

{Made Easy}

Oracle Database

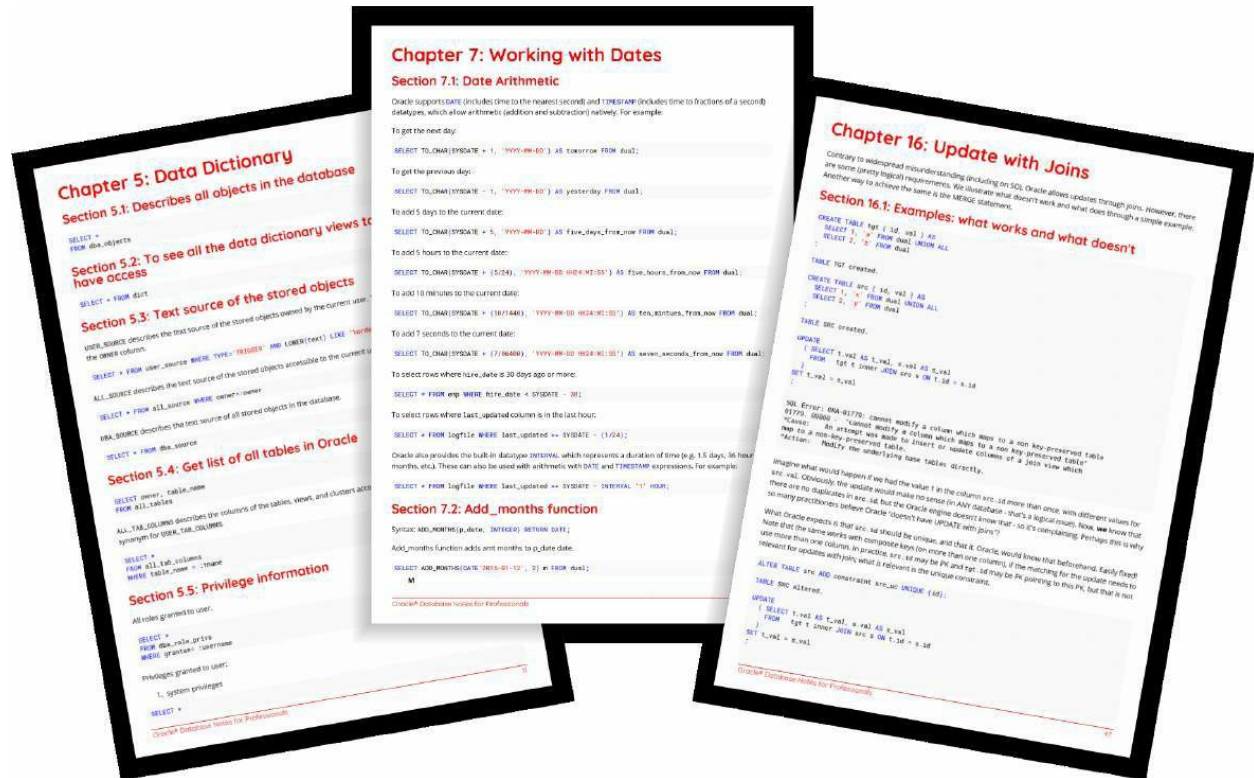
MADE
EASY

**A Beginners Handbook To Easily Learn
Oracle Database**

Oracle Database

Oracle[®] Database

Notes for Professionals



100+ pages

of professional hints and tricks

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Chapter 1: Getting started with Oracle Database

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Oracle V2 1979-01-01

Oracle Version 3 1983-01-01

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Oracle8 1997-07-01

Oracle8i 1999-02-01

Oracle9i 2001-06-01

Oracle 10g 2003-01-01

Oracle 11g 2007-01-01

Oracle 12c 2013-01-01

Section 1.1: Hello World

```
SELECT 'Hello world!' FROM dual;
```

In Oracle's flavor of SQL, "dual is just a convenience table". It was originally intended to double rows via a JOIN, but now contains one row with a DUMMY value of 'X'.

Section 1.2: SQL Query

List employees earning more than \$50000 born this century. List their name, date of birth and salary, sorted alphabetically by name.

```
SELECT employee_name, date_of_birth, salary
FROM employees
WHERE salary > 50000
```

```
AND date_of_birth >= DATE '2000-01-01'
ORDER BY employee_name;
```

Show the number of employees in each department with at least 5 employees. List the largest departments first.

```
SELECT department_id, COUNT(*) FROM employees
GROUP BY department_id
HAVING COUNT(*) >= 5
ORDER BY COUNT(*) DESC;
```

Section 1.3: Hello world! from table

Create a simple table

```
CREATE TABLE MY_table (
what VARCHAR2(10),
who VARCHAR2(10),
mark VARCHAR2(10)
);
```

Insert values (you can omit target columns if you provide values for all columns)

```
INSERT INTO my_table (what, who, mark) VALUES ('Hello', 'world', '!');
INSERT INTO my_table VALUES ('Bye bye', 'ponies', '?');
INSERT INTO my_table (what) VALUES('Hey');
```

Remember to commit, because Oracle uses *transactions* COMMIT;

Select your data:

```
SELECT what, who, mark FROM my_table WHERE what='Hello';
```

Section 1.4: Hello World from PL/SQL

```
/* PL/SQL is a core Oracle Database technology, allowing you to build  
clean, secure, optimized APIs to SQL and business logic. */
```

```
SET serveroutput ON
```

```
BEGIN  
DBMS_OUTPUT.PUT_LINE ('Hello World!');  
END;
```

Chapter 2: Getting started with PL/SQL

Section 2.1: Hello World

```
SET serveroutput ON
```

```
DECLARE  
message CONSTANT VARCHAR2(32767):= 'Hello, World!';  
BEGIN  
DBMS_OUTPUT.put_line(message);  
END;  
/
```

Command `SET serveroutput ON` is required in SQL*Plus and SQL Developer clients to enable the output of `DBMS_OUTPUT`. Without the command nothing is displayed.

The `END;` line signals the end of the anonymous PL/SQL block. To run the code from SQL command line, you may need to type `/` at the beginning of the first blank line after the last line of the code. When the above code is executed at SQL prompt, it produces the following result:

Hello, World! PL/SQL procedure successfully completed.

Section 2.2: Definition of PL/SQL

PL/SQL (Procedural Language/Structured Query Language) is Oracle Corporation's procedural extension for SQL and the Oracle relational database. PL/SQL is available in Oracle Database (since version 7), TimesTen in-memory database (since version 11.2.1), and IBM DB2 (since version 9.7).

The basic unit in PL/SQL is called a block, which is made up of three parts: a declarative part, an executable part, and an exception-building part.

DECLARE

<declarations section>

BEGIN

<executable command(s)>

EXCEPTION

<EXCEPTION handling>

END;

Declarations - This section starts with the keyword DECLARE. It is an optional section and defines all variables, cursors, subprograms, and other elements to be used in the program.

Executable Commands - This section is enclosed between the keywords BEGIN and END and it is a mandatory section. It consists of the executable PL/SQL statements of the program. It should have at least one executable line of code, which may be just a NULL command to indicate that nothing should be executed.

Exception Handling - This section starts with the keyword EXCEPTION. This section is again optional and contains exception(s) that handle errors in the program.

Every PL/SQL statement ends with a semicolon (;). PL/SQL blocks can be nested within other PL/SQL blocks using BEGIN and END.

In anonymous block, only executable part of block is required, other parts are not necessary. Below is example of simple anonymous code, which does not do anything but perform without error reporting.

BEGIN

```
NULL;  
END;  
/
```

Missing executable instruction leads to an error, because PL/SQL does not support empty blocks. For example, execution of code below leads to an error:

```
BEGIN END;  
/
```

Application will raise error:

```
END;  
*
```

ERROR AT line 2:

ORA-06550: line 2, column 1:

PLS-00103: Encountered the symbol "END" WHEN expecting one OF the following: (BEGIN CASE DECLARE EXIT FOR GOTO IF LOOP MOD NULL PRAGMA

RAISE RETURN SELECT UPDATE WHILE WITH <an identifier>
<a double-quoted delimited-identifier> <a bind variable> <<
continue CLOSE CURRENT DELETE FETCH LOCK INSERT OPEN
ROLLBACK SAVEPOINT SET SQL EXECUTE COMMIT FORALL
MERGE pipe purge

Symbol " * " in line below keyword "END;" means, that the block which ends with this block is empty or bad constructed. Every execution block needs instructions to do, even if it does nothing, like in our example.

Section 2.3: Difference between %TYPE and %ROWTYPE

%TYPE: Used to declare a field with the same type as that of a specified table's column.

```
DECLARE vEmployeeName Employee.Name%TYPE;  
BEGIN  
SELECT Name
```

```
INTO vEmployeeName FROM Employee  
WHERE ROWNUM = 1;
```

```
DBMS_OUTPUT.PUT_LINE(vEmployeeName); END;  
/
```

%ROWTYPE: Used to declare a record with the same types as found in the specified table, view or cursor (= multiple columns).

```
DECLARE rEmployee Employee%ROWTYPE;  
BEGIN rEmployee.Name := 'Matt'; rEmployee.Age := 31;
```

```
DBMS_OUTPUT.PUT_LINE(rEmployee.Name);  
DBMS_OUTPUT.PUT_LINE(rEmployee.Age); END;  
/
```

Section 2.4: Create or replace a view

In this example we are going to create a view.

A view is mostly used as a simple way of fetching data from multiple tables.

Example 1:

View with a select on one table.

```
CREATE OR REPLACE VIEW LessonView AS  
SELECT L.*  
FROM Lesson L;
```

Example 2:

View with a select on multiple tables.

```
CREATE OR REPLACE VIEW ClassroomLessonView AS SELECT C.Id,  
C.Name,  
L.Subject,  
L.Teacher  
  
FROM Classroom C,  
Lesson L  
WHERE C.Id = L.ClassroomId;
```

To call this views in a query you can use a select statement.

```
SELECT * FROM LessonView;  
SELECT * FROM ClassroomLessonView;
```

Section 2.5: Create a table

Below we are going to create a table with 3 columns.

The column Id must be filled is, so we define it **NOT NULL**.

On the column Contract we also add a check so that the only value allowed is 'Y' or 'N'. If an insert is done and this column is not specified during the insert then default a 'N' is inserted.

```
CREATE TABLE Employee (  
  Id NUMBER NOT NULL,  
  Name VARCHAR2(60),  
  Contract CHAR DEFAULT 'N' NOT NULL,  
  --  
  CONSTRAINT p_Id PRIMARY KEY(Id),  
  CONSTRAINT c_Contract CHECK (Contract IN('Y','N'))  
);
```

Section 2.6: About PL/SQL

PL/SQL stands for Procedural Language extensions to SQL. PL/SQL is available only as an "enabling technology" within other software products; it does not exist as a standalone language. You can use PL/SQL in the Oracle relational database, in the Oracle Server, and in client-side application development tools, such as Oracle Forms. Here are some of the ways you might use PL/SQL:

1. To build stored procedures. .
2. To create database triggers.
3. To implement client-side logic in your Oracle Forms application.
4. To link a World Wide Web home page to an Oracle database.

Chapter 3: Anonymous PL/SQL Block

Section 3.1: An example of an anonymous block

```

DECLARE
-- declare a variable
message VARCHAR2(20);

BEGIN
-- assign value to variable
message := 'HELLO WORLD';

-- print message to screen

DBMS_OUTPUT.PUT_LINE(message);
END;
/

```

Chapter 4: PL/SQL procedure

PL/SQL procedure is a group of SQL statements stored on the server for reuse. It increases the performance because the SQL statements do not have to be recompiled every time it is executed.

Stored procedures are useful when same code is required by multiple applications. Having stored procedures eliminates redundancy, and introduces simplicity to the code. When data transfer is required between the client and server, procedures can reduce communication cost in certain situations.

Section 4.1: Syntax

```

CREATE [OR REPLACE] PROCEDURE procedure_name
[(parameter_name [IN | OUT | IN OUT] TYPE [, ...])]
{IS | AS}

```

< declarations >

```

BEGIN

```

< procedure_body >

```

EXCEPTION -- Exception-handling part begins

```

```

<EXCEPTION handling goes here >

```

```
WHEN exception1 THEN
exception1-handling-statements
END procedure_name;
```

procedure-name specifies the name of the procedure.

[OR REPLACE] option allows modifying an existing procedure.

The optional parameter list contains name, mode and types of the parameters. IN represents that value will be passed from outside and OUT represents that this parameter will be used to return a value outside of the procedure. If no mode is specified, parameter is assumed to be of IN mode.

In the declaration section we can declare variables which will be used in the body part.

procedure-body contains the executable part.

The AS keyword is used instead of the IS keyword for creating a standalone procedure.

exception section will handle the exceptions from the procedure. This section is optional.

Section 4.2: Hello World

The following simple procedure displays the text "Hello World" in a client that supports `DBMS_OUTPUT`.

```
CREATE OR REPLACE PROCEDURE helloworld
AS
BEGIN

DBMS_OUTPUT.put_line('Hello World!');
END;
/
```

You need to execute this at the SQL prompt to create the procedure in the database, or you can run the query below to get the same result:

```
SELECT 'Hello World!' FROM dual;
```

Section 4.3: In/Out Parameters

PL/SQL uses IN, OUT, IN OUT keywords to define what can happen to a passed parameter.

IN specifies that the parameter is read only and the value cannot be changed by the procedure. OUT specifies the parameter is write only and a procedure can assign a value to it, but not reference the value.

IN OUT specifies the parameter is available for reference and modification.

```
PROCEDURE procedureName(x IN INT, strVar IN VARCHAR2, ans OUT  
VARCHAR2) ...
```

```
...
```

```
END procedureName;
```

```
procedureName(firstvar, secondvar, thirdvar);
```

The variables passed in the above example need to be typed as they are defined in the procedure parameter section.

Chapter 5: Data Dictionary

Section 5.1: Describes all objects in the database

```
SELECT *  
FROM dba_objects
```

Section 5.2: To see all the data dictionary views to which you have access

```
SELECT * FROM dict
```

Section 5.3: Text source of the stored objects

USER_SOURCE describes the text source of the stored objects owned by the current user. This view does not display the OWNER column.

```
SELECT * FROM user_source WHERE TYPE='TRIGGER' AND  
LOWER(text) LIKE '%order%'
```

ALL_SOURCE describes the text source of the stored objects accessible to the current user.

```
SELECT * FROM all_source WHERE owner=:owner
```

DBA_SOURCE describes the text source of all stored objects in the database.

```
SELECT * FROM dba_source
```

Section 5.4: Get list of all tables in Oracle

```
SELECT owner, table_name  
FROM all_tables
```

ALL_TAB_COLUMNS describes the columns of the tables, views, and clusters accessible to the current user. COLS is a synonym for USER_TAB_COLUMNS.

```
SELECT *  
FROM all_tab_columns  
WHERE table_name = :tname
```

Section 5.5: Privilege information

All roles granted to user.

```
SELECT *  
FROM dba_role_privs  
WHERE grantee = :username
```

Privileges granted to user:

1. system privileges

```
SELECT *  
FROM dba_sys_privs  
WHERE grantee = :username
```

2. object grants

```
SELECT *  
FROM dba_tab_privs  
WHERE grantee = :username
```

Permissions granted to roles.

Roles granted to other roles.

```
SELECT *  
FROM role_role_privs
```

```
WHERE role IN (SELECT granted_role FROM dba_role_privs WHERE grantee= :username)
```

1. system privileges

```
SELECT *  
FROM role_sys_privs  
WHERE role IN (SELECT granted_role FROM dba_role_privs WHERE grantee= :username)
```

2. object grants

```
SELECT *  
FROM role_tab_privs  
WHERE role IN (SELECT granted_role FROM dba_role_privs WHERE grantee= :username)
```

Section 5.6: Oracle version

```
SELECT *  
FROM v$version
```

Chapter 6: Dates

Section 6.1: Date Arithmetic - Difference between Dates in Days, Hours, Minutes and/or Seconds

In oracle, the difference (in days and/or fractions thereof) between two DATES can be found using subtraction:

```
SELECT DATE '2016-03-23' - DATE '2015-12-25' AS difference FROM DUAL;
```

Outputs the number of days between the two dates:

```
DIFFERENCE  
-----89
```

And:

```
SELECT TO_DATE( '2016-01-02 01:01:12', 'YYYY-MM-DD HH24:MI:SS'
)
- TO_DATE( '2016-01-01 00:00:00', 'YYYY-MM-DD HH24:MI:SS' ) AS
difference
```

```
FROM DUAL
```

Outputs the fraction of days between two dates:

```
DIFFERENCE
-----1.0425
```

The difference in hours, minutes or seconds can be found by multiplying this number by 24, $24*60$ or $24*60*60$ respectively.

The previous example can be changed to get the days, hours, minutes and seconds between two dates using:

```
SELECT TRUNC( difference ) AS days, TRUNC( MOD( difference * 24, 24
) ) AS hours, TRUNC( MOD( difference * 24*60, 60 ) ) AS minutes,
TRUNC( MOD( difference * 24*60*60, 60 ) ) AS seconds
```

```
FROM (
SELECT TO_DATE( '2016-01-02 01:01:12', 'YYYY-MM-DD HH24:MI:SS'
)
- TO_DATE( '2016-01-01 00:00:00', 'YYYY-MM-DD HH24:MI:SS' ) AS
difference
```

```
FROM DUAL
```

```
);
```

(Note: `TRUNC()` is used rather than `FLOOR()` to correctly handle negative differences.)

Outputs:

```
DAYS HOURS MINUTES SECONDS
---- -----1 1 1 12
```

The previous example can also be solved by converting the numeric difference to an **interval** using `NUMTODSINTERVAL()`:

```
SELECT EXTRACT( DAY EXTRACT( HOUR FROM difference ) AS
days, FROM difference ) AS hours,
```

```
EXTRACT( MINUTE FROM difference ) AS minutes,
EXTRACT( SECOND FROM difference ) AS seconds
```

```
FROM (
```

```
SELECT NUMTODSINTERVAL(
```

```
TO_DATE ( '2016-01-02 01:01:12', 'YYYY-MM-DD HH24:MI:SS' )
```

```
- TO_DATE( '2016-01-01 00:00:00', 'YYYY-MM-DD HH24:MI:SS' ),
```

```
'DAY'
```

```
) AS difference
```

```
FROM DUAL
```

```
);
```

Section 6.2: Setting the Default Date Format Model

When Oracle implicitly converts from a `DATE` to a string or vice-versa (or when `TO_CHAR()` or `TO_DATE()` are explicitly called without a format model) the `NLS_DATE_FORMAT` session parameter will be used as the format model in the conversion. If the literal does not match the format model then an exception will be raised.

