PostgreSQL is YeSQL!

All Your Base Conference 2015

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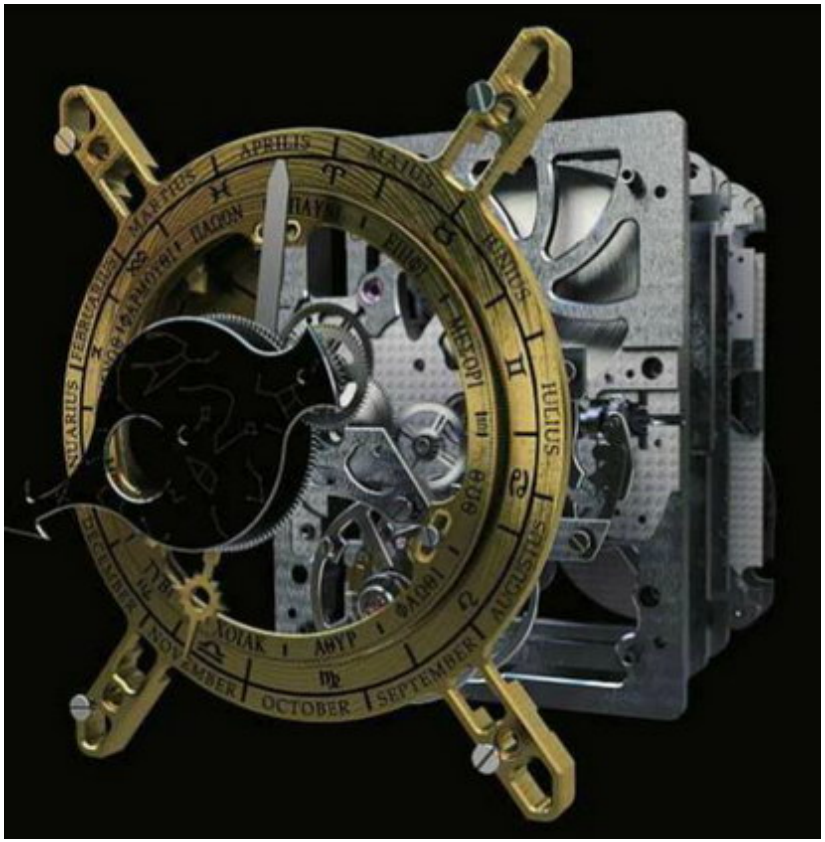
Relational Database Management System

