQL Details: czzzubf8fjz96

Parsing Schema APPS Execution Frequency 3

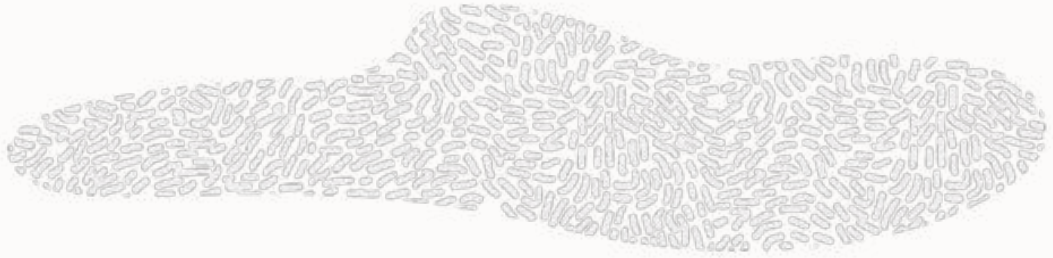
▷ SQL Text

```
SELECT /* my_query_21 */ /*+ ORDERED INDEX(t1) USE_HASH(t1) */ 'B' || t2.take_02 take_02, 'B' || t2.take_15
take_15, 'B' || t2.take_08 take_08, 'r' || t3.record_nr price_eur_id,...
```

Single Execution Statistics

	Execution Statistic Name	Net Impact on Workload (%)	Execution Statistic Collected		Net Impact on SQL (%)
			SQL Trial 1	SQL Trial 2	
⇩	Elapsed Time (sec)	-0.240	0.112	0.164	-46.170
⇧	Parse Time (sec)	0.220	0.001	0.001	14.490
⇩	CPU Time (sec)	-0.030	0.108	0.114	-5.040
⇨	User I/O Time (sec)	0.000	0.000	0.000	0.000
⇩	Buffer Gets	-0.030	1,410	1,981	-40.500

SPA | Regressed Report



Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0ag	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

