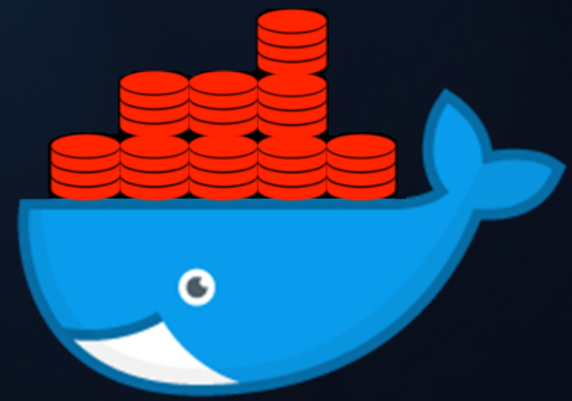
VISCOSITY

NORTH AMERICA

www.viscosityna.com

Running Oracle Upgrades …on Docker!



docker

ORACLE

VISCOSITY
NORTH AMERICA

www.viscosityna.com

Sean Scott

25 years working with Oracle technology

UTOUG Board ·:· RAC SIG Board

Oracle OpenWorld ·:· Collaborate/IOUG ·:· Regional UG

RAC/MAA ·:· DR/HA ·:· TFA/AHF ·:· Exadata/ODA

Automation ·:· DevOps ·:· Containers ·:· Virtualization

Ultramarathon Running ·:· Bouldering

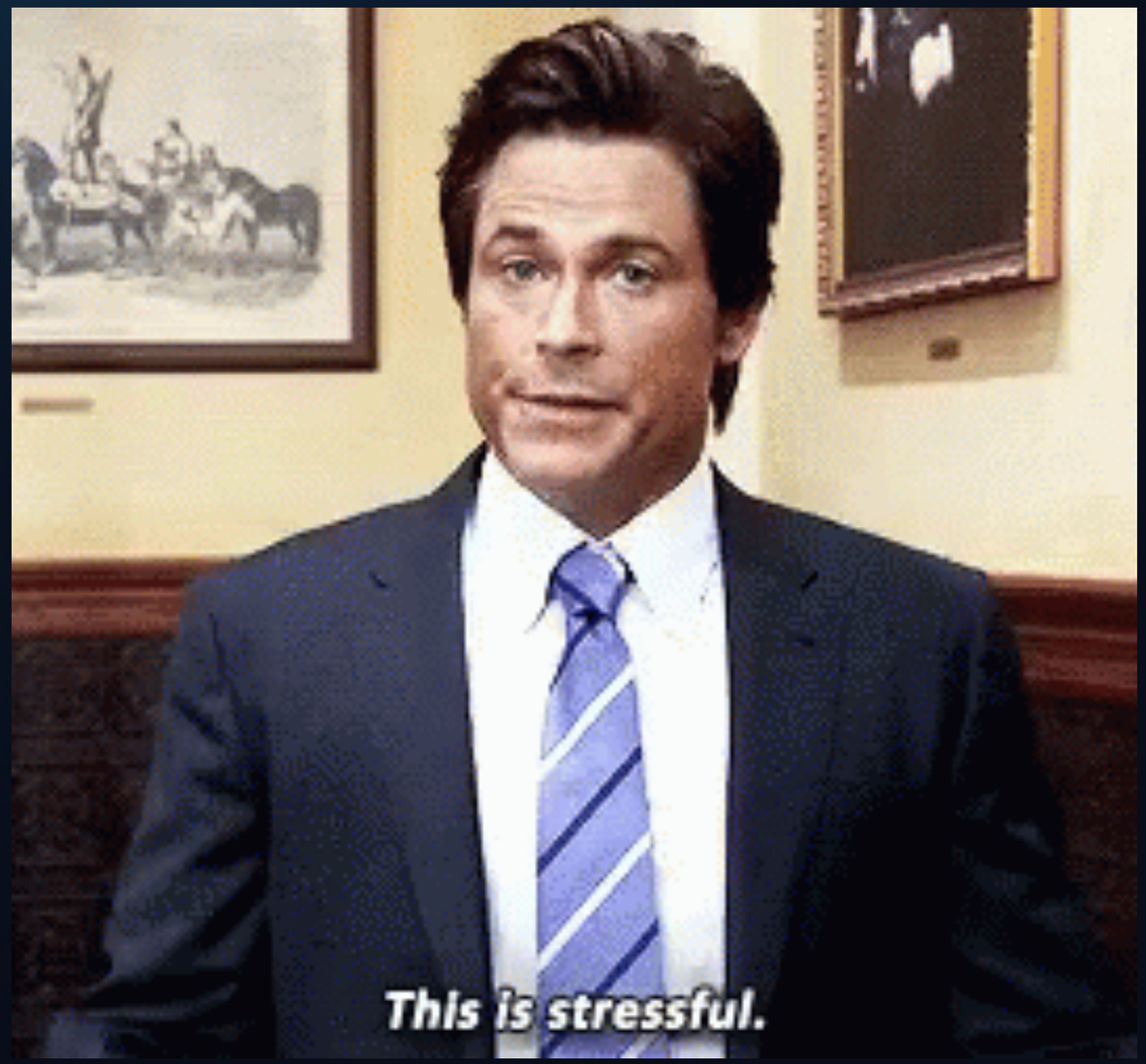
www.viscosityna.com

Database Upgrades: The World Cup for DBAs

www.viscosityna.com

World Cup/Olympics vs. Upgrades

- High stakes
- Infrequent
- Attention
- Scrutiny
- Pressure!



