



O-DB-DOCKER

Lab and Exercise Guide

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1 Preface

1.1 About O-DB-DOCKER

Oracle has long supported the use of Docker to install its products, including the latest versions of the Oracle database.

In theory, a simple “docker run” instantiates a corresponding container from a docker image. But why isn’t the database container ready in a few seconds?? Where does Oracle Database Image come from and what happens if the container is stopped again? The functional scope as well as the size of the Oracle database container presuppose that one or the other thoughts about the use and operation are made in advance. This includes topics such as data persistence, licensing and other operational aspects.

With a focus on the current versions of Oracle Database and Oracle Unified Directory the following topics will be discussed:

- Docker overview with focus on images, containers and volumes.
- Structure of Oracle Docker Images
- Operating an Oracle Docker Database Container
- Various use cases for Oracle database docker containers such as Oracle Enterprise, User Security, Test and Engineering databases, Migration and more.
- Other topics such as high availability, backup & recovery and licensing.

Within the scope of this training, basics and extended know-how in the area of Oracle database and Docker will be elaborated. The theory will be accompanied by demos and practical exercises.

1.2 Disclaimer

This guide has been created with utmost care, but does not claim to be complete. It was compiled as part of the preparation for the O-DB-DOCKER workshop. The author assumes no responsibility for the accuracy, completeness and timeliness of the content. The use of the available content is at your own risk.

1.3 Document information

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1.4 Revision History

Version	Date	Visa	Comment
0.1	2019.10.12	soe	Initial release O-DB-DOCKER workshop
0.2	2019.10.17		Add Lab requirements
0.3 - 0.8	2019.11.19		Add initial version of Lab exercises
1.0	2019.11.20	soe	First official release of O-DB-DOCKER workshop

If you have any questions, please do not hesitate to contact us via stefan.oehrli@trivadis.com.

2 Workshop Introduction

2.1 Requirements Workshop Environment

During the workshop *O-DB-DOCKER Oracle-Databases in Docker-Containers* there will be the possibility to explore different topics with practical examples. Each participant will be provided with a compute node in the Oracle Cloud for the duration of the *O-DB-DOCKER* training. Alternatively, participants can perform the exercises in their own local VM or Docker environment. Participants are free to choose which environment they want to use for the workshop. Although the setup of the local VM respectively local Docker environment is not part of the workshop itself. The following summary gives a short overview of the different requirements for the three workshop environments.

Detailed information on the workshop environment, documents, instructions etc. are available prior to the training via [DOAG2019 O-DB-DOCKER](#).

2.2 Skills and Knowledge

The different exercises of the workshop allow a step-by-step introduction to the topic *Oracle databases in Docker containers*. The following knowledge of the participants is recommended:

- Oracle database basics like installation, configuration and basic database administration
- Docker basics (see also [Get Started, Part 1: Orientation and setup](#))
- Practical experience with shell scripts, SSH and the command line.

2.3 Compute Node in the Oracle Cloud

The Compute Node in the Oracle Cloud will be specially prepared for this workshop and will be available for practical work for the duration of the training. Each compute node is configured as follows:

- Host name: ol7dockerXX.trivadislabs.com (See host overview provided by the teacher.)
- Internal IP address: 10.0.0.2
- External IP address: See host overview provided by the teacher.
- VM shape: VM.Standard2.2
 - CPU: 2.0 GHz Intel® Xeon® Platinum 8167M (2 Cores)
 - Memory: 30GB
 - Disk: ca 256GB
- Software:
 - Oracle Enterprise Linux 7.7

- Docker Engine / Community Edition
- Predefined Docker Images
- Miscellaneous Oracle binaries and Git client

The following figure gives an overview of the OCI compute instance and access via SSH. Detailed installation and configuration guide can be found in [Appendix A](#).

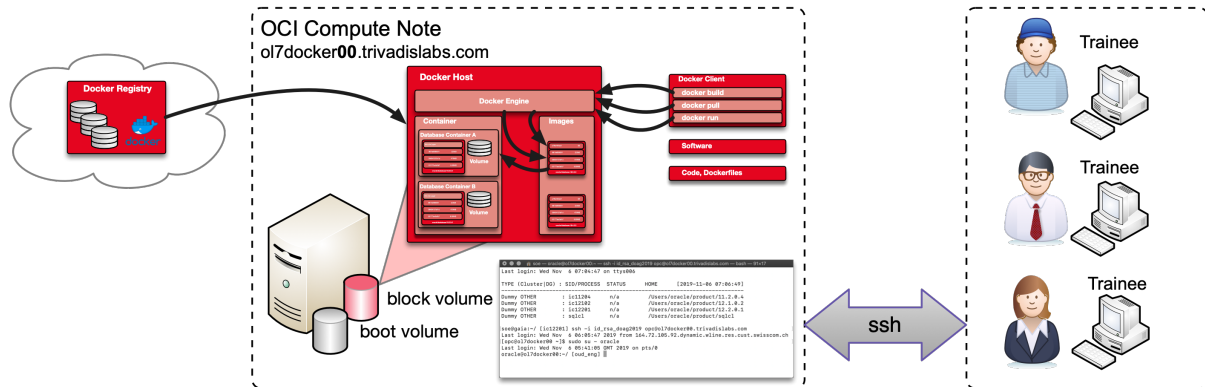


Figure 1: OCI Compute Instance Architecture

Access to the compute nodes is exclusively via SSH and Private Keys. Workshop participants must ensure that they meet the following requirements:

- SSH client for remote access, e.g. Putty, MobaXterm or similar.
- SCP Client to copy files remotely, e.g. WinSCP, Putty or similar.
- Text editor for customizing / developing docker files, scripts etc. e.g. MS Visual Studio Code, UltraEdit, Notepad++ or similar
- It must also be ensured that access to a public IP address or host name is possible via an SSH key.

The following *optional* points are recommended:

- GitHub account to access and download the source code. Simple download does not require an account.

2.4 Local Vagrant VM

As with compute nodes, all exercises can be performed directly in a Local VM. Appropriate vagrant scripts for building a VM are available in the Git Repository [oehrlis/o-db-docker](https://github.com/oehrlis/o-db-docker). The following requirements must be met in order to set up this VM with Vagrant:

- [Virtualbox](#)
- [Vagrant](#)
- Local clone of the Git repository [oehrlis/o-db-docker](#)
- Oracle Binaries for Oracle 19c and current RU.

- Sufficient hard disk space for the VM and the Docker Images approx. 50GB
- If necessary, additional tools to access and work with the VM, e.g. SSH client, text editor, etc.

Setting up a local VM is not part of the workshop. Participants who wish to work with a VM must configure it in advance. Detailed installation and configuration guide can be found in [Appendix B](#).

2.5 Local Docker Environment

As a third option, the exercises can also be performed in a local docker environment. This is especially useful for working on Linux or MacOS notebooks. In order to perform the workshop locally, the following requirements must be met:

- Installing the Docker Community Edition. See also [About Docker - Community](#)
- Local clone of the Git repository [oehrlis/o-db-docker](#) and [oracle/docker-images](#)
- Oracle Binaries for Oracle 19c and current RU.
- Sufficient hard disk space for the VM and the Docker Images approx. 50GB
- If necessary, additional tools to access and work with the VM, e.g. SSH client, text editor, git client etc.

Building a local Docker environment is not part of the workshop. Participants who wish to work with a local Docker installation must configure it in advance. detailed installation and configuration guide can be found in [Appendix C](#).

3 Workshop Exercises

3.1 Overview of Exercises

The exercises are grouped in individual directories and can generally be performed independently of each other. Each exercise contains at least a short description of the tasks (`1x??en-Exercise.md`) as well as a solution (`1x??en-Solution.md`). In addition, scripts, docker files, etc. are part of every exercise. For exercises where software (Oracle Binaries, Patch) or code from other Git repositories is required, we refer to it accordingly.

ID	Topic	Description	Duration
01	Get known the Environment	Log in and get to know the workshop environment.	10
02	Simple docker image	Build simple Docker images.	10
03	Docker Image Size	Build different version of an Oracle Instant Client Docker images.	15
04	Local Software Repository	Setup a local Software Repository	15
05	Simple DB Docker Image	Build simple DB images. Identify challenges.	20
06	Oracle Docker Image	Build a Docker DB images using the Oracle build scripts.	20
07	OraDBA Docker Image	Build a Docker DB images using the OraDBA build scripts.	20
08	Simple DB Docker Container	Run a simple DB container.	30
09	Accessing database container	Access and work with the DB container.	10
10	Oracle Unified Audit Setup	Setup a DB Container with Unified Audit and do some tests.	15
11	Oracle RU with datapatch	Patch a Docker DB Container using datapatch.	30
12	Oracle Enterprise User Security	Setup Oracle Enterprise User Security with OUD.	30
13	Oracle PDB	Plugin an Oracle PDB.	30
14	Oracle RAC with Docker	Setup and Build a RAC Docker environment.	45
15	Container Monitoring	Setup and Configure container monitoring.	45

ID	Topic	Description	Duration
16	Additional Exercises	Ideas for additional exercises.	n/a

3.2 Access Workshop Hosts

The workshop hosts are running as a compute instance in the Oracle Cloud. Each system is accessible via public IP address or its hostname. you have to use a SSH client of your choice for access (e.g. Putty, MochaXterm, SSH etc.)

- Start a Putty session from command line. Replace NN with the number of you host.

```
putty -ssh opc@ol7dockerNN.trivadislabs.com -i keys/
id_rsa_ol7dockerNN.ppk
```

- Start a SSH session from command line

```
ssh opc@ol7dockerNN.trivadislabs.com -i keys/id_rsa_ol7dockerNN
```

The instructor supplements the following table with the relevant information for the O-DB-DOCKER course. A compute instance will be assigned to each participant.

ID	Hostname	IP Address	User	Key's	Comment
00	ol7docker00.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	Trainer
01	ol7docker01.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
02	ol7docker02.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
03	ol7docker03.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
04	ol7docker04.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
05	ol7docker05.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
06	ol7docker06.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
07	ol7docker07.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
08	ol7docker08.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
09	ol7docker09.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	
10	ol7docker10.trivadislabs.com	n/a	opc	public, OpenSSH, Putty	

3.3 Exercise 1: Get known the Environment

3.3.1 Exercise Goals

Simple exercise to get to know the environment.

- Everybody can access his/her compute instance.

3.3.2 Tasks

- Login to your individual OCI compute instance eg. `ol7dockerXX`.
- Switch to user `oracle`.
- Check what Docker images are available.
- Check directories for workshop and software.

3.4 Solution 1: Get known the Environment

The following steps are performed in this exercise:

- login via SSH client as user `opc` to the individual OCI compute instance eg. `ol7dockerXX`.
- Switch to user `oracle`
- Run `docker images` to see which images are available
- Check the different directories.

3.4.1 Detailed Solution

The following steps have been performed on the `ol7docker00` host. If necessary, adjust the commands, filenames or the host name according to your environment.

