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Creating and Working with JSON in Oracle Database

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About me

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Agenda

1. What is JSON?
2. Creating JSON
3. Working with JSON

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What is JSON?

- JavaScript Object Notation
  - A simple data interchange format
  - Has its roots in JavaScript but is language independent
- Heavily used in browser based & native mobile applications
  - Lighter weight and easier to use than XML

JSON overview

- Based on 2 structures (can be recursive)
  - object: {}
  - array: []
- Objects are made of key/value pairs
- Values can be one of the following
  - string: “test”
  - number: 100
  - Boolean: true or false
  - structure: object or array
  - no value: null

One row from the departments table

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700

Same department in JSON

```
1  {
2    "DEPARTMENT_ID": 10,
3    "DEPARTMENT_NAME": "Administration",
4    "MANAGER_ID": 200,
5    "LOCATION_ID": 1700
6  }
```

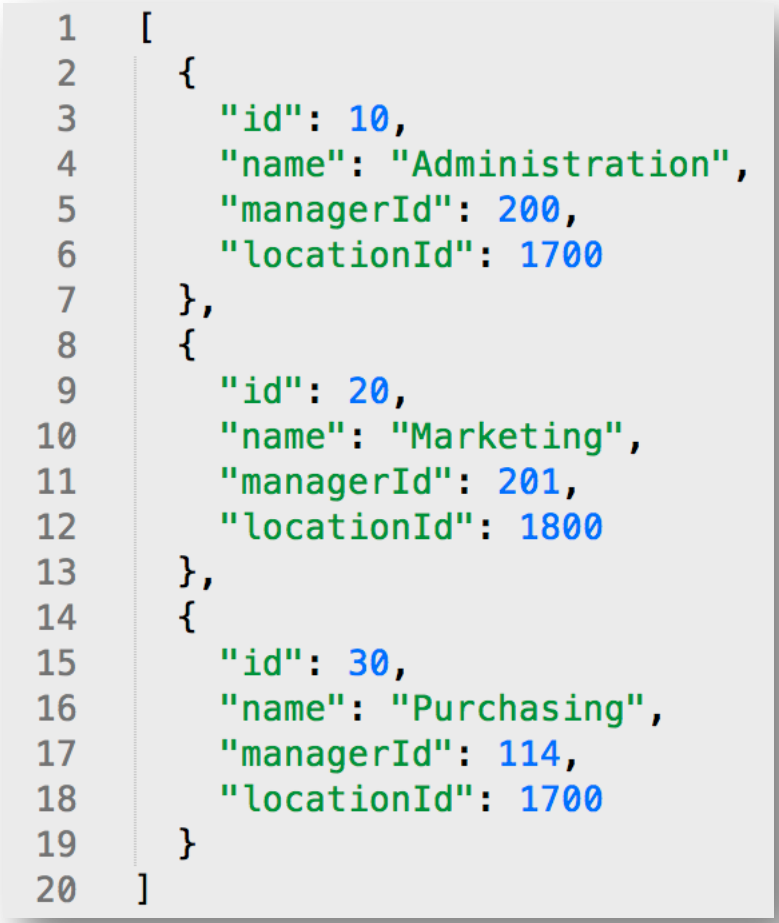
Now with “cooler” keys

```
{
  "id": 10,
  "name": "Administration",
  "managerId": 200,
  "locationId": 1700
}
```

Several rows from the departments table

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	30	Purchasing	114	1700

Those departments in JSON



```
[
  {
    "id": 10,
    "name": "Administration",
    "managerId": 200,
    "locationId": 1700
  },
  {
    "id": 20,
    "name": "Marketing",
    "managerId": 201,
    "locationId": 1800
  },
  {
    "id": 30,
    "name": "Purchasing",
    "managerId": 114,
    "locationId": 1700
  }
]
```

A row from department with related employees

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	20	Marketing	201	1800

	EMPLOYEE_ID	DEPARTMENT_ID	NAME	SALARY	HIRE_DATE
1	201	20	Michael Hartstein	13000	17-FEB-04
2	202	20	Pat Fay	6000	17-AUG-05