Plan Comparison

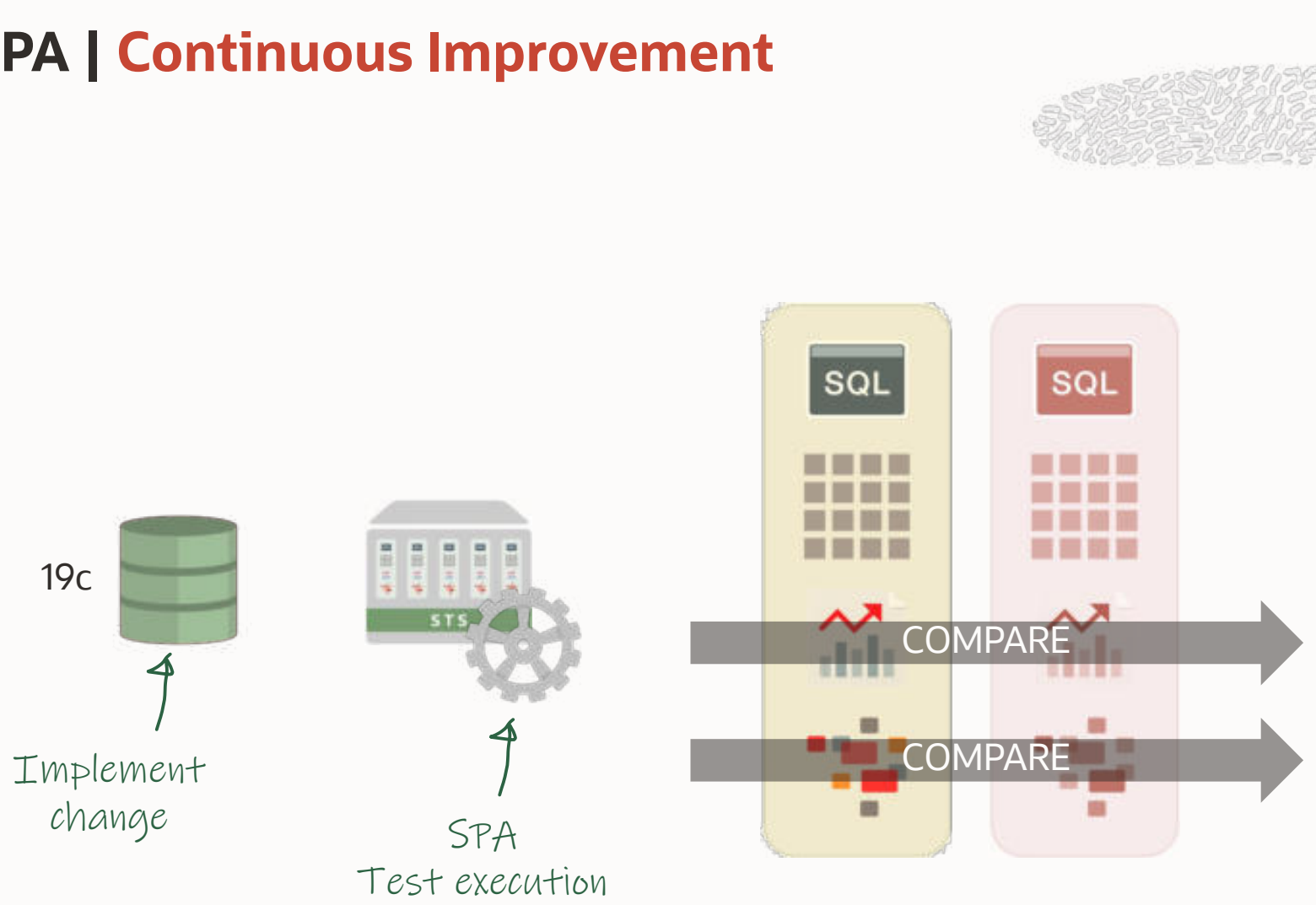
SQL_TRIAL_1353942463446

Plan Hash Value 1165613724

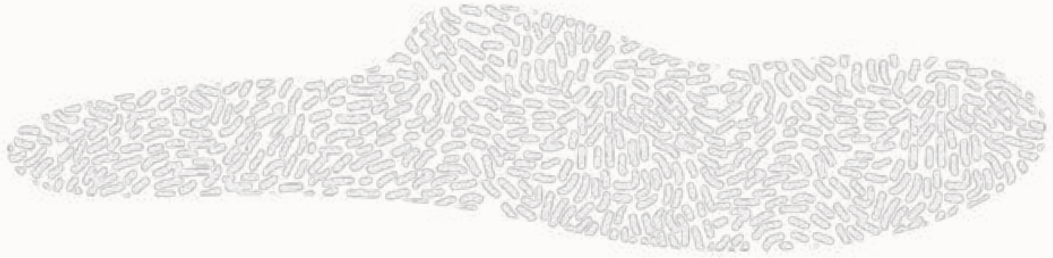
Expand All | Collapse All

Operation	Line ID	Object	Rows	Cost	Predicate
▽ SELECT STATEMENT	0		1	9,830	
▽ HASH GROUP BY	1		1	9,830	
▽ MERGE JOIN	2		1	9,829	
▽ SORT JOIN	3		8	9,795	
▽ HASH JOIN	4		8	9,794	"T1"."PERIOD_CODE"="T4"."FLYER...
INDEX RANGE SCAN	5	APPS.IDX$$_080F0004	1	2	"T4"."EXPORT_LIC_NR"=14659
▽ HASH JOIN	6		14,210	9,792	"T1"."SKU_NR"="T2"."SKU_NR" AN...