- Start a Putty session from command line.

```
putty -ssh opc@ol7docker00.trivadislabs.com -i keys/
id_rsa_ol7docker00.ppk
```

- Alternatively start a SSH session from command line

```
ssh opc@ol7docker00.trivadislabs.com -i id_rsa_ol7docker00
```

- Switch to user `oracle`

```
sudo su - oracle
```

- Run `docker images` to see which images are available

```
docker images
```

- Run `docker volumes` to see which volumes are available

```
docker volumes ls
```

- Check the different directories and aliases.

```
cd /u01/volumes
cdl
ex01
o-db-docker
```

3.5 Exercise 2: Simple docker image

3.5.1 Exercise Goals

Create a simple Docker image to get warm.

- Everybody can successfully build a docker image.
- Everybody can successfully run a docker container.

3.5.2 Tasks

- Create an Dockerfile with a simple *hello world*
- Build Docker image
- Run the Docker *hello world* example.
- Run a few basic docker commands.

3.6 Solution 2: Simple docker image

The following steps are performed in this exercise:

- Create an Dockerfile with a simple *hello world*
- Build Docker image
- Run the Docker *hello world* example.
- Run a few basic docker commands.

Create / review the `Dockerfile`.

```
vi Dockerfile
```

Build a image `doag` using `docker`. This way the image will automatically be tagged as `doag:latest`.

```
docker build -t doag .
```

Build a image doag using `docker`.

```
docker build -t doag:2019 .
```

Run the docker image as container.

```
docker run doag
```

Check the containers using `docker ps -a`. You will see that the container still exists

```
docker ps -a
```

Remove the container. Copy the container ID from above.

```
docker rm <CONTAINER ID>
```

Build the Docker image using a build argument.

```
docker build -t doag --build-arg DOAG_USER="Mr. Docker" .
```

Run the docker image as container but use `--rm` to remove the container when it is stopped.

```
docker run --rm doag
```

Run the docker image as container interactive (`-i`) with a pseudo-TTY (`-t`) and overwrite the default command with `sh`. Within the container you can check the environment variables using `env` and the text file copied to the root folder `cat /beispiel.txt`

```
docker run --rm -it doag sh
env
cat /beispiel.txt
```

Cleanup old doag images either using `docker system prune`, `docker image prune` or `docker rmi <IMAGE ID>`.

```
docker images
docker image prune
docker system prune
docker rmi doag
docker rmi doag:2019
docker images
```

Your dangling images should be gone as well as the doag image.

3.7 Exercise 3: Docker Image Size

3.7.1 Exercise Goals

Identify the reason for different image size for the same Image.

- Everybody know why its image gets large.

3.7.2 Tasks

Build Oracle Instant Client Docker images with different Dockerfiles.

- Dockerfile with several `RUN` commands.
- Dockerfile with a combined `RUN` command.
- Using a build stage build.
- Verify if Docker experimental is enabled
- Build an image using squash
- Analyse the different images using `docker history`

3.8 Solution 3: Docker Image Size

The following steps are performed in this exercise:

- Dockerfile with several `RUN` commands.
- Dockerfile with a combined `RUN` command.
- Using a build stage build.
- Verify if Docker experimental is enabled
- Build an image using squash
- Analyse the different images using `docker history`

3.8.1 Background Information

To simplify and speed up the build we do build a Docker image for SQL*Plus using the instant client. The same procedure could also be done for an Oracle binary installation. It just takes a bit longer. The base image is `oraclelinux:7-slim`. The exercise does use the following Dockerfiles:

- `ic19_separate.Dockerfile` with multiple respectively separate `RUN` statements.
- `ic19.Dockerfile` with one `RUN` statement.
- `ic19_multistage.Dockerfile` for multi stage build.

3.8.2 Build Image with multiple RUN Statements

Build the Docker image for Oracle instant client with multiple `RUN` statements. Since we do not use a default `Dockerfile` we do have to provide the file name.

```
docker build -t oracle/sqlplus:separate -f ic19_separate.Dockerfile .
```

3.8.3 Build Image with one RUN Statements

Build the Docker image for Oracle instant client with one *RUN* statements. Since we do not use a default `Dockerfile` we do have to provide the file name.

```
docker build -t oracle/sqlplus:one -f ic19.Dockerfile .
```

3.8.4 Use Experimental Feature squash

First check if experimental feature is enabled.

```
docker info
docker version -f '{{.Server.Experimental}}'
```

Enable experimental features using `daemon.json`. Add `"experimental": true` but don't forget the comma.

```
sudo vi /etc/docker/daemon.json
```

Restart the Docker daemon.

```
sudo systemctl stop docker
sudo systemctl start docker
```

Check again if experimental is enabled.

```
docker version -f '{{.Server.Experimental}}'
```

Build again the Docker image with multiple *RUN* commands but use `--squash`.

```
docker build -t oracle/sqlplus:squash --squash -f ic19_separate.
Dockerfile .
```

3.8.5 Use Multi Stage Build

Build the Docker image for Oracle instant client with one *RUN* statements. Since we do not use a default `Dockerfile` we do have to provide the file name.

```
docker build -t oracle/sqlplus:multistage -f ic19_multistage.
Dockerfile .
```

3.8.6 Compare the different Docker images

Here we go, let's compare the different Docker images.

```
docker images
```


With `docker history` you can see the different layers and there size.

```
docker history oracle/sqlplus:separate
docker history oracle/sqlplus:one
docker history oracle/sqlplus:squash
docker history oracle/sqlplus:multistage
```

The squash images is small but does missing all layer information. This does also have impact when a container is started / loaded e.g. existing layers can not be reused.

3.9 Exercise 4: Local Software Repository

3.9.1 Exercise Goals

Be able to use a local software repository during build.

3.9.2 Tasks

- Create docker-compose file for the local software repository
- Start the container using `docker-compose`
- Use the local software repository in a Docker build.

3.10 Solution 4: Local Software Repository

The following steps are performed in this exercise:

- login via SSH client as user `opc` to the individual OCI compute instance eg. `ol7dockerXX`.
- Switch to user `oracle`
- Run `docker images` to see which images are available
- Check the different directories.

3.10.1 Background Information

Oracle Software usually can not be downloaded during build without providing some credentials. If the binaries are downloaded using `curl` or `wget` the credentials will remain in the docker image. One solution would be to keep the binaries in the docker build context and use squash or multi stage builds. Alternatively it is also possible to use a local web server (docker container) to download the files locally.

3.10.2 Start ORAREPO Container

Start a simple web server to locally share the software during docker build using simple `docker` command.

```
docker run -dit \
  --hostname orarepo \
  --name orarepo \
  -p 80:80 \
  -v /u00/app/oracle/software:/www \
  busybox httpd -fvvv -h /www
```

Stop and remove the container.

```
docker stop orarepo
docker rm orarepo
```

A little more comfortable is the use of `docker-compose`.

```
docker-compose up -d
```

Get the IP of the web server.

```
orarepo_ip=$(docker inspect -f '{{range .NetworkSettings.
  Networks}}{{.IPAddress}}{{end}}' orarepo)
echo $orarepo_ip
```

3.10.3 Build a Image using ORAREPO

Build a Docker images using the orarepo.

```
docker build --add-host=orarepo:${orarepo_ip} -t oracle/java:
orarepo .
```

3.10.4 Build a Image using local Software

Create a hard link for the java package (you can also copy the file)

```
ln /u00/app/oracle/software/p29657335_170231_Linux-x86-64.zip .
```

Build a Docker images using the local software package.

```
docker build -t oracle/java:local .
```

3.10.5 Compare the Docker Images

Lets compare the Docker images using `docker images`.

```
docker images
```

And check what's in the images

```
docker history oracle/java:local  
docker history oracle/java:orarepo
```

3.11 Exercise 5: Simple DB Docker Image

3.11.1 Exercise Goals

- Create a simple database Docker image
- Identify challenges

3.11.2 Tasks

- Customize the Dockerfile for build a simple database image using Oracle RPM package.
- Build the database Docker image. Either by using orarepo or the local software.
- Think about what this image lacks.
- Optional: Create a simple database image using regular Oracle packages.

3.12 Solution 5: Simple DB Docker Image

The following steps are performed in this exercise:

- Customize the Dockerfile for build a simple database image using Oracle RPM package.
- Build the database Docker image. Either by using orarepo or the local software.
- Think about what this image lacks.
- Optional: Create a simple database image using regular Oracle packages.

Each build takes about 10-15minutes. It does not make sense to build all of them.

3.12.1 Background Information

In this exercise you can either use the local software from the Docker build context or download the packages during build from the OraREPO. Beside this the build can be done by using the regular Oracle software packages or the new RPM packages.

3.12.2 Build Image using local RPM

Create a hard link for the java package (you can also copy the file)

```
ln /u00/app/oracle/software/oracle-database-ee-19c-1.0-1.x86_64.  
rpm .
```

Build the Docker images using the local software package.

```
docker build -f rpm.Dockerfile -t oracle/database:19.3_local_rpm .
```

3.12.3 Build Image using OraREPO RPM

Get the IP of the web server.

```
orarepo_ip=$(docker inspect -f '{{range .NetworkSettings.  
  Networks}}{{.IPAddress}}{{end}}' orarepo)  
echo $orarepo_ip
```

Build the Docker images using the software package from orarepo.

```
docker build --add-host=orarepo:${orarepo_ip} -f rpm.Dockerfile  
-t oracle/database:19.3_orarepo_rpm .
```

3.12.4 Optional: Build Image using local Software Package

Create a hard link for the java package (you can also copy the file)

```
ln /u00/app/oracle/software/LINUX.X64_193000_db_home.zip .
```

Build the Docker images using the local software package.

```
docker build -f regular.Dockerfile -t oracle/database:19.3  
_local_reg .
```

3.12.5 Optional: Build Image using OraREPO Software Package

Get the IP of the web server.

```
orarepo_ip=$(docker inspect -f '{{range .NetworkSettings.  
  Networks}}{{.IPAddress}}{{end}}' orarepo)  
echo $orarepo_ip
```

Build the Docker images using the software package from orarepo.

```
docker build --add-host=orarepo:${orarepo_ip} -f regular.  
Dockerfile -t oracle/database:19.3_orarepo_reg .
```

3.12.6 Compare the Docker Images

Lets compare the Docker images using `docker images`.

```
docker images
```

And check what's in the images

```
docker history oracle/database:19.3_local_rpm
docker history oracle/database:19.3_orarepo_rpm
docker history oracle/database:19.3_local_reg
docker history oracle/database:19.3_orarepo_reg
```

What else is missing?

- No Oracle environment variables defined.
- All configuration files are still in the container. e.g. no script to move TNS_ADMIN etc to a volume
- Database would be created within the container. No volume defined.
- Overall size is rather large.
- Database can not be accessed from outside the container since the Oracle ports are not exported.
- No entrypoint nor command defined. There will be no database created / started when the container is created
- When using the Oracle RPM in Docker it is mandatory to set the environment variable ORACLE_DOCKER_INSTALL. Otherwise Oracle will look for sudo.
- What about release updates (RU) patches etc?
- Oracle 18c/19c installation is rather simple, but what about other releases?
- Quite a lot is hardcoded and not easy to maintain.
- And a couple of other stuff...