Antikythera mechanism

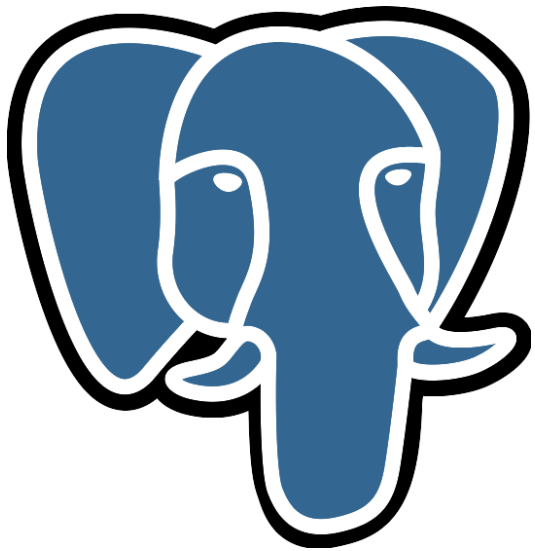
Relational Database Management System



Antikythera mechanism

Relational Database Management System

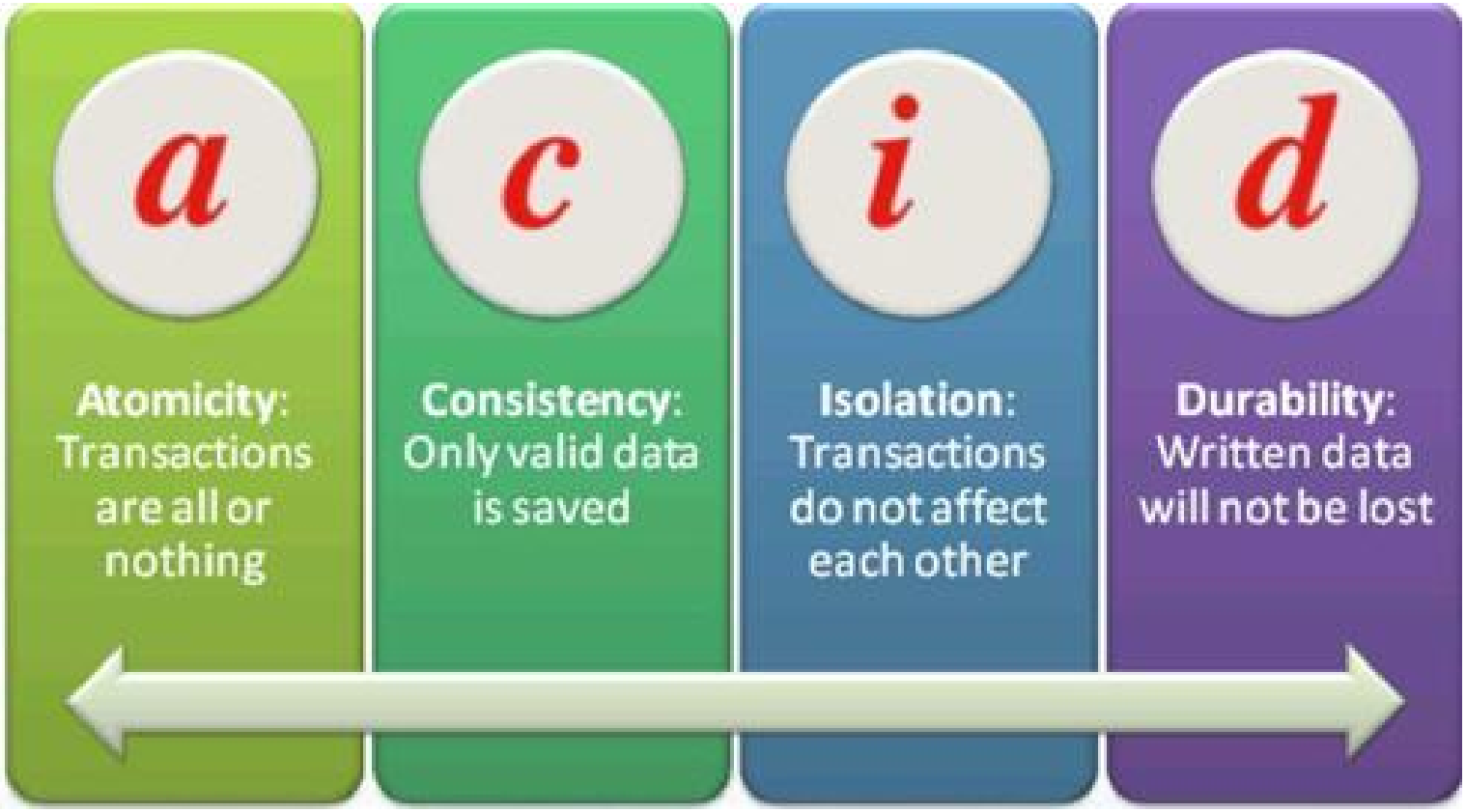
PostgreSQL is YeSQL!



PostgreSQL is YeSQL!

Relational Database Management System

Relational Database Management System



D is for Durability

A is for Atomic, that is, *Transactions*

Transactions

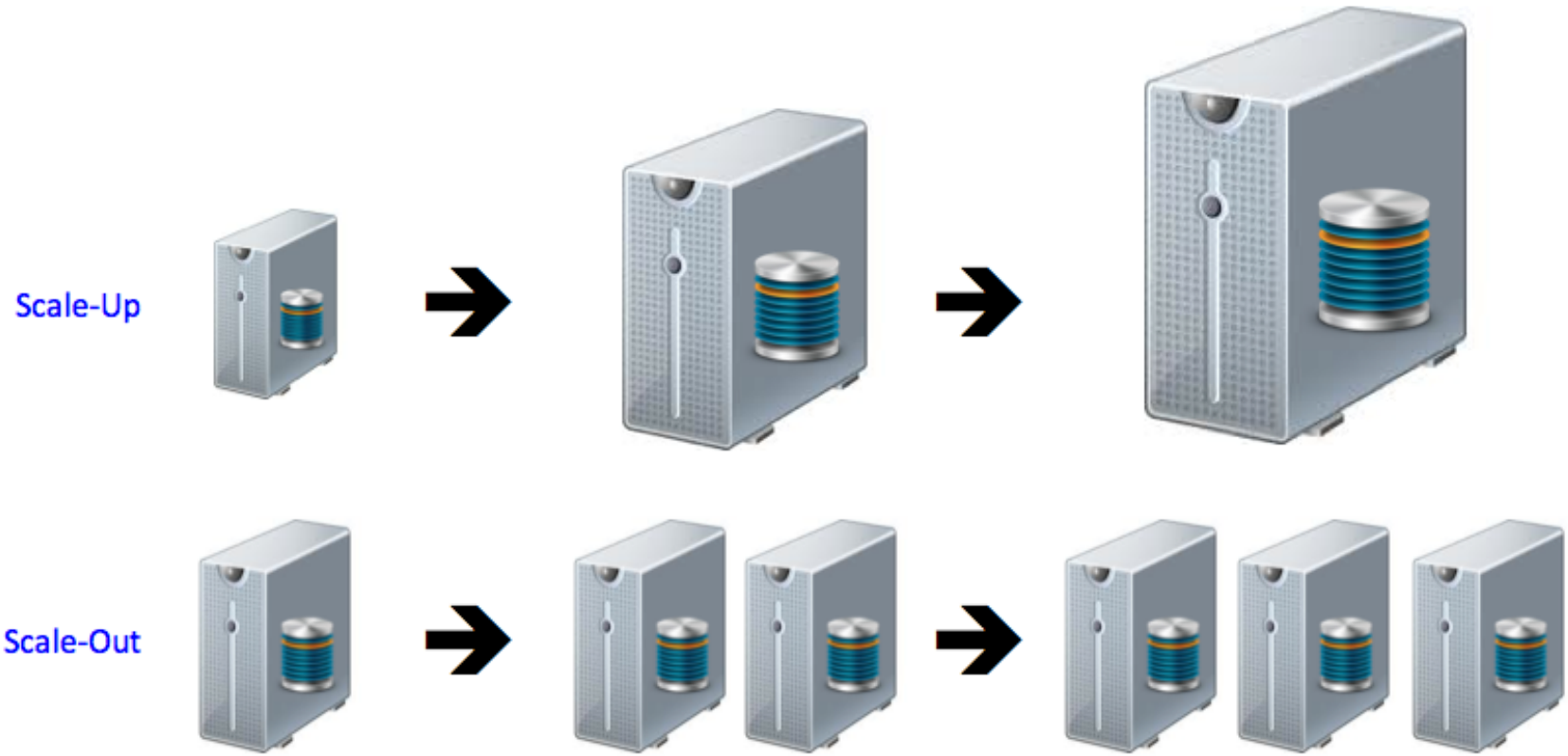
```
BEGIN;
  DROP TABLE critical_data;
ROLLBACK;
```

