



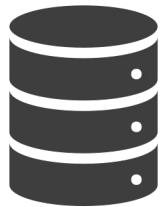
A summary of the most useful new SQL features in **23ai**

Andrzej Nowicki

POUG, Poznań, 2024



Andrzej Nowicki



12 years of Oracle DB experience
Database Engineer @ CERN since 2020



andrzejnowicki



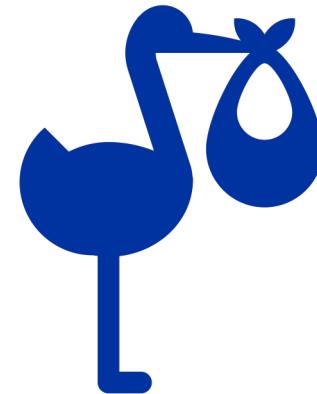
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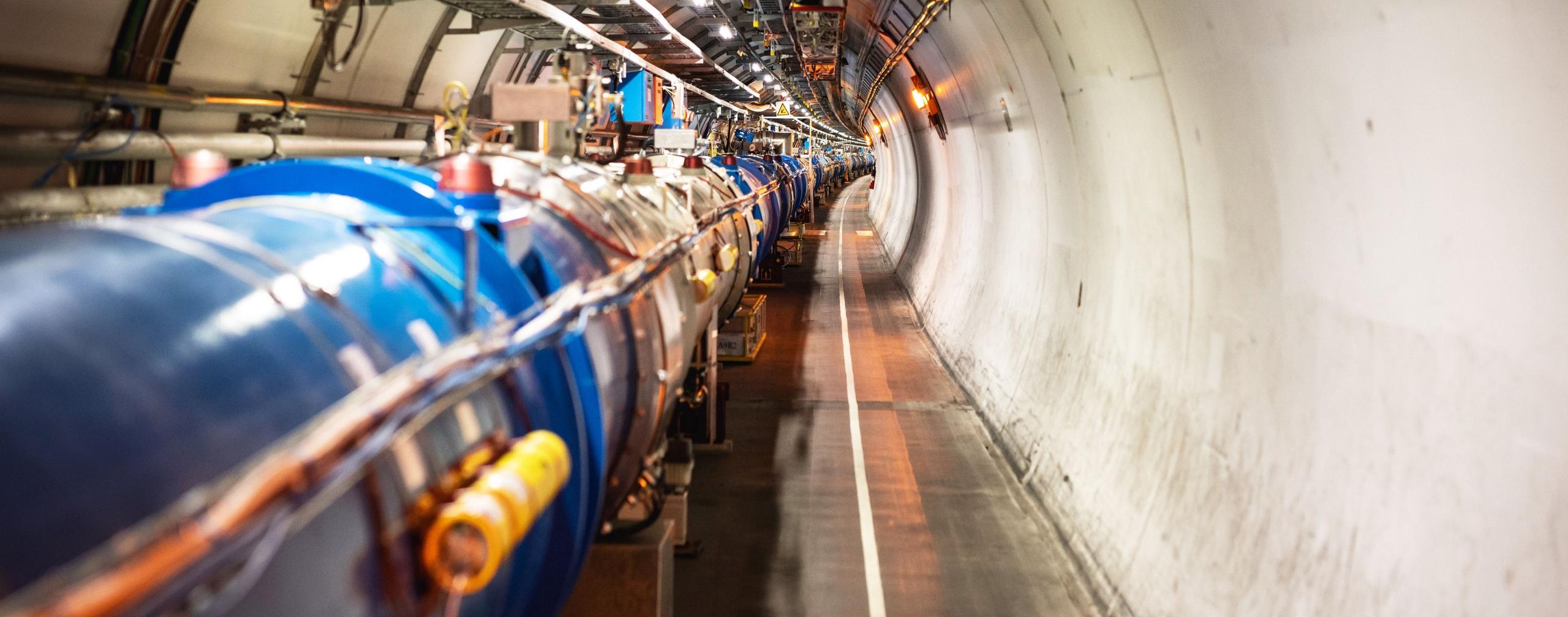
Try
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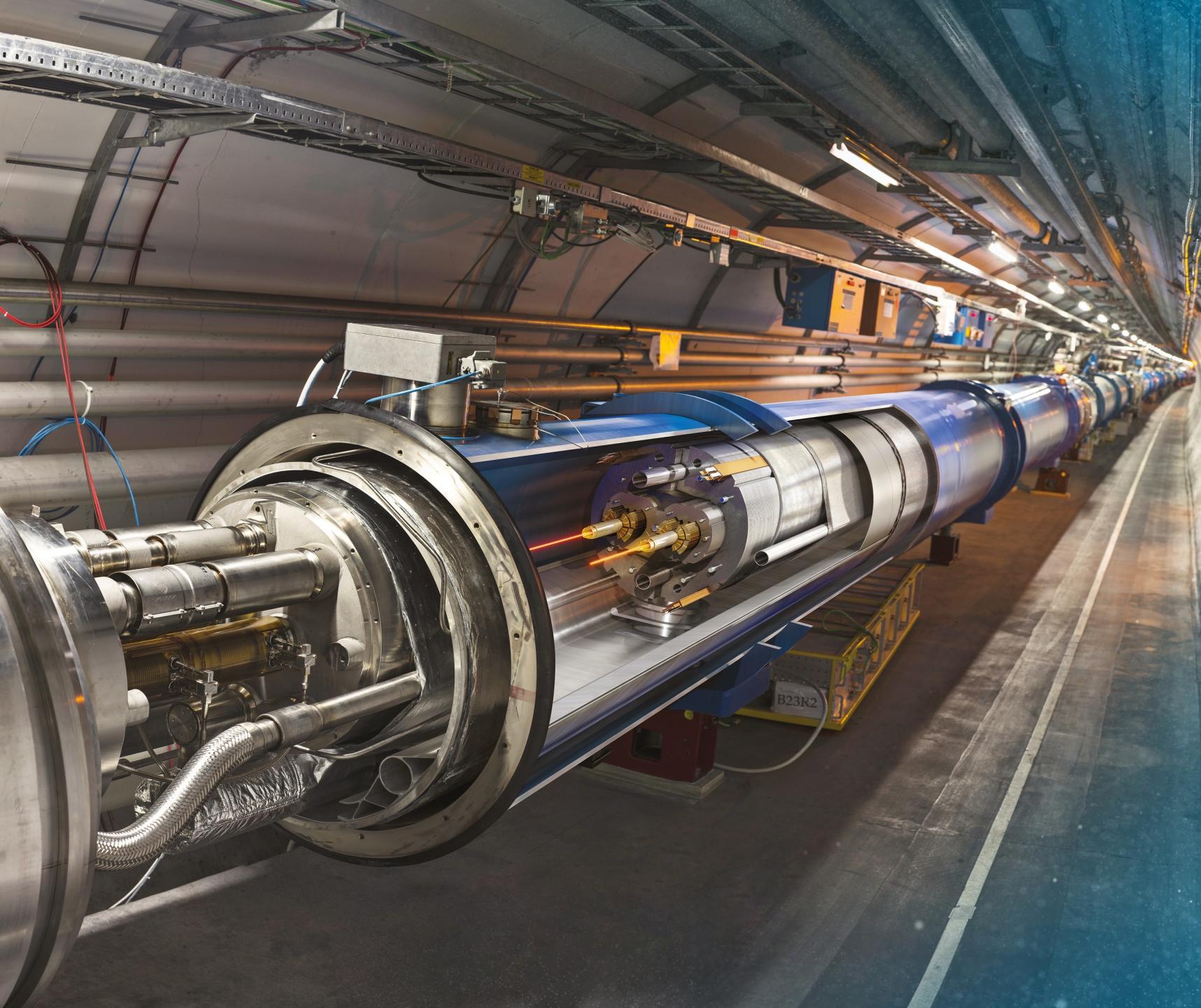
BORN IN A HOSPITAL <1KM FROM HERE



CERN is the world's biggest laboratory for particle physics.
Our goal is to understand the most fundamental particles and laws of the universe.