3.13 Exercise 6: Oracle Docker Image

3.13.1 Exercise Goals

- Create database Docker image using the Oracle build scripts.

3.13.2 Tasks

- Update local git working copy of *oracle/docker-images*
- Check whether all the prerequisites have been fulfilled.
- Build Docker image using `buildDockerImage.sh` or manually using `docker build`

3.14 Solution 6: Oracle Docker Image

The following steps are performed in this exercise:

- Create database Docker image using the Oracle build scripts.

- Update local git working copy of `oracle/docker-images`
- Check whether all the prerequisites have been fulfilled.
- Build Docker image using `buildDockerImage.sh` or manually using `docker build`

3.14.1 Preparations

Change to the Oracle Docker image folder `/u00/app/oracle/local/docker-images` and pull the latest updates.

```
cd /u00/app/oracle/local/docker-images
git pull
```

Change to the `OracleDatabase` folder. In this example we do use 19.3.0 but you can take as well an other release.

```
cd OracleDatabase/SingleInstance/dockerfiles/19.3.0
```

Check the Software requirements

```
cat Checksum.ee
```

Create a hard link for the software

```
ln /u00/app/oracle/software/LINUX.X64_193000_db_home.zip .
```

For more information regarding Oracle Docker images see [README.md](#) of `oracle/docker-images`.

3.14.2 Build the Image using `buildDockerImage.sh`

Oracle does provide a shell wrapper script to build the Oracle Docker images `buildDockerImage.sh`. The script does have a couple of parameter.

```
buildDockerImage.sh -h

Usage: buildDockerImage.sh -v [version] [-e | -s | -x] [-i] [-o]
      [Docker build option]
Builds a Docker Image for Oracle Database.

Parameters:
  -v: version to build
      Choose one of: 11.2.0.2  12.1.0.2  12.2.0.1  18.3.0
                      18.4.0  19.3.0
  -e: creates image based on 'Enterprise Edition'
  -s: creates image based on 'Standard Edition 2'
  -x: creates image based on 'Express Edition'
  -i: ignores the MD5 checksums
  -o: passes on Docker build option
```

```
* select one edition only: -e, -s, or -x
```

Build an Oracle Docker image for Enterprise Edition and 19.3.0

```
buildDockerImage.sh -v 19.3.0 -e
```

3.14.3 Build the Image using Docker

Alternatively you can build the Docker images regularly using `docker build`.

```
cd 19.3.0  
time docker build -t oracle/database:19.3.0-ee .
```

3.15 Exercise 7: OraDBA Docker Image

3.15.1 Exercise Goals

- Create database Docker image using the OraDBA build scripts.

3.15.2 Tasks

- Update local git working copy of `oehrlis/docker`
- Review the Dockerfile and define Oracle version to build
- Check whether all the prerequisites have been fulfilled.
- Build Docker image using `docker build`

3.16 Solution 7: OraDBA Docker Image

The following steps are performed in this exercise:

- Update local git working copy of `oehrlis/docker`
- Review the Dockerfile and define Oracle version to build
- Check whether all the prerequisites have been fulfilled.
- Build Docker image using `docker build`

3.16.1 Preparations

Change to the OraDBA Docker image folder `/u00/app/oracle/local/docker` and pull the latest updates.

```
cd /u00/app/oracle/local/docker  
git pull
```

Change to the `OracleDatabase` folder. In this example we do use 19.3.0 but you can take as well an other release.

```
cd OracleDatabase/19.0.0.0
```

Check the Software requirements

```
cd software
cat LINUX.X64_193000_db_home.zip.download
```

Create a hard link for the software. This is only required if you want to not use OraREPO.

```
cd software
ln /u00/app/oracle/software/LINUX.X64_193000_db_home.zip .
```

Optional you can also add the hard links for release updates.

For more information regarding Oracle Docker images see [README.md](#) of [oehrlis/docker](#).

3.16.2 Build the Image using OraREPO

Get the IP of the OraREPO web server.

```
orarepo_ip=$(docker inspect -f '{{range .NetworkSettings.
  Networks}}{{.IPAddress}}{{end}}' orarepo)
echo $orarepo_ip
```

Build the Docker image for Oracle 19c (19.3.0)

```
docker build --add-host=orarepo:${orarepo_ip} -f 19.3.0.0.
  Dockerfile -t oracle/database:19.3.0.0 .
```

Build the Docker image for Oracle 19c (19.3.0) with RU July 2019

```
docker build --add-host=orarepo:${orarepo_ip} -f 19.4.0.0.
  Dockerfile -t oracle/database:19.4.0.0 .
```

Build the Docker image for Oracle 19c (19.3.0) with RU October 2019

```
docker build --add-host=orarepo:${orarepo_ip} -f 19.5.0.0.
  Dockerfile -t oracle/database:19.5.0.0 .
```

3.16.3 Build the Image using local Software

Create a hard link for the software. This is only required if you want to not use OraREPO.

```
cd software
ln /u00/app/oracle/software/LINUX.X64_193000_db_home.zip .
ln /u00/app/oracle/software/basenv-18.11.final.a.zip .
ln /u00/app/oracle/software/p6880880_190000_Linux-x86-64.zip .
```


Optional you can also add the hard links for release updates.

```
ln /u00/app/oracle/software/p30125133_190000_Linux-x86-64.zip .
ln /u00/app/oracle/software/p30128191_190000_Linux-x86-64.zip .
ln /u00/app/oracle/software/p6880880_190000_Linux-x86-64.zip .
```

Build the Docker image for Oracle 19c (19.3.0)

```
docker build -f 19.3.0.0.Dockerfile -t oracle/database:19.3.0.0
.
```

Build the Docker image for Oracle 19c (19.3.0) with RU October 2019

```
docker build -f 19.5.0.0.Dockerfile -t oracle/database:19.5.0.0
.
```

3.17 Exercise 8: Simple DB Docker Container

3.17.1 Exercise Goals

- Run an Oracle database in a Docker container.
- See the difference between `docker run` and `docker-compose`
- See what happens if you forget to specify a volume.

3.17.2 Tasks

- Create a Docker container by using `docker run` without a volume.
- Create a Docker container by using `docker run` with a volume.
- Create a Docker container using `docker-compose` with a predefined volume.

3.18 Solution 8: Simple DB Docker Container

The following steps are performed in this exercise:

- Create a Docker container by using `docker run` without a volume.
- Create a Docker container by using `docker run` with a volume.
- Create a Docker container using `docker-compose` with a predefined volume.

Task where a Docker container does create a new database do take a while (15-20min). Due to this it does not make sense to create all tasks.

3.18.1 Database Container without a volume

This container will be build based on an [oracle/docker-images](#). See the [README.md](#) for more run options.

```
docker run --name doag193 \
-p 1521:1521 -p 5500:5500 \
-e ORACLE_SID=TDOAG \
-e ORACLE_PDB=PDB1 \
oracle/database:19.3.0-ee
```

The problem with this container is, that the DB is now create in the read/write layer of the container. Beside this `docker run` has been executed without detach. If you cancel the command, the container will be stopped.

To create a container and run it in daemon mode use the `-d` option.

```
docker run --name doag193 \
-p 1521:1521 -p 5500:5500 \
-e ORACLE_SID=TDOAG \
-e ORACLE_PDB=PDB1 \
oracle/database:19.3.0-ee
```

Check the logs

```
docker logs -f doag193
```

The database is ready to use when you see the following strings in the log files.

```
#####
DATABASE IS READY TO USE!
#####
```

If not specified by `ORACLE_PWD` the password for SYS, SYSTEM and PDBADMIN will be generated. It can be reset by the following command.

```
docker exec <container name> ./setPassword.sh <your password>
```

3.18.2 Database Container with a volume

This container will be build based on an [oehrlis/docker](#). See the [README.md](#) for more run options.

```
docker volume create ex08_db_doag194
```

Create the Docker container for 19.4.0.0. We just use a default values and do not configure additional stuff like PDB, custom template etc.

```
docker run --name doag194 \
--hostname doag194 -p 2521:1521 \
-e ORACLE_SID=TDB194S \
--volume vol_doag194:/u01 \
--detach \
oracle/database:19.4.0.0
```

Check the logs

```
docker logs -f doag194
```

The database is ready to use when you see the following strings in the log files.

```
-----  
- DATABASE TDB194S IS READY TO USE!  
-----
```

Password for the Oracle users e.g. SYS and SYSTEM is create when not specified via ORACLE_PWD. It is visible in the Docker log as well in the DB admin directory

```
docker logs doag194|grep -i password  
  
Oracle Database Server auto generated password:  
----> Password      : U3SQ8XFWI1  
ORACLE PASSWORD FOR SYS, SYSTEM AND PDBADMIN: U3SQ8XFWI1
```

3.18.3 Database Container with a bind mount

This container will be build based on an [oehrlis/docker](#). See the [README.md](#) for more run options.

```
mkdir /u01/volumes/doag195
```

Create the Docker container for 19.5.0.0. We just use a default values and do not configure additional stuff like PDB, custom template etc.

```
docker run --name doag195 \  
--hostname doag195 -p 3521:1521 \  
-e ORACLE_SID=TDB195S \  
--volume /u01/volumes/doag195:/u01 \  
--detach \  
oracle/database:19.5.0.0
```

Check the logs

```
docker logs -f doag195
```

The database is ready to use when you see the following strings in the log files.

```
-----  
- DATABASE TDB195S IS READY TO USE!  
-----
```

Password for the Oracle users e.g. SYS and SYSTEM is create when not specified via ORACLE_PWD. It is visible in the Docker log as well in the DB admin directory

```
docker logs doag195|grep -i password  
  
Oracle Database Server auto generated password:  
----> Password      : U3SQ8XFWI1
```

```
ORACLE PASSWORD FOR SYS, SYSTEM AND PDBADMIN: U3SQ8XFwI1
```

3.18.4 Database Container with predefined volume

This container will be build based on an [oehrlis/docker](#). See the [README.md](#) for more run options.