You can review this parameter using:

```
SELECT VALUE FROM NLS_SESSION_PARAMETERS WHERE
PARAMETER = 'NLS_DATE_FORMAT';
```

You can set this value within your current session using:

```
ALTER SESSION SET NLS_DATE_FORMAT = 'YYYY-MM-DD
HH24:MI:SS';
```

(Note: this does not change the value for any other users.)

If you rely on the `NLS_DATE_FORMAT` to provide the format mask in `TO_DATE()` or `TO_CHAR()` then you should not be surprised when your queries break if this value is ever changed.

Section 6.3: Date Arithmetic - Difference between Dates in Months or Years

The difference in months between two dates can be found using the MONTHS_BETWEEN(date1, date2):

```
SELECT MONTHS_BETWEEN( DATE '2016-03-10', DATE '2015-03-10' )  
AS difference FROM DUAL;
```

Outputs:

```
DIFFERENCE  
-----12
```

If the difference includes part months then it will return the fraction of the month based on there being 31 days in each month:

```
SELECT MONTHS_BETWEEN( DATE '2015-02-15', DATE '2015-01-01' )  
AS difference FROM DUAL;
```

Outputs:

```
DIFFERENCE  
-----1.4516129
```

Due to MONTHS_BETWEEN assuming 31 days per month when there can be fewer days per month then this can result in different values for differences spanning the boundaries between months.

Example:

```
SELECT MONTHS_BETWEEN( DATE'2016-02-01', DATE'2016-02-01' -  
INTERVAL '1' DAY ) AS "JAN-FEB", MONTHS_BETWEEN(  
DATE'2016-03-01', DATE'2016-03-01' - INTERVAL '1' DAY ) AS "FEB-  
MAR", MONTHS_BETWEEN( DATE'2016-04-01', DATE'2016-04-01' -  
INTERVAL '1' DAY ) AS "MAR-APR", MONTHS_BETWEEN(  
DATE'2016-05-01', DATE'2016-05-01' - INTERVAL '1' DAY ) AS "APR-  
MAY"
```

```
FROM DUAL;
```

Output:

```
JAN-FEB FEB-MAR MAR-APR APR-MAY  
-----0.03226 0.09677 0.03226 0.06452
```

The difference in years can be found by dividing the month difference by 12.

Section 6.4: Extract the Year, Month, Day, Hour, Minute or Second Components of a Date

The year, month or day components of a **DATE** data type can be found using the **EXTRACT([YEAR | MONTH | DAY] FROM datevalue)**

```
SELECT EXTRACT (YEAR FROM DATE '2016-07-25') AS YEAR,  
EXTRACT (MONTH FROM DATE '2016-07-25') AS MONTH, EXTRACT  
(DAY FROM DATE '2016-07-25') AS DAY
```

```
FROM DUAL;
```

Outputs:

```
YEAR MONTH DAY  
---- -  
--2016 7 25
```

The time (hour, minute or second) components can be found by either:

Using **CAST(datevalue AS TIMESTAMP)** to convert the **DATE** to a **TIMESTAMP** and then using **EXTRACT([HOUR | MINUTE | SECOND] FROM timestampvalue);** or

Using **TO_CHAR(datevalue, format_model)** to get the value as a string.

For example:

```
SELECT EXTRACT( HOUR FROM CAST( datetime AS TIMESTAMP ) )  
AS Hours,  
EXTRACT( MINUTE FROM CAST( datetime AS TIMESTAMP ) ) AS  
Minutes, EXTRACT( SECOND FROM CAST( datetime AS TIMESTAMP )  
) AS Seconds
```

```
FROM (  
SELECT TO_DATE( '2016-01-01 09:42:01', 'YYYY-MM-DD HH24:MI:SS'  
) AS datetime FROM DUAL  
);
```

Outputs:

```
HOURS MINUTES SECONDS
```

Section 6.5: Generating Dates with No Time Component

All **DATE**s have a time component; however, it is customary to store dates which do not need to include time information with the hours/minutes/seconds set to zero (i.e. midnight).

Use an **ANSI DATE literal** (using **ISO 8601 Date format**):

```
SELECT DATE '2000-01-01' FROM DUAL;
```

Convert it from a string literal using **TO_DATE()**:

```
SELECT TO_DATE( '2001-01-01', 'YYYY-MM-DD' ) FROM DUAL;
```

*(More information on the **date format models** can be found in the Oracle documentation.)*

or:

```
SELECT TO_DATE(  
'January 1, 2000, 00:00 A.M.',  
'Month dd, YYYY, HH12:MI A.M.',  
'NLS_DATE_LANGUAGE = American'
```

```
)
```

```
FROM DUAL;
```

*(If you are converting language specific terms such as month names then it is good practice to include the 3rd nlsparam parameter to the **TO_DATE()** function and specify the language to be expected.)*

Section 6.6: Generating Dates with a Time Component

Convert it from a string literal using **TO_DATE()**:

```
SELECT TO_DATE( '2000-01-01 12:00:00', 'YYYY-MM-DD HH24:MI:SS'  
) FROM DUAL;
```

Or use a **TIMESTAMP literal**:

```
CREATE TABLE date_table(  
date_value DATE  
);
```

```
INSERT INTO date_table ( date_value ) VALUES ( TIMESTAMP '2000-01-01 12:00:00' );
```

Oracle will implicitly cast a **TIMESTAMP** to a **DATE** when storing it in a **DATE** column of a table; however you can explicitly **CAST()** the value to a **DATE**:

```
SELECT CAST( TIMESTAMP '2000-01-01 12:00:00' AS DATE ) FROM DUAL;
```

Section 6.7: The Format of a Date

In Oracle a **DATE** data type does not have a format; when Oracle sends a **DATE** to the client program (SQL/Plus, SQL/Developer, Toad, Java, Python, etc) it will send 7- or 8- bytes which represent the date.

A **DATE** which is not stored in a table (i.e. generated by **SYSDATE** and having "type 13" when using the **DUMP()** command) has 8-bytes and has the structure (the numbers on the right are the internal representation of **2012-11-26 16:41:09**):

BYTE VALUE EXAMPLE

```
-----1 Year modulo
256 220
2 Year multiples of 256 7 (7 * 256 + 220 = 2012) 3 Month 11
4 Day 26
5 Hours 16
6 Minutes 41
7 Seconds 9
8 Unused 0
```

A **DATE** which is stored in a table ("type 12" when using the **DUMP()** command) has 7-bytes and has the structure (the numbers on the right are the internal representation of **2012-11-26 16:41:09**):

BYTE VALUE EXAMPLE

```
-----1 ( Year
multiples of 100 ) + 100 120
2 ( Year modulo 100 ) + 100 112 ((120-100)*100 + (112-100) = 2012) 3
```

Month 11
4 Day 26
5 Hours + 1 17
6 Minutes + 1 42
7 Seconds + 1 10

If you want the date to have a specific format then you will need to convert it to something that has a format (i.e. a string). The SQL client may implicitly do this or you can explicitly convert the value to a string using `TO_CHAR(DATE, format_model, nls_params)`.

Section 6.8: Converting Dates to a String

Use `TO_CHAR(DATE [, format_model [, nls_params]])`:

*(Note: if a **format model** is not provided then the `NLS_DATE_FORMAT` session parameter will be used as the default format model; this can be different for every session so should not be relied on. It is good practice to always specify the format model.)*

```
CREATE TABLE table_name (  
date_value DATE  
);
```

```
INSERT INTO table_name ( date_value ) VALUES ( DATE '2000-01-01' );  
INSERT INTO table_name ( date_value ) VALUES ( TIMESTAMP '2016-  
07-21 08:00:00' ); INSERT INTO table_name ( date_value ) VALUES ( SYSDATE );
```

Then:

```
SELECT TO_CHAR( date_value, 'YYYY-MM-DD' ) AS formatted_date  
FROM table_name;
```

Outputs:

```
FORMATTED_DATE  
-----2000-01-01  
2016-07-21  
2016-07-21
```

And:

```
SELECT TO_CHAR(  
date_value,  
'FMMonth d yyyy, hh12:mi:ss AM', 'NLS_DATE_LANGUAGE = French'  
) AS formatted_date  
FROM table_name;
```

Outputs:

```
FORMATTED_DATE  
-----Janvier 01 2000, 12:00:00 AM Juillet 21 2016,  
08:00:00 AM Juillet 21 2016, 19:08:31 PM
```

Section 6.9: Changing How SQL/Plus or SQL Developer Display Dates

When SQL/Plus or SQL Developer display dates they will perform an implicit conversion to a string using the default date format model (see the Setting the Default Date Format Model example).

You can change how a date is displayed by changing the NLS_DATE_FORMAT parameter.

Section 6.10: Time Zones and Daylight Savings Time

The `DATE` data type does not handle time zones or changes in daylight savings time.

Either:

use the `TIMESTAMP WITH TIME ZONE` data type; or handle the changes in your application logic.

A `DATE` can be stored as Coordinated Universal Time (UTC) and converted to the current session time zone like this:

```
SELECT FROM_TZ(  
CAST(  
TO_DATE('2016-01-01 12:00:00', 'YYYY-MM-DD HH24:MI:SS') AS  
TIMESTAMP
```

```
),  
'UTC'  
)  
AT LOCAL AS TIME  
FROM DUAL;
```

If you run `ALTER SESSION SET TIME_ZONE = '+01:00'`; then the output is:

```
TIME  
-----2016-01-01 13:00:00.000000000 +01:00
```

and `ALTER SESSION SET TIME_ZONE = 'PST'`; then the output is:

```
TIME  
-----2016-01-01 04:00:00.000000000 PST
```

Section 6.11: Leap Seconds

Oracle **does not handle leap seconds**. See My Oracle Support note 2019397.2 and 730795.1 for more details.

Section 6.12: Getting the Day of the Week

You can use `TO_CHAR(date_value, 'D')` to get the day-of-week.

However, this is dependent on the `NLS_TERRITORY` session parameter:

```
ALTER SESSION SET NLS_TERRITORY = 'AMERICA'; -- First day of  
week is Sunday SELECT TO_CHAR( DATE '1970-01-01', 'D' ) FROM  
DUAL;
```

Outputs 5

```
ALTER SESSION SET NLS_TERRITORY = 'UNITED KINGDOM'; --  
First day of week is Monday SELECT TO_CHAR( DATE '1970-01-01', 'D' )  
FROM DUAL;
```

Outputs 4

To do this independent of the NLS settings, you can truncate the date to midnight of the current day (to remove any fractions of days) and subtract the

date truncated to the start of the current iso-week (which always starts on Monday):

```
SELECT TRUNC( date_value ) TRUNC( date_value, 'IW' ) + 1 FROM DUAL
```

Chapter 7: Working with Dates

Section 7.1: Date Arithmetic

Oracle supports **DATE** (includes time to the nearest second) and **TIMESTAMP** (includes time to fractions of a second) datatypes, which allow arithmetic (addition and subtraction) natively. For example:

To get the next day:

```
SELECT TO_CHAR(SYSDATE + 1, 'YYYY-MM-DD') AS tomorrow FROM dual;
```

To get the previous day:

```
SELECT TO_CHAR(SYSDATE - 1, 'YYYY-MM-DD') AS yesterday FROM dual;
```

To add 5 days to the current date:

```
SELECT TO_CHAR(SYSDATE + 5, 'YYYY-MM-DD') AS five_days_from_now FROM dual;
```

To add 5 hours to the current date:

```
SELECT TO_CHAR(SYSDATE + (5/24), 'YYYY-MM-DD HH24:MI:SS') AS five_hours_from_now FROM dual;
```

To add 10 minutes to the current date:

```
SELECT TO_CHAR(SYSDATE + (10/1440), 'YYYY-MM-DD HH24:MI:SS') AS ten_mintues_from_now FROM dual;
```

To add 7 seconds to the current date:

```
SELECT TO_CHAR(SYSDATE + (7/86400), 'YYYY-MM-DD HH24:MI:SS') AS seven_seconds_from_now FROM dual;
```

To select rows where hire_date is 30 days ago or more:

```
SELECT * FROM emp WHERE hire_date < SYSDATE - 30;
```

To select rows where last_updated column is in the last hour:

```
SELECT * FROM logfile WHERE last_updated >= SYSDATE - (1/24);
```

Oracle also provides the built-in datatype **INTERVAL** which represents a duration of time (e.g. 1.5 days, 36 hours, 2 months, etc.). These can also be used with arithmetic with **DATE** and **TIMESTAMP** expressions. For

example: `SELECT * FROM logfile WHERE last_updated >= SYSDATE - INTERVAL '1' HOUR;`

Section 7.2: Add_months function

Syntax: `ADD_MONTHS(p_date, INTEGER) RETURN DATE;`

Add_months function adds amt months to p_date date.

`SELECT ADD_MONTHS(DATE'2015-01-12', 2) m FROM dual;`

M

2015-03-12

You can also subtract months using a negative amt

`SELECT ADD_MONTHS(DATE'2015-01-12', 2) m FROM dual; M`

2014-11-12

When the calculated month has fewer days as the given date, the last day of the calculated month will be returned.

`SELECT TO_CHAR(ADD_MONTHS(DATE'2015-01-31', 1), 'YYYY-MM-DD') m FROM dual; M`

2015-02-28

Chapter 8: DUAL table

Section 8.1: The following example returns the current operating system date and time

`SELECT SYSDATE FROM dual`

Section 8.2: The following example generates numbers between start_value and end_value

`SELECT : start_value + LEVEL 1 n`

`FROM dual`

`CONNECT BY LEVEL <= :end_value - :start_value + 1`

Chapter 9: JOINS

Section 9.1: CROSS JOIN

A **CROSS JOIN** performs a join between two tables that does not use an explicit join clause and results in the Cartesian product of two tables. A Cartesian product means each row of one table is combined with each row of the second table in the join. For example, if TABLEA has 20 rows and TABLEB has 20 rows, the result would be $20*20 = 400$ output rows.

Example:

```
SELECT *  
FROM TABLEA CROSS JOIN TABLEB;
```

This can also be written as:

```
SELECT *  
FROM TABLEA, TABLEB;
```

Here's an example of cross join in SQL between two tables:

Sample Table: TABLEA

```
+-----+-----+ | VALUE | NAME | +-----+-----+ | 1 | ONE | | 2 | TWO  
| +-----+-----+
```

Sample Table: TABLEB

```
+-----+-----+ | VALUE | NAME | +-----+-----+ | 3 | THREE | | 4 |  
FOUR | +-----+-----+
```

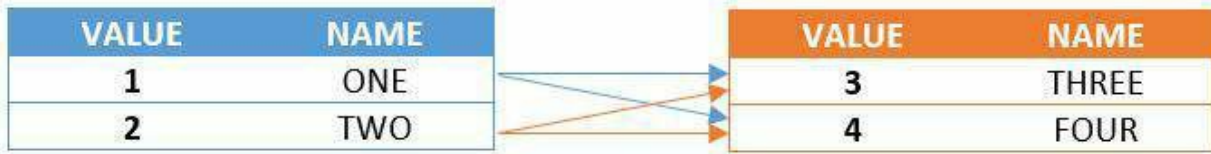
Now, If you execute the query:

```
SELECT *  
FROM TABLEA CROSS JOIN TABLEB;
```

Output:

```
+-----+-----+-----+-----+ | VALUE | NAME | VALUE | NAME | +-----  
-- +-----+-----+-----+ | 1 | ONE | 3 | THREE | | 1 | ONE | 4 | FOUR | | 2 |  
TWO | 3 | THREE | | 2 | TWO | 4 | FOUR | +-----+-----+-----+-----+
```

This is how cross joining happens between two tables:



More about Cross Join:

[Oracle documentation](#)

Section 9.2: LEFT OUTER JOIN

A LEFT OUTER JOIN performs a join between two tables that requires an explicit join clause but does not exclude unmatched rows from the first table.

Example:

```
SELECT
ENAME,
DNAME,
EMP.DEPTNO,
DEPT.DEPTNO
```

```
FROM
SCOTT.EMP LEFT OUTER JOIN SCOTT.DEPT ON EMP.DEPTNO =
DEPT.DEPTNO;
```

Even though ANSI syntax is the **recommended** way, it is likely to encounter legacy syntax very often. Using (+) within a condition determines which side of the equation to be considered as *outer*.

```
SELECT ENAME,
DNAME,
EMP.DEPTNO,
DEPT.DEPTNO
```

```
FROM
SCOTT.EMP, SCOTT.DEPT
```

```
WHERE
EMP.DEPTNO = DEPT.DEPTNO(+);
```

Here's an example of Left Outer Join between two tables:

Sample Table: EMPLOYEE

```
+-----+-----+ | NAME | DEPTNO | +-----+-----+ | A | 2 | | B |
1 | | C | 3 | | D | 2 | | E | 1 | | F | 1 | | G | 4 | | H | 4 | +-----+-----+
```

Sample Table: DEPT

```
+-----+-----+ | DEPTNO | DEPTNAME | +-----+-----+ |
1 | ACCOUNTING | | 2 | FINANCE | | 5 | MARKETING | | 6 | HR | +-----+
+-----+
```

Now, If you execute the query:

```
SELECT *
FROM
EMPLOYEE LEFT OUTER JOIN DEPT ON EMPLOYEE.DEPTNO =
DEPT.DEPTNO;
```

Output:

```
+-----+-----+-----+-----+ | NAME | DEPTNO | DEPTNO |
DEPTNAME | +-----+-----+-----+-----+ | F | 1 | 1 |
ACCOUNTING | | E | 1 | 1 | ACCOUNTING | | B | 1 | 1 | ACCOUNTING | |
D | 2 | 2 | FINANCE | | A | 2 | 2 | FINANCE | | C | 3 | | | H | 4 | | | G | 4 | | | +
-----+-----+-----+-----+
```

Section 9.3: RIGHT OUTER JOIN

A RIGHT OUTER JOIN performs a join between two tables that requires an explicit join clause but does not exclude unmatched rows from the second table.