I is for Isolated, that is, *Transactions*

You don't want backups, you want data loss recovery!

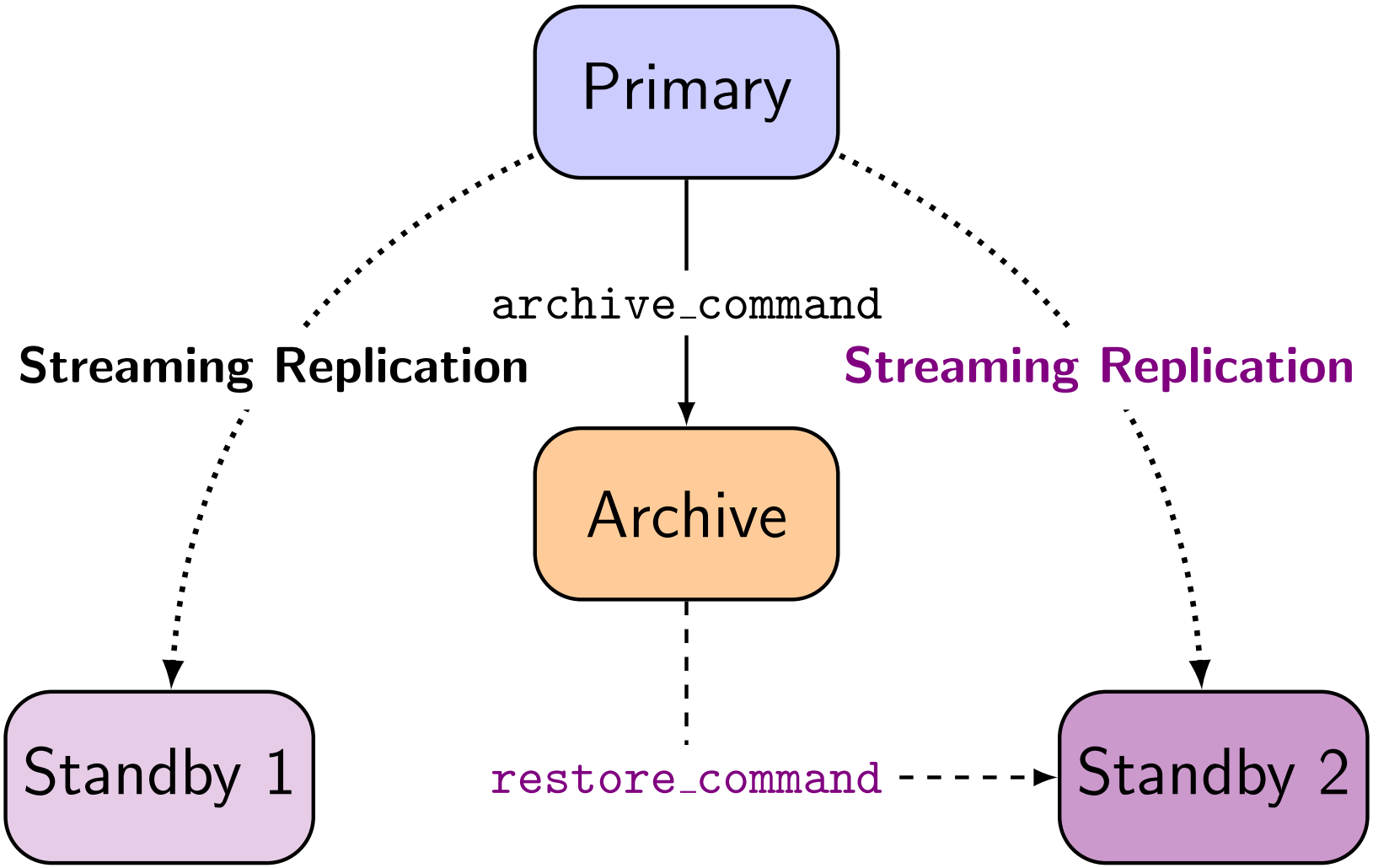
C is for Consistency

Scaling: up or out?

