h_da

HOCHSCHULE DARMSTADT
UNIVERSITY OF APPLIED SCIENCES

fbi

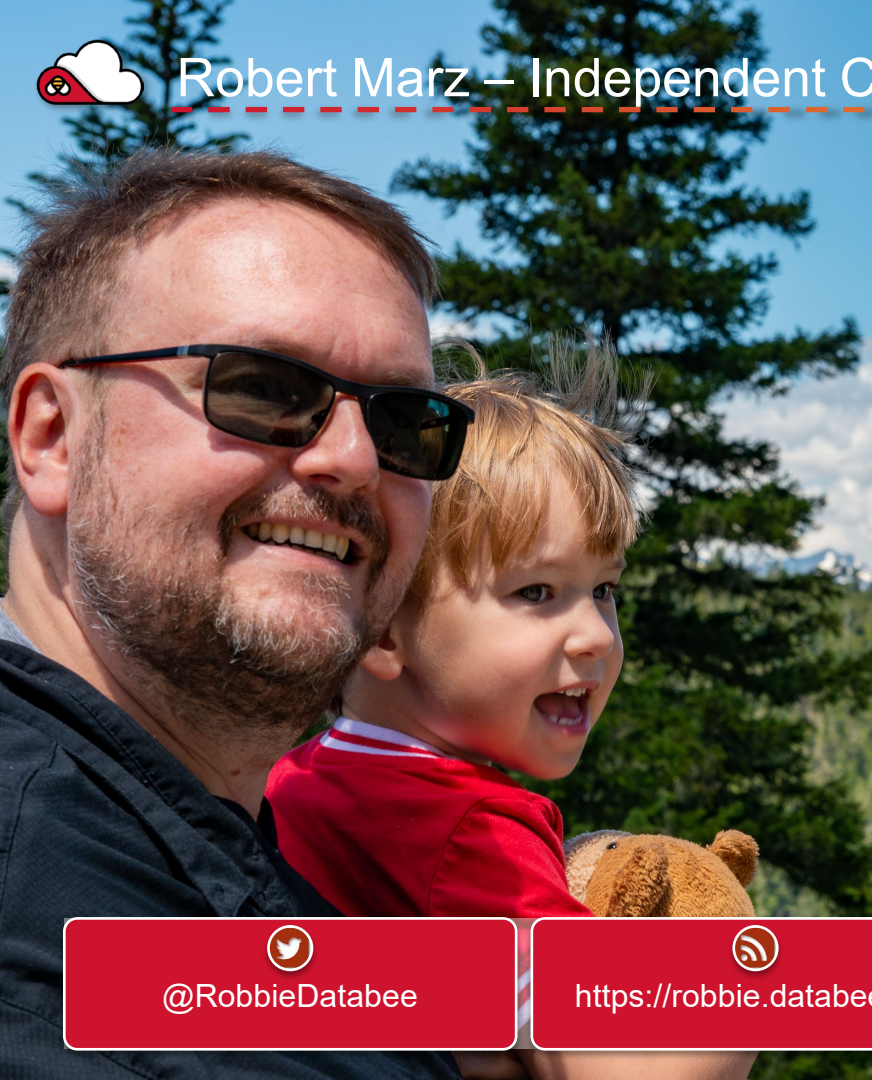
FACHBEREICH INFORMATIK

Robert Marz
DATABEE
Die IT-Architekten

JSON in Oracle

Mittwoch, 28. März 13:00

Robert Marz – Independent Consultant



Primary Role

Senior Technical Architect
with database centric view of the world

DOAG (German Oracle User Group)

Active Member of Database Community
Responsible for Cloud Topics

Databees.

DATABEE
Die IT-Architekten

@RobbieDatabee

https://robbie.databee.org

robert.marz@databee.org

Oracle ACE Pro

Oracle ACE Program

500+ technical experts helping peers globally

The **Oracle ACE Program** recognizes and rewards community members for their technical and community contributions to the Oracle community

3 membership tiers

Oracle ACE Director | Oracle ACE Pro | Oracle ACE Associate

For more details on Oracle ACE Program:
ace.oracle.com

Oracle ACE

Nominate

yourself or someone you know:

ace.oracle.com/nominate

Connect: aceprogram_ww@oracle.com Facebook.com/OracleACEs @oracleace

Introduction

What to expect

An Overview

How to deal with JSON in the Database

Absolutly Not

All JSON Commands

Complete Syntax Diagrams

Evolution over Database Versions

Setting the Stage: Who is Jason?