SPA | Continuous Improvement



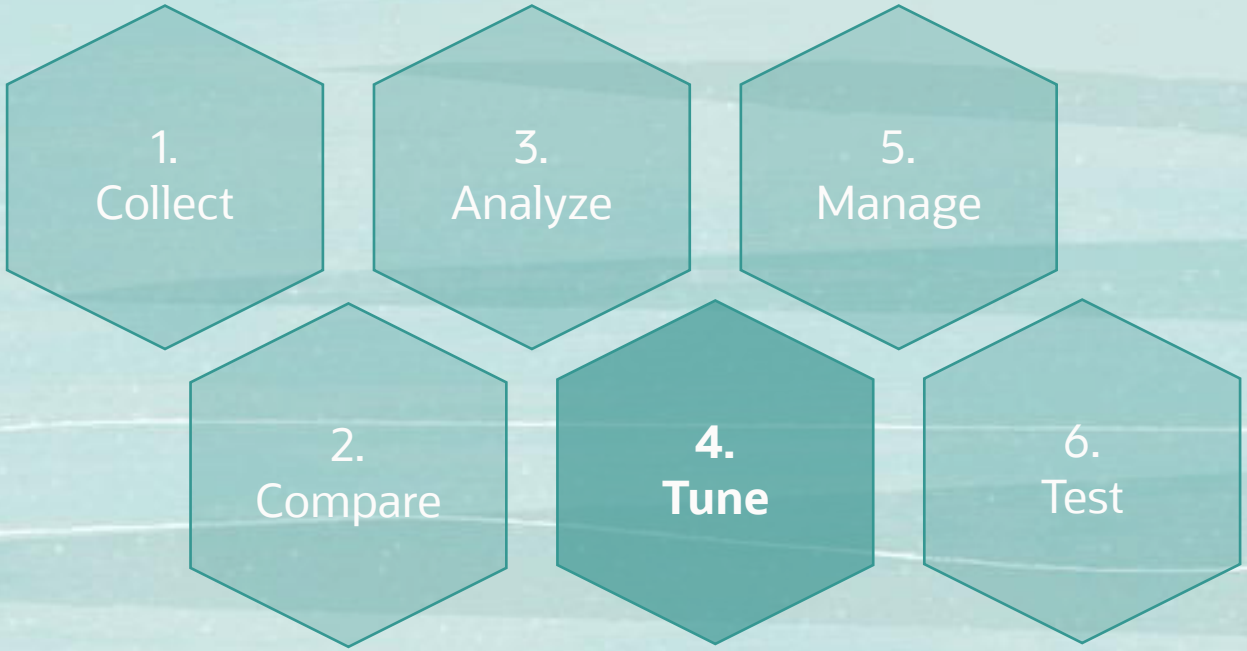
SPA | Regressed Report



Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

Performance Stability Prescription

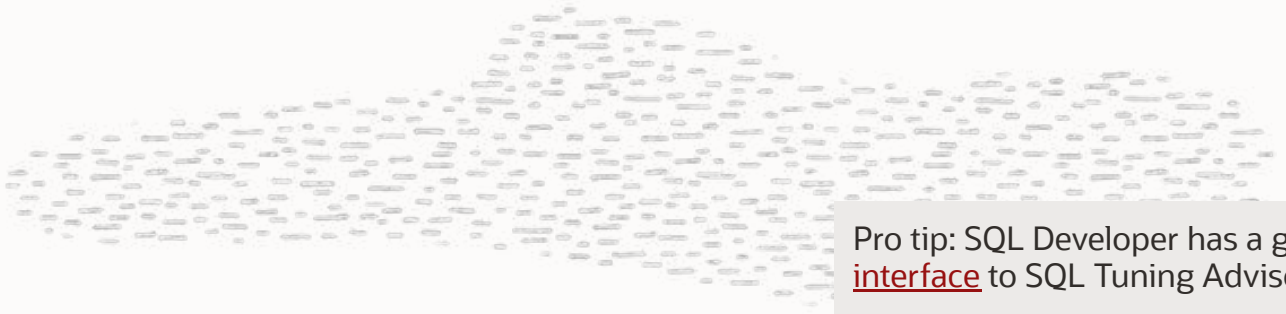


SQL Tuning Advisor | Findings

Types of findings:

1. Collection of object statistics
2. Creation of indexes
3. Rewriting SQL statements
4. Creation of SQL profiles

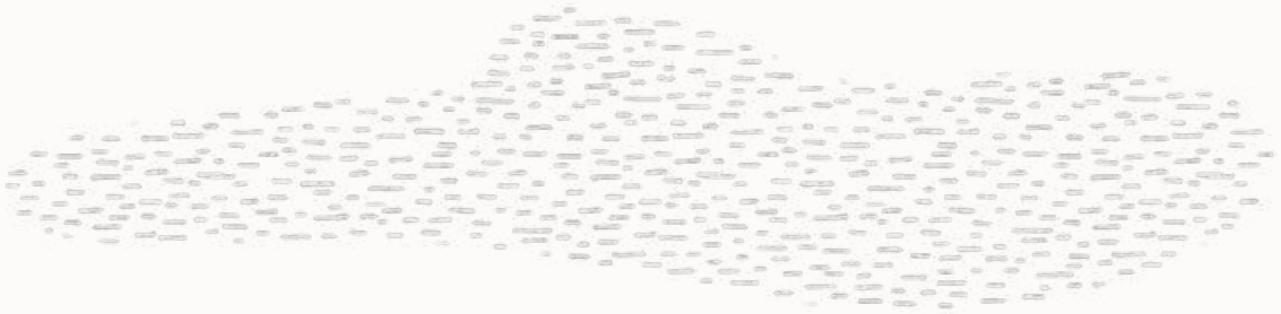
.... and more



Pro tip: SQL Developer has a good interface to SQL Tuning Advisor

SQL Profiles | Facts

1. Part of Tuning Pack
   - Included in some cloud offerings
2. Stores a set of hints that causes the optimizer to select a plan
3. Affects one statement only