Create the Docker container for 19.4.0.0. The `docker-compose.yml` file does include the parameters to configure a CONTAINER DB as well other stuff.

```
docker-compose up -d
```

Check the logs

```
docker-compose logs -f
```

The database is ready to use when you see the following strings in the log files.

```
-----  
- DATABASE TDB190C IS READY TO USE!  
-----
```

Password for the Oracle users e.g. SYS and SYSTEM is create when not specified via `ORACLE_PWD`. It is visible in the Docker log as well in the DB admin directory

```
docker logs tdb190c|grep -i password
```

3.19 Exercise 9: Accessing database container

3.19.1 Exercise Goals

Be able to access and use the Docker database container

3.19.2 Tasks

- Access Docker container via shell
- Access Docker container via SQLPlus / SQL Developer

3.20 Solution 9: Accessing database container

The following steps are performed in this exercise:

- Access Docker container via shell
- Access Docker container via SQLPlus / SQL Developer

3.20.1 Detailed Solution

Access the container via Shell (user oracle is default)

```
docker exec -it -u oracle tdb190c bash --login
```

Sometimes there could be issues with the terminal columns

```
docker exec -e COLUMNS=`tput cols` -e LINES=`tput lines` -it  
-u oracle tdb190c bash --login
```

You can also access the container as root

```
docker exec -it -u root tdb190c bash --login
```

Or start SQL*Plus instead

```
docker exec -it tdb190c sqlplus "/" as sysdba
```

You can also access the container from outside via port forwarding.

```
docker logs tdb190c | grep -i password  
sqlplus sys/BoWfrrxGO7@localhost:9000/TDB190C
```

You can also access the container from outside via port forwarding.

```
docker inspect tdb190c  
sqlplus sys/BoWfrrxGO7@172.17.0.4:1521/TDB190C as sysdba
```

If you prepared port forwarding in ssh you can also access from the local PC.

```
ssh -L 9000:127.0.0.1:9000 -i id_rsa_doag2019 opc@ol7docker00.  
trivadislabs.com
```

Or even a bit more for exercise 12

```
ssh -L 5389:127.0.0.1:5389 \  
-L 5636:127.0.0.1:5636 \  
-L 5444:127.0.0.1:5444 \  
-L 5001:127.0.0.1:5001 \  
-L 5002:127.0.0.1:5002 \  
-L 5521:127.0.0.1:5521 \  
-i id_rsa_doag2019 opc@ol7docker00.trivadislabs.com
```

3.21 Exercise 10: Oracle Unified Audit Setup

3.21.1 Exercise Goals

Use the startup / setup script folder to customize the database Docker container. In this exercise using Oracle Unified Directory as an example.

3.21.2 Tasks

- Review the setup scripts
- Refine a `docker-compose.yml` file
- Create a Docker container using `docker-compose` and review the database configuration. In particular the Unified Audit configuration.
- Re-create the Docker container using `docker-compose` to see that Oracle Unified Audit gets linked again

3.21.3 Additions to the Solution

- The `docker-compose` file does include the services for Oracle 12.2, 18c and 19c. But the services `tua122` and `tua180` are commented out.
- The database is pre-configured in volume `db-tua190` if used a different Oracle version the DB may have to be created.

3.22 Solution 10: Oracle Unified Audit Setup

The following steps are performed in this exercise:

- Review the configuration in `docker-compose.yml` and the scripts defined in `setup / startup` folder.
- Create / start a container based on 19.4.0.0 with the service `tua190`.
- Stop and remove the container.
- Re-create a container based on 19.4.0.0 with the service `tua190`.
- Review the database configuration and Oracle Unified Directory status.
- Optional: Reconfigure Unified Audit Policies.

3.22.1 Background Information

This example shows how to enable Unified Audit an Oracle database in a Docker Container. The persistent data (e.g. data files, config files etc.) is stored on an external volume. The startup script `01_check_unified_audit.sh` will check if Oracle Unified Audit is enabled if not it will stop the database, relink Oracle and start the database again. Some prerequisites and basic principles:

- `01_check_unified_audit.sh` does check if Oracle Unified Audit is enabled. If not it will stop the database, relink Oracle and start the database again
- Script can be put in the startup as well setup folder.
- Setup folder does provide a couple of additional Scripts

File	Purpose
01_check_unified_audit.sh	Script to check and enable unified audit.
02_create_scott_pdb1.sql	Script to create the SCOTT schema.
03_create_tvd_hr_pdb1.sql	Main script to create the TVD_HR schema in PDB1.
04_config_audit.sql	Script to config unified audit.
05_clone_pdb1_pdb2.sql	Script to clone PDB1 to PDB2.

3.22.2 Run the Oracle Database Unified Audit

Update the `docker-compose.yml` file and set the desired base image. Default is 19.4.0.0.

```
vi docker-compose.yml
```

Create a container `tua190`, `tua180` or `tua122` using `docker-compose`. This will also create the corresponding database `TUA190`, `TUA180` respectively `TUA122`. It is important to specify the service when calling `docker-compose` otherwise all three container and databases will be created.

```
docker-compose up -d tua190
```

Monitor the progress of database creation using `docker-compose`.

```
docker-compose logs -f
```

The database is ready when you see the following message in your docker logs.

```
-----
- DATABASE TUA190 IS READY TO USE!
-----
```

You now can shutdown and destroy the container using `docker-compose`. Database will remain since it is stored on a volumem / bind-mount folder.

```
docker-compose down
```

Re-create the container `tua190` using `docker-compose`. The database `TUA190` will be reused. The run script `50_run_database.sh` will make sure make sure, that the scripts in the **startup** folder are executed. This includes `01_check_unified_audit.sh`.

```
docker-compose up -d tua190
```

Monitor the progress of database startup / datapach using `docker-compose`.

```
docker-compose logs -f
```

Connect to the database via Shell or SQLPlus and check your Oracle Audit Configuration.

3.22.3 Customization

By default the volume will be created in the directory specified by the environment variable `DOCKER_VOLUME_BASE`. If the environment variable is not specified, it will use the default value from `*.env` which is the current path. Beside the usual changes e.g. container name, hostname, ports etc. you can configure how the DB itself will be created by specify several configuration parameter.

- `ORACLE_SID` Default Oracle SID. Usually it will default to the variable which has been specified during build. A custom SID can / should be specified. Default is either `TUA190`, `TUA180` or `TUA122`.
- `ORACLE_PDB` Default PDB name, if `CONTAINER` is set to `TRUE` (default `PDB1`)
- `CONTAINER` Flag to create a container or single tenant database. Default set to `FALSE`.
- `ORACLE_PWD` Custom admin password for common admin user like `SYS` and `SYSTEM`. If not specified a random password will be generated.
- `INSTANCE_INIT` Folder for customize setup and startup. The database create script will look for a folder `setup` during initial setup or `startup` during each container startup. All bash `.sh` scripts as well sql `.sql` script will be executed. Make sure to add a sequence to keep the order of the scripts. In this use case we will set the `INSTANCE_INIT` to `/u01/config` which is mapped to the local `config` folder. `/u01/config`
- `ORADBA_TEMPLATE_PREFIX` Prefix to use a custom dbca template or the general purpose default template. By default this variable is not set. In this case dbca will use the general purpose template with the starter database. If set to `custom_` dbca will use a custom template to create a fresh database. This will take longer since the database will be create from scratch.

3.23 Exercise 11: Oracle RU with datapatch

3.23.1 Exercise Goals

See how to install a Oracle RU in a dockerized database.

3.23.2 Tasks

- Review scripts defined in `setup` / `startup` folder.
- Create a container based on 19.4.0.0 (Volume / database is pre-configured)

- Stop and remove the container.
- Update the `docker-compose.yml` file to match the new Docker image.
- Create a container based on 19.5.0.0.
- Review the database configuration and patch status.
- Optional: switch back to old Docker image.

3.24 Solution 11: Oracle RU with datapatch

The following steps are performed in this exercise:

- Review the configuration in `docker-compose.yml` and the scripts defined in setup / startup folder.
- Choose either `tcpu01` or `tcpu02` database service to work with.
 - `tcpu01` Single tenant database with full option installed eg. JAVA, XDB etc.
 - `tcpu02` Single tenant database with minimal option installed.
- Create / start a container based on 19.4.0.0
- Stop and remove the container.
- Update the `docker-compose.yml` file to match the new Docker image.
- Create a container based on 19.5.0.0.
- Review the database configuration and patch status.
- Optional: switch back to old Docker image.
- Optional: Do the same test with the other service e.g. `tcpu01` or `tcpu02`.

3.24.1 Background Information

This example shows how to install an Oracle release update (RU) on an Oracle database in a Docker Container. The persistent data (e.g. data files, config files etc.) is stored on an external volume. This allows to stop /remove the container and create a new one based on a Docker image with additional RU's, patch etc. The startup script `00_run_datapatch.sh` will run Oracle datapatch to apply / rollback the patch in the database. Some prerequisites and basic principles:

- `00_run_datapatch.sh` does check if you database has java installed. If so, it will restart the database in upgrade mode to run datapatch.
- If database is a container database the PDB's will be open to run datapatch.
- This use case does only run within an Oracle major release eg. 19.x.0.0 or 18.x.0.0 but not as a method to upgrade from 18c to 19c.
- It is relevant if you have a basic container with an RU or any kind of one-off patch.

The following figure illustrates the patch process of an Oracle database container.

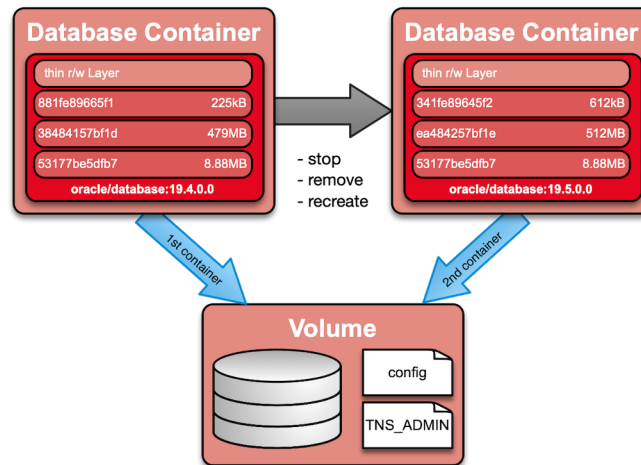


Figure 2: Patch Database Container

3.24.2 Run the Patch Update

Update the `docker-compose.yml` file and set the desired base image. Default is 19.4.0.0.

```
vi docker-compose.yml
```

Create a container `tcpu01` using `docker-compose`. This will also create an initial database `TCPU01`.

```
docker-compose up -d tcpu01
```

Monitor the progress of database creation using `docker-compose`.

```
docker-compose logs -f
```

The database is ready when you see the following message in your docker logs.

```
-----
- DATABASE TDB194S IS READY TO USE!
-----
```

You now can shutdown and destroy the container using `docker-compose`. Database will remain since it is stored on a volume / bind-mount folder.

```
docker-compose down
```

Update the `docker-compose.yml` file and set the desired base image. e.g 19.5.0.0.

```
vi docker-compose.yml
```

Re-create the container `tcpu01` using `docker-compose`. The database `TCPU01` will be reused. The run script `50_run_database.sh` will make sure, that the scripts in the **startup** folder are executed. This includes `00_run_datapatch.sh`.

```
docker-compose up -d tcpu01
```

Monitor the progress of database startup / datapach using `docker-compose`.

```
docker-compose logs -f
```

You may also run the use case to downgrade / remove an existing RU.

3.24.3 Customization

By default the volume will be created in the directory specified by the environment variable `DOCKER_VOLUME_BASE`. If the environment variable is not specified, it will use the default value from `*.env` which is the current path. Beside the usual changes e.g. container name, hostname, ports etc. you can configure how the DB itself will be created by specify several configuration parameter.