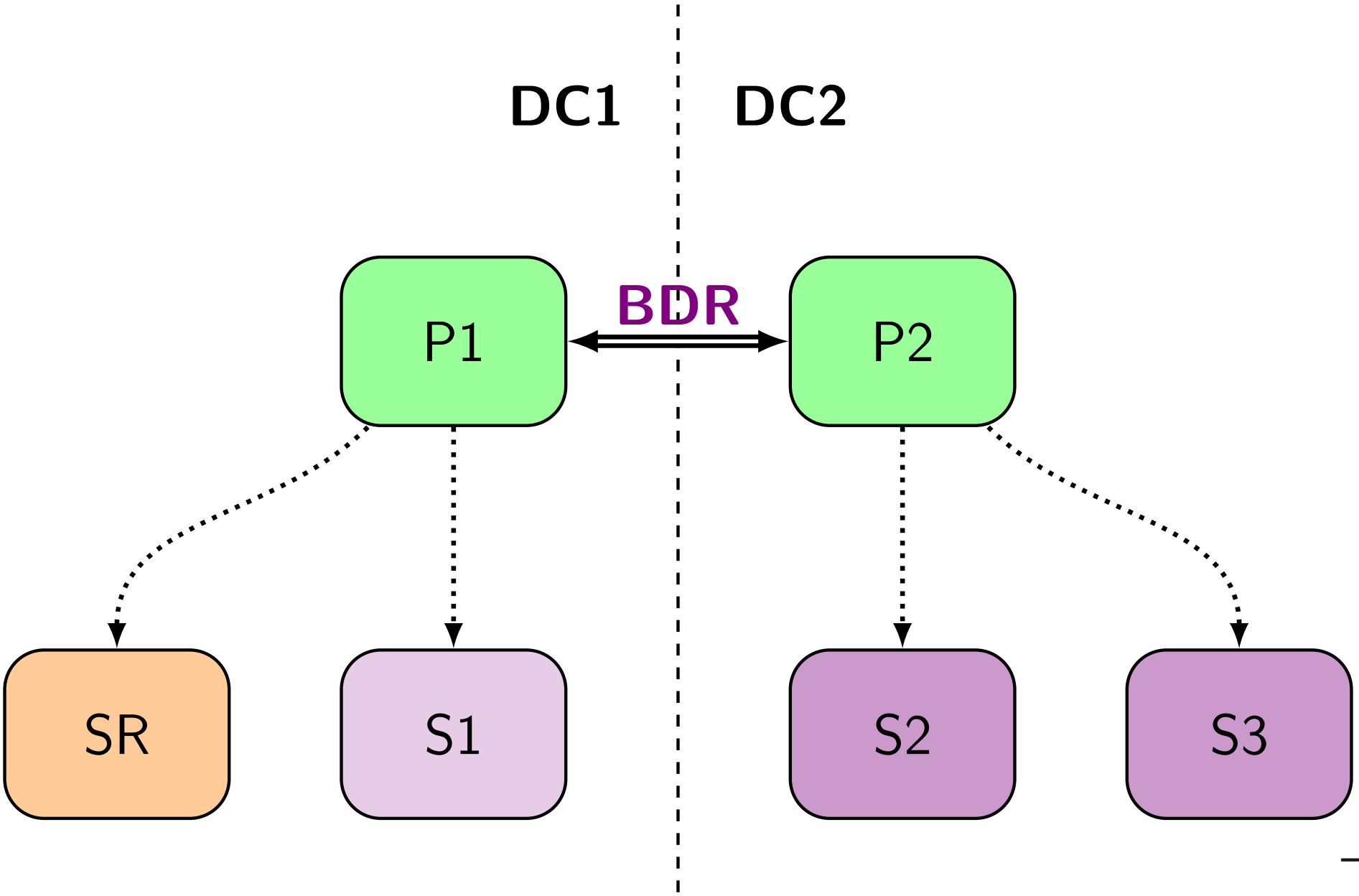


High Availability of Services and Data

High Availability: Consistency and Durability



High Availability



Consistency

Data Types and Constraints

Data integrity First Layer: data type

- Integer
- Arbitrary precision numbers, UUID
- Floating point
- Character, Text
- Bytea, bitstring
- Date/Time, Time Zones
- Boolean
- Enum, Arrays, Composite Types, Range Types
- Point, Line Segments, Boxes
- Paths, Polygons, Circles
- Inet, CIDR, Macaddr
- JSON, XML

Advanced data types and constraints

```
CREATE TABLE reservation
(
  room      text,
  professor text,
  during    period,
  EXCLUDE USING gist
  (
      room with =,
    during with &&
  )
 );
```

```
CREATE TABLE circles (
  c circle,
  EXCLUDE USING gist
    (c WITH &&)
);
```

