
# PostgreSQL Tips & Tricks For App Devs

## Work Smart, Not Hard!

PGDay Nordic 2025

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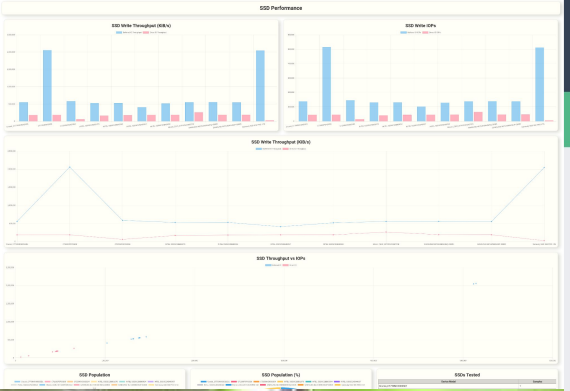
# Hello!

- I’m Chris
  - IT jack of all trades, studied Electronic Engineering
  - These days, mostly a technical architect
  - Spend most of my time building apps on top of PostgreSQL
- Been using PostgreSQL for about ~20 years
- Worked on various PostgreSQL and IoT projects





Classes

Classes

This Week | Next Week

Tuesday 05 September 2023

**Intermediate**
16:30 - 17:30
Kingston Dojo

Wednesday 06 September 2023

**Advanced**
17:00 - 18:00
Kingston Dojo

Tuesday 12 September 2023

## Your Account

### Your Membership

**Pay As You Go**
Come and train on an ad-hoc basis, pay per session, ideal for students starting out.

£25 per year - Membership Fee

£8 per class - Each class

Your next payment will be taken on

Pause Membership

### Your Balance

**Pay As You Go**
**Train as you need**
Come and train on an ad-hoc basis, pay per session, ideal for students starting out.

2
Classes until
05 October 2023

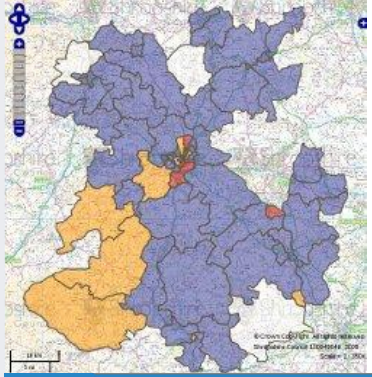
### Your Details

Hello John Smith
8th Kyu
Email: info@mokuso.cloud
Mobile: 07848123456
Member since 05 September 2023

Change Details | Logout

Home | Classes | Account

Account



NEXTEAM

Shropshire Council

Home | Contact us | A to Z of services | Frequently asked questions

Shropshire Council | Family Information Directory | Community Directory

Search

returned 98 results in 0.13 Seconds

**63 (Bridgnorth) Squadron Air Training Corps**
Air Training Corps for young people between 13 and 20 years.

**Albrighton Trust**
Albrighton Trust provides recreation and education for people with disabilities.

**Apprenticeships**
Information about apprenticeships.

**Archaeology Service**
The Archaeology Service aims to provide community focused services which preserve and interpret the archaeological heritage of the county.

**Ashley Music School**
Ashley Music School offers tuition in piano and all keyboard, voice, woodwind, strings, drum kit, electric and acoustic guitar, recorders and theory.

**Bishop's Castle IT Centre**

Filter by category:
- [x] education and learning
- [ ] leisure and culture
- [ ] community and living
- [ ] health and social care
- [ ] environment and planning
- [ ] jobs and careers
- [ ] business
- [ ] transport and streets
- [ ] advice and benefits
- [ ] housing

Filter by location:
- [x] shropshire wide

# <3 PostgreSQL

# Right Tool For The Job?

# Text Search

AS A: customer

I Want: to be easily able to find an applicable fault code for my appliance when raising a repair

So That: to get a better chance of my appliance being fixed first time

## Text Search - Simple

```
SELECT *
FROM reference.fault_code
WHERE
 to_tsvector('english',
  title || ' ' || coalesce(description, '')
 )
 @@ to_tsquery('english', 'leak');
```

## Text Search - Simple Yet Fast

```
CREATE INDEX fc_text_idx
ON reference.fault_code
USING GIN
(to_tsvector('english',
   title || ' ' || coalesce(description, '')
));
```