Example:

```
SELECT
ENAME,
DNAME,
EMP.DEPTNO,
DEPT.DEPTNO
```

```
FROM
SCOTT.EMP RIGHT OUTER JOIN SCOTT.DEPT ON EMP.DEPTNO =
DEPT.DEPTNO;
```

As the unmatched rows of SCOTT.DEPT are included, but unmatched rows of SCOTT.EMP are not, the above is equivalent to the following statement using LEFT OUTER JOIN.

```
SELECT ENAME,
DNAME,
EMP.DEPTNO,
DEPT.DEPTNO
```

```
FROM
SCOTT.DEPT RIGHT OUTER JOIN SCOTT.EMP ON DEPT.DEPTNO =
EMP.DEPTNO;
```

Here's an example of Right Outer Join between two tables:

Sample Table: EMPLOYEE

```
+-----+-----+ | NAME | DEPTNO | +-----+-----+ | A | 2 | | B |
1 | | C | 3 | | D | 2 | | E | 1 | | F | 1 | | G | 4 | | H | 4 | +-----+-----+
```

Sample Table: DEPT

```
+-----+-----+ | DEPTNO | DEPTNAME | +-----+-----+ |
1 | ACCOUNTING | | 2 | FINANCE | | 5 | MARKETING | | 6 | HR | +-----+
+-----+
```

Now, If you execute the query:

```
SELECT *
FROM
EMPLOYEE RIGHT OUTER JOIN DEPT ON EMPLOYEE.DEPTNO =
DEPT.DEPTNO;
```

Output:

```
+-----+-----+-----+-----+ | NAME | DEPTNO | DEPTNO |
```

```

DEPTNAME | +-----+-----+-----+-----+ | A | 2 | 2 |
FINANCE || B | 1 | 1 | ACCOUNTING || D | 2 | 2 | FINANCE || E | 1 | 1 |
ACCOUNTING || F | 1 | 1 | ACCOUNTING || | 5 | MARKETING || | 6 |
HR | +-----+-----+-----+-----+

```

Oracle (+) syntax equivalent for the query is:

```

SELECT *
FROM EMPLOYEE, DEPT
WHERE EMPLOYEE.DEPTNO(+) = DEPT.DEPTNO;

```

Section 9.4: FULL OUTER JOIN

A FULL OUTER JOIN performs a join between two tables that requires an explicit join clause but does not exclude unmatched rows in either table. In other words, it returns all the rows in each table.

Example:

```

SELECT
*
FROM
EMPLOYEE FULL OUTER JOIN DEPT ON EMPLOYEE.DEPTNO =
DEPT.DEPTNO;

```

Here's an example of Full Outer Join between two tables:

Sample Table: EMPLOYEE

```

+-----+-----+ | NAME | DEPTNO | +-----+-----+ | A | 2 | | B |
1 | | C | 3 | | D | 2 | | E | 1 | | F | 1 | | G | 4 | | H | 4 | +-----+-----+

```

Sample Table: DEPT

```

+-----+-----+ | DEPTNO | DEPTNAME | +-----+-----+ |
1 | ACCOUNTING | | 2 | FINANCE | | 5 | MARKETING | | 6 | HR | +-----+
+-----+

```

Now, If you execute the query:

```
SELECT *
FROM
EMPLOYEE FULL OUTER JOIN DEPT ON EMPLOYEE.DEPTNO =
DEPT.DEPTNO;
```

Output

```
+-----+-----+-----+-----+ | NAME | DEPTNO | DEPTNO |
DEPTNAME | +-----+-----+-----+-----+ | A | 2 | 2 |
FINANCE || B | 1 | 1 | ACCOUNTING || C | 3 || | D | 2 | 2 | FINANCE || E
| 1 | 1 | ACCOUNTING || F | 1 | 1 | ACCOUNTING || G | 4 || | H | 4 || | |
6 | HR || | 5 | MARKETING | +-----+-----+-----+-----+
```

Here the columns that do not match has been kept NULL.

Section 9.5: ANTIJOIN

An antijoin returns rows from the left side of the predicate for which there are no corresponding rows on the right side of the predicate. It returns rows that fail to match (NOT IN) the subquery on the right side.

```
SELECT * FROM employees
WHERE department_id NOT IN
(SELECT department_id FROM departments
```

```
WHERE location_id = 1700)
ORDER BY last_name;
```

Here's an example of Anti Join between two tables:

Sample Table: EMPLOYEE

```
+-----+-----+ | NAME | DEPTNO | +-----+-----+ | A | 2 || B |
1 || C | 3 || D | 2 || E | 1 || F | 1 || G | 4 || H | 4 | +-----+-----+
```

Sample Table: DEPT

```
+-----+-----+ | DEPTNO | DEPTNAME | +-----+-----+ |
1 | ACCOUNTING || 2 | FINANCE || 5 | MARKETING || 6 | HR | +-----+
+-----+
```

Now, If you execute the query:

```
SELECT *  
FROM  
EMPLOYEE WHERE DEPTNO NOT IN (SELECT DEPTNO FROM  
DEPT);
```

Output:

```
+-----+-----+ | NAME | DEPTNO | +-----+-----+ | C | 3 | | H |  
4 | | G | 4 | +-----+-----+
```

The output shows that only the rows of EMPLOYEE table, of which DEPTNO were not present in DEPT table.

Section 9.6: INNER JOIN

An INNER JOIN is a JOIN operation that allows you to specify an explicit join clause.

Syntax

```
TableExpression [ INNER ] JOIN TableExpression { ON booleanExpression  
| USING clause }
```

You can specify the join clause by specifying ON with a boolean expression. The scope of expressions in the ON clause includes the current tables and any tables in outer query blocks to the current SELECT. In the following example, the ON clause refers to the current tables:

```
-- Join the EMP_ACT and EMPLOYEE tables  
-- select all the columns from the EMP_ACT table and  
-- add the employee's surname (LASTNAME) from the EMPLOYEE table  
-- to each row of the result
```

```
SELECT SAMP.EMP_ACT.*, LASTNAME  
FROM SAMP.EMP_ACT JOIN SAMP.EMPLOYEE  
ON EMP_ACT.EMPNO = EMPLOYEE.EMPNO
```

```
-- Join the EMPLOYEE and DEPARTMENT tables,  
-- select the employee number (EMPNO),
```

-- employee surname (LASTNAME),
-- department number (WORKDEPT in the EMPLOYEE table and DEPTNO
in the
-- DEPARTMENT table)
-- and department name (DEPTNAME)
-- of all employees who were born (BIRTHDATE) earlier than 1930.

```
SELECT EMPNO, LASTNAME, WORKDEPT, DEPTNAME  
FROM SAMP.EMPLOYEE JOIN SAMP.DEPARTMENT  
ON WORKDEPT = DEPTNO  
AND YEAR(BIRTHDATE) < 1930
```

-- Another example of "generating" new data values,
-- using a query which selects from a VALUES clause (which is an
-- alternate form of a fullselect).
-- This query shows how a table can be derived called "X"
-- having 2 columns "R1" and "R2" and 1 row of data

```
SELECT *  
FROM (VALUES (3, 4), (1, 5), (2, 6))  
AS VALUETABLE1(C1, C2)  
JOIN (VALUES (3, 2), (1, 2),  
(0, 3)) AS VALUETABLE2(c1, c2)  
ON VALUETABLE1.c1 = VALUETABLE2.c1
```

-- This results in:

-- C1 |C2 |C1 |2

-- 3 |4 |3 |2

-- 1 |5 |1 |2

-- List every department with the employee number and
-- last name of the manager

```
SELECT DEPTNO, DEPTNAME, EMPNO, LASTNAME FROM  
DEPARTMENT INNER JOIN EMPLOYEE ON MGRNO = EMPNO
```

-- List every employee number and last name

-- with the employee number and last name of their manager SELECT

```
E.EMPNO, E.LASTNAME, M.EMPNO, M.LASTNAME FROM  
EMPLOYEE E INNER JOIN
```

```
DEPARTMENT INNER JOIN EMPLOYEE M  
ON MGRNO = M.EMPNO  
ON E.WORKDEPT = DEPTNO
```

Section 9.7: JOIN

The **JOIN** operation performs a join between two tables, excluding any unmatched rows from the first table. From Oracle 9i forward, the **JOIN** is equivalent in function to the **INNER JOIN**. This operation requires an explicit join clause, as opposed to the **CROSS JOIN** and **NATURAL JOIN** operators.

Example:

```
SELECT t1.*,  
t2.DeptId  
FROM table_1 t1  
JOIN table_2 t2 ON t2.DeptNo = t1.DeptNo
```

Oracle documentation:

10g
11g
12g

Section 9.8: SEMIJOIN

A semijoin query can be used, for example, to find all departments with at least one employee whose salary exceeds 2500.

```
SELECT * FROM departments WHERE EXISTS
```

```
(SELECT 1 FROM employees  
WHERE departments.department_id = employees.department_id AND  
employees.salary > 2500)
```

`ORDER BY department_name;`

This is more efficient than the full join alternatives, as inner joining on employees then giving a where clause detailing that the salary has to be greater than 2500 could return the same department numerous times. Say if the Fire department has n employees all with salary 3000, `SELECT * FROM departments, employees` with the necessary join on ids and our where clause would return the Fire department n times.

Section 9.9: NATURAL JOIN

NATURAL JOIN requires no explicit join condition; it builds one based on all the fields with the same name in the joined tables.

```
CREATE TABLE tab1(id NUMBER, descr VARCHAR2(100));
CREATE TABLE tab2(id NUMBER, descr VARCHAR2(100));
INSERT INTO tab1 VALUES(1, 'one');
INSERT INTO tab1 VALUES(2, 'two');
INSERT INTO tab1 VALUES(3, 'three');
INSERT INTO tab2 VALUES(1, 'ONE');
INSERT INTO tab2 VALUES(3, 'three');
```

The join will be done on the fields ID and DESCR, common to both the tables:

```
SQL > SELECT *
2 FROM tab1
3 NATURAL JOIN
4 tab2;
```

```
ID DESCR
-----
-----3 three
```

Columns with different names will not be used in the JOIN condition:

```
SQL > SELECT *
2 FROM (SELECT id AS id, descr AS descr1 FROM tab1)
3 NATURAL JOIN
```

```
4 (SELECT id AS id, descr AS descr2 FROM tab2);
```

```
ID DESCR1 DESCR2
```

```
-----1 one ONE
```

```
3 three three
```

If the joined tables have no common columns, a JOIN with no conditions will be done:

```
SQL > SELECT *
```

```
2 FROM (SELECT id AS id1, descr AS descr1 FROM tab1)
```

```
3 NATURAL JOIN
```

```
4 (SELECT id AS id2, descr AS descr2 FROM tab2);
```

```
ID1 DESCR1 ID2 DESCR2
```

```
-----1 one 1 ONE 2 two 1 ONE 3 three 1 ONE
```

```
1 one 3 three 2 two 3 three 3 three 3 three
```

Chapter 10: Handling NULL values

A column is NULL when it has no value, regardless of the data type of that column. A column should never be compared to NULL using this syntax `a = NULL` as the result would be UNKNOWN. Instead use a `IS NULL` or a `IS NOT NULL` conditions. NULL is not equal to NULL. To compare two expressions where null can happen, use one of the functions described below. All operators except concatenation return NULL if one of their operand is NULL. For instance the result of `3 * NULL + 5` is null.

Section 10.1: Operations containing NULL are NULL, except concatenation

```
SELECT 3 * NULL + 5, 'Hello ' || NULL || 'world' FROM DUAL;
```

```
3*NULL+5 'HELLO' || NULL || 'WORLD'
```

```
(null) Hello world
```

Section 10.2: NVL2 to get a different result if a value is null or not

If the first parameter is NOT NULL, NVL2 will return the second parameter. Otherwise it will return the third one.

```
SELECT NVL2(NULL, 'Foo', 'Bar'), NVL2(5, 'Foo', 'Bar') FROM DUAL;  
NVL2(NULL,'FOO','BAR') NVL2(5,'FOO','BAR')  
Bar Foo
```

Section 10.3: COALESCE to return the first non-NULL value

```
SELECT COALESCE(a, b, c, d, 5) FROM  
(SELECT NULL A, NULL b, NULL c, 4 d FROM DUAL);  
COALESCE(A,B,C,D,5)  
4
```

In some case, using COALESCE with two parameters can be faster than using NVL when the second parameter is not a constant. NVL will always evaluate both parameters. COALESCE will stop at the first non-NULL value it encounters. It means that if the first value is non-NULL, COALESCE will be faster.

Section 10.4: Columns of any data type can contain NULLs

```
SELECT 1 NUM_COLUMN, 'foo' VARCHAR2_COLUMN FROM DUAL  
UNION ALL  
SELECT NULL, NULL FROM DUAL;
```

```
NUM_COLUMN VARCHAR2_COLUMN  
1 foo  
(null) (null)
```

Section 10.5: Empty strings are NULL

```
SELECT 1 a, " b FROM DUAL;  
A B  
1 (null)
```

Section 10.6: NVL to replace null value

```
SELECT a column_with_null, NVL(a, 'N/A') column_without_null FROM  
(SELECT NULL a FROM DUAL);
```

```
COLUMN_WITH_NULL COLUMN_WITHOUT_NULL
```

```
(null) N/A
```

NVL is useful to compare two values which can contain NULLs :

```
SELECT
```

```
CASE WHEN a = b THEN 1 WHEN a <> b THEN 0 ELSE 1 END
```

```
comparison_without_nvl, CASE WHEN NVL(a, 1) = NVL(b, 1) THEN 1
```

```
WHEN NVL(a, 1) <> NVL(b, 1) THEN 0 ELSE 1 END
```

```
comparison_with_nvl
```

```
FROM
```

```
(SELECT NULL a, 3 b FROM DUAL
```

```
UNION ALL
```

```
SELECT NULL, NULL FROM DUAL);
```

```
COMPARISON_WITHOUT_NVL COMPARISON_WITH_NVL
```

```
-1 0
```

```
-1 1
```

Chapter 11: String Manipulation

Section 11.1: INITCAP

The INITCAP function converts the case of a string so that each word starts with a capital letter and all subsequent letters are in lowercase.

```
SELECT INITCAP('HELLO mr macdonald!') AS NEW FROM dual;
```

Output

```
NEW
```

```
-----Hello Mr Macdonald!
```

Section 11.2: Regular expression

Let's say we want to replace only numbers with 2 digits: regular expression will find them with (\d\d)

```
SELECT REGEXP_REPLACE ('2, 5, and 10 are numbers in this example',  
'(\d\d)', '#') FROM dual;
```

Results in:

```
'2, 5, and # are numbers in this example'
```

If I want to swap parts of the text, I use \1, \2, \3 to call for the matched strings:

```
SELECT REGEXP_REPLACE ('swap around 10 in that one ', '(.*)(\d\d )  
(.*)', '\3\2\1\3') FROM dual;
```

Section 11.3: SUBSTR

SUBSTR retrieves part of a string by indicating the starting position and the number of characters to extract

```
SELECT SUBSTR('abcdefg',2,3) FROM DUAL;
```

returns:

```
bcd
```

To count from the end of the string, SUBSTR accepts a negative number as the second parameter, e.g.

```
SELECT SUBSTR('abcdefg',4,2) FROM DUAL;
```

returns:

```
de
```

To get the last character in a string: SUBSTR(mystring,1,1)

Section 11.4: Concatenation: Operator || or concat() function

The Oracle SQL and PL/SQL || operator allows you to concatenate 2 or more strings together.

Example:

Assuming the following customers table:

```
id firstname lastname  
---  
-----1 Thomas Woody
```

Query:

```
SELECT firstname || ' ' || lastname || ' is in my database.' AS "My Sentence"  
FROM customers;
```

Output:

My Sentence

-----Thomas Woody is in my database.

Oracle also supports the standard SQL CONCAT(str1, str2) function:

Example:

Query:

```
SELECT CONCAT(firstname, ' is in my database.') FROM customers;
```

Output:

Expr1

-----Thomas is in my database.

Section 11.5: UPPER

The UPPER function allows you to convert all lowercase letters in a string to uppercase.

```
SELECT UPPER('My text 123!') AS result FROM dual;
```

Output:

RESULT

-----MY TEXT 123!

Section 11.6: LOWER

LOWER converts all uppercase letters in a string to lowercase.

```
SELECT LOWER('HELLO World123!') text FROM dual;
```

Outputs:

text

hello world123!

Section 11.7: LTRIM / RTRIM

LTRIM and RTRIM remove characters from the beginning or the end (respectively) of a string. A set of one or more characters may be supplied (default is a space) to remove.

For example,

```
SELECT LTRIM('<====>HELLO<====>', '<=>')
,RTRIM('<====>HELLO<====>', '<=>')
FROM dual;
```

Returns:

```
HELLO<====> <====>HELLO
```

Chapter 12: IF-THEN-ELSE Statement

Section 12.1: IF-THEN

```
DECLARE
```

```
v_num1 NUMBER(10);
```

```
v_num2 NUMBER(10);
```

```
BEGIN
```

```
v_num1 := 2;
```

```
v_num2 := 1;
```

```
IF v_num1 > v_num2 THEN
```

```
DBMS_OUTPUT.put_line('v_num1 is bigger than v_num2');
```

```
END IF;
```

```
END;
```

Section 12.2: IF-THEN-ELSE

```
DECLARE
```

```
v_num1 NUMBER(10);
```

```
v_num2 NUMBER(10);
```

```
BEGIN
```

```
v_num1 := 2;
```

```
v_num2 := 10;
```

```
IF v_num1 > v_num2 THEN
```

```
DBMS_OUTPUT.put_line('v_num1 is bigger than v_num2');
```

```
ELSE
```

```
DBMS_OUTPUT.put_line('v_num1 is NOT bigger than v_num2');
```

```
END IF;  
END;
```

Section 12.3: IF-THEN-ELSIF-ELSE

```
DECLARE  
v_num1 NUMBER(10);  
v_num2 NUMBER(10);  
  
BEGIN  
v_num1 := 2;  
v_num2 := 2;  
  
IF v_num1 > v_num2 THEN  
DBMS_OUTPUT.put_line('v_num1 is bigger than v_num2');  
ELSIF v_num1 < v_num2 THEN  
DBMS_OUTPUT.put_line('v_num1 is NOT bigger than v_num2');  
ELSE  
DBMS_OUTPUT.put_line('v_num1 is EQUAL to v_num2');  
END IF;  
END;
```

Chapter 13: Limiting the rows returned by a query (Pagination)

Section 13.1: Get first N rows with row limiting clause

The `FETCH` clause was introduced in Oracle 12c R1:

```
SELECT val  
FROM mytable  
ORDER BY val DESC  
FETCH FIRST 5 ROWS ONLY;
```

An example without `FETCH` that works also in earlier versions:

```
SELECT * FROM (  
SELECT val
```

```
FROM mytable  
ORDER BY val DESC
```

```
) WHERE ROWNUM <= 5;
```

Section 13.2: Get row N through M from many rows (before Oracle 12c)

Use the analytical function row_number():

```
WITH t AS (  
SELECT col1  
, col2  
, ROW_NUMBER() over (ORDER BY col1, col2) rn FROM TABLE  
)  
SELECT col1  
, col2  
FROM t  
WHERE rn BETWEEN N AND M; -- N and M are both inclusive
```

Oracle 12c handles this more easily with OFFSET and FETCH.

Section 13.3: Get N numbers of Records from table

We can limit no of rows from result using rownum clause

```
SELECT * FROM  
(  
SELECT val FROM mytable  
) WHERE rownum<=5
```

If we want first or last record then we want order by clause in inner query that will give result based on order.

