IT4011

Database Administration and Storage Systems

Assignment – Oracle Database Administration

IT20131074

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Question 1 - Install the latest Oracle database version (19.X c or 21.X c) on the UNIX platform. Preferably on Linux.

Step 1 - The command ifconfig was used to get the IP address which is 192.168.122.1

```
[thisara@localhost ~]$ ifconfig
ens160: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.81.128  netmask 255.255.255.0  broadcast 192.168.81.255
        inet6 fe80::20c:29ff:fe19:1a78  prefixlen 64  scopeid 0x20<link>
        ether 00:0c:29:19:1a:78  txqueuelen 1000  (Ethernet)
        RX packets 2080487  bytes 2954253712 (2.7 GiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 401929  bytes 22795005 (21.7 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        inet6 ::1  prefixlen 128  scopeid 0x10<host>
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

virbr0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500
        inet 192.168.122.1  netmask 255.255.255.0  broadcast 192.168.122.255
        ether 52:54:00:5c:f8:7f  txqueuelen 1000  (Ethernet)
        RX packets 0  bytes 0 (0.0 B)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

Step 2 - The hostname is taken using the hostname command

```
[thisara@localhost ~]$ hostname
localhost.Thisara
[thisara@localhost ~]$
[thisara@localhost ~]$
[thisara@localhost ~]$
[thisara@localhost ~]$
```

Step 3 - The content of the /etc/hosts file was updated by adding the IP address, hostname and the Oracle version. Type vi /etc/hosts

```
[thisara@localhost ~]$
[thisara@localhost ~]$ vi /etc/hosts
[thisara@localhost ~]$ su
Password:
[root@localhost thisara]#
```

```
127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4
::1         localhost localhost.localdomain localhost6 localhost6.localdomain6
192.168.122.1 localhost.Thisara
~
~
~
```

Step 4 - List down the preinstalled Oracle 21c packages in the system using the yum list command.

```
[root@localhost thisara]#
[root@localhost thisara]# yum list oracle-database-preinstall-21c
Last metadata expiration check: 0:12:28 ago on Sun 24 Sep 2023 05:22:31 AM EDT.
Available Packages
oracle-database-preinstall-21c.src                1.0-1.el8              ol8_appstream
oracle-database-preinstall-21c.x86_64             1.0-1.el8              ol8_appstream
[root@localhost thisara]#
```

Step 5 - The Oracle database package installation is performed using the yum install command.

```
[root@localhost thisara]#
[root@localhost thisara]# yum install -y oracle-database-preinstall-21c
Last metadata expiration check: 0:18:40 ago on Sun 24 Sep 2023 05:22:31 AM EDT.
Dependencies resolved.
================================================================================
 Package                Arch   Version                          Repository         Size
================================================================================
Installing:
 oracle-database-preinstall-21c
                        x86_64 1.0-1.el8                        ol8_appstream      30 k
Installing dependencies:
 compat-openssl10       x86_64 1:1.0.2o-4.el8_6                 ol8_appstream     1.1 M
 glibc-devel            x86_64 2.28-225.0.2.el8                 ol8_baseos_latest  85 k
 ksh                    x86_64 20120801-257.0.1.el8             ol8_appstream     929 k
 libnsl                 x86_64 2.28-225.0.2.el8                 ol8_baseos_latest 107 k
 libxcrypt-devel        x86_64 4.1.1-6.el8                      ol8_baseos_latest  25 k
 lm_sensors-libs        x86_64 3.4.0-23.20180522git70f7e08.el8 ol8_baseos_latest  59 k
 make                   x86_64 1:4.2.1-11.el8                   ol8_baseos_latest 498 k
 sysstat                x86_64 11.7.3-9.0.1.el8                 ol8_appstream     427 k

Transaction Summary
================================================================================
Install  9 Packages

Total download size: 3.2 M
Installed size: 9.4 M
Downloading Packages:
```

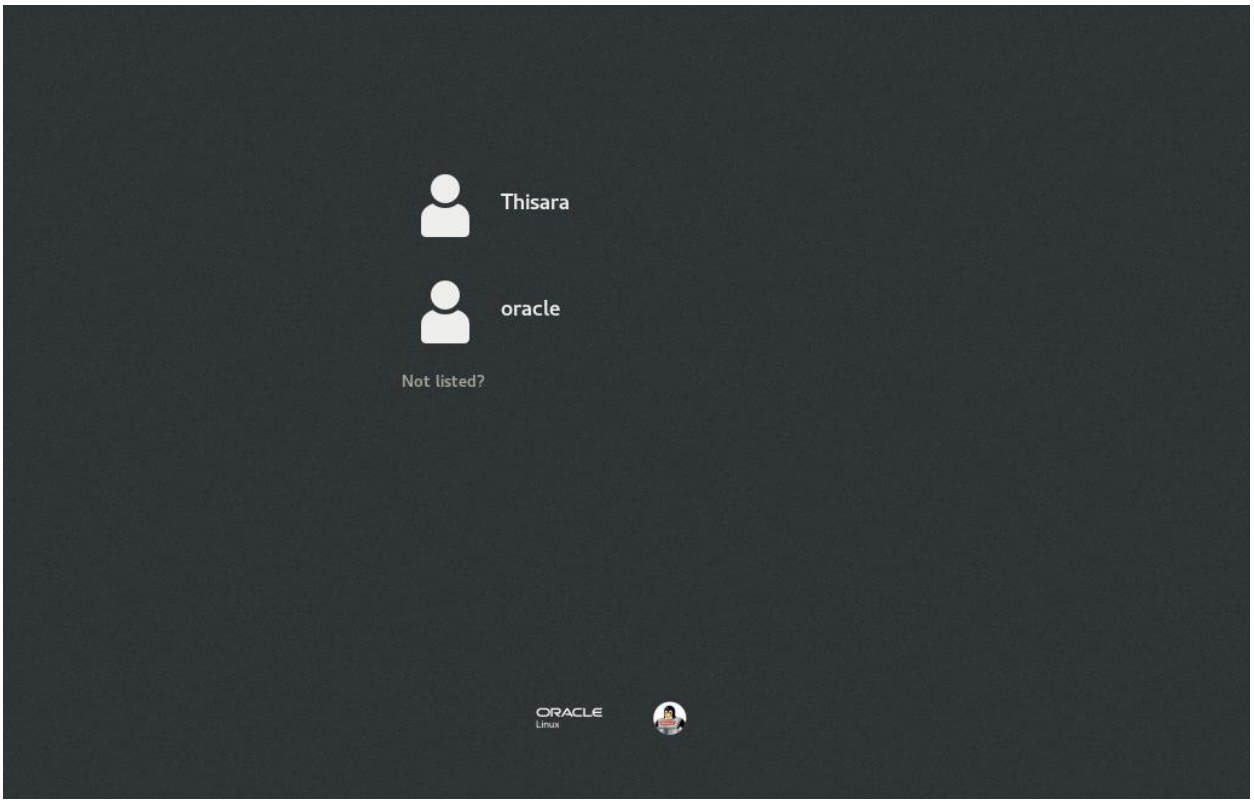
The installation can be verified as successful by the “Complete!” message displayed at the end.

```
  Installing       : lm_sensors-libs-3.4.0-23.20180522git70f7e08.el8.x86_64       6/9
  Running scriptlet: lm_sensors-libs-3.4.0-23.20180522git70f7e08.el8.x86_64       6/9
  Installing       : sysstat-11.7.3-9.0.1.el8.x86_64                             7/9
  Running scriptlet: sysstat-11.7.3-9.0.1.el8.x86_64                             7/9
  Installing       : libnsl-2.28-225.0.2.el8.x86_64                              8/9
  Installing       : oracle-database-preinstall-21c-1.0-1.el8.x86_64             9/9
  Running scriptlet: oracle-database-preinstall-21c-1.0-1.el8.x86_64             9/9
  Running scriptlet: oracle-database-preinstall-21c-1.0-1.el8.x86_64                                   9/9
  Verifying        : glibc-devel-2.28-225.0.2.el8.x86_64                                               1/9
  Verifying        : libnsl-2.28-225.0.2.el8.x86_64                                                    2/9
  Verifying        : libxcrypt-devel-4.1.1-6.el8.x86_64                                                3/9
  Verifying        : lm_sensors-libs-3.4.0-23.20180522git70f7e08.el8.x86_64                            4/9
  Verifying        : make-1:4.2.1-11.el8.x86_64                                                        5/9
  Verifying        : compat-openssl10-1:1.0.2o-4.el8_6.x86_64                                          6/9
  Verifying        : ksh-20120801-257.0.1.el8.x86_64                                                   7/9
  Verifying        : oracle-database-preinstall-21c-1.0-1.el8.x86_64                                   8/9
  Verifying        : sysstat-11.7.3-9.0.1.el8.x86_64                                                   9/9

Installed:
  compat-openssl10-1:1.0.2o-4.el8_6.x86_64        glibc-devel-2.28-225.0.2.el8.x86_64
  ksh-20120801-257.0.1.el8.x86_64                 libnsl-2.28-225.0.2.el8.x86_64
  libxcrypt-devel-4.1.1-6.el8.x86_64              lm_sensors-libs-3.4.0-23.20180522git70f7e08.el8.x86_64
  make-1:4.2.1-11.el8.x86_64                      oracle-database-preinstall-21c-1.0-1.el8.x86_64
  sysstat-11.7.3-9.0.1.el8.x86_64

Complete!
[root@localhost thisara]#
```

Step 6 - As the next step a new user named Oracle is created and a password is assigned to the created user