SQL Profiles | Facts

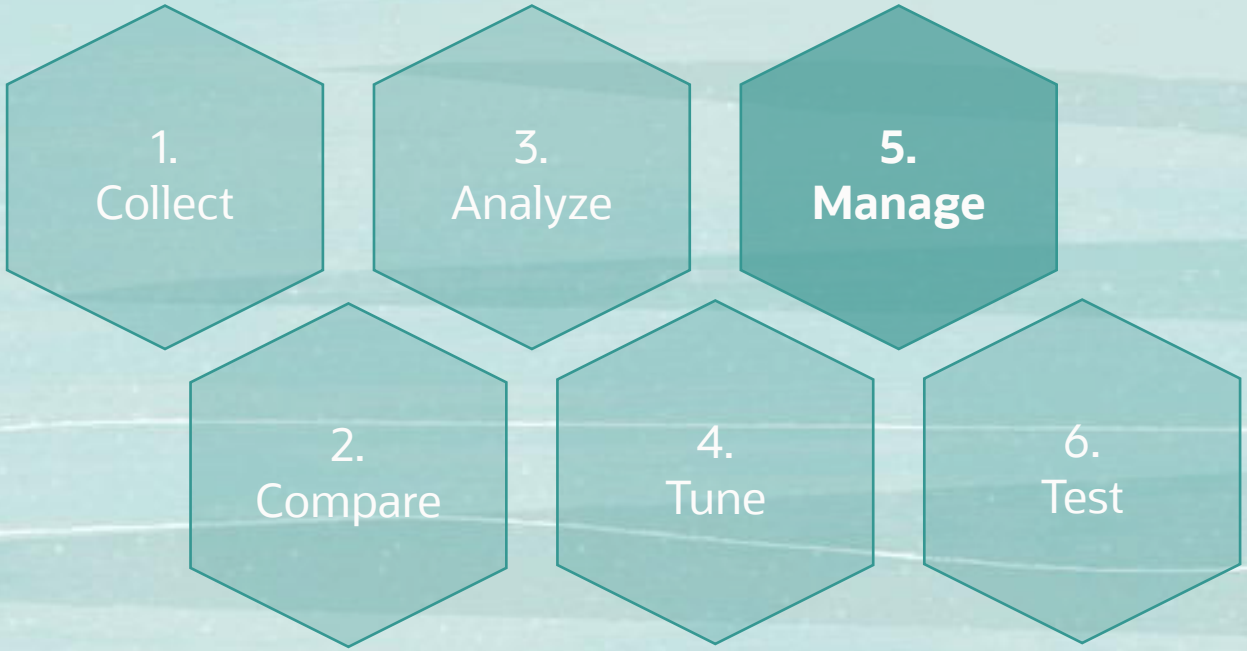
4. You can enable/disable a profile

5. Transparent to application
   - Does not require application changes

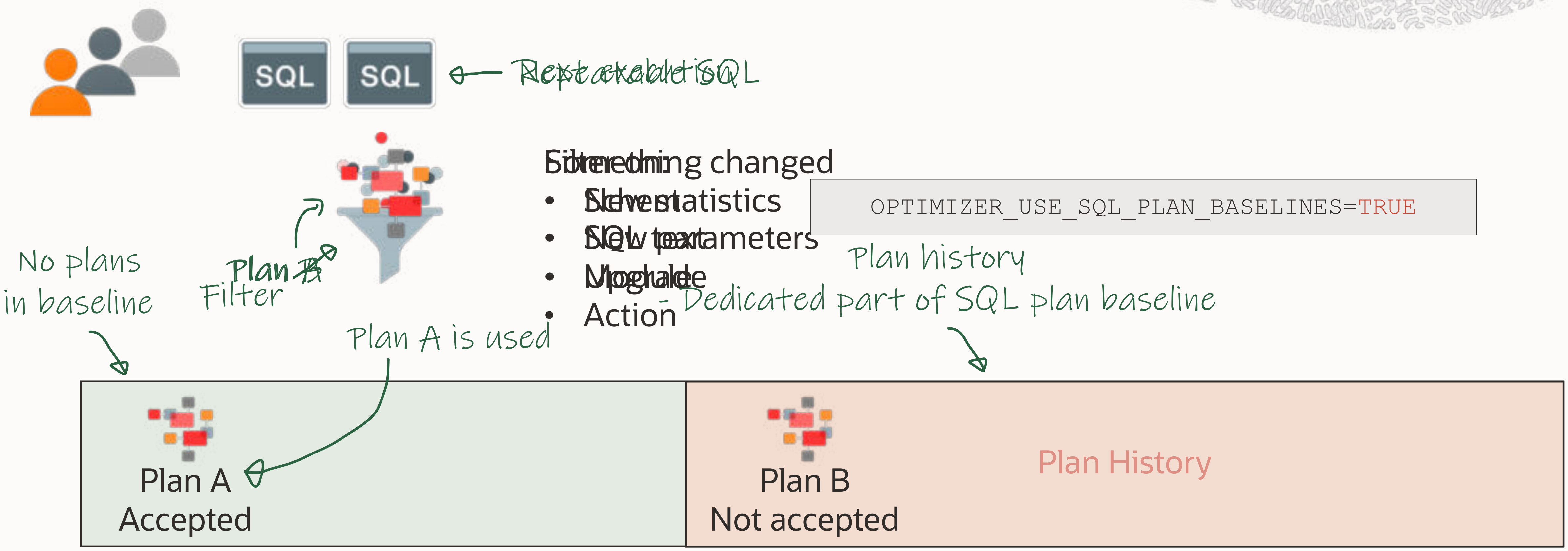
6. Persistent and transportable
   - Documentation