Last Five Record :

```
SELECT * FROM  
(  
SELECT val FROM mytable ORDER BY val DESC ) WHERE rownum<=5
```

First Five Record

```
SELECT * FROM (  
SELECT val FROM mytable ORDER BY val ) WHERE rownum<=5
```

Section 13.4: Skipping some rows then taking some

In Oracle 12g+

```
SELECT Id, Col1  
FROM TableName  
ORDER BY Id  
OFFSET 20 ROWS FETCH NEXT 20 ROWS ONLY;
```

In earlier Versions

```
SELECT Id,  
Col1
```

```
FROM (SELECT Id,  
Col1,  
ROW_NUMBER() over (ORDER BY Id) RowNumber
```

```
FROM TableName)  
WHERE RowNumber BETWEEN 21 AND 40
```

Section 13.5: Skipping some rows from result

In Oracle 12g+

```
SELECT Id, Col1  
FROM TableName  
ORDER BY Id  
OFFSET 5 ROWS;
```

In earlier Versions

```
SELECT Id,  
Col1
```

```
FROM (SELECT Id,  
Col1,
```

ROW_NUMBER() over (ORDER BY Id) RowNumber

FROM TableName)

WHERE RowNumber > 20

Section 13.6: Pagination in SQL

SELECT val

FROM (SELECT val, ROWNUM AS rnum

FROM (SELECT val

FROM rownum_order_test ORDER BY val)

WHERE ROWNUM <= :upper_limit)

WHERE rnum >= :lower_limit ;

this way we can paginate the table data , just like web serch page

Chapter 14: Recursive Sub-Query Factoring using the WITH Clause (A.K.A.

Common Table Expressions)

Section 14.1: Splitting a Delimited String

Sample Data:

```
CREATE TABLE table_name ( VALUE VARCHAR2(50) );
```

```
INSERT INTO table_name ( VALUE ) VALUES ( 'A,B,C,D,E' );
```

Query:

```
WITH items ( list, item, lvl ) AS (
```

```
SELECT VALUE,
```

```
REGEXP_SUBSTR( VALUE, '[^,]+' , 1, 1 ),
```

```
1
```

```
FROM table_name
```

```
UNION ALL
```

```
SELECT VALUE,
```

```
REGEXP_SUBSTR( VALUE, '[^,]+' , 1, lvl + 1 ),
```

```
lvl + 1
```

```
FROM items
WHERE lvl < REGEXP_COUNT( VALUE, '[^,]+' )
)
SELECT * FROM items;
```

Output:

```
LIST ITEM LVL
----- ---- --A,B,C,D,E A 1 A,B,C,D,E B 2 A,B,C,D,E C 3 A,B,C,D,E D 4
A,B,C,D,E E 5
```

Section 14.2: A Simple Integer Generator

Query:

```
WITH generator ( VALUE ) AS (
SELECT 1 FROM DUAL
UNION ALL
SELECT VALUE + 1
FROM generator
WHERE VALUE < 10
)
SELECT VALUE
FROM generator;
```

Output:

```
VALUE
----1
2
3
4
5
6
7
8
9
10
```

Chapter 15: Different ways to update records

Section 15.1: Update using Merge

Using Merge

```
MERGE INTO
TESTTABLE
USING
(SELECT
T1.ROWID AS RID, T2.TESTTABLE_ID FROM
TESTTABLE T1
INNER JOIN
MASTERTABLE T2
ON TESTTABLE.TESTTABLE_ID = MASTERTABLE.TESTTABLE_ID
WHERE ID_NUMBER=11)
ON
( ROWID = RID )
WHEN MATCHED
THEN
UPDATE SET TEST_COLUMN= 'Testvalue';
```

Section 15.2: Update Syntax with example

Normal Update

```
UPDATE
TESTTABLE
SET
TEST_COLUMN= 'Testvalue',TEST_COLUMN2= 123
WHERE
EXISTS
(SELECT MASTERTABLE.TESTTABLE_ID FROM MASTERTABLE
WHERE ID_NUMBER=11);
```

Section 15.3: Update Using Inline View

Using Inline View (If it is considered updateable by Oracle)

Note: If you face a non key preserved row error add an index to resolve the same to make it update-able

```
UPDATE
(SELECT
TESTTABLE.TEST_COLUMN AS OLD, 'Testvalue' AS NEW

FROM
TESTTABLE

INNER JOIN
MASTERTABLE
ON TESTTABLE.TESTTABLE_ID = MASTERTABLE.TESTTABLE_ID
WHERE ID_NUMBER=11) T
SET

T.OLD = T.NEW;
```

Section 15.4: Merge with sample data

```
DROP TABLE table01;
DROP TABLE table02;
```

```
CREATE TABLE table01 (
code int,
name VARCHAR(50),
old int

);
```

```
CREATE TABLE table02 ( code int,
name VARCHAR(50), old int

);
```

```
truncate TABLE table01;
INSERT INTO table01 VALUES (1, 'A', 10); INSERT INTO table01
VALUES (9, 'B', 12); INSERT INTO table01 VALUES (3, 'C', 14); INSERT
```

```
INTO table01 VALUES (4, 'D', 16); INSERT INTO table01 VALUES (5, 'E', 18);
```

```
truncate TABLE table02;  
INSERT INTO table02 VALUES (1, 'AA', NULL); INSERT INTO table02  
VALUES (2, 'BB', 123); INSERT INTO table02 VALUES (3, 'CC', NULL);  
INSERT INTO table02 VALUES (4, 'DD', NULL); INSERT INTO table02  
VALUES (5, 'EE', NULL);
```

```
SELECT * FROM table01 a ORDER BY 2; SELECT * FROM table02 a  
ORDER BY 2;
```

-

```
MERGE INTO table02 a USING (  
SELECT b.code, b.old FROM table01 b  
) c ON (  
a.code = c.code  
)  
WHEN matched THEN UPDATE SET a.old = c.old  
;
```

-

```
SELECT a.*, b.* FROM table01 a  
inner JOIN table02 b ON a.code = b.codetable01;
```

```
SELECT * FROM table01 a WHERE  
EXISTS (  
SELECT 'x' FROM table02 b WHERE a.code = b.codetable01 );
```

```
SELECT * FROM table01 a WHERE a.code IN (SELECT b.codetable01  
FROM table02 b);
```

-

```
SELECT * FROM table01 a WHERE  
NOT EXISTS (  
SELECT 'x' FROM table02 b WHERE a.code = b.codetable01 );
```

```
SELECT * FROM table01 a WHERE a.code NOT IN (SELECT
```

b.codetable01 FROM table02 b);

Chapter 16: Update with Joins

Contrary to widespread misunderstanding (including on SO), Oracle allows updates through joins. However, there are some (pretty logical) requirements. We illustrate what doesn't work and what does through a simple example. Another way to achieve the same is the MERGE statement.

Section 16.1: Examples: what works and what doesn't

```
CREATE TABLE tgt ( id, val ) AS
SELECT 1, 'a' FROM dual UNION ALL
SELECT 2, 'b' FROM dual

;
TABLE TGT created.
```

```
CREATE TABLE src ( id, val ) AS
SELECT 1, 'x' FROM dual UNION ALL
SELECT 2, 'y' FROM dual

;
TABLE SRC created.
UPDATE
( SELECT t.val AS t_val, s.val AS s_val
FROM tgt t inner JOIN src s ON t.id = s.id
)
SET t_val = s_val
;
```

SQL Error: ORA-01779: cannot modify a column which maps to a non key-preserved table 01779. 00000 - "cannot modify a column which maps to a non key-preserved table" *Cause: An attempt was made to insert or update columns of a join view which map to a non-key-preserved table.

*Action: Modify the underlying base tables directly.

Imagine what would happen if we had the value 1 in the column src.id more than once, with different values for src.val. Obviously, the update would make no sense (in ANY database - that's a logical issue). Now, **we** know that there are no duplicates in src.id, but the Oracle engine doesn't know that - so it's complaining. Perhaps this is why so many practitioners believe Oracle "doesn't have UPDATE with joins"?

What Oracle expects is that src.id should be unique, and that it, Oracle, would know that beforehand. Easily fixed! Note that the same works with composite keys (on more than one column), if the matching for the update needs to use more than one column. In practice, src.id may be PK and tgt.id may be FK pointing to this PK, but that is not relevant for updates with join; what *is* relevant is the unique constraint.

```
ALTER TABLE src ADD constraint src_uc UNIQUE (id);
```

```
TABLE SRC altered.
```

```
UPDATE
```

```
( SELECT t.val AS t_val, s.val AS s_val
```

```
FROM tgt t inner JOIN src s ON t.id = s.id )
```

```
SET t_val = s_val
```

```
;
```

```
2 rows updated.
```

```
SELECT * FROM tgt;
```

```
ID VAL
```

```
-- --1 x
```

```
2 y
```

The same result could be achieved with a MERGE statement (which deserves its own Documentation article), and I personally prefer MERGE in these cases, but the reason is not that "Oracle doesn't do updates with joins." As this example shows, Oracle *does* do updates with joins.

Chapter 17: Functions

Section 17.1: Calling Functions

There are a few ways to use functions.
Calling a function with an assignment statement

```
DECLARE  
x NUMBER := functionName(); --functions can be called in declaration  
section  
BEGIN  
x := functionName();  
END;
```

Calling a function in IF statement

```
IF functionName() = 100 THEN NULL;  
END IF;
```

Calling a function in a SELECT statement `SELECT functionName() FROM DUAL;`

Chapter 18: Statistical functions

Section 18.1: Calculating the median of a set of values

The **MEDIAN function** since Oracle 10g is an easy to use aggregation function:

```
SELECT MEDIAN(SAL)  
FROM EMP
```

It returns the median of the values

Works on DATETIME values too.

The result of MEDIAN is computed by first ordering the rows. Using N as the number of rows in the group, Oracle calculates the row number (RN) of interest with the formula $RN = (1 + (0.5 * (N - 1)))$. The final result of the aggregate function is computed by linear interpolation between the values from rows at row numbers $CRN = CEILING(RN)$ and $FRN = FLOOR(RN)$.

Since Oracle 9i you can use **PERCENTILE_CONT** which works the same as MEDIAN function with percentile value defaults to 0.5

```
SELECT PERCENTILE_CONT(.5) WITHIN GROUP(ORDER BY SAL)  
FROM EMP
```

Chapter 19: Window Functions

Section 19.1: Ratio_To_Report

Provides the ratio of the current rows value to all the values within the window.

--Data

```
CREATE TABLE Employees (Name VARCHAR2(30), Salary  
NUMBER(10)); INSERT INTO Employees VALUES ('Bob',2500);
```

```
INSERT INTO Employees VALUES ('Alice',3500);  
INSERT INTO Employees VALUES ('Tom',2700);  
INSERT INTO Employees VALUES ('Sue',2000);
```

--Query

```
SELECT Name, Salary, RATIO_TO_REPORT(Salary) OVER () AS Ratio  
FROM Employees  
ORDER BY Salary, Name, Ratio;
```

--Output

```
NAME SALARY RATIO  
-----  
-----Sue 2000 .186915888 Bob 2500  
.23364486 Tom 2700 .252336449 Alice 3500 .327102804
```

Chapter 20: Creating a Context

Parameter OR REPLACE

namespace

schema

package

INITIALIZED EXTERNALLY

GLOBALLY

Details

Redefine an existing context namespace

Name of the context - this is the namespace for calls to SYS_CONTEXT

Owner of the package

Database package that sets or resets the context attributes. Note: the database package doesn't have to exist in order to create the context.

Specify an entity other than Oracle Database that can set the context.

Allow the OCI interface to initialize the context.

Allow the LDAP directory to initialize the context when establishing the session.

ACCESSED GLOBALLY

Allow the context to be accessible throughout the entire instance - multiple sessions can share the attribute values as long as they have the same Client ID.

Section 20.1: Create a Context

```
CREATE CONTEXT my_ctx USING my_pkg;
```

This creates a context that can only be set by routines in the database package my_pkg, e.g.:

```
CREATE PACKAGE my_pkg AS  
PROCEDURE set_ctx;  
END my_pkg;
```

```
CREATE PACKAGE BODY my_pkg AS  
PROCEDURE set_ctx IS  
BEGIN
```

```
DBMS_SESSION.set_context('MY_CTX','THE KEY','Value');  
DBMS_SESSION.set_context('MY_CTX','ANOTHER','Bla');  
END set_ctx;  
END my_pkg;
```

Now, if a session does this:

```
my_pkg.set_ctx;
```

It can now retrieve the value for the key thus:

```
SELECT SYS_CONTEXT('MY_CTX','THE KEY') FROM dual; VALUE
```

Chapter 21: Splitting Delimited Strings

Section 21.1: Splitting Strings using a Hierarchical Query

Sample Data:

```
CREATE TABLE table_name ( id, list ) AS
SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list
```

Query:

```
SELECT t.id,
REGEXP_SUBSTR( list, '([^\,]*)($)', 1, LEVEL, NULL, 1 ) AS VALUE,
LEVEL AS lvl

FROM table_name t

CONNECT BY
id = PRIOR id
AND PRIOR SYS_GUID() IS NOT NULL
AND LEVEL < REGEXP_COUNT( list, '([^\,]*)($)' )
```

Output:

```
ID ITEM LVL
-----1 a 1
1 b 2
1 c 3
1 d 4
2 e 1
3 (NULL) 1
4 f 1
4 (NULL) 2
4 g 3
```

Section 21.2: Splitting Strings using a PL/SQL Function

PL/SQL Function:

```
CREATE OR REPLACE FUNCTION split_String(
i_str IN VARCHAR2,
i_delim IN VARCHAR2 DEFAULT ','
) RETURN SYS.ODCIVARCHAR2LIST DETERMINISTIC

AS
p_result SYS.ODCIVARCHAR2LIST := SYS.ODCIVARCHAR2LIST();
p_start NUMBER(5) := 1;
p_end NUMBER(5);
c_len CONSTANT NUMBER(5) := LENGTH( i_str );
c_ld CONSTANT NUMBER(5) := LENGTH( i_delim );

BEGIN
IF c_len > 0 THEN
p_end := INSTR( i_str, i_delim, p_start );
WHILE p_end > 0 LOOP

p_result .EXTEND;
p_result( p_result.COUNT ) := SUBSTR( i_str, p_start, p_end - p_start );
p_start := p_end + c_ld;
p_end := INSTR( i_str, i_delim, p_start );

END LOOP;
IF p_start <= c_len + 1 THEN
p_result.EXTEND;
p_result( p_result.COUNT ) := SUBSTR( i_str, p_start, c_len - p_start + 1 );
END IF;
END IF;
RETURN p_result;
END;
/
```

Sample Data:

```
CREATE TABLE table_name ( id, list ) AS
```

```

SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list

```

Query:

```

SELECT t.id,
v.column_value AS VALUE,
ROW_NUMBER() OVER ( PARTITION BY id ORDER BY ROWNUM )
AS lvl

```

```

FROM table_name t,
TABLE( split_String( t.list ) ) (+) v

```

Output:

```

ID ITEM LVL
-----
-----1 a 1
1 b 2
1 c 3
1 d 4
2 e 1
3 (NULL) 1
4 f 1
4 (NULL) 2
4 g 3

```

Section 21.3: Splitting Strings using a Recursive Sub-query Factoring Clause

Sample Data:

```

CREATE TABLE table_name ( id, list ) AS
SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list

```

Query:

```
WITH bounds ( id, list, start_pos, end_pos, lvl ) AS ( SELECT id, list, 1, INSTR( list, ',' ), 1 FROM table_name
```

```
UNION ALL
```

```
SELECT id,  
list,  
end_pos + 1,  
INSTR( list, ',', end_pos + 1 ),  
lvl + 1
```

```
FROM bounds
```

```
WHERE end_pos > 0
```

```
)
```

```
SELECT id,  
SUBSTR(  
list,  
start_pos,  
CASE end_pos  
WHEN 0  
THEN LENGTH( list ) + 1  
ELSE end_pos  
END start_pos  
) AS item,  
lvl  
FROM bounds  
ORDER BY id, lvl;
```

Output:

```
ID ITEM LVL  
-----  
-----1 a 1  
1 b 2  
1 c 3  
1 d 4  
2 e 1  
3 (NULL) 1  
4 f 1
```

4 (NULL) 2
4 g 3

Section 21.4: Splitting Strings using a Correlated Table Expression

Sample Data:

```
CREATE TABLE table_name ( id, list ) AS
SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list
```

Query:

```
SELECT t.id,
v.COLUMN_VALUE AS VALUE,
ROW_NUMBER() OVER ( PARTITION BY id ORDER BY ROWNUM )
AS lvl

FROM table_name t,
TABLE(
CAST(
MULTISET(

SELECT REGEXP_SUBSTR( t.list, '([,]*)($)', 1, LEVEL, NULL, 1 )
FROM DUAL
CONNECT BY LEVEL < REGEXP_COUNT( t.list, '[,]*($)' )

)
AS SYS.ODCIVARCHAR2LIST
)
) v;
```

Output:

```
ID ITEM LVL
-----1 a 1
```

```
1 b 2
1 c 3
1 d 4
2 e 1
3 (NULL) 1
4 f 1
4 (NULL) 2
4 g 3
```

Section 21.5: Splitting Strings using CROSS APPLY (Oracle 12c)

Sample Data:

```
CREATE TABLE table_name ( id, list ) AS
SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list
```

Query:

```
SELECT t.id,
REGEXP_SUBSTR( t.list, '([^\,]*)($|,)', 1, l.lvl, NULL, 1 ) AS item, l.lvl
FROM table_name t
CROSS APPLY
(
SELECT LEVEL AS lvl
FROM DUAL
CONNECT BY LEVEL <= REGEXP_COUNT( t.list, ',' ) + 1
) l;
```

Output:

```
ID ITEM LVL
-----1 a 1
```

```
1 b 2
1 c 3
1 d 4
2 e 1
3 (NULL) 1
4 f 1
4 (NULL) 2
4 g 3
```

Section 21.6: Splitting Strings using XMLTable and FLWOR expressions

This solution uses the `ora:tokenize XQuery` function that is available from Oracle 11.