# Text Search - Simple Yet Fast

```
Seq Scan on fault_code  (cost=0.00..870.51 rows=15
width=170) (actual time=0.084..24.966 rows=37
loops=1)
  Rows Removed by Filter: 2978
Planning Time: 0.172 ms
Execution Time: 25.069 ms
```

# Text Search - Simple Yet Fast

```
Bitmap Heap Scan on fault_code  (cost=3.03..22.53
rows=15 width=170) (actual time=0.044..0.167 rows=37
loops=1)
  Heap Blocks: exact=20
  ->  Bitmap Index Scan on fc_text_idx
(cost=0.00..3.03 rows=15 width=0) (actual
time=0.027..0.028 rows=37 loops=1)
Planning Time: 0.308 ms
Execution Time: 0.271 ms
```

## Text Search - Realistic

```
ALTER TABLE reference.fault_code
 ADD COLUMN vector TSVECTOR;

CREATE INDEX fc_vector_idx
ON reference.fault_code
USING GIN (vector);
```

# Text Search - Realistic

```
UPDATE reference.fault_code
SET vector =
  setweight(
    to_tsvector(coalesce(category,'')), 'A'
  ) ||
  setweight(
    to_tsvector(coalesce(description,'')), 'B'
  );
```

## Text Search - Realistic

```
SELECT
  ts_rank_cd(vector,
    websearch_to_tsquery(...)), *
FROM reference.fault_code
WHERE vector @@ websearch_to_tsquery(
  'english', 'leaking door')
ORDER BY 1;
```

AS A: complaints analyst

I Want: to be able to filter call recordings by matched keywords / topics

So That: to prioritize which calls to proactively investigate

## Tags / Topics / Keywords

```
CREATE TABLE comms.call (
  id                UUID          NOT NULL,
  phone             TEXT          NOT NULL,
  transcript        JSON          NOT NULL,
  …
  topics            TEXT[]                 ,
);
```

## Tags / Topics / Keywords

```
SELECT *
FROM comms.call
WHERE topics @> ARRAY['breakdown'];

SELECT *
FROM comms.call
WHERE topics @> ARRAY['breakdown', 'boiler'];
```

## Tags / Topics / Keywords

```
CREATE TABLE comms.call (
   id                UUID          NOT NULL,
   phone             TEXT          NOT NULL,
   transcript        JSON          NOT NULL,
   …
   keywords          JSONB                 ,
);
```

## Tags / Topics / Keywords

```
SELECT *
FROM comms.call
WHERE keywords @>
        '{"make": "bosch"}'::JSONB;
```

## Tags / Topics / Keywords

```
CREATE INDEX topics_idx
ON comms.call USING GIN (topics);

CREATE INDEX keywords_idx
ON comms.call USING GIN (keywords);
```

# GIS

AS A: customer

I Want: to find classes at venues near to me

So That: I can book classes that I can easily get to

## Location Search

```
CREATE TABLE club.venue (
   id              UUID        NOT NULL,
   name            TEXT        NOT NULL,
   description     TEXT        NOT NULL,
   address         TEXT        NOT NULL,
   location        POINT
);
```

## Location Search

```
SELECT *
FROM club.venue
WHERE st_dwithin(location, $1, 2000);
```

AS A: repair provider

I Want: to allocate visits to different engineers nearest to their operating areas

So That: we can optimally allocate which engineers attend which appointments

## Location Matching

```
CREATE TABLE provider.engineer (
   id     UUID          NOT NULL,
   name   TEXT          NOT NULL,
   area   Geometry(MultiPolygon, 4326)
);
```

## Location Matching

```
SELECT *
FROM provider.engineer
WHERE st_contains(area, $1);
```

## Location Matching

```
SELECT *
FROM provider.engineer
WHERE st_intersects(area,
   st_buffer(
      st_point(-71.104, 42.315, 4326),
      0.025
   )
);
```

## Location Search / Matching - Faster

```
CREATE INDEX venue_location_idx
ON club.venue GIST (location);
```

## All Together Now

```
SELECT *
FROM search.content
WHERE vector @@ to_tsquery('library')
AND st_dwithin(location, my_location, 2000)
AND tags @> ARRAY['service_catalogue'];
```

# Unknown Unknowns

AS A: product owner

I Want: to be able to analyse how the questions we ask customers effect sales

So That: we can optimise the get a quote user flow

## Unknown Unknowns

```
CREATE TABLE insurance.quote (
  id              UUID          NOT NULL,
  customer_id     UUID          NOT NULL,
  status          STATUS        NOT NULL,
  price           NUMERIC       NOT NULL,
  answers         JSONB
);
```

