Digital Career Institute

Python Course - Advanced SQL

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Advanced Data Types
-
Enumerated Types

Enumerated

Types of data that comprise **an ordered set of values**.

- Days of the week
  Monday < Tuesday < Wednesday < Thursday < ...
- Months
  January < February < March < April < May < ...
- Hierarchical position
  Intern < Employed < Coordinator < ...
- Stepped processes
  To define < To start < Doing < Reviewing < ...

Enumerated

Basic definition of an enumerated type.

```
ENUM(
    “Selling point”,
    “Local office”,
    “Headquarters”
);
```

In PostgreSQL a new type has to be defined first:

```
CREATE TYPE location_type AS ENUM(
    “Selling point”,
    “Local office”,
    “Headquarters”
);
ALTER TABLE Location ADD COLUMN type location_type;
```

In other RDBMS the `ENUM` declaration may be used directly in the `ADD COLUMN` clause.

Enumerated

Validation

```
UPDATE "Location" SET type = 'Something else';

ERROR:  invalid input value for enum location_type:
"Something else"
```

```
UPDATE "Location" SET type = 'SELLING POINT';

ERROR:  invalid input value for enum location_type:
"Something else"
```

Enumerated types are case sensitive.

Enumerated

Sorting

```
UPDATE Location SET type = 'Local office';
UPDATE Location SET type = 'Headquarters'
WHERE name = 'Headquarters';
UPDATE Location SET type = 'Selling point'
WHERE name = 'Location 3';

SELECT * FROM Location
ORDER BY type ASC;
```

The enum fields are sorted according to the order each item was given on the field definition.

Result

name	city_id	type
Location 3	2	Selling point
Location 2	1	Local office
Location 4	3	Local office
Location 5	4	Local office
Location 6	21	Local office
Headquarters	2	Headquarters

Enumerated

Relational

```
SELECT * FROM Location
WHERE type > 'Selling point';
```

Result

name	city_id	type
Headquarters	2	Headquarters
Location 2	1	Local office
Location 4	3	Local office
Location 5	4	Local office
Location 6	21	Local office

It uses the order of the value in the field definition to evaluate the relational expression.

Advanced Data Types

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UUID

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UUID

Integer identifiers are good enough for most cases, but sometimes we want our IDs to be unique across different datasets or applications.

Universally Unique Identifiers

```
a0eebc99-9c0b-4ef8-bb6d-6bb9bd380a11
```

UUID

```
ALTER TABLE Location ADD COLUMN my_uuid_field uuid;
```

Validation + Relational

PostgreSQL does not provide functions to generate UUIDs.

The module uuid-ossp can be installed for that purpose.

Advanced Data Types
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JSON Types

JSON Fields

JavaScript Object Notation

```
{“key1”: “Value 1”, “key2”: 136}
```

The JSON Type

Validation

```
ALTER TABLE Location ADD COLUMN info json;

UPDATE Location SET info = 23
WHERE type = 'Headquarters';
ERROR:  invalid input syntax for type json

UPDATE Location SET info = '{"forgot": "a_curly"'
WHERE type = 'Headquarters';
ERROR:  invalid input syntax for type json

UPDATE Location SET info = '{"all": "ok", "none": 2}'
WHERE type = 'Headquarters';
Query returned successfully
```

The JSON Type

Basic JSON specific operators

{field} **->** {key}

Returns a JSON data type.

{field} **->>** {key}

Returns a text data type.

The JSON Type

Querying

```
SELECT
    info->'all', pg_typeof(info->'all'),
    info->>'all', pg_typeof(info->>'all')
FROM Location
WHERE info->>'all' = 'ok'
```

Result

?column?	pg_typeof	?column?	pg_typeof
“ok”	json	ok	text

The JSON Type

Querying: nested JSON paths

{field} **#>** {key}

{field} **#>>** {key}

```
UPDATE Location SET info = '{"all": {"ok": true}}'
WHERE type = 'Headquarters';

SELECT
    info#>'{all,ok}', pg_typeof(info#>'{all,ok}'),
    info#>>'{all,ok}', pg_typeof(info#>>'{all,ok}')
FROM Location WHERE info#>>'{all,ok}' = 'true';
```

Result

?column?	pg_typeof	?column?	pg_typeof
true	json	true	text

The JSONB Type

The type **`jsonb`** is very similar to the type **`json`** but it is stored in **binary form**.

Advantages over the **`json`** type:

- more efficient,
- significantly faster to process,
- supports indexing.

The JSONB Type

Definition

```
ALTER TABLE Location ADD COLUMN infob jsonb;

UPDATE Location SET infob = '{"all": "ok", "none": 2}'
WHERE type = 'Headquarters';
Query returned successfully
```

The JSONB Type

Additional operators: inclusion

{json} **@>** {json}

Returns **`True`** if the left JSON includes the right JSON.