JSONJava **S**cript **O**bject **N**otation

Java **S**cript **O**bject **N**otation

Lightweight Format

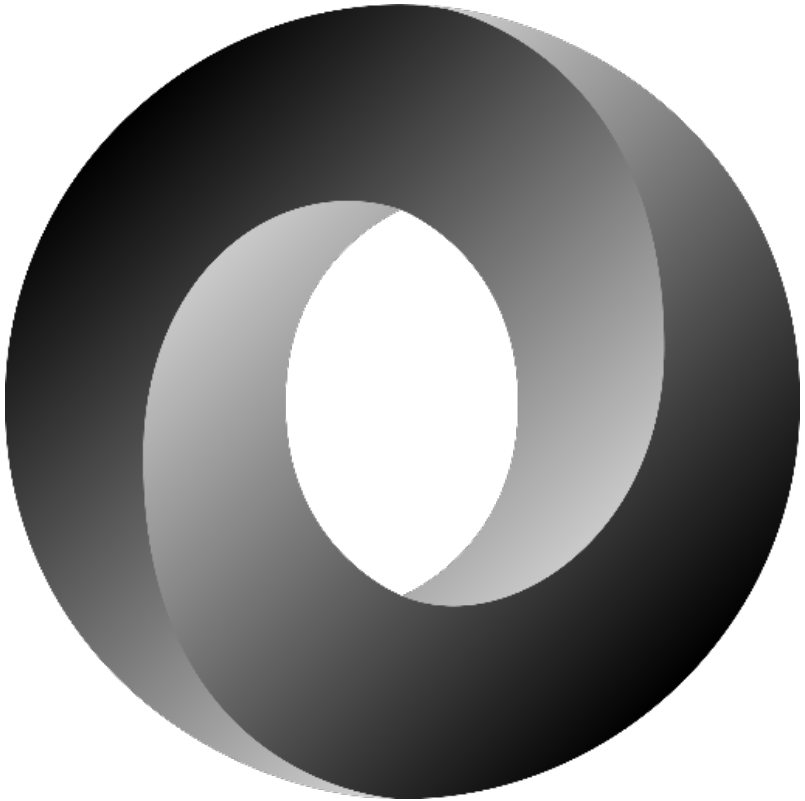
Text-based
Data Interchange
Document Format (can be stored as Files)

Originally designend

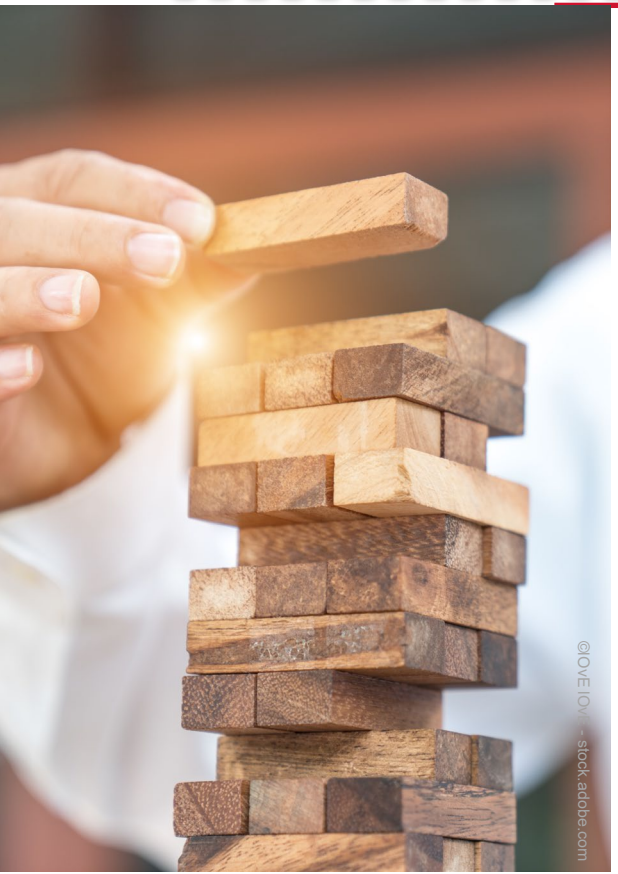
to persist JavaScript Objects

Standards:

json.org
ECMA-404



JSON: Simple Format



Structures

unordered collection

- “key”:”value” pairs
- separated by commas
- enclosed by braces { }
- also realized as **object**, record, struct, dictionary, hash table, keyed list or associative array

ordered list of values

- separated by commas
- enclosed by square brackets [ ]
- also realized as **array**, vector, list or sequence