```
[root@localhost thisara]#
[root@localhost thisara]# passwd oracle
Changing password for user oracle.
New password:
BAD PASSWORD: The password is shorter than 8 characters
Retype new password:
passwd: all authentication tokens updated successfully.
[root@localhost thisara]#
[root@localhost thisara]#
```

Two user accounts are created to log in with the creation of the oracle user account.



Step 7 - Next the content of the /etc/selinux/config file is modified by setting the attribute “SELINUX = permissive”. Type vi /etc/selinux/config

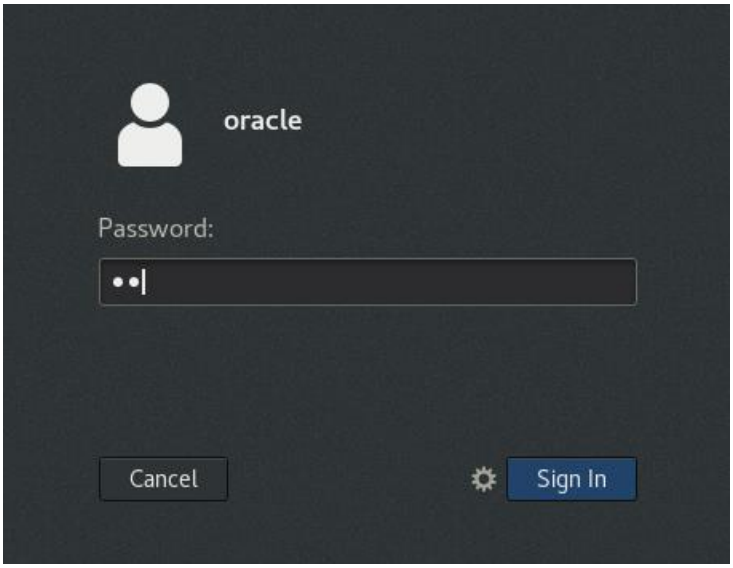
```
# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
SELINUX=permissive
#SELINUX=enforcing
# SELINUXTYPE= can take one of these three values:
#     targeted - Targeted processes are protected,
#     minimum - Modification of targeted policy. Only selected processes are pro
tected.
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted


~
~
```

Step 8 -

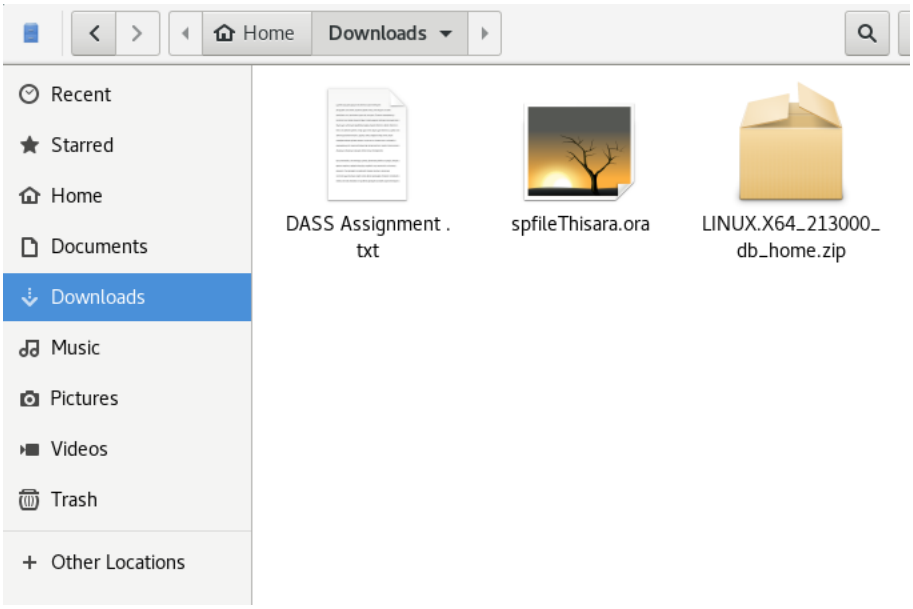
- create a directory structure, for an Oracle Database installation.
- chown is used to change the ownership of files and directories.
- chmod is used to change the permissions (read, write, execute) of files and directories.