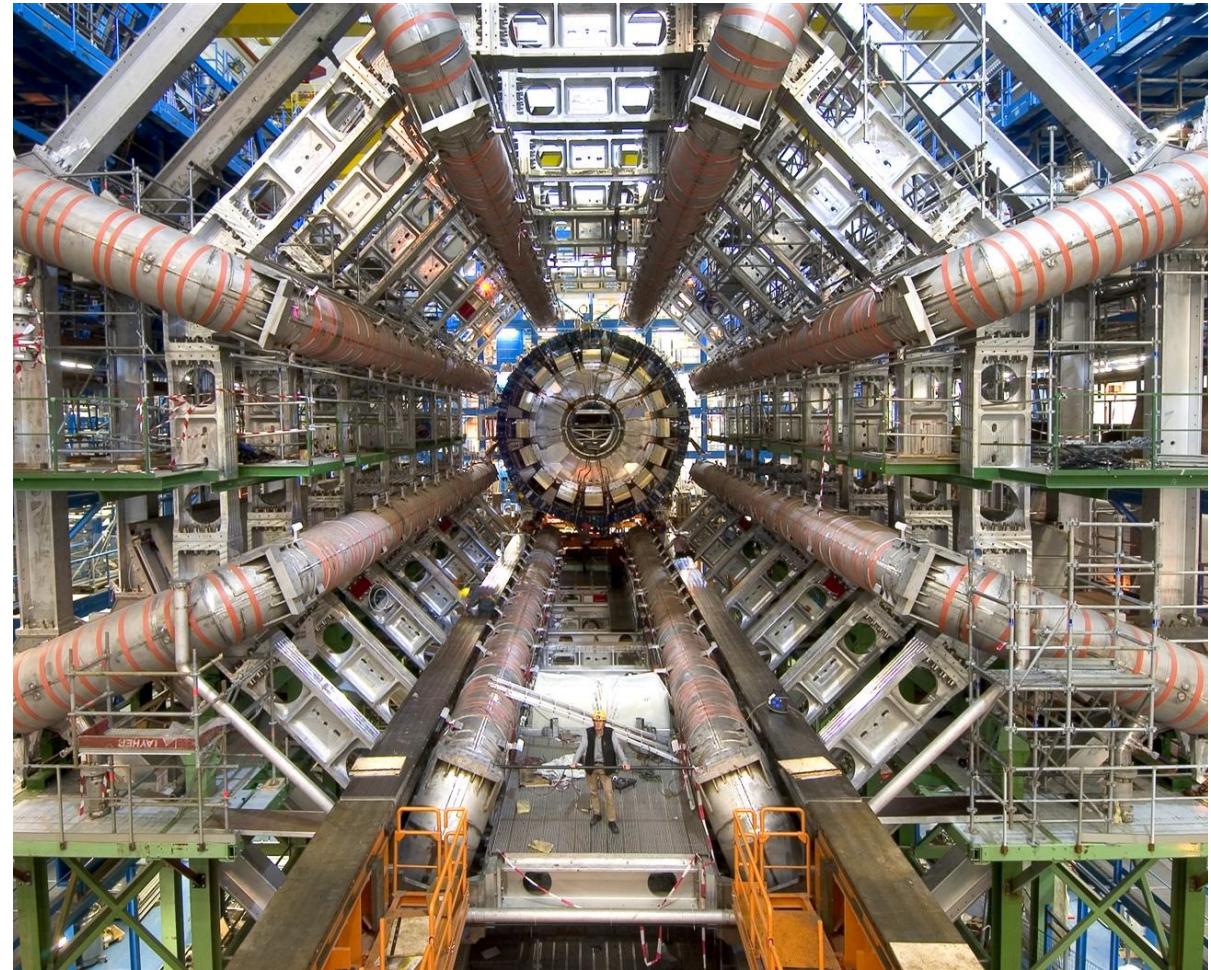
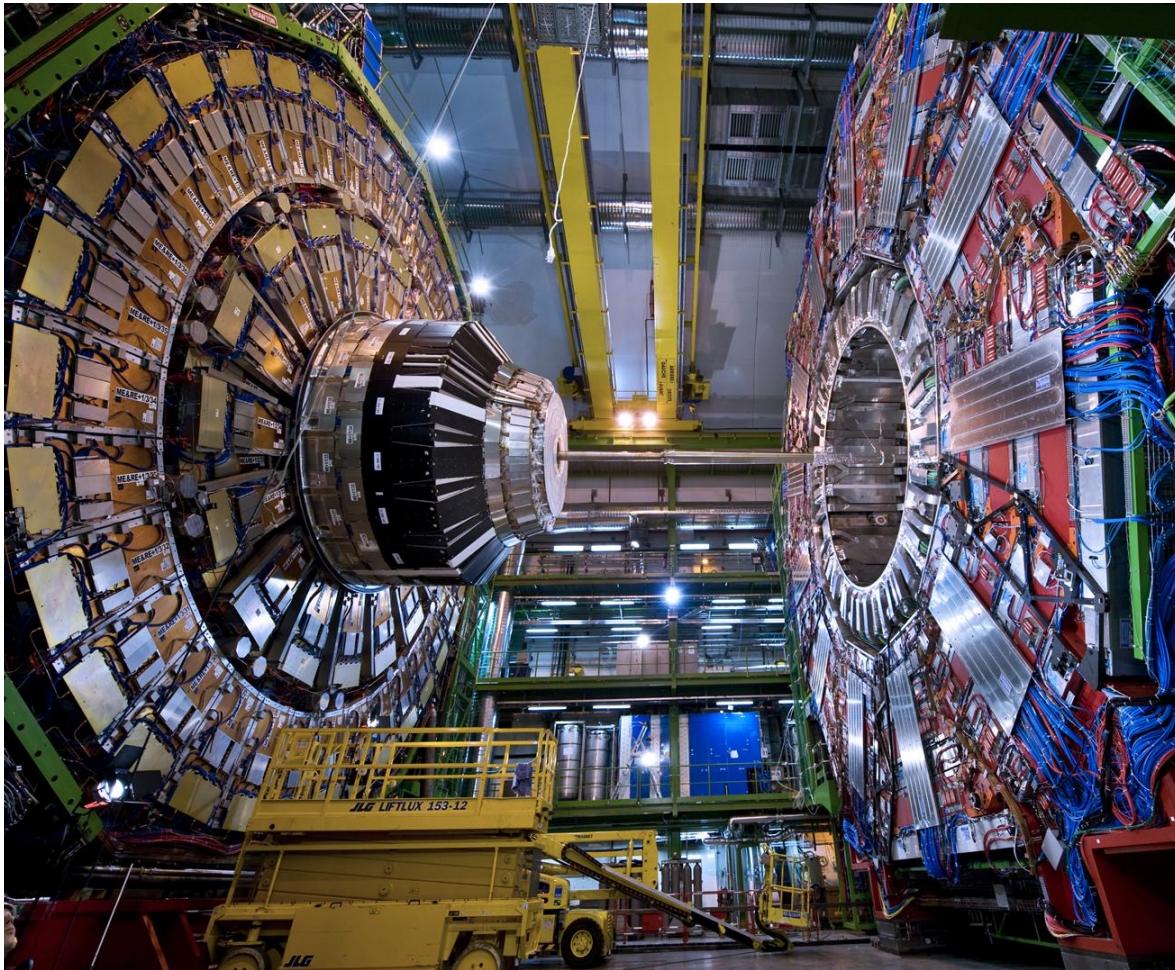
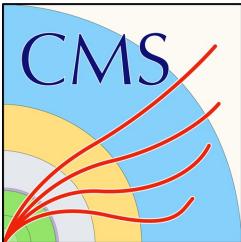