A department with nested employees in JSON

```json
{
  "id": 20,
  "name": "Marketing",
  "managerId": 201,
  "locationId": 1800,
  "employees": [
    {
      "id": 201,
      "name": "Michael Hartstein",
      "salary": 13000,
      "hireDate": "2004-02-17T00:00:00Z"
    },
    {
      "id": 202,
      "name": "Pat Fay",
      "salary": 6000,
      "hireDate": "2005-08-17T00:00:00Z"
    }
  ]
}
```

Other notes on JSON structure

- JSON is schemaless

```
1  [
2    "this is cool",
3    1,
4    [],
5    {}
6  ]
```

- There is no standard for handling dates
  - People often use:
    - ISO 8601: "2016-01-20T16:17:52.792Z"
    - Epoch time: 1453324612507

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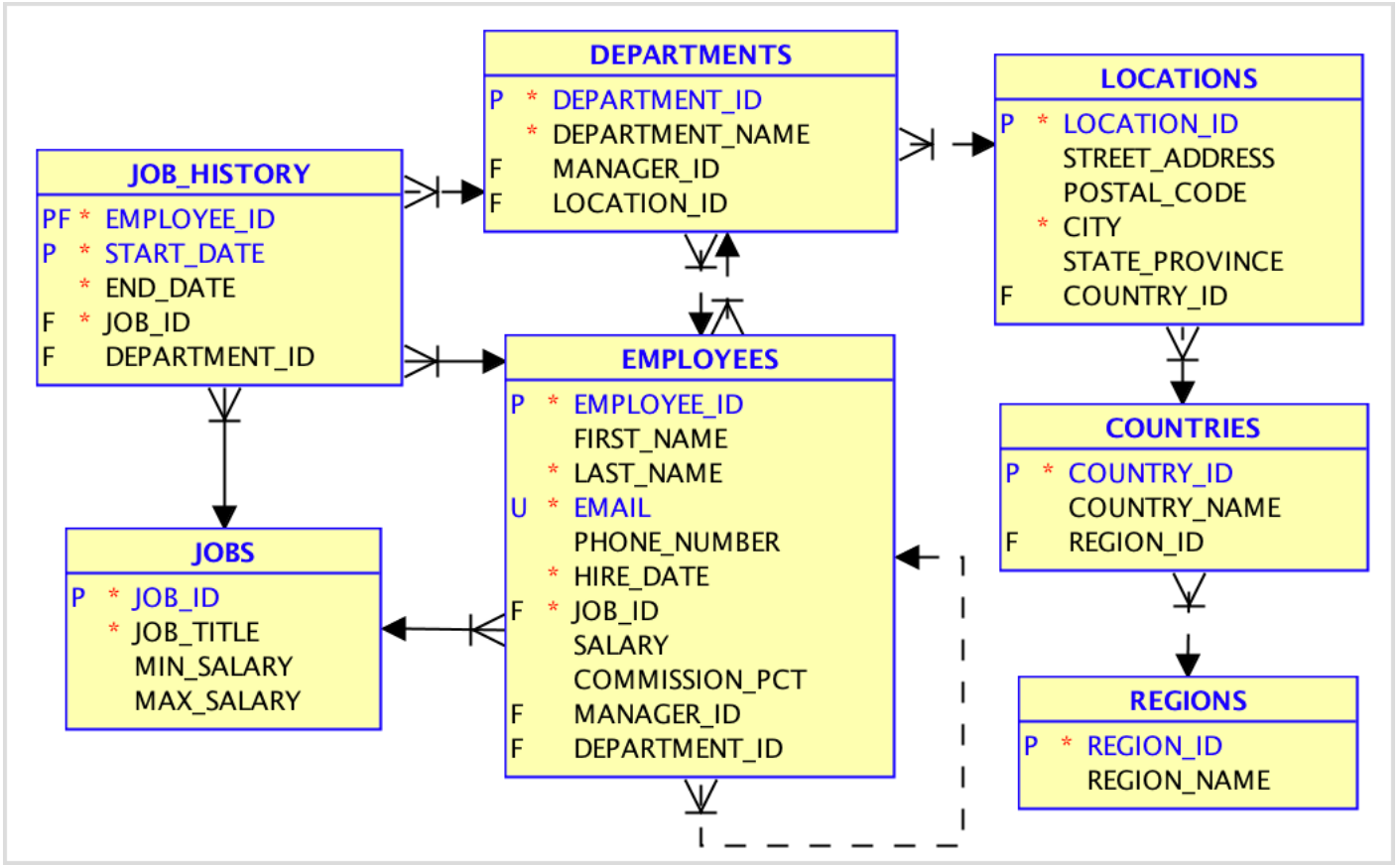
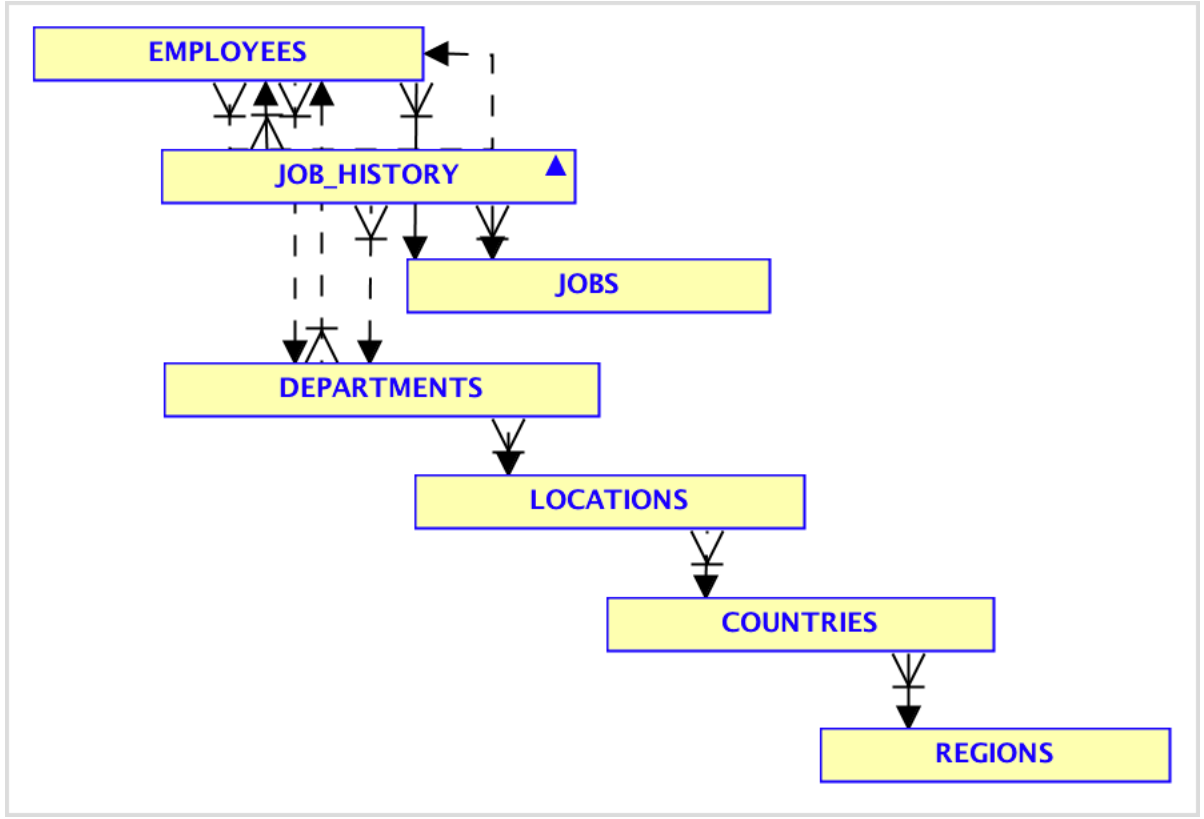
Options for creating JSON in Oracle

- Roll your own
- PL/JSON
- APEX_JSON
- ORDS
- Pick almost any language
  - Most have a driver for Oracle and features for JSON