```
[root@localhost thisara]# ls
Desktop  Documents  Downloads  Music  Pictures  Public  Templates  Videos
[root@localhost thisara]#  cd ..
[root@localhost home]# ls
oracle  thisara
[root@localhost home]#  cd ..
[root@localhost /]# ls
bin  boot  dev  etc  home  lib  lib64  media  mnt  opt  proc  root  run  sbin  srv  sys  tmp  usr  var
[root@localhost /]#  mkdir -p /u01/app/oracle/product/21.0.0/dbhome_1
[root@localhost /]# ls
bin  boot  dev  etc  home  lib  lib64  media  mnt  opt  proc  root  run  sbin  srv  sys  tmp  u01  usr  var
[root@localhost /]# mkdir -p /u02/oradata
[root@localhost /]# ls
bin  boot  dev  etc  home  lib  lib64  media  mnt  opt  proc  root  run  sbin  srv  sys  tmp  u01  u02  usr  var
[root@localhost /]# chown -R oracle:oinstall /u01 /u02
[root@localhost /]# chmod -R 775 /u01 /u02
```

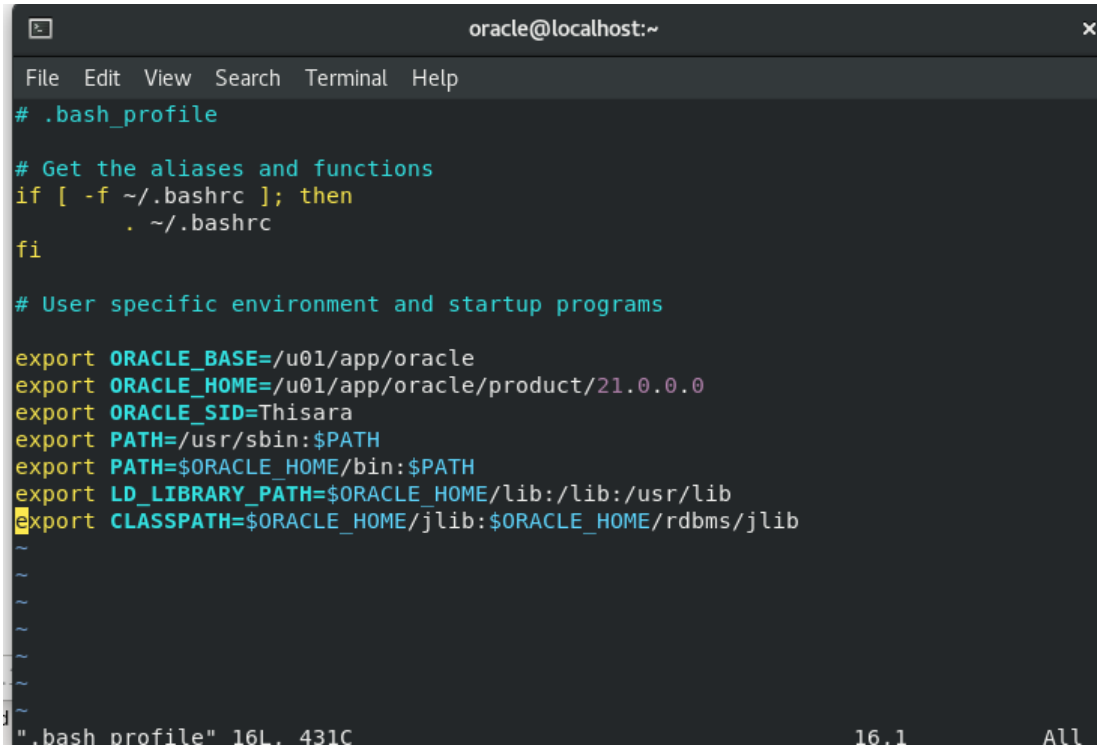
Step 9 - As the next step sign out from the root user account and log in to the created Oracle account.