- `ORACLE_SID` Default Oracle SID. Usually it will default to the variable which has been specified during build. A custom SID can / should be specified.
- `ORACLE_PDB` Default PDB name, if `CONTAINER` is set to `TRUE` (default `PDB1`)
- `CONTAINER` Flag to create a container or single tenant database. Default set to `FALSE`.
- `ORACLE_PWD` Custom admin password for common admin user like `SYS` and `SYSTEM`. If not specified a random password will be generated.
- `INSTANCE_INIT` Folder for customize setup and startup. The database create script will look for a folder `setup` during initial setup or `startup` during each container startup. All bash `.sh` scripts as well sql `.sql` script will be executed. Make sure to add a sequence to keep the order of the scripts. In this use case we will set the `INSTANCE_INIT` to `/u01/config` which is mapped to the local `config` folder. `/u01/config`
- `ORADBA_TEMPLATE_PREFIX` Prefix to use a custom dbca template or the general purpose default template. By default this variable is not set. In this case dbca will use the general purpose template with the starter database. If set to `custom_dbca` will use a custom template to create a fresh database. This will take longer since the database will be create from scratch.

3.25 Exercise 12: Oracle Enterprise User Security

3.25.1 Exercise Goals

- See how a more complex test environment can be setup using `docker-compose`
- Test Oracle Enterprise User Security.

3.25.2 Tasks

- Review the `docker-compose.yml`
- Start the container using `docker-compose`
- Test Oracle Names Resolution within the database container.
- Test EUS Login within the database container.

3.26 Solution 12: Oracle Enterprise User Security

The following steps are performed in this exercise:

- Review the `docker-compose.yml`
- Start the container using `docker-compose`
- Test Oracle Names Resolution within the database container.
- Test EUS Login within the database container.

3.26.1 Background Information

This example shows how to configure an Oracle Database with Enterprise User Security and Oracle Unified directory. The persistent data (e.g. data files, config files etc.) is stored on an external volume. The start scripts are configured in the way, that the database does register itself in OUD and then configure EUS. Some prerequisites and basic principles:

- To automate the setup the two container do share a common configuration directory `./oud`. This allows to share information like the `eusadmin` password and the trusted certificate.
- The compose file does also include a service for OUDSM.
- The setup of Oracle Unified Directory includes a sample set of directory users.
- The database does setup an HR schema suitable for the sample schema.

The following figure illustrates the an Oracle Database and Oracle Unified Directory container with Enterprise User Security (EUS).

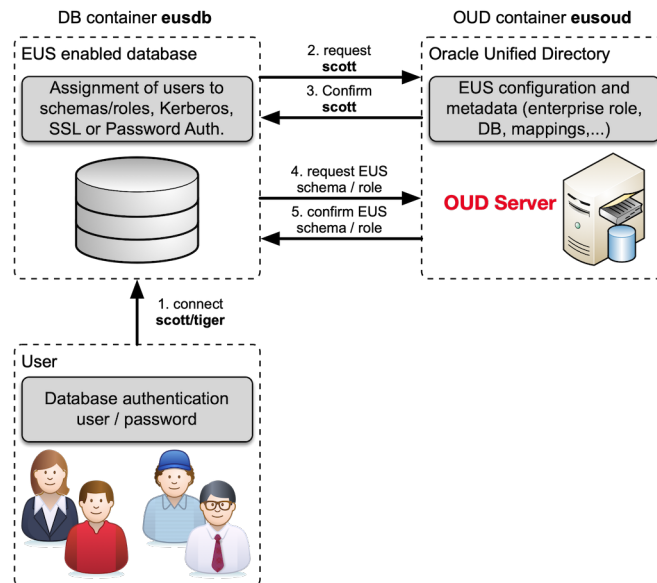


Figure 3: Oracle EUS with OUD standalone in Docker

Oracle Unified Directory does use the following scripts to setup the OUD with EUS:

- `00_init_environment` File for setting the instance-specific environment. The setup scripts are based on the OUD Base environment.
- `01_create_eus_instance.sh` Script to create the OUD instance with EUS context using `oud-setup`.
- `02_config_basedn.sh` Wrapper script to configure base DN and add ou's for users and groups.
- `02_config_basedn.ldif` LDIF file loaded by wrapper script `02_config_basedn.sh`.
- `03_config_eus_realm.sh` Wrapper script to configure EUS realm to the OUD instance.
- `03_config_eus_realm.ldif` LDIF file loaded by wrapper script `03_config_eus_realm.sh`.
- `04_config_oud.sh` Wrapper script to configure the OUD instance.
- `04_config_oud.conf` dsconfig batch file loaded by wrapper script `04_config_oud.sh`.
- `05_update_directory_manager.sh` Adjust `cn=Directory Manager` to use new password storage scheme
- `06_create_root_users.sh` Wrapper script to create additional root user.
- `06_create_root_users.conf` dsconfig batch file loaded by wrapper script `06_create_root_users.sh`.
- `06_create_root_users.ldif` LDIF file loaded by wrapper script `06_create_root_users.sh`.
- `07_create_eusadmin_users.sh` Script to create EUS Context Admin according to

MOS Note 1996363.1.

- `08_create_demo_users.sh` Wrapper script to create a couple of users and groups.
- `08_create_demo_users.ldif` LDIF file loaded by wrapper script `08_create_demo_users.sh`.
- `09_migrate_keystore.sh` Script to migrate the java keystore to PKCS12.
- `10_export_trustcert_keystore.sh` Script to export the java keystore to PKCS12.
- `11_create_eus_ou_tree.conf` dsconfig batch file loaded by wrapper script `11_create_eus_ou_tree.sh`.
- `11_create_eus_ou_tree.ldif` LDIF file loaded by wrapper script `03_config_eus_realm.sh`.
- `11_create_eus_ou_tree.sh` Script to create additional root user.

The Database does run the following scripts during initial setup:

- `01_create_scott.sql` Wrapper script for `utlsampl.sql` to create the SCOTT schema.
- `02_create_tvd_hr.sql` Script to create the TVD_HR schema. TVD_HR schema corresponds to Oracle's standard HR schema. The data has been adjusted so that it matches the example LDAP data of trivadislabs.com |
- `03_eus_registration.sh` Script to register database in OUD instance using `dbca`.
- `04_eus_config.sql` Script to create the EUS schemas for global shared and private schemas.
- `05_eus_mapping.sh` Script to create the EUS mapping to different global shared and private schemas as well global roles.
- `06_keystore_import_trustcert.sh` Script to import the trust certificate into java keystore.

3.26.2 Use predefined Volumes

Since it takes a while to setup the database, we have predefined volumes for OUD, OUDSM and the database.

- Create and start all containers

```
docker-compose up -d
```

- check the status of the containers

```
docker-compose logs -f
```

3.26.3 Re-Create the Containers

To see how the EUS setup does work, it make sense to remove the volumes and create everything from scratch.

- remove the volumes

```
docker volume rm ex12_db-eusdb
docker volume rm ex12_oud-eusoud
docker volume rm ex12_oud-eusoudsm
```

- Create and start all containers. This will take a while until the database is created.

```
docker-compose up -d
```

- check the status of the containers

```
docker-compose logs -f
```

3.26.4 Test EUS

Test the EUS configuration using sqlplus. Alternatively you can also connect SQLDeveloper, etc.

```
sqlplus king/LAB01schulung@localhost:5521/TEUS01

@db/scripts/sousrinf
```

Check the session context

```
set linesize 160 pagesize 200
col NAMESPACE for a30
col ATTRIBUTE for a30
col VALUE for a50
SELECT * FROM session_context;
SELECT * FROM session_roles;
```

Select employee table as user king.

```
conn king/LAB01schulung
SELECT first_name,last_name,email FROM tvd_hr.employees;
```

Select employee table as user bond.

```
conn bond/LAB01schulung
SELECT first_name,last_name,email FROM tvd_hr.employees;
```

Select employee table as user moneypenny.

```
conn moneypenny/LAB01schulung
SELECT first_name,last_name,email FROM tvd_hr.employees;
```

VPD does limit the access to tvd_hr.employees based on LDAP attributes.

3.27 Exercise 13: Oracle PDB

3.27.1 Exercise Goals

Plugin an existing PDB into a new container.

3.27.2 Tasks

- Create the `docker-compose.yml` for a Oracle Container Database
- Prepare the scripts to look for the PDB.
- Start the container and plugin the PDB.
- Verify the status of the PDB.

3.28 Solution 13: Oracle PDB

The following steps are performed in this exercise:

- Create the `docker-compose.yml` for a Oracle Container Database
- Prepare the scripts to look for the PDB.
- Start the container and plugin the PDB.
- Verify the status of the PDB.

3.28.1 Detailed Solution

The detailed solution is still pending. You find the following information prepared:

- `docker-compose.yml` file for a container tcdb190 with a CDB TCDB190 based on Oracle 19.5.0.0
- config scripts to setup SCOTT and HR schemas
- Script to clone PDB1 to PDB2

You can work out the following solutions:

- create the container TCDB190
- create a script to unplug a PDB
- create a script to plug in a PDB on startup

3.29 Exercise 14: Oracle RAC with Docker

3.29.1 Exercise Goals

Setup a simple RAC based test environment on Docker

3.29.2 Tasks

- Create the Docker network.
- Create a RAC storage server Docker container.
- Create a NFS volume
- Creating the Docker GI and RAC Container
- Assign networks to RAC containers
- Adding a RAC Node using a Docker container
- Connecting to RAC Database

3.30 Solution 14: Oracle RAC with Docker

The following steps are performed in this exercise:

- Create the Docker network.
- Create a RAC storage server Docker container.
- Create a NFS volume
- Creating the Docker GI and RAC Container
- Assign networks to RAC containers
- Adding a RAC Node using a Docker container
- Connecting to RAC Database

3.30.1 Detailed Solution

Setup Oracle RAC on docker is well documented in the Oracle Git repository [oracle/docker-images](#) respectively in [README.md](#).

[-OracleConnectionManager/README.md](#) [-OracleRACStorageServer/README.md](#) [-OracleRealApplicationC](#)

3.31 Exercise 15: Container Monitoring

3.31.1 Exercise Goals

Test the different Monitoring solutions for Oracle databases on Docker.

3.31.2 Tasks

- configure and review HEALTHCHECK
- Setup and configure Prometheus
- Setup and configure Grafana.

3.32 Solution 15: Container Monitoring

The following steps are performed in this exercise:

- configure and review HEALTHCHECK
- Setup and configure Prometheus
- Setup and configure Grafana.

