PGDAY'17 RUSSIA

DataArt

DataArt

Technology Consulting & Solution Design

New York USA
London UK
Munich Germany
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We Help Clients Achieve Important Business Outcomes by

DataArt

- Building New Products and Services
- Modernizing and Re-engineering Legacy systems
- Consulting on New Technology Approaches
- Providing On-Demand IT
- Controlling Costs via Managed Support Services

JSON caveats

Oracle 12.1

Agenda

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1. JSON in relational storage
2. RDMS Configuration
3. Storage
4. Ingestion
5. Retrieval
6. Search
7. Maintenance
8. Fast search
9. Summary
10. Q&A session

JSON in RDBMS

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Why

- Consistency (integrity, transaction ACIDity) for storing JSON documents
- Denormalization of complex objects

What

- Logs with responses/requests received/sent during software interaction
- Configuration data, key/value user preferences
- Unstructured or semi-structured complex objects

and please forget about any analytics by JSON fields ☺

DB configuration

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- Install JSON fixes on regular base
- Retain scripts to check old issues – new fixes restores them often
- These patches MUST be installed
  1. Patch 20080249: JSON Patch Bundle 1
  2. Patch 20885778: JSON Patch Bundle 2
  3. Patch 24836374: JSON Patch Bundle 3

Oracle thinks JSON is stable now so no more dedicated JSON Bundle patches!

Fixes are inside ordinal database proactive bundle patches (Doc ID 1937782.1).

Table structure

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```
create   table json_storage_vc (
id number not null,
created_dtm timestamp not null,
json_data varchar2(4000)
--32767
-- please take into account only 3.5K are stored inline
);
```

```
create   table json_storage_cl (
id number not null,
created_dtm timestamp not null,
json_data clob
);
```

```
create   table json_storage_bl (
id number not null,
created_dtm timestamp not null,
json_data blob
);
```

```
{
    "glossary": {
        "title": "example glossary",
                "GlossDiv": {
            "title": "S",
                        "GlossList": {
                "GlossEntry": {
                    "ID": "SGML",
                                        "SortAs": "SGML",
                                        "GlossTerm": "Standard Generalized Markup Language",
                                        "Acronym": "SGML",
                                        "Abbrev": "ISO 8879:1986",
                                        "GlossDef": {
                        "para": "A meta-markup language, used to create markup languages such as DocBook.",
                                                "GlossSeeAlso": ["GML", "XML"]
                    },
                                        "GlossSee": "markup"
                }
            }
        }
    }
}
```

10000

```
SELECT  SEGMENT_NAME, ROUND(SUM(DS.BYTES) / (1024 * 1024)) AS MB
  FROM DBA_SEGMENTS DS
  WHERE SEGMENT_NAME IN ('JSON_STORAGE_VC', 'JSON_STORAGE_CL', 'JSON_STORAGE_BL')
 GROUP BY DS.TABLESPACE_NAME,
       SEGMENT_NAME;
```

ript Output | Query Result

SQL | All Rows Fetched: 3 in 0.077 seconds

	SEGMENT_NAME	MB
1	JSON STORAGE CL	16
2	JSON STORAGE VC	8
3	JSON STORAGE BL	8

UCS2

Table structure

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BLOB for JSON benefits:

- Twice less space consumption
- less I/O due less space
- No implicit character-set conversion if the database character set is not AL32UTF8

RFC 4627

3. Encoding

JSON text SHALL be encoded in Unicode. The default encoding is UTF-8.

Table structure

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```
insert into perso.json_storage
   values(
   1,
   systimestamp,
   utl_raw.cast_to_raw(
   '
{
    "widget": {
        "debug": "on",
        "window": {
            "title": "Sample Widget",
            "name": "main_window",
            "width": 500,
            "height": 500
        },
        "image": {
            "src": "Images/Sun.png",
            "name": "sun1",
            "hOffset": .250,
            "vOffset": .250,
            "alignment": "center"
        }
    }
}
   ')
   );
   1 row inserted;
   commit;
```

```
ALTER TABLE json_storage ADD CONSTRAINT ck_json CHECK (json_data IS JSON);
```

```
select *
from user_constraints
where lower(constraint_name) = 'ck_json'
```

ipt Output × | Query Result ×

SQL | All Rows Fetched: 1 in 0.481 seconds

OWNER	CONSTRAINT_NAME	CONSTRAINT_TYPE	TABLE_NAME	SEARCH_CONDITION	SEARCH_CONDITION_VC
PERSO	CK_JSON	C	JSON_STORAGE	json_data IS JSON	json_data IS JSON

```
insert into perso.json_storage
   values(
   1,
   systimestamp,
   utl_raw.cast_to_raw(
   '
{
    "widget":
   ')
   );

Error report -
SQL Error: ORA-02290: check constraint (PERSO.CK_JSON) violated
02290. 00000 -  "check constraint (%s.%s) violated"
*Cause:    The values being inserted do not satisfy the named check

*Action:   do not insert values that violate the constraint
```

Constraint works fine but JAVA still fails ☹

Table structure

39.5.2.4 About Strict and Lax JSON Syntax

The Oracle default syntax for JSON is lax. In particular: it reflects the JavaScript syntax for object fields; the Boolean and null values are not case-sensitive; and it is more permissive with respect to numerals, whitespace, and escaping of Unicode characters.

```
ALTER TABLE json_storage ADD CONSTRAINT ck_json CHECK (json_data IS JSON strict);
```

Ingestion

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- Oracle treats JSON as string – no tailored object type
- Insert works fine
- No option to update a piece of JSON

```
update json_storage a
set a.JSON_DATA.menu.id = '25'
where id = 1
```

```
Error report -
SQL Error: ORA-40557: cannot update a JSON value
```

Ingestion

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```
declare
 lStart number;
begin
 lStart := DBMS_UTILITY.get_time;

 for lCounter in 1..10000 loop
   insert into perso.json_storage
   values(
   lCounter,
   systimestamp,
   utl_raw.cast_to_raw('
                         {"menu": {
                        "id": ' || lCounter  ||',
                        "value": "File",
                        "popup": {
                          "menuitem": [
                            {"value": "New", "onclick": "CreateNewDoc()"}
                            {"value": "Open", "onclick": "OpenDoc()"},
                            {"value": "Close", "onclick": "CloseDoc()"}
                          ]
                        }
                      }}
                       '
                    )
   );
 end loop;

 DBMS_OUTPUT.put_line('Elapsed: ' ||  (DBMS_UTILITY.get_time - lStart));
end;