JSON: Types of Values

```
{
  "string":"String are quoted",
  "escape": "\n control chars",
  "number": 1234,
  "boolean": true,
  "collection": {
                  "object":"fields",
                  "can":"nested"
                },
  "array": [ "one",
             "two",
             {"three":true}]
}
```

Types of Values

string		“always enclosed in double quotes”
number	Integer	-256
	Float	256.123
	E-notation	2.3e3
Boolean	true	
	false	
	null	
Object	Nested Objects	
	Arrays	
Array	Simple Types	
	Objects	

JSON Document Format: Odds & Ends

©whitehoune - stock.adobe.com

Characterset

always Unicode

Number encoding

always English, Decimal Point

Whitespace

between Tokens is ignored
space, linefeed, carriage return, tab

Dates are represented as strings

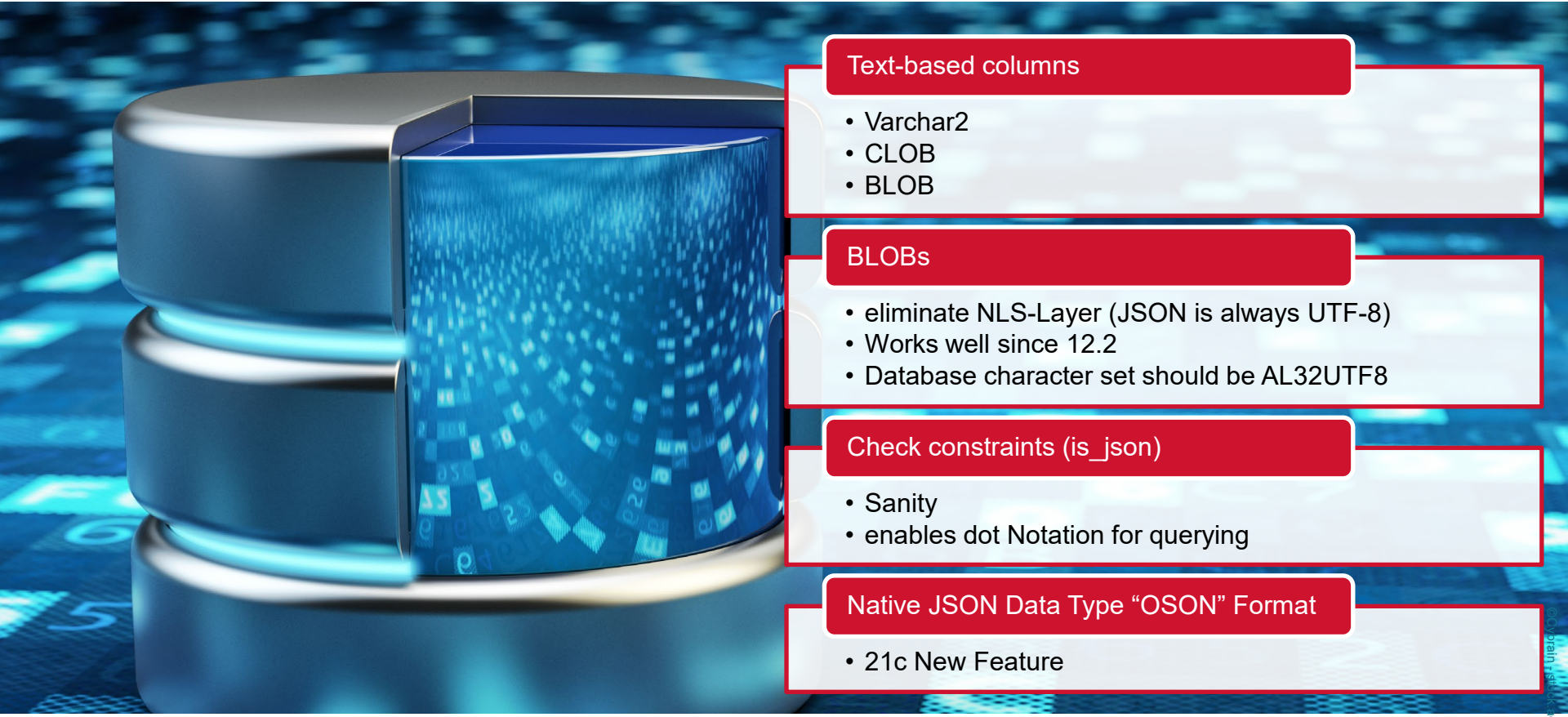
usually ISO 8601 Zulu (UTC) Time
"2019-11-19**T**15:13:23**Z**"