Large Hadron Collider (LHC)



Large Hadron Collider (LHC)

- 27 km (17 mi) in circumference
- About 100 m (300 ft) underground
- Superconducting magnets steer the particles around the ring
- Particles are accelerated to close to the speed of light





IT @ CERN



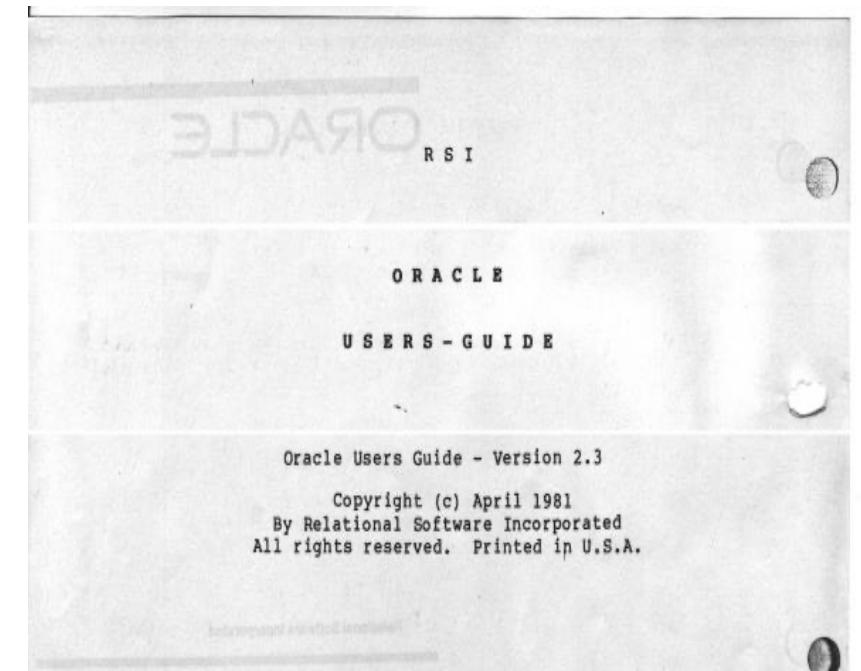
Databases at CERN

Oracle since 1982

- 105 Oracle databases, more than 11.800 Oracle accounts
- RAC, Active Data Guard, GoldenGate, OEM, RMAN, APEX, Cloud...
- Complex environment

Database on Demand (DBoD) since 2011

- \approx 600 MySQL, \approx 400 PostgreSQL, \approx 200 InfluxDB
- Automated backup and recovery services, monitoring, clones, replicas
- HA MySQL clusters (Proxy + primary replica)



Size of the database environment

	Total size
Oracle	$\approx 5 \text{ PB}$
DBoD (MySQL, PostgreSQL, InfluxDB)	$\approx 150 \text{ TB}$
Backups	$\approx 3 \text{ PB}$

Oracle 23ai

Where to test 23ai?

<https://livesql.oracle.com> ?

The screenshot shows the Oracle Livesql website. At the top, there is a large red button with the text "Run" and a play icon. Below it, a blue box contains the text "Running on Oracle Database 19c". The main heading "Learn and share SQL" is displayed in large black font, followed by the text "Running on Oracle Database 19c". A search bar at the bottom left contains the placeholder "Search scripts and tutorials" and a magnifying glass icon. Two buttons below the search bar are "Start Coding" (black background) and "View Scripts and Tutorials" (white background). At the bottom center, there is a link "Instructor's Guide".

Where to test 23ai?

Cool, I'll spin up an ADB...

If you are using Autonomous Database with Oracle Database 23ai, the following Oracle Database 23ai functionality is not supported:

Autonomous Database with Oracle Database 23ai in the Paid tier is available in all commercial public cloud regions **except the following regions**: South Africa Central: Johannesburg: (JNB), Brazil Southeast: Vinhedo (VCP), Canada Southeast: Toronto (YYZ), and **Switzerland North: Zurich (ZHR)**.

Always Free Autonomous Database with Oracle Database 23ai **is available in the regions**: US West: Phoenix (PHX), US East: Ashburn (IAD), **UK South: London (LHR)**, **France Central: Paris (CDG)**, Australia East: Sydney (SYD), India West: Mumbai (BOM), Singapore (SIN), and Japan East: Tokyo (NRT).

<https://docs.oracle.com/en-us/iaas/autonomous-database-serverless/doc/autonomous-always-free-23ai.html>

Where to test 23ai?

Oracle Exadata Cloud@Customer

OCI Exadata Database Service

OCI Base Database Service

Oracle Database 23ai Free – <https://www.oracle.com/database/free/get-started/>

Available as: Docker image, VM VirtualBox, rpm for OEL & RHEL.

Side note, if you have an ARM-based Mac, you can run the docker image.

See Eduardo Claro's and Ron Ekin's blogs:

<https://clarodba.wordpress.com/> and <https://ronekins.com/>

Docker

```
$ colima start --arch x86_64 \
--vm-type=vz --vz-rosetta --mount-type=virtiofs --memory
```

```
$ docker start 23ai
```

```
$ sqlplus sys/magicpass@localhost:1623 as sysdba
SQL*Plus: Release 23.0.0.0.0 - Production
Version 23.3.0.23.09
```

```
Copyright (c) 1982, 2023, Oracle. All rights reserved.
```

Connected to:

Oracle Database 23ai Free Release 23.0.0.0.0 - Develop, Learn, and Run for Free
Version 23.4.0.24.05

SQL>



Oracle 23ai Database New Features

<https://docs.oracle.com/en/database/oracle/oracle-database/23/nfcoa/>

Oracle Database New Features

Title and Copyright Information

1 Introduction

[About](#)[Feature Highlights](#)

2 AI Vector Search

3 Application Development

[JSON](#)[SQL](#)[Graph](#)[Microservices](#)[General](#)[Java](#)[JavaScript](#)[Application Connectivity](#)[Database Drivers API Enhancements](#)

4 Data Analytics

5 Data Warehousing/Big Data

6 Cloud Migration

7 Cloud Operations

SQL

Schema Annotations

Schema annotations enable you to store and retrieve metadata about database objects. These are name-value pairs or simply a name. These are free-form text fields applications can use to customize business logic or user interfaces.

Annotations help you use database objects in the same way across all applications. This simplifies development and improves data quality.