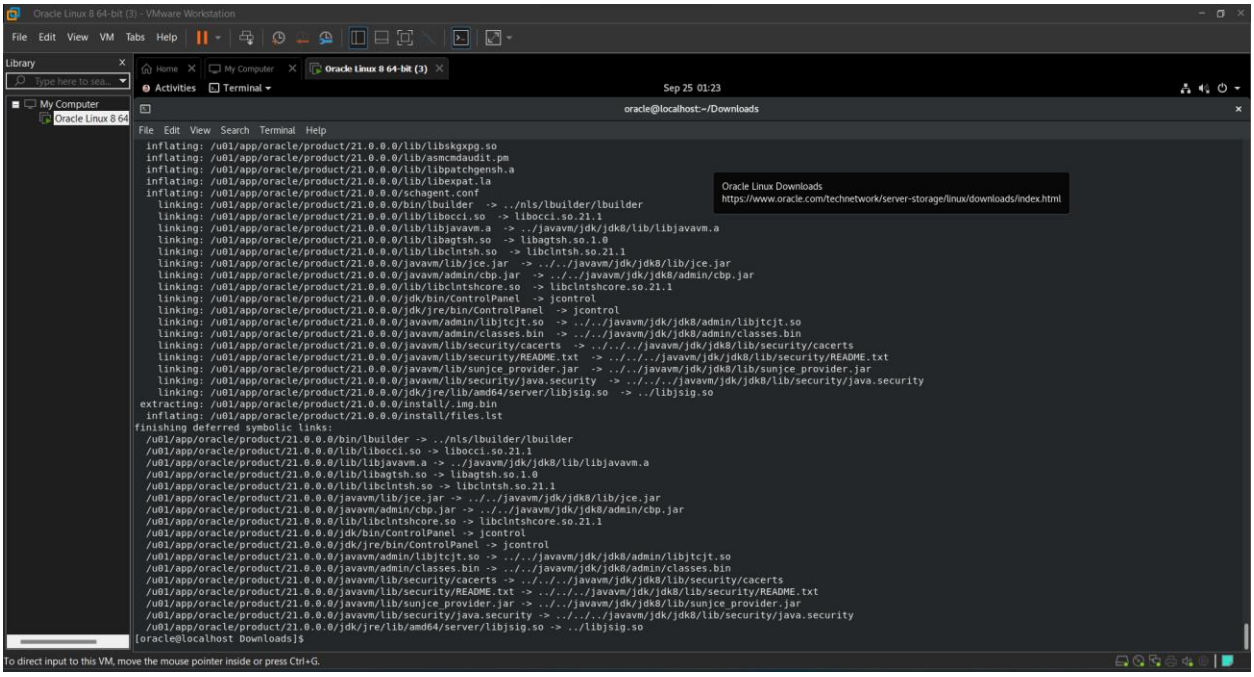
The downloaded Oracle database 21c package downloaded.



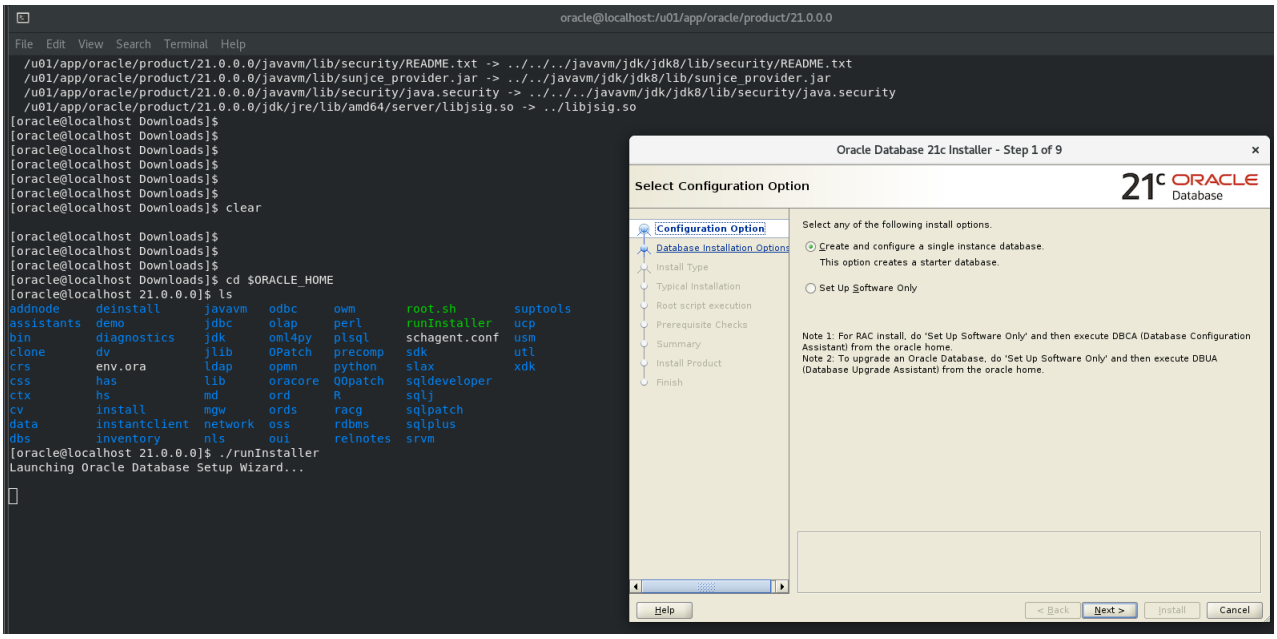
Step 10 – type “vi .bash_profile” and edit the profile as below.



Step 11 – go to Downloads folder and Run unzip command here.

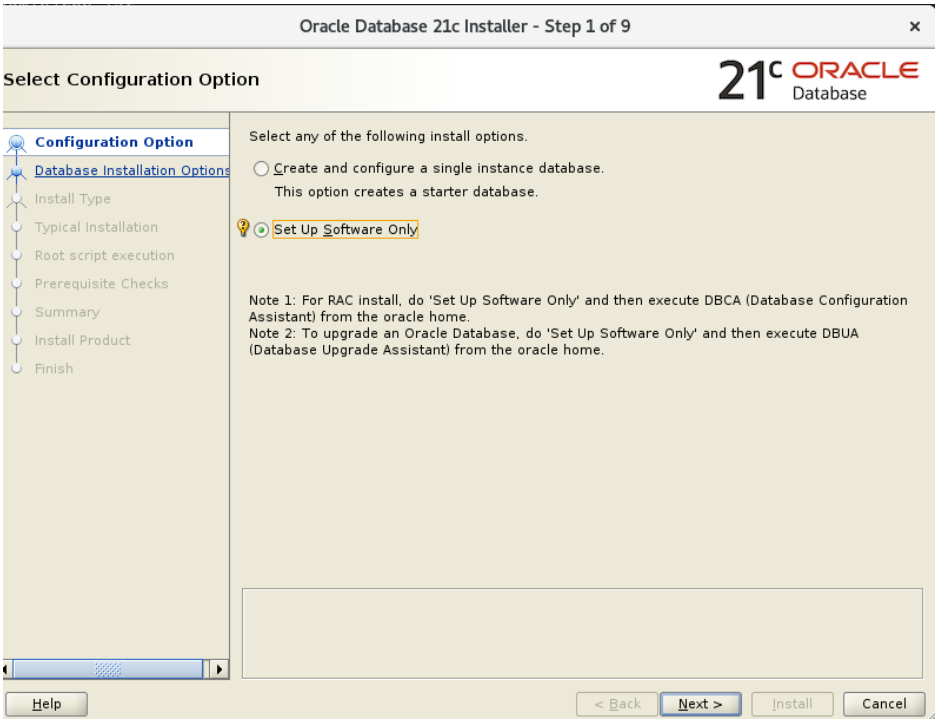


Step 12 - Launch the database setup using ./runInstaller command

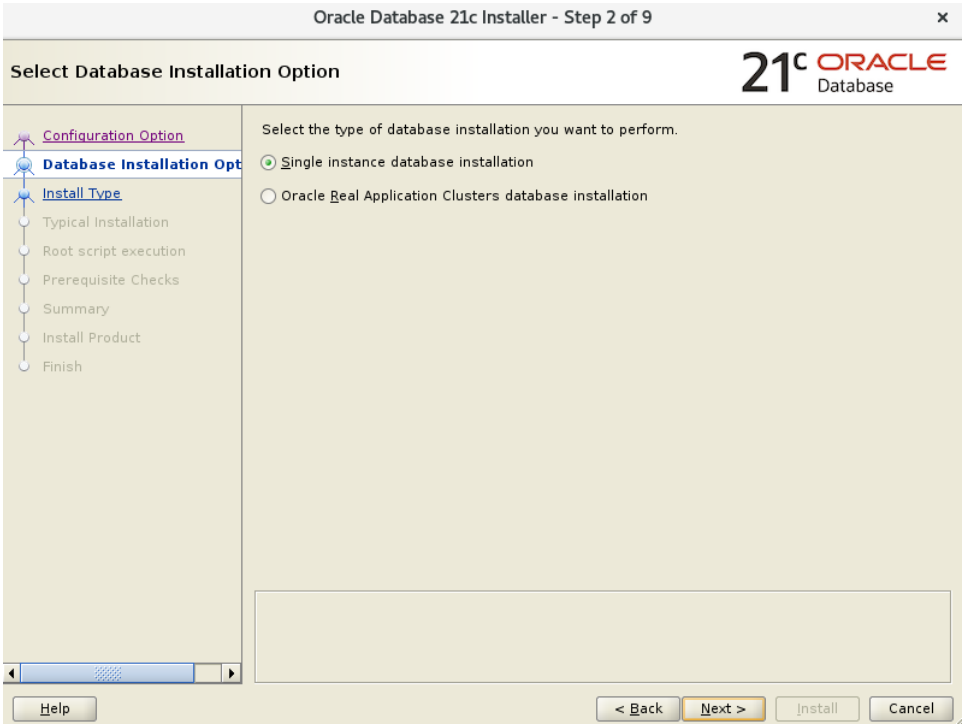


Step 13 - Setup the oracle database The database setup will be launched after a few seconds. The database setup displays several steps to set up the database.

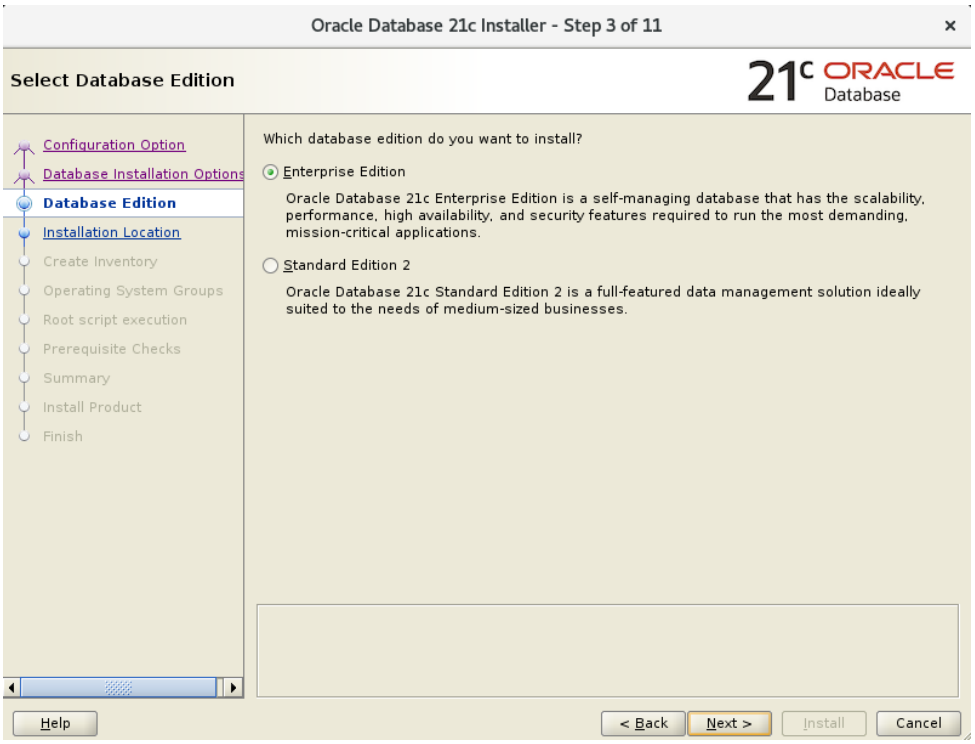
- Select ‘Set Up Software Only’ option in the configuration option step.



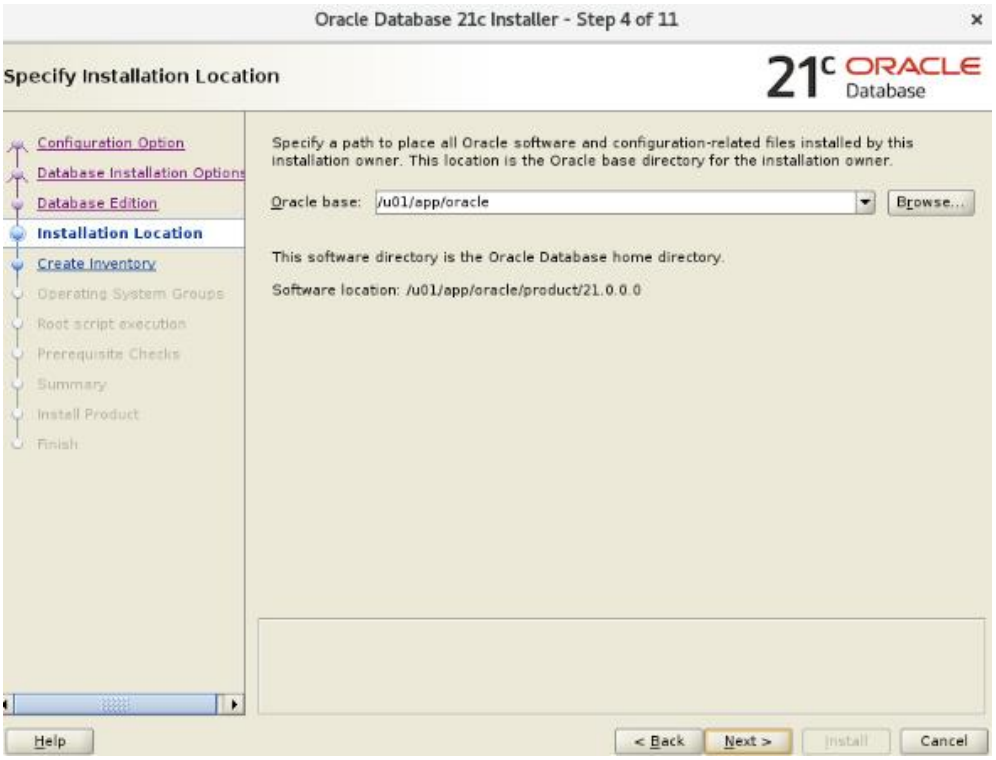
- Select ‘Single Instance database installation’ option



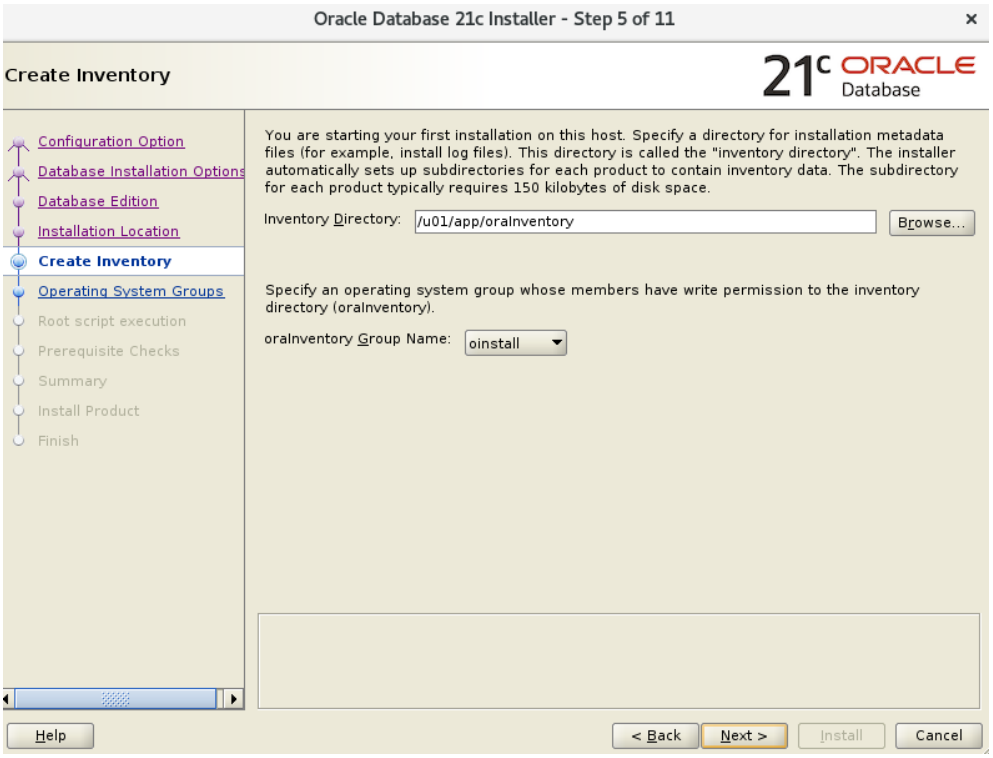