ALTER TABLE json_storage ADD CONSTRAINT ck_json CHECK (json_data IS JSON strict);
aLTER TABLE json_storage drop CONSTRAINT ck_json;
ALTER TABLE json_storage ADD CONSTRAINT ck_json CHECK (json_data IS JSON LAX);
aLTER TABLE json_storage drop CONSTRAINT ck_json;
ALTER TABLE json_storage ADD CONSTRAINT ck_json CHECK (json_data IS JSON with unique keys);
aLTER TABLE json_storage drop CONSTRAINT ck_json;
```

Ingestion

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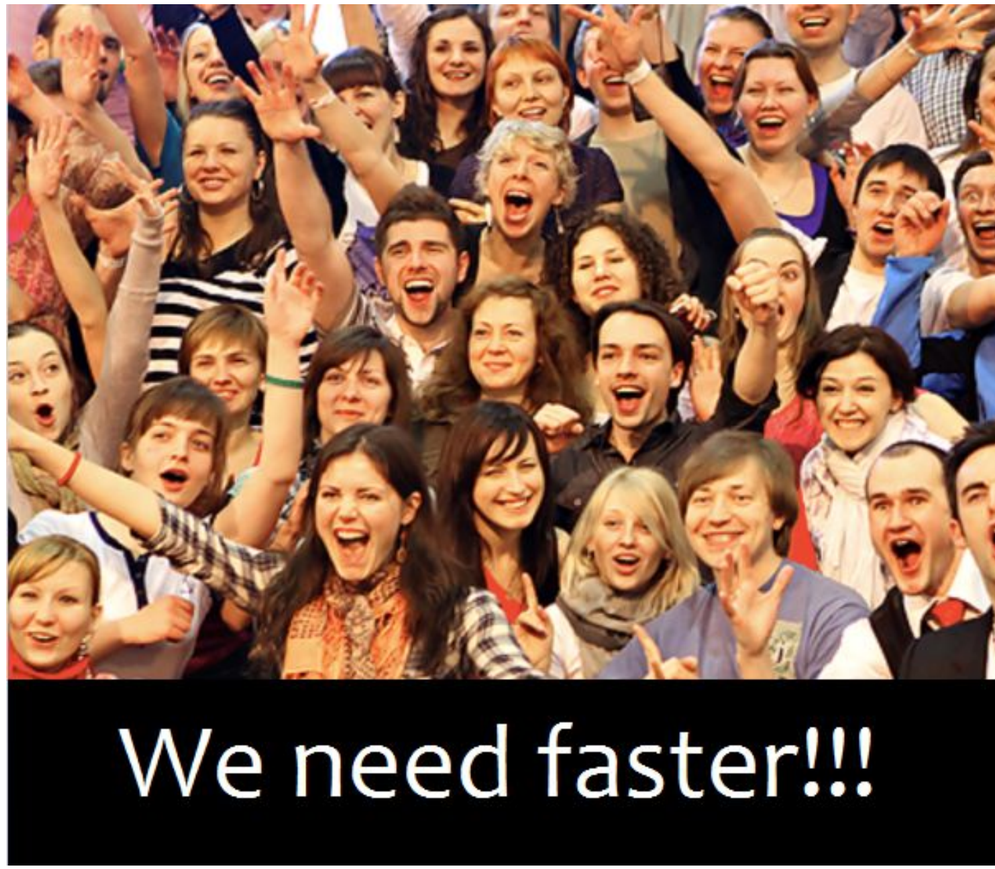
N, run	with json strict	with json lax	with json lax and unique names	without constraints
1	115	121	132	83
2	119	117	142	80
3	119	115	132	91
4	115	110	136	90
5	117	125	138	92
6	122	117	135	90
7	116	117	134	88
8	127	120	142	81
9	115	125	152	80
10	118	114	147	83
AVG	***118,3***	***118,1***	***139***	***85,8***



Ingestion

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```
select *
from user_lobs
where table_name = 'JSON_STORAGE'
```

Query Result

SQL | All Rows Fetched: 1 in 0.109 seconds

	TABLE_NAME	COLUMN_NAME	SEGMENT_NAME	TABLESPACE_NAME	INDEX_NAME	CHUNK	PCTVERSION	RETENTION	FREEPOOLS	CACHE
1	JSON_STORAGE	JSON_DATA	SYS_LOB0000099977C00003$$	USERS	SYS_IL0000099977C00003$$	8192	(null)	(null)	(null)	NO

`CACHE`	`VARCHAR2(10)`	Indicates whether and how the LOB data is to be cached in the buffer cache: • `YES` - LOB data is placed in the buffer cache • `NO` - LOB data either is not brought into the buffer cache or is brought into the buffer cache and placed at the least recently used end of the LRU list • `CACHEREADS` - LOB data is brought into the buffer cache only during read operations but not during write operations

```
select table_name, column_name
from user_lobs
where cache <> 'YES'
```

Ingestion

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N, run	with json strict	with json lax	with json lax and unique names	without constraints	with cache
1	115	121	132	83	78
2	119	117	142	80	78
3	119	115	132	91	84
4	115	110	136	90	75
5	117	125	138	92	78
6	122	117	135	90	75
7	116	117	134	88	75
8	127	120	142	81	78
9	115	125	152	80	77
10	118	114	147	83	77
AVG	***118,3***	***118,1***	***139***	***85,8***	***77,5***

Retrieval

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- Extract 1 row with raw JSON data and pass it to application server as is
- Issue SQL statement which extracts 1 row from table and parses it via Oracle JSON feature
- Create a view which encapsulates JSON treatment and extract a row from the view

Retrieval

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```
select json_data.menu.id from  json_storage
```

```
ORA-00904: "JSON_DATA"."MENU"."ID": invalid identifier
```

```
select a.json_data.menu.id from  json_storage a
```

```
ORA-00904: "A"."JSON_DATA"."MENU"."ID": invalid identifier
```

Nothing changes

```
ALTER TABLE json_storage ADD CONSTRAINT ck_json CHECK (json_data IS JSON LAX);
```

	MENU
1	25
2	26
3	27
4	28
5	29
6	30
7	31
8	32
9	33

Retrieval

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```
select json_value(json_data, '$.menu.id') id from  json_storage a
```

	ID
1	25
2	26
3	27
4	28

```
select json_value(json_data, '$.menu.id') id, json_value(json_data, '$.menu.value') val, json_value(json_data, '$.menu.popup.menuitem[0].value')val2
from  json_storage a
```

	ID	VAL	VAL2
1	25	File	New
2	26	File	New
3	27	File	New
4	28	File	New
5	29	File	New
6	30	File	New

Bad approach – each json_value function parses JSON again!