Structured Query Language

Finding the last counter value before *reset*

Write some SQL here

```
 tick | nb | max
------+----+-----
    1 |  0 |
    2 | 10 |
    3 | 20 |
    4 | 30 |
    5 | 40 |  40
    6 |  0 |
    7 | 20 |
    8 | 30 |
    9 | 60 |  60
(9 rows)
```

Window Functions: lead() over()

```
select tick,
       nb,
       lead(nb) over (order by tick)
  from measures;
```

```
 tick | nb | lead
------+----+------
    1 |  0 |   10
    2 | 10 |   20
    3 | 20 |   30
    4 | 30 |   40
    5 | 40 |    0
    6 |  0 |   20
    7 | 20 |   30
    8 | 30 |   60
    9 | 60 |
(9 rows)
```

Window Functions and CASE

```
select tick, nb,
       case when lead(nb) over w < nb
            then nb

            when lead(nb) over w is null
            then nb

            else null
        end as max
  from measures
window w as (order by tick);
```

```
 tick | nb | max
------+----+-----
    1 |  0 |
    2 | 10 |
    3 | 20 |
    4 | 30 |
    5 | 40 |  40
    6 |  0 |
    7 | 20 |
    8 | 30 |
    9 | 60 |  60
(9 rows)
```

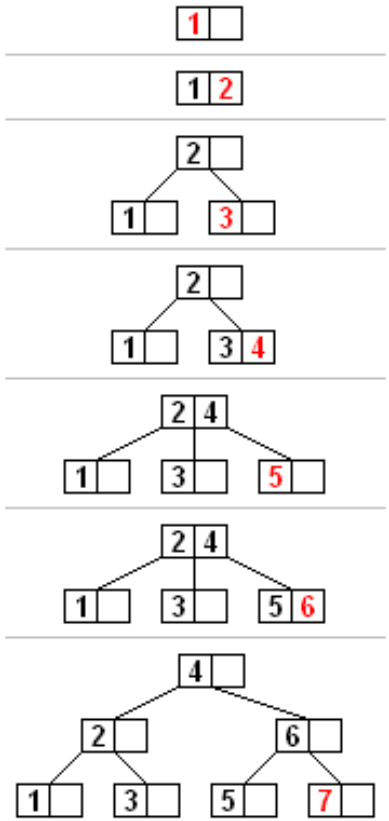
PostgreSQL Extensibility

PostgreSQL is *highly* **extensible**

B-Tree

Balanced Tree, the default index type

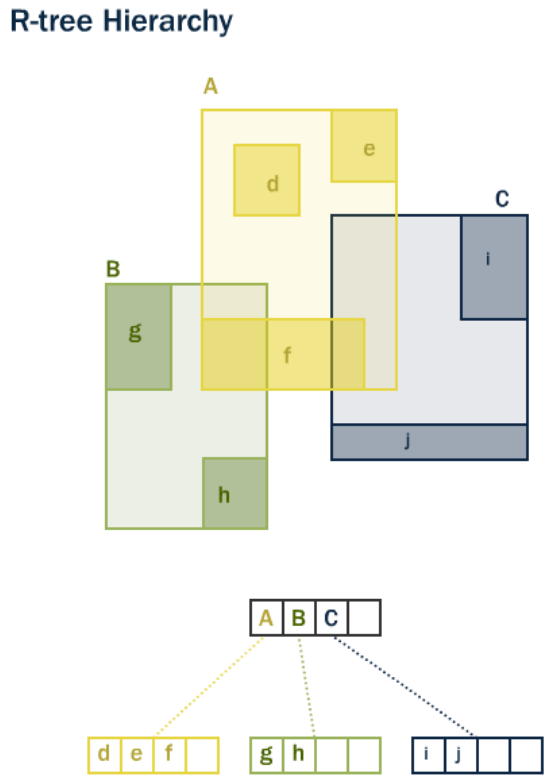
- Built for speed
- *unique* concurrency tricks
- Balanced
- support function: `cmp`
- operators: `<=` `<` `=` `>` `>=`



Generalized Index Search Tree

GiST or the Indexing API

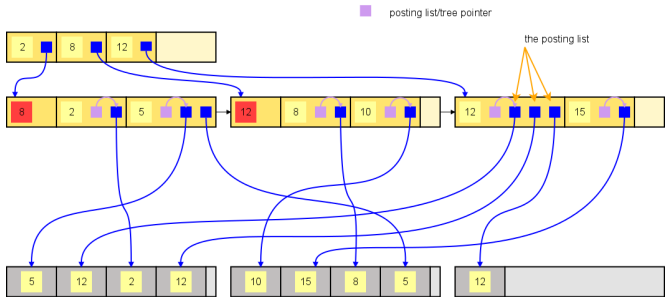
- Built for comfort
- Balanced
- API: `consistent`, `same`, `union`
- API: `penalty`, `picksplit`
- API: `compress`, `decompress`
- operators: `@>` `<@` `&&` `@@` `=` `&<` `&>` `<<|` ...



