ENTERPRISE DATABASE SYSTEMS

Oracle Database: architecture, capabilities and business applications

MULTITENANT | SECURITY | ANALYTICS | HIGH AVAILABILITY

An introduction to enterprise-grade data platforms

Lessons roadmap

Part I · Fundamentals

1. Introduction and deployment
2. NLS: language and locale settings
3. Session management
4. Listeners and network services
5. Initialization parameter files

Part II · Administration

6. Containerization
7. CDB root and PDB users
8. Backup and recovery
9. Privileges, roles and profiles

What makes a database ,,enterprise-grade”?

Reliability

Transactions, recovery, backups and disaster recovery.

Scale

Large data volumes, concurrent users and complex workloads.

Governance

Fine-grained privileges, auditing and compliance controls.

Operational continuity

High availability and controlled maintenance windows.

Multiple workload types

OLTP, reporting, analytics and mixed-model data.

Administration

Monitoring, performance tuning and automation.

The enterprise database ecosystem

Major vendors and platforms

Oracle Database

Enterprise RDBMS / multi-model

Microsoft SQL Server

Enterprise RDBMS

PostgreSQL

Open-source relational database

IBM Db2

Enterprise database platform

Amazon Aurora / RDS

Managed cloud databases

Google Cloud databases

Managed relational and analytical services

Different systems serve overlapping workloads, but differ in cost, architecture, ecosystem and operational model.

Global database market: context and metrics

Worldwide DBMS spending by deployment model (2024)



Oracle ranked #1 in DB-Engines popularity (October 2026).

Important: popularity scores are not vendor revenue shares. A verified Oracle-specific global market-share percentage is not publicly disclosed in the cited free abstracts.

Sources: Gartner “Market Share: DBMS, Worldwide, 2024” (2025); DB-Engines archive, Oct 2026.

Where is Oracle used?

Finance and banking

Transactions, auditability, resilience and regulated data.

Telecommunications

Customer records, billing and high-volume operations.

Public sector

Critical services, identity, record management and reporting.