The same for .notation!

```
select a.json_data.menu.popup.menuitem[0].value from  json_storage a    ORA-00923: FROM keyword not found where expected
```

Retrieval

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Storage logic could be encapsulated inside virtual columns

```
create or replace function get_2nd_item(pJson json_storage.json_data%type) return varchar2  deterministic is
 lResult varchar2(1000);
begin
 select json_value(pJson, '$.menu.popup.menuitem[1].value')
 into lResult
 from dual;  --json_value isn't permitted in plsql

 return lResult;
end;
```

```
ALTER TABLE json_storage ADD (j_id VARCHAR2(100)
    GENERATED ALWAYS AS (JSON_VALUE(json_data, '$.menu.id' RETURNING VARCHAR2(100))))

ALTER TABLE json_storage ADD (j_item VARCHAR2(100)
    GENERATED ALWAYS AS (get_2nd_item(json_data) ))
```

```
select * from json_storage
```

	ID	CREATED_DTM	JSON_DATA	J_ITEM	J_ID
1	25	27-JUN-17 03.32.51.568262000 AM	(BLOB)	Open	25

Retrieval

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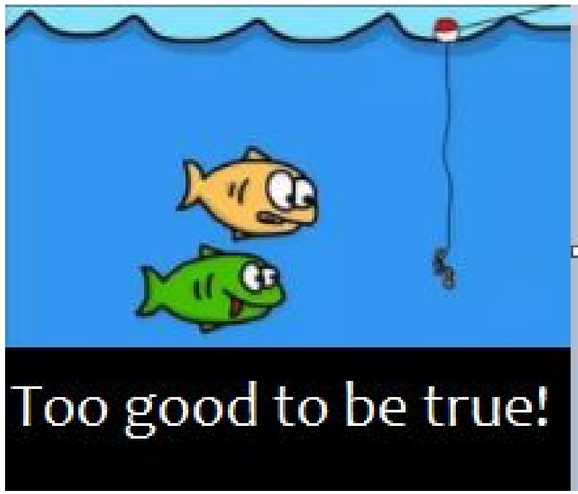
```
select s.id,
       jt.*
from json_storage s,
      JSON_TABLE(json_data, '$.menu'
         COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                  val     VARCHAR2(50 CHAR) PATH '$.value'
                 )
                ) jt
```

SQL | Fetched

	ID	CODE	VAL
1	25	25	File
2	26	26	File
3	27	27	File
4	28	28	File
5	29	29	File




```
SELECT  *
FROM  JSON_TABLE(
                 '
                  {
                   "data":[[26,"Alex",2],[17,"Tom",1],[31,"Jane",1],[18,"Dim",1]]
                  }
                 ',
                 '$.data[*]'
                 columns
                   id VARCHAR2(20) PATH '$[0]',
                   name VARCHAR2(20) PATH '$[1]',
                   type VARCHAR2(20) PATH '$[2]'
                )
```

	ID	NAME	TYPE
1	26	Alex	2
2	17	Tom	1
3	31	Jane	1
4	18	Dim	1

Retrieval

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```
select s.id,
       jt.*,
       jt2.*
from json_storage s,
      JSON_TABLE(json_data, '$.menu'
         COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                  val     VARCHAR2(50 CHAR) PATH '$.value',
                  items  varchar2(4000) format json path '$.popup.menuitem'
                 )
                ) jt,
      json_table(jt.items, '$.menu.popup.menuitem[*]'
                 columns item VARCHAR2(50 CHAR)  path '$.value'
                ) jt2
```

```
ORA-40556: unsupported chaining of JSON_TABLE
```

```
with tmp as (
  select    s.id,
            jt.*
  from json_storage s,
        JSON_TABLE(json_data, '$.menu'
           COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                    val     VARCHAR2(50 CHAR) PATH '$.value',
                    items  varchar2(4000) format json path '$.popup.menuitem'
                   )
                  ) jt
    )
   select /*+ no_merge(t)*/
          t.*
        , jt2.item
   from tmp t
      , json_table(t.items,
          '$[*]'
          columns item varchar2(50) path '$.value'
        ) jt2
```

	ID	CODE	VAL	ATTR1
1	25	25	File	New
2	25	25	File	Open
3	25	25	File	Close
4	26	26	File	New
5	26	26	File	Open
6	26	26	File	Close

Id	Operation	Name	Rows	Bytes	Cost (%CPU)	Time
0	SELECT STATEMENT		667G	1348T	2217M (1)	24:03:34
1	NESTED LOOPS		667G	1348T	2217M (1)	24:03:34
2	VIEW		81M	168G	271K (1)	00:00:11
3	NESTED LOOPS		81M	46G	271K (1)	00:00:11
4	TABLE ACCESS FULL	JSON_STORAGE	10004	5969K	238 (0)	00:00:01
5	JSONTABLE EVALUATION					
6	JSONTABLE EVALUATION					

Retrieval

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```
select s.id,
        jt.*,
        jt2.*
 from json_storage s,
       JSON_TABLE(json_data, '$.menu'
          COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                   val     VARCHAR2(50 CHAR) PATH '$.value'
                  )
                 ) jt,
       json_table(json_data, '$.menu.popup.menuitem[*]'
                  columns attr1 VARCHAR2(50 CHAR)  path '$.value'
                 ) jt2
```

	ID	CODE	VAL	ATTR1
1	25	25	File	New
2	25	25	File	Open
3	25	25	File	Close
4	26	26	File	New
5	26	26	File	Open
6	26	26	File	Close

```
-------------------------------------------------------------------------------------------
| Id  | Operation                | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT         |              |   667G|   374T|  2217M  (1)| 24:03:34 |
|   1 |  NESTED LOOPS            |              |   667G|   374T|  2217M  (1)| 24:03:34 |
|   2 |   NESTED LOOPS           |              |    81M|    46G|   271K  (1)| 00:00:11 |
|   3 |    TABLE ACCESS FULL     | JSON_STORAGE | 10004 |  5969K|   238   (0)| 00:00:01 |
|   4 |    JSONTABLE EVALUATION  |              |       |       |            |          |
|   5 |   JSONTABLE EVALUATION   |              |       |       |            |          |
-------------------------------------------------------------------------------------------
```

Retrieval

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```
select s.id,
       jt.*
from json_storage s,
      JSON_TABLE(json_data, '$.menu'
         COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                  val     VARCHAR2(50 CHAR) PATH '$.value',
                   nested    path '$.popup.menuitem[*]'  columns (
                                                          val_item  varchar2(100) path '$.value'
                                                         )
                 )
                ) jt
```

ID	CODE	VAL	ATTR1
1	25	25	File	New
2	25	25	File	Open
3	25	25	File	Close
4	26	26	File	New
5	26	26	File	Open
6	26	26	File	Close