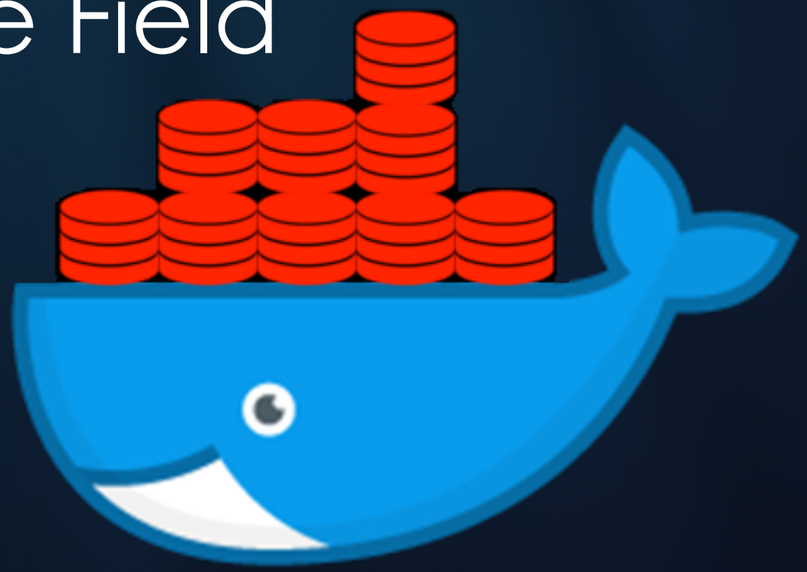
Everyone's suddenly an expert!

High expectations may eclipse exceptional performances

Train for Upgrades

Docker: The Practice Field

- Free
- Fast
- Easy



docker

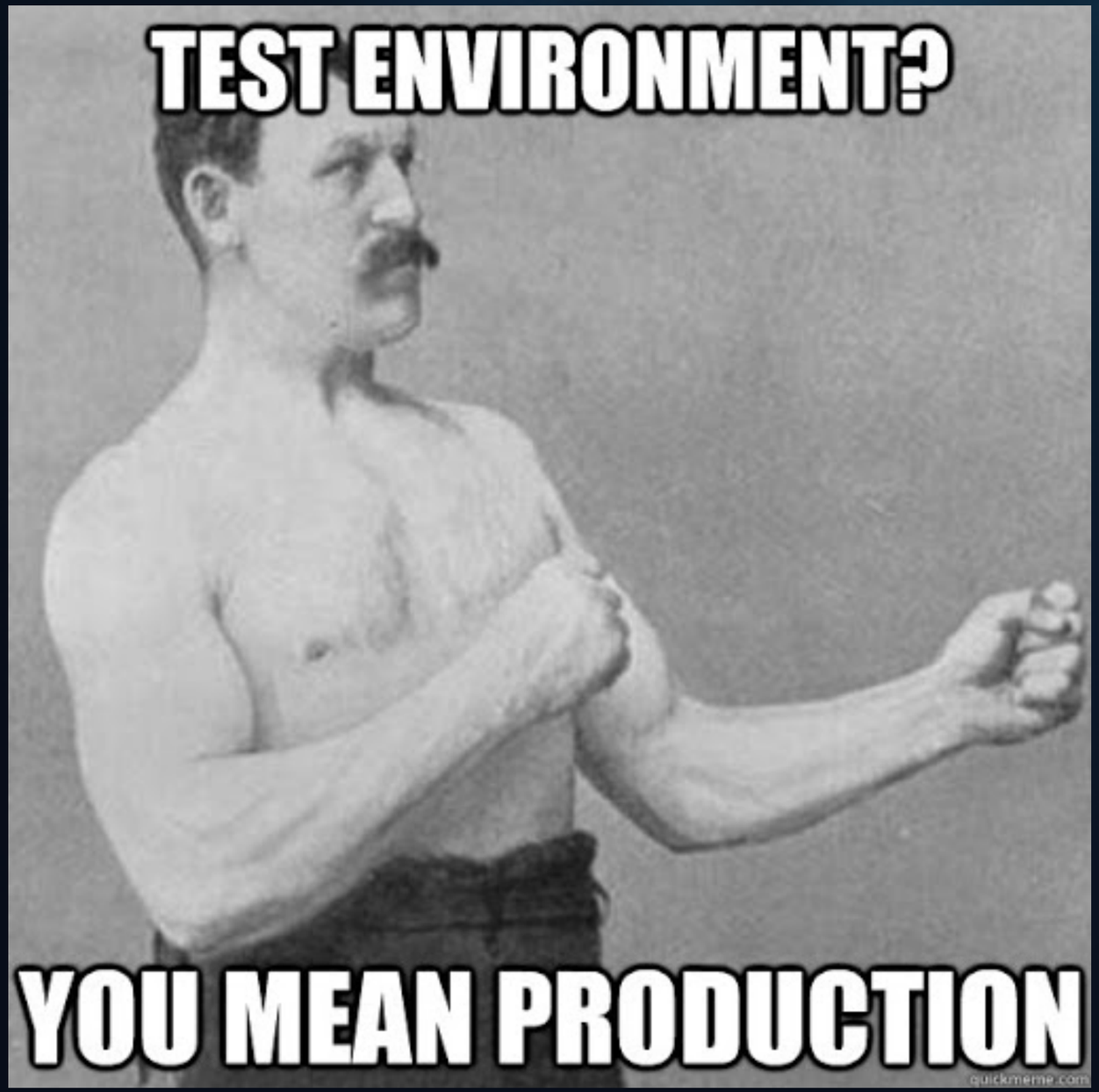
ORACLE

Docker: The Practice Field

- Portable
- Versionable
- Distributable

Docker: The Practice Field

- Configurable
- Reproducible
- Disposable
- Convenient



We Don't Test in Production or Deploy on Fridays (and Other Lies)

Internal Customers are Still Customers

- Dev is production for development
- Test is production for testing
- QA is production for QA

Pre-production environments support pre-production efforts that end up in… production.

If you can't take and break an environment for an unspecified, extended period, without consequences, it's not really test.

Bob thought the upgrade looked easy so he took it straight to dev.

Bob broke dev and developers couldn't work for a week.

Don't be like Bob. Work it out in Docker first.