7. Useful with literals using `FORCE_MATCH=TRUE`

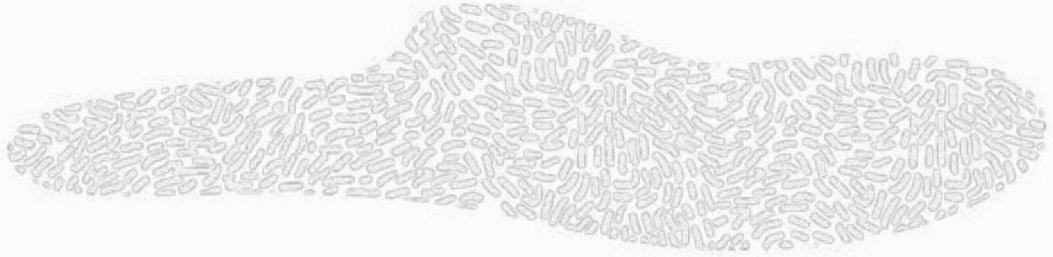
Performance Stability Prescription

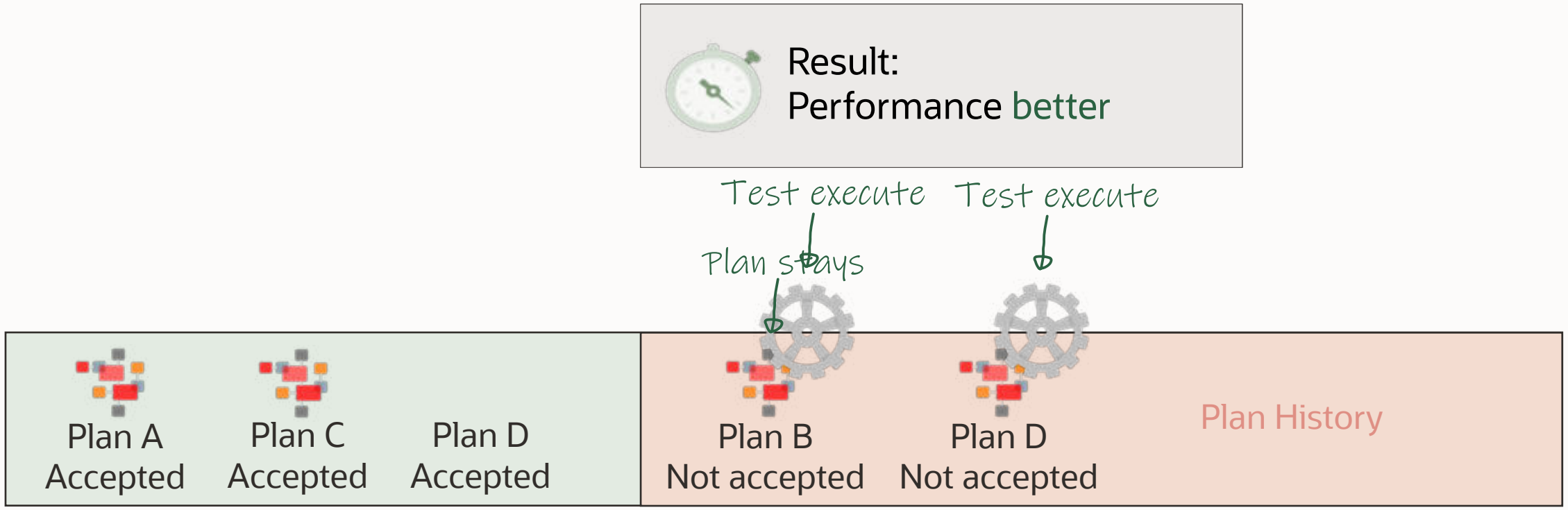


SPM | Concept

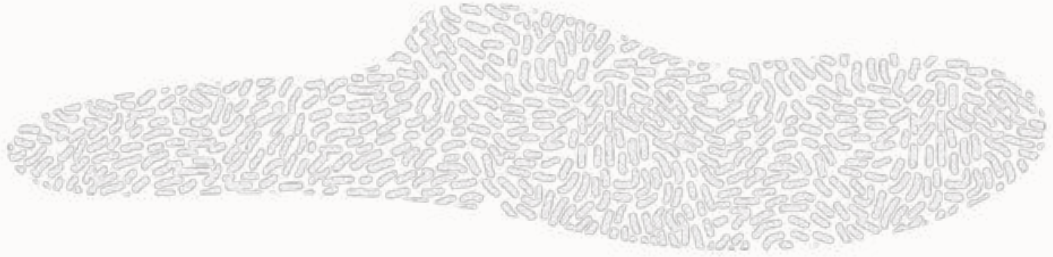


SPM | Evolve

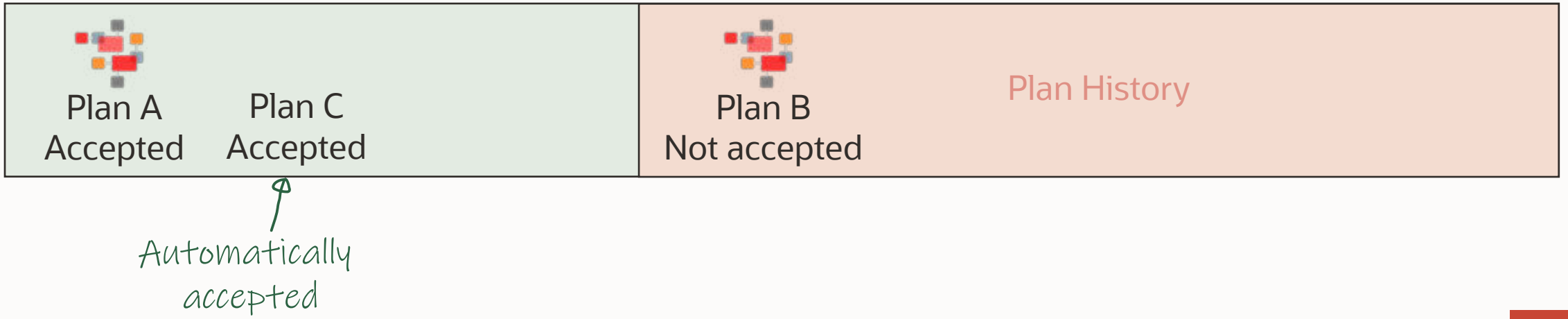




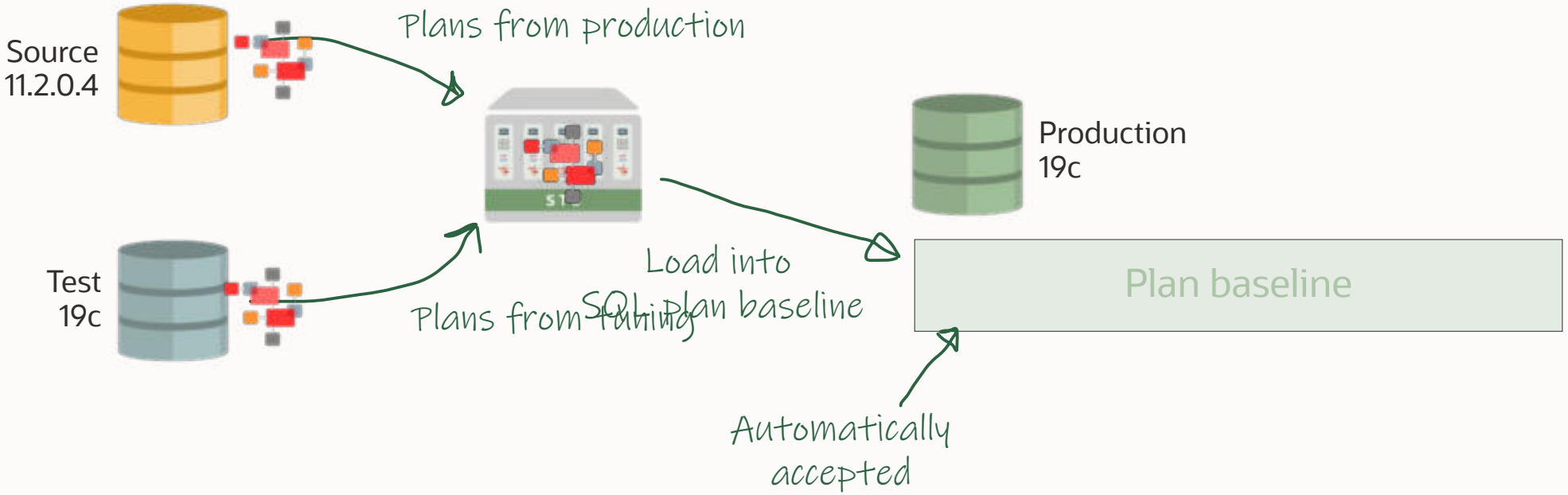
SPM | Load from STS