```
-------------------------------------------------------------------------------------
| Id  | Operation              | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT       |              |    81M|    46G|   271K  (1)| 00:00:11 |
|   1 |  NESTED LOOPS          |              |    81M|    46G|   271K  (1)| 00:00:11 |
|   2 |   TABLE ACCESS FULL    | JSON_STORAGE | 10004 |  5969K|   238   (0)| 00:00:01 |
|   3 |   JSONTABLE EVALUATION |              |       |       |            |          |
-------------------------------------------------------------------------------------
```

Retrieval

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Views

1. Often become non mergable so performance degrades
2. If 2 or more *json_table* are used exception doesn't occur but results could be wrong in aggregate functions. *no_merge* hint helps sometimes.
3. *ORA-600* and *ORA-7445 No Data to be read from socket* arise in arbitrary places
4. Count(distinct <field>) fails with *ORA-7445 No Data to be read from socket.* Could be fixed by removing *group by*, adding *row_number() over (partition by <group by fields>) rn* and filtering out records where *rn <> 1*

Search

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```
select * from json_storage where json_value(json_data, '$.menu.id') = 3500

-------------------------------------------------------------------------------------
| Id  | Operation         | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |              |     1 |   622 |   241   (1)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| JSON_STORAGE |     1 |   622 |   241   (1)| 00:00:01 |
-------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(TO_NUMBER(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id'
              RETURNING VARCHAR2(4000) NULL ON ERROR))=3500)
```

```
create index json_storage_idx on json_storage (json_value(json_data, '$.menu.id' returning number ERROR on ERROR) ) ;
```

Search

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```
create  index json_storage_idx_2 on json_storage (to_number(json_value(json_data, '$.menu.id' returning varchar2(4000) null on error) )) ;

select * from json_storage where json_value(json_data, '$.menu.id') = 3500
```

```
-----------------------------------------------------------------------------------------------------
| Id  | Operation                           | Name               | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                    |                    |   600 |   364K|    22   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| JSON_STORAGE       |   600 |   364K|    22   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                  | JSON_STORAGE_IDX_2 |   240 |       |     1   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access(TO_NUMBER(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING VARCHAR2(4000)
              NULL ON ERROR))=3500)
```

```
create  index json_storage_idx_3 on json_storage (json_value(json_data, '$.menu.id' returning varchar2(4000) null on error) ) ;

select * from json_storage where json_value(json_data, '$.menu.id') = '3500'
```

```
-----------------------------------------------------------------------------------------------------
| Id  | Operation                           | Name               | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                    |                    |   600 |   364K|    61   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| JSON_STORAGE       |   600 |   364K|    61   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                  | JSON_STORAGE_IDX_3 |   240 |       |     1   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING VARCHAR2(4000) NULL ON
              ERROR)='3500')
```

Search

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```
select * from json_storage a where a.json_data.menu.id = 3500

-------------------------------------------------------------------------------
| Id  | Operation         | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |              |     1 |   622 |   241   (1)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| JSON_STORAGE |     1 |   622 |   241   (1)| 00:00:01 |
-------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(TO_NUMBER(JSON_QUERY("A"."JSON_DATA" FORMAT JSON ,
              '$.menu.id' RETURNING VARCHAR2(4000) ASIS  WITHOUT ARRAY WRAPPER NULL ON
              ERROR))=3500)

select * from json_storage a where a.json_data.menu.id = '3500'
-------------------------------------------------------------------------------
| Id  | Operation         | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |              |     1 |   622 |   241   (1)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| JSON_STORAGE |     1 |   622 |   241   (1)| 00:00:01 |
-------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(JSON_QUERY("A"."JSON_DATA" FORMAT JSON , '$.menu.id'
              RETURNING VARCHAR2(4000) ASIS  WITHOUT ARRAY WRAPPER NULL ON
              ERROR)='3500')
```

Separate indexes should be created for .notation?

Search

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```
create index json_storage_idx on json_storage (json_data.menu.id)      ORA-15179: missing or invalid alias name

create index json_storage_idx_2 on json_storage j (j.json_data.menu.id) ;

select * from json_storage a where a.json_data.menu.id = '3500'
```

```
-------------------------------------------------------------------------------------------------------
| Id  | Operation                             | Name              | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                      |                   |   600 |   364K|     61   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| JSON_STORAGE      |   600 |   364K|     61   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                    | JSON_STORAGE_IDX |   240 |       |      1   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access(JSON_QUERY("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING VARCHAR2(4000) ASIS
              WITHOUT ARRAY WRAPPER NULL ON ERROR)='3500')
```

Search

DataArt

```
create  index json_storage_idx_4 on json_storage (json_value(json_data, '$.menu.id' returning varchar2(4000) error on error) ) ;
```

```
select * from json_storage a where a.json_data.menu.id = '3500'
```

```
-------------------------------------------------------------------------------------------------------
| Id  | Operation                           | Name               | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                    |                    |   100 | 63200 |    12   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| JSON_STORAGE       |   100 | 63200 |    12   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                  | JSON_STORAGE_IDX_4 |    40 |       |     1   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING VARCHAR2(4000) ERROR ON
              ERROR)='3500')
```

Query rewrite

```
2 - access(JSON_QUERY("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING VARCHAR2(4000) ASIS
           WITHOUT ARRAY WRAPPER NULL ON ERROR)='3500')
```

Search

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Use index side effect – create JSON validation

```
create index json_storage_idx_4 on json_storage (json_value(json_data, '$.menu.id' returning number ERROR on ERROR) ) ;

insert into perso.json_storage
   values(
   -2,
   systimestamp,
   utl_raw.cast_to_raw('
                         {"menu": {
                        "id": "' || '1a'  ||'",
                        "value": "File",
                        "popup": {
                          "menuitem": [
                            {"value": "New", "onclick": "CreateNewDoc()"},
                            {"value": "Open", "onclick": "OpenDoc()"},
                            {"value": "Close", "onclick": "CloseDoc()"}
                          ]
                        }
                      }}
                       '
                    )
   );
```

Validator ☺

ORA-01722: invalid number

Search

DataArt

Multiple columns indexing

```
create index json_storage_idx
on json_storage (json_value(json_data, '$.menu.id' returning varchar2(100) null on error),
                 json_value(json_data, '$.menu.value'  returning varchar2(100)  null on error)
                );

select *
from json_storage
where json_value(json_data, '$.menu.id' returning varchar2(100) ) = '2000'
      and json_value(json_data, '$.menu.value' returning varchar2(100) ) = 'File'
```


```
-------------------------------------------------------------------------------------------------------
| Id  | Operation                           | Name             | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                    |                  |    36 | 22392 |    10   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| JSON_STORAGE     |    36 | 22392 |    10   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                  | JSON_STORAGE_IDX |    36 |       |     1   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING VARCHAR2(100) NULL ON
              ERROR)='2000' AND JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.value' RETURNING VARCHAR2(100)
              NULL ON ERROR)='File')
```

Search

DataArt