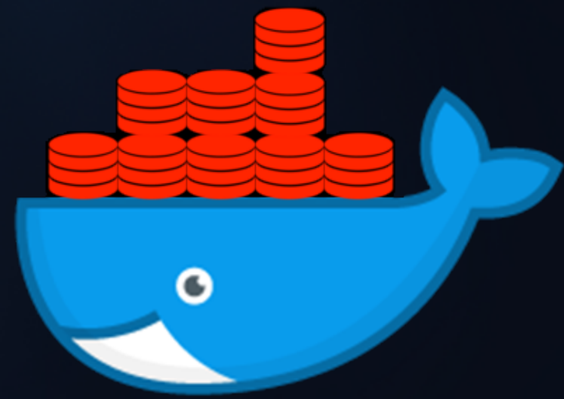
www.viscosityna.com

Wisdom from my Father:

Don’t buy cheap tools.

If you don’t have time to do it right,
you don’t have time to do it over.

Use the right tool for the job.



docker

ORACLE

Understanding Scope

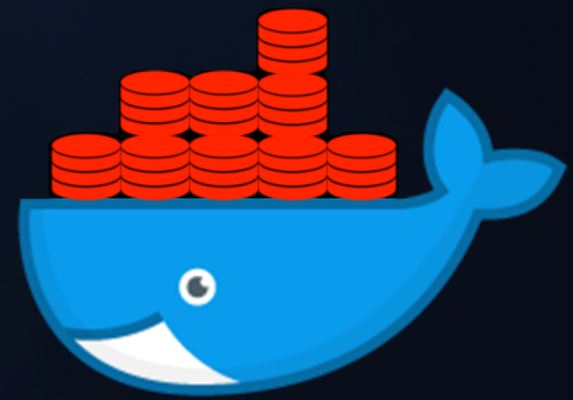
Process

- Determine methods
- Write procedures and documentation
- Build automation
- Adjust monitoring

Functional

- Preview features and behaviors
- Understand changes

Building skills



docker

ORACLE

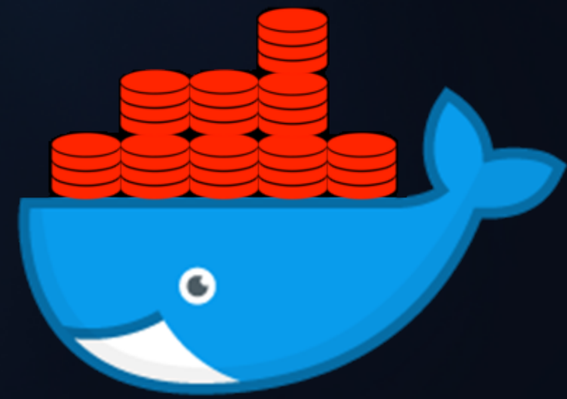
Understanding Scope

Environmental

- ASM Filter Driver, ASMLib
- OS configuration

Topology

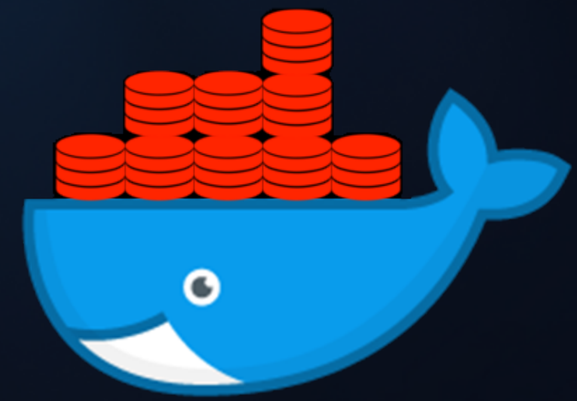
- Transparent Application Failover
- Cluster performance
- Infrastructure dependencies
- Replication



docker

ORACLE

Building the Images



docker

ORACLE

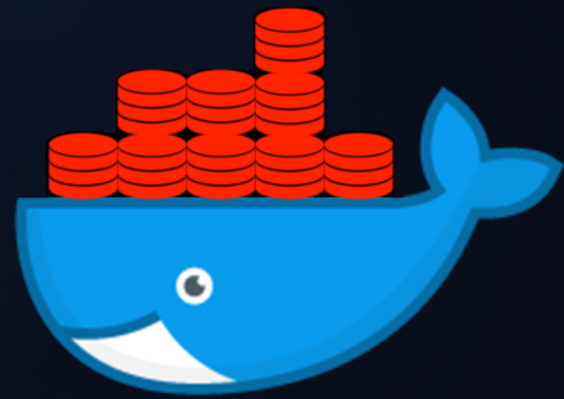
VISCOSITY

NORTH AMERICA

www.viscosityna.com

Source Database Image

- Modify the database installation script
  - Prevent component deletion
  - Add OPatch, patch installation
- Modify the Dockerfile
  - Add variables
  - Copy files
- Update Linux with the target preinstall RPM
  - Optionally add binaries
- Modify response files to non-CDB

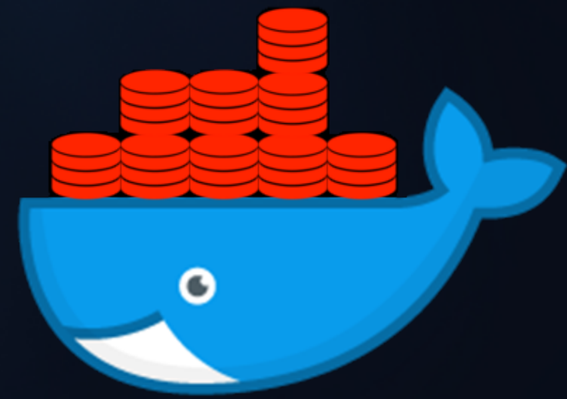


docker

ORACLE

Target Database Image

- Modify the database installation script
  - Prevent component deletion
  - Add OPatch, patch installation
- Modify the Dockerfile
  - Add variables
  - Add AutoUpgrade/DBUA (optional)
  - Copy files