Sample Data:

```
CREATE TABLE table_name ( id, list ) AS
SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list
```

Query:

```
SELECT t.id,
x.item,
x.lvl

FROM table_name t,
XMLTABLE(

'let $list := ora:tokenize(.,","), $cnt := count($list)
for $val at $r in $list
where $r < $cnt
return $val'

PASSING list ||','
COLUMNS
```

```
item VARCHAR2(100) PATH '.', lvl FOR ORDINALITY
)(+) x;
```

Output:

```
ID ITEM LVL
-----1 a 1
1 b 2
1 c 3
1 d 4
2 e 1
3 (NULL) (NULL)
4 f 1
4 (NULL) 2
4 g 3
```

Section 21.7: Splitting Delimited Strings using XMLTable

Sample Data:

```
CREATE TABLE table_name ( id, list ) AS
SELECT 1, 'a,b,c,d' FROM DUAL UNION ALL -- Multiple items in the list
SELECT 2, 'e' FROM DUAL UNION ALL -- Single item in the list
SELECT 3, NULL FROM DUAL UNION ALL -- NULL list
SELECT 4, 'f,,g' FROM DUAL; -- NULL item in the list
```

Query:

```
SELECT t.id,
SUBSTR( x.item.getStringVal(), 2 ) AS item, x.lvl

FROM table_name t
CROSS JOIN
XMLTABLE(

('#' || REPLACE( t.list, ',', '#') || '' ) COLUMNS item XMLTYPE PATH
',
lvl FOR ORDINALITY
```

```
) x;
```

(Note: the # character is appended to facilitate extracting *NULL* values; it is later removed using `SUBSTR(item, 2)`. If *NULL* values are not required then you can simplify the query and omit this.)

Output:

```
ID ITEM LVL
-----1 a 1
1 b 2
1 c 3
1 d 4
2 e 1
3 (NULL) 1
4 f 1
4 (NULL) 2
4 g 3
```

Chapter 22: Collections and Records

Section 22.1: Use a collection as a return type for a split function

It's necessary to declare the type; here `t_my_list`; a collection is a `TABLE OF something`

```
CREATE OR REPLACE TYPE t_my_list AS TABLE OF
VARCHAR2(100);
```

Here's the function. Notice the `()` used as a kind of constructor, and the `COUNT` and `EXTEND` keywords that help you create and grow your collection;

```
CREATE OR REPLACE
FUNCTION cto_table(p_sep IN VARCHAR2, p_list IN VARCHAR2)
```

```
RETURN t_my_list
```

```
AS
```

```
--- this function takes a string list, element being separated by p_sep
-- as separator
```

```
l_string VARCHAR2(4000) := p_list || p_sep;
```

```

l_sep_index PLS_INTEGER;
l_index PLS_INTEGER := 1;
l_tab t_my_list := t_my_list();

BEGIN
LOOP
l_sep_index := INSTR(l_string, p_sep, l_index);
EXIT

WHEN l_sep_index = 0;
l_tab.EXTEND;
l_tab(l_tab.COUNT) := TRIM(SUBSTR(l_string,l_index,l_sep_index -
l_index)); l_index := l_sep_index + 1;

END LOOP;
RETURN l_tab;
END cto_table;
/

```

Then you can see the content of the collection with the `TABLE()` function from SQL; it can be used as a list inside a SQL `IN (..)` statement:

```

SELECT * FROM A_TABLE
WHERE A_COLUMN IN ( TABLE(cto_table('|','a|b|c|d')) )
--- gives the records where A_COLUMN in ('a', 'b', 'c', 'd') -

```

Chapter 23: Object Types

Section 23.1: Accessing stored objects

```

CREATE SEQUENCE test_seq START WITH 1001;

CREATE TABLE test_tab
(
test_id INTEGER, test_obj base_type, PRIMARY KEY (test_id)
);

INSERT INTO test_tab (test_id, test_obj)
VALUES (test_seq.NEXTVAL, base_type(1,'BASE_TYPE'));

```

```

INSERT INTO test_tab (test_id, test_obj)
VALUES (test_seq.NEXTVAL, base_type(2,'BASE_TYPE'));
INSERT INTO test_tab (test_id, test_obj)
VALUES (test_seq.NEXTVAL, mid_type(3, 'MID_TYPE',SYSDATE 1));
INSERT INTO test_tab (test_id, test_obj)
VALUES (test_seq.NEXTVAL, mid_type(4, 'MID_TYPE',SYSDATE + 1));
INSERT INTO test_tab (test_id, test_obj)
VALUES (test_seq.NEXTVAL, leaf_type(5, 'LEAF_TYPE',SYSDATE
20,'Maple')); INSERT INTO test_tab (test_id, test_obj)
VALUES (test_seq.NEXTVAL, leaf_type(6, 'LEAF_TYPE',SYSDATE +
20,'Oak'));

```

Returns object reference:

```
SELECT test_id ,test_obj FROM test_tab;
```

Returns object reference, pushing all to subtype

```
SELECT test_id
,TREAT(test_obj AS mid_type) AS obj FROM test_tab;
```

Returns a string descriptor of each object, by type

```
SELECT test_id
,TREAT(test_obj AS base_type).to_string() AS to_string -- Parenthesis are
needed after the
function name, or Oracle will look for an attribute of this name.
FROM test_tab;
```

Section 23.2: BASE_TYPE

Type declaration:

```

CREATE OR REPLACE TYPE base_type AS OBJECT (
base_id INTEGER,
base_attr VARCHAR2(400),
null_attr INTEGER, -- Present only to demonstrate non-default constructors
CONSTRUCTOR FUNCTION base_type
(

```

```
i_base_attr VARCHAR2
) RETURN SELF AS RESULT,
MEMBER FUNCTION get_base_id RETURN INTEGER, MEMBER
FUNCTION get_base_attr RETURN VARCHAR2, MEMBER
PROCEDURE set_base_id(i_base_id INTEGER), MEMBER PROCEDURE
set_base_attr(i_base_attr VARCHAR2), MEMBER FUNCTION to_string
RETURN VARCHAR2
```

```
) INSTANTIABLE NOT FINAL
```

Type body:

```
CREATE OR REPLACE TYPE BODY base_type AS CONSTRUCTOR
FUNCTION base_type (
```

```
i_base_id INTEGER,
i_base_attr VARCHAR2
) RETURN SELF AS RESULT
IS
```

```
BEGIN
```

```
self.base_id := i_base_id; self.base_attr := i_base_attr; RETURN;
```

```
END base_type;
```

```
MEMBER FUNCTION get_base_id RETURN INTEGER IS BEGIN
```

```
RETURN self.base_id;
```

```
END get_base_id;
```

```
MEMBER FUNCTION get_base_attr RETURN VARCHAR2 IS BEGIN
```

```
RETURN self.base_attr;
```

```
END get_base_attr;
```

```
MEMBER PROCEDURE set_base_id(i_base_id INTEGER) IS
```

```
BEGIN
```

```
self.base_id := i_base_id;
```

```
END set_base_id;
```

```
MEMBER PROCEDURE set_base_attr(i_base_attr VARCHAR2) IS
```

```
BEGIN
```

```
self.base_attr := i_base_attr;
```

```
END set_base_attr;
```

```
MEMBER FUNCTION to_string RETURN VARCHAR2 IS  
BEGIN  
RETURN 'BASE_ID [||self.base_id||]; BASE_ATTR [||self.base_attr||]';  
END to_string;  
END;
```

Section 23.3: MID_TYPE

Type declaration:

```
CREATE OR REPLACE TYPE mid_type UNDER base_type (  
mid_attr DATE,  
CONSTRUCTOR FUNCTION mid_type (  
  
i_base_attr VARCHAR2,  
i_mid_attr DATE  
) RETURN SELF AS RESULT,  
MEMBER FUNCTION get_mid_attr RETURN DATE,  
MEMBER PROCEDURE set_mid_attr(i_mid_attr DATE),  
OVERRIDING MEMBER FUNCTION to_string RETURN VARCHAR2 )  
INSTANTIABLE NOT FINAL
```

Type body:

```
CREATE OR REPLACE TYPE BODY mid_type AS CONSTRUCTOR  
FUNCTION mid_type (  
  
i_base_id INTEGER,  
i_base_attr VARCHAR2,  
i_mid_attr DATE  
  
) RETURN SELF AS RESULT  
IS  
BEGIN  
  
self.base_id := i_base_id; self.base_attr := i_base_attr; self.mid_attr :=
```

```

i_mid_attr; RETURN;

END mid_type;
MEMBER FUNCTION get_mid_attr RETURN DATE IS BEGIN
RETURN self.mid_attr;
END get_mid_attr;
MEMBER PROCEDURE set_mid_attr(i_mid_attr DATE) IS

BEGIN
self.mid_attr := i_mid_attr;
END set_mid_attr;

OVERRIDING MEMBER FUNCTION to_string RETURN VARCHAR2
IS
BEGIN

RETURN (SELF AS base_type).to_string || '; MID_ATTR [' || self.mid_attr ||
]'; END to_string;
END;

```

Section 23.4: LEAF_TYPE

Type declaration:

```

CREATE OR REPLACE TYPE leaf_type UNDER mid_type (
leaf_attr VARCHAR2(1000), CONSTRUCTOR FUNCTION leaf_type (
i_base_id INTEGER,
i_base_attr VARCHAR2,
i_mid_attr DATE,
i_leaf_attr VARCHAR2
) RETURN SELF AS RESULT,
MEMBER FUNCTION get_leaf_attr RETURN VARCHAR2, MEMBER
PROCEDURE set_leaf_attr(i_leaf_attr VARCHAR2), OVERRIDING
MEMBER FUNCTION to_string RETURN VARCHAR2
) INSTANTIABLE FINAL

```

Type Body:

```

CREATE OR REPLACE TYPE BODY leaf_type AS CONSTRUCTOR
FUNCTION leaf_type (

i_base_id INTEGER,
i_base_attr VARCHAR2,
i_mid_attr DATE,
i_leaf_attr VARCHAR2

) RETURN SELF AS RESULT
IS
BEGIN

self.base_id := i_base_id; self.base_attr := i_base_attr; self.mid_attr :=
i_mid_attr; self.leaf_attr := i_leaf_attr; RETURN;

END leaf_type;
MEMBER FUNCTION get_leaf_attr RETURN VARCHAR2 IS BEGIN
RETURN self.leaf_attr;
END get_leaf_attr;
MEMBER PROCEDURE set_leaf_attr(i_leaf_attr VARCHAR2) IS

BEGIN
self.leaf_attr := i_leaf_attr;
END set_leaf_attr;

OVERRIDING MEMBER FUNCTION to_string RETURN VARCHAR2 IS
BEGIN
RETURN (SELF AS mid_type).to_string || '; LEAF_ATTR [' || self.leaf_attr ||
']'; END to_string;
END;

```

Chapter 24: Loop

Section 24.1: Simple Loop

```

DECLARE
v_counter NUMBER(2);

BEGIN

```

```
v_counter := 0;
LOOP

v_counter := v_counter + 1;
DBMS_OUTPUT.put_line('Line number' || v_counter);
EXIT WHEN v_counter = 10;
END LOOP;
END;
```

Section 24.2: WHILE Loop

The WHILE loop is executed until the condition of end is fulfilled. Simple example:

```
DECLARE
v_counter NUMBER(2); --declaration of counter variable
BEGIN
v_counter := 0; --point of start, first value of our iteration
WHILE v_counter < 10 LOOP --exit condition

DBMS_OUTPUT.put_line('Current iteration of loop is ' || v_counter); --show current iteration number in dbms script output
v_counter := v_counter + 1; --incrementation of counter value, very important step

END LOOP; --end of loop declaration
END;
```

This loop will be executed until current value of variable v_counter will be less than ten.

The result:

```
CURRENT iteration OF LOOP IS 0
CURRENT iteration OF LOOP IS 1
CURRENT iteration OF LOOP IS 2
CURRENT iteration OF LOOP IS 3
CURRENT iteration OF LOOP IS 4
CURRENT iteration OF LOOP IS 5
CURRENT iteration OF LOOP IS 6
```

```
CURRENT iteration OF LOOP IS 7  
CURRENT iteration OF LOOP IS 8  
CURRENT iteration OF LOOP IS 9
```

The most important thing is, that our loop starts with '0' value, so first line of results is 'Current iteration of loop is 0'.

Section 24.3: FOR Loop

Loop FOR works on similar rules as other loops. FOR loop is executed exact number of times and this number is known at the beginning - lower and upper limits are directly set in code. In every step in this example, loop is increment by 1.

Simple example:

```
DECLARE  
v_counter NUMBER(2); --declaration of counter variable  
BEGIN  
v_counter := 0; --point of start, first value of our iteration, execute of variable  
FOR v_counter IN 1..10 LOOP --The point, where lower and upper point of  
loop statement is declared  
- in this example, loop will be executed 10 times, start with value of 1  
DBMS_OUTPUT.put_line('Current iteration of loop is ' || v_counter); --show  
current iteration number in dbms script output  
END LOOP; --end of loop declaration END;
```

And the result is:

```
CURRENT iteration OF LOOP IS 1  
CURRENT iteration OF LOOP IS 2  
CURRENT iteration OF LOOP IS 3  
CURRENT iteration OF LOOP IS 4  
CURRENT iteration OF LOOP IS 5  
CURRENT iteration OF LOOP IS 6  
CURRENT iteration OF LOOP IS 7  
CURRENT iteration OF LOOP IS 8  
CURRENT iteration OF LOOP IS 9  
CURRENT iteration OF LOOP IS 10
```

Loop FOR has additional property, which is working in reverse. Using additional word 'REVERSE' in declaration of lower and upper limit of loop allow to do that. Every execution of loop decrement value of v_counter by 1.

Example:

```
DECLARE
```

```
v_counter NUMBER(2); --declaration of counter variable
```

```
BEGIN
```

```
v_counter := 0; --point of start
```

```
FOR v_counter IN REVERSE 1..10 LOOP
```

```
DBMS_OUTPUT.put_line('Current iteration of loop is ' || v_counter); --show  
current iteration number in dbms script output
```

```
END LOOP; --end of loop declaration END;
```

And the result:

```
CURRENT iteration OF LOOP IS 10 CURRENT iteration OF LOOP IS 9
```

```
CURRENT iteration OF LOOP IS 8 CURRENT iteration OF LOOP IS 7
```

```
CURRENT iteration OF LOOP IS 6 CURRENT iteration OF LOOP IS 5
```

```
CURRENT iteration OF LOOP IS 4 CURRENT iteration OF LOOP IS 3
```

```
CURRENT iteration OF LOOP IS 2 CURRENT iteration OF LOOP IS 1
```

Chapter 25: Cursors

Section 25.1: Parameterized "FOR loop" Cursor

```
DECLARE
```

```
CURSOR c_emp_to_be_raised(p_sal emp.sal%TYPE) IS
```

```
SELECT * FROM emp WHERE sal < p_sal;
```

```
BEGIN
```

```
FOR cRowEmp IN c_emp_to_be_raised(1000) LOOP
```

```
DBMS_OUTPUT.Put_Line(cRowEmp.eName || ' ' || cRowEmp.sal || '... should  
be raised ;)');
```

```
END LOOP;
```

```
END;
```

```
/
```

Section 25.2: Implicit "FOR loop" cursor

```

BEGIN
FOR x IN (SELECT * FROM emp WHERE sal < 100) LOOP

DBMS_OUTPUT.Put_Line(x.eName || ' ' || x.sal || '... should REALLY be raised
:D'); END LOOP;
END;
/

```

First advantage is there is no tedious declaration to do (think of this horrible "CURSOR" thing you had in previous versions)

second advantage is you first build your select query, then when you have what you want, you immediately can access the fields of your query (x.<myfield>) in your PL/SQL loop

The loop opens the cursor and fetches one record at a time for every loop. At the end of the loop the cursor is closed.

Implicit cursors are faster because the interpreter's work grows as the code gets longer. The less code the less work the interpreter has to do.

Section 25.3: Handling a CURSOR

Declare the cursor to scan a list of records

Open it

Fetch current record into variables (this increments position)

Use %notfound to detect end of list

Don't forget to close the cursor to limit resources consumption in current context

-

```

DECLARE

```

```

CURSOR curCols IS -- select column name and type from a given table

```

```

SELECT column_name, data_type FROM all_tab_columns WHERE

```

```

table_name='MY_TABLE'; v_tab_column

```

```

all_tab_columns.column_name%TYPE;

```

```

v_data_type all_tab_columns.data_type%TYPE;

```

```

v_ INTEGER := 1;

```

```

BEGIN

```

```

OPEN curCols;
LOOP

FETCH curCols INTO v_tab_column, v_data_type;
IF curCols%notfound OR v_ > 2000 THEN
EXIT;
END IF;
DBMS_OUTPUT.put_line(v_||':Column '||v_tab_column||' is of '||
v_data_type||' Type. '); v_:= v_ + 1;
END LOOP;
-- Close in any case IF curCols%ISOPEN THEN

CLOSE curCols;
END IF;
END;
/

```

Section 25.4: Working with SYS_REFCURSOR

SYS_REFCURSOR can be used as a return type when you need to easily handle a list returned not from a table, but more specifically from a function:
function returning a cursor

```

CREATE OR REPLACE FUNCTION list_of (required_type_in IN
VARCHAR2) RETURN SYS_REFCURSOR
IS
v_ SYS_REFCURSOR;
BEGIN
CASE required_type_in
WHEN 'CATS'
THEN
OPEN v_ FOR
SELECT nickname FROM (
SELECT 'minou' nickname FROM dual UNION ALL SELECT 'minâ'
FROM dual UNION ALL SELECT 'minon' FROM dual );
WHEN 'DOGS'
THEN

```

```

OPEN v_ FOR
SELECT dog_call FROM (
SELECT 'bill' dog_call FROM dual UNION ALL SELECT 'nestor' FROM
dual UNION ALL SELECT 'raoul' FROM dual );
END CASE;
-- Whit this use, you must not close the cursor. RETURN v_;
END list_of;
/

```

and how to use it:

```

DECLARE
v_names SYS_REFCURSOR;
v_ VARCHAR2 (32767);

BEGIN
v_names := list_of('CATS');
LOOP

FETCH v_names INTO v_;
EXIT WHEN v_names%NOTFOUND;
DBMS_OUTPUT.put_line(v_);

END LOOP;
-- here you close it
CLOSE v_names;

END;
/

```

Chapter 26: Sequences

Parameter Details

schema schema name
increment by interval between the numbers
start with first number needed
maxvalue Maximum value for the sequence
nomaxvalue Maximum value is defaulted

minvalue minimum value for the sequence
nominvalue minimum value is defaulted
cycle
nocycle cache
nocache order
noorder Reset to the start after reaching this value Default
Preallocation limit
Default
Guarantee the order of numbers
default

Section 26.1: Creating a Sequence: Example

Purpose

Use the CREATE SEQUENCE statement to create a sequence, which is a database object from which multiple users may generate unique integers. You can use sequences to automatically generate primary key values.

When a sequence number is generated, the sequence is incremented, independent of the transaction committing or rolling back. If two users concurrently increment the same sequence, then the sequence numbers each user acquires may have gaps, because sequence numbers are being generated by the other user. One user can never acquire the sequence number generated by another user. After a sequence value is generated by one user, that user can continue to access that value regardless of whether the sequence is incremented by another user.