# Unknown Unknowns

```
SELECT count(*),
       count(*) FILTER (WHERE (answers ->> 'locks')
                         IS NULL),
       count(*) FILTER (WHERE (answers ->> 'locks')
                         IS NOT NULL),
       count(*) FILTER (WHERE (answers ->> 'locks')
                         = '3-lever'),
       count(*) FILTER (WHERE (answers ->> 'locks')
                         = 'unknown')
FROM insurance.quotes;
```

AS A: tech-lead

I Want: to prevent my developers inserting invalid data

So That: we find problems, before they really become problems

## Check Constraints

```
ALTER TABLE insurance.quote

ADD CONSTRAINT answers_chk

CHECK (

  jsonb_typeof( answers ) = 'object'

);
```

# Stopping Things Going Wrong

AS A: customer

I Want: I don’t want to get billed twice for my subscription

So That: should be obvious really…

## Subscriptions

```
CREATE TABLE club.subscription (
   id              UUID        NOT NULL,
   member_id       UUID        NOT NULL,
   plan_id         UUID        NOT NULL,
   status          STATUS      NOT NULL,
   …
);
```

## Subscriptions

```
CREATE UNIQUE INDEX active_subs
ON club.subscription
   (member_id)
WHERE status = 'active';
```

# Invoicing With SQL

AS A: app developer

I Want: to get paid by the users of my app

So That: all is good in the world

## Generate Invoices - Writable CTEs

```
WITH invoice_commission AS (
    UPDATE billing.commission_record
    SET invoice_id = 123
    WHERE invoice_id IS NULL
    RETURNING *
) INSERT INTO billing.invoice
SELECT 123, current_date, sum(value) AS total
FROM invoice_commission;
```

# Get Latest Invoice - Lateral Joins

```
SELECT t.*, q.*
FROM platform.tenant t
LEFT JOIN LATERAL (
    SELECT invoice_date, total
    FROM billing.invoice i
    WHERE i.tenant_id = t.id
    ORDER BY invoice_date DESC
    LIMIT 1
) q ON (true);
```

# Tasks & Queues

AS A: platform

I Want: ensure that we process subscription payments and payment events, and can replay them if needed

So That: our payments handling does not require manual intervention

## Queues - A Simple Queue / Task

```
CREATE TABLE queue.event (
  created     TIMESTAMP  NOT NULL,
  updated     TIMESTAMP             ,
  status      INTEGER    NOT NULL,
  payload     TEXT
);
```

## Queues - Fetch A Batch

```
SELECT ctid, * FROM queue.event
WHERE status < 5 AND (status = 0 OR
 updated < (now() - '1 hour'::INTERVAL))
ORDER BY created DESC
LIMIT 1 /* Or more */
FOR UPDATE SKIP LOCKED;
```

## Queues - Index Time

```
CREATE INDEX queue_event_idx
ON queue.event (created)
WHERE status < 5;
```

# Queues - Fetch A Batch

```
 Limit
 (cost=0.29..0.86 rows=10 width=54)
 (actual time=0.060..0.114 rows=10 loops=1)
  ->  LockRows
      (cost=0.29..4920.33 rows=86401 width=54)
      (actual time=0.057..0.109 rows=10 loops=1)
        ->  Index Scan Backward using queue_event_idx on event
            (cost=0.29..4056.32 rows=86401 width=54)
            (actual time=0.037..0.060 rows=10 loops=1)
              Filter: ((status < 5) AND ((status = 0) OR
                       (updated < (now() - '1 hour'::interval))))
Planning Time: 0.260 ms
Execution Time: 0.179 ms
```

# Queues - Retry An Event

```
UPDATE queue.event
SET updated = now(),
    status = status + 1
WHERE ctid = '(719,117)';
```

# Queues - Processed An Event

```
UPDATE queue.event
SET updated = now(),
    status = 2147483647
WHERE ctid = '(720,2)';
```

# Mind The Gap

AS A: DBA

I Want: efficiently store energy meter data in PostgreSQL

So That: we don’t waste too much storage space

## Roll Ups

```
CREATE TABLE iot.daily_reading (
   meter_id        UUID        NOT NULL,
   read_range      DATERANGE   NOT NULL,
   energy          BIGINT,
   energy_profile BIGINT[],
   PRIMARY KEY (device_id, read_range)
);
```