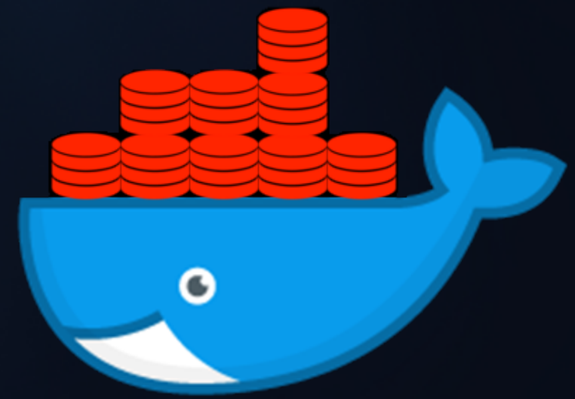
docker

ORACLE

Final “Upgrade” Image

Create a new `Dockerfile`

- `FROM` the source image
- `COPY` target ORACLE_HOME
- `RUN root` scripts (as `root`)
- `RUN attachHome.sh` (as `oracle`)
- Start the source database as normal



docker

ORACLE

For 18c + 19c targets, APEX must be removed or upgraded in the source database:

```
Upgrade Oracle Application Express (APEX) manually before the database upgrade.

The database contains APEX version 5.0.4.00.12. Upgrade APEX to at least
version 18.2.0.00.12.

Starting with Oracle Database Release 18, APEX is not upgraded automatically as
part of the database upgrade. Refer to My Oracle Support Note 1088970.1 for
information about APEX installation and upgrades.
```

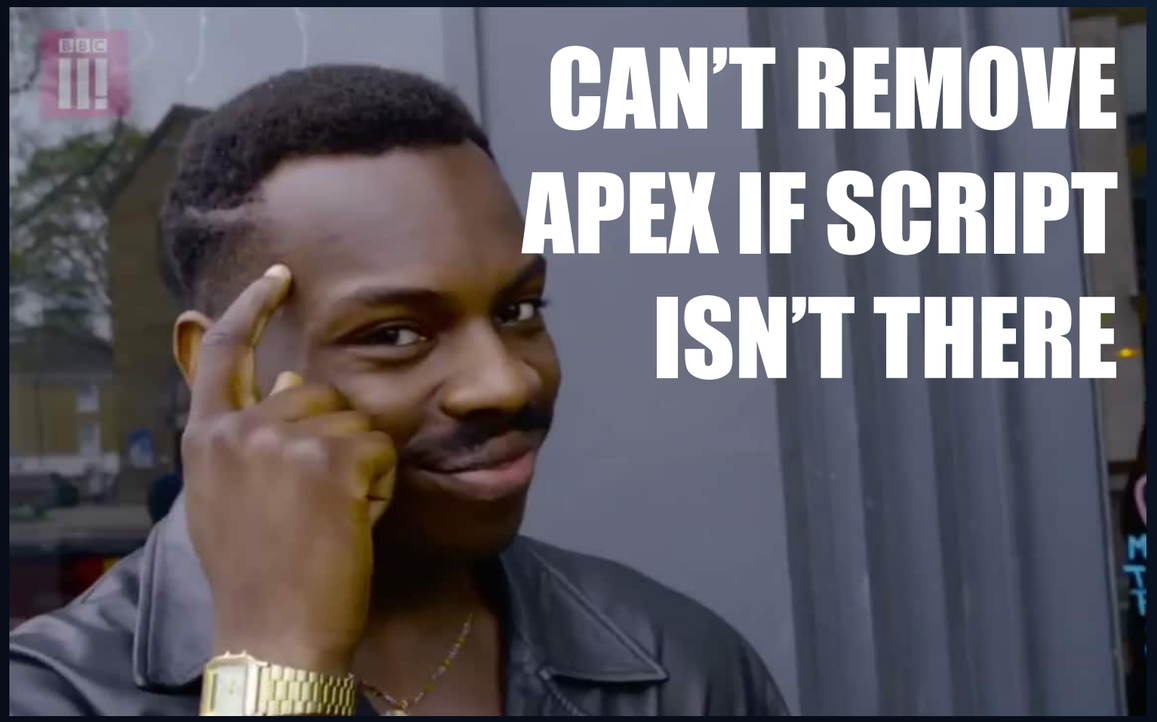
To remove APEX...

```
cd $ORACLE_HOME/apex
@apxremov_con.sql
```


Source and Target Images

`installDBBinaries.sh` *removes components* from ORACLE_HOME after DBCA runs.

Including APEX. :(



Remove this line

```
# Remove not needed components
# APEX
rm -rf $ORACLE_HOME/apex && \
# ORDS
rm -rf $ORACLE_HOME/ords && \
# SQL Developer
rm -rf $ORACLE_HOME/sqldeveloper && \
```

www.viscosityna.com

Source and Target Images

`installDBBinaries.sh`: Patch Oracle Home

Add commands to `installDBBinaries.sh`:

- Unzip the latest OPatch to $ORACLE_HOME
- Apply patches

```
unzip -oq -d $ORACLE_HOME $INSTALL_DIR/$OPATCH
unzip -oq -d $INSTALL_DIR $INSTALL_DIR/$DBRU
# Apply the RU
$ORACLE_HOME/OPatch/opatch apply -silent $INSTALL_DIR/$DBRU_ID
```

(Hard-coding optional)

Source and Target Images

Dockerfile: Add Patch Variables

In Dockerfile, add matching variables:

```
ARG DBRU=p31281355_190000_Linux-x86-64.zip
ARG DBRU_ID=31281355
ARG OPATCH=p6880880_190000_Linux-x86-64.zip
```

Add OPatch & patches to the COPY command:

```
COPY --chown=oracle:dba $DB_INSTALL_FILE $DBRU $OPATCH \
$INSTALL_DIR/
```

Add files to the appropriate version directory, e.g. 19.3.0/

Source and Target Images

`Dockerfile`: Add Upgrade Tools (Optional)

In the `Dockerfile`, copy and add additional files, e.g.:

- AutoUpgrade
- DBUA jar file

Copy files to ORACLE_BASE or ORACLE_HOME

Source Image Only

Which RPM?

```
grep preinstall */setupLinuxEnv.sh
12.1.0.2/setupLinuxEnv.sh:yum -y install oracle-rdbms-server-12cR1-preinstall
12.2.0.1/setupLinuxEnv.sh:yum -y install oracle-database-server-12cR2-preinstall
18.3.0/setupLinuxEnv.sh:yum -y install oracle-database-preinstall-18c
19.3.0/setupLinuxEnv.sh:yum -y install oracle-database-preinstall-19c
```

oracle-database-preinstall-19c

Wait. Why?