JSON is Schemaless

no constraints for your implementation
Developers Hell - when dealing with documents not produced by your code
JSON Schema addon – not yet a standard

Storing JSON Data

Storing JSON Docs in the Database



Text-based columns

- Varchar2
- CLOB
- BLOB

BLOBs

- eliminate NLS-Layer (JSON is always UTF-8)
- Works well since 12.2
- Database character set should be AL32UTF8

Check constraints (is_json)

- Sanity
- enables dot Notation for querying

Native JSON Data Type “OSON” Format

- 21c New Feature

Speeding things up –Function Based Indexes

```
select *
 from departments_json
 where json_value ( department_data
                  , '$.department' ) = 'Sales'
```

Function Based Index – Useful when searching for a specific attribute

```
create index dept_department_name_i on
 departments_json (
  json_value (
   department_data, '$.department'
    error on error
    null on empty
  )
 )
```

Chris Saxon: How to Store, Query, and Create JSON Documents in Oracle Database

Speeding things up – JSON Search Indexes

```
create
   search index
   dept_json_i
   on departments_json
      ( department_data )
   for json;

select *
 from departments_json d
 where json_textcontains
  ( department_data, '$'
  , 'Public' );
```

Oracle Text

Index

Can be used for

json_value
json_textcontains

Indexes

whole Document for every row

Chris Saxon: How to Store, Query, and Create JSON Documents in Oracle Database

When do I store JSON Docs

©vipman4 - stock.adobe.com

Original Document

needed for

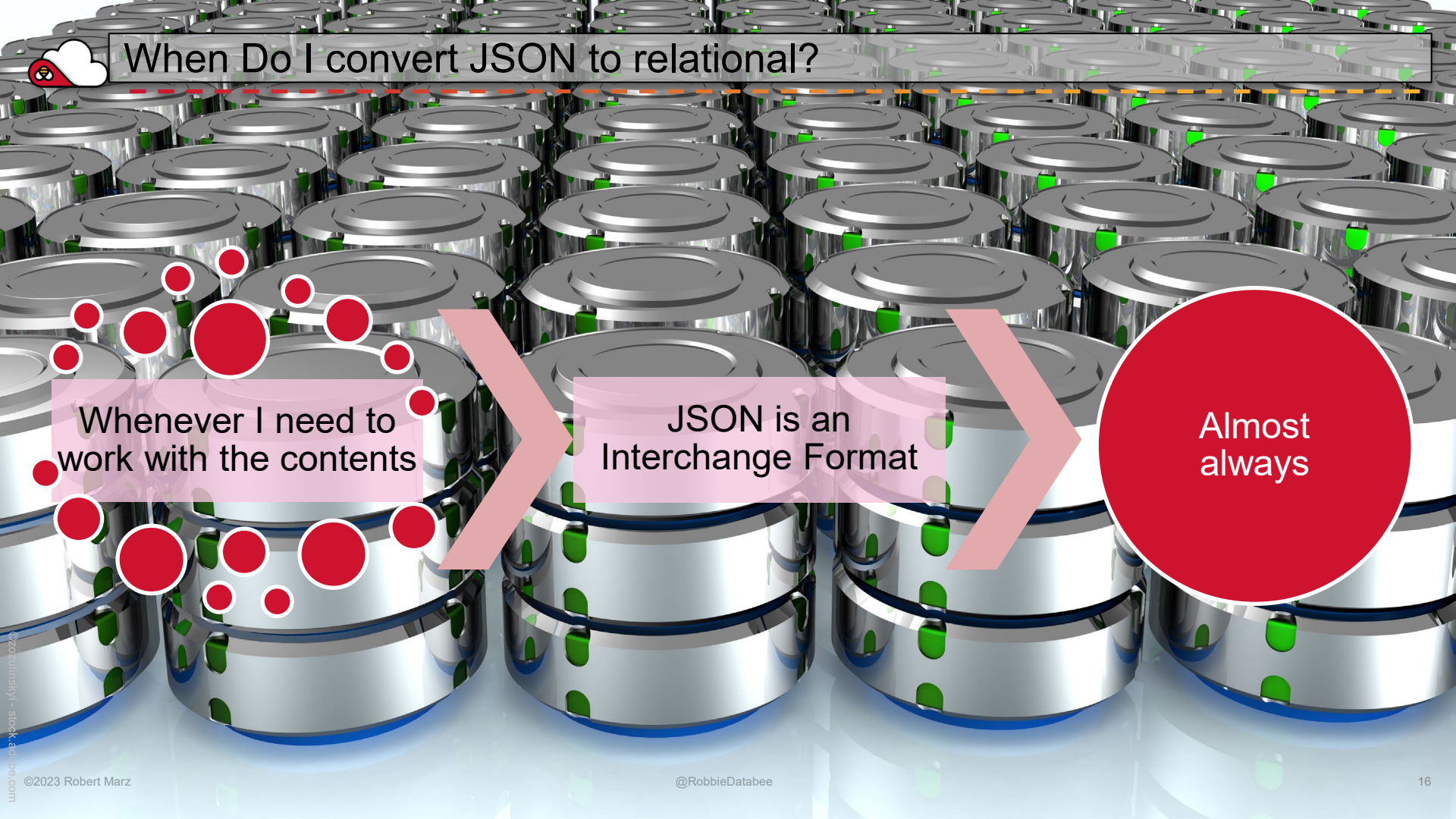
- Reference
- Archive
- Redistribution

JSON structure

Varies

and may be queried later on

When Do I convert JSON to relational?



Feeding JSON to the DB

Loading JSON into the Database: Insert

```
insert into departments_jsonjson