Generalized Inverted iNdex

Indexing several pointers per value, inversed cardinality

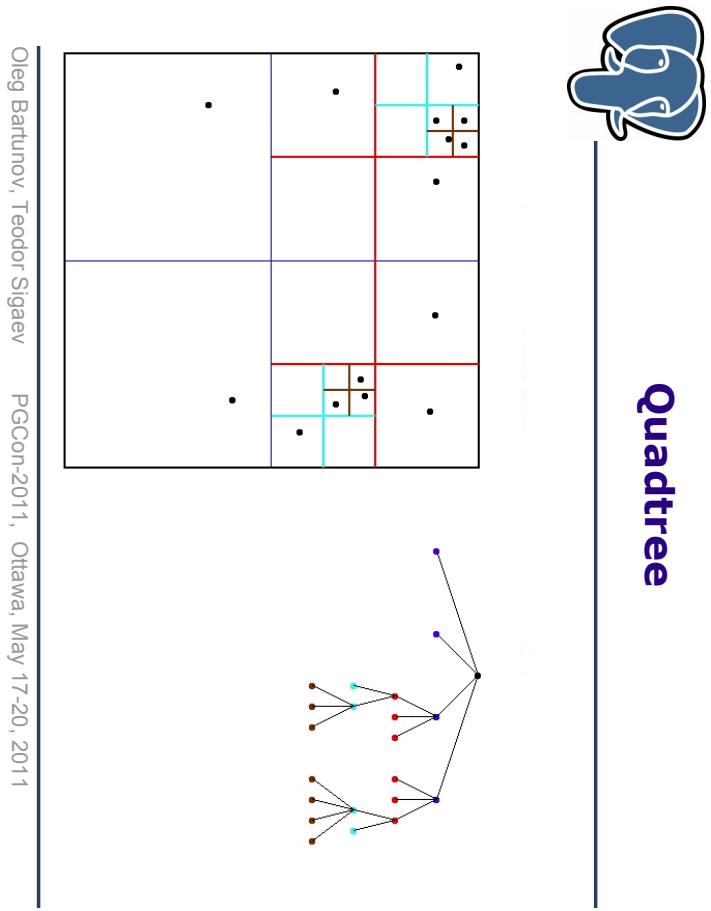
- Built for Text Search and Arrays
- Balanced
- API: `compare`, `consistent`
- API: `extractValue`, `extractQuery`
- operators: `@>` `<@` `&&` `=`



PostgreSQL Full Text Search

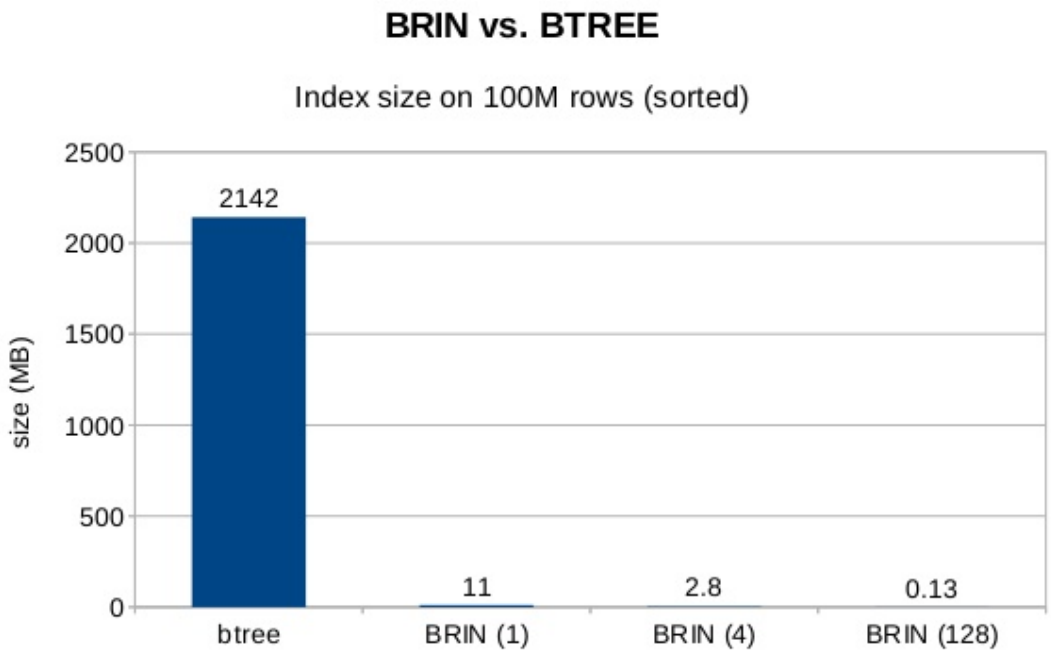
Spaced Partition GiST

Unbalanced index, used for GIS



BRIN

Block Range Index for Big Data



2ndQuadrant
Professional PostgreSQL

Structured Query Language

IP Ranges, ip4r, Geolocation

PostgreSQL allows using SQL and JOINs to match IP4R with geolocation.

```
select *
  from geolite.blocks
  join geolite.location
       using(locid)
 where iprange
           >>=
       '74.125.195.147';
```