- Select the ‘Enterprise Edition’ as the Database edition.



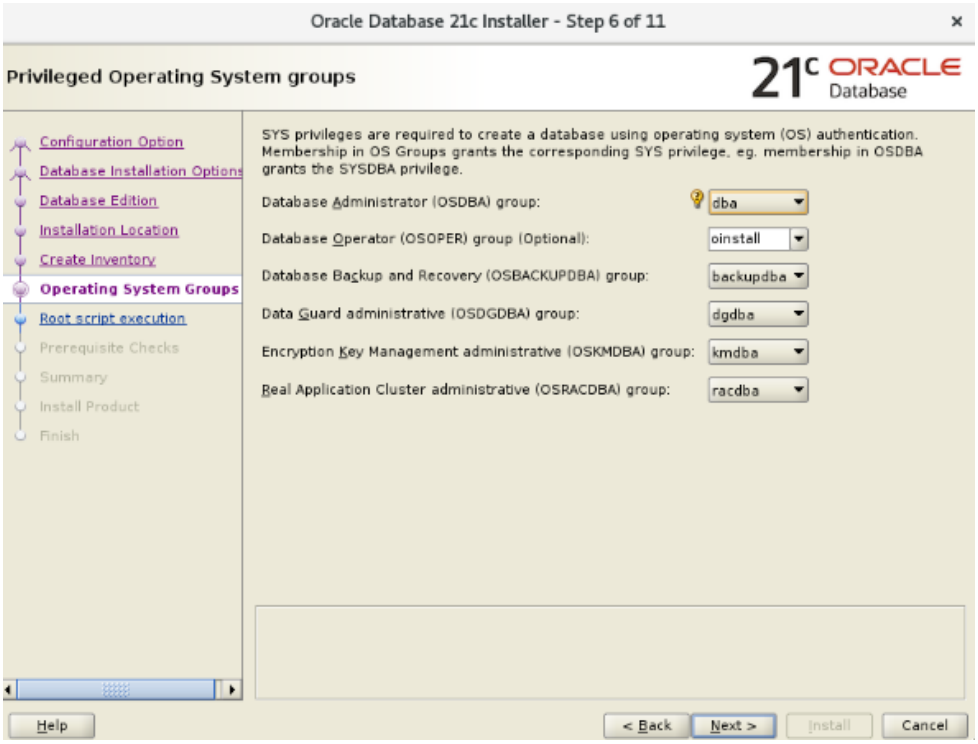
- Set the path of the Oracle base.



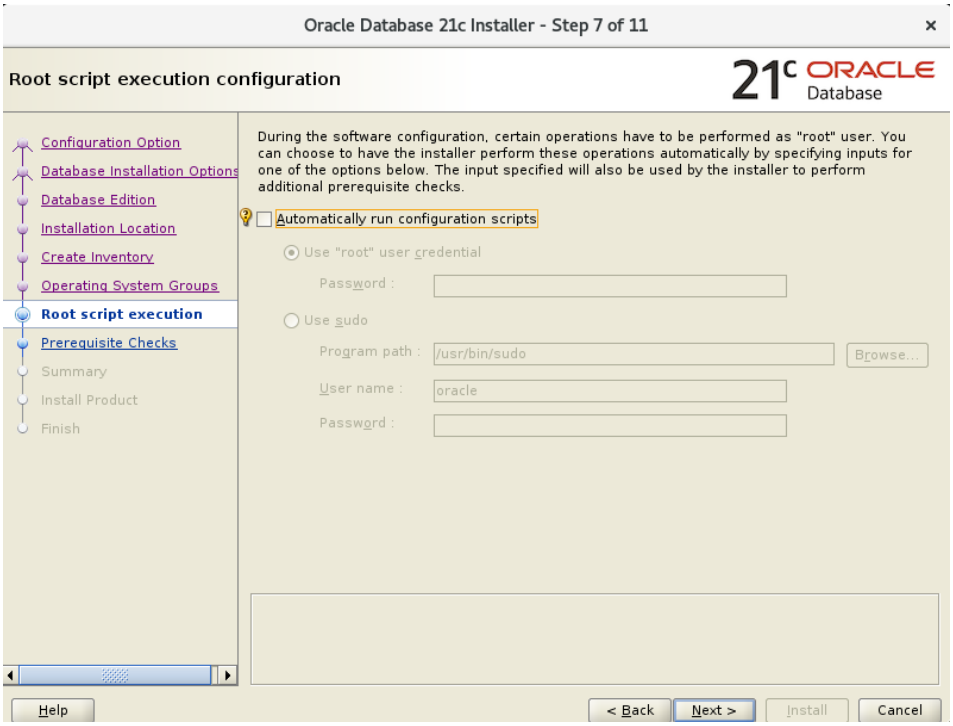
- Set the path of the Inventory Directory.



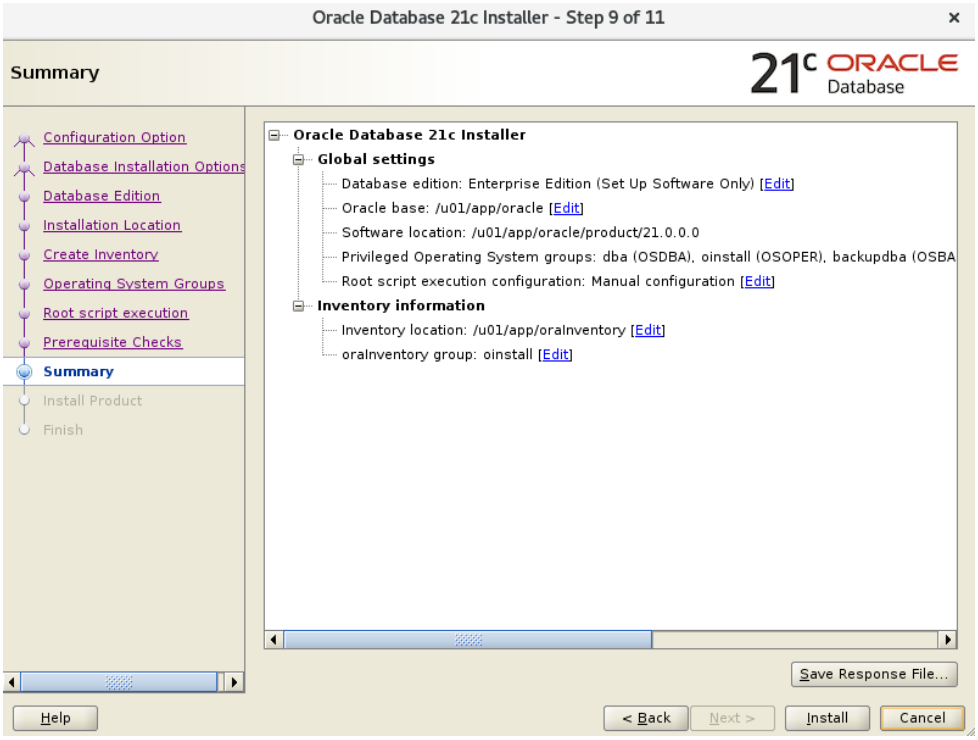
- Select the corresponding Operating system groups from the drop-down options.



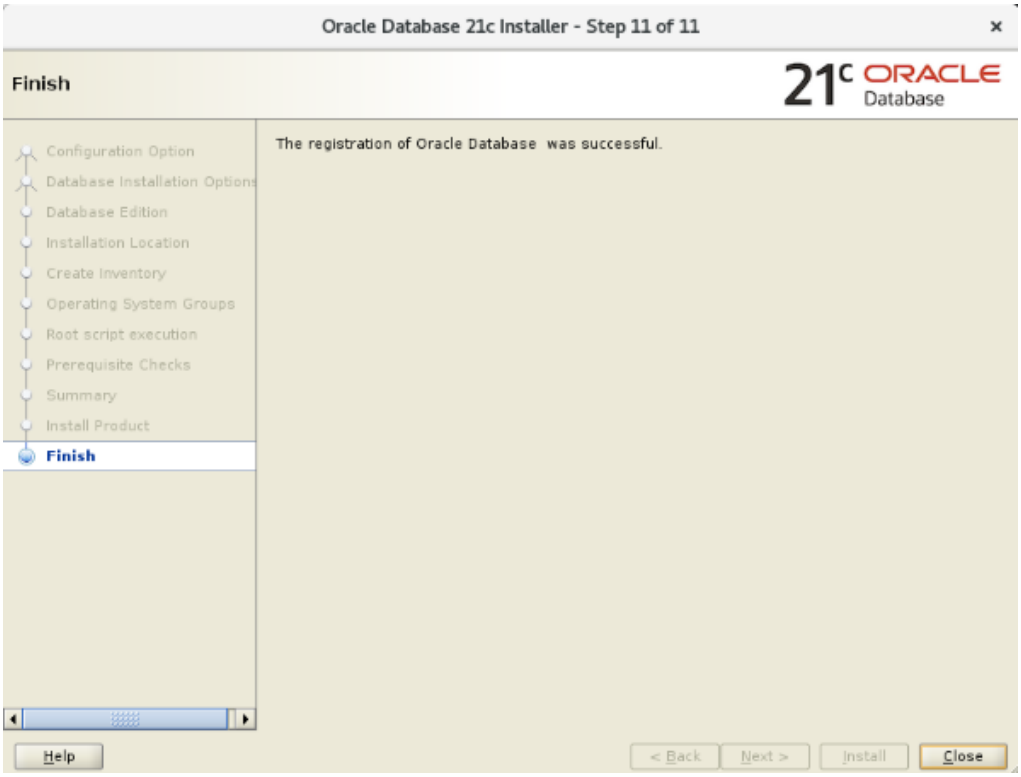
- Tick the ‘Automatically run configuration scripts’ option and enter the root user password.



- A summary page will be displayed of the set configurations.



- The completion of the oracle database setup.

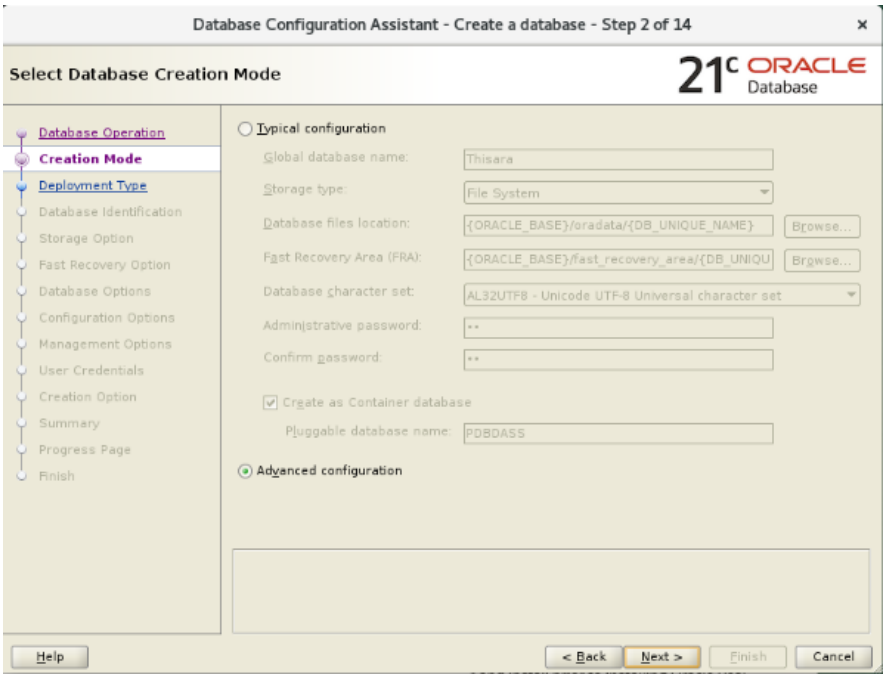


Question 2 - Create CDB in non-archive log mode named using DBCA and create a PDB called PDBDASS.

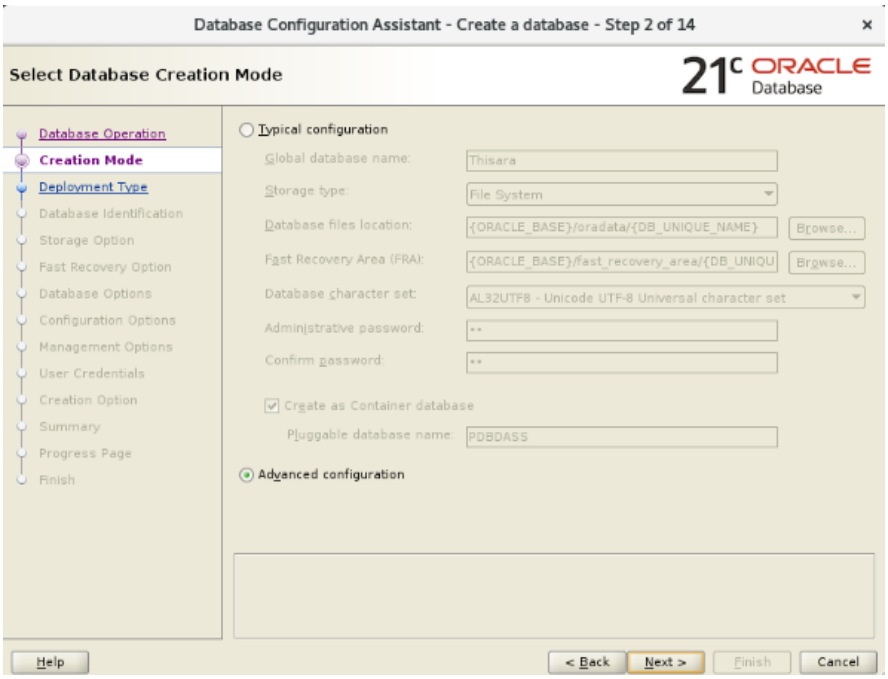
Step 1 - Change the path to ./bin and start the database configuration using ./dbca command

Step 2 – Setup Database Configurations

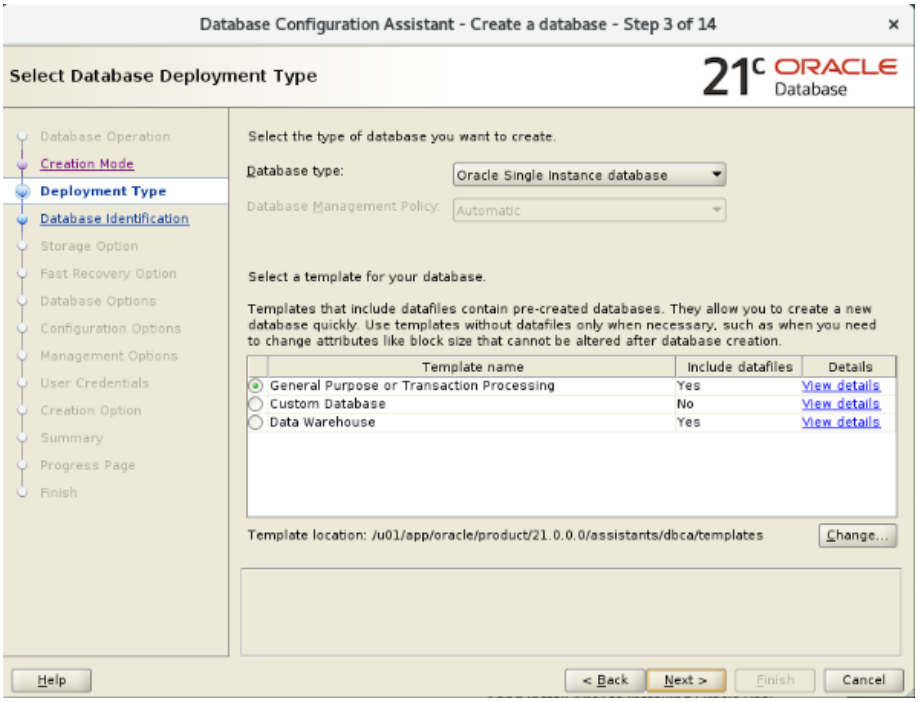