  values ( 110, utl_raw.cast_to_raw (
'{ "department": "Accounting",
   "employees": [
     {
       "name": "Higgins, Shelley",
       "job": "Accounting Manager",
       "hireDate": "2002-06-07T00:00:00Z"
     },
     {
       "name": "Gietz, William",
       "job": "Public Accountant",
       "hireDate": "2002-06-07T00:00:00Z"
     }
   ]
}' ));
```

Datatype BLOB

JSON Documents

are Text

Insert / Update

works fine

as long as Documents size < 4000 / 32000

Check Constraint

is_json

rejects non-json Texts

Chris Saxon: How to Store, Query, and Create JSON Documents in Oracle Database

Loading JSON into the Database: External Table / SQL*Loader

```
create table
   json_dump_file_contents
         (json_document blob)
 organization external
 ( type oracle_loader
  default directory json_dump_dir
  access parameters
  ( records delimited by 0x'0a'
    disable_directory_link_check
    fields (json_document raw)
  )
  location ('JSONdocs.dmp')
 )
 parallel
 reject limit unlimited;
```

JSON Dump Files

contain one JSON Doc per row

usually produce by NoSQL DBs

e.g. MongoDB

Load via

SQL *Loader

External Table

Loading JSON into the Database: SQLcl

```
var HashMap = Java.type("java.util.HashMap");
var bindmap = new HashMap();

print("\nreading file: "+ args[1]);
var filePath=args[1];

var blob=conn.createBlob();
var bstream=blob.setBinaryStream(1);

java.nio.file.Files.copy(
  java.nio.file.FileSystems.getDefault().getPath(filePath)
                , bstream );
bstream.flush();

bindmap.put("inhalt",  blob);
bindmap.put("pfad", filePath);

if(!util.execute( "insert into dokument  "
            +  "(datei_inhalt,datei_pfad) "
            +  " values(:inhalt, :pfad)"
           , bindmap)
 ){ print("insert failed, exiting");
    exit;
}
```