{json} **<@** {json}

Returns **`True`** if the right JSON includes the left JSON.

The JSONB Type

Additional operators: inclusion

```
SELECT name, infob, infob@>'{"all": "ok"}' FROM Location;
```

name	infob	?column?
Location 2		
Location 4		
Location 5		
Location 6		
Location 3		
Headquarters	{“all”: “ok”, “none”: 2}	t

The JSONB Type

Additional operators: key exists

```
SELECT name, infob, infob?'all', infob?'something'
FROM Location;
```

{jsonb} **?** {key}

Returns `True` if the left JSON has a key with the name `key`.

name	infob	?column?	?column?
Location 2			
Location 4			
Location 5			
Location 6			
Location 3			
Headquarters	{“all”: “ok”, “none”: 2}	t	f

Advanced Data Types
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Array Types

Array Types

A field can be defined as an array of any other data type.

```
[145, 543, 234]
```

Arrays

Appending `[]` to a data type will define an array of elements of that type.

```
ALTER TABLE Location
ADD COLUMN quarterly_earnings integer[];
```

```
ALTER TABLE City
ADD COLUMN alternate_name varchar[];
```

```
ALTER TABLE Country
ADD COLUMN boundaries jsonb[];
```

Arrays

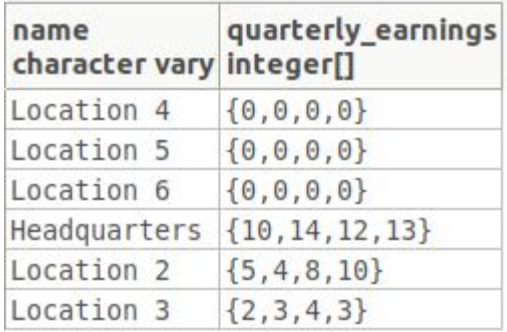
```
UPDATE Location
SET quarterly_earnings = ARRAY[0, 0, 0, 0];

UPDATE Location
SET quarterly_earnings = ARRAY[10, 14, 12, 13]
WHERE name = 'Headquarters';

UPDATE Location
SET quarterly_earnings = ‘{5, 4, 8, 10}’
WHERE name = 'Location 2';

UPDATE Location
SET quarterly_earnings = ARRAY[2, 3, 4, 1]
WHERE name = 'Location 3';

UPDATE Location
SET quarterly_earnings[4] = 3
WHERE name = 'Location 3';
```



name character vary	quarterly_earnings integer[]
Location 4	{0,0,0,0}
Location 5	{0,0,0,0}
Location 6	{0,0,0,0}
Headquarters	{10,14,12,13}
Location 2	{5,4,8,10}
Location 3	{2,3,4,3}

Array indexes start at **1**.

Arrays

Accessing elements in the array

```
SELECT
    name,
    type,
    quarterly_earnings[1] AS Q1,
    quarterly_earnings[2] AS Q2
FROM Location
WHERE quarterly_earnings[2] < quarterly_earnings[1];
```

name	type	Q1	Q2
Location 2	Local office	5	4

Multidimensional Arrays

Append as many `[]` as dimensions in the array.

```
ALTER TABLE Location
ADD COLUMN opening_times integer[][];
```

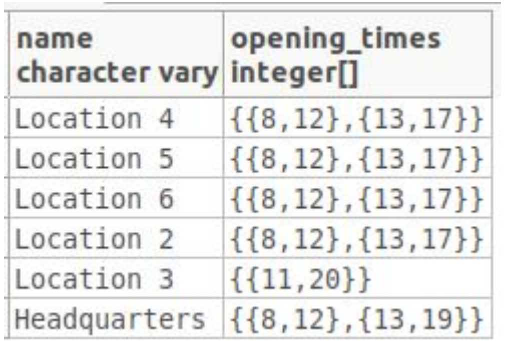
```
[[8, 12],[13, 17]]
```

Multidimensional Arrays

```
UPDATE Location
SET opening_times = ARRAY[[8, 12], [13, 17]];

UPDATE Location
SET opening_times = '{{11, 20}}'
WHERE type = 'Selling point';

UPDATE Location
SET opening_times[2][2] = 19
WHERE name = 'Headquarters';
```



name character vary	opening_times integer[]
Location 4	{{8,12},{13,17}}
Location 5	{{8,12},{13,17}}
Location 6	{{8,12},{13,17}}
Location 2	{{8,12},{13,17}}
Location 3	{{11,20}}
Headquarters	{{8,12},{13,19}}

Multidimensional Arrays

```
UPDATE Location
SET opening_times = '{{11, 20}, {21}}'
WHERE type = 'Selling point';

ERROR:  malformed array literal: "{{11, 20}, {21}}"
DETAIL:  Multidimensional arrays must have sub-arrays
with matching dimensions.
```

All arrays of the main array must have the same length.