IP Ranges, ip4r, Geolocation

PostgreSQL allows using SQL and JOINs to match IP4R with geolocation.

```
select *
  from geolite.blocks
  join geolite.location
       using(locid)
 where iprange
           >>=
       '74.125.195.147';
```

```
-[ RECORD 1 ]----------------------
locid      | 2703
iprange    | 74.125.189.24-74.125.
country    | US
region     | CA
city       | Mountain View
postalcode | 94043
location   | (-122.0574,37.4192)
metrocode  | 807
areacode   | 650

Time: 1.335 ms
```

Geolocation: `ip4r` meets earthdistance

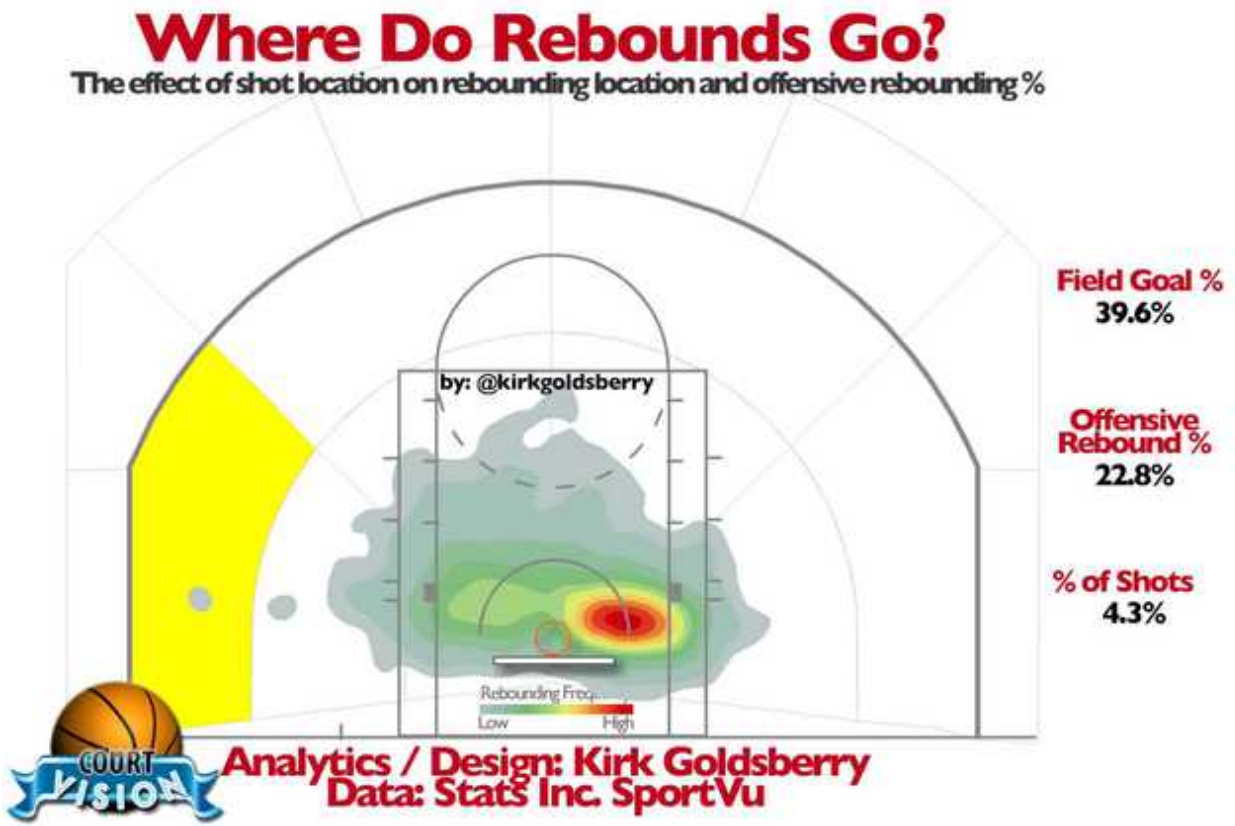
Some pubs nearby... some place...

```
with geoloc as
 (
  select location as l
    from location
    join blocks using(locid)
   where iprange
         >>=
         '212.58.251.195'
 )
  select name,
         pos <@> l miles
    from pubnames, geoloc
order by pos <-> l
   limit 10;
```

```
        name          | miles
----------------------+-------
 Blue Anchor          | 0.299
 Dukes Head           | 0.360
 Blue Ball            | 0.337
 Bell (aka The Rat)   | 0.481
 on the Green         | 0.602
 Fox & Hounds         | 0.549
 Chequers             | 0.712
 Sportsman            | 1.377
 Kingswood Arms       | 1.205
 Tattenham Corner     | 2.007
(10 rows)

Time: 3.275 ms
```

NBA Games Statistics



NBA Games Statistics

An interesting factoid: the team that recorded the fewest defensive rebounds in a win was the 1995-96 Toronto Raptors, who beat the Milwaukee Bucks 93-87 on 12/26/1995 despite recording only 14 defensive rebounds.