# Roll Ups

| t_xmin | t_xmax | t_cid | t_xvac | t_ctid | t_infomask2 | t_infomask | t_hoff |
|---|---|---|---|---|---|---|---|
| 4 | 4 | 4 | 4 | 6 | 2 | 2 | 1 |

**24 bytes**

| device_id | read_at | temperature | light |
|---|---|---|---|
| 16 | 8 | 4 | 4 |

**32 bytes**

AS A: customer

I Want: to be able to visualise my energy consumption

So That: I can better understand how I consume my energy and can reduce my usage

# Generate Series - Presenting Data

```
SELECT r.device_id, t.time, array_agg(r.read_at),
       avg(r.temperature), avg(r.light)
FROM generate_series(
   '2022-10-06 00:00:00'::TIMESTAMP,
   '2022-10-07 00:00:00'::TIMESTAMP, '10 minutes') t(time)
JOIN iot.alhex_reading r
   ON (r.device_id = '26170b53-ae8f-464e-8ca6-2faeff8a4d01'::UUID
       AND r.read_at >= t.time
       AND r.read_at < (t.time + '10 minutes'))
GROUP BY 1, 2
ORDER BY t.time;
```

## Window Functions - Roll Up

```
SELECT
   commission AS daily_total,
   sum(commission) OVER
   (PARTITION BY date_trunc('week', day))
    AS weekly_total
FROM billing.daily;
```

## Window Functions - Counters

```
SELECT
 day,
 energy,
 energy - coalesce(lag(energy)
    OVER (ORDER BY day), 0) AS consumed
FROM iot.meter_reading
ORDER BY day;
```

# Custom Aggregates - Mind The Gap

```
WITH days AS (
  SELECT t.day::DATE
  FROM generate_series('2017-01-01'::DATE,
'2017-01-15'::DATE, '1 day') t(day)
), data AS (
   SELECT *
   FROM iot.meter_reading
   WHERE day >= '2017-01-01'::DATE
   AND   day <= '2017-01-15'::DATE
)
```

# Custom Aggregates - Mind The Gap

```
SELECT day,
       coalesce(energy,
         (((next_read - last_read)
            / (next_read_time - last_read_time))
            * (day - last_read_time))
            + last_read) AS energy_interpolated
FROM (
    ... from next slide ...
) q
ORDER BY day
```

# Custom Aggregates - Mind The Gap

```
SELECT t.day, d.energy,
  last(d.day)    OVER lookback    AS last_read_time,
  last(d.day)    OVER lookforward AS next_read_time,
  last(d.energy) OVER lookback    AS last_read,
  last(d.energy) OVER lookforward AS next_read
FROM days t
LEFT JOIN data d ON (t.day = d.day)
WINDOW
  lookback AS (ORDER BY t.day),
  lookforward AS (ORDER BY t.day DESC)
```

# Custom Aggregates - Mind The Gap

```
CREATE FUNCTION last_agg(anyelement, anyelement)
RETURNS anyelement LANGUAGE SQL IMMUTABLE STRICT AS $$
        SELECT $2;
$$;

CREATE AGGREGATE last (
        sfunc = last_agg,
        basetype = anyelement,
        stype = anyelement
);
```

# Any Questions?

# Appendix - Mind The Gap

```
WITH days AS (
  SELECT t.day::DATE
  FROM generate_series('2017-01-01'::DATE, '2017-01-15'::DATE, '1 day') t(day)
), data AS (
       SELECT *
       FROM iot.meter_reading
       WHERE day >= '2017-01-01'::DATE AND day <= '2017-01-15'::DATE
)
SELECT day, coalesce(energy_import_wh, (((next_read - last_read) / (next_read_time - last_read_time)) * (day -
last_read_time)) + last_read) AS energy_import_wh_interpolated
FROM (
  SELECT t.day, d.energy_import_wh,
       last(d.day) OVER lookback AS last_read_time,
       last(d.day) OVER lookforward AS next_read_time,
       last(d.energy_import_wh) OVER lookback AS last_read,
       last(d.energy_import_wh) OVER lookforward AS next_read
  FROM days t
  LEFT JOIN data d ON (t.day = d.day)
  WINDOW
       lookback AS (ORDER BY t.day),
       lookforward AS (ORDER BY t.day DESC)
) q  ORDER BY q.day
```