```
ALTER TABLE json_storage ADD (j_id VARCHAR2(100)
  GENERATED ALWAYS AS (JSON_VALUE(json_data, '$.menu.id' RETURNING VARCHAR2(100))));

ALTER TABLE json_storage ADD (j_value VARCHAR2(100)
  GENERATED ALWAYS AS (JSON_VALUE(json_data, '$.menu.value' RETURNING VARCHAR2(100))));


CREATE INDEX json_storage_c_idx ON json_storage (j_id, j_value);


select * from json_storage  where j_id = '2000' and j_value = 'File'
```

```
-----------------------------------------------------------------------------------------------------
| Id  | Operation                            | Name               | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT                     |                    |    36 | 22392 |    10   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID BATCHED| JSON_STORAGE       |    36 | 22392 |    10   (0)| 00:00:01 |
|*  2 |   INDEX RANGE SCAN                   | JSON_STORAGE_C_IDX |    36 |       |     1   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access("J_ID"='2000' AND "J_VALUE"='File')
```

```
select column_name, c.data_type from dba_tab_cols c where lower(table_name) = 'json_storage' and virtual_column = 'YES'
```

	COLUMN_NAME	DATA_TYPE
1	SYS_NC00006$	VARCHAR2
2	SYS_NC00005$	VARCHAR2
3	SYS_NC00004$	NUMBER

Search

DataArt

```
select s.*,
       jt.*
from json_storage s,
      JSON_TABLE(json_data, '$.menu'
         COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                  val     VARCHAR2(50 CHAR) PATH '$.value'
                 )
                ) jt
where jt.code = '3500'
```

```
-------------------------------------------------------------------------------------
| Id  | Operation              | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT       |              |  4901K|  2926M|  1632K  (1)| 00:01:04 |
|   1 |  NESTED LOOPS          |              |  4901K|  2926M|  1632K  (1)| 00:01:04 |
|   2 |   TABLE ACCESS FULL    | JSON_STORAGE | 60005 |    35M|   238   (0)| 00:00:01 |
|*  3 |   JSONTABLE EVALUATION |              |       |       |            |          |
-------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   3 - filter("P"."CODE"='3500')
```

Search

DataArt

```
CREATE  INDEX json_fts_idx  ON json_storage (json_data)  INDEXTYPE IS CTXSYS.CONTEXT    PARAMETERS ('section group CTXSYS.JSON_SECTION_GROUP')
```

```
select JSON_VALUE(json_data, '$.menu.id')  from json_storage  where json_textcontains(json_data, '$.menu.id', '10')
```

```
-----------------------------------------------------------------------------------------
| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |              |     1 |   619 |    20   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   619 |    20   (0)| 00:00:01 |
|*  2 |   DOMAIN INDEX               | JSON_FTS_IDX |       |       |    20   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access("CTXSYS"."CONTAINS"("JSON_STORAGE"."JSON_DATA",'10
              INPATH(/menu/id)')>0)
```

```
select *  from json_storage  where JSON_value(json_data, '$.menu.id') = '10'
```

```
-----------------------------------------------------------------------------------------
| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |              |     1 |   632 |    20   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   632 |    20   (0)| 00:00:01 |
|*  2 |   DOMAIN INDEX               | JSON_FTS_IDX |       |       |    20   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING
              VARCHAR2(4000) NULL ON ERROR)='10')
   2 - access("CTXSYS"."CONTAINS"("JSON_STORAGE"."JSON_DATA",'{10}
              INPATH(/menu/id)')>0)
```

```
select *  from json_storage  where JSON_exists(json_data, '$.menu.id')
```

```
-----------------------------------------------------------------------------------------
| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |              |  1399 |  863K|   413   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |  1399 |  863K|   413   (0)| 00:00:01 |
|*  2 |   DOMAIN INDEX               | JSON_FTS_IDX |       |       |   100   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access("CTXSYS"."CONTAINS"("JSON_STORAGE"."JSON_DATA",'HASPATH(/menu/id)')>0)
```

Search

DataArt

```
select s.*,
       jt.*
 from json_storage s,
      JSON_TABLE(json_data, '$.menu'
         COLUMNS (code    VARCHAR2(50 CHAR) PATH '$.id',
                  val     VARCHAR2(50 CHAR) PATH '$.value'
                 )
                ) jt
 where jt.code = '10'
```

```
-------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |    11 |  6996 |    49   (0)| 00:00:01 |
|   1 |  NESTED LOOPS                 |              |    11 |  6996 |    49   (0)| 00:00:01 |
|   2 |   TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   632 |    20   (0)| 00:00:01 |
|*  3 |    DOMAIN INDEX               | JSON_FTS_IDX |       |       |    20   (0)| 00:00:01 |
|*  4 |   JSONTABLE EVALUATION        |              |       |       |            |          |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   3 - access("CTXSYS"."CONTAINS"("S"."JSON_DATA",'{10} INPATH(/menu/id)')>0)
   4 - filter("P"."CODE"='10')
```

```
select * from json_storage where JSON_value(json_data, '$.menu.id') = '1' and JSON_value(json_data, '$.menu.value') = 'File'
```

```
-----------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |     1 |   632 |    75   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   632 |    75   (0)| 00:00:01 |
|*  2 |   DOMAIN INDEX                | JSON_FTS_IDX |       |       |    75   (0)| 00:00:01 |
-----------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(JSON_VALUE("JSON_DATA" FORMAT JSON , '$.menu.id' RETURNING
              VARCHAR2(4000) NULL ON ERROR)='1' AND JSON_VALUE("JSON_DATA" FORMAT JSON ,
              '$.menu.value' RETURNING VARCHAR2(4000) NULL ON ERROR)='File')
   2 - access("CTXSYS"."CONTAINS"("JSON_STORAGE"."JSON_DATA",'({1}
              INPATH(/menu/id)) and ({File} INPATH(/menu/value))')>0)
```

Search

DataArt

```
select *  from json_storage j where j.json_data.menu.id = '10'

-------------------------------------------------------------------------------------
| Id  | Operation         | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |              |     1 |   632 |   239   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| JSON_STORAGE |     1 |   632 |   239   (0)| 00:00:01 |
-------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(JSON_QUERY("J"."JSON_DATA" FORMAT JSON , '$.menu.id'
              RETURNING VARCHAR2(4000) ASIS  WITHOUT ARRAY WRAPPER NULL ON ERROR)='10')
```

. notation is not supported again!

Search

DataArt