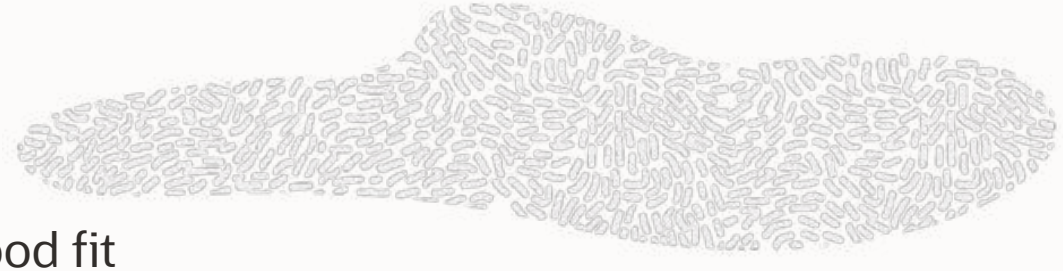

```
SQL> DECLARE
       cnt number;
   BEGIN
       cnt := DBMS_SPM.LOAD_PLANS_FROM_SQLSET('UPG_STS_1');
   END;
/
```



SPM | Use Case



SPM | What if … literals



SQL Plan Management in a system with literals is not a good fit

- Many distinct statements
- CURSOR_SHARING = FORCE? No!
- SQL profiles can do force matching