[View Documentation](#)

Direct Joins for UPDATE and DELETE Statements

Join the target table in `UPDATE` and `DELETE` statements to other tables using the `FROM` clause. These other tables can limit the rows changed or be the source of new values.

Direct joins make it easier to write SQL to change and delete data.

[View Documentation](#)

IF [NOT] EXISTS Syntax Support

DDL object creation, modification, and deletion now support the `IF EXISTS` and `IF NOT EXISTS` syntax modifiers. This enables you to control whether an error should be raised if a given object exists or does not exist.

The `IF [NOT] EXISTS` syntax can simplify error handling in scripts and by applications.

[View Documentation](#)

New Database Role for Application Developers

[Automatic PL/SQL to SQL Transpiler](#)[Client Describe Call Support for Tag Options](#)[DEFAULT ON NULL for UPDATE Statements](#)[DESCRIBE Now Supports Column Annotations](#)[Data Use Case Domain Metadata Support in OCCI](#)[Data Use Case Domains](#)[Error Message Improvement](#)[Extended CASE Controls](#)[GROUP BY Column Alias or Position](#)[Improved TNS Error Messages](#)[Multilingual Engine Support for SQL BOOLEAN Data Type](#)[Oracle C++ Call Interface \(OCCI\) Support for SQL BOOLEAN Data Type](#)

database must perform.

[View Documentation](#)

SQL*Plus Support for SQL BOOLEAN Data Type

SQL*Plus supports the new SQL BOOLEAN data type in SQL statements and the DESCRIBE command. Enhancements to the COLUMN and VARIABLE command syntax have also been made.

SQL*Plus scripts can take advantage of the new SQL BOOLEAN data type for easy development.

[View Documentation](#)

Table Value Constructor

The database's SQL engine now supports a VALUES clause for many types of statements. This new clause allows for materializing rows of data on the fly by specifying them using the new syntax without relying on existing tables. Oracle supports the VALUES clause for the SELECT, INSERT, and MERGE statements.

The introduction of the new VALUES clause allows developers to write less code for ad-hoc SQL commands, leading to better readability with less effort.

[View Documentation](#)

Unicode 15.0 Support

The National Language Support (NLS) data files for AL32UTF8 and AL16UTF16 character sets are updated to match version 15.0 of the Unicode Standard character database.

This enhancement enables Oracle Database to conform to the latest version of the Unicode Standard.

[View Documentation](#)

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Next Page ▶

Feel free to take photos, but...

**The presentation is
on my website**



<https://www.andrzejnowicki.pl/slides/>

I'll not cover SELECT AI

SQL> **SELECT AI** What are total sales of tom hanks movies
70,318.23

SQL> **SELECT AI** showsql What are total sales of tom hanks movies
SELECT SUM(sales_sample.list_price) AS total_sales
FROM moviestream.sales_sample
JOIN moviestream.movie **ON** sales_sample.movie_id = movie.movie_id
WHERE movie.cast **LIKE** '%Tom Hanks%'

Livelabs: Chat with your data in Autonomous Database using generative AI
https://apexapps.oracle.com/pls/apex/r/dbpm/livelabs/run-workshop?p210_wid=3831

IT'S POUG

...

LET'S IMPROVISE
A DEMO

https://apexapps.oracle.com/pls/apex/r/dbpm/livelabs/run-workshop?p210_wid=3831

How to enable SELECT AI

```
SQL> BEGIN
  DBMS_CLOUD.CREATE_CREDENTIAL (
    credential_name => 'OCI_CRED',
    user_ocid       => 'ocid1.user.oc1...',
    tenancy_ocid    => 'ocid1.tenancy.oc1.....',
    private_key     => 'MI...=',
    fingerprint     => '44:....');
END;
/
```

How to enable SELECT AI

```
SQL> BEGIN
  DBMS_CLOUD_AI.create_profile(
    'OCI',
    '{"provider": "oci",
      "credential_name": "OCI_CRED",
      "oci_compartment_id": "ocid1.compartment.oc1.....",
      "region" :"eu-frankfurt-1",
      "object_list": [{"owner": "ADMIN", "name": "employees"}]
    }');
END;
/
SQL> select * from employees;
```

ID	NAME	SALARY
1	Kamil	999
2	Luiza	999999999
3	Larry	10

How to use SELECT AI

```
SQL> EXEC DBMS_CLOUD_AI.set_profile('OCI');
```

```
SQL> select ai chat how many people live in Poland;
```

RESPONSE

```
-----  
As of 2021, the estimated population of Poland is approximately 38.6 million people
```

```
SQL> select ai how many customers do we have;
```

CustomerCount

```
-----  
3
```

How to use **SELECT AI**

```
SQL> select ai showsql how many customers do we have;
```

RESPONSE

```
-----  
SELECT COUNT(c."ID") AS "CustomerCount"  
FROM "ADMIN"."CUSTOMERS" c
```

```
SQL> select ai narrate how many customers do we have;
```

RESPONSE

```
-----  
We have 3 customers.
```

Enough of AI... for now

SELECT without DUAL

```
SQL> select sysdate;
```

SYSDATE

21-SEP-24

```
SQL> select 12-2;
```

12-2

10

```
SQL> select 'Andrzej' FirstName;
```

FIRSTNA

Andrzej

```
SQL> select 'Andrzej' FirstName;
```

FIRSTNA

Andrzej



SELECT without DUAL

```
SQL> select0;  
select0  
*  
ERROR at line 1:  
ORA-24333: zero iteration count  
Help: https://docs.oracle.com/error-help/db/ora-24333/
```

```
SQL> select+0;
```

```
+0  
-----  
0
```

sqlplus 23ai provides a link to documentation explaining the cause of the error

SELECT without DUAL

```
SQL> selectsysdate;
```

```
SP2-0734: unknown command beginning "selectsysd..." - rest of line ignored.  
Help: https://docs.oracle.com/error-help/db/sp2-0734/
```

```
SQL> select-sysdate;  
select-sysdate
```

```
*
```

```
ERROR at line 1:
```

```
ORA-00932: expression is of data type DATE, which is incompatible with expected  
data type NUMBER
```

```
Help: https://docs.oracle.com/error-help/db/ora-00932/
```

```
SQL> select+sysdate;
```

```
+SYSDATE
```

```
-----
```

```
21-SEP-24
```



SQLPLUS improvements

SET ERRORDETAILS – controls the error message handling URL

ARGUMENT command which is a nicer way to handle arguments like “&1”

New functions:

PING (tnsping other services in the same listener)

OERR

SQLPLUS improvements – oerr – quick demo

SQL> oerr ora 25000

Message: "invalid use of bind variable in trigger WHEN clause"

Help: <https://docs.oracle.com/error-help/db/ora-25000/>

Cause: A bind variable was used in the when clause of a trigger.

Action: Remove the bind variable. To access the table columns use
(new/old).column_name.

SQL> oerr ora 600

Message: "internal error code, arguments: [%s], [%s], [%s], [%s], [%s], [%s], [%s], [%s]

Help: <https://docs.oracle.com/error-help/db/ora-00600/>

Cause: This is the generic internal error number for Oracle program exceptions. It indicates that a process has encountered a low-level, unexpected condition. The first argument is the internal message number. This argument and the database version number are critical in identifying the root cause and the potential impact to your system.