SQLcl

SQLDeveloper Worksheet as CLI
99,8% SQL*Plus compatible

Modern CLI

Tab-Completion
Editor
History

Enhancements

Liquibase & HashiCorp Vault integration
DDL Command
lots more

Scripting

in JSR-223 Languages
(e.g. JavaScript, Python, etc)
Oracle DB Tools GitHub Examples

Loading JSON into the Database: REST Service

Oracle REST Data Services ORDS

Free
Java-Based
evolved from APEX Listener

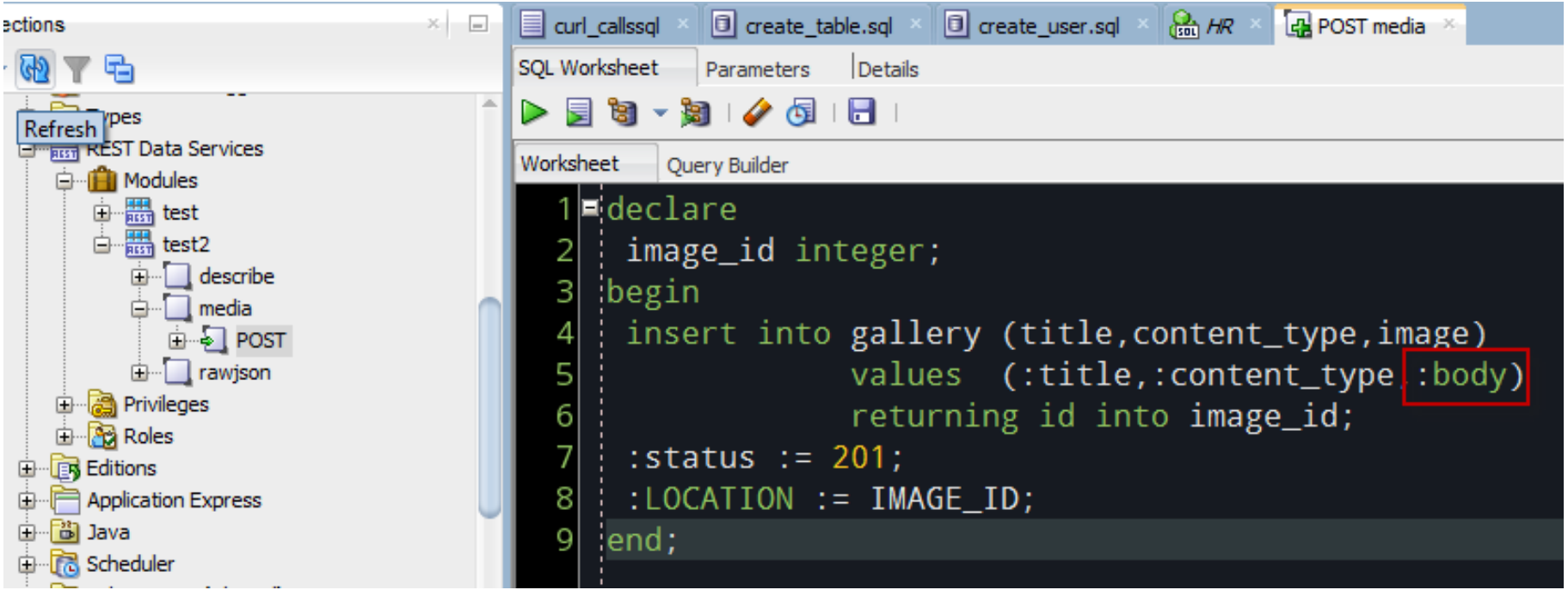
REST enables Database

very easy
SQL Developer Wizards
ORDS REST Services are pure Metadata

Developed & Deployed in Minutes

POST Up a BLOB to an Oracle Table via REST - Jeff Smith

Loading JSON into the Database: REST Service Example



[POST Up a BLOB to an Oracle Table via REST - Jeff Smith]

Loading JSON into the Database: utl_http

Oracle Database

can do http_requests
  e.g. for using REST Services
Package utl_http

Prerequires

ACL/ACE for Network Access
Wallet for https-Requests

PL/SQL implementiation

straight forward
Example: REST DB Links

JSONPath - Reference

- JSONPath is Xpath for JSON
- Used all over the place
- Uses dot-Notation: $.store.book[0].title
- Returns JSON Document or single element
- JSONPath Online Evaluator