Sequence numbers are generated independently of tables, so the same sequence can be used for one or for multiple tables. It is possible that individual sequence numbers will appear to be skipped, because they were generated and used in a transaction that ultimately rolled back. Additionally, a single user may not realize that other users are drawing from the same sequence.

After a sequence is created, you can access its values in SQL statements with the CURRVAL pseudocolumn, which returns the current value of the sequence, or the NEXTVAL pseudocolumn, which increments the sequence

and returns the new value.

Prerequisites

To create a sequence in your own schema, you must have the CREATE SEQUENCE system privilege.

To create a sequence in another user's schema, you must have the CREATE ANY SEQUENCE system privilege.

Creating a Sequence: Example The following statement creates the sequence customers_seq in the sample schema oe. This sequence could be used to provide customer ID numbers when rows are added to the customers table.

```
CREATE SEQUENCE customers_seq  
START WITH 1000  
INCREMENT BY 1  
NOCACHE  
NOCYCLE;
```

The first reference to customers_seq.nextval returns 1000. The second returns 1001. Each subsequent reference will return a value 1 greater than the previous reference.

Chapter 27: Indexes

Here I will explain different index using example, how index increase query performance, how index decrease DML performance etc

Section 27.1: b-tree index

```
CREATE INDEX ord_customer_ix ON orders (customer_id);
```

By default, if we do not mention anything, oracle creates an index as a b-tree index. But we should know when to use it. B-tree index stores data as binary tree format. As we know that, index is a schema object which stores some sort of entry for each value for the indexed column. So, whenever any search happens on those columns, it checks in the index for the exact location of that record to access fast. Few points about indexing:

To search for entry in the index, some sort of binary search algorithm used. When **data cardinality is high**, **b-tree** index is perfect to use. Index makes DML slow, as for each record, there should be one entry in the index for indexed column. So, if not necessary, we should avoid creating index.

Section 27.2: Bitmap Index

```
CREATE BITMAP INDEX  
emp_bitmap_idx  
ON index_demo (gender);
```

Bitmap index is used when **data cardinality is low**. Here, **Gender** has value with low cardinality. Values are may be Male, Female & others. So, if we create a binary tree for this 3 values while searching it will have unnecessary traverse. In bitmap structures, a two-dimensional array is created with one column for every row in the table being indexed. Each column represents a distinct value within the bitmapped index. This two-dimensional array represents each value within the index multiplied by the number of rows in the table. At row retrieval time, Oracle decompresses the bitmap into the RAM data buffers so it can be rapidly scanned for matching values. These matching values are delivered to Oracle in the form of a Row-ID list, and these Row-ID values may directly access the required information.

Section 27.3: Function Based Index

```
CREATE INDEX first_name_idx ON user_data (UPPER(first_name));  
  
SELECT *  
FROM user_data  
WHERE UPPER(first_name) = 'JOHN2';
```

Function based index means, creating index based on a function. If in search (where clause), frequently any function is used, it's better to create index based on that function. Here, in the example, for search, **Upper()** function is being used. So, it's better to create index using upper function.

Chapter 28: Hints

Parameters Details

Degree of Parallelism (DOP) It is the number of parallel connection/processes which you want your query to open up. It is usually 2, 4, 8, 16 so on.

Table Name The name of the table on which parallel hint will be applied.

Section 28.1: USE_NL

Use Nested Loops.

Usage : use_nl(A B)

This hint will ask the engine to use nested loop method to join the tables A and B. That is row by row comparison. The hint does not force the order of the join, just asks for NL.

```
SELECT /*+use_nl(e d)*/ *  
FROM Employees E  
JOIN Departments D ON E.DepartmentID = D.ID
```

Section 28.2: APPEND HINT

"Use DIRECT PATH method for inserting new rows".

The APPEND hint instructs the engine to use **direct path load**. This means that the engine will not use a conventional insert using memory structures and standard locks, but will write directly to the tablespace the data. Always creates new blocks which are appended to the table's segment. This will be faster, but have some limitations:

You cannot read from the table you appended in the same session until you commit or rollback the transaction.

If there are triggers defined on the table Oracle **will not use direct path**(it's a different story for sqlldr loads). others

Example.

```
INSERT /*+append*/ INTO Employees  
SELECT *  
FROM Employees;
```

Section 28.3: Parallel Hint

Statement-level parallel hints are the easiest:

```
SELECT /*+ PARALLEL(8) */ first_name, last_name FROM employee emp;
```

Object-level parallel hints give more control but are more prone to errors; developers often forget to use the alias instead of the object name, or they forget to include some objects.

```
SELECT /*+ PARALLEL(emp,8) */ first_name, last_name FROM employee  
emp;
```

```
SELECT /*+ PARALLEL(table_alias,Degree of Parallelism) */ FROM  
table_name table_alias;
```

Let's say a query takes 100 seconds to execute without using parallel hint. If we change DOP to 2 for same query, then *ideally* the same query with parallel hint will take 50 second. Similarly using DOP as 4 will take 25 seconds.

In practice, parallel execution depends on many other factors and does not scale linearly. This is especially true for small run times where the parallel overhead may be larger than the gains from running in multiple parallel servers.

Section 28.4: USE_HASH

Instructs the engine to use hash method to join tables in the argument.

Usage : use_hash(TableA [TableB] ... [TableN])

As **explained** in **many places**, "in a HASH join, Oracle accesses one table (usually the smaller of the joined results) and builds a hash table on the join key in memory. It then scans the other table in the join (usually the larger one) and probes the hash table for matches to it."

It is preferred against Nested Loops method when the tables are big, no indexes are at hand, etc.

Note: The hint does not force the order of the join, just asks for HASH JOIN

method.

Example of usage:

```
SELECT /*+use_hash(e d)*/ *  
FROM Employees E  
JOIN Departments D ON E.DepartmentID = D.ID
```

Section 28.5: FULL

The FULL hint tells Oracle to perform a full table scan on a specified table, no matter if an index can be used.

```
CREATE TABLE fullTable(id) AS SELECT LEVEL FROM dual  
CONNECT BY LEVEL < 100000; CREATE INDEX idx ON fullTable(id);
```

With no hints, the index is used:

```
SELECT COUNT(1) FROM fullTable f WHERE id BETWEEN 10 AND  
100;
```

```
-----| Id |  
| Id | Operation | Name | Rows | Bytes | Cost (%CPU)| Time |  
-----|-----|-----|-----|-----|-----|-----|-----|
```

```
| 0 | SELECT STATEMENT | | 1 | 13 | 3 (0)| 00:00:01 |  
| 1 | SORT AGGREGATE | | 1 | 13 | | |  
|* 2 | INDEX RANGE SCAN| IDX | 2 | 26 | 3 (0)| 00:00:01 |  
-----|-----|-----|-----|-----|-----|
```

FULL hint forces a full scan:

```
SELECT /*+ full(f) */ COUNT(1) FROM fullTable f WHERE id  
BETWEEN 10 AND 100;
```

```
-----| Id |  
Operation | Name | Rows | Bytes | Cost (%CPU)| Time |  
-----|-----|-----|-----|-----|-----| 0 |  
SELECT STATEMENT | | 1 | 13 | 47 (3)| 00:00:01 | | 1 | SORT  
AGGREGATE | | 1 | 13 | | |* 2 | TABLE ACCESS FULL| FULLTABLE | 2 |  
26 | 47 (3)| 00:00:01 |  
-----|-----|-----|-----|-----|-----|
```

Section 28.6: Result Cache

Oracle (*11g and above*) allows the SQL queries to be cached in the **SGA** and reused to improve performance. It queries the data from cache rather than database. Subsequent execution of same query is faster because now the data is being pulled from cache.

```
SELECT /*+ result_cache */ NUMBER FROM main_table;
```

Output

Number

-----1

2

3

4

5

6

7

8

9

10

Elapsed: 00:00:02.20

If I run the same query again now, the time to execute will reduce since the data is now fetched from cache which was set during the first execution.

Output

Number

-----1

2

3

4

5

6

7

8

9

10

Elapsed: 00:00:00.10

Notice how the elapsed time reduced from **2.20 seconds** to **0.10 seconds**. Result Cache holds the cache until the data in database is updated/altered/deleted. Any change will release the cache.

Chapter 29: Packages

Section 29.1: Define a Package header and body with a function

In this example we define a package header and a package body with a function.

After that we are calling a function from the package that return a return value.

Package header:

```
CREATE OR REPLACE PACKAGE SkyPkg AS
FUNCTION GetSkyColour(vPlanet IN VARCHAR2)
RETURN VARCHAR2;
END;
/
```

Package body:

```
CREATE OR REPLACE PACKAGE BODY SkyPkg AS

FUNCTION GetSkyColour(vPlanet IN VARCHAR2)
RETURN VARCHAR2
AS
```

```
vColour VARCHAR2(100) := NULL;
BEGIN
IF vPlanet = 'Earth' THEN vColour := 'Blue';
ELSIF vPlanet = 'Mars' THEN vColour := 'Red';
END IF;
```

```
RETURN vColour; END;
END; /
```

Calling the function from the package body:

```

DECLARE vColour VARCHAR2(100);
BEGIN
vColour := SkyPkg.GetSkyColour(vPlanet => 'Earth');
DBMS_OUTPUT.PUT_LINE(vColour);
END;
/

```

Section 29.2: Overloading

Functions and procedures in packages can be overloaded. The following package **TEST** has two procedures called **print_number**, which behave differently depending on parameters they are called with.

```

CREATE OR REPLACE PACKAGE TEST IS
PROCEDURE print_number(p_number IN INTEGER);

PROCEDURE print_number(p_number IN VARCHAR2); END TEST;
/
CREATE OR REPLACE PACKAGE BODY TEST IS

PROCEDURE print_number(p_number IN INTEGER) IS BEGIN
DBMS_OUTPUT.put_line('Digit: ' || p_number); END;
PROCEDURE print_number(p_number IN VARCHAR2) IS BEGIN
DBMS_OUTPUT.put_line('String: ' || p_number); END;
END TEST; /

```

We call both procedures. The first with integer parameter, the second with varchar2.

```

SET serveroutput ON;
-- call the first procedure exec test.print_number(3);
-- call the second procedure exec test.print_number('three');

```

The output of the above script is:

```

SQL>
Digit: 3
PL/SQL procedure successfully completed String: three
PL/SQL procedure successfully completed

```

Restrictions on Overloading

Only local or packaged subprograms, or type methods, can be overloaded. Therefore, you cannot overload standalone subprograms. Also, you cannot overload two subprograms if their formal parameters differ only in name or parameter mode

Section 29.3: Package Usage

Packages in PL/SQL are a collection of procedures, functions, variables, exceptions, constants, and data structures. Generally the resources in a package are related to each other and accomplish similar tasks.

Why Use Packages

Modularity

Better Performance/ Functionality

Parts of a Package

Specification - Sometimes called a package header. Contains variable and type declarations and the signatures of the functions and procedures that are in the package which are **public** to be called from outside the package.

Package Body - Contains the code and **private** declarations.

The package specification must be compiled before the package body, otherwise the package body compilation will report an error.

Chapter 30: Exception Handling

Oracle produces a variety of exceptions. You may be surprised how tedious it can be to have your code stop with some unclear message. To improve your PL/SQL code's ability to get fixed easily it is necessary to handle exceptions at the lowest level. Never hide an exception "under the carpet", unless you're here to keep your piece of code for you only and for no one else to maintain.

The **predefined errors**.

Section 30.1: Syntax

The general syntax for exception section:

```

DECLARE
declaration Section
BEGIN
some statements

EXCEPTION
WHEN exception_one THEN

DO something
WHEN exception_two THEN
DO something
WHEN exception_three THEN
DO something
WHEN OTHERS THEN
DO something
END;

```

An exception section has to be on the end of the PL/SQL block. PL/SQL gives us the opportunity to nest blocks, then each block may have its own exception section for example:

```

CREATE OR REPLACE PROCEDURE nested_blocks IS
BEGIN

some statements
BEGIN
some statements
EXCEPTION
WHEN exception_one THEN DO something
END;
EXCEPTION
WHEN exception_two THEN DO something
END;

```

If exception will be raised in the nested block it should be handled in the inner exception section, but if inner exception section does not handle this exception then this exception will go to exception section of the external block.

Section 30.2: User defined exceptions

As the name suggest user defined exceptions are created by users. If you want to create your own exception you have to:

1. Declare the exception
2. Raise it from your program
3. Create suitable exception handler to catch him.

Example

I want to update all salaries of workers. But if there are no workers, raise an exception.

```
CREATE OR REPLACE PROCEDURE update_salary IS
no_workers EXCEPTION;
v_counter NUMBER := 0;
BEGIN
SELECT COUNT(*) INTO v_counter FROM emp; IF v_counter = 0 THEN
RAISE no_workers;
ELSE
UPDATE emp SET salary = 3000; END IF;

EXCEPTION

WHEN no_workers THEN
raise_application_error(20991,'We don't have workers!'); END;
/
```

What does it mean **RAISE**?

Exceptions are raised by database server automatically when there is a need, but if you want, you can raise explicitly any exception using **RAISE**.

Procedure raise_application_error(error_number,error_message);

error_number must be between -20000 and -20999 error_message message to display when error occurs.

Section 30.3: Internally defined exceptions

An internally defined exception doesn't have a name, but it has its own code.

When to use it?

If you know that your database operation might raise specific exceptions those which don't have names, then you can give them names so that you can write exception handlers specifically for them. Otherwise, you can use them only with **OTHERS** exception handlers.

Syntax

```
DECLARE
my_name_exc EXCEPTION;
PRAGMA exception_init(my_name_exc,37);

BEGIN
...
EXCEPTION
WHEN my_name_exc THEN
DO something
END;
```

my_name_exc **EXCEPTION**; that is the exception name declaration.
PRAGMA exception_init(my_name_exc,37); assign name to the error code of internally defined exception.

Example

We have an emp_id which is a primary key in emp table and a foreign key in dept table. If we try to remove emp_id when it has child records, it will be thrown an exception with code -2292.

```
CREATE OR REPLACE PROCEDURE remove_employee IS
emp_exception EXCEPTION;
PRAGMA exception_init(emp_exception,2292);
BEGIN
DELETE FROM emp WHERE emp_id = 3;
EXCEPTION
WHEN emp_exception THEN
DBMS_OUTPUT.put_line('You can not do that!');
END;
/
```

Oracle documentation says: "An internally defined exception with a user-declared name is still an internally defined exception, not a user-defined exception."

Section 30.4: Predefined exceptions

Predefined exceptions are internally defined exceptions but they have names. Oracle database raise this type of exceptions automatically.

Example

```
CREATE OR REPLACE PROCEDURE insert_emp
IS
BEGIN

INSERT INTO emp (emp_id, ename) VALUES ('1','Jon');
EXCEPTION
WHEN DUP_VAL_ON_INDEX THEN

DBMS_OUTPUT.put_line('Duplicate value on index!');
END;
/
```

Below are examples exceptions name with theirs codes:

Exception Name	Error Code
NO_DATA_FOUND	-1403
ACCESS_INTO_NULL	-6530
CASE_NOT_FOUND	-6592
ROWTYPE_MISMATCH	-6504
TOO_MANY_ROWS	-1422
ZERO_DIVIDE	-1476

Full list of exception names and their codes on Oracle web-site.

Section 30.5: Define custom exception, raise it and see where it comes from

To illustrate this, here is a function that has 3 different "wrong" behaviors

the parameter is completely stupid: we use a user-defined expression
the parameter has a typo: we use Oracle standard **NO_DATA_FOUND** error
another, but not handled case

Feel free to adapt it to your standards:

```
DECLARE
this_is_not_acceptable EXCEPTION;
PRAGMA EXCEPTION_INIT(this_is_not_acceptable, 20077);
g_err VARCHAR2 (200) := 'to-be-defined';
w_schema all_tables.OWNER%TYPE;

PROCEDURE get_schema( p_table IN VARCHAR2, p_schema OUT
VARCHAR2)

IS
w_err VARCHAR2 (200) := 'to-be-defined';
BEGIN
w_err := 'get_schema-step-1: ';
IF (p_table = 'Delivery-Manager-Is-Silly') THEN
RAISE this_is_not_acceptable;
END IF;
w_err := 'get_schema-step-2: ';
SELECT owner INTO p_schema
FROM all_tables
WHERE table_name LIKE(p_table||'%');
EXCEPTION
WHEN NO_DATA_FOUND THEN
-- handle Oracle-defined exception
DBMS_OUTPUT.put_line(['[WARN]'||w_err||'This can happen. Check the
table name you entered.']);
WHEN this_is_not_acceptable THEN
-- handle your custom error
DBMS_OUTPUT.put_line(['[WARN]'||w_err||'Please don't make fun of the
delivery manager.']);
WHEN OTHERS THEN
DBMS_OUTPUT.put_line(['[ERR]'||w_err||'unhandled
exception: '||SQLERRM]);
```

```

RAISE;
END Get_schema;

BEGIN
g_err := 'Global; first call:';
get_schema('Delivery-Manager-Is-Silly', w_schema);
g_err := 'Global; second call:';
get_schema('AAA', w_schema);
g_err := 'Global; third call:';
get_schema("", w_schema);
g_err := 'Global; 4th call:';
get_schema('Can"t reach this point due to previous error.', w_schema);

EXCEPTION
WHEN OTHERS THEN

DBMS_OUTPUT.put_line(['[ERR]'||g_err||'unhandled
exception:'||SQLERRM]);
-- you may raise this again to the caller if error log isn't enough.
-- raise;
END;
/

```

Giving on a regular database:

```

[WARN]get_schema-step-1:Please don't make fun of the delivery manager.
[WARN]get_schema-step-2:This can happen. Check the table name you
entered.
[ERR]get_schema-step-2:unhandled exception:ORA-01422: exact fetch
returns more than requested number of rows
[ERR]Global; third call:unhandled exception:ORA-01422: exact fetch returns
more than requested number of rows

```

Remember that exception are here to handle *rare* cases. I saw applications who raised an exception at every access, just to ask for the user password, saying "not connected" ... so much computation waste.