SP2-0642: SQL*Plus internal error state 2590, context 52275:32768:0

Help: <https://docs.oracle.com/error-help/db/sp2-0642/>

Unable to proceed

Disconnected from Oracle Database 23ai Free Release 23.0.0.0.0 - Develop, Learn, and Run
Version 23.4.0.24.05

VALUES constructor... the past

```
SQL> create table product_sales (product varchar2(10),sale_date date,amount number);
```

Table created.

```
SQL> insert into product_sales values ('beer',sysdate-10,10);
SQL> insert into product_sales values ('beer',sysdate-9,2);
SQL> insert into product_sales values ('beer',sysdate-7,100);
SQL> insert into product_sales values ('wine',sysdate-14,10);
SQL> insert into product_sales values ('wine',sysdate-4,1);
SQL> insert into product_sales values ('wine',sysdate-1,11);
```

VALUES constructor... the future

```
SQL> create table product_sales (product varchar2(10),sale_date date,amount number);
```

Table created.

```
SQL> insert into product_sales values ('beer',sysdate-10,10),  
      ('beer',sysdate-9,2),  
      ('beer',sysdate-7,100),  
      ('wine',sysdate-14,10),  
      ('wine',sysdate-4,1),  
      ('wine',sysdate-1,11);
```

6 rows created.

VALUES constructor

```
SQL> select *  
      from  (values  
              (1, 'beer', 'My favourite'),  
              (2, 'wine', 'My second best'),  
              (3, 'whisky', 'My third choice')  
            ) tab (position, name, description);
```

POSITION	NAME	DESCRIPTION
-----	-----	-----
1	beer	My favourite
2	wine	My second best
3	whisky	My third choice

```
SQL> with ranking(position, name, description) as  
      (values  
          (1, 'beer', 'My favourite'),  
          (2, 'wine', 'My second best'),  
          (3, 'whisky', 'My third choice')  
        )  
    select * from ranking;
```

POSITION	NAME	DESCRIPTION
-----	-----	-----
1	beer	My favourite
2	wine	My second best
3	whisky	My third choice

GROUP BY improvements

```
SQL> select * from product_sales;
```

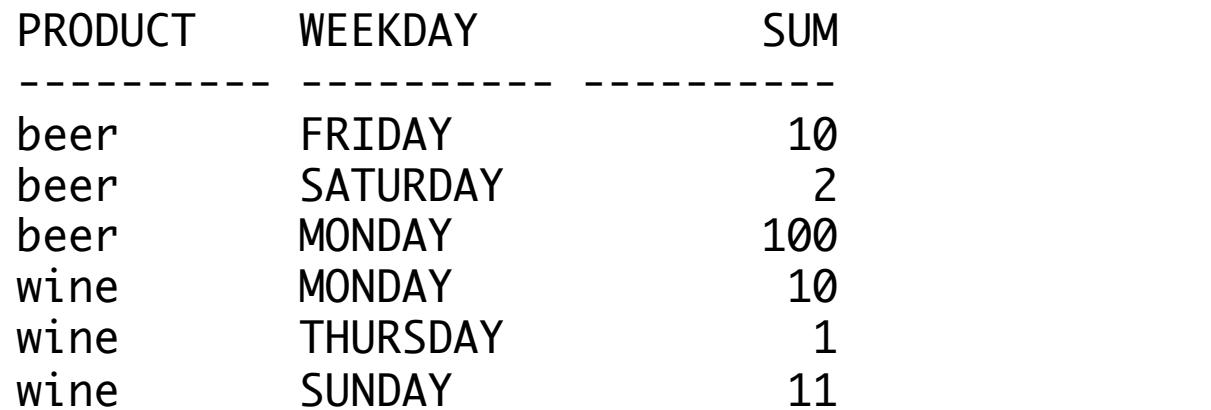
PRODUCT	SALE_DATE	AMOUNT
beer	13-SEP-24	10
beer	14-SEP-24	2
beer	16-SEP-24	100
wine	09-SEP-24	10
wine	19-SEP-24	1
wine	22-SEP-24	11

```
SQL> select product,to_char(sale_date,'DAY') weekday,  
           sum(amount) sum  
      from product_sales  
   group by product, to_char(sale_date,'DAY');
```

PRODUCT	WEEKDAY	SUM
beer	FRIDAY	10
beer	SATURDAY	2
beer	MONDAY	100
wine	MONDAY	10
wine	THURSDAY	1
wine	SUNDAY	11

GROUP BY improvements

```
SQL> select product, to_char(sale_date, 'DAY') weekday, sum(amount) sum  
      from product_sales  
     group by product, weekday;
```



PRODUCT	WEEKDAY	SUM
beer	FRIDAY	10
beer	SATURDAY	2
beer	MONDAY	100
wine	MONDAY	10
wine	THURSDAY	1
wine	SUNDAY	11

GROUP BY improvements

```
SQL> alter session set group_by_position_enabled=true;
```

Session altered.

```
SQL> select product,to_char(sale_date,'DAY') weekday, sum(amount) sum  
      from product_sales  
     group by 1,2;
```

PRODUCT	WEEKDAY	SUM
beer	FRIDAY	10
beer	SATURDAY	2
beer	MONDAY	100
wine	MONDAY	10
wine	THURSDAY	1
wine	SUNDAY	11

ERROR at line 1:

ORA-03162: "PRODUCT": must appear in the GROUP BY clause or be used in an aggregate function as 'group_by_position_enabled' is FALSE
Help: <https://docs.oracle.com/error-help/db/ora-03162/>

Let's clean up our table

```
SQL> drop table if exists product_sales;
```

Table dropped.

```
SQL> drop table if exists product_sales;
```

Table dropped.

A bit misleading...

If we want to recreate it...

```
SQL> create table if not exists product_sales  
          (product varchar2(10), sale_date date, amount number);
```

Table created.

```
SQL> create table if not exists product_sales  
          (product varchar2(10), sale_date date, amount number);
```

Table created.

BOOL

TRUE, FALSE, NULL

```
SQL> create table employees ( id number generated always as identity,  
      name varchar2(20),  
      is_active bool,  
      is_retired boolean);
```

Table created.

```
SQL> insert into employees (name, is_active, is_retired) values  
      ('Obama',false,true),  
      ('Trump',false,false),  
      ('Biden',true,false);
```

3 rows created.

BOOL

```
SQL> select * from employees;
```

ID	NAME	IS_ACTIVE	IS_RETIRIED
1	Obama	FALSE	TRUE
2	Trump	FALSE	FALSE
3	Biden	TRUE	FALSE

```
SQL> select * from employees where is_active or is_retired;
```

ID	NAME	IS_ACTIVE	IS_RETIRIED
1	Obama	FALSE	TRUE
3	Biden	TRUE	FALSE



BOOL

```
SQL> select text, to_boolean(text) to_bool  
  from (values ('yes'),('on'),('true'),('1'),('0'),('off'),('n')) tab (text);
```

TEXT	TO_BOOL
yes	TRUE
on	TRUE
true	TRUE
1	TRUE
0	FALSE
off	FALSE
n	FALSE

BOOL

```
SQL> select to_boolean('a');  
select to_boolean('a')  
*
```

ERROR at line 1:

ORA-61800: invalid boolean literal: a

Help: <https://docs.oracle.com/error-help/db/ora-61800/>

```
export NLS_LANG=POLISH_POLAND.UTF8
```

Połączono z Oracle Database 23ai...

```
SQL> select to_boolean('tak');  
select to_boolean('tak')  
      *
```

BŁĄD w linii 1:

ORA-61800: niepoprawny literał logiczny: tak

Pomoc: <https://docs.oracle.com/error-help/db/ora-61800/>

SCHEMA-LEVEL PERMISSIONS

```
SQL> grant select any table on schema bob to alice;
```

Grant succeeded.

```
SQL> insert into bob.secret_table values (1024);
```

1 row created.

```
SQL> commit;
```

Commit complete.

```
SQL> connect alice  
Connected.
```

```
SQL> select *  
      from bob.secret_table;
```

A

1024

SCHEMA-LEVEL PERMISSIONS

```
SQL> select * from DBA_SCHEMA_PRIVS;
```

Include it in your permissions reports, etc.