```
insert into json_storage(id, created_dtm, json_data) values(1, systimestamp, utl_raw.cast_to_raw('{"values":"RS_485"}'))

select *  from json_storage  where JSON_TEXTCONTAINS(json_data, '$.values', 'RS_485')
```

= 0

```
select * from json_storage  where JSON_TEXTCONTAINS(json_data, '$.values', 'RS') and JSON_TEXTCONTAINS(json_data, '$.values', '485')

-------------------------------------------------------------------------------------------
| Id  | Operation                    | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT             |              |     1 |   632 |    39   (0)| 00:00:01 |
|   1 |  TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   632 |    39   (0)| 00:00:01 |
|*  2 |   DOMAIN INDEX               | JSON_FTS_IDX |       |       |    39   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - access("CTXSYS"."CONTAINS"("JSON_STORAGE"."JSON_DATA",'(RS INPATH(/values))
              and (485 INPATH(/values))')>0)
```

2 different tokens

= 1

```
select *  from json_storage where JSON_TEXTCONTAINS(json_data, '$.values', '{RS_485}')
```

All Oracle text reserved words - https://docs.oracle.com/database/121/CCREF/cqspcl.htm#CCREF2091

Search

DataArt


```
{
 "class":[
          {
           "class_type":"ownership",
           "values":[{"nm":"id","value":"1"}]
          },
          {
           "class_type":"country",
           "values":[{"nm":"id","value":"640"}]
          },
          ,
          {
           "class_type":"features",
           "values":[{"nm":"id","value":"15"},{"nm":"id","value":"20"}]
          }
         ]
}
```

```
{
 "class":[
          {
           "class_type":"ownership",
           "values":[{"nm":"id","value":"18"}]
          },
          {
           "class_type":"country",
           "values":[{"nm":"id","value":"11"}]
          },
          ,
          {
           "class_type":"features",
           "values":[{"nm":"id","value":"7"},{"nm":"id","value":"640"}]
          }
         ]
}
```

Search

DataArt

```
select *
from json_storage
where JSON_TEXTCONTAINS(json_data, '$.class.values.value', '640')
      and JSON_TEXTCONTAINS(json_data, '$.class.class_type', 'country')

select *
from perso.json_storage
where ctxsys.contains(json_data, '(640 INPATH(/class/values/value)) and (country inpath (/class/class_type))')>0
```

	ID	JS
1	-100	(BLOB)
2	-200	(BLOB)

```
select s.id,
        jt.*
 from json_storage s,
       JSON_TABLE(json_data, '$.class[*]'
          COLUMNS (class_type    VARCHAR2(50 CHAR) PATH '$.class_type',
                   nested path '$.values.value' columns(val     VARCHAR2(50 CHAR) PATH '$')
                  )
                 ) jt
 where s.id in (-100, -200)
       and class_type = 'country'
       and val = '640'
```

ID	CLASS_TYPE	VAL
-100	country	640

```
-----------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |     1 |   627 |   126   (0)| 00:00:01 |
|   1 |  NESTED LOOPS                 |              |     1 |   627 |   126   (0)| 00:00:01 |
|*  2 |   TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   623 |    97   (0)| 00:00:01 |
|*  3 |    DOMAIN INDEX               | JSON_FTS_IDX |       |       |    97   (0)| 00:00:01 |
|*  4 |   JSONTABLE EVALUATION        |              |       |       |            |          |
-----------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   2 - filter("S"."ID"=(-200) OR "S"."ID"=(-100))
   3 - access("CTXSYS"."CONTAINS"("S"."JSON_DATA",'({country}
              INPATH(/class/class_type)) and ({640} INPATH(/class/values/value))')>0)
   4 - filter("P"."CLASS_TYPE"='country' AND "P"."VAL"='640')
```

Search

DataArt

```
select ID, json_data
from json_storage
where JSON_EXISTS(json_data,'$.class?(@.values.value == $VALUE && @.class_type == $TYPE)' passing '640' as "VALUE", 'features' as "TYPE")
```

filter

Anchor Inside one object

	ID	JS
1	-200	(BLOB)

```
-------------------------------------------------------------------------------------------
| Id  | Operation                     | Name         | Rows  | Bytes | Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |              |     1 |   623 |    97   (0)| 00:00:01 |
|*  1 |  TABLE ACCESS BY INDEX ROWID| JSON_STORAGE |     1 |   623 |    97   (0)| 00:00:01 |
|*  2 |   DOMAIN INDEX                | JSON_FTS_IDX |       |       |    97   (0)| 00:00:01 |
-------------------------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter(JSON_EXISTS2("JSON_DATA" FORMAT JSON , '$.class?(@.values.value ==
              $VALUE && @.class_type == $TYPE)' FALSE ON ERROR)=1)
   2 - access("CTXSYS"."CONTAINS"("JSON_STORAGE"."JSON_DATA",'{640} INPATH
              (/class/values/value) and {features} INPATH (/class/class_type)')>0)
```

Ingestion

DataArt

```
insert into json_storage(id, created_dtm, json_data)
   values(
   -1000,
   systimestamp,
   utl_raw.cast_to_raw('
                         {"menu": {
                        "id": "' || '888888888'  ||'",
                        "value": "File",
                        "popup": {
                          "menuitem": [
                            {"value": "New", "onclick": "CreateNewDoc()"},
                            {"value": "Open", "onclick": "OpenDoc()"},
                            {"value": "Close", "onclick": "CloseDoc()"}
                          ]
                        }
                      }}
                       '
                    )
   );
```

```
select count(*)
from json_storage
where json_textcontains(json_data, '$.menu.id', '888888888')
```

= 0

```
begin
 ctx_ddl.SYNC_INDEX('PERSO.json_fts_idx'); --schema inside :)
end;
```

```
select count(*)
from json_storage
where json_textcontains(json_data, '$.menu.id', '888888888')
```

= 1

Ingestion

DataArt

```
select i.idx_sync_interval, idx_sync_type, i.*
from ctxsys.CTX_INDEXES i
where idx_table = 'JSON_STORAGE'
```

	IDX_SYNC_INTERVAL	IDX_SYNC_TYPE	IDX_ID	IDX_OWNER	IDX_NAME	IDX_TABLE_OWNER	IDX_TABLE
1	(null)	(null)	1441	PERSO	JSON FTS IDX	PERSO	JSON STORAGE

```
begin
 CTX_DDL.REPLACE_INDEX_METADATA('PERSO.json_fts_idx', 'REPLACE METADATA SYNC (ON COMMIT)'); --wtf so many metadata????
end;
```

	IDX_SYNC_INTERVAL	IDX_SYNC_TYPE	IDX_ID	IDX_OWNER	IDX_NAME	IDX_TABLE_OWNER	IDX_TABLE
1	(null)	ON COMMIT	1441	PERSO	JSON FTS IDX	PERSO	JSON STORAGE