3.32.1 Docker HEALTHCHECK

During the `docker build` a HEALTHCHECK script has been specified. This script is execute on a regular basis. The result is visible vi `docker ps`

```
docker ps
```

Alternatively it is also possible to see the resource used by the container

```
docker stats eusoud
```

3.32.2 Prometheus

Prometheus will not be set up as part of the DOAG Training Day. See [getting started](#)

3.32.3 Grafana

Grafana will not be set up as part of the DOAG Training Day. See [getting started](#)

3.33 Additional Exercises

A couple of ideas for additional exercises:

- Oracle Data Guard
- Oracle Database Backup and Recovery
- Oracle APEX test DB

4 Appendix A Setup OCI Environment

4.1 Requirements and Preparations

The following appendix contains a step-by-step guide on how to set up the Workshop VM in the Oracle Cloud. The different steps are performed via command line and scripts. Alternatively the OCI configurations can be done via OCI Web Console. For the sake of simplicity, we will limit this guide to the OCI command line utility.

The following prerequisites must be fulfilled:

- Oracle Cloud Infrastructure subscription and access to the OCI console see [Oracle Cloud Infrastructure Documentation](#)
- Corresponding subscription level to create different resources in OCI (Cloud Credits, up to date billing, etc.) The [Oracle Cloud Free Tier](#) does work for basic configuration. But the free OCI compute does not have enough resources to run Oracle Database Docker containers.
- Appropriate Compartment to create the different OCI resources.
- Local installation of the OCI command line tool see [OCI Command Line Interface \(CLI\)](#)

For the workshop O-DB-DOCKER we use a separate compartment, which is also named O-DB-DOCKER. If you follow this guide, you either have to create a compartment with an identical name or adapt the commands accordingly. The creation of a compartment is not discussed here in detail. The workshop itself is setup in Oracle Cloud region Germany Central (Frankfurt) identified as *eu-frankfurt-1*.

Disclaimer: This guide has been created with utmost care, but does not claim to be complete. It was compiled as part of the preparation for the O-DB-DOCKER workshop. The author assumes no responsibility for the accuracy, completeness and timeliness of the content. The use of the available content is at your own risk.

4.1.1 Install OCI CLI

The installation of the OCI CLI has to be done according to the [OCI documentation](#). Under MacOS and Linux this is fairly straightforward.

- Download and install OCI. You will have to specify an installation location, update PATH etc.

```
bash -c "$(curl -L https://raw.githubusercontent.com/oracle/oci-cli/master/scripts/install/install.sh)"
```

- Configure oci using the following command. You will be asked for your tenancy OCID, user OCID as well region and configure a SSH key.

```
oci setup config
```

4.2 Create a Compartment

Create a compartment for O-DB-DOCKER withing the compartment `Compartment_trivadislabs`.

- Get the parent compartment id. For O-DB-DOCKER we search for a parent compartment containing `trivadislabs`.

```
PARENT_COMP_ID=$(oci search resource free-text-search \
--text "trivadislabs" \
--raw-output \
--query "data.items[*].identifier|[0]")
```

- Create the new compartment for O-DB-DOCKER.

```
oci iam compartment create \
--compartment-id $PARENT_COMP_ID \
--description "DOAG 2019 Training Day Oracle DB in Docker
containers" \
--name "O-DB-DOCKER"
```

Create a Virtual Cloud Network (VCN) within the new compartment O-DB-DOCKER.

- Get the compartment id as variable `COMPARTMENT_OCID`.

```
COMPARTMENT_OCID=$(oci iam compartment list \
--compartment-id-in-subtree true --all \
--raw-output --query "data [?name == 'O-DB-DOCKER'].id|[0]")
```

- create a VCN `vcn-o-db-docker`

```
oci network vcn create \
--compartment-id $COMPARTMENT_OCID \
--cidr-block "10.0.0.0/16" \
--display-name "vcn-o-db-docker" \
--dns-label "vcnodbdocker"
```

4.3 Compute Instance

In the following section we will reference to some names eg. host name, compartment name etc. To simplify the upcoming commands we define a couple of environment variables.

```
export HOST_NAME="ol7docker00"
export COMPARTMENT_NAME="O-DB-DOCKER"
```

4.3.1 Create Compute Instance

To create a compute instance we first have to get a few OCID's for different components.

- Get the compartment id as variable `COMPARTMENT_OCID`.

```
COMPARTMENT_OCID=$(oci iam compartment list \
--compartment-id-in-subtree true --all \
--raw-output --query "data [?name == '${COMPARTMENT_NAME}'].id
|[0]")
```

- Get the ocid of the Oracle Linux image as variable `IMAGE_OCID`.

```
IMAGE_OCID=$(oci compute image list --compartment-id
$COMPARTMENT_OCID \
--operating-system-version "7.7" \
--operating-system "Oracle Linux" \
--sort-by TIMECREATED \
--raw-output --query "data [*].id|[0]")
```

- Get the ocid of the virtual cloud network (VCN) `vcn-o-db-docker` as variable `VCN_OCID`.

```
VCN_OCID=$(oci network vcn list --compartment-id
$COMPARTMENT_OCID \
--raw-output \
--query "data [?contains(\"display-name\", 'o-db-docker')].id|[0]
")
```

- Get the ocid of the subnet as variable `SUBNET_OCID`.

```
SUBNET_OCID=$(oci network subnet list \
--compartment-id $COMPARTMENT_OCID \
--vcn-id $VCN_OCID \
--sort-by DISPLAYNAME --raw-output \
--query "data [*].id|[0]")
```

- Get the availability domain of the subnet as variable `AV_DOAMIN`.

```
AV_DOAMIN=$(oci network subnet list \
--compartment-id $COMPARTMENT_OCID \
--vcn-id $VCN_OCID \
--sort-by DISPLAYNAME --raw-output \
--query "data [*].\"availability-domain\"|[0]")
```

- Create a SSH key pair for the compute instance

```
cd o-db-docker/lab/oci/
ssh-keygen -b 4096 -C "DOAG 2019 Training" -f id_rsa_doag2019
```

Finally lets create the OCI compute instance using the following specification:

- `ol7docker01`

- VM.Standard2.2
- COMPARTMENT_OCID
- AV_DOAMIN
- IMAGE_OCID
- SUBNET_OCID
- SSH public key from file
- check the variables

```
echo "COMPARTMENT_OCID = $COMPARTMENT_OCID" && \
echo "HOST_NAME        = $HOST_NAME" && \
echo "AV_DOAMIN         = $AV_DOAMIN" && \
echo "IMAGE_OCID        = $IMAGE_OCID" && \
echo "SUBNET_OCID       = $SUBNET_OCID" && \
echo "SSH Key           = $(cat id_rsa_doag2019.pub)"
```

- create the compute instance

```
oci compute instance launch --compartment-id $COMPARTMENT_OCID \
--availability-domain $AV_DOAMIN \
--display-name $HOST_NAME \
--image-id $IMAGE_OCID \
--subnet-id $SUBNET_OCID \
--shape VM.Standard2.2 \
--assign-public-ip true \
--metadata "{\"ssh_authorized_keys\": \"$(cat id_rsa_doag2019.
pub)\"}"
```

- check the provisioning status

```
oci compute instance list --compartment-id $COMPARTMENT_OCID \
--output table \
--query "data [?contains(\"display-name\",$HOST_NAME)].{\"
display-name\":\"display-name\", id:id,\"lifecycle-state\":\"
lifecycle-state\"}"
```

```
oci compute instance list --compartment-id $COMPARTMENT_OCID \
--output table \
--query "data [?contains(\"display-name\",'$HOST_NAME')].{\"
display-name\":\"display-name\", \"lifecycle-state\":\"
lifecycle-state\"}"
```

display-name	lifecycle-state
ol7docker00	TERMINATED
ol7docker00	RUNNING

- get the compute instance ID as variable *INSTANCE_OCID*.

```
INSTANCE_OCID=$(oci compute instance list \
--compartment-id $COMPARTMENT_OCID \
--lifecycle-state 'RUNNING' \
--raw-output --query "data [?contains(\"display-name\",'
$HOST_NAME')].id|[0]")
```

4.3.2 Create Block Storage

Create a new block volume to use with the compute instance `o-db-docker`. We use the variable `COMPARTMENT_OCID` and `AV_DOAMIN` from the previous section. First let's check the variables.

```
echo "COMPARTMENT_OCID = $COMPARTMENT_OCID" && \
echo "AV_DOAMIN = $AV_DOAMIN"
```

Create the block volume in the compartment `O-DB-DOCKER`.

```
oci bv volume create --compartment-id $COMPARTMENT_OCID \
--availability-domain $AV_DOAMIN \
--display-name "o-db-docker_bv00" \
--size-in-gbs 512
```

Get the block volume OCID as variable `VOLUME_OCID`.

```
VOLUME_OCID=$(oci bv volume list \
--compartment-id $COMPARTMENT_OCID \
--raw-output --query "data [?contains(\"display-name\",'o-db-
docker_bv00')].id|[0]")
```

Assign block volume to compute instance `ol7docker00`.

```
oci compute volume-attachment attach \
--instance-id $INSTANCE_OCID \
--type "iscsi" \
--volume-id $VOLUME_OCID \
--device "/dev/oracleoci/oracleldb"
```

Get the volume IP and volume IQN for the `iscsiadm` utility later on.

```
VOLUME_ATTACH_ID=$(oci compute volume-attachment list \
--compartment-id $COMPARTMENT_OCID --raw-output \
--query "data [?\\"volume-id\\" == '$VOLUME_OCID'].id|[0]")
VOLUME_IP=$(oci compute volume-attachment get \
--volume-attachment-id $VOLUME_ATTACH_ID \
--raw-output --query "data.ipv4")
VOLUME_IQN=$(oci compute volume-attachment get \
--volume-attachment-id $VOLUME_ATTACH_ID \
--raw-output --query "data.iqn")
```

Log into the compute instance `ol7docker00` and attach the iscsi device

```
ssh opc@ol7docker00.trivadislabs.com -C "sudo iscsiadm -m node -
o new -T $VOLUME_IQN -p $VOLUME_IP:3260"
ssh opc@ol7docker00.trivadislabs.com -C "sudo iscsiadm -m node -
o update -T $VOLUME_IQN -n node.startup -v automatic"
ssh opc@ol7docker00.trivadislabs.com -C "sudo iscsiadm -m node -
T $VOLUME_IQN -p $VOLUME_IP:3260 -l"
```

4.3.3 DNS Configuration

Optionally we add the IP of the compute instance to the DNS Zone `trivadislabs.com`.

- Get DNS OCID as variable `DNS_OCID`.

```
DNS_OCID=$(oci dns record zone get \
--zone-name-or-id "trivadislabs.com" \
--query "etag" --raw-output | sed 's/.*\ (ocid.*\ ) #.*\/\1/' )
```

- Get IP address of compute instance as variable `IP_ADDRESS`.

```
IP_ADDRESS=$(oci compute instance list-vnics \
--instance-id $INSTANCE_OCID --raw-output \
--query "data[.].\"public-ip\"|[0]" )
```

- Add DNS record `u`

```
oci dns record domain update \
--domain "$HOST_NAME.trivadislabs.com" \
--zone-name-or-id "trivadislabs.com" \
--force \
--items "[{\"domain\": '$HOST_NAME.trivadislabs.com', \"
isProtected\": true, \"rdata\": \"$IP_ADDRESS\", \"recordHash\"
: null, \"rrsetVersion\": \"4\", \"rtype\": \"A\", \"ttl\": 30}]"
```

- remove DNS record

```
oci dns record domain delete \
--zone-name-or-id "trivadislabs.com" \
--domain "$HOST_NAME.trivadislabs.com" --force
```

4.4 Setup OS

This section is not released for production use. Use this just as reference. Do not run the commands 1:1 on your environment.