GRANTEE	PRIVILEGE	SCHEMA	ADM	COM	INH
ALICE	SELECT ANY TABLE	BOB	NO	NO	NO

```
SQL> grant all privileges on schema alice to bob;
```

Grant succeeded.

```
SQL> revoke all privileges on schema alice from bob;
```

Revoke succeeded.

PROPERTY GRAPHS

```
SQL> create table people (person_id number primary key, name varchar2(20));
```

```
SQL> create table connections (connection_id number primary key,  
    person_id1 number,  
    person_id2 number,  
    comments varchar2(20));
```

```
SQL> select * from people;
```

PERSON_ID	NAME
1	Freddie Mercury
2	Mary Austin
3	Brian May

```
SQL> select * from connections;
```

CONNECTION_ID	PERSON_ID1	PERSON_ID2	COMMENTS
1	1	1	2 Partners
2	2	1	3 Friends

PROPERTY GRAPHS

```
SQL> create property graph connections_pg
  vertex tables (
    people
      key (person_id)
      label person
      properties all columns
  )
  edge tables (
    connections
      key (connection_id)
      source key (person_id1) references people (person_id)
      destination key (person_id2) references people (person_id)
      label connection
      properties all columns
  );

```

Property graph created.



PROPERTY GRAPHS

```
SQL> select person1, person2, comments  
      from graph_table (connections_pg  
                          match  
                          (p1 is person) -[c is connection]-> (p2 is person)  
                          columns( p1.name as person1,  
                                    p2.name as person2,  
                                    c.comments as comments)  
      );
```

PERSON1	PERSON2	COMMENTS
Freddie Mercury	Brian May	Friends
Freddie Mercury	Mary Austin	Partners

PROPERTY GRAPHS

```
SQL> select person1, comments1, person2, comments2, person3  
  from graph_table (connections_pg  
    match  
      (p1 is person where p1.name='Brian May') -[c1 is connection]-  
        (p2 is person) -[c2 is connection]-  
          (p3 is person where p3.name='Mary Austin')  
    columns (p1.name as person1,  
             p2.name as person2,  
             p3.name as person3,  
             c1.comments as comments1,  
             c2.comments as comments2)  
);
```

PERSON1	COMMENTS1	PERSON2	COMMENTS2	PERSON3
Brian May	Friends	Freddie Mercury	Partners	Mary Austin

PROPERTY GRAPHS



Staging tables

```
SQL> create table staging_table (
    id number,
    name varchar2(30),
    city varchar2(30),
    country varchar2(30)
) for staging;
SQL> insert into staging_table values (1,'John Smith','Zurich','CH'),
   (2,'Jane Doe','Zuerich','Switzerland'), (3,'James Cook','Zurich','Swiss');
SQL> update staging_table set city='Zurich';
SQL> update staging_table set country='Switzerland';
SQL> select * from staging_table;
```

ID	NAME	CITY	COUNTRY
1	John Smith	Zurich	Switzerland
2	Jane Doe	Zurich	Switzerland
3	James Cook	Zurich	Switzerland

No stats!
only dynamic sampling

```
SQL> insert into other_table select * from staging_table;
SQL> truncate table staging_table;
```

VECTOR

```
SQL> exec dbms_vector.load_onnx_model(
  directory=>'model_dir',
  file_name => 'all_MiniLM_L12_v2.onnx',
  model_name => 'ALL_MINILM_L12_V2',
  metadata => JSON('{
    "function" : "embedding",
    "embeddingOutput" : "embedding",
    "input": {"input": ["DATA"]}
  } ')
);
```



VECTOR

```
SQL> SELECT VECTOR_EMBEDDING(  
      ALL_MINILM_L12_V2  
      USING 'The quick brown fox jumped' as DATA  
    ) AS embedding;  
EMBEDDING  
-----  
[1.65517051E-002,3.19098569E-002,-1.96293015E-002,-3.56926955E-002,9.21710581E-0
```

VECTOR

```
SQL> desc vector.my_data
```

Name	Null?	Type
ID		NUMBER
BEER_NAME		VARCHAR2(128)
INFO		VARCHAR2(4000)

```
SQL> alter table vector.my_data add vector_l12_v2 vector;  
SQL> desc vector.my_data
```

Name	Null?	Type
ID		NUMBER
BEER_NAME		VARCHAR2(128)
INFO		VARCHAR2(4000)
VECTOR_L12_V2		CLOB VALUE

VECTOR

```
SQL> update vector.my_data set vector_l12_v2 =
    VECTOR_EMBEDDING(ALL_MINILM_L12_V2 USING info as data);
```

VECTOR INDEX (optional)

```
SQL> create vector index vector.l12_v2a on vector.my_data(vector_l12_v2)
  ORGANIZATION INMEMORY NEIGHBOR GRAPH
    distance cosine
  with target accuracy 95;
```

```
SQL> show parameter vector_index_neighbor_graph_reload
```

NAME	TYPE	VALUE
vector_index_neighbor_graph_reload	string	OFF

VECTOR SEARCH

```
SQL> select beer_name, info  
  from vector.my_data  
  order by vector_distance(  
      VECTOR_L12_V2,  
      VECTOR_EMBEDDING(ALL_MINILM_L12_V2 USING  
          '&prompt' as data),  
      cosine)  
fetch approximate first 5 rows only;
```

VECTOR SEARCH

Prompt: '**Fruity with some tangerine aftertaste**'

Commodore Perry IPA

A medium-bodied and well hopped India Pale Ale with a dry, **fruity** aftertaste.

Dreadnaught Imperial IPA

A hop lovera??s dream! **Mango and peach aromas** with a crisp **citrus** finish.

Pays du Soleil

Amber ale with Palmetto **berries** and hibiscus.

Bam Noire

Dark, smooth, delicious. Aromas of worn leather and cool autumn nights. Notes of **sweet plum** and toasted raisin, hints of coffee and cacao. Lingering tart and refreshing finish. Only available for a few short months. Not to be missed.

Broadside Ale

Rich **fruitcake aromas** a?? almonds, **zest** and conserved fruit. A wonderful balance of malt and hop flavours. A beer to savour and rich in flavour.



VECTOR SEARCH – quick demo

```
SQL> select beer_name, info  
  from vector.my_data  
  order by vector_distance(  
            VECTOR_L12_V2,  
            VECTOR_EMBEDDING(ALL_MINILM_L12_V2 USING  
                            '&prompt' as data),  
            cosine)  
  fetch approximate first 5 rows only;
```

Direct JOINS for UPDATE/DELETE

```
SQL> update t1 a  
      set a.xxx = 7  
      from t2 b  
     where a.id = b.id  
       and b.id <= 5;
```

```
SQL> delete t1 a  
      from t2 b  
     where a.id = b.id  
       and b.id <= 5;
```

<https://medium.com/@andrei.manoliu/update-and-delete-statements-f68990cfa997>



PL/SQL transpiler

The SQL Transpiler automatically and wherever possible converts (transpiles) PL/SQL functions within SQL into SQL expressions, without user intervention.