```
select count(*)
from json_storage
where json_textcontains(json_data, '$.menu.id', '888888888')
```

= 0

```
commit;
```

```
select count(*)
from json_storage
where json_textcontains(json_data, '$.menu.id', '888888888')
```

= 1

Ingestion

DataArt

```
declare
 lStart number;
begin
 lStart := DBMS_UTILITY.get_time;

 for lCounter in 1..10000 loop
   insert into perso.json_storage
   values(
   lCounter,
   systimestamp,
   utl_raw.cast_to_raw('
                         {"menu": {
                        "id": ' || lCounter ||',
                        "value": "File",
                        "popup": {
                          "menuitem": [
                            {"value": "New", "onclick": "CreateNewDoc()"},
                            {"value": "Open", "onclick": "OpenDoc()"},
                            {"value": "Close", "onclick": "CloseDoc()"}
                          ]
                        }
                      }}
                       '
                    )
   );
   commit;
 end loop;

 DBMS_OUTPUT.put_line('Elapsed: ' ||   (DBMS_UTILITY.get_time - lStart));
 commit;
end;
```

Execution time: ~125 seconds

```
begin ctxsys.drvdml.com_sync_index(:idxname, :idxmem, :partname);
```

Ingestion

DataArt

```
begin
 CTX_DDL.REPLACE_INDEX_METADATA('PERSO.json_fts_idx', 'REPLACE METADATA SYNC (EVERY "SYSDATE+1/24/60")');
end;

select i.idx_sync_interval, idx_sync_type, idx_sync_jobname, i.*
from ctxsys.CTX_INDEXES i
where idx_table = 'JSON_STORAGE'
```

	IDX_SYNC_INTERVAL	IDX_SYNC_TYPE	IDX_SYNC_JOBNAME	IDX_ID	IDX_OWNER	IDX_NAME	IDX_TABLE_OWNER	IDX_TABLE
1	SYSDATE+1/24/60	AUTOMATIC	DR$JSON FTS IDX$J	1441	PERSO	JSON FTS IDX	PERSO	JSON STORAGE

```
select job_name, job_type, job_action, repeat_interval from dba_scheduler_jobs where owner = 'PERSO'
```

JOB_NAME	JOB_TYPE	JOB_ACTION	REPEAT_INTERVAL
DR$JSON FTS IDX$J	PLSQL BLOCK	ctxsys.drvdml.auto sync index('JSON FTS IDX', 67108864, NULL, NULL, NULL, 0);	SYSDATE+1/24/60

```
declare
 lStart number;
begin
 lStart := DBMS_UTILITY.get_time;

 for lCounter in 1..10000 loop
   insert into perso.json_storage
   values(
   lCounter,
   systimestamp,
   utl_raw.cast_to_raw('
                        {"menu": {
                       "id": ' || lCounter ||',
                       "value": "File",
                       "popup": {
                         "menuitem": [
                           {"value": "New", "onclick": "CreateNewDoc()"},
                           {"value": "Open", "onclick": "OpenDoc()"},
                           {"value": "Close", "onclick": "CloseDoc()"}
                         ]
                       }
                     }}
                      '
                    )
   );
   commit;
 end loop;

 DBMS_OUTPUT.put_line('Elapsed: ' ||  (DBMS_UTILITY.get_time - lStart));
 commit;
end;
```

Execution time: ~7 seconds

Refresh job execution time: ~4 seconds

Ingestion

DataArt

```
drop INDEX json_fts_idx force;

CREATE drop INDEX json_fts_idx force  ON json_storage (json_data)  INDEXTYPE IS CTXSYS.CONTEXT
PARAMETERS ('section group CTXSYS.JSON_SECTION_GROUP SYNC (EVERY "SYSDATE+1/24") TRANSACTIONAL') ;

declare
 lStart number;
begin
 lStart := DBMS_UTILITY.get_time;

 for lCounter in 1..10000 loop
   insert into perso.json_storage
   values(
   lCounter,
   systimestamp,
   utl_raw.cast_to_raw('
                         {"menu": {
                        "id": ' || lCounter ||',
                        "value": "File",
                        "popup": {
                          "menuitem": [
                            {"value": "New", "onclick": "CreateNewDoc()"},
                            {"value": "Open", "onclick": "OpenDoc()"},
                            {"value": "Close", "onclick": "CloseDoc()"}
                          ]
                        }
                      }}
                       '
                    )
   );
   --commit;
 end loop;

 DBMS_OUTPUT.put_line('Elapsed: ' ||  (DBMS_UTILITY.get_time - lStart));

end;
```

Execution time: ~8 seconds

Ingestion

DataArt

```
select count(*)  from json_storage  where json_textcontains(json_data, '$.menu.id', '1') ;
```
= 0

```
select count(*)  from json_storage   where contains(json_data, '1 INPATH(/menu/id)') >0;
```
= 0

```
commit;
```

```
select count(*)  from json_storage  where json_textcontains(json_data, '$.menu.id', '1') ;
```
= 0

```
select count(*)  from json_storage   where contains(json_data, '1 INPATH(/menu/id)') >0;
```
= 0


```
select count(*) from json_storage where contains(json_data, '1') >0;
```
= 1

TRANSACTIONAL doesn't work for sections! Only for tokens!

Ingestion

DataArt

```
begin
 ctx_ddl.create_preference('PERSO_STORE', 'BASIC_STORAGE');
 ctx_ddl.set_attribute('PERSO_STORE', 'STAGE_ITAB', 'YES');
end;
```

```
create index  json_fts_idx on json_storage (json_data)
indextype is ctxsys.context PARAMETERS ('section group CTXSYS.JSON_SECTION_GROUP storage PERSO_STORE sync (on commit)')
```

```
begin
 ctx_ddl.add_auto_optimize('json_fts_idx'); --to move data async
end;
```

```
select owner, job_name, program_name,last_start_date,state from dba_scheduler_jobs where owner='CTXSYS';
```

OWNER	JOB_NAME	PROGRAM_NAME	LAST_START_DATE	STATE
CTXSYS	DR$BGOPTJOB	DR$BGOPTPRG	25-JUN-17 11.04.15.128537000 AM AMERICA/NEW YORK	SUCCEEDED

```
select table_name from dba_tables where table_name like '%$G%' and owner = 'PERSO'
```

	TABLE_NAME
1	DR$JSON_FTS_IDX$G

Ingestion

DataArt