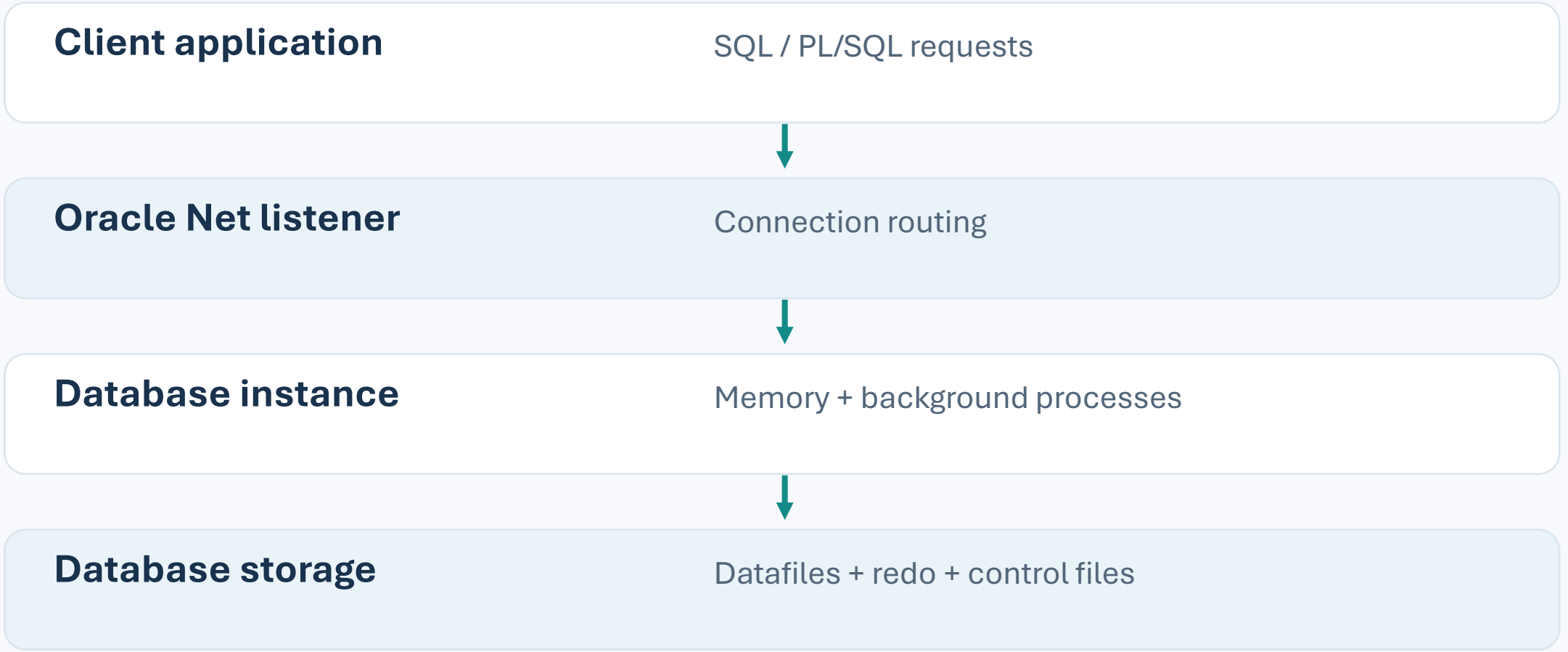
Manufacturing and logistics

Supply chains, ERP and operational reporting.