Expression	Description
$	the root object / element
@	the current object / element
. or []	child operator
[start:end:step]	array slice operator
?()	filter expression

JSONPath	Result
$.store.book[*].author	the authors of all books in the store
$..author	all authors
$.store.*	all things in store, which are some books and a red bicycle.
$.store..price	the price of everything in the store.
$..book[2]	the third book
$..book[(@.length-1)] $..book[-1:]	the last book in order.
$..book[0,1] $..book[:2]	the first two books
$..book[?(@.isbn)]	filter all books with isbn number
$..book[?(@.price<10)]	filter all books cheapier than 10
$..*	All members of JSON structure.

https://goessner.net/articles/JsonPath/

Querying JSON: Dot-Notation

```
select d.department_data.department
  from departments_json d
```

```
select d.department_data.employees[0].name
  from departments_json d
 where department_id = 110;

EMPLOYEES
Gietz, William
```

```
select d.department_data.employees[*].name
  from departments_json d
 where department_id = 110;

EMPLOYEES
["Gietz, William","Higgins, Shelley"]
```

```
-- Column needs is_json constraint
-- or "treat as json" function (18c)

with j_data as (
  select treat (
         d.department_data as json
        ) as department_data
  from   departments_json d
  where  department_id = 110
)
  select j.department_data.department
  from   j_data j
  where  department_data is json;

DEPARTMENT
Accounting
```

Chris Saxon: How to Store, Query, and Create JSON Documents in Oracle Database

Querying JSON: The JSON_TABLE Operator (1/2)

JSON_TABLE

Lives inside the SQL-From-Clause

Produces **Rows** and **Columns**

Accepts LOBs with JSON data

Included in SQL:2016 Standard

Querying JSON: The JSON_TABLE Operator (2/2)

The JSON Document

```
select wert
  from json_table( '["Eins", "Zwei", "Drei",
                    "Vier", "Fünf", "Sechs"]'
                 , '$[*]'
                 columns wert varchar2 path '$'
                 )
/
```

Produces rows
(JSONPath Object)

```
WERT
--------------------
Eins
Zwei
Drei
Vier
Fünf
Sechs

6 rows selected

Elapsed: 00:00:00.011
```

Produces columns
(JSONPath Element)

Dates in JSON – Dealing with ISO 8601 Zulu

JSON Dates usually ISO 8601 Zulu (UTC) Time Strings

"2019-11-19T15:33:54Z"

```
-- Converting in Oracle is tricky
cast( to_timestamp_tz
     ( to_char(
         to_date(tstamp, 'YYYY-MM-DD"T"HH24:MI:SS"Z"')
         , 'YYYY-MM-DD HH24:MI:SS "UTC"')
     , 'YYYY-MM-DD HH24:MI:SS TZR')
     at time zone sessiontimezone as date ) tstamp
```

```
-- Oracle 18c has new date function
select TO_UTC_TIMESTAMP_TZ('2019-11-19T15:33:54Z') tstamp
  from dual;
```

Working with JSON

Comparing JSON Documents

```
select case
       when json_equal('{"one": 1, "two":[ "three", 4]}'
                      ,'{  "two":[ "three"
                             , 4]
                             ,"one": 1 }'
                      )
        then 'EQUAL'
        else 'DIFFERENT'
       end compare
  from dual;
```

```
COMPARE
--------------
EQUAL
```

```
select case
       when json_equal('{"one": 1, "two":[ "three", 4]}'
                      ,'{"one": 1, "two":[ 4, "three"]}'
                      )
        then 'EQUAL'
        else 'DIFFERENT'
       end compare
  from dual;
```

```
COMPARE
--------------
DIFFERENT
```

Updating JSON Docs – json_merge_patch

JSON_merge_patch()

- – new Feature in 19c

Creates / Updates / Delete

- Objects in JSON Docs
  Works like Unix patch or SQL merge

```
json_mergepatch('{"FirstName":"Eric", "LastName":"Cartman"}', '{"LastName":„Fox"}')
{"FirstName":"Eric", "LastName":"Fox"}

json_mergepatch('{"FirstName":"Eric", "LastName":"Cartman"}', '{"Salaray":1000}')
{"FirstName":"Eric", "LastName":"Cartman", "Salaray":1000}

json_mergepatch('{"FirstName":"Eric", "LastName":"Cartman"}', '{"FirstName":null}')
{"LastName":"Cartman"}
```