```
declare
 lStart number;
begin
 lStart := DBMS_UTILITY.get_time;

 for lCounter in 1..10000 loop
  insert into perso.json_storage
  values(
  lCounter,
  systimestamp,
  utl_raw.cast_to_raw('
                        {"menu": {
                       "id": ' || lCounter ||',
                       "value": "File",
                       "popup": {
                         "menuitem": [
                           {"value": "New", "onclick": "CreateNewDoc()"},
                           {"value": "Open", "onclick": "OpenDoc()"},
                           {"value": "Close", "onclick": "CloseDoc()"}
                         ]
                       }
                     }}
                      '
                   )
  );
  --commit;
 end loop;

 DBMS_OUTPUT.put_line('Elapsed: ' ||  (DBMS_UTILITY.get_time - lStart));
 commit;
end;
```

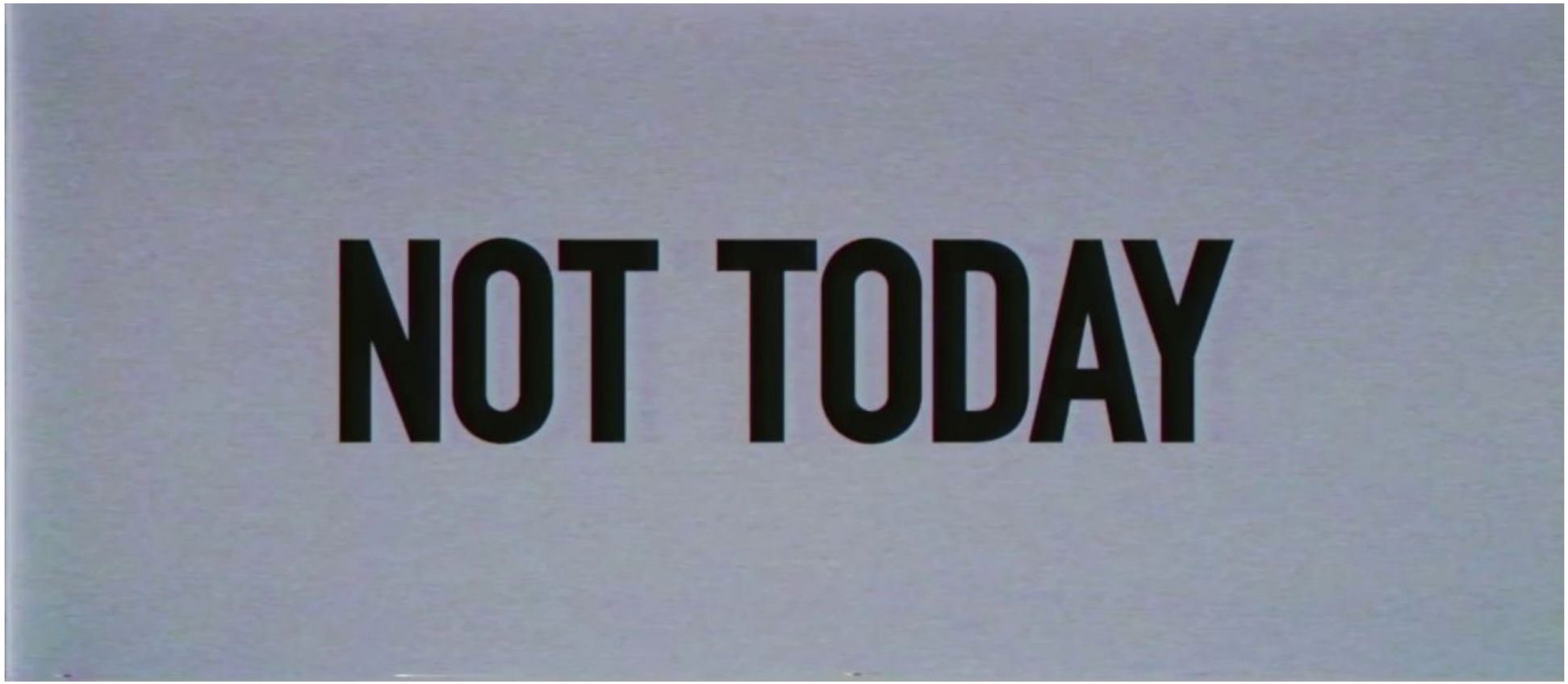
Execution time: ~6 seconds

```
select job_name, log_date, run_duration
from dba_scheduler_job_run_details r
where owner='CTXSYS'
order by log_date desc;
```

	JOB_NAME	LOG_DATE	RUN_DURATION
1	DR$BGOPTJOB	26-JUN-17 08.45.39.069395000 AM -04:00	+00 00:00:01.000000
2	DR$BGOPTJOB	26-JUN-17 08.43.19.174367000 AM -04:00	+00 00:00:00.000000

Fast search

DataArt



Follow DataArt ITTalks on https://dataart.ru/events

Maintenance

DataArt

Pos/prefix columns with JSON data via _JSON like *INVOICE_JSON* before.

- Create daily checks
  1. If you need control JSON format (strict/lax) use *dba_tab_columns* and *all_json_columns* views to check JSON constrains
  2. If you need insert performance check *dba_lobs* to check *cache* attribute
- Check CONTEXT indexes are in proper state

Maintenance

DataArt

Provide regular indexes optimization

1. Collect fragmented indexes (*estimated row fragmentation*)
2. Collect indexes with many deleted rows (*estimated garbage size*)
3. Run *ctx_ddl.optimize_index* in FULL mode (SERIAL or PARALLEL)

```
declare
 lXML clob;
 lOffset number := 0;
begin
   ctx_report.index_stats('json_fts_idx', lXML, frag_stats => true, report_format => 'XML');
end;
```

```
<STAT_FRAG_STATS>
    <STAT_STATISTIC NAME="total size of $I data">3,810,329 (3.63 MB)</STAT_STATISTIC>
    <STAT STATISTIC NAME="$I rows">31,069</STAT STATISTIC>
    <STAT_STATISTIC NAME="estimated row fragmentation">65 %</STAT_STATISTIC>
    <STAT_STATISTIC NAME="garbage docids">0</STAT_STATISTIC>
    <STAT_STATISTIC NAME="estimated garbage size">0</STAT_STATISTIC>
```

```
begin
 ctx_ddl.optimize_index('json_fts_idx', CTX_DDL.OPTLEVEL_FULL);
end;
```

Conclusion

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- JSON is always tradeoff between performance/data treatment convenience/integrity
- Indexing strategy should be checked very careful you use 2 notations especially
- JSON treatment is acceptable in row-per-row scenario
- JSON features are still non-stable
- Oracle fails with JSON more 2 Mb very often
- Current implementation doesn’t look like “document-stored” DB
- Tailored search solutions bring better performance

and we are waiting Oracle 12.2 ☺

Q&A

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THANK YOU.
WE ARE HIRING!

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