Source Image Only

While we're here… add Helpful Things

`file-5.11`: Prerequisite for 19c preinstall

Amend this list to suit your needs and tastes

```
file-5.11-36.el7.x86_64      strace
less                         vi
oracle-epel-release-el7      which
```

`rlwrap`: Adds bash-like functionality to CLI

```
sync
yum -y install rlwrap
```


Source Image Only

Do You PDB?

Official Oracle images on GitHub are PDB only!

Database creation performed by DBCA…

…using response files…

…created from templates in each version directory!

```
egrep -i "^createascontainer" */*.rsp.tmpl
12.1.0.2/dbca.rsp.tmpl:createAsContainerDatabase=true
12.2.0.1/dbca.rsp.tmpl:createAsContainerDatabase=true
18.3.0/dbca.rsp.tmpl:createAsContainerDatabase=true
19.3.0/dbca.rsp.tmpl:createAsContainerDatabase=true
```

For non CDB, change to `false`

Source Image, Target Optional

Build the Source, Target Images

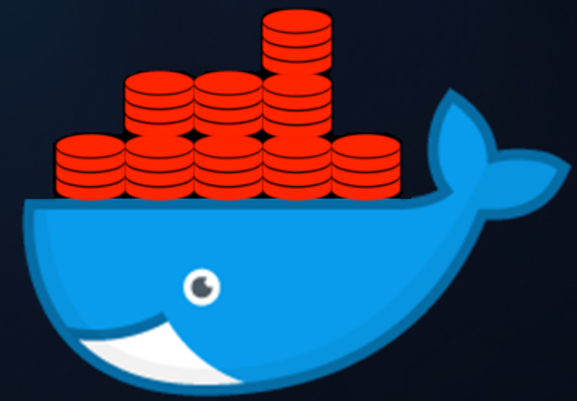
Run `.buildDockerImage.sh` as normal

Completed: Source, Target Images

```
> docker images
REPOSITORY              TAG                 IMAGE ID            CREATED             SIZE
oracle/database         11.2.0.4-ee         d2f10e8741d3        8 weeks ago         5.56GB
oracle/database         19.8.0-ee           3e7ca820fc55        2 months ago        9.53GB
oracle/database         12.1.0.2-ee         1f04faeab590        2 months ago        5.29GB
oracle/database         19.3.0-ee           df13428803ce        3 months ago        6.51GB
oraclelinux             7-slim              3f15c01b91bb        4 months ago        120MB
```

How do we upgrade this?

COPY Magic!



docker

ORACLE

VISCOSITY

NORTH AMERICA

www.viscosityna.com

Create an Upgrade Image `Dockerfile`

Start with the `source` image

Add a new `ENV` variable

`COPY` the target `ORACLE_HOME`

```
FROM oracle/database:12.1.0.2-ee
ENV ORACLE_19C_HOME=/opt/oracle/product/19c/dbhome_1

USER oracle
COPY --chown=oracle:dba --from=oracle/database:19.8.0-ee \
     $ORACLE_19C_HOME $ORACLE_19C_HOME
```

Upgrade Image `Dockerfile`

Run the `root` scripts, including the target `root` script

Attach the target `ORACLE_HOME`

```
USER root
RUN $ORACLE_BASE/oraInventory/orainstRoot.sh && \
    $ORACLE_HOME/root.sh && \
    $ORACLE_19C_HOME/root.sh

USER oracle
RUN $ORACLE_19C_HOME/oui/bin/attachHome.sh
```

Upgrade Image `Dockerfile`

Optionally add 8080 to `EXPOSE`

The remainder is identical to the original `Dockerfile`(s)

```
WORKDIR /home/oracle

VOLUME ["$ORACLE_BASE/oradata"]
EXPOSE 1521 5500 8080
HEALTHCHECK --interval=1m --start-period=5m \
   CMD "$ORACLE_BASE/$CHECK_DB_FILE" >/dev/null || exit 1

# Define default command to start Oracle Database.
CMD exec $ORACLE_BASE/$RUN_FILE
```

Build the Upgrade Image

Run `docker build` from the `Dockerfile` directory

```
docker build -t oracle/database:12c-19c-ee .
```

Use `-f` to identify a non-standard `Dockerfile`:

```
docker build -t oracle/database:12c-19c-ee \
    -f Dockerfile.Name .
```

Tip: Create the `Dockerfile` in a new directory or add a `.dockerignore` file to prevent lengthy context builds

Completed: Source, Target and Upgrade Images!

```
> docker images
REPOSITORY              TAG                 IMAGE ID            CREATED             SIZE
oracle/database         11.2.0.4-ee         d2f10e8741d3        8 weeks ago         5.56GB
oracle/database         12c-19c-ee          ea79f8b6081e        2 months ago        14.3GB
oracle/database         19.8.0-ee           3e7ca820fc55        2 months ago        9.53GB
oracle/database         12.1.0.2-ee         1f04faeab590        2 months ago        5.29GB
oracle/database         19.3.0-ee           df13428803ce        3 months ago        6.51GB
oraclelinux             7-slim              3f15c01b91bb        4 months ago        120MB
```

Question: Why not install binaries “normally”?

```
docker cp /localdir/target_install.zip SOURCE:/opt/oracle
```

Then:

```
unzip /opt/oracle/target_install.zip etc.
```

Seems easier (and obvious)

Docker uses *union filesystems* (read only)

Modifying files & directories:

- Creates new layers
- Increases container size

Is there an easier way?