4.4.1 Configure the Disk and Volume

- Partition disk using `sfdisk`.


```
sfdisk /dev/sdb <<EOF
0,25000
,,8e
EOF
```

- List block devices.

```
[root@ol7docker00 ~]# lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
sdb          8:16   0    512G  0 disk ┌─
sdb2         8:18   0 320.5G  0 part └─
sdb1         8:17   0 191.5G  0 part
sda          8:0    0   46.6G  0 disk ┌─
sda2         8:2    0     8G  0 part [SWAP] └─
sda3         8:3    0   38.4G  0 part /└─
sda1         8:1    0   200M  0 part /boot/efi
[root@ol7docker00 ~]# fdisk -l /dev/sdb

Disk /dev/sdb: 549.8 GB, 549755813888 bytes, 1073741824 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 4096 bytes
I/O size (minimum/optimal): 4096 bytes / 1048576 bytes
Disk label type: dos
Disk identifier: 0x00000000

   Device Boot      Start         End      Blocks   Id  System
/dev/sdb1              1    401624999    200812499+   83   Linux
Partition 1 does not start on physical sector boundary.
/dev/sdb2    401625000    1073736404    336055702+   8e   Linux
    LVM
```

- Create a physical volume on /dev/sdb2 using pvcreate.

```
[root@ol7docker00 ~]$ pvcreate /dev/sdb2
Physical volume "/dev/sdb2" successfully created.

[root@ol7docker00 ~]$ pvs
PV          VG Fmt  Attr PSize   PFree
/dev/sdb2   lvm2 ---  <320.49g <320.49g

[root@ol7docker00 ~]$ pvdisplay /dev/sdb2
"/dev/sdb2" is a new physical volume of "<320.49 GiB"
--- NEW Physical volume ---
PV Name                /dev/sdb2
VG Name
PV Size                 <320.49 GiB
Allocatable             NO
PE Size                 0
Total PE                0
Free PE                 0
Allocated PE            0
PV UUID                ONMpyt-j3RW-D4EQ-xpum-l3tR-fL7H-jgAseL
```

- Create volume group **vgora** using **vgcreate**

```
[root@ol7docker00 ~]$ vgcreate vgora /dev/sdb2
Volume group "vgora" successfully created

[root@ol7docker00 ~]$ vgdisplay vgora
--- Volume group ---
VG Name                vgora
System ID
Format                 lvm2
Metadata Areas         1
Metadata Sequence No   1
VG Access               read/write
VG Status               resizable
MAX LV                 0
Cur LV                0
Open LV                0
Max PV                 0
Cur PV                1
Act PV                 1
VG Size                320.48 GiB
PE Size                4.00 MiB
Total PE               82044
Alloc PE / Size        0 / 0
Free PE / Size         82044 / 320.48 GiB
VG UUID                qDKwXo-M8ad-L0eL-SLld-Mbd9-v83g-b0A6e3
```

- Create a logical volume.

```
[root@ol7docker00 ~]$ lvcreate -n vol_u00 -L 100G vgora
Logical volume "vol_u00" created.
[root@ol7docker00 ~]$ lvcreate -n vol_u01 -L 100G vgora
Logical volume "vol_u01" created.

[root@ol7docker00 ~]$ lvdisplay
--- Logical volume ---
LV Path                /dev/vgora/vol_u00
LV Name                vol_u00
VG Name                vgora
LV UUID                BJ3T5W-xzgy-jpwr-u1vS-Jl3y-tHKJ-bAnXED
LV Write Access        read/write
LV Creation host, time ol7docker00, 2019-10-23 15:14:52 +0000
LV Status               available
# open                 0
LV Size                100.00 GiB
Current LE              25600
Segments               1
Allocation              inherit
Read ahead sectors     auto
- currently set to    256
Block device           252:0

--- Logical volume ---
LV Path                /dev/vgora/vol_u01
LV Name                vol_u01
```

```

VG Name          vgora
LV UUID          c2zepi-PnVA-6Cs1-EQgB-yJmz-Wtm5-Q6eL4b
LV Write Access  read/write
LV Creation host, time ol7docker00, 2019-10-23 15:15:06 +0000
LV Status        available
# open           0
LV Size          100.00 GiB
Current LE       25600
Segments        1
Allocation       inherit
Read ahead sectors auto
- currently set to 256
Block device     252:1

```

- Create the filesystem on the new volume.

```

[root@ol7docker00 ~]# mkfs.ext4 /dev/vgora/vol_u00
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Blocksize=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=256 blocks
6553600 inodes, 26214400 blocks
1310720 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2174746624
800 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912, 819200, 884736,
    1605632, 2654208,
    4096000, 7962624, 11239424, 20480000, 23887872

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done

[root@ol7docker00 ~]# mkfs.ext4 /dev/vgora/vol_u01
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=256 blocks
6553600 inodes, 26214400 blocks
1310720 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2174746624
800 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:

```

```
32768, 98304, 163840, 229376, 294912, 819200, 884736,
1605632, 2654208,
4096000, 7962624, 11239424, 20480000, 23887872
```

```
Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

- Get the block device information.

```
[root@ol7docker00 ~]# blkid /dev/vgora/vol_u00 /dev/vgora/
vol_u01
/dev/vgora/vol_u00: UUID="2d8a938f-5960-4664-9091-eb9bd6132f91"
TYPE="ext4"
/dev/vgora/vol_u01: UUID="2c74d466-221e-49d0-a644-8e1e299cabf4"
TYPE="ext4"
```

- Create mount points

```
mkdir -p /u00 /u01
```

- update fstab and mount the filesystem.

```
echo "$(blkid /dev/vgora/vol_u00|cut -d' ' -f2|tr -d '"'"') /u00
ext4 defaults,noatime,_netdev 0 0" >>/etc/fstab
echo "$(blkid /dev/vgora/vol_u01|cut -d' ' -f2|tr -d '"'"') /u01
ext4 defaults,noatime,_netdev 0 0" >>/etc/fstab

mount /u00
mount /u01
```

4.4.2 Setup ORAbase_init Scripts

Define the variable to download the oradba_init scripts.

```
DOWNLOAD="/tmp/download"
SETUP_INIT="00_setup_oradba_init.sh"
GITHUB_URL="https://github.com/oehrlis/oradba_init/raw/master/
bin"
```

Download the oradba_init script

```
mkdir -p ${DOWNLOAD}
curl -Lsf ${GITHUB_URL}/${SETUP_INIT} -o ${DOWNLOAD}/${SETUP_INIT}
```

Setup the OraDBA init environment.

```
chmod 755 ${DOWNLOAD}/${SETUP_INIT}
${DOWNLOAD}/${SETUP_INIT}
```

Setup the OUDBase environment

```
sudo -u oracle /opt/oradba/bin/20_setup_oudbase.sh

echo "oud_eng:1389:1636:4444:8989:OUD:Y" >>${ETC_BASE}/oudtab
. oudenv.sh

sed -i 's|\. ${OUD_BASE}/bin/oudenv.sh|\. ${OUD_BASE}/bin/oudenv
.sh SILENT|' $HOME/.bash_profile
```

4.4.3 Update User / Group information

Configure the opc user

```
sudo usermod -a -G oinstall opc
```

Adjust a few directory settings:

```
chmod 775 /u00/app/
chmod 775 /u00/app/oracle/
chmod 775 /u00/app/oracle/software/
```

4.4.4 Setup OS Oracle DB

Setup the OS using the oradba_init script.

```
nohup /opt/oradba/bin/01_setup_os_db.sh > /tmp/01_setup_os_db.sh
2>&1 &
```

Install Docker

```
nohup /opt/oradba/bin/01_setup_os_docker.sh > /tmp/01
_setup_os_docker.log 2>&1 &
```

Install git

```
yum install git
```

Configure docker volumen on sdb1.

```
systemctl stop docker
rm -rf /var/lib/docker
docker-storage-config -s btrfs -d /dev/sdb1
systemctl start docker
systemctl enable docker
```

Clone the git repositories.

```
cd /u00/app/oracle/local
git clone https://github.com/oehrlis/docker.git docker
git clone https://github.com/oehrlis/o-db-docker.git o-db-docker
```

```
git clone https://github.com/oracle/docker-images.git docker-images
```

4.4.5 Build Software Depot

Generate download url file from the *.download files which are part of the [oradba/docker](#) repository.

- change to the oci working directory and remove the old download url files.

```
cd $cdl/o-db-docker/lab/oci
rm download*.url
```

- build a new download url file

```
find $cdl/docker -name *.download \
-exec grep -i "Direct Download" {} \; | \
sed "s/# Direct Download : //" | \
grep -iv '^#' | grep -iv 'n/a' | sort -u >> download.url
```

- Separate OTN from MOS downloads

```
grep -i "download.oracle.com" download.url >download_otn.url
grep -iv "download.oracle.com" download.url >download_mos.url
```

Start to download the patch from MOS using `curl`.

- Temporary create a `.netrc` file with MOS credentials. Replace `MOS_USER` and `MOS_PASSWORD` with corresponding values.

```
cd $cdl/o-db-docker/lab/oci
echo 'machine login.oracle.com login MOS_USER password
MOS_PASSWORD' >.netrc
```

- Download the files from MOS using `download_mos.url`.

```
cd $cdl/o-db-docker/lab/oci
sw="/u00/app/oracle/software"
for url in $(cat download_mos.url); do
  file=$(echo $url | cut -d= -f3)
  log=$(basename $file .zip).log
  echo "Initiate download job for file : $file"
  nohup curl --netrc-file .netrc --cookie-jar cookie-jar.txt \
    --location-trusted "${url}" -o ${sw}/${file} > ${sw}/${log}
  2>&1 &
done
```

- Wait until all curl background jobs are done:

```
ps -ef|grep curl
ps -ef|grep curl|wc -l
```

4.4.6 Other Task to Configure Environment

Tasks to configure the environment:

- Disk partition
- Docker Volume
- Docker images
- Clone the Git repositories
- Download Oracle Binaries

4.5 Create Custom Image

Stop the compute instance

- define my variables

```
export HOST_NAME="ol7docker00"
export COMPARTMENT_NAME="O-DB-DOCKER"
```

- Get the compartment id as variable *COMPARTMENT_OCID*.

```
COMPARTMENT_OCID=$(oci iam compartment list \
--compartment-id-in-subtree true --all \
--raw-output --query "data [?name == '${COMPARTMENT_NAME}'].id
| [0]")
```

- get the compute instance ID as variable *INSTANCE_OCID*.

