JSON Data

- JavaScript Object Notation (JSON) data interchange format: RFC 7159

- Data formatted in JavaScript syntax

- Basic elements:

  - Object {"key": "value", "key2": "value"}

  - List ["string", 5, 6.24, true, "other string"]

  - Atomics "string", 5, 2.64, true, false, null

IETF RFC 7159: The JavaScript Object Notation (JSON) Data Interchange Format

JSON Data: Example

```
[
  {
    "id": "usajobs:377106500",
    "url": "https://www.usajobs.gov/GetJob/ViewDetails/377106500",
    "maximum": 254848,
    "minimum": 98000,
    "end_date": "2015-07-29",
    "locations": ["San Francisco, CA", "Washington, DC"],
    "start_date": "2014-07-31",
...
  },
  {
    "id": "usajobs:382608000",
    "url": "https://www.usajobs.gov/GetJob/ViewDetails/382608000",
...
  },
...
]
```

USAJobs: http://api.usa.gov/jobs/search.json?lat_lon=37.783333,-122.416667&query=full-time+positions&size=100&from=0

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But... Analysis Data

- As a data analyst/scientist/hacker/..., we often want tabular analysis data

- JSON format is convenient for API responses, but not usually for analysis

- Somehow, we need to munge that data into a clean table (often lots of work)

- PostgreSQL adds JSON processing to the already available relational model (unlike other relational dbms with json)

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Now, to the DataBase!

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- For this, we'll be looking at PostgreSQL version 9.4 (Released Dec 18, 2014)

- PostgreSQL adds extensions to SQL for JSON manipulation

- JSON is supported via column types

  - json (text, for fast inserts; 9.2, improved in 9.3)

  - jsonb (binary, indexable, for fast reads; 9.4)

- Other databases do this differently!

Review: Relational Data

- Relational data is organized in tables consisting of columns and rows

- Fields (columns) consist of a column name and data type constraint

- Records (rows) in a table have a common field (column) structure and order

- Records (rows) are linked across tables by key fields

Relational Data Model: Codd, Edgar F. "A Relational Model of Data for Large Shared Data Banks" (1970)

SQL: Working with Objects

- Data Definition Language (DB Objects)
  - CREATE (table, index, view, function, …)
  - ALTER (table, index, view, function, …)
  - DROP (table, index, view, function, …)

SQL: Working with Rows

- Query Language (Records)

  - SELECT ... FROM ...

  - INSERT INTO ...

  - UPDATE ... SET ...

  - DELETE FROM ...

JSON in PostgreSQL

```
CREATE TABLE my_raw_api_data (
   response      JSON, /* or JSONB */
   captured_at   TIMESTAMP WITH TIME ZONE
                 NOT NULL
                 DEFAULT CURRENT_TIMESTAMP,
   captured_by   CHARACTER VARYING
                 NOT NULL
                 DEFAULT CURRENT_USER
);
```

JSON in PostgreSQL

```
/* Note specified column list: default
   values used for everything else.     */


COPY my_raw_api_data (response)
FROM PROGRAM
  'curl "http://api.usa.gov/jobs/..."';


SELECT response, captured_at, captured_by
FROM my_raw_api_data;
```

JSON Operators

```
/* Field 'a' of object j */
SELECT j->'a' FROM my_table; /* json return */
SELECT j->>'a' FROM my_table; /* text return */


/* Second element of list j (zero indexed) */
SELECT j->1 FROM my_table; /* json return */
SELECT j->>1 FROM my_table; /* text return */


/* Walk object j along specified path */
SELECT j#>'{a,1,b}' FROM my_table; /* json */
SELECT j#>>'{a,1,b}' FROM my_table; /* text */
```

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Parsing JSON

```
/* If response is a list. [ ... ] */

SELECT json_array_length(response)
FROM my_raw_api_data;


SELECT json_array_elements(response)
FROM my_raw_api_data;
```

Parsing JSON

```sql
/* If response is an object. { ... } */
SELECT json_object_keys(response)
FROM my_raw_api_data;


SELECT response->'a', response#>'{a,b}'
FROM my_raw_api_data;


SELECT response->>'id' AS object_id,
       (jsonb_each(response)).key AS field_name,
       (jsonb_each(response)).value AS field_value
FROM my_raw_api_data;
```

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Populating Tables

```
/* If response is an object. { ... } */
CREATE TABLE my_table (...field list...);

SELECT
  json_populate_record(NULL::my_table, response)
FROM my_raw_api_data;

INSERT INTO my_table (...columns...)
SELECT ...manipulate results of above...
FROM (...above query...);
```

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JSONB Key Existence

```sql
/* Does key 'a' exist in response? */
SELECT response ? 'a'
FROM my_raw_api_data;


/* Do any of the keys listed exist in response? */
SELECT response ?| array['a','b','c']
FROM my_raw_api_data;


/* Do all of the keys listed exist in response? */
SELECT response ?& array['a','b','c']
FROM my_raw_api_data;
```

JSONB Containment

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```
/* Is the specified JSON contained in response? */

SELECT response @> '{"a":1, "b":2}'::jsonb
FROM my_raw_api_data;


SELECT '{"a":1, "b":2}'::jsonb <@ response
FROM my_raw_api_data;
```

JSONB Indexing

- For the jsonb data type, containment and existence tests can be sped up considerably via the GIN index types.

  - json_ops (default): indexes every key and value; supports @>, ?, ?&, ?| ops

  - json_path_ops: indexes hash of value and keys leading to it; only supports @>

Caveats: Use UTF8

- If you're processing JSON, it's best to use the UTF8 character set.

- PostgreSQL (and RFC 7159) allow Unicode escape sequences of the form \uXXXX (where X is a hex digit).

- The jsonb type restricts Unicode escapes for non-ASCII characters (above \u007F) unless the database is UTF8.

Caveats: Nulls

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- The JSON null value does not have its own type in PostgreSQL (it's a TEXT value), and is not the SQL NULL type.

- To see the difference:

  - /* JSON null value */
    SELECT json_typeof('null'::json);

  - /* SQL NULL value */
    SELECT json_typeof(NULL::json);

Relevant Docs

- IETF RFC 7159
  http://rfc7159.net/rfc7159

- PostgreSQL 9.4 Documentation

  - JSON Types
    http://www.postgresql.org/docs/9.4/
    interactive/datatype-json.html

  - JSON Functions and Operators
    http://www.postgresql.org/docs/9.4/
    interactive/functions-json.html

Example Code & Data

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- All code for examples is on GitHub at: https://github.com/nihonjinrxs/dwdc-january2015

- Examples use data from two public APIs:

  - Open Weather Map http://openweathermap.org/api

  - USAJobs REST API https://data.usajobs.gov/Rest

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Thank you!
Questions?

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