Optimal solution: Change your application to use bind variables

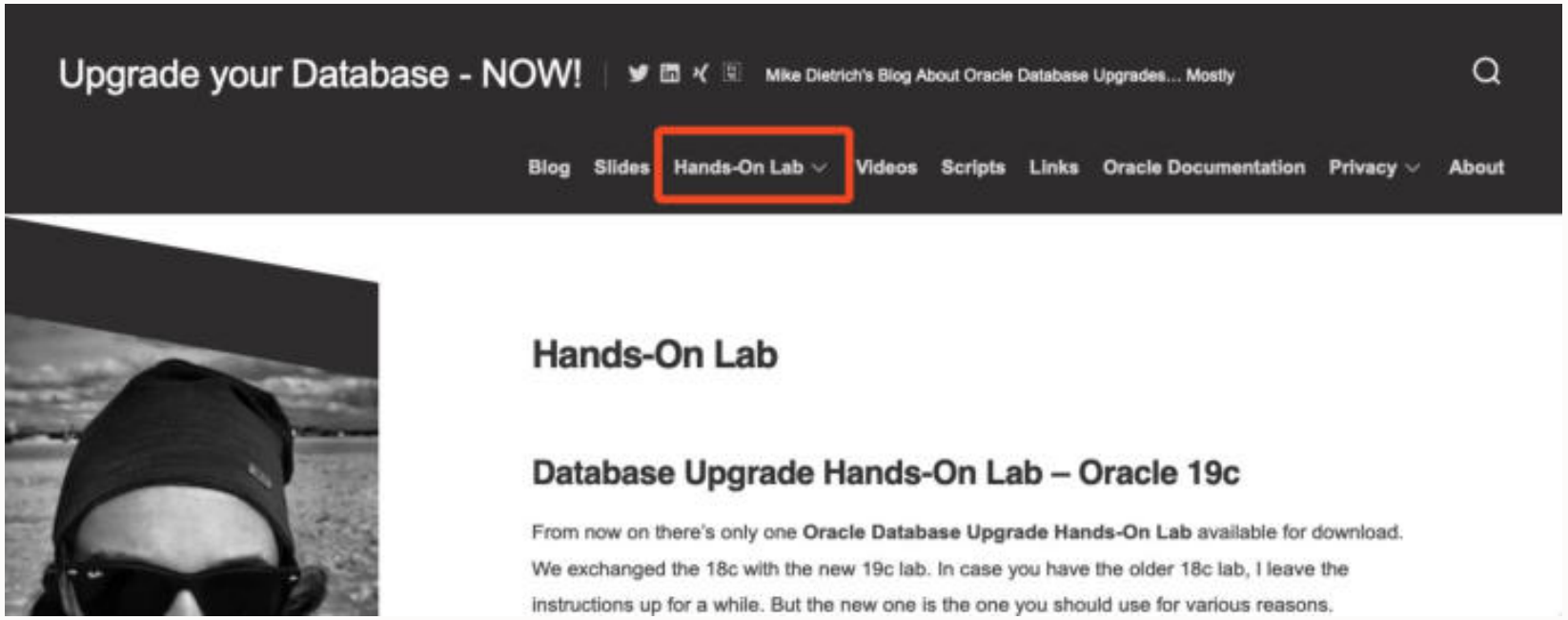
Performance Stability Prescription

1. Collect
2. Compare
3. Analyze
4. Tune
5. Manage
6. Test

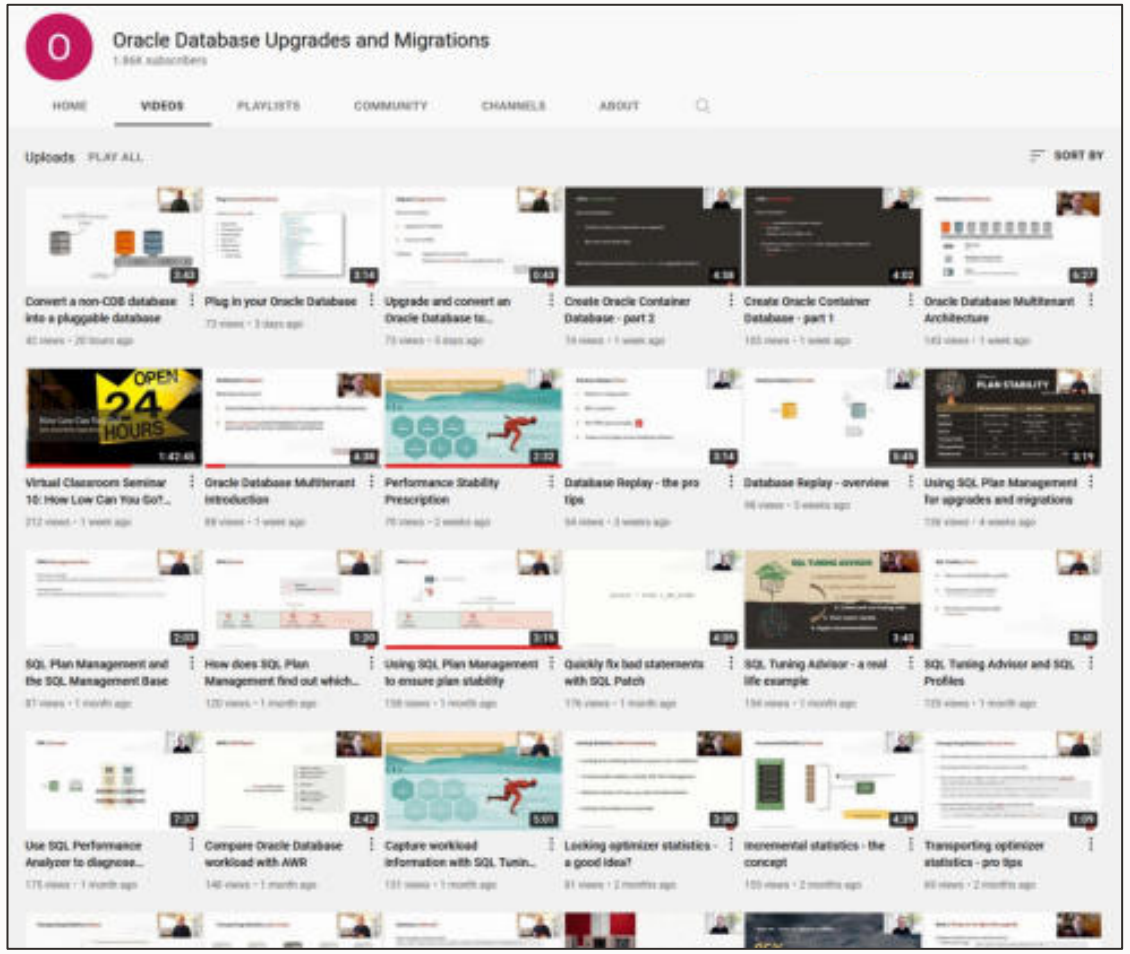
Hands-On Lab | Create Your Lab

On Mike's blog (https://mikedietrichde.com) get

- the lab as Virtual Box image
- the instructions



YouTube | Oracle Database Upgrades and Migrations



Link

- 300+ videos
- New videos every week
- No marketing
- No buzzword
- All tech

SCAN ME

From SR to Patch

Insights into the Oracle Database Development Process

June 22, 2023 – 16:00 CEST

SCAN ME

THANK YOU