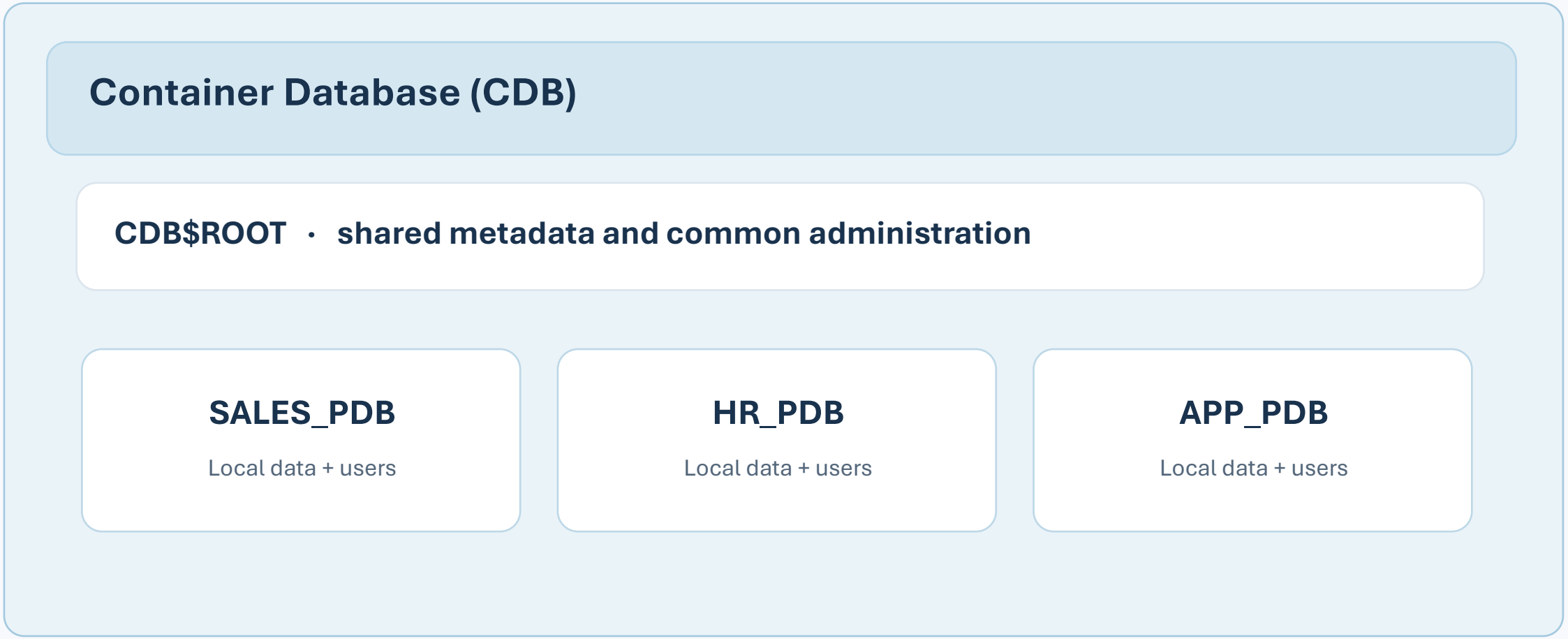
Retail and large enterprises

Orders, payments, inventory and analytical reporting.

How Oracle Database is organized



Multitenant architecture: CDB and PDB



Isolation and permissions

Logical isolation

Data and schemas are separated between pluggable databases.

Administrative scope

Common users work across containers when granted privileges; local users are scoped to a PDB.

Resource governance

Resource Manager can control CPU and other resources assigned to PDB workloads.

Isolation is logical, not the same as a dedicated physical server or full VM boundary.

Availability, resilience and recovery

RAC

Multiple database instances support availability and horizontal workload capacity.

Data Guard

Standby databases and disaster recovery architecture.

RMAN

Backup, restore and recovery management.

Flashback

Time-oriented recovery from some logical errors.

Monitoring

Diagnostics, performance metrics and operational alerts.

Security and governance

- Authentication and encrypted network connections
- Roles, system privileges and object privileges
- Profiles: password policies and resource limits
- Auditing and activity monitoring
- Data encryption and fine-grained access controls
- Separation of duties across CDB root and PDBs

How to connect to Oracle Database

SQL*Plus	Native Oracle command-line utility	Administration, scripts, diagnostics
SQLcl	Modern Oracle SQL command-line client	History, completion, formatting, automation
SQL Developer	Graphical database IDE	SQL worksheets, PL/SQL, DBA tasks
Visual Studio Code	Oracle SQL Developer extension	SQL, PL/SQL and schema navigation

Assessment and lab requirements

- Assessment is primarily based on attendance and active participation.
- An optional assignment may include installing an operating system on a virtual machine.
- The assignment should be documented in a PDF report.

Oracle Database instance parameters

- A short practical case study will introduce basic administration and troubleshooting.
- We will inspect parameters, processes, connection errors, sessions, and NLS settings.

Case study: a database connection problem

- Jan is a systems administrator at a company using Oracle Database.
- A client reports that the database is no longer accessible.
- Before the failure, the application displayed messages in an unfamiliar language.
- Jan investigates the connection problem and the language settings.

Step 1: SYSDBA access and parameters

Jan connects with SYSDBA privileges and reviews the Oracle Database instance parameters.

```
select * from v$parameter;
```

Query Result

SQL | All Rows Fetched: 474 in 0,267 seconds

	NUM	NAME	TYPE	VALUE	DISPLAY_VALUE	DEFAULT_VALUE
1	51	lock_name_space	2	(null)	(null)	(null)
2	52	processes	3	480	480	0
3	53	sessions	3	742	742	(null)
4	82	timed_statistics	1	TRUE	TRUE	FALSE
5	83	timed_os_statistics	3	0	0	0
6	84	resource_limit	1	TRUE	TRUE	TRUE
7	85	license_max_sessions	3	0	0	0
8	86	license_sessions_warning	3	0	0	0
9	95	long_module_action	1	TRUE	TRUE	TRUE
10	117	standby_db_preserve_states	2	NONE	NONE	NONE
11	121	instance_abort_delay_time	3	0	0	0
12	136	cpu_count	3	2	2	0
13	137	cpu_min_count	2	2	2	(null)
14	149	instance_groups	2	(null)	(null)	(null)
15	158	event	2	(null)	(null)	NONE
16	173	sga_max_size	6	1610612736	1536M	0

Step 2: database processes

Jan inspects Oracle background and session-related processes to identify possible connection issues.