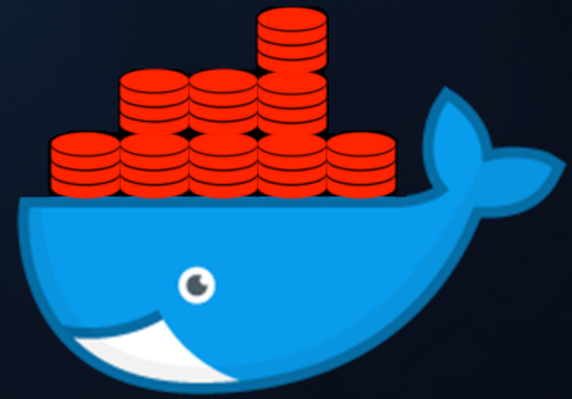
Yes:

https://github.com/oraclesean/oracle-docker

Oracle/Docker builds including:

- 11.2.0.4
- 19.6.0
- 19.7.0
- 19.8.0
- CDB, non-CDB
- Upgrades
- Multiple/custom PDBs
- Dynamic builds
- Separate BASE, HOME, Inventory, Oradata directories
- Data Guard
- Sharding

`docker run` an upgrade!



docker

ORACLE

VISCOSITY

NORTH AMERICA

www.viscosityna.com

Run the Container

```
CON_NAME=test

docker run -d \
       -v /data_dir/$CON_NAME:/opt/oracle/oradata \
       -e ORACLE_SID=VNA \
       -p 1921:1521 \
       -p 1980:8080 \
       --name $CON_NAME \
       oracle/database:12c-19c-ee

docker logs -f $CON_NAME
docker exec -it $CON_NAME bash
```

Use unique directories for oradata volumes

DON'T DO THIS!

```
docker run -d –name container1
       -v /data_dir:/opt/oracle/oradata imagename
docker run -d –name container2
       -v /data_dir:/opt/oracle/oradata imagename
```

The databases in these containers will share the same directory structure including control files and datafiles!

(That is a *Bad Thing*!)

Source Database Preparations

Set init parameters

Optionally start archivelog (required for AutoUpgrade):

```
alter system set ... scope=spfile;
shutdown immediate
startup mount
alter database archivelog;
shutdown immediate
startup
```

Environment Preparations

Set useful environment variables

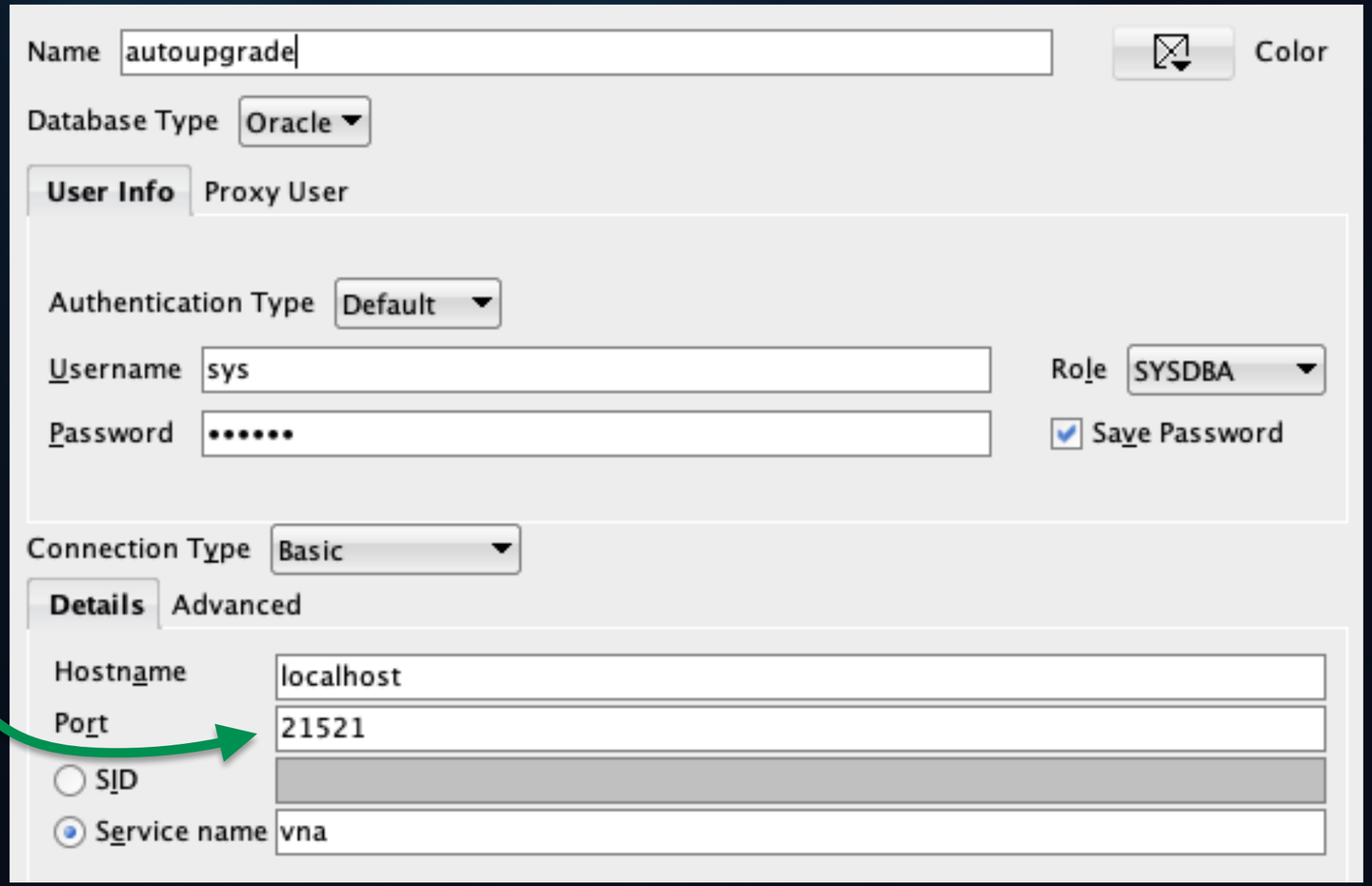
```
export NEW_HOME=$ORACLE_19C_HOME
export OLD_HOME=$ORACLE_HOME
```