- Select the ‘Create a database option’



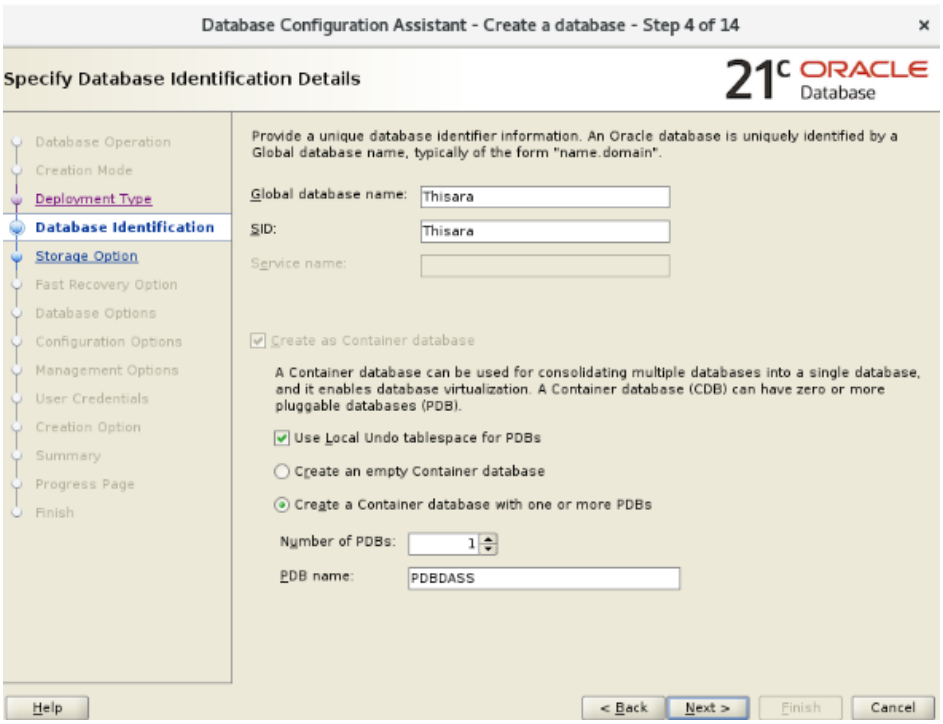
- Select advanced configuration.



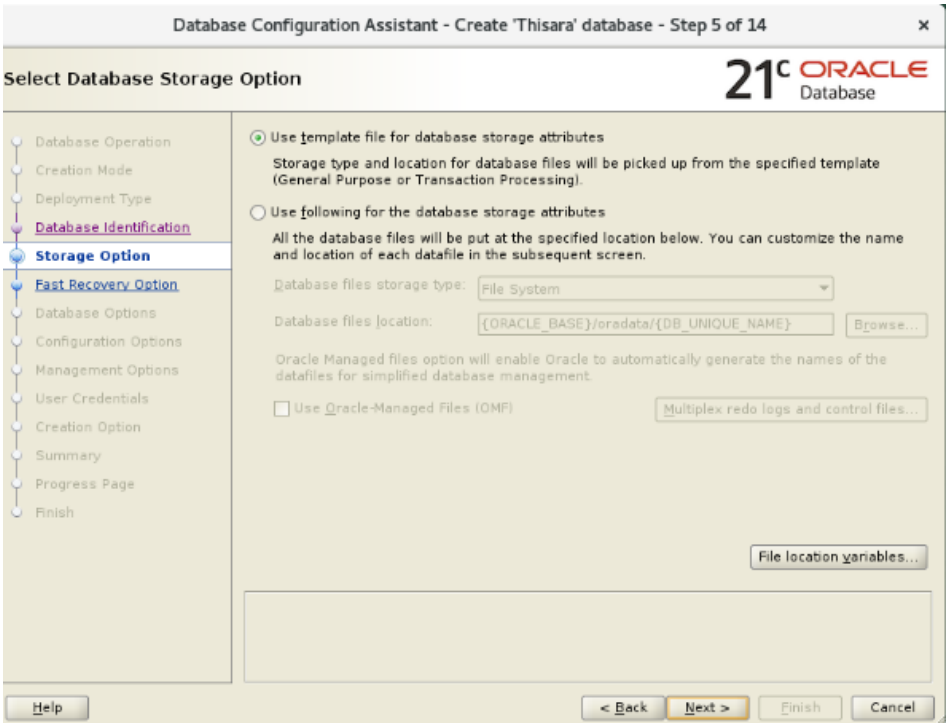
- Deployment type.



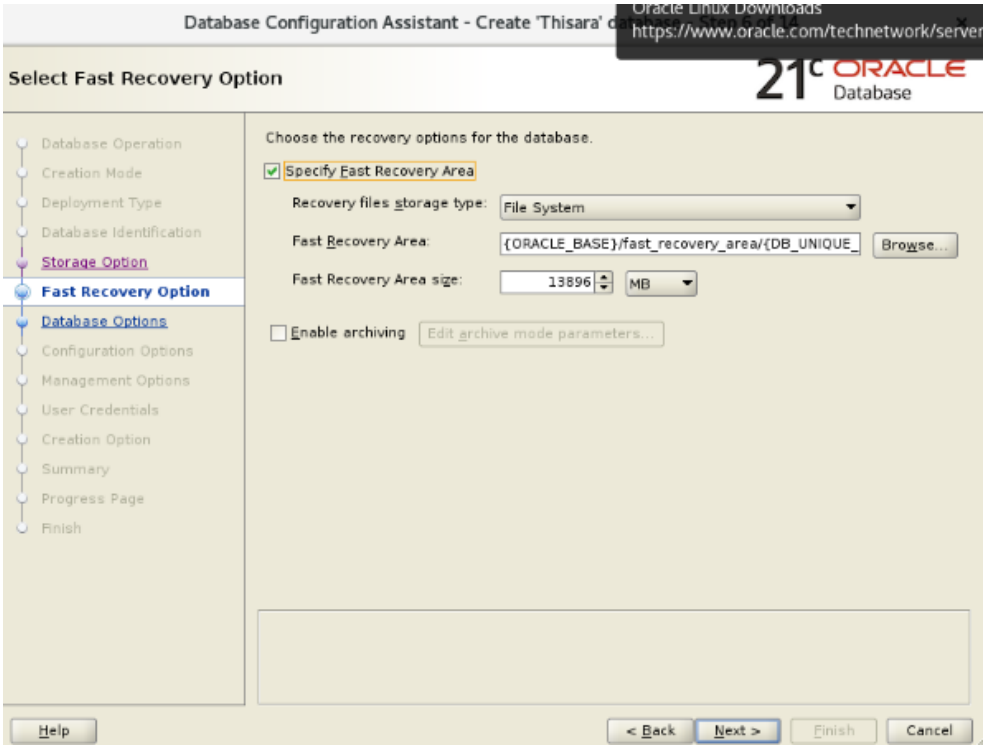
- Database identification.
  change the Global database name into “Thisara” and change PDB name into “PDBDASS”.



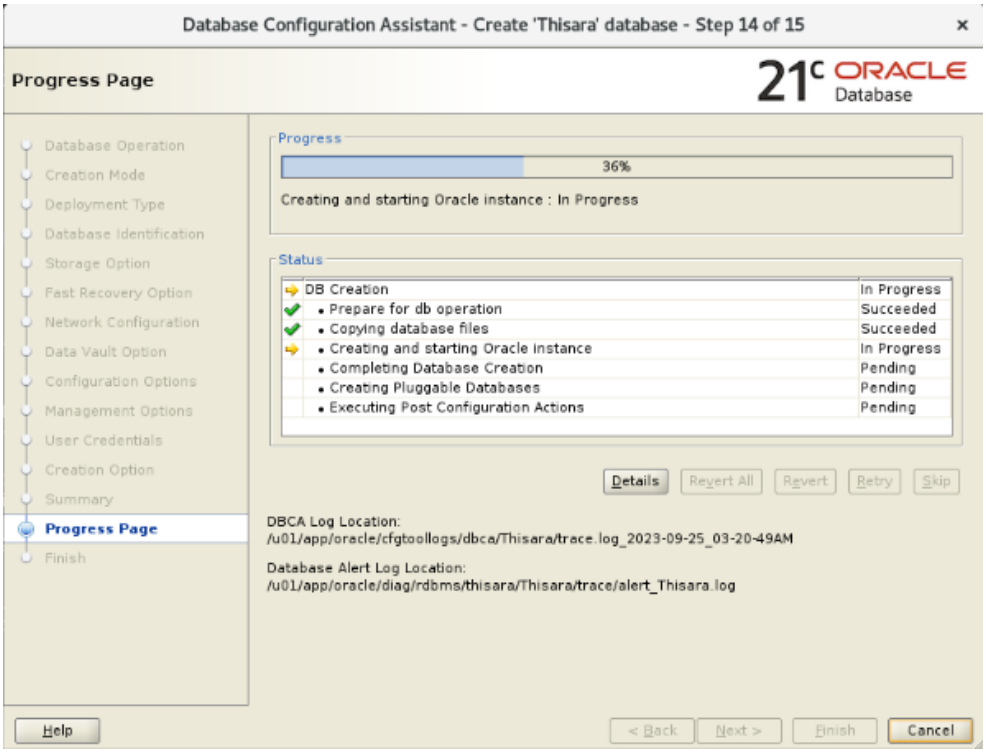
- Storage option.



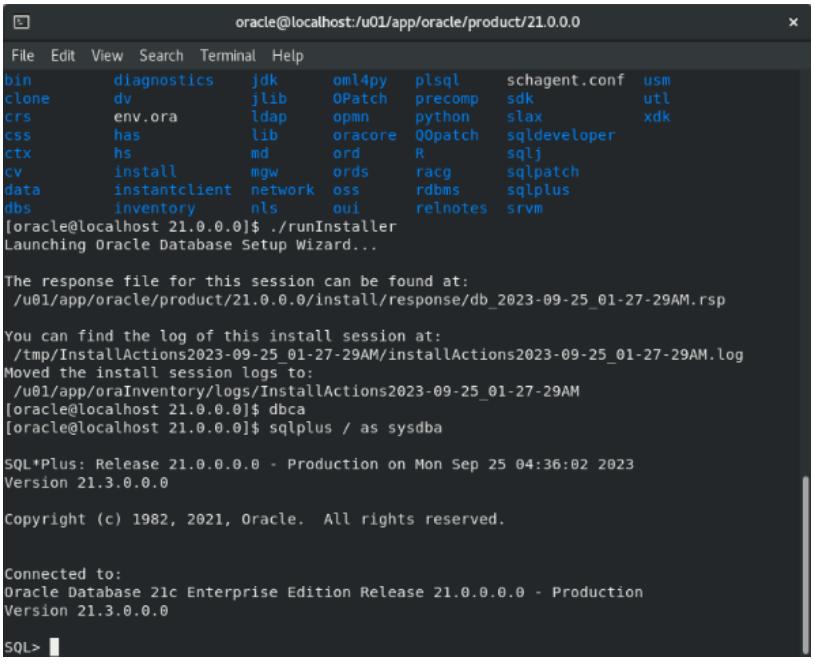
- Fast recovery option.
  Select specify fast recovery area.



- Progress page.



- Type sqlplus / as sysdba to use Oracle database.
- Succefully Connected to Oracle database 21c.



Question 3 - Answer the following questions.

(a) The database you created in question number 2 above uses a binary-type parameter file. When a parameter file is corrupted or missing how can you recover it and start the database? Demonstrate your answer using your database.