Worksheet | Query Builder

```
select * from v$process
```

Script Output | Query Result

SQL | Fetched 50 rows in 0,014 seconds

	ADDR	PID	SOSID	SPID	STID	EXECUTION_TYPE	PNAME	USERNAME	SERIAL#	TERMINAL	PROGRAM
4	00007FFB4155FCF0	4	3264_6204	3264	6204	THREAD	CLMN	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (CLMN)
5	00007FFB41561378	5	3264_6220	3264	6220	THREAD	PSP0	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (PSP0)
6	00007FFB41562A00	6	3264_6224	3264	6224	THREAD	VKTM	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (VKTM)
7	00007FFB41564088	7	3264_6272	3264	6272	THREAD	GEN0	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (GEN0)
8	00007FFB41565710	8	3264_6284	3264	6284	THREAD	MMAN	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (MMAN)
9	00007FFB41566D98	9	3264_7356	3264	7356	THREAD	TT00	OracleServiceXE	2	DESKTOP-EKGFUOC	ORACLE.EXE (TT00)
10	00007FFB41568420	10	3264_6296	3264	6296	THREAD	GEN1	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (GEN1)
11	00007FFB41569AA8	11	3264_6300	3264	6300	THREAD	GEN2	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (GEN2)
12	00007FFB4156B130	12	3264_6304	3264	6304	THREAD	VOSD	OracleServiceXE	1	DESKTOP-EKGFUOC	ORACLE.EXE (VOSD)

Step 3: failed login attempts

Jan examines failed connections to determine whether authentication errors are involved.

```
Audit connect;
--SELECT * FROM SYS.AUD$;
SELECT NTIMESTAMP#, USERHOST, TERMINAL, COMMENT$TEXT, CURRENT_USER
FROM SYS.AUD$
WHERE ACTION# = 100
ORDER BY NTIMESTAMP# DESC;
```

Script Output × Query Result ×

SQL | All Rows Fetched: 15 in 0,003 seconds

	NTIMESTAMP#	USERHOST	TERMINAL	COMMENT$TEXT	CURRENT_USER
1	23/05/12 10:52:08,893000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
2	23/05/12 10:52:08,645000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
3	23/05/12 10:52:08,424000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
4	23/05/12 10:52:08,173000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
5	23/05/12 10:52:07,940000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
6	23/05/12 10:52:07,709000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
7	23/05/12 10:52:07,469000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
8	23/05/12 10:52:07,240000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
9	23/05/12 10:52:07,012000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
10	23/05/12 10:52:06,742000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
11	23/05/12 10:52:04,980000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
12	23/05/12 10:52:04,805000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
13	23/05/12 10:52:04,435000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
14	23/05/12 10:52:03,812000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM
15	23/05/12 10:48:01,449000000	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	Authenticated by: DATABASE;AUTHENTICATED IDENTITY: SYSTEM; DB_UNIQUE_NAME="XE"	SYSTEM

Step 4: ORA-01017 identified

The RETURNCODE value 1017 indicates an invalid username or password (ORA-01017).

```
Audit connect;
--SELECT * FROM SYS.AUD$;
SELECT NTIMESTAMP#, USERHOST, TERMINAL, COMMENT$TEXT, CURRENT_USER
FROM SYS.AUD$
WHERE ACTION# = 100
ORDER BY NTIMESTAMP# DESC;
```

Script Output | Query...