Add `rlwrap` aliases to `.bash_profile`

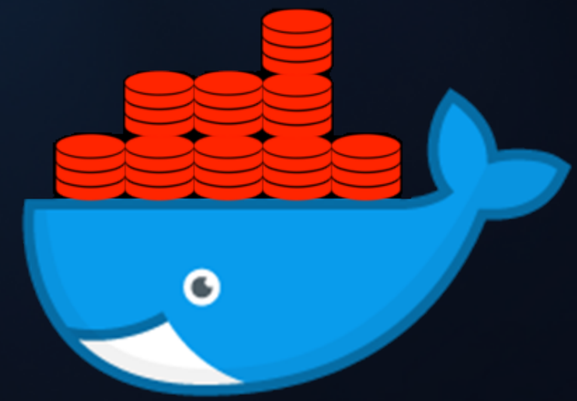
```
alias sqlplus="rlwrap $ORACLE_HOME/bin/sqlplus"
alias rman="rlwrap $ORACLE_HOME/bin/rman"
```

Connect to SQL Developer

Local port mapped to container port 1521 by `docker run`



Run AutoUpgrade



docker

ORACLE

VISCOSITY

NORTH AMERICA

www.viscosityna.com

Run AutoUpgrade

Create a configuration file

```
cat /opt/oracle/autoupgrade/config.txt
global.autoupg_log_dir=/opt/oracle/autoupgrade
vna1.source_home=/opt/oracle/product/12.1.0.2/dbhome_1
vna1.target_home=/opt/oracle/product/19c/dbhome_1
vna1.sid=VNA
vna1.start_time=now
vna1.log_dir=/opt/oracle/autoupgrade/VNA
vna1.upgrade_node=855dea5a845e              # <- Container name
vna1.target_version=19.8
```

Run AutoUpgrade

```
$NEW_HOME/jdk/bin/java -jar $NEW_HOME/rdbms/admin/autoupgrade.jar \
                       -config /opt/oracle/autoupgrade/config.txt \
                       -mode analyze

$NEW_HOME/jdk/bin/java -jar $NEW_HOME/rdbms/admin/autoupgrade.jar \
                       -config /opt/oracle/autoupgrade/config.txt \
                       -mode deploy
```

Monitor AutoUpgrade

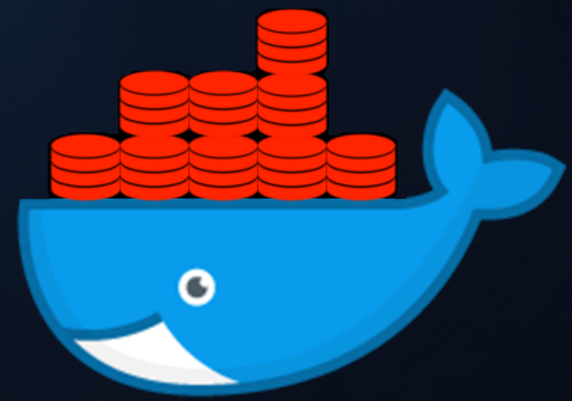
```
cd $ORACLE_BASE/autoupgrade/cfgtools/upgrade/auto
nohup python -m SimpleHTTPServer 8080 &

http://localhost:1980/state.html
```

Local port mapped to container port 8080 by `docker run`

Tips and Tricks

VISCOSITY
NORTH AMERICA

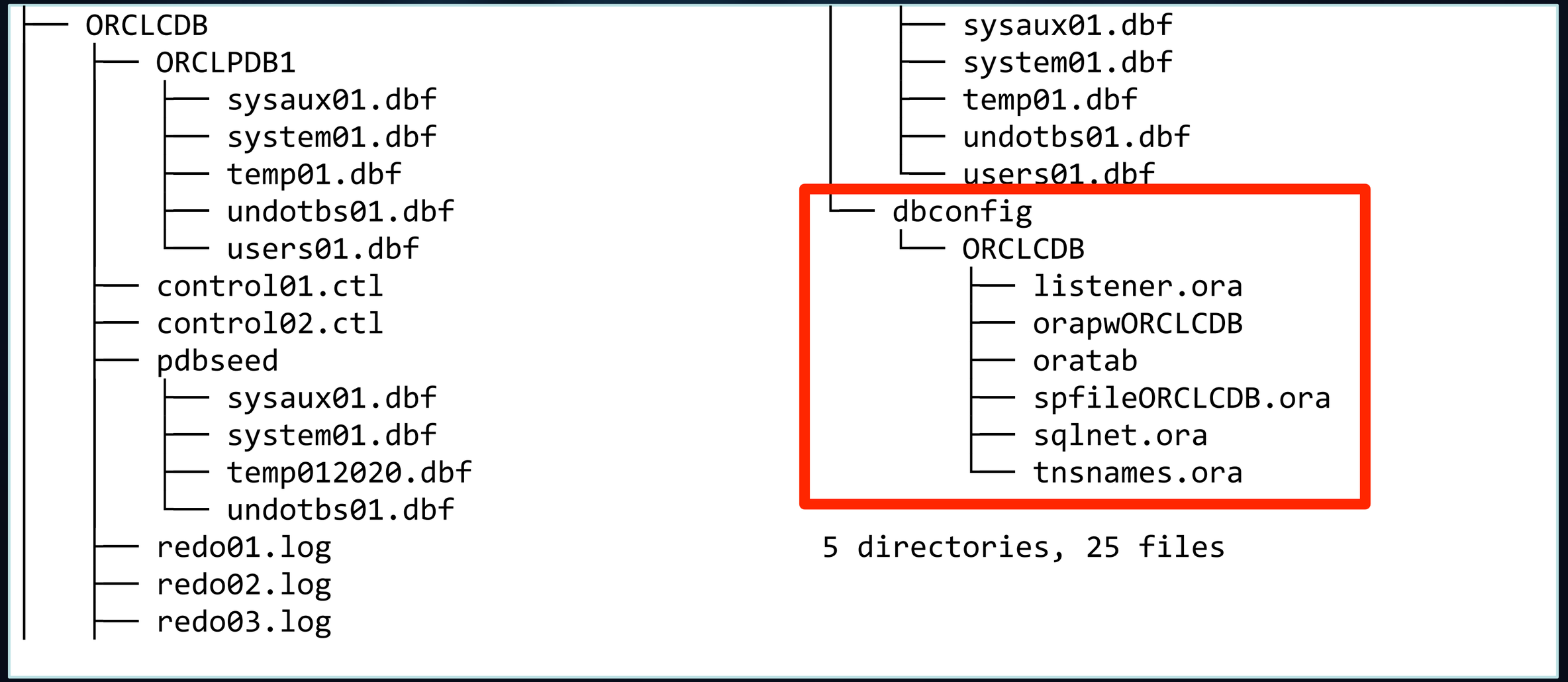
www.viscosityna.com



docker

ORACLE

Create Gold Images for Data



Create Gold Images for Data

```
docker run … -v /data_dir/$CON_NAME:/opt/oracle/oradata
```