The SQL Transpiler is disabled by default.

`SQL_TRANSLATOR = [ON | OFF]`

Helps avoid PL/SQL vs SQL context switches
a lot of limitations e.g. doesn't work for packages

<https://docs.oracle.com/en/database/oracle/oracle-database/23/tgsql/introduction-to-sql-tuning.html>

PL/SQL transpiler

```
create function get_month_abbreviation ( date_value date ) return varchar2 is
begin
    return to_char ( date_value, 'MON', 'NLS_DATE_LANGUAGE=English' );
end;
/
select employee_id from hr.employees where get_month_abbreviation( hire_date ) = 'MAY';
...
Predicate Information (identified by operation id):
filter(TO_CHAR(INTERNAL_FUNCTION("HIRE_DATE"),'MON','NLS_DATE_LANGUAGE=English')='MAY')
```

<https://docs.oracle.com/en/database/oracle/oracle-database/23/tgsql/introduction-to-sql-tuning.html>

JSON-Relational duality

```
SQL> create or replace json relational duality view department_dv as
  select json {'_id' : d.deptno,
    'departmentName' : d.dname,
    'location' : d.loc,
    'employees' :
      [ select json {'employeeNumber' : e.empno,
                     'employeeName' : e.ename,
                     'job' : e.job,
                     'salary' : e.sal}
        from emp e with insert update delete
        where d.deptno = e.deptno ]}
from dept d with insert update delete;
```

<https://oracle-base.com/articles/23/json-relational-duality-views-23>

JSON-Relational duality

```
SQL> select json_serialize(d.data pretty)
  from department_dv d
 where d.data."_id" = 40;
```

```
JSON_SERIALIZE(D.DATAPRETTY)
```

```
-----
{
  "_id" : 40,
  "_metadata" :
  {
    "etag" : "6FAB9798FF405D87F0EB44456398A5D5",
    "asof" : "0000000002F2799"
  },
  "departmentName" : "OPERATIONS",
  "location" : "BOSTON",
  "employees" :
  [
  ]
}
```

Optimistic locking based on the etag

<https://oracle-base.com/articles/23/json-relational-duality-views-23>

JSON-Relational duality

```
SQL> insert into department_dv d (data) SQL> select * from dept where deptno = 50;
values (
{
  "_id" : 50,
  "departmentName" : "DBA",
  "location" : "BIRMINGHAM",
  "employees" : [
    {
      "employeeNumber" : 9999,
      "employeeName" : "HALL",
      "job" : "CLERK",
      "salary" : 500
    }
  ]
});
```

DEPTNO	DNAME	LOC
50	DBA	BIRMINGHAM

```
SQL> select empno, ename, job
  from emp
 where deptno = 50;
```

EMPNO	ENAME	JOB
9999	HALL	CLERK

<https://oracle-base.com/articles/23/json-relational-duality-views-23>

Lots of JSON improvements

JSON_ARRAY accepts subquery as input:

```
json_array(select json_object('employee-number' : e.empno) from emp e)
```

JSON_BEHAVIOR parameter controls behaviour of error handling
(ERROR ON ERROR, NULL ON ERROR, FALSE ON ERROR, etc.)

Many improvements to JSON data type

JSON Schema to check validity and structure of JSON documents – **VALIDATE** keyword

DBMS_JSON.JSON_TYPE_CONVERTIBLE_CHECK to help migration CLOB -> JSON

Priority of Transactions

```
SQL> ALTER SESSION SET txn_priority = 'HIGH/MEDIUM/LOW';
SQL> ALTER SESSION SET priority_txns_high_wait_target = 30;
SQL> ALTER SESSION SET priority_txns_medium_wait_target = 90;
SQL> ALTER SESSION SET priority_txns_mode = 'TRACK/ROLLBACK';
```

If a **HIGH** priority transaction is blocked for a row lock, Oracle Database can roll back the transaction that is holding the row lock only if the holder is **LOW** or **MEDIUM** priority. Oracle Database never rolls back a **HIGH** priority transaction.

If a **MEDIUM** priority transaction is blocked for a row lock, Oracle Database can roll back the transaction that is holding the row lock only if the holder is **LOW** priority.

If a **LOW** priority transaction is blocked for a row lock, Oracle Database will not attempt to roll back the transaction holding the row lock irrespective of its priority.

<https://blogs.oracle.com/dbstorage/post/new-priority-transactions-capability-with-oracle-database-23ai>

BIGFILE TABLESPACES

**Starting with Oracle Database 23ai, the SYSTEM, SYSAUX, and USER tablespaces are created as bigfile tablespaces by default.
A database upgraded from a previous release retains its tablespace type.**

<https://docs.oracle.com/en/database/oracle/oracle-database/23/cncpt/logical-storage-structures.html>

BIGFILE TABLESPACES – let's check

```
SQL> alter session set  
  container=cdb$root;
```

Session altered.

```
SQL> select tablespace_name, bigfile  
  from dba_tablespaces;
```

TABLESPACE_NAME	BIG
SYSTEM	YES
SYSAUX	YES
UNDOTBS1	YES
TEMP	NO
USERS	YES

```
SQL> alter session set  
  container=freepdb1;
```

Session altered.

```
SQL> select tablespace_name, bigfile  
  from dba_tablespaces;
```

TABLESPACE_NAME	BIG
SYSTEM	YES
SYSAUX	YES
UNDOTBS1	YES
TEMP	NO
USERS	NO

23ai

PL/SQL packages

DBMS_HCHECK

Replacing the hcheck.sql script which checks the internal dictionary structures

It didn't work for me... package doesn't exist

But I found blogs where people managed to run it.

DBMS_SEARCH

Indexing of multiple schema objects in a single index.

```
exec DBMS_SEARCH.CREATE_INDEX('MYINDEX');
exec DBMS_SEARCH.ADD_SOURCE('MYINDEX', 'PRODUCTS');
exec DBMS_SEARCH.ADD_SOURCE('MYINDEX', 'CUSTOMERS');
```

```
SELECT METADATA
from MYINDEX
WHERE CONTAINS(data, 'shiny or street')>0;
```

METADATA

```
{"OWNER": "SCOTT", "SOURCE": "PRODUCTS", "KEY": {"ID": 2}}
{"OWNER": "SCOTT", "SOURCE": "CUSTOMERS", "KEY": {"ID": 1}}
{"OWNER": "SCOTT", "SOURCE": "CUSTOMERS", "KEY": {"ID": 99}}
```

https://docs.oracle.com/en/database/oracle/oracle-database/23/ccapp/performing-ubiquitous-search-dbms_search-apis.html

DBMS_SQL_FIREWALL

SQL Firewall – database firewall features such as allow-listing, deny-listing, and object-and command-based access control inside the Oracle Database kernel.