```
[oracle@localhost 21.0.0.0]$ rman

Recovery Manager: Release 21.0.0.0.0 - Production on Mon Sep 25 04:44:45 2023
Version 21.3.0.0.0

Copyright (c) 1982, 2021, Oracle and/or its affiliates.  All rights reserved.

RMAN> startup mount;

RMAN-00571: ===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS ===============
RMAN-00571: ===========================================================
RMAN-03002: failure of startup command at 09/25/2023 04:46:17
RMAN-06171: not connected to target database

RMAN> connect target Thisara

target database Password:
connected to target database (not started)

RMAN> startup mount;

Oracle instance started
database mounted

Total System Global Area    1526725760 bytes

Fixed Size                     9686144 bytes
Variable Size                956301312 bytes
Database Buffers             553648128 bytes
Redo Buffers                   7090176 bytes

RMAN>
```

```
RMAN> alter database archivelog;

Statement processed
```

```
RMAN> backup database plus archivelog;


Starting backup at 25-SEP-23
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=262 device type=DISK
specification does not match any archived log in the repository
backup cancelled because there are no files to backup
Finished backup at 25-SEP-23

Starting backup at 25-SEP-23
using channel ORA_DISK_1
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00001 name=/u01/app/oracle/oradata/THISARA/system01.dbf
input datafile file number=00003 name=/u01/app/oracle/oradata/THISARA/sysaux01.dbf
input datafile file number=00004 name=/u01/app/oracle/oradata/THISARA/undotbs01.dbf
input datafile file number=00007 name=/u01/app/oracle/oradata/THISARA/users01.dbf
channel ORA_DISK_1: starting piece 1 at 25-SEP-23
channel ORA_DISK_1: finished piece 1 at 25-SEP-23
piece handle=/home/oracle/THISARA/backupset/2023_09_25/o1_mf_nnndf_TAG20230925T045406_lk1k8pqw_.bkp tag=TAG20230925T045406 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:35
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00010 name=/u01/app/oracle/oradata/THISARA/PDBDASS/sysaux01.dbf
input datafile file number=00009 name=/u01/app/oracle/oradata/THISARA/PDBDASS/system01.dbf
input datafile file number=00011 name=/u01/app/oracle/oradata/THISARA/PDBDASS/undotbs01.dbf
input datafile file number=00012 name=/u01/app/oracle/oradata/THISARA/PDBDASS/users01.dbf
channel ORA_DISK_1: starting piece 1 at 25-SEP-23
channel ORA_DISK_1: finished piece 1 at 25-SEP-23
piece handle=/home/oracle/THISARA/0623BEA8FECE40F6E063017AA8C0151B/backupset/2023_09_25/o1_mf_nnndf_TAG20230925T045406_lk1k9sww_.bkp tag=TAG20230925T045406 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:15
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00006 name=/u01/app/oracle/oradata/THISARA/pdbseed/sysaux01.dbf
ove the mouse pointer inside or press Ctrl+G.
```

```
input datafile file number=00005 name=/u01/app/oracle/oradata/THISARA/pdbseed/system01.dbf
input datafile file number=00008 name=/u01/app/oracle/oradata/THISARA/pdbseed/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 25-SEP-23
channel ORA_DISK_1: finished piece 1 at 25-SEP-23
piece handle=/home/oracle/THISARA/0623A2278A1C3C37E063017AA8C0299B/backupset/2023_09_25/o1_mf_nnndf_TAG201
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:15
Finished backup at 25-SEP-23

Starting backup at 25-SEP-23
using channel ORA_DISK_1
specification does not match any archived log in the repository
backup cancelled because there are no files to backup
Finished backup at 25-SEP-23

Starting Control File and SPFILE Autobackup at 25-SEP-23
piece handle=/home/oracle/THISARA/autobackup/2023_09_25/o1_mf_s_1148445869_lk1kbrlz_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 25-SEP-23

RMAN>
```

```
RMAN> shutdown immediate

database dismounted
Oracle instance shut down

RMAN> exit


Recovery Manager complete.
[oracle@localhost 21.0.0.0]$
```

- Manually delete spfileThisara.ora
- This file is in the “u01/app/oracle/dbs”.

```
[oracle@localhost 21.0.0.0]$ rman

Recovery Manager: Release 21.0.0.0.0 - Production on Mon Sep 25 05:06:34 2023
Version 21.3.0.0.0

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```

```
RMAN> connect target Thisara

target database Password:
connected to target database (not started)

RMAN> startup nomount;

startup failed: ORA-01078: failure in processing system parameters
ORA-01565: error in identifying file '/u01/app/oracle/dbs/spfileThisara.ora'
ORA-27037: unable to obtain file status
Linux-x86_64 Error: 2: No such file or directory
Additional information: 7

starting Oracle instance without parameter file for retrieval of spfile
Oracle instance started

Total System Global Area    1073740480 bytes

Fixed Size                     9693888 bytes
Variable Size                276824064 bytes
Database Buffers             780140544 bytes
Redo Buffers                   7081984 bytes
```

```
RMAN> set DBID 230773994

executing command: SET DBID
```

```
RMAN> restore SPFILE from '/home/oracle/THISARA/autobackup/2023_09_25/o1_mf_s_1148445869_lk1kbrlz_.bkp';

Starting restore at 25-SEP-23
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=184 device type=DISK

channel ORA_DISK_1: restoring spfile from AUTOBACKUP /home/oracle/THISARA/autobackup/2023_09_25/o1_mf_s_1148445869_lk1kbrlz_.bkp
channel ORA_DISK_1: SPFILE restore from AUTOBACKUP complete
Finished restore at 25-SEP-23

RMAN> shutdown immediate

Oracle instance shut down

RMAN> startup

connected to target database (not started)
Oracle instance started
database mounted
database opened

Total System Global Area    1526725760 bytes

Fixed Size                     9686144 bytes
Variable Size                956301312 bytes
Database Buffers             553648128 bytes
Redo Buffers                   7090176 bytes

RMAN> select name,dbid from v$database;

NAME            DBID
--------- ----------
THISARA    230773994
```

(b) Increase the processes parameter by 10.

- Step 1: Log in to SQL PLUS as sysdba

```
[oracle@localhost 21.0.0.0]$ sqlplus / as sysdba

SQL*Plus: Release 21.0.0.0.0 - Production on Mon Sep 25 05:42:38 2023
Version 21.3.0.0.0

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Connected to:
Oracle Database 21c Enterprise Edition Release 21.0.0.0.0 - Production
Version 21.3.0.0.0

SQL> show parameter sessions;
```
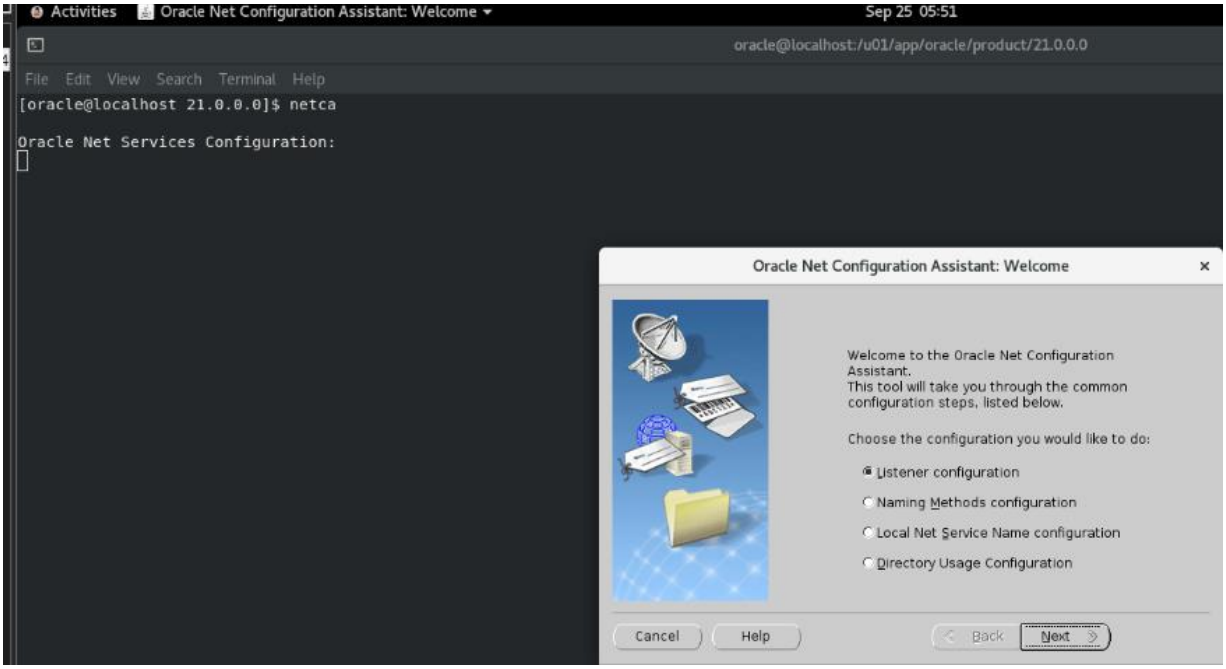
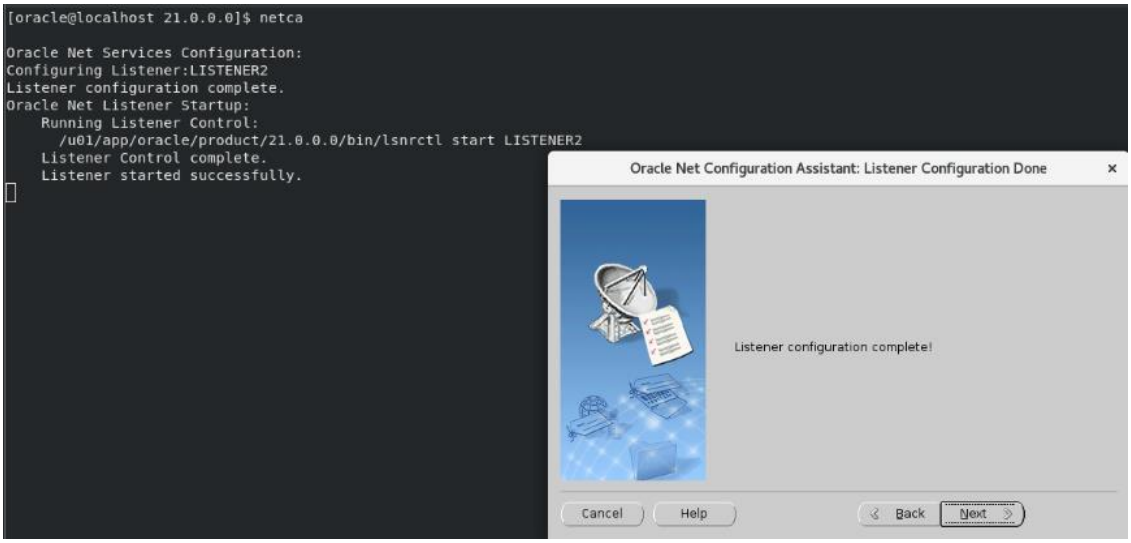
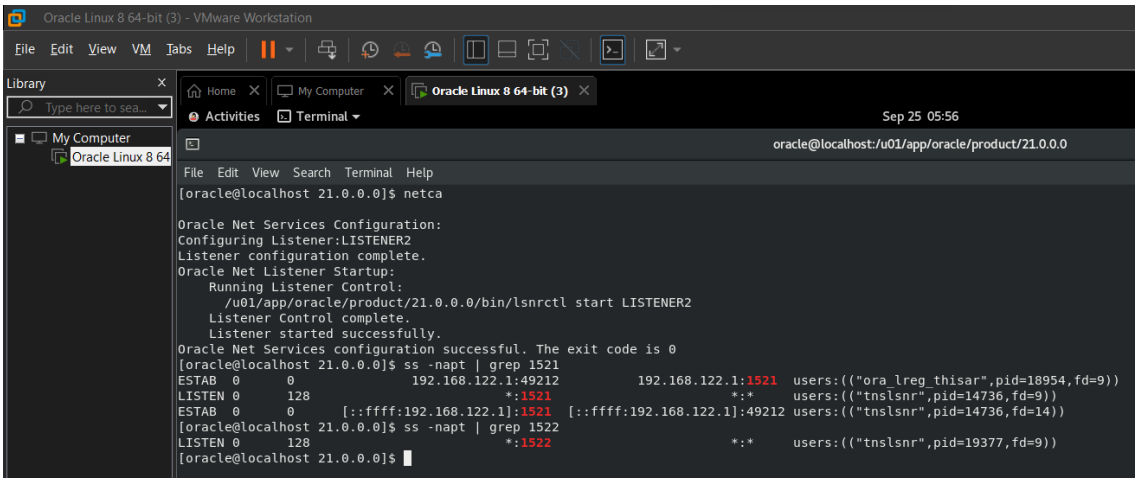

```
SQL> show parameter processes;

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
aq_tm_processes                      integer     1
db_writer_processes                  integer     1
gcs_server_processes                 integer     0
global_txn_processes                 integer     1
job_queue_processes                  integer     40
log_archive_max_processes            integer     4
processes                            integer     300
```

```
SQL> alter system set processes=310 scope=spfile;

System altered.

SQL> shutdown abort
ORACLE instance shut down.
SQL> startup
ORACLE instance started.

Total System Global Area 1526725784 bytes
Fixed Size                  9686168 bytes
Variable Size             956301312 bytes
Database Buffers          553648128 bytes
Redo Buffers                7090176 bytes
Database mounted.
Database opened.
SQL> show parameter processes;

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
aq_tm_processes                      integer     1
db_writer_processes                  integer     1
gcs_server_processes                 integer     0
global_txn_processes                 integer     1
job_queue_processes                  integer     40
log_archive_max_processes            integer     4
processes                            integer     310
SQL>
```

(c) Create a new listener called LISTNER2 with port number 1522.







Question 4 - Create a new tablespace EXAMPLE1 of size 5 MB with one data file. After that, expand the tablespace size to 8MB by adding a new data file.

```
SQL> create tablespace EXAMPLE1 datafile '/u01/app/oracle/oradata/THISARA/EXAMPLE1_1.dbf' size 5M;

Tablespace created.

SQL> ALTER TABLESPACE EXAMPLE1
  2  ADD DATAFILE '//u01/app/oracle/oradata/THISARA/EXAMPLE1_2.dbf'
  3  SIZE 3M;

Tablespace altered.

SQL> select tablespace_name,bytes / 1024 / 1024 MB From dba_free_space Where tablespace_name = 'EXAMPLE1';

TABLESPACE_NAME                        MB
------------------------------ ----------
EXAMPLE1                                2
EXAMPLE1                                4

SQL>
```

Question 5 - Write a report about database security features and their use in Oracle 19c or 21c. The word count is 300 words.

Oracle Database 19c and 21c are at the forefront of database technology, offering advanced features and capabilities to meet the evolving needs of modern organizations. In the era of data-centric operations, the importance of robust database security cannot be overstated.

01. Authentication and Access Control

a) Role-based Access Control (RBAC):
Role-based access control (RBAC) in Oracle 19c/21c is a pivotal security feature that enables organizations to finely tune user access to their databases. It operates on the principle of assigning roles to users, each with specific privileges, rather than assigning privileges directly to users. Here's how RBAC is relevant to database security in Oracle 19c/21c:

- Granular Access Control:
RBAC provides a granular level of control over who can access what data and perform specific actions within the database. This granularity reduces the risk of unauthorized data access and helps organizations enforce the principle of least privilege.

- Simplified Administration:
RBAC simplifies user management and access control. Instead of managing individual user privileges, administrators can create roles with appropriate permissions and assign users to these roles, making access control more manageable and reducing the risk of errors.

b) Privilege Analysis:
Privilege analysis is a security feature that assists in identifying and managing unnecessary or unused privileges within the database. Here's its relevance:

- Enhancing Security:
Privilege analysis enhances security by identifying privileges that are no longer necessary for a user's role. Unnecessary privileges can be revoked, reducing the potential attack surface and minimizing the risk of privilege abuse or unauthorized access.

- Optimizing Performance:
By eliminating unused privileges, privilege analysis can also improve database performance since it reduces the overhead associated with unnecessary access controls.

c) Multifactor Authentication (MFA):

- Multifactor authentication (MFA) is a robust authentication mechanism that requires users to provide multiple forms of verification to access the database. Its relevance lies in:

- Strengthening User Authentication:
  MFA enhances database security by requiring users to provide multiple forms of verification, such as a password, a smart card, a fingerprint, or a one-time code. This makes it significantly harder for malicious actors to gain unauthorized access, even if they obtain one authentication factor.

- Protecting Against Credential Theft:
  MFA mitigates the risk of credential theft, as even if an attacker manages to steal a password, they would still need the second factor for access.

d) Oracle Label Security (OLS):
   Oracle Label Security (OLS) is a specialized feature for organizations with strict data classification and access control requirements. Its relevance includes:

- Data Labeling and Access Control:
  OLS enforces data labeling and access controls based on data classifications. This is particularly valuable for organizations dealing with sensitive or classified information, as it ensures that data is accessed only by users with the appropriate security labels.

- Compliance Assurance:
  OLS helps organizations adhere to regulatory compliance requirements by providing a robust framework for data classification and access control, making it an essential feature for industries with stringent compliance mandates.

02. Data Encryption

e) Transparent Data Encryption (TDE):
   Transparent Data Encryption (TDE) is a fundamental security feature in Oracle 19c/21c that ensures the confidentiality of data at rest. Its relevance includes:

- Preventing Unauthorized Access:
  TDE encrypts data stored on disk, preventing unauthorized access to sensitive information even if physical storage devices are compromised.

- Regulatory Compliance:
  TDE helps organizations meet regulatory compliance requirements by safeguarding sensitive data, which is particularly crucial for industries dealing with sensitive customer information, financial data, or healthcare records.

f) Data Redaction:

Data Redaction is another crucial feature in Oracle 19c/21c that helps protect data confidentiality while allowing controlled access:

- Confidentiality Control:
  Data Redaction allows organizations to mask or partially obscure sensitive data based on user privileges, ensuring that only authorized users see complete information while protecting sensitive data from unauthorized viewing.

- Data Privacy Compliance:
  It assists in complying with data privacy regulations, such as GDPR, by enabling organizations to share data while protecting individual privacy.

g) Encryption of Backup Data:
   The encryption of backup data in Oracle 19c/21c is significant for ensuring the security of data during backup and restore operations:

- Backup Data Security:
  Encrypting backup data prevents unauthorized access to sensitive information during backup and restore processes, safeguarding data both at rest and during data transfer.

- Disaster Recovery:
  Encrypted backups enhance disaster recovery strategies by ensuring that backed-up data remains secure, even if backup files are lost or stolen.

h) Integration with Hardware Security Modules (HSM):
   Integration with Hardware Security Modules (HSMs) in Oracle 19c/21c is crucial for securing encryption keys:

- Key Security:
  HSM integration adds an extra layer of security by safeguarding encryption keys in dedicated, tamper-resistant hardware devices, making it extremely difficult for attackers to access or tamper with the keys.

- Regulatory Compliance:
  It helps meet compliance requirements that mandate strong key management practices, as HSMs are often required for storing cryptographic keys securely.