`data_dir/$CON_NAME` contains the *entire database!*

- `data_dir/$CON_NAME/SID` = datafiles
- `data_dir/$CON_NAME/dbconfig/SID` = configurations

Create a gold image:

```
cp -r /data_dir/$CON_NAME /data_dir/gold
```

Recreate from the Gold Image

Remove the container and data:

```
docker rm $CON_NAME
rm -fr /data_dir/$CON_NAME
```

Restore the data and recreate the container:

```
cp -r /data_dir/gold /data_dir/$CON_NAME
docker run ...
     -v /data_dir/$CON_NAME:/opt/oracle/oradata ...
```

Clone from the Gold Image

Create a *new container* with existing Gold data:

```
cp -r /data_dir/gold /data_dir/CLONE

docker run -d
       -v /data_dir/CLONE:/opt/oracle/oradata \
       -e ORACLE_SID=VNA \          # <- Same SID
       -p 2021:1521 \               # <- Change local port
       -p 2080:8080 \               # <- Change local port
       --name CLONE \               # <- New container name
       oracle/database:12c-19c-ee # <- Same image
```

Snapshots (PIT backups) from Containers

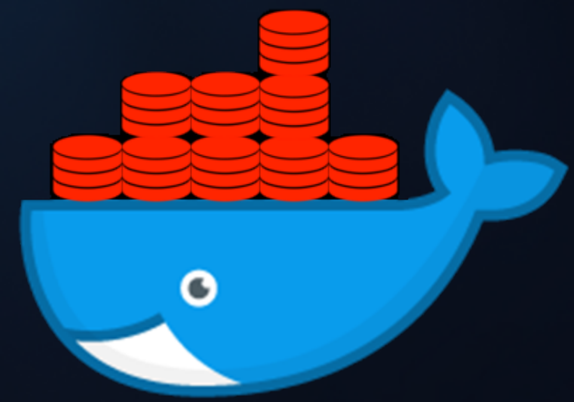
Create a snapshot as a new image:

```
docker commit $CON_NAME post_upgrade
cp -r /data_dir/$CON_NAME /data_dir/post_upgrade
```

Restore a snapshot:

```
docker rm -f $CON_NAME
cp -r /data_dir/post_upgrade /data_dir/$CON_NAME
docker run -d \
   -v /data_dir/$CON_NAME:/opt/oracle/oradata \
   -e ORACLE_SID=VNA ... # Same values used to create container
   --name $CON_NAME post_upgrade
```

Opportunities for Testing Upgrades on Docker



docker

ORACLE

VISCOSITY

NORTH AMERICA

www.viscosityna.com

Opportunities—Process

Compare different methods

Test backup and restore

Test GRP and Flashback

Update and correct documentation

Iterate and perfect process

Validate assumptions

Explore new features

Opportunities—Performance

Use Data Pump to export, import statistics

- Compare before/after plans
- Get comfortable with new optimizer options
- Determine changes for immediate implementation
- Develop action plans to:
  - Identify and isolate problems
  - React and resolve

Opportunities—Operations

Employ DevOps practices

- Establish metrics
- Build automation
- Create unit & functional tests

Opportunities—Operations

Develop and exercise tooling

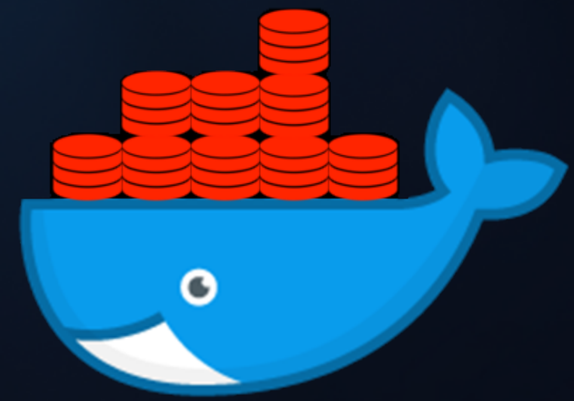
- Monitor
- Discover/observe patterns & anti-patterns
- Test observations
- Get smarter
- Add monitoring
- Repeat

Opportunities—Practice, Practice, Practice

Prepare like elite athletes and teams

- Build confidence in yourself, others
- Develop “muscle memory” for your upgrade
  - Respond instinctively
  - Improve reaction time
  - Know your tools and systems

Parting Thoughts



docker

ORACLE

VISCOSITY

NORTH AMERICA

www.viscosityna.com

MYTH: We have documentation for that

Is it current?
Is it accurate?

Documentation doesn't address:

Stress	Coordination	Research
Urgency	Phone calls	Management
Confusion	Messaging	Doubt, Panic
Multitasking	Alerts	Conflict

MYTH: If it works in pre-prod, it will work in prod

Production environments may include
exotic complexities or configurations that
aren't well duplicated in lower environments.

MYTH: Production is under change control

Older systems are more likely to contain undocumented or unexpected idiosyncrasies that introduce brittleness and fragility.

MYTH: Success in pre-prod assures success in prod

Production upgrades rarely go without incident.

The best way to prepare for the unexpected
is to make the fundamentals second-nature.

Questions

oraclesean.com

https://www.linkedin.com/in/soscott/

@oraclesean

https://github.com/oraclesean

sean.scott@viscosityna.com

Search "OracleSean" on YouTube