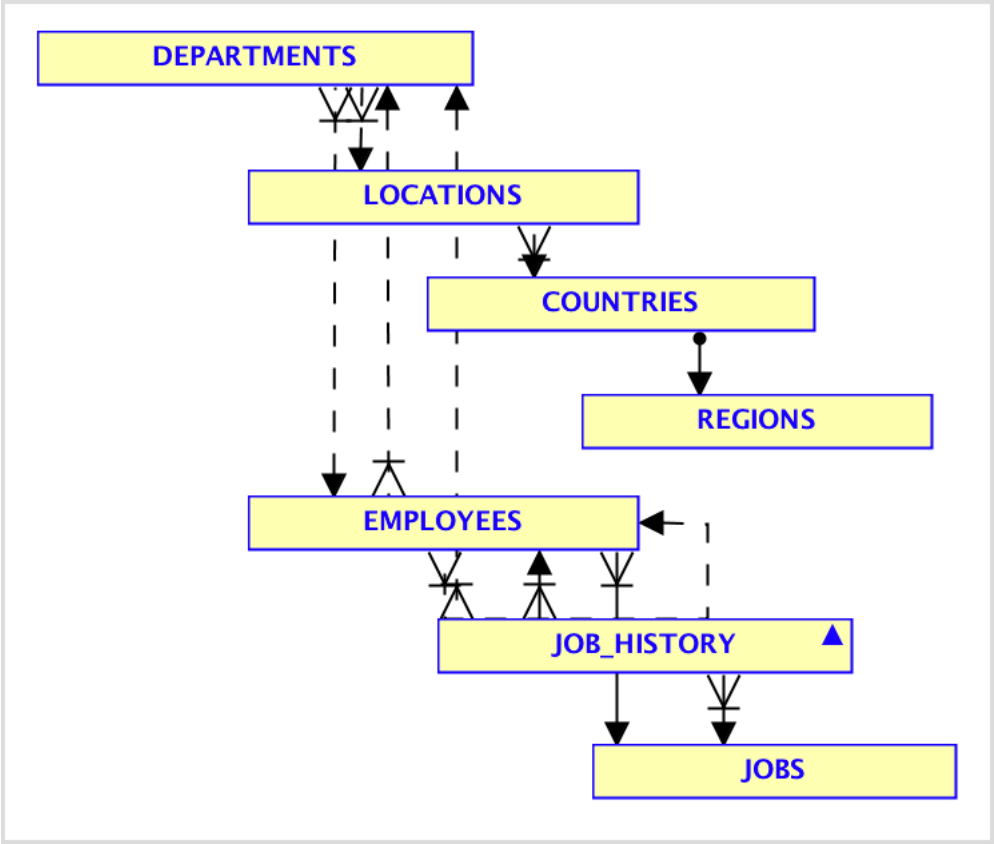
HR Schema



Traversing from employees down



Traversing from departments down



Resulting JSON


```
{
  "id": 10,
  "name": "Administration",
  "location": {
    "id": 1700,
    "streetAddress": "2004 Charade Rd",
    "postalCode": "98199",
    "country": {
      "id": "US",
      "name": "United States of America",
      "regionId": 2
    }
  },
  "manager": {
    "id": 200,
    "name": "Jennifer Whalen",
    "salary": 4400,
    "job": {
      "id": "AD_ASST",
      "title": "Administration Assistant",
      "minSalary": 3000,
      "maxSalary": 6000
    }
  },
  "employees": [
    {
      "id": 200,
      "name": "Jennifer Whalen",
      "isSenior": true,
      "commissionPct": null,
      "jobHistory": [
        {
          "id": "AD_ASST",
          "departmentId": 90,
          "startDate": "17-SEP-1995",
          "endDate": "17-JUN-2001"
        },
        {
          "id": "AC_ACCOUNT",
          "departmentId": 90,
          "startDate": "01-JUL-2002",
          "endDate": "31-DEC-2006"
        }
      ]
    }
  ]
}
```

Roll your own

- JSON is easy, I can make it myself, right?
- Strings are not escaped
  - You'd have to write an escape function
- Limited use, can only *create* JSON
  - Want to write your own parser while you're at it? ☺

PL/JSON overview

- An open source library for working with JSON in Oracle
- Object based: JSON & JSON_LIST
  - Builds up an object that can be manipulated
- Many utility functions for all kinds of things
  - A little complicated

APEX_JSON overview

- A PL/SQL package aimed at helping APEX devs working with JSON
- Not object based
  - Writes to the htp buffer by default; can redirect to a clob
- Features for creating and working with JSON
  - Easy to learn and use
- Only available with APEX 5.0