SQL | All Rows Fetched: 2 in 0,004 seconds

	SESSIONID	ENTRYID	STATEMENT	TIMESTAMP#	USERID	USERHOST	TERMINAL	ACTION#	RETURN...	OBJ$CREATOR
1	90016	1	1	(null)	SYSTEM	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	100	1017	(null)
2	90017	1	1	(null)	SYSTEM	WORKGROUP\DESKTOP-EKGFUOC	DESKTOP-EKGFUOC	100	1017	(null)

Step 5: session inspection

Jan lists active sessions and examines connections that might be related to the reported problem.

```
SELECT * from V$SESSION where PROGRAM not like '%ORACLE.EXE%';
```

Script Output | Query Result

SQL | All Rows Fetched: 3 in 0,025 seconds

	SADDR	SID	SERIAL#	AUDSID	PADDR	USER#	USERNAME	COMMAND	OWNERID	TADDR	LOCKWAIT	STATUS	SERVER	SCHEMA#	SCHEMANAME	OSU
1	00007FFB402CB700	401	49326	4294967295	00007FFB415A4CF8	0	SYS	0	2147483644	(null)	(null)	INACTIVE	DEDICATED	0	SYS	BD
2	00007FFB40315DD0	430	42429	4294967295	00007FFB415B2E48	0	SYS	3	2147483644	(null)	(null)	ACTIVE	DEDICATED	0	SYS	BD
3	00007FFB4031D900	433	14028	80002	00007FFB415B8868	9	SYSTEM	3	2147483644	(null)	(null)	INACTIVE	DEDICATED	9	SYSTEM	BD

Step 6: database NLS configuration

Jan checks the database language and locale settings, including character encoding and session behavior.

	PARAMETER	DATABASE	INSTANCE	SESSION
1	NLS_CALENDAR	GREGORIAN	(null)	GREGORIAN
2	NLS_CHARACTERSET	AL32UTF8	(null)	(null)
3	NLS_COMP	BINARY	BINARY	BINARY
4	NLS_CURRENCY	$	(null)	zł
5	NLS_DATE_FORMAT	DD-MON-RR	(null)	RR/MM/DD
6	NLS_DATE_LANGUAGE	AMERICAN	(null)	POLISH
7	NLS_DUAL_CURRENCY	$	(null)	zł
8	NLS_ISO_CURRENCY	AMERICA	(null)	POLAND
9	NLS_LANGUAGE	AMERICAN	POLISH	POLISH
10	NLS_LENGTH_SEMANTICS	BYTE	BYTE	BYTE
11	NLS_NCHAR_CHARACTERSET	AL16UTF16	(null)	(null)
12	NLS_NCHAR_CONV_EXCP	FALSE	FALSE	FALSE
13	NLS_NUMERIC_CHARACTERS	.,	(null)	,
14	NLS_RDBMS_VERSION	21.0.0.0.0	(null)	(null)
15	NLS_SORT	BINARY	(null)	POLISH
16	NLS_TERRITORY	AMERICA	POLAND	POLAND
17	NLS_TIME_FORMAT	HH.MI.SSXFF AM	(null)	HH24:MI:SSXFF
18	NLS_TIMESTAMP_FORMAT	DD-MON-RR HH.MI.SSXFF AM	(null)	RR/MM/DD HH24:MI:SSXFF
19	NLS_TIMESTAMP_TZ_FORMAT	DD-MON-RR HH.MI.SSXFF AM TZR	(null)	RR/MM/DD HH24:MI:SSXFF TZR
20	NLS_TIME_TZ_FORMAT	HH.MI.SSXFF AM TZR	(null)	HH24:MI:SSXFF TZR

Step 7: client and session NLS settings

The comparison shows that the session language has been set to German.