PostgreSQL Data Mining

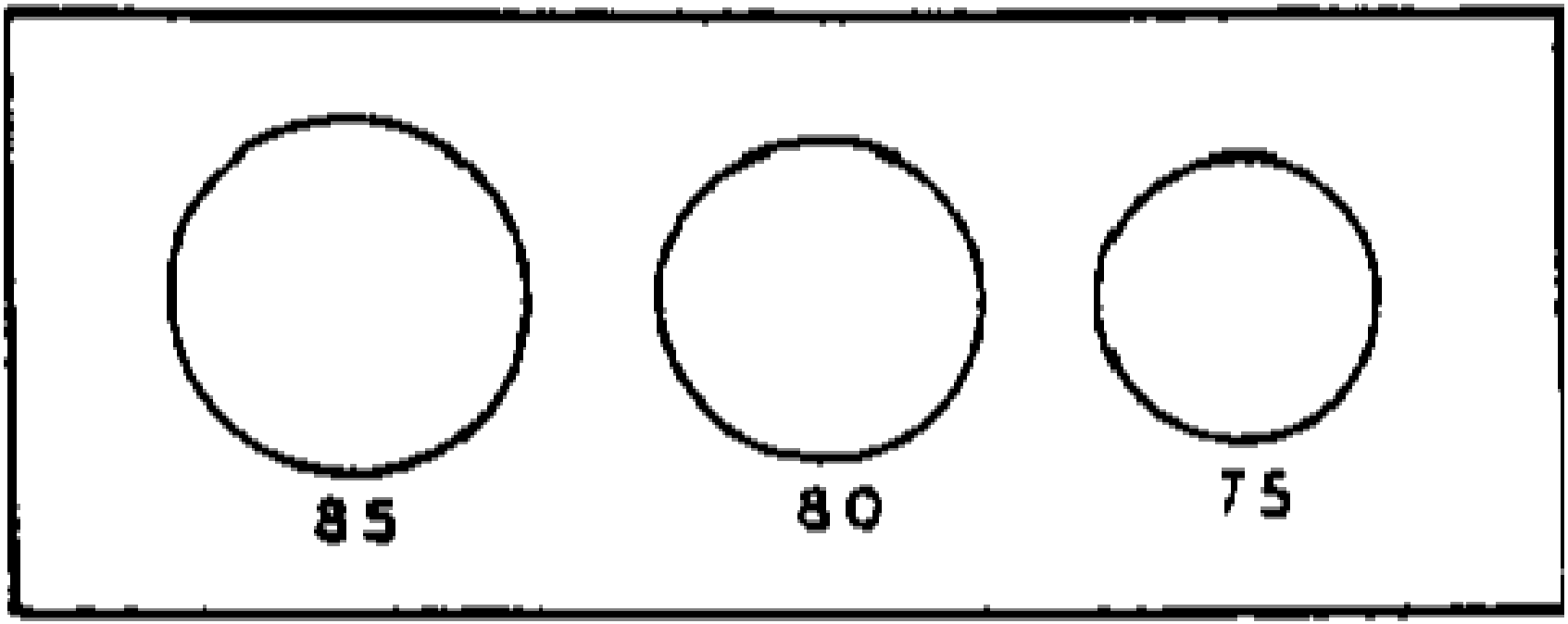
```
with stats(game, team, drb, min) as (
    select ts.game, ts.team, drb, min(drb) over ()
      from team_stats ts
           join winners w on w.id = ts.game
                         and w.winner = ts.team
)
select game.date::date,
       host.name || ' -- ' || host_score as host,
       guest.name || ' -- ' || guest_score as guest,
       stats.drb as winner_drb
  from stats
       join game on game.id = stats.game
       join team host on host.id = game.host
       join team guest on guest.id = game.guest
 where drb = min;
```

PostgreSQL Data Mining

```
-[ RECORD 1 ]-------------------------
date       | 1995-12-26
host       | Toronto Raptors -- 93
guest      | Milwaukee Bucks -- 87
winner_drb | 14
-[ RECORD 2 ]-------------------------
date       | 1996-02-02
host       | Golden State Warriors -- 114
guest      | Toronto Raptors -- 111
winner_drb | 14
-[ RECORD 3 ]-------------------------
date       | 1998-03-31
host       | Vancouver Grizzlies -- 101
guest      | Dallas Mavericks -- 104
winner_drb | 14
-[ RECORD 4 ]-------------------------
date       | 2009-01-14
host       | New York Knicks -- 128
guest      | Washington Wizards -- 122
winner_drb | 14

Time: 126.276 ms
```

Pure SQL Histogram drawing



Pure SQL Histogram drawing

```
with drb_stats as (
     select min(drb) as min,
            max(drb) as max
       from team_stats
),
     histogram as (
    select width_bucket(drb, min, max, 9) as bucket,
           int4range(min(drb), max(drb), '[]') as range,
           count(*) as freq
      from team_stats, drb_stats
  group by bucket
  order by bucket
)
  select bucket, range, freq,
         repeat('*', (freq::float / max(freq) over() * 30)::int
    from histogram;
```

Pure SQL Histogram drawing