Generating JSON

Generate JSON Documents

- SQL-Functions starting with 12gR2
- JSON_Object
- JSON_Array
- JSON_ArrayAgg

Generate JSON Documents – JSON_Object

```
select json_object ('id2' value cust_id,
                    'name' value (first ||' '|| last),
                    'joined' value join_date) customers
  from customers;
```

```
CUSTOMERS
----------------------------------------------------------------
{"id2":1,"name":"Eric Cartman","joined":"2017-07-10T16:26:15"}
{"id2":2,"name":"Kenny McCormick","joined":"2017-07-10T16:26:15"}
{"id2":3,"name":"Kyle Brofloski","joined":"2017-07-10T16:26:15"}
{"id2":4,"name":"Stan Marsh","joined":"2017-07-10T16:26:15"}
```

Generate JSON Documents JSON_Array

```
select json_array(first, last) customers
  from customers;
```

```
CUSTOMERS
----------------------
["Eric","Cartman"]
["Kenny","McCormick"]
["Kyle","Brofloski"]
["Stan","Marsh"]
```

Generate JSON Documents JSON_ArrayAgg

```
select json_arrayagg(
          json_object('id'       value item_id,
                      'name'     value name,
                      'quantity' value stock_quantity)
                 ) stock_items
  from items
 where stock_quantity > 10;
```

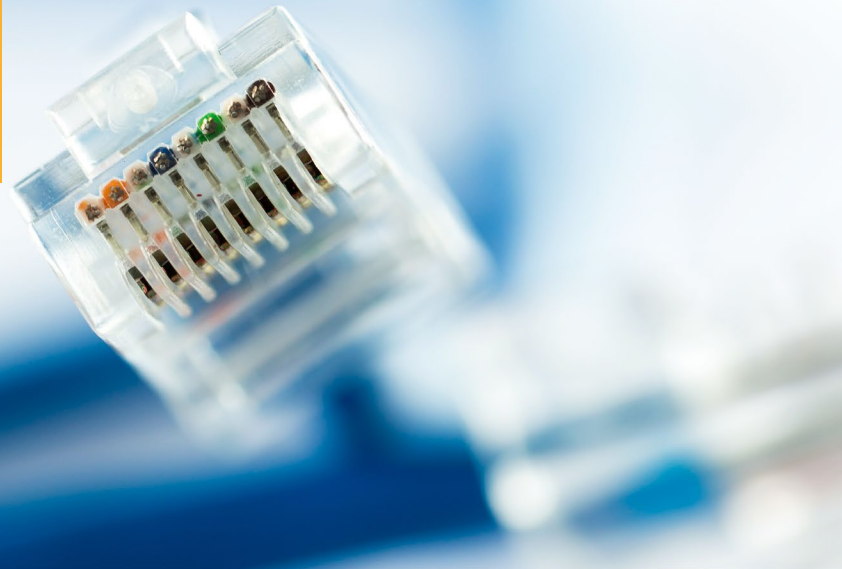
```
STOCK_ITEMS
--------------------------------------------------------
[{"id":345,"name":"Border Patrol Costume","quantity":20},
{"id":429,"name":"Air Guitar","quantity":14}]
```

Publishing JSON

Publishing JSON

utl_file	let the database write files
sql*plus	spool files
SQLcl	script your JSON Docs
REST Service	let the clients request Documents on demand deliver via http(s)

Conclusion



Topics covered

- What is JSON
- Storing JSON content
- Loading JSON
- Querying JSON
- Manipulating JSON
- Generating JSON
- Publishing JSON

Didn‘t mention

- PLSQL APIs
- JSON Data Guide
- APEX JSON Packages
- Native JSON Data Type, OSON Format (not in depth)
- SODA
- Oracle Database API for MongoDB
- 23c JSON Duality Views

JSON, the Database and I

- **JSON is a flexible Interchange Format**
  - Lingua Franca of modern Web Apps
- **Loading JSON is easy**
  - It‘s just Text
- **Features evolve quickly**
  - 20c JSON Datatype, JSON Dictionary
- **The Database can be turned into the Backbone of RESTful Services**