	PARAMETER	DATABASE	INSTANCE	SESSION
1	NLS_CALENDAR	GREGORIAN	(null)	GREGORIAN
2	NLS_CHARACTERSET	AL32UTF8	(null)	(null)
3	NLS_COMP	BINARY	BINARY	BINARY
4	NLS_CURRENCY	$	(null)	zł
5	NLS_DATE_FORMAT	DD-MON-RR	(null)	RR/MM/DD
6	NLS_DATE_LANGUAGE	AMERICAN	(null)	POLISH
7	NLS_DUAL_CURRENCY	$	(null)	zł
8	NLS_ISO_CURRENCY	AMERICA	(null)	POLAND
9	NLS_LANGUAGE	AMERICAN	POLISH	POLISH
10	NLS_LENGTH_SEMANTICS	BYTE	BYTE	BYTE
11	NLS_NCHAR_CHARACTERSET	AL16UTF16	(null)	(null)
12	NLS_NCHAR_CONV_EXCP	FALSE	FALSE	FALSE
13	NLS_NUMERIC_CHARACTERS	.,	(null)	,
14	NLS_RDBMS_VERSION	21.0.0.0.0	(null)	(null)
15	NLS_SORT	BINARY	(null)	POLISH
16	NLS_TERRITORY	AMERICA	POLAND	POLAND
17	NLS_TIME_FORMAT	HH.MI.SSXFF AM	(null)	HH24:MI:SSXFF
18	NLS_TIMESTAMP_FORMAT	DD-MON-RR HH.MI.SSXFF AM	(null)	RR/MM/DD HH24:MI:SSXFF
19	NLS_TIMESTAMP_TZ_FORMAT	DD-MON-RR HH.MI.SSXFF AM TZR	(null)	RR/MM/DD HH24:MI:SSXFF TZR
20	NLS_TIME_TZ_FORMAT	HH.MI.SSXFF AM TZR	(null)	HH24:MI:SSXFF TZR

	PARAMETER	DATABASE	INSTANCE	SESSION
1	NLS_CALENDAR	GREGORIAN	(null)	GREGORIAN
2	NLS_CHARACTERSET	AL32UTF8	(null)	(null)
3	NLS_COMP	BINARY	BINARY	BINARY
4	NLS_CURRENCY	$	(null)	zł
5	NLS_DATE_FORMAT	DD-MON-RR	(null)	RR/MM/DD
6	NLS_DATE_LANGUAGE	AMERICAN	(null)	GERMAN
7	NLS_DUAL_CURRENCY	$	(null)	zł
8	NLS_ISO_CURRENCY	AMERICA	(null)	POLAND
9	NLS_LANGUAGE	AMERICAN	POLISH	GERMAN
10	NLS_LENGTH_SEMANTICS	BYTE	BYTE	BYTE
11	NLS_NCHAR_CHARACTERSET	AL16UTF16	(null)	(null)
12	NLS_NCHAR_CONV_EXCP	FALSE	FALSE	FALSE
13	NLS_NUMERIC_CHARACTERS	.,	(null)	,
14	NLS_RDBMS_VERSION	21.0.0.0.0	(null)	(null)
15	NLS_SORT	BINARY	(null)	GERMAN
16	NLS_TERRITORY	AMERICA	POLAND	POLAND
17	NLS_TIME_FORMAT	HH.MI.SSXFF AM	(null)	HH24:MI:SSXFF
18	NLS_TIMESTAMP_FORMAT	DD-MON-RR HH.MI.SSXFF AM	(null)	RR/MM/DD HH24:MI:SSXFF
19	NLS_TIMESTAMP_TZ_FORMAT	DD-MON-RR HH.MI.SSXFF AM TZR	(null)	RR/MM/DD HH24:MI:SSXFF TZR
20	NLS_TIME_TZ_FORMAT	HH.MI.SSXFF AM TZR	(null)	HH24:MI:SSXFF TZR

Step 8: resolving the incident

- Jan resets the affected user password.
- He corrects the session language settings.
- He verifies that the client can connect and display messages correctly.