Section 30.6: Handling connexion error exceptions

Each standard Oracle error is associated with an error number. It's important to anticipate what could go wrong in your code. Here for a connection to another database, it can be:

- 28000 account is locked
- 28001 password expired
- 28002 grace period
- 1017 wrong user / password

Here is a way to test what goes wrong with the user used by the database link:

```
DECLARE
v_dummy NUMBER;
BEGIN
-- testing db link
EXECUTE IMMEDIATE 'select COUNT(1) from dba_users@pass.world'
INTO v_dummy ;
-- if we get here, exception wasn't raised: display COUNT's result
DBMS_OUTPUT.put_line(v_dummy||' users on PASS db');

EXCEPTION
-- exception can be referred by their name in the predefined Oracle's list
WHEN LOGIN_DENIED
THEN

DBMS_OUTPUT.put_line('ORA-1017 / USERNAME OR PASSWORD
INVALID, TRY AGAIN'); WHEN OTHERS
THEN

-- or referred by their number: stored automatically in reserved variable
SQLCODE IF SQLCODE = '-2019'
THEN

DBMS_OUTPUT.put_line('ORA-2019 / Invalid db_link name');
ELSIF SQLCODE = '-1035'
THEN
```

```

DBMS_OUTPUT.put_line('ORA-1035 / DATABASE IS ON RESTRICTED
SESSION, CONTACT YOUR DBA');
ELSIF SQLCODE = '-28000'
THEN

DBMS_OUTPUT. put_line('ORA-28000 / ACCOUNT IS LOCKED.
CONTACT YOUR DBA'); ELSIF SQLCODE = '-28001'
THEN

DBMS_OUTPUT. put_line('ORA-28001 / PASSWORD EXPIRED.
CONTACT YOUR DBA FOR CHANGE'); ELSIF SQLCODE = '-28002'
THEN

DBMS_OUTPUT.put_line('ORA-28002 / PASSWORD IS EXPIRED,
CHANGED IT'); ELSE

-- and if it's not one of the exception you expected
DBMS_OUTPUT.put_line('Exception not specifically handled');
DBMS_OUTPUT.put_line('Oracle Said'||SQLCODE||':'||SQLERRM);

END IF; END;
/

```

Section 30.7: Exception handling

1. What is an exception?

Exception in PL/SQL is an error created during a program execution.

We have three types of exceptions:

Internally defined exceptions Predefined exceptions

User-defined exceptions

2. What is an exception handling?

Exception handling is a possibility to keep our program running even if appear runtime error resulting from for example coding mistakes, hardware failures. We avoid it from exiting abruptly.

Chapter 31: Error logging

Section 31.1: Error logging when writing to database

Create Oracle error log table ERR\$_EXAMPLE for existing EXAMPLE table:

```
EXECUTE DBMS_ERRLOG.CREATE_ERROR_LOG('EXAMPLE',  
NULL, NULL, NULL, TRUE);
```

Make writing operation with SQL:

```
INSERT INTO EXAMPLE (COL1) VALUES ('example')  
LOG ERRORS INTO ERR$_EXAMPLE reject limit unlimited;
```

Chapter 32: Database Links

Section 32.1: Creating a database link

```
CREATE DATABASE LINK dblink_name  
CONNECT TO remote_username  
IDENTIFIED BY remote_password  
USING 'tns_service_name';
```

The remote DB will then be accessible in the following way:

```
SELECT * FROM MY_TABLE@dblink_name;
```

To test a database link connection without needing to know any of the object names in the linked database, use the following query:

```
SELECT * FROM DUAL@dblink_name;
```

To explicitly specify a domain for the linked database service, the domain name is added to the USING statement. For example:

```
USING 'tns_service_name.WORLD'
```

If no domain name is explicitly specified, Oracle uses the domain of the database in which the link is being created.

Oracle documentation for database link creation:

10g:

https://docs.oracle.com/cd/B19306_01/server.102/b14200/statements_5005.htm

11g:

https://docs.oracle.com/cd/B28359_01/server.111/b28310/ds_concepts002.htm

12g:

https://docs.oracle.com/database/121/SQLRF/statements_5006.htm#SQLRF0

Section 32.2: Create Database Link

Let us assume we have two databases "ORA1" and "ORA2". We can access the objects of "ORA2" from database "ORA1" using a database link.

Prerequisites: For creating a private Database link you need a **CREATE DATABASE LINK** privilege. For creating a private Database link you need a **CREATE PUBLIC DATABASE LINK** privilege.

***Oracle Net** must be present on both the instances.

How to create a database link:

From ORA1:

```
SQL> CREATE <public> DATABASE LINK ora2 CONNECT TO user1  
IDENTIFIED BY pass1 USING <tns name OF ora2>;
```

Database link created.

Now that we have the DB link set up, we can prove that by running the following from ORA1:

```
SQL> SELECT name FROM V$DATABASE@ORA2; -- should return  
ORA2
```

You can also access the DB Objects of "ORA2" from "ORA1", given the user user1 has the **SELECT** privilege on those objects on ORA2 (such as TABLE1 below):

```
SELECT COUNT(*) FROM TABLE1@ORA2;
```

Pre-requisites:

Both databases must be up and running (opened).

Both database listeners must be up and running.

TNS must be configured correctly.

User user1 must be present in ORA2 database, password must be checked and verified. User user1 must have at least the **SELECT** privilege, or any other required to access the objects on ORA2.

Chapter 33: Table partitioning

Partitioning is a functionality to split tables and indexes into smaller pieces. It is used to improve performance and to manage the smaller pieces individually. The partition key is a column or a set of columns that defines in which partition each row is going to be stored. [Partitioning Overview in official Oracle documentation](#)

Section 33.1: Select existing partitions

Check existing partitions on Schema

```
SELECT * FROM user_tab_partitions;
```

Section 33.2: Drop partition

```
ALTER TABLE table_name DROP PARTITION partition_name;
```

Section 33.3: Select data from a partition

Select data from a partition

```
SELECT * FROM orders PARTITION(partition_name);
```

Section 33.4: Split Partition

Splits some partition into two partitions with another high bound.

```
ALTER TABLE table_name SPLIT PARTITION old_partition  
AT (new_high_bound) INTO (PARTITION new_partition TABLESPACE  
new_tablespace, PARTITION old_partition)
```

Section 33.5: Merge Partitions

Merge two partitions into single one

```
ALTER TABLE table_name  
MERGE PARTITIONS first_partition, second_partition  
INTO PARTITION splitted_partition TABLESPACE new_tablespace
```

Section 33.6: Exchange a partition

Exchange/convert a partition to a non-partitioned table and vice versa. This facilitates a fast "move" of data between the data segments (opposed to doing something like "insert...select" or "create table...as select") as the operation is DDL (the partition exchange operation is a data dictionary update without moving the actual data) and not DML (large undo/redo overhead).

Most basic examples :

1. Convert a non-partitioned table (table "B") to a partition (of table "A") :
Table "A" doesn't contain data in partition "OLD_VALUES" and table "B" contains data

```
ALTER TABLE "A" EXCHANGE PARTITION "OLD_VALUES" WITH  
TABLE "B";
```

Result : data is "moved" from table "B" (contains no data after operation) to partition "OLD_VALUES"

2. Convert a partition to a non-partitioned table :

Table "A" contains data in partition "OLD_VALUES" and table "B" doesn't contain data

```
ALTER TABLE "A" EXCHANGE PARTITION "OLD_VALUES" WITH  
TABLE "B";
```

Result : data is "moved" from partition "OLD_VALUES" (contains no data after operation) to table "B"

Note : there is a quite a few additional options, features and restrictions for this operation

Further info can be found on this link --->

["https://docs.oracle.com/cd/E11882_01/server.112/e25523/part_admin002.htm](https://docs.oracle.com/cd/E11882_01/server.112/e25523/part_admin002.htm)
(section "Exchanging Partitions")

Section 33.7: Hash partitioning

This creates a table partitioned by hash, in this example on store id.

```
CREATE TABLE orders (  
order_nr NUMBER(15),  
user_id VARCHAR2(2),  
order_value NUMBER(15),  
store_id NUMBER(5)
```

```
)
```

```
PARTITION BY HASH(store_id) PARTITIONS 8;
```

You should use a power of 2 for the number of hash partitions, so that you get an even distribution in partition size.

Section 33.8: Range partitioning

This creates a table partitioned by ranges, in this example on order values.

```
CREATE TABLE orders (  
  order_nr NUMBER(15),  
  user_id VARCHAR2(2),  
  order_value NUMBER(15),  
  store_id NUMBER(5)  
  
)  
  
PARTITION BY RANGE( order_value) (  
  PARTITION p1 VALUES LESS THAN(10),  
  PARTITION p2 VALUES LESS THAN(40),  
  PARTITION p3 VALUES LESS THAN(100),  
  PARTITION p4 VALUES LESS THAN(MAXVALUE)  
  
);
```

Section 33.9: List partitioning

This creates a table partitioned by lists, in this example on store id.

```
CREATE TABLE orders (  
  order_nr NUMBER(15),  
  user_id VARCHAR2(2),  
  order_value NUMBER(15),  
  store_id NUMBER(5)  
  
)  
  
PARTITION BY LIST(store_id) (  
  PARTITION p1 VALUES (1,2,3),  
  PARTITION p2 VALUES(4,5,6), PARTITION p3 VALUES(7,8,9),  
  PARTITION p4 VALUES(10,11)  
  
);
```

Section 33.10: Truncate a partition

```
ALTER TABLE table_name TRUNCATE PARTITION partition_name;
```

Section 33.11: Rename a partition

```
ALTER TABLE table_name RENAME PARTITION p3 TO p6;
```

Section 33.12: Move partition to different tablespace

```
ALTER TABLE table_name  
MOVE PARTITION partition_name TABLESPACE tablespace_name;
```

Section 33.13: Add new partition

```
ALTER TABLE table_name  
ADD PARTITION new_partition VALUES LESS THAN(400);
```

Chapter 34: Oracle Advanced Queuing (AQ)

Section 34.1: Simple Producer/Consumer

Overview

Create a queue that we can send a message to. Oracle will notify our stored procedure that a message has been enqueued and should be worked. We'll also add some subprograms we can use in an emergency to stop messages from being dequeued, allow dequeuing again, and run a simple batch job to work through all of the messages.

These examples were tested on Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production.

Create Queue

We will create a message type, a queue table that can hold the messages, and a queue. Messages in the queue will be dequeued first by priority then by their enqueue time. If anything goes wrong working the message and the dequeue is rolled-back AQ will make the message available for dequeue 3600

seconds later. It will do this 48 times before moving it an exception queue.

```
CREATE TYPE message_t AS object
(
  sender VARCHAR2 ( 50 ),
  message VARCHAR2 ( 512 )
);

/
-- Type MESSAGE_T compiled
BEGIN DBMS_AQADM.create_queue_table(

queue_table => 'MESSAGE_Q_TBL',
queue_payload_type => 'MESSAGE_T',
sort_list => 'PRIORITY,ENQ_TIME',
multiple_consumers => FALSE,
compatible => '10.0.0');

END;

/
-- PL/SQL procedure successfully completed.
BEGIN DBMS_AQADM.create_queue(

queue_name => 'MESSAGE_Q',
queue_table => 'MESSAGE_Q_TBL',
queue_type => 0,
max_retries => 48,
retry_delay => 3600,
dependency_tracking => FALSE);

END;

/
-- PL/SQL procedure successfully completed.
```

Now that we have a place to put the messages lets create a package to manage and work messages in the queue.

```
CREATE OR REPLACE PACKAGE message_worker_pkg IS
queue_name_c CONSTANT VARCHAR2(20) := 'MESSAGE_Q';
```

```

-- allows the workers to process messages in the queue
PROCEDURE enable_dequeue;
-- prevents messages from being worked but will still allow them to be
created and enqueued
PROCEDURE disable_dequeue;
-- called only by Oracle Advanced Queueing. Do not call anywhere else.

PROCEDURE on_message_enqueued (context IN RAW,
reginfo IN sys.aq$_reg_info, descr IN sys.aq$_descriptor, payload IN RAW,
payloadl IN NUMBER);

-- allows messages to be worked if we missed the notification (or a retry
-- is pending)
PROCEDURE work_old_messages;

END; /

CREATE OR REPLACE PACKAGE BODY message_worker_pkg IS
-- raised by Oracle when we try to dequeue but no more messages are ready
to
-- be dequeued at this moment
no_more_messages_ex EXCEPTION;
PRAGMA exception_init (no_more_messages_ex,
-25228);

-- allows the workers to process messages in the queue
PROCEDURE enable_dequeue
AS

BEGIN
DBMS_AQADM.start_queue (queue_name => queue_name_c, dequeue =>
TRUE);
END enable_dequeue;

-- prevents messages from being worked but will still allow them to be
created and enqueued
PROCEDURE disable_dequeue
AS

```

```

BEGIN
DBMS_AQADM.stop_queue (queue_name => queue_name_c, dequeue =>
TRUE, enqueue => FALSE);
END disable_dequeue;

PROCEDURE work_message (message_in IN OUT NOCOPY message_t)
AS
BEGIN

DBMS_OUTPUT.put_line ( message_in.sender || ' says ' ||
message_in.message ); END work_message;
-- called only by Oracle Advanced Queueing. Do not call anywhere else.

PROCEDURE on_message_enqueued (context IN RAW,
reginfo IN sys.aq$_reg_info, descr IN sys.aq$_descriptor, payload IN RAW,
payloadl IN NUMBER)

AS
PRAGMA autonomous_transaction;
dequeue_options_l DBMS_AQ.dequeue_options_t; message_id_l RAW (16);
message_l message_t;
message_properties_l DBMS_AQ.message_properties_t;

BEGIN
dequeue_options_l.msgid := descr.msg_id;
dequeue_options_l.consumer_name := descr.consumer_name;
dequeue_options_l.wait := DBMS_AQ.no_wait; DBMS_AQ.dequeue
(queue_name => descr.queue_name, dequeue_options => dequeue_options_l,
message_properties => message_properties_l, payload => message_l,
msgid => message_id_l);

work_message (message_l);
COMMIT;

EXCEPTION
WHEN no_more_messages_ex
THEN

```

-- it's possible work_old_messages already dequeued the message

COMMIT;
WHEN OTHERS
THEN

*-- we don't need to have a raise here. I just wanted to point out that
-- since this will be called by AQ throwing the exception back to it
-- will have it put the message back on the queue and retry later RAISE;*

END on_message_enqueued;

*-- allows messages to be worked if we missed the notification (or a retry
-- is pending)*

PROCEDURE work_old_messages

AS

PRAGMA autonomous_transaction;

dequeue_options_l DBMS_AQ.dequeue_options_t; message_id_l RAW (16);

message_l message_t;

message_properties_l DBMS_AQ.message_properties_t;

BEGIN

dequeue_options_l.wait := DBMS_AQ.no_wait;

dequeue_options_l.navigation := DBMS_AQ.first_message;

WHILE (TRUE) LOOP *-- way out is no_more_messages_ex*

DBMS_AQ.dequeue (queue_name => queue_name_c, dequeue_options =>
dequeue_options_l, message_properties => message_properties_l, payload
=> message_l, msgid => message_id_l);

work_message (message_l);

COMMIT;

END LOOP;

EXCEPTION

WHEN no_more_messages_ex

THEN

```
NULL;  
END work_old_messages;  
END;
```

Next tell AQ that when a message is enqueued to MESSAGE_Q (and committed) notify our procedure it has work to do. AQ will start up a job in its own session to handle this.

```
BEGIN  
DBMS_AQ.register (  
sys.aq$_reg_info_list (  
sys.aq$_reg_info (USER || ':' || message_worker_pkg.queue_name_c,  
  
DBMS_AQ.namespace_aq,  
'plssql://' || USER || '.message_worker_pkg.on_message_enqueued',  
HEXTORAW ('FF'))),
```

```
1);  
COMMIT;
```

Start Queue and Send a Message

```
DECLARE  
enqueue_options_l DBMS_AQ.enqueue_options_t;  
message_properties_l DBMS_AQ.message_properties_t;  
message_id_l RAW (16);  
message_l message_t;  
  
BEGIN  
-- only need to do this next line ONCE  
DBMS_AQADM.start_queue (queue_name =>  
message_worker_pkg.queue_name_c, enqueue => TRUE , dequeue  
=> TRUE);  
message_l := NEW message_t ( 'Jon', 'Hello, world!' );  
  
DBMS_AQ.enqueue (queue_name => message_worker_pkg.queue_name_c,  
enqueue_options => enqueue_options_l, message_properties =>  
message_properties_l, payload => message_l,  
msgid => message_id_l);
```

```
COMMIT;  
END;
```

Chapter 35: constraints

Section 35.1: Update foreign keys with new value in Oracle

Suppose you have a table and you want to change one of this table primary id. you can use the following script. primary ID here is "PK_S"

```
BEGIN  
FOR i IN (SELECT a.table_name, c.column_name  
  
FROM user_constraints a, user_cons_columns c  
WHERE a.CONSTRAINT_TYPE = 'R'  
AND a.R_CONSTRAINT_NAME = 'PK_S'  
AND c.constraint_name = a.constraint_name) LOOP  
  
EXECUTE IMMEDIATE 'update ' || i.table_name || ' set ' || i.column_name ||  
'=to_number("1000" || ' || i.column_name || ')';  
END LOOP; END;
```

Section 35.2: Disable all related foreign keys in oracle

Suppose you have the table T1 and it has relation with many tables and its primary key constraint name is "pk_t1" you want to disable these foreign keys you can use:

```
BEGIN  
FOR I IN (SELECT table_name, constraint_name FROM user_constraint t  
WHERE  
r_constraint_name='pk_t1') LOOP  
  
EXECUTE IMMEDIATE ' alter table ' || I.table_name || ' disable constraint ' ||  
i.constraint_name; END LOOP;
```

Chapter 36: Autonomous Transactions

Section 36.1: Using autonomous transaction for logging errors

The following procedure is a generic one which will be used to log all errors in an application to a common error log table.

```
CREATE OR REPLACE PROCEDURE log_errors
(
p_calling_program IN VARCHAR2, p_error_code IN INTEGER,
p_error_description IN VARCHAR2
)
IS
PRAGMA AUTONOMOUS_TRANSACTION;
BEGIN
INSERT INTO error_log
VALUES
(
p_calling_program,
p_error_code,
p_error_description,
SYSDATE,
USER
);
COMMIT;
END log_errors;
```

The following anonymous PL/SQL block shows how to call the log_errors procedure.

```
BEGIN
DELETE FROM dept WHERE deptno = 10;
EXCEPTION
WHEN OTHERS THEN
log_errors('Delete dept',SQLCODE, SQLERRM); RAISE;
END;
```

```
SELECT * FROM error_log;
```

```
CALLING_PROGRAM ERROR_CODE ERROR_DESCRIPTION
ERROR_DATETIME DB_USER
DELETE dept -2292 ORA-02292: integrity constraint violated - child
```

RECORD found 08/09/2016 APEX_PUBLIC_USER

Chapter 37: Oracle MAF

Section 37.1: To get value from Binding

```
ValueExpression ve = AdfmfJavaUtilities.getValueExpression(<binding>,
String.class); String <variable_name> = (String)
ve.getValue(AdfmfJavaUtilities.getELContext());
```

Here "binding" indicates the EL expression from which the value is to be get. "variable_name" the parameter to which the value from the binding to be stored

Section 37.2: To set value to binding

```
ValueExpression ve = AdfmfJavaUtilities.getValueExpression(<binding>,
String.class); ve.setValue(AdfmfJavaUtilities.getELContext(), <value>);
```

Here "binding" indicates the EL expression to which the value is to be stored. "value" is the desired value to be add to the binding

Section 37.3: To invoke a method from binding

```
AdfELContext adfELContext = AdfmfJavaUtilities.getAdfELContext();
MethodExpression me;
me = AdfmfJavaUtilities.getMethodExpression(<binding>, Object.class,
NEW Class[] { }); me.invoke(adfELContext, NEW Object[] { });
```

"binding" indicates the EL expression from which a method to be invoked

Section 37.4: To call a javascript function

```
AdfmfContainerUtilities.invokeContainerJavaScriptFunction(AdfmfJavaUtiliti
<function>, NEW Object[] {
}); "function" is the desired js function to be invoked
```

Chapter 38: level query

Section 38.1: Generate N Number of records

```
SELECT ROWNUM NO FROM DUAL CONNECT BY LEVEL <= 10
```

Section 38.2: Few usages of Level Query

/* This is a simple query which can generate a sequence of numbers. The following example generates a sequence of numbers from 1..100 */

```
SELECT LEVEL FROM dual CONNECT BY LEVEL <= 100;
```

/*The above query is useful in various scenarios like generating a sequence of dates from a given date. The following query generates 10 consecutive dates */

```
SELECT TO_DATE('01-01-2017','mm-dd-yyyy')+level-1 AS dates FROM dual CONNECT BY LEVEL <= 10;
```

01-JAN-17

02-JAN-17

03-JAN-17

04-JAN-17

05-JAN-17

06-JAN-17

07-JAN-17

08-JAN-17

09-JAN-17

10-JAN-17

Chapter 39: Hierarchical Retrieval With Oracle Database 12C

You can use hierarchical queries to retrieve data based on a natural hierarchical relationship between rows in a table

Section 39.1: Using the CONNECT BY Clause

```
SELECT E.EMPLOYEE_ID,E.LAST_NAME,E.MANAGER_ID FROM HR.EMPLOYEES E CONNECT BY PRIOR E.EMPLOYEE_ID = E.MANAGER_ID;
```

The **CONNECT BY** clause to define the relationship between employees and managers.

Section 39.2: Specifying the Direction of the Query From the Top Down

```
SELECT E.LAST_NAME|| ' reports to ' ||  
PRIOR E.LAST_NAME "Walk Top Down"  
FROM HR.EMPLOYEES E  
START WITH E.MANAGER_ID IS NULL  
CONNECT BY PRIOR E.EMPLOYEE_ID = E.MANAGER_ID;
```

Chapter 40: Data Pump

Following are the steps to create a data pump import/export:

Section 40.1: Monitor Datapump jobs

Datapump jobs can be monitored using

1. data dictionary views:

```
SELECT * FROM dba_datapump_jobs;  
SELECT * FROM DBA_DATAPUMP_SESSIONS;  
SELECT username,opname,target_desc,sofar,totalwork,message FROM  
V$SESSION_LONGOPS WHERE username
```

```
= 'bkpadmin';
```

2. Datapump status:

Note down the job name from the import/export logs or data dictionary name and

Run **attach** command:

type status in Import/Export prompt

```
impdp <bkpadmin>/<bkp123> attach=<SYS_IMPORT_SCHEMA_01>  
Import> status
```

Press press **CTRL+C** to come out of Import/Export prompt

Section 40.2: Step 3/6 : Create directory

CREATE OR REPLACE directory DATAPUMP_REMOTE_DIR AS
'/oracle/scripts/expimp';

Section 40.3: Step 7 : Export Commands

Commands:

```
expdp <bkpadmin>/<bkp123> parfile=<EXP.par>
```

*Please replace the data in <> with appropriate values as per your environment. You can add/modify parameters as per your requirements. In the above example all the remaining parameters are added in parameter files as stated below: *

Export Type : **User Export**

Export entire schema

Parameter file details [say exp.par] :

```
schemas =<schema>  
directory= DATAPUMP_REMOTE_DIR  
dumpfile=<dbname>_<schema>.dmp  
logfile=exp_<dbname>_<schema>.LOG
```

Export Type : **User Export for large schema**

Export entire schema for large datasets: Here the export dump files will be broken down and compressed. Parallelism is used here (*Note : Adding parallelism will increase the CPU load on server*)

Parameter file details [say exp.par] :

```
schemas =<schema>  
directory= DATAPUMP_REMOTE_DIR dumpfile=  
<dbname>_<schema>_%U.dmp logfile=exp_<dbname>_<schema>.LOG  
compression = ALL  
parallel=5
```

Export Type : **Table Export** [Export set of tables] Parameter file details [say exp.par] :

```
tables = tname1, tname2, tname3 directory= DATAPUMP_REMOTE_DIR
dumpfile=<dbname>_<schema>.dmp
logfile=exp_<dbname>_<schema>.LOG
```

Section 40.4: Step 9 : Import Commands

Prerequisite:

Prior to user import it is a good practice to drop the schema or table imported.

Commands:

```
impdp <bkpadmin>/<bkp123> parfile=<imp.par>
```

*Please replace the data in <> with appropriate values as per your environment. You can add/modify parameters as per your requirements. In the above example all the remaining parameters are added in parameter files as stated below: *

Import Type : **User Import**

Import entire schema

Parameter file details [say imp.par] :

```
schemas =<schema>
directory= DATAPUMP_REMOTE_DIR
dumpfile=<dbname>_<schema>.dmp
logfile=imp_<dbname>_<schema>.LOG
```

Import Type : **User Import for large schema**

Import entire schema for large datasets: Parallelism is used here (*Note : Adding parallelism will increase the CPU load on server*)

Parameter file details [say imp.par] :

```
schemas =<schema>
directory= DATAPUMP_REMOTE_DIR dumpfile=
<dbname>_<schema>_%U.dmp logfile=imp_<dbname>_<schema>.LOG
parallel=5
```

Import Type : **Table Import** [Import set of tables] Parameter file details [say imp.par] :

```
tables = tname1, tname2, tname3
directory= DATAPUMP_REMOTE_DIR
dumpfile=<dbname>_<schema>.dmp
logfile=exp_<dbname>_<schema>.LOG
TABLE_EXISTS_ACTION= <APPEND /SKIP /TRUNCATE /REPLACE>
```

Section 40.5: Datapump steps

Source Server [Export Data]

1. Create a datapump folder that will contain the export dump files
2. Login to database schema that will perform the export.
3. Create directory pointing to step 1.
7. Run Export Statements.
8. Copy/SCP the dump files to Target Server.

Target Server [Import Data]

4. Create a datapump folder that will contain the import dump files
5. Login to database schema that will perform the import.
6. Create directory pointing to step 4.
9. Run Import statements
10. check data ,compile invalid objects and provide related grants

Section 40.6: Copy tables between different schemas and tablespaces

```
expdp <bkpadmin>/<bkp123> directory=DATAPUMP_REMOTE_DIR
dumpfile=<customer.dmp>
```

```
impdp <bkpadmin>/<bkp123> directory=DATAPUMP_REMOTE_DIR
dumpfile=<customer.dmp> remap_schema=<source schema>:<target
schema> remap_tablespace=<source tablespace>:<target tablespace>
```

Chapter 41: Bulk collect

Section 41.1: Bulk data Processing

local collections are not allowed in select statements. Hence the first step is to

create a schema level collection. If the collection is not schema level and being used in SELECT statements then it would cause "PLS-00642: local collection types not allowed in SQL statements"

```
CREATE OR REPLACE TYPE table1_t IS OBJECT (  
a_1 INTEGER,  
a_2 VARCHAR2(10)  
);
```

--Grant permissions on collection so that it could be used publically in database

```
GRANT EXECUTE ON table1_t TO PUBLIC;  
CREATE OR REPLACE TYPE table1_tbl_typ IS TABLE OF table1_t;  
GRANT EXECUTE ON table1_tbl_typ TO PUBLIC;
```

--fetching data from table into collection and then loop through the collection and print the data.

```
DECLARE  
table1_tbl table1_tbl_typ;  
BEGIN  
table1_tbl := table1_tbl_typ(); SELECT table1_t(a_1,a_2) BULK COLLECT  
INTO table1_tbl FROM table1 WHERE ROWNUM<10;  
  
FOR rec IN (SELECT a_1 FROM TABLE(table1_tbl))--table(table1_tbl)  
won't give error) LOOP  
DBMS_OUTPUT.put_line('a_1'||rec.a_1);  
DBMS_OUTPUT.put_line('a_2'||rec.a_2);  
END LOOP;  
END;  
/
```

Chapter 42: Real Application Security

Oracle Real Application Security was introduced in Oracle 12c. It summarize many Security Topics like User-RoleModel, Access Control, Application vs. Database, End-User-Security or Row- and Column Level Security

Section 42.1: Application

To associate an Application with something in the Database there are three main parts:

Application Privilege: An Application Privilege describes Privileges like **SELECT**, **INSERT**, **UPDATE**, **DELETE**, ... Application Privileges can be summarized as an Aggregate Privilege.

```
XS$PRIVILEGE (  
name=>'privilege_name'  
[, implied_priv_list=>XS$NAME_LIST("SELECT", "INSERT",  
"UPDATE", "DELETE")]  
)
```

```
XS$PRIVILEGE_LIST (  
XS$PRIVILEGE(...),  
XS$PRIVILEGE(...),  
...  
);
```

Application User:

Simple Application User:

```
BEGIN  
SYS.XS_PRINCIPAL.CREATE_USER('user_name');  
END;
```

Direct Login Application User:

```
BEGIN  
SYS.XS_PRINCIPAL.CREATE_USER(name => 'user_name', schema =>  
'schema_name');  
END;
```

```
BEGIN  
SYS.XS_PRINCIPAL.SET_PASSWORD('user_name', 'password');  
END;
```

```
CREATE PROFILE prof LIMIT
PASSWORD_REUSE_TIME 1/4440
PASSWORD_REUSE_MAX 3
PASSWORD_VERIFY_FUNCTION Verify_Pass;
```

```
BEGIN
SYS.XS_PRINCIPAL.SET_PROFILE('user_name', 'prof');
END;
```

```
BEGIN
SYS.XS_PRINCIPAL.GRANT_ROLES('user_name', 'XSONNCENT');
END;
```

(optional:)

```
BEGIN
SYS.XS_PRINCIPAL.SET_VERIFIER('user_name', '6DFF060084ECE67F',
XS_PRINCIPAL.XS_SHA512");
END;
```

Application Role:

Regular Application Role:

```
DECLARE
st_date TIMESTAMP WITH TIME ZONE;
ed_date TIMESTAMP WITH TIME ZONE;
```

```
BEGIN
st_date := SYSTIMESTAMP;
ed_date := TO_TIMESTAMP_TZ('2013-06-18 11:00:00 -5:00','YYYY-MM-
DD HH:MI:SS'); SYS.XS_PRINCIPAL.CREATE_ROLE
```

```
( name => 'app_regular_role',
enabled => TRUE,
start_date => st_date,
end_date => ed_date);
```

```
END;
```

Dynamic Application Role: (gets enabled dynamical based on the authentication state)

```
BEGIN
SYS.XS_PRINCIPAL.CREATE_DYNAMIC_ROLE (name =>
'app_dynamic_role',
duration => 40,
scope => XS_PRINCIPAL.SESSION_SCOPE); END;
```

Predefined Application Roles:

Regular:

```
XSPUBLIC
XSBYPASS
XSSESSIONADMIN XS_NAMESPACEADMIN XSPROVISIONER
XSCACHEADMIN
XSDISPATCHER
```

Dynamic: (depended on the authentication state of application user)

```
DBMS_AUTH : (direct-logon or other database authentication method)
EXTERNAL_DBMS_AUTH: (direct-logon or other database authentication
method and user is external) DBMS_PASSWD: (direct-logon with password)
MIDTIER_AUTH: (authentication through middle tier application)
XSAUTHENTICATED: (direct or middle tier application)
XSSWITCH: (user switched from proxy user to application user)
```

Chapter 43: Assignments model and language

Section 43.1: Assignments model in PL/SQL

All programming languages allow us to assign values to variables. Usually, a value is assigned to variable, standing on left side. The prototype of the overall assignment operations in any contemporary programming language looks like this:

```
left_operand assignment_operand right_operand instructions_of_stop
```

This will assign right operand to the left operand. In PL/SQL this operation looks like this:

```
left_operand := right_operand;
```

Left operand **must be always a variable**. Right operand can be value,

variable or function:

```
SET serveroutput ON
DECLARE
v_hello1 VARCHAR2(32767);
v_hello2 VARCHAR2(32767);
v_hello3 VARCHAR2(32767);
FUNCTION hello RETURN VARCHAR2 IS BEGIN RETURN 'Hello from
a function!'; END;
BEGIN
-- from a value (string literal)
v_hello1 := 'Hello from a value!';
-- from variable
v_hello2 := v_hello1;
-- from function
v_hello3 := hello;

DBMS_OUTPUT.put_line(v_hello1);
DBMS_OUTPUT.put_line(v_hello2);
DBMS_OUTPUT.put_line(v_hello3);

END;
/
```

When the code block is executed in SQL*Plus the following output is printed in console:

```
Hello from a value! Hello from a value! Hello from a function!
```

There is a feature in PL/SQL that allow us to assign "from right to the left". It's possible to do in SELECT INTO statement. Prototype of this instrunction you will find below:

```
SELECT [ literal | column_value ]
INTO local_variable
FROM [ table_name | aliastable_name ]
WHERE comparison_instructions;
```

This code will assign character literal to a local variable:

```
SET serveroutput ON
```

```
DECLARE
v_hello VARCHAR2(32767);
BEGIN
SELECT 'Hello world!' INTO v_hello
FROM dual;

DBMS_OUTPUT.put_line(v_hello); END;
/
```

When the code block is executed in SQL*Plus the following output is printed in console:
Hello world!

Assignment "from right to the left" **is not a standard**, but it's valuable feature for programmers and users. Generally it's used when programmer is using cursors in PL/SQL - this technique is used, when we want to return a single scalar value or set of columns in the one line of cursor from SQL cursor.

Further Reading: [Assigning Values to Variables](#)

Chapter 44: Triggers

Introduction:

Triggers are a useful concept in PL/SQL. A trigger is a special type of stored procedure which does not require to be explicitly called by the user. It is a group of instructions, which is automatically fired in response to a specific data modification action on a specific table or relation, or when certain specified conditions are satisfied. Triggers help maintain the integrity, and security of data. They make the job convenient by taking the required action automatically.

Section 44.1: Before INSERT or UPDATE trigger

```
CREATE OR REPLACE TRIGGER CORE_MANUAL_BIUR
BEFORE INSERT OR UPDATE ON CORE_MANUAL
FOR EACH ROW
```

```

BEGIN
IF inserting THEN
-- only set the current date if it is not specified
IF :NEW.created IS NULL THEN

:NEW.created := SYSDATE;
END IF;
END IF;

-- always set the modified date to now
IF inserting OR updating THEN
:NEW.modified := SYSDATE;

END IF;
END;
/

```

Chapter 45: Dynamic SQL

Dynamic SQL allows you to assemble an SQL query code in the runtime. This technique has some disadvantages and have to be used very carefully. At the same time, it allows you to implement more complex logic. PL/SQL requires that all objects, used in the code, have to exist and to be valid at compilation time. That's why you can't execute DDL statements in PL/SQL directly, but dynamic SQL allows you to do that.

Section 45.1: Select value with dynamic SQL

Let's say a user wants to select data from different tables. A table is specified by the user.

```

FUNCTION get_value(p_table_name VARCHAR2, p_id NUMBER)
RETURN VARCHAR2 IS
VALUE VARCHAR2(100);
BEGIN
EXECUTE IMMEDIATE 'select column_value from ' || p_table_name ||
' where id = :P' INTO VALUE USING p_id;
RETURN VALUE;

```

```
END;
```

Call this function as usual:

```
DECLARE
```

```
table_name VARCHAR2(30) := 'my_table'; id NUMBER := 1;
```

```
BEGIN
```

```
DBMS_OUTPUT.put_line(get_value(table_name, id));
```

```
END;
```

Table to test:

```
CREATE TABLE my_table (id NUMBER, column_value  
VARCHAR2(100)); INSERT INTO my_table VALUES (1, 'Hello, world!');
```

Section 45.2: Insert values in dynamic SQL

Example below inserts value into the table from the previous example:

```
DECLARE
```

```
query_text VARCHAR2(1000) := 'insert into my_table(id, column_value)  
values (:P_ID, :P_VAL)'; id NUMBER := 2;
```

```
VALUE VARCHAR2(100) := 'Bonjour!';
```

```
BEGIN
```

```
EXECUTE IMMEDIATE query_text USING id, VALUE;
```

```
END;
```

```
/
```

Section 45.3: Update values in dynamic SQL

Let's update table from the first example:

```
DECLARE
```

```
query_text VARCHAR2(1000) := 'update my_table set column_value =  
:P_VAL where id = :P_ID'; id NUMBER := 2;
```

```
VALUE VARCHAR2(100) := 'Bonjour le monde!';
```

```
BEGIN
```

```
EXECUTE IMMEDIATE query_text USING VALUE, id; END;  
/
```

Section 45.4: Execute DDL statement

This code creates the table:

```
BEGIN  
EXECUTE IMMEDIATE 'create table my_table (id number, column_value  
varchar2(100))';  
END;  
/
```

Section 45.5: Execute anonymous block

You can execute anonymous block. This example shows also how to return value from dynamic SQL:

```
DECLARE  
query_text VARCHAR2(1000) := 'begin :P_OUT := cos(:P_IN); end;';  
in_value NUMBER := 0;  
out_value NUMBER;  
  
BEGIN  
EXECUTE IMMEDIATE query_text USING OUT out_value, IN in_value;  
DBMS_OUTPUT.put_line('Result of anonymous block: ' ||  
TO_CHAR(out_value));  
  
END;  
/
```

Credits

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Nogueira Jr
Pancho
phonetic_man
Pirate X
ppeterka
Pranav Shah
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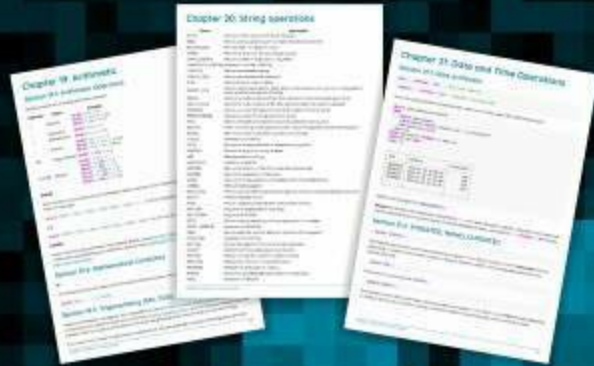
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