```
INSTANCE_OCID=$(oci compute instance list \
--compartment-id $COMPARTMENT_OCID \
--lifecycle-state 'RUNNING' \
--raw-output --query "data [?contains(\"display-name\",'${
HOST_NAME}')].id|[0]")
```

- stopping compute instance

```
oci compute instance action \
--action SOFTSTOP \
--instance-id ${INSTANCE_OCID}
```

- check if stoppend

```
oci compute instance list --compartment-id $COMPARTMENT_OCID \
--output table \
--query "data [?contains(\"display-name\",'${HOST_NAME}')].{\"
  display-name\": \"display-name\", \"lifecycle-state\": \"
  lifecycle-state\"}"
```

- Create a custom image

```
oci compute image create \
--compartment-id $COMPARTMENT_OCID \
--display-name "${COMPARTMENT_NAME}_master" \
--instance-id ${INSTANCE_OCID}
```

Disclaimer: This guide has been created with utmost care, but does not claim to be complete. It was compiled as part of the preparation for the O-DB-DOCKER workshop. The author assumes no responsibility for the accuracy, completeness and timeliness of the content. The use of the available content is at your own risk. # Appendix B Setup Vagrant Environment

4.6 Requirements and Preparations

The following appendix contains a step-by-step guide on how to set up the workshop environment with local Virtualbox installation. The different steps are performed via command line and scripts.

The following prerequisites must be fulfilled:

- Oracle Virtual Box <https://www.virtualbox.org/>
- Oracle Vagrant Box <https://yum.oracle.com/boxes>
- Vagrant <https://www.vagrantup.com/>
- optional local git client.
- And binaries required to build the Docker images e.g. Oracle database software

The following figure shows the schematic layout of the Docker environment based on Vagrant / Virtualbox. The provided vagrant environment does only have a minimal disk setup. It may be necessary to add an additional hard disk or extend the existing one.

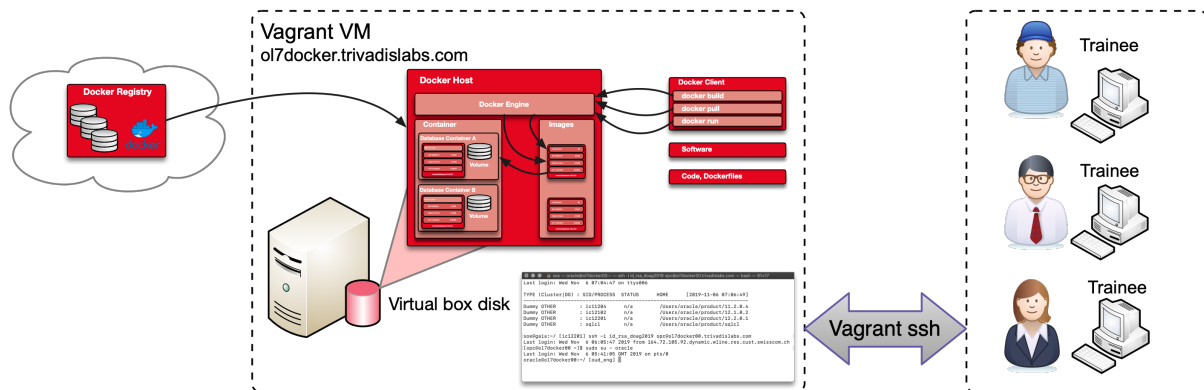


Figure 4: Vagrant VM Workshop Architecture

4.7 Setup Using Vagrant

The installation and configuration of the VM is fairly straightforward using vagrant.

- Add the latest Oracle Linux 7 vagrant box

```
vagrant box add --name ol7-latest https://yum.oracle.com/boxes/oraclelinux/latest/ol7-latest.box
```

- Clone the O-DB-DOCKER git Repository to you local working or development directory

```
git clone https://github.com/oehrlis/o-db-docker.git o-db-docker
```

- Change to the LAB Vagrant folder.

```
cd o-db-docker/lab/ol7docker
```

- Install Vagrant Plugin's.

```
vagrant plugin install vagrant-reload
vagrant plugin install vagrant-vbguest
```

- Setup virtualbox using vagrant

```
vagrant up
```

- as soon as the VM provisioning is finished you can login.

```
vagrant ssh
```

- Within the VM you now can switch to user Oracle and run docker commands.

```
sudo su - oracle
docker images
```

The VM is now basically ready to work with Docker. The Git repositories for [O-DB-DOCKER](#) as well as [oracle/docker-images](#) and [oehrlis/docker](#) are available under /xx. Nevertheless there are a few things to consider.

- Oracle binaries and patches must be downloaded separately. Ideally, the software is made available via a shared folder in order not to occupy the disk space in the VM.
- Available disk space is at best too small for many Oracle Docker images. Either create bind mount's on a VM shared folder or increase disk space.
- The O-DB-DOCKER workshop does provide a couple of pre-build docker images, which are not available within a local VM. This is not an issue, since all images, volumes etc can be build. It just takes some time.

4.8 Manual Setup

The O-DB-DOCKER environment can also be installed manually on an existing Oracle VM. The following steps have to be performed.

- Update the OEL 7 OS using `yum upgrade`
- Install the latest `docker-engine` and `docker-compose` via `yum`.
- Configure a dedicated docker volume / disk
- Configure a user which is used for Docker Engineering.

4.8.1 Manual Setup Using the Vagrant Scripts

The scripts used to setup the Vagrant VM can be used to setup / configure an existing VM. So that not all paths have to be adapted, the scripts are simply copied to a directory /vagrant on the VM.

- Copy all vagrant files from VM host to the VM.

```
scp -r o-db-docker/lab/ol7docker VMNAME:/vagrant
```

- Manual run the vagrant provisioning script to setup the OS (update yum packages, install oracle packages and create an oracle user)

```
cd /vagrant
scripts/01_setup_os_db.sh
```

- Manual install oudbase environment

```
scripts/10_configure_oudbase.sh
```

- Clone git repositories using the script

```
scripts/11_clone_git_repos.sh
```

- install some base images

```
scripts/12_pull_base_images.sh
```

4.8.2 Manual Setup Using the oradba_init Scripts

The vagrant setup scripts are all based on the [oradba_init](#) scripts. VM can therefor also configured using these scripts.

- Install the OraDBA init scripts

```
mkdir -p /tmp/download

curl -Lsf https://raw.githubusercontent.com/oehrlis/oradba_init/master/bin/00_setup_oradba_init.sh \
-o /tmp/download/00_setup_oradba_init.sh

chmod 755 /tmp/download/00_setup_oradba_init.sh
/tmp/download/00_setup_oradba_init.sh
rm -rf /opt/oradba/oradba_init-master
```

- Run the OS install script. This script does install oracle preinstall packages and creates an oracle user

```
/opt/oradba/01_setup_os_db.sh
```

- Run the Docker install script. Just install `docker-engine` and `docker-compose`.

```
/opt/oradba/01_setup_os_docker.sh
```

- install git client

```
yum install git -y
```

- Install OUD base a simple Oracle environment similar to Trivadis BasEnv.

```
/opt/oradba/20_setup_oudbase.sh
```

- Clone the git repo either as user root, oracle or any other user you plan to use.

```
export ORACLE_BASE=${ORACLE_BASE:-/u00/app/oracle}
su -l oracle -c "cd ${ORACLE_BASE}/local;git clone https://github.com/oehrlis/o-db-docker.git"
su -l oracle -c "cd ${ORACLE_BASE}/local;git clone https://github.com/oehrlis/docker.git"
su -l oracle -c "cd ${ORACLE_BASE}/local;git clone https://github.com/oracle/docker-images.git"
```

- Pull a couple of docker base images.

```
docker pull busybox
docker pull alpine
docker pull oraclelinux:7-slim
```

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4.9 Requirements and Preparations

The following appendix contains a step-by-step guide on how to set up the workshop environment with local Docker installation. The different steps are performed via command line and scripts.

The following prerequisites must be fulfilled:

- Docker Community Edition <https://docs.docker.com/install>
- git to check out the different git repository. Either git commandline or git desktop.
- Software required to setup the Docker images eg. the Oracle binaries.

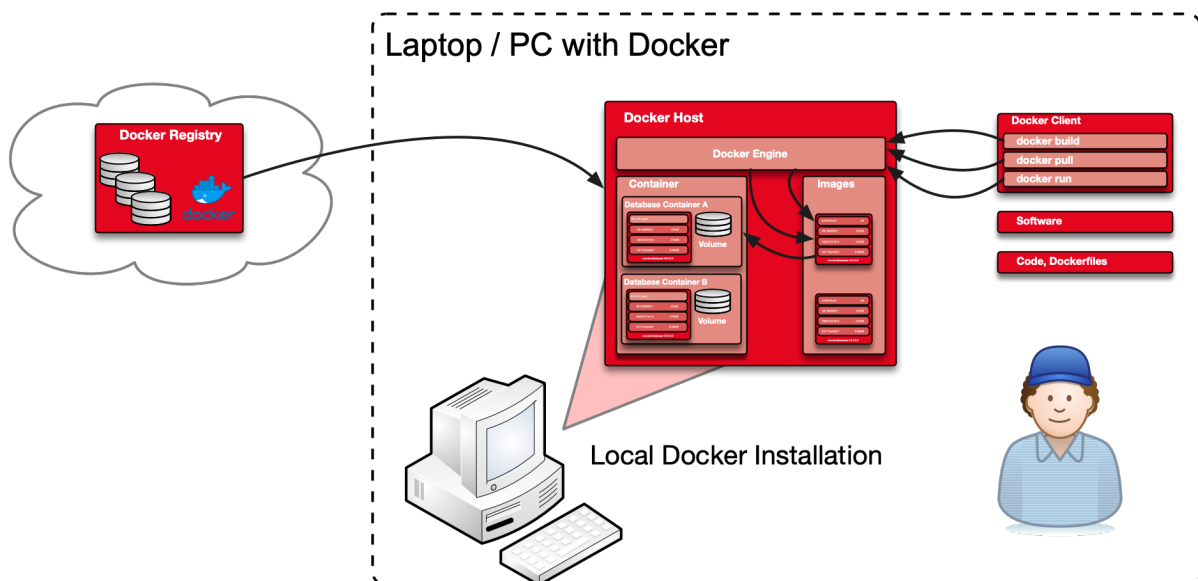


Figure 5: Local Docker Workshop Architecture

A local development folder as well software repository is not part of this picture.

4.10 Configure local Docker Environment

The configuration of a local Docker environment is rather simple. Depending on your OS you just have to install the Docker Community Edition for MacOS, Windows or Linux according

the official Docker documentation. As soon as you have Docker install you have to prepare the software.

- clone git repositories

```
cd /u00/app/oracle/local
git clone https://github.com/oehrlis/docker.git docker
git clone https://github.com/oehrlis/o-db-docker.git o-db-docker
git clone https://github.com/oracle/docker-images.git docker-
images
```

- create folder for you software

```
mkdir /u00/app/oracle/software
```

- download the different oracle binaries as required

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