ORDS overview

- Java based server designed to enable RESTful web services
  - Creates URL to serve JSON content
- Supports SQL to JSON
  - Does have some limitations on the JSON that can be generated
  - If SQL to JSON isn't sufficient, you can still use the other options with ORDS
- Can do much more
  - REST enable tables
  - APEX Listener
  - SODA

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Options for working with JSON in Oracle

- Roll your own
- PL/JSON
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- ORDS
- Pick almost any other language
  - Most have a driver for Oracle and features for JSON
- New features in 12c

JSON features in Oracle Database 12c (12.1.0.2)

- Simple dot-notation allows for easy access to data
- Functions
  - JSON_VALUE
  - JSON_QUERY
  - JSON_TABLE
- Conditions
  - IS (NOT) JSON
  - JSON_EXISTS
  - JSON_TEXTCONTAINS

Simple dot-notation

- An easy way to get the value of keys in the document
  - All values returned as VARCHAR2(4000)
- Gotchas
  - Must add the IS JSON check constraint to the column
  - Must alias the table and use it in the SELECT clause
  - JSON keys ARE case sensitive
  - Keys must be valid SQL identifiers
  - No support for Boolean

Typical usage of JSON functions & conditions

```
1   select JSON_VALUE(),
2     JSON_QUERY()
3   from JSON_TABLE()
4   where JSON_VALUE() = ...
5     and JSON_EXISTS()
6     and JSON_TEXTCONTAINS()
```

Overview of JSON path expressions

- Example: `$.location.streetAddress`
- Allow access to JSON documents via SQL
  - An extension of JSON syntax
    - They are case sensitive
    - Add wildcards, array ranges, predicates
- Can address
  - entire document
  - scalar values
  - arrays
  - objects

Basic syntax of JSON path expressions

- Example: `$.employees[0].name`
- Context item
  - Always starts with a dollar sign (`$`), representing the document
- Object step
  - A period (`.`) followed by a key name
- Array step
  - Left bracket, index expression, followed by a right bracket
  - Examples: `[*]`, `[0]`, `[0-2]`, `[0,1, 3 to 5]`

Clauses used in JSON functions and conditions

- RETURNING Clause
  - Optional Keywords
    - PRETTY – For pretty-printed JSON
    - ASCII – For escaping non-ASCII Unicode characters
- Wrapper clauses
  - WITH WRAPPER
  - WITHOUT WRAPPER
  - WITH CONDITIONAL WRAPPER
- Error clauses

JSON_VALUE

- Returns a single scalar value from a JSON document
- Takes in 2 arguments
  - JSON column
  - JSON path expression
- Has optional modifiers to
  - Specify data types returned
  - Control error handling

JSON_QUERY

- Only returns an array or object from a JSON document
- Takes in 2 arguments
  - JSON column
  - JSON path expression
- Has optional modifiers to
  - Wrap results
  - Pretty results
  - Control error handling

JSON_EXISTS

- Returns a Boolean indicating a match of a JSON path expression
  - Allows differentiation between missing keys, null values, and empty values
- Takes in 2 arguments
  - JSON column
  - JSON path expression

JSON_TABLE

- Enables the creating of inline relational view of JSON data
  - A powerful means work with JSON using relational tools
  - Includes many options for controlling output
- Uses a driving table which contains the JSON documents
  - No need to specify a join condition, it's implicit
- Avoid joins on data created by JSON_TABLE via the same documents
  - Bring all required values through as needed

JSON_TEXTCONTAINS

- Enables full-text searching of JSON documents
- Takes in 3 arguments
  - JSON column
  - JSON path expression
  - The string to search for
- Must be used with JSON Oracle Text Index
  - CTXSYS.JSON_SECTION_GROUP

Summary

- JSON is a simple data interchange format
  - Easy to learn and use
- There are many options for creating and working with JSON in Oracle
  - Provides the simplicity of JSON with the power of Oracle Database
- Next steps
  - Read the docs JSON in Oracle Database
  - Checkout the HOL in the Database App Development VM
  - Read more about Relational to JSON in Oracle Database


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