Array Operators

INCLUDES

{array} **@>** {array}
{array} **<@** {array}

CONCATENATE

{array} **||** {array}

OVERLAPS

{array} **&&** {array}

Array Functions

APPEND()

```
array = array_append(
    array,
    element
)
```

REMOVE()

```
array = array_remove(
    array,
    element
)
```

LENGTH()

```
array = array_length(
    array,
    integer
)
```

The **`integer`** indicates the depth of the array hierarchy, starting at 1 as the first dimension of the array.

Advanced Data Types
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Time Types

Temporal Data

SQL has specific types to manage time data.

```
0001-01-01 00:00:00
```

Temporal Data

There are 4 basic types to work with temporal data.

DATE

TIME

INTERVAL

TIMESTAMP

Time Fields

Defining Time Fields

```
ALTER TABLE Location
ADD COLUMN opened_on date;
ALTER TABLE Location
ALTER COLUMN opened_on TYPE time;
ALTER TABLE Location
ALTER COLUMN opened_on TYPE timestamp;

ALTER TABLE Location
ALTER COLUMN opened_on TYPE time with time zone;
ALTER TABLE Location
ALTER COLUMN opened_on TYPE timestamp with time zone;
```

Time and timestamp can also be made aware of the time zone.

Time Fields

Using Time Fields

```
ALTER TABLE Location
ADD COLUMN opened_on date;
UPDATE Location SET opened_on = ‘1999-01-23’;

ALTER TABLE Location
ALTER COLUMN opened_on TYPE time;
UPDATE Location SET opened_on = ‘14:21:02’;

ALTER TABLE Location
ALTER COLUMN opened_on TYPE timestamp;
UPDATE Location SET opened_on = ‘2004-10-19 10:23:54’;
```

Time Fields

Using Time Fields

```
ALTER TABLE Location
ALTER COLUMN opened_on TYPE time with time zone;
UPDATE Location SET opened_on = ‘14:21:02 PST’;

ALTER TABLE Location
ALTER COLUMN opened_on TYPE timestamp with time zone;
UPDATE Location
SET opened_on = ‘2004-10-19 10:23:54+02’;

ALTER TABLE Location
ALTER COLUMN opened_on TYPE time[];
UPDATE Location
SET opened_on = [time ‘14:21:02’, time ‘15:34:21’];
```

Time Fields

Using Time Fields

```
SELECT * FROM Location
WHERE opened_on >= ‘2000-01-01’;

SELECT * FROM Location
WHERE opened_on BETWEEN ‘2000-01-01’ AND ‘2003-01-01’;

SELECT CURRENT_TIMESTAMP - opened_on AS “Days open”
FROM Location;
```

Subtracting a **`timestamp`** from a **`timestamp`** produces a value of type **`interval`**.

Interval Fields

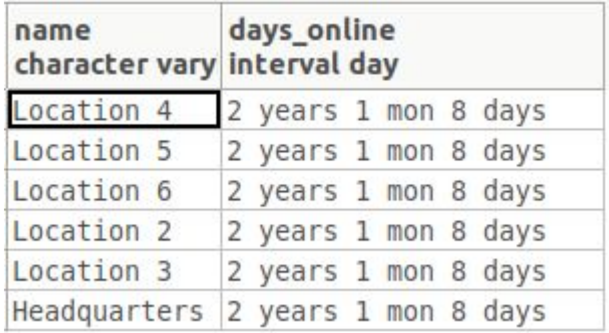
Defining Interval Fields

We can specify the resolution we desire.

```
ALTER TABLE Location
ADD COLUMN days_online interval day;

UPDATE Location SET days_online = ‘P2Y1M1W1DT1H1M1S’;
```

- **P** indicates the formatting used.
- **2Y1M1W1D** adds 2 years, 1 month, 1 week and 1 day.
- **T** indicates the following is referring to time
- And **1H1M1S** adds 1 hour, 1 minute and 1 second.



name character vary	days_online interval day
Location 4	2 years 1 mon 8 days
Location 5	2 years 1 mon 8 days
Location 6	2 years 1 mon 8 days
Location 2	2 years 1 mon 8 days
Location 3	2 years 1 mon 8 days
Headquarters	2 years 1 mon 8 days

We learned ...

- That enumerate types are data types that are ordered lists in nature and that we can use this to sort the records.
- That there is a data type called UUID to store and validate universal identifiers.
- That we can store JSON objects in a field and we can query them using specific SQL operators.
- That any type can be used as an array of any dimension.
- That we can store binary files directly into a field.
- That there are specific data types to manage time-related data.

THANK YOU

Contact Details
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