Should help preventing SQL Injections

https://docs.oracle.com/en/database/oracle/oracle-database/23/arpls/dbms_sql_firewall.html

DEFAULT ON NULL FOR INSERT AND UPDATE

```
SQL> create table t1(
  id number,
  description varchar2(15) default 'banana'
  description1 varchar2(15) default on null 'pear',
  description2 varchar2(15) default on null for insert only 'apple',
  description3 varchar2(15) default on null for insert and update 'kiwi'
);
```

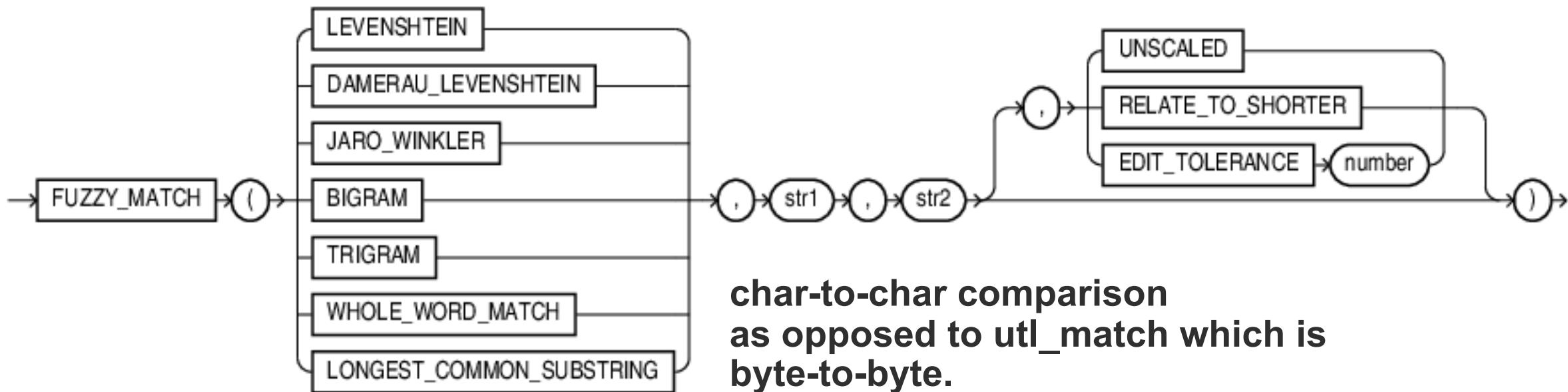
<https://oracle-base.com/articles/23/default-on-null-for-insert-and-update-23>

FUZZY_MATCH & PHONIC_ENCODE

```
SQL> select fuzzy_match(levenshtein,'Andrzej Nowicki','Andrei Nowitzki');
```

```
FUZZY_MATCH(LEVENSHTEIN,'ANDRZEJNOWICKI','ANDREINOWITZKI')
```

74



**char-to-char comparison
as opposed to `utl_match` which is
byte-to-byte.**

<https://docs.oracle.com/en/database/oracle/oracle-database/23/sqlrf/data-quality-operators.html>

Honourable mentions

RETURNING clause returns new/old values

Stored procedures in JavaScript

SQL Domains – reuse the same constraints checks across different objects

Object Annotations – comments on steroids

Lock-free reservations – for modification of rows in highly-concurrent fashion

Max columns limit raised to 4096: compatible = 23.0.0, max_columns=EXTENDED

New powerful role: db_developer_role

Column level auditing

References

Oracle Docs

<https://docs.oracle.com/en/database/oracle/oracle-database/index.html>

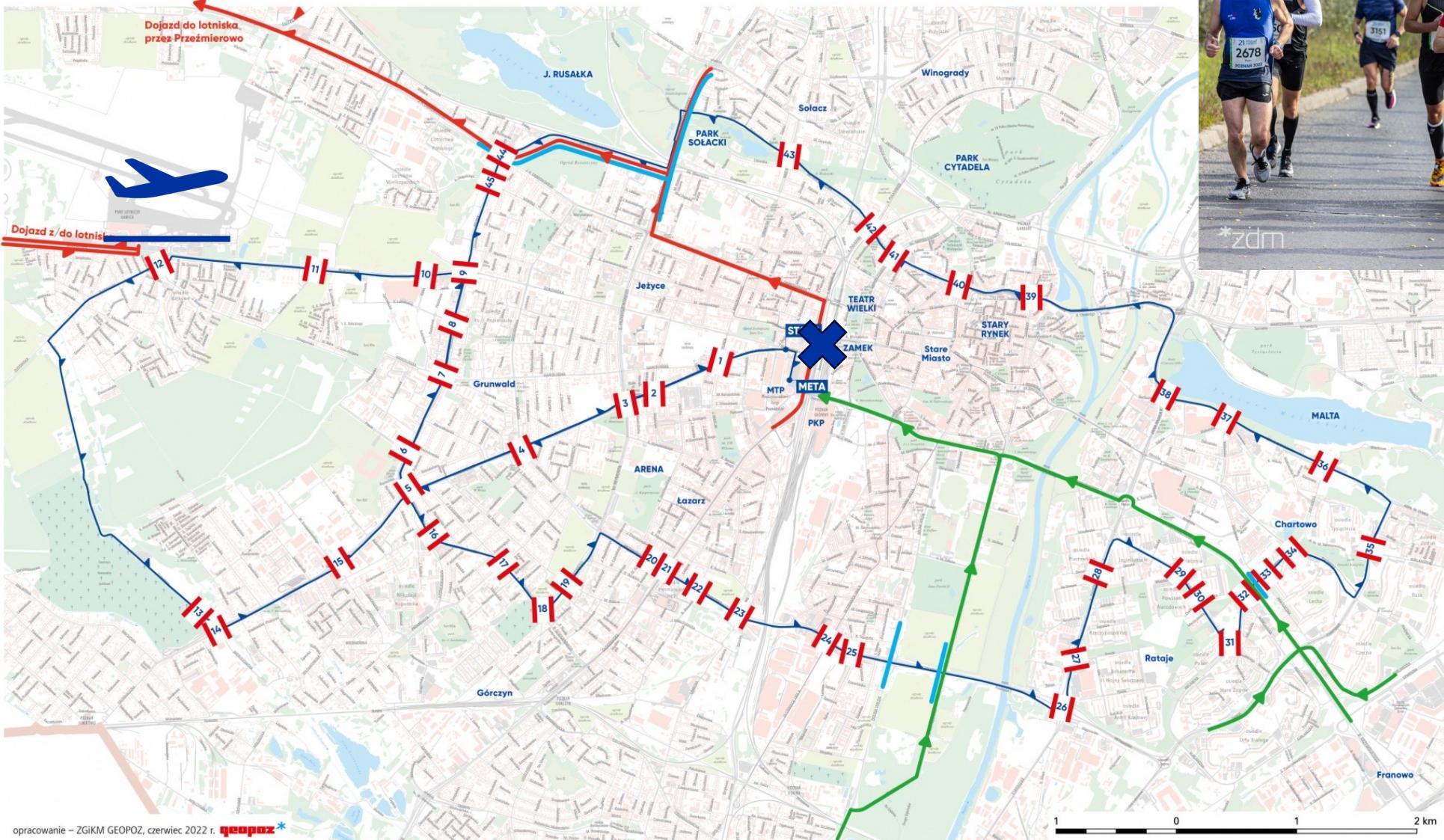
Tim Hall's Articles

<https://oracle-base.com/articles/23/articles-23>

Oracle Blogs

<https://blogs.oracle.com/database/>

BEWARE TOMORROW





Come visit CERN!

<https://visit.cern>

Thank you !



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Slides are available:

