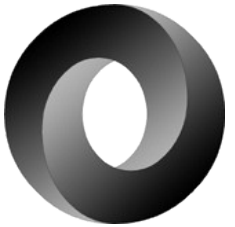
NoSQL The SQL Way

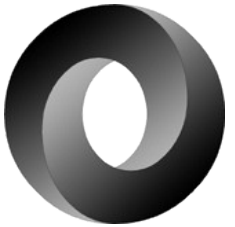


PostgreSQL JSON Features

Berlin PostgreSQL User Group
30/03/2017
Stefanie Janine Stölting

@sjstoelting
mail@stefanie-stoelting.de

JSON



JavaScript Object Notation

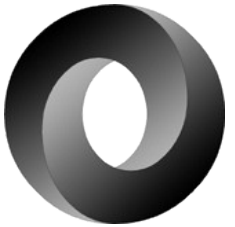
Don't have to care about encoding, it is always Unicode, most implementations use UTF8

Used for data exchange in web application

Currently two standards RFC 7159 by Douglas Crockford and ECMA-404

PostgreSQL implementation is RFC 7159

JSON Datatypes



JSON

Available since 9.2

BSON

Available as extension on GitHub since 2013

JSONB

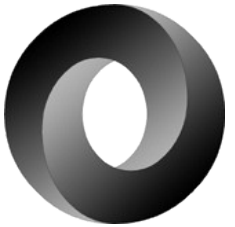
Available since 9.4

Compressed JSON

Fully transactional

Up to 1 GB (uses TOAST)

JSON Functions

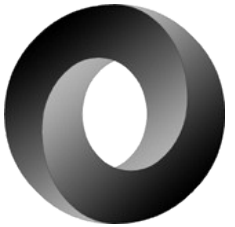


row_to_json({row})
Returns the row as JSON

array_to_json({array})
Returns the array as JSON

jsonb_to_recordset
Returns a recordset from JSONB

JSON Opertators



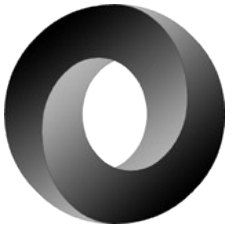
Array element
->{int}

Array element by name
->{text}

Object element
->> {text}

Value at path
#> {text}

Index on JSON



Index JSONB content for faster access with indexes

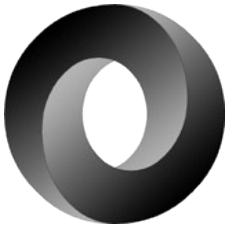
- GIN index overall

```
CREATE INDEX idx_1 ON jsonb.actor USING
GIN (jsondata);
```

- Even unique B-Tree indexes are possible

```
CREATE UNIQUE INDEX actor_id_2 ON
jsonb.actor((CAST(jsondata->>'actor_id' AS
INTEGER)));
```

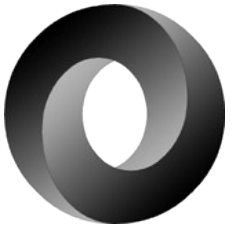
New JSON functions



PostgreSQL 9.6 new JSONB function:

jsonb_insert:
Insert a new value into a JSONB by path returning the changed JSONB
See 9.6 JSONB documentation for details

New JSON functions



PostgreSQL 9.5 new JSONB functions:

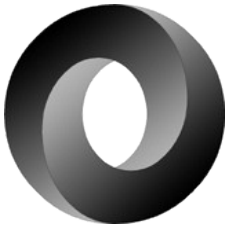
- jsonb_pretty: Formats JSONB human readable
- jsonb_set: Update or add values

PostgreSQL 9.5 new JSONB operators:

- ||: Concatenate two JSONB
- -: Delete key

Available as extions for 9.4 at PGXN: jsonbx

Data sources



The Chinook database is available at chinookdatabase.codeplex.com

Amazon book reviews of 1998 are available at examples.citusdata.com/customer_reviews_nested_1998.json.gz

Chinook Tables

	tablename
1	Artist
2	Invoice
3	Employee
4	Customer
5	Playlist
6	InvoiceLine
7	Album
8	Genre
9	PlaylistTrack
10	MediaType
11	Track

	table_name	column_name	data_type
1	Artist	ArtistId	integer
2	Artist	Name	character varying (120)

	table_name	column_name	data_type
1	Album	AlbumId	integer
2	Album	Title	character varying (160)
3	Album	ArtistId	integer

	table_name	column_name	data_type
1	Track	TrackId	integer
2	Track	Name	character varying (200)
3	Track	AlbumId	integer
4	Track	MediaTypeId	integer
5	Track	GenreId	integer
6	Track	Composer	character varying (220)
7	Track	Milliseconds	integer
8	Track	Bytes	integer
9	Track	UnitPrice	numeric

CTE

Common Table Expressions will be used in examples

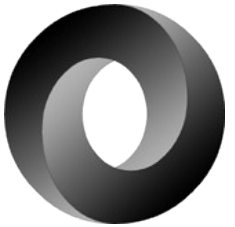
- Example:

```
WITH RECURSIVE t(n) AS (
    VALUES (1)
  UNION ALL
    SELECT n+1 FROM t WHERE n < 100
)
SELECT sum(n), min(n), max(n) FROM t;
```

- Result:

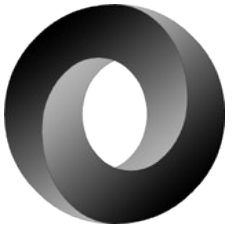
	sum bigint	min integer	max integer
1	5050	1	100

Live Examples



Let's see, how it does work.

Live with Chinook data



```
-- Lets start the easy way: With a function call to get album data
SELECT json_build_object (
          'album_id', "AlbumId",
          'track_id, ', "TrackId",
          'track_name', "Name"
     )
FROM "Track"
;
```

	json_build_object
1	{"album_id" : 1, "track_id, " : 1, "track_name" : "For Those About To Rock (We Salute You)"}
2	{"album_id" : 2, "track_id, " : 2, "track_name" : "Balls to the Wall"}
3	{"album_id" : 3, "track_id, " : 3, "track_name" : "Fast As a Shark"}
4	{"album_id" : 3, "track_id, " : 4, "track_name" : "Restless and Wild"}
5	{"album_id" : 3, "track_id, " : 5, "track_name" : "Princess of the Dawn"}
6	{"album_id" : 1, "track_id, " : 6, "track_name" : "Put The Finger On You"}
7	{"album_id" : 1, "track_id, " : 7, "track_name" : "Let's Get It Up"}
8	{"album_id" : 1, "track_id, " : 8, "track_name" : "Inject The Venom"}
9	{"album_id" : 1, "track_id, " : 9, "track_name" : "Snowballed"}
10	{"album_id" : 1, "track_id, " : 10, "track_name" : "Evil Walks"}
11	{"album_id" : 1, "track_id, " : 11, "track_name" : "C.O.D."}
12	{"album_id" : 1, "track_id, " : 12, "track_name" : "Breaking The Rules"}
13	{"album_id" : 1, "track_id, " : 13, "track_name" : "Night Of The Long Knives"}
14	{"album_id" : 1, "track_id, " : 14, "track_name" : "Spellbound"}

Save Cancel Script Record Panels Grid Text 200 row(s) fetched - 2ms

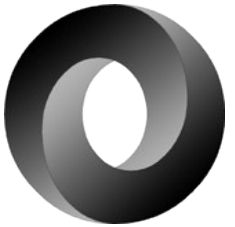
Live with Chinook data

```
-- Adding array_agg to build JSON arrays
WITH tracks AS
     (
          SELECT "AlbumId" AS album_id
               , json_build_object (
                    'track_id, ', "TrackId",
                    'track_name', "Name"
               )
          FROM "Track"
     )
SELECT album_id
     , json_build_object ('tracks', array_agg (tracks)) AS tracks
FROM tracks
GROUP BY album_id
;
```

	album_id	tracks
1	129	{"tracks" : [{"album_id":129,"json_build_object":{"track_id, " : 1595, "track_name" : "The Song Remains The Same"}},{"albu
2	195	{"tracks" : [{"album_id":195,"json_build_object":{"track_id, " : 2391, "track_name" : "Around The World"}},{"album_id":195,
3	251	{"tracks" : [{"album_id":251,"json_build_object":{"track_id, " : 3200, "track_name" : "Gay Witch Hunt"}},{"album_id":251,"js
4	106	{"tracks" : [{"album_id":106,"json_build_object":{"track_id, " : 1335, "track_name" : "Where Eagles Dare"}},{"album_id":106
5	120	{"tracks" : [{"album_id":120,"json_build_object":{"track_id, " : 1479, "track_name" : "Foxy Lady"}},{"album_id":120,"json_bu
6	285	{"tracks" : [{"album_id":285,"json_build_object":{"track_id, " : 3416, "track_name" : "Ave Maria"}}]}
7	264	{"tracks" : [{"album_id":264,"json_build_object":{"track_id, " : 3352, "track_name" : "Distance"}},{"album_id":264,"json_buil
8	305	{"tracks" : [{"album_id":305,"json_build_object":{"track_id, " : 3439, "track_name" : "Das Lied Von Der Erde, Von Der Jugen
9	80	{"tracks" : [{"album_id":80,"json_build_object":{"track_id, " : 999, "track_name" : "Still"}},{"album_id":80,"json_build_object
10	318	{"tracks" : [{"album_id":318,"json_build_object":{"track_id, " : 3452, "track_name" : "SCRIABIN: Prelude in B Major, Op. 11,
11	312	{"tracks" : [{"album_id":312,"json_build_object":{"track_id, " : 3446, "track_name" : "Symphonie Fantastique, Op. 14: V. Sor
12	179	{"tracks" : [{"album_id":179,"json_build_object":{"track_id, " : 2165, "track_name" : "Life Wasted"}},{"album_id":179,"json_
13	209	{"tracks" : [{"album_id":209,"json_build_object":{"track_id, " : 2572, "track_name" : "Midnight From The Inside Out"}},{"alb
14	276	{"tracks" : [{"album_id":276,"json_build_object":{"track_id, " : 3407, "track_name" : "Concerto for 2 Violins in D Minor, BWV

Save Cancel Script Record Panels Grid Text 200 row(s) fetched - 13ms

Live with Chinook data

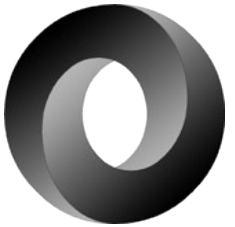


```
-- Step 1: Tracks as JSON with the album identifier
WITH tracks AS
    (
        SELECT "AlbumId" AS album_id
            , "TrackId" AS track_id
            , "Name" AS track_name
        FROM "Track"
    )
SELECT row_to_json(tracks) AS tracks
FROM tracks
;
```

	tracks
1	{"album_id":1,"track_id":1,"track_name":"For Those About To Rock (We Salute You)"}
2	{"album_id":2,"track_id":2,"track_name":"Balls to the Wall"}
3	{"album_id":3,"track_id":3,"track_name":"Fast As a Shark"}
4	{"album_id":3,"track_id":4,"track_name":"Restless and Wild"}
5	{"album_id":3,"track_id":5,"track_name":"Princess of the Dawn"}
6	{"album_id":1,"track_id":6,"track_name":"Put The Finger On You"}
7	{"album_id":1,"track_id":7,"track_name":"Let's Get It Up"}

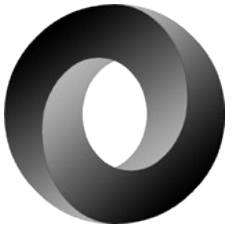
200 row(s) fetched - 7ms Grid

Live with Chinook data



```
-- Step 2 Abums including tracks with aritst identifier
WITH tracks AS
    (
        SELECT "AlbumId" AS album_id
            , "TrackId" AS track_id
            , "Name" AS track_name
        FROM "Track"
    )
, json_tracks AS
    (
        SELECT row_to_json(tracks) AS tracks
        FROM tracks
    )
, albums AS
    (
        SELECT a."ArtistId" AS artist_id
            , a."AlbumId" AS album_id
            , a."Title" AS album_title
            , array_agg(t.tracks) AS album_tracks
        FROM "Album" AS a
            INNER JOIN json_tracks AS t
            ON a."AlbumId" = (t.tracks->>'album_id')::int
        GROUP BY a."ArtistId"
            , a."AlbumId"
            , a."Title"
    )
SELECT artist_id
    , array_agg(row_to_json(albums)) AS album
FROM albums
GROUP BY artist_id
;
```

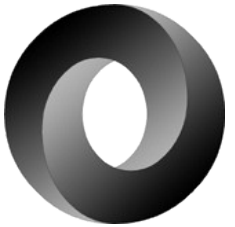
Live with Chinook data



	artist_id	album
1	251	{"artist_id":251,"album_id":319,"album_title":"Armada: Music from the Courts of England and Spain","albu
2	120	{"artist_id":120,"album_id":183,"album_title":"Dark Side Of The Moon","album_tracks":[{"album_id":183,"tr
3	227	{"artist_id":227,"album_id":293,"album_title":"Pavarotti's Opera Made Easy","album_tracks":[{"album_id":2
4	8	'{"artist_id":8,"album_id":271,"album_title":"Revelations","album_tracks":[{"album_id":271,"track_id":3389,"
5	247	{"artist_id":247,"album_id":314,"album_title":"English Renaissance","album_tracks":[{"album_id":314,"track
6	138	{"artist_id":138,"album_id":211,"album_title":"The Singles","album_tracks":[{"album_id":211,"track_id":2591
7	242	{"artist_id":242,"album_id":307,"album_title":"Adams, John: The Chairman Dances","album_tracks":[{"albur

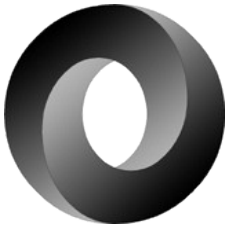
168 row(s) fetched - 38ms Grid

Live with Chinook data



```
-- Step 3 Return one row for an artist with all albums as VIEW
CREATE OR REPLACE VIEW v_json_artist_data AS
WITH tracks AS
    (
        SELECT "AlbumId" AS album_id
            , "TrackId" AS track_id
            , "Name" AS track_name
            , "MediaTypeId" AS media_type_id
            , "Milliseconds" As milliseconds
            , "UnitPrice" AS unit_price
        FROM "Track"
    )
, json_tracks AS
    (
        SELECT row_to_json(tracks) AS tracks
        FROM tracks
    )
, albums AS
    (
        SELECT a."ArtistId" AS artist_id
            , a."AlbumId" AS album_id
            , a."Title" AS album_title
            , array_agg(t.tracks) AS album_tracks
FROM "Album" AS a
    INNER JOIN json_tracks AS t
        ON a."AlbumId" = (t.tracks->>'album_id')::int
GROUP BY a."ArtistId"
    , a."AlbumId"
    , a."Title"
)
, json_albums AS
    (
        SELECT artist_id
            , array_agg(row_to_json(albums)) AS album
        FROM albums
        GROUP BY artist_id
    )
-- -> Next Page
```

Live with Chinook data



```
-- Step 3 Return one row for an artist with all albums as VIEW
, artists AS
    (
        SELECT a."ArtistId" AS artist_id
            , a."Name" AS artist
            , jsa.album AS albums
        FROM "Artist" AS a
            INNER JOIN json_albums AS jsa
                ON a."ArtistId" = jsa.artist_id
    )
SELECT (row_to_json(artists))::jsonb AS artist_data
FROM artists
;
```

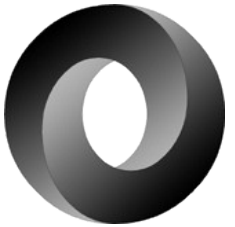
Live with Chinook data

```
-- Select data from the view
SELECT *
FROM v_json_artist_data
;
```

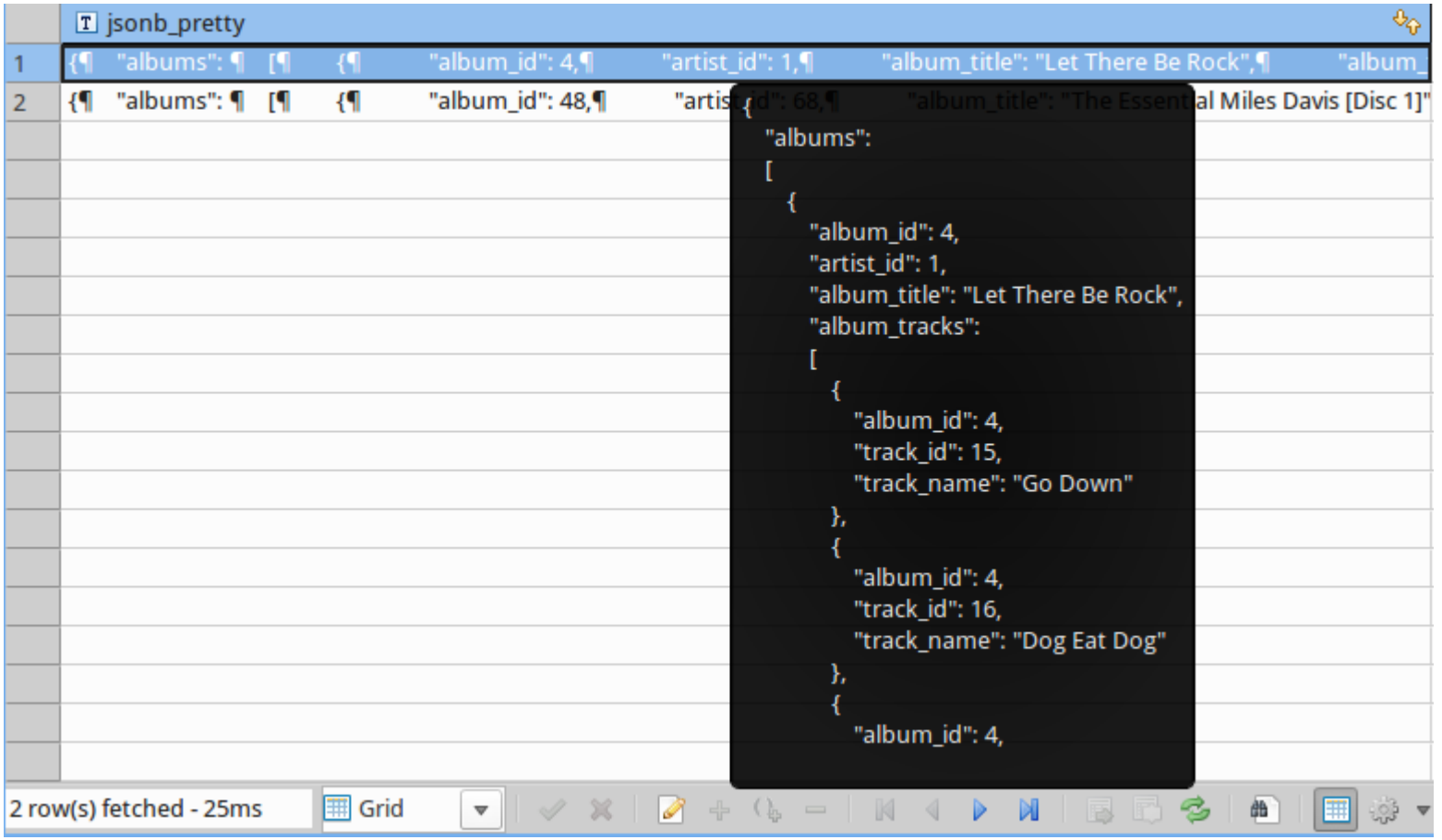
	artist_data
1	{"albums": [{"album_id": 319, "artist_id": 251, "album_title": "Armada: Music from the Courts of England and Spain", "album_tr
2	{"albums": [{"album_id": 183, "artist_id": 120, "album_title": "Dark Side Of The Moon", "album_tracks": [{"album_id": 183, "track
3	{"albums": [{"album_id": 293, "artist_id": 227, "album_title": "Pavarotti's Opera Made Easy", "album_tracks": [{"album_id": 293,
4	{"albums": [{"album_id": 271, "artist_id": 8, "album_title": "Revelations", "album_tracks": [{"album_id": 271, "track_id": 3389, "tra
5	{"albums": [{"album_id": 314, "artist_id": 247, "album_title": "English Renaissance", "album_tracks": [{"album_id": 314, "track_id"
6	{"albums": [{"album_id": 211, "artist_id": 138, "album_title": "The Singles", "album_tracks": [{"album_id": 211, "track_id": 2591, "
7	{"albums": [{"album_id": 307, "artist_id": 242, "album_title": "Adams, John: The Chairman Dances", "album_tracks": [{"album_id

168 row(s) fetched - 29ms Grid

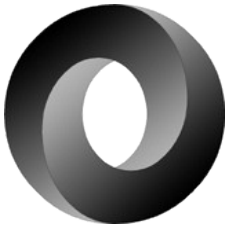
Live with Chinook data



```
-- SELECT data from that VIEW, that does querying
SELECT jsonb_pretty(artist_data)
FROM v_json_artist_data
WHERE artist_data->>'artist' IN ('Miles Davis', 'AC/DC')
;
```



Live with Chinook data

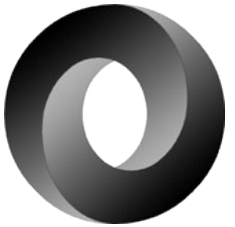


```
-- SELECT some data from that VIEW using JSON methods
SELECT artist_data->>'artist' AS artist
    , artist_data#>'{albums, 1, album_title}' AS album_title
    , jsonb_pretty(artist_data#>'{albums, 1, album_tracks}') AS album_tracks
FROM v_json_artist_data
WHERE artist_data->'albums' @> '[{"album_title":"Miles Ahead"}]'
;
```

	artist	album_title	album_tracks
1	Miles Davis	"Miles Ahead"	[¶ {¶ "album_id": 157,¶ "track_id": 1902

1 row(s) fetched - 27ms Grid

Live with Chinook data

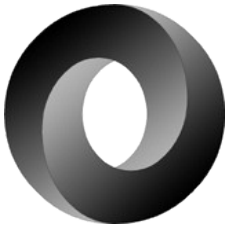


```
-- Array to records
SELECT artist_data->>'artist_id' AS artist_id
    , artist_data->>'artist' AS artist
    , jsonb_array_elements(artist_data#>'{albums}')->>'album_title' AS album_title
    , jsonb_array_elements(jsonb_array_elements(artist_data#>'{albums}')#>'{album_tracks}')->>'track_name' AS song_titles
      , jsonb_array_elements(jsonb_array_elements(artist_data#>'{albums}')#>'{album_tracks}')->>'track_id' AS song_id
FROM v_json_artist_data
WHERE artist_data->>'artist' = 'Metallica'
ORDER BY album_title
      , song_id
;
```

	artist_id	artist	album_title	song_titles	song_id
1	50	Metallica	...And Justice For All	Sad But True	1802
2	50	Metallica	...And Justice For All	The Unforgiven	1804
3	50	Metallica	...And Justice For All	Don't Tread On Me	1806
4	50	Metallica	...And Justice For All	Nothing Else Matters	1808
5	50	Metallica	...And Justice For All	The God That Failed	1810
6	50	Metallica	...And Justice For All	The Struggle Within	1812
7	50	Metallica	...And Justice For All	Helpless	1813
8	50	Metallica	...And Justice For All	The Wait	1815
9	50	Metallica	...And Justice For All	Last Caress/Green Hell	1817
10	50	Metallica	...And Justice For All	Blitzkrieg	1819
11	50	Metallica	...And Justice For All	The Prince	1821
12	50	Metallica	...And Justice For All	So What	1823
13	50	Metallica	...And Justice For All	Overkill	1825
14	50	Metallica	...And Justice For All	Stone Dead Forever	1827
15	50	Metallica	...And Justice For All	Hit The Lights	1829
16	50	Metallica	...And Justice For All	Motorbreath	1831
17	50	Metallica	...And Justice For All	(Anesthesia) Pulling Teeth	1833

200 row(s) fetched - 47ms

Live with Chinook data

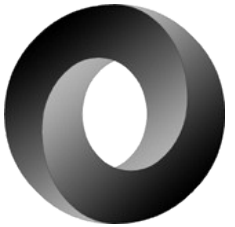


```
-- Convert albums to a recordset
SELECT *
FROM jsonb_to_recordset(
     (
          SELECT (artist_data->>'albums')::jsonb
          FROM v_json_artist_data
          WHERE (artist_data->>'artist_id')::int = 50
     )
) AS x(album_id int, artist_id int, album_title text, album_tracks jsonb)
;
```

	album_id	artist_id	album_title	album_tracks
1	152	50	Master Of Puppets	[{"album_id": 152, "track_id": 1853, "track_name": "Battery"}, {"album_i
2	35	50	Garage Inc. (Disc 1)	[{"album_id": 35, "track_id": 408, "track_name": "Free Speech For The D
3	154	50	Ride The Lightning	[{"album_id": 154, "track_id": 1874, "track_name": "Fight Fire With Fire"
4	149	50	Garage Inc. (Disc 2)	[{"album_id": 149, "track_id": 1813, "track_name": "Helpless"}, {"album_
5	150	50	Kill 'Em All	[{"album_id": 150, "track_id": 1829, "track_name": "Hit The Lights"}, {"a
6	151	50	Load	[{"album_id": 151, "track_id": 1839, "track_name": "Ain't My Bitch"}, {"a
7	153	50	ReLoad	[{"album_id": 153, "track_id": 1861, "track_name": "Fuel"}, {"album_id":
8	148	50	Black Album	[{"album_id": 148, "track_id": 1801, "track_name": "Enter Sandman"}, {"
9	155	50	St. Anger	[{"album_id": 155, "track_id": 1882, "track_name": "Frantic"}, {"album_i
10	156	50	...And Justice For All	[{"album_id": 156, "track_id": 1893, "track_name": "Blackened"}, {"albu

10 row(s) fetched - 29ms Grid

Live with Chinook data



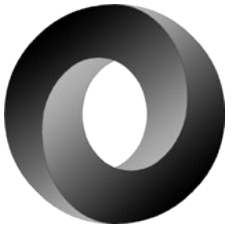
```
-- Convert the tracks to a recordset
SELECT album_id
    , track_id
    , track_name
    , media_type_id
    , milliseconds
    , unit_price
FROM jsonb_to_recordset(
    (
        SELECT artist_data#>'{albums, 1, album_tracks}'
        FROM v_json_artist_data
        WHERE (artist_data->>'artist_id')::int = 50
    )
) AS x(album_id int, track_id int, track_name text, media_type_id int, milliseconds int, unit_price float)
;
```

	album_id	track_id	track_name	media_type_id	milliseconds	unit_price
1	35	408	Free Speech For The Dumb	1	155.428	0,99
2	35	409	It's Electric	1	213.995	0,99
3	35	410	Sabbra Cadabra	1	380.342	0,99
4	35	411	Turn The Page	1	366.524	0,99
5	35	412	Die Die My Darling	1	149.315	0,99
6	35	413	Loverman	1	472.764	0,99
7	35	414	Mercyful Fate	1	671.712	0,99
8	35	415	Astronomy	1	397.531	0,99
9	35	416	Whiskey In The Jar	1	305.005	0,99
10	35	417	Tuesday's Gone	1	545.750	0,99
11	35	418	The More I See	1	287.973	0,99

11 row(s) fetched - 44ms

Grid

Live with Chinook data

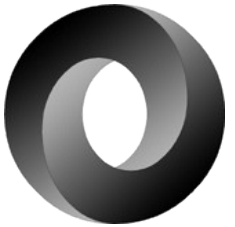


```
-- Create a function, which will be used for UPDATE on the view v_artrist_data
CREATE OR REPLACE FUNCTION trigger_v_json_artist_data_update()
      RETURNS trigger AS
$BODY$
      -- Data variables
      DECLARE rec             RECORD;
      -- Error variables
      DECLARE v_state         TEXT;
      DECLARE v_msg           TEXT;
      DECLARE v_detail        TEXT;
      DECLARE v_hint          TEXT;
      DECLARE v_context       TEXT;
BEGIN
      -- Update table Artist
      IF (OLD.artist_data->>'artist')::varchar(120) <> (NEW.artist_data->>'artist')::varchar(120) THEN
            UPDATE "Artist"
            SET "Name" = (NEW.artist_data->>'artist')::varchar(120)
            WHERE "ArtistId" = (OLD.artist_data->>'artist_id')::int;
      END IF;
-- Update table Album with an UPSERT
-- Update table Track with an UPSERT
RETURN NEW;

      EXCEPTION WHEN unique_violation THEN
            RAISE NOTICE 'Sorry, but the something went wrong while trying to update artist data';
            RETURN OLD;

      WHEN others THEN
            GET STACKED DIAGNOSTICS
                  v_state = RETURNED_SQLSTATE,
                  v_msg = MESSAGE_TEXT,
                  v_detail = PG_EXCEPTION_DETAIL,
                  v_hint = PG_EXCEPTION_HINT,
                  v_context = PG_EXCEPTION_CONTEXT;
            RAISE NOTICE '%', v_msg;
            RETURN OLD;
END;
$BODY$
      LANGUAGE plpgsql;
```

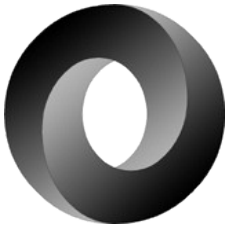
Live with Chinook data



Name	Value
	-- Create a function, which will be used for UPDATE on the view v_artrist_data CREATE OR REPLACE FUNCTION trigger_v_json_artist_data_update() RETURNS trigger AS $BODY$ -- Data variables DECLARE rec RECORD; -- Error variables DECLARE v_state TEXT; DECLARE v_msg TEXT; DECLARE v_detail TEXT;

1 row(s) fetched - 8ms Grid

Live with Chinook data

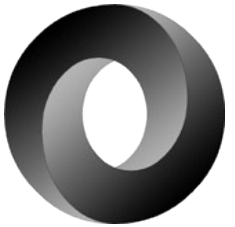


```
-- The trigger will be fired instead of an UPDATE statement to save data
CREATE TRIGGER v_json_artist_data_instead_update INSTEAD OF UPDATE
    ON v_json_artist_data
    FOR EACH ROW
    EXECUTE PROCEDURE trigger_v_json_artist_data_update()
;
```

Name	Value
Query	-- The trigger will be fired instead of an UPDATE statemen to save data CREATE TRIGGER v_json_artist_data_instead_update INSTEAD OF UPDATE ON v_json_artist_data FOR EACH ROW EXECUTE PROCEDURE trigger_v_json_artist_data_update()
Updated Rows	0

1 row(s) fetched - 13ms Grid

Live with Chinook data

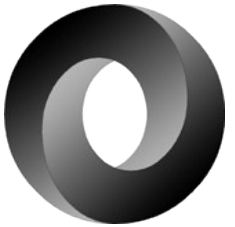


```
-- Manipulate data with jsonb_set
SELECT artist_data->>'artist_id' AS artist_id
    , artist_data->>'artist' AS artist
    , jsonb_set(artist_data, '{artist}', '"Whatever we want, it is just text"'::jsonb)->>'artist' AS new_artist
FROM v_json_artist_data
WHERE (artist_data->>'artist_id')::int = 50
;
```

	artist_id	artist	new_artist
1	50	Metallica	Whatever we want, it is just text

1 row(s) fetched - 5ms Grid

Live with Chinook data

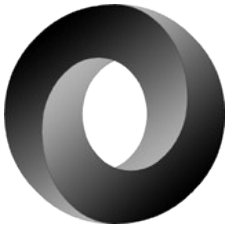


```
-- Update a JSONB column with a jsonb_set result
UPDATE v_json_artist_data
SET artist_data= jsonb_set(artist_data, '{artist}', '"NEW Metallica"'::jsonb)
WHERE (artist_data->>'artist_id')::int = 50
;
```

Name	Value
Query	-- Update a JSONB column with a jsonb_set result UPDATE json_artist_data SET artist_data= jsonb_set(artist_data, '{artist}', '"NEW Metallica"'::jsonb) WHERE (artist_data->>'artist_id')::int = 50
Updated Rows	1

1 row(s) fetched - 20ms Grid

Live with Chinook data

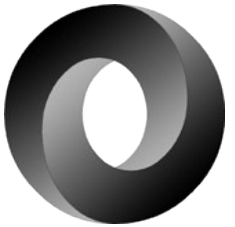


```
-- View the changes done by the UPDATE statement
SELECT artist_data->>'artist_id' AS artist_id
    , artist_data->>'artist' AS artist
FROM v_json_artist_data
WHERE (artist_data->>'artist_id')::int = 50
;
```

	artist_id	artist
1	50	NEW Metallica

1 row(s) fetched - 1ms Grid

Live with Chinook data

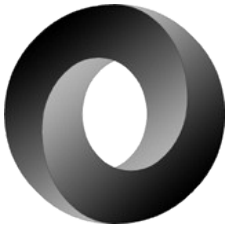


```
-- Lets have a view on the explain plans

— SELECT the data from the view
```

Node Type	Entity	Cost
▼ Subquery Scan		309.51 - 317.03
▼ CTE Scan		309.51 - 317.01
Seq Scan	Track	0.00 - 68.83
CTE Scan		0.00 - 64.87
▼ Aggregate		146.83 - 150.65
▼ Hash Join		9.89 - 118.00
CTE Scan		0.00 - 57.66
▼ Hash		6.06 - 6.06
Seq Scan	Album as a	0.00 - 6.06
▼ Aggregate		8.42 - 10.92
CTE Scan		0.00 - 6.12
▼ Hash Join		7.49 - 14.24
CTE Scan		0.00 - 4.00
▼ Hash		4.44 - 4.44
Seq Scan	Artist as a_1	0.00 - 4.44

Live with Chinook data

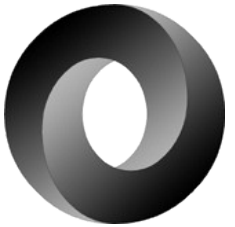


```
-- View the changes in in the table instead of the JSONB view
-- The result should be the same, only the column name differ
SELECT *
FROM "Artist"
WHERE "ArtistId" = 50
;
```

	ArtistId	Name
1	50	NEW Metallica

1 row(s) fetched - 3ms

Live with Chinook data

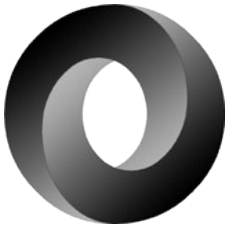


```
-- Lets have a view on the explain plans

— SELECT the data from table Artist
```

Node Type	Entity	Cost
Seq Scan	Artist	0.00 - 5.05

Live with Chinook data

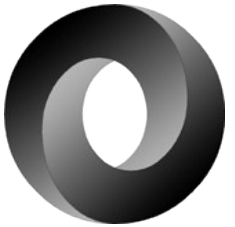


```
-- Manipulate data with the concatenating / overwrite operator
SELECT artist_data->>'artist_id' AS artist_id
    , artist_data->>'artist' AS artist
    , jsonb_set(artist_data, '{artist}', '"Whatever we want, it is just text"'::jsonb)->>'artist' AS new_artist
    , artist_data || '{"artist":"Metallica"}'::jsonb->>'artist' AS correct_name
FROM v_json_artist_data
WHERE (artist_data->>'artist_id')::int = 50
;
```

	artist_id	artist	new_artist	correct_name
1	50	NEW Metallica	Whatever we want, it is just text	Metallica

1 row(s) fetched - 6ms Grid

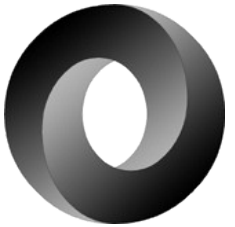
Live with Chinook data



```
-- Revert the name change of Metallica with in a different way: With the replace operator
UPDATE v_json_artist_data
SET artist_data = artist_data || '{"artist":"Metallica"}'::jsonb
WHERE (artist_data->>'artist_id')::int = 50
;
```

Name	Value
Query	-- Revert the name change of Metallica with in a different way: With the replace operator UPDATE json_artist_data SET artist_data = artist_data || '{"artist":"Metallica"}'::jsonb WHERE (artist_data->>'artist_id')::int = 50
Updated Rows	1

Live with Chinook data



```
-- View the changes done by the UPDATE statement with the replace operator
SELECT artist_data->>'artist_id' AS artist_id
    , artist_data->>'artist' AS artist
FROM v_json_artist_data
WHERE (artist_data->>'artist_id')::int = 50
;
```

	artist_id	artist
1	50	Metallica

1 row(s) fetched - 5ms Grid

Live with Chinook data

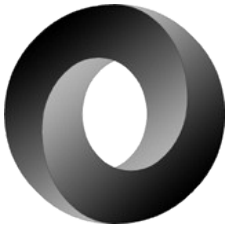
```
-- Remove some data with the - operator
SELECT jsonb_pretty(artist_data) AS complete
    , jsonb_pretty(artist_data - 'albums') AS minus_albums
    , jsonb_pretty(artist_data) = jsonb_pretty(artist_data - 'albums') AS is_different
FROM v_json_artist_data
WHERE artist_data->>'artist' IN ('Miles Davis', 'AC/DC')
;
```

	complete	minus_albums	is_different
1	{¶ "albums": [¶ {¶ "album_id": 4,¶ "artist_id": 1,¶ "album_title": "Let There Be Rock",¶	{¶ "artist": "AC/DC",¶ "artist_id": 1¶}	false
2	{¶ "albums": [¶ {¶ "album_id": 48,¶ "artist_id": 68,¶ "album_title": "The Essential Miles Davi	{¶ "artist": "Miles Davis",¶ "artist_id": 68¶}	false

2 row(s) fetched - 29ms

Grid

Live Amazon reviews

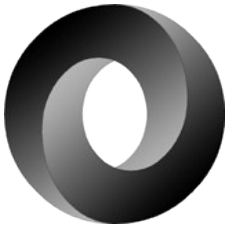


```
-- Create a table for JSON data with 1998 Amazon reviews
CREATE TABLE reviews(review_jsonb jsonb);
```

Name	Value
Query	CREATE TABLE reviews(review_jsonb jsonb)
Updated Rows	0

1 row(s) fetched - 32ms

Live Amazon reviews

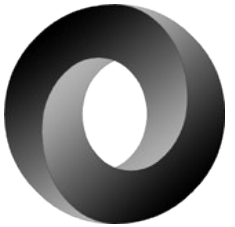


```
-- Import customer reviews from a file
COPY reviews
FROM '/var/tmp/customer_reviews_nested_1998.json'
;
```

Name	Value
Query	-- Import customer reviews from a file COPY reviews FROM '/var/tmp/customer_reviews_nested_1998.json'
Updated Rows	0

1 row(s) fetched - 10730ms

Live Amazon reviews



```
-- There should be 589.859 records imported into the table
SELECT count(*)
FROM reviews
;
```

	count
1	589.859

1 row(s) fetched - 104ms

Live Amazon reviews

```
SELECT jsonb_pretty(review_jsonb)
FROM reviews
LIMIT 1
;
```

jsonb_pretty

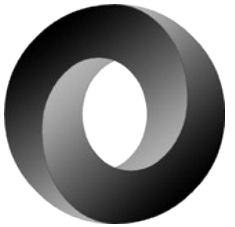
1 {¶ "review": ¶ {¶ "date": "1970-12-30",¶ "votes": 10,¶ "rating": 5,¶ "helpful_votes": 0¶ },¶ "product": ¶ {¶ "id": "1551803542",¶


```
{
  "review":
  {
    "date": "1970-12-30",
    "votes": 10,
    "rating": 5,
    "helpful_votes": 0
  },
  "product":
  {
    "id": "1551803542",
    "group": "Book",
    "title": "Start and Run a Coffee Bar (Start  Run a)",
    "category": "Business  Investing",
    "sales_rank": 11611,
    "similar_ids":
    [
      "0471136174",
      "0910627312",
      "047112138X",
      "0786883561",
      "0201570483"
    ],
    "subcategory": "General"
  },
  "customer_id": "AE22YDHSBFYIP"
}
```


1 row(s) fetched - 4ms

Grid

Live Amazon reviews



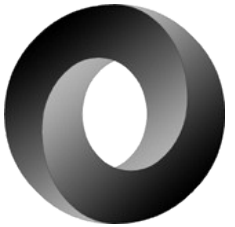
```
-- Select data with JSON
SELECT
    review_jsonb#>> '{product,title}' AS title
    , avg((review_jsonb#>> '{review,rating}')::int) AS average_rating
FROM reviews
WHERE review_jsonb@>'{"product": {"category": "Sheet Music & Scores"}}'
GROUP BY title
ORDER BY average_rating DESC
;
```

Without an Index: 248ms

	title	average_rating
1	Complete Works for Solo Keyboard	5
2	The Magic Flute (Die Zauberflote in Full Score)	5
3	Requiem in Full Score	5
4	The Four Seasons and Other Violin Concertos in Full Score	5
5	Symphony No. 3 (Dover Miniature Scores)	5

12 row(s) fetched - 248ms Grid

Live Amazon reviews



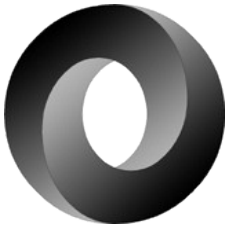
```
-- Create a GIN index
CREATE INDEX review_review_jsonb ON reviews USING GIN (review_jsonb);
```

Name	Value
Query	-- Create a GIN index CREATE INDEX review_review_jsonb ON reviews USING GIN (review_jsonb)
Updated Rows	0

1 row(s) fetched - 21079ms

Grid

Live Amazon reviews



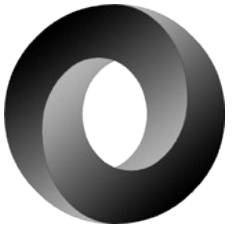
```
-- Select data with JSON
SELECT review_jsonb#>> '{product,title}' AS title
    , avg((review_jsonb#>> '{review,rating}')::int) AS average_rating
FROM reviews
WHERE review_jsonb@>'{"product": {"category": "Sheet Music & Scores"}}'
GROUP BY title
ORDER BY average_rating DESC
;
```

The same query as before with the previously created GIN Index: 7ms

	title	average_rating
1	Complete Works for Solo Keyboard	5
2	The Magic Flute (Die Zauberflote in Full Score)	5
3	Requiem in Full Score	5
4	The Four Seasons and Other Violin Concertos in Full Score	5
5	Symphony No. 3 (Dover Miniature Scores)	5

12 row(s) fetched - 7ms Grid

Live Amazon reviews



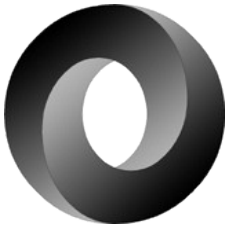
```
-- SELECT some statistics from the JSON data
SELECT  review_jsonb#>>'{product,category}' AS category
    , avg((review_jsonb#>>'{review,rating}')::int) AS average_rating
    , count((review_jsonb#>>'{review,rating}')::int) AS count_rating
FROM reviews
GROUP BY category
;
```

Without an Index: 9747ms

	category	average_rating	count_rating
1		4,487	1.521
2	Accessories	4,703	37
3	Action & Adventure	4,261	3.938
4	African American Cinema	4,694	36
5	Alternative Rock	4,522	15.508

84 row(s) fetched - 9747ms Grid

Live Amazon reviews



```
-- Create a B-Tree index on a JSON expression
CREATE INDEX reviews_product_category ON reviews ((review_jsonb#>>'{product,category}'));
```

Name	Value
Query	-- Create a B-Tree index on a JSON expression CREATE INDEX reviews_product_category ON reviews ((review_jsonb#>>'{product,category}'))
Updated Rows	0

1 row(s) fetched - 11875ms

Grid

Live Amazon reviews

```
-- SELECT some statistics from the JSON data
SELECT  review_jsonb#>>'{product,category}' AS category
    , avg((review_jsonb#>>'{review,rating}')::int) AS average_rating
    , count((review_jsonb#>>'{review,rating}')::int) AS count_rating
FROM reviews
GROUP BY category
;
```

The same query as before with the previously created BTREE Index: 1605ms

	category	average_rating	count_rating
1		4,487	1.521
2	Accessories	4,703	37
3	Action & Adventure	4,261	3.938
4	African American Cinema	4,694	36
5	Alternative Rock	4,522	15.508

84 row(s) fetched - 1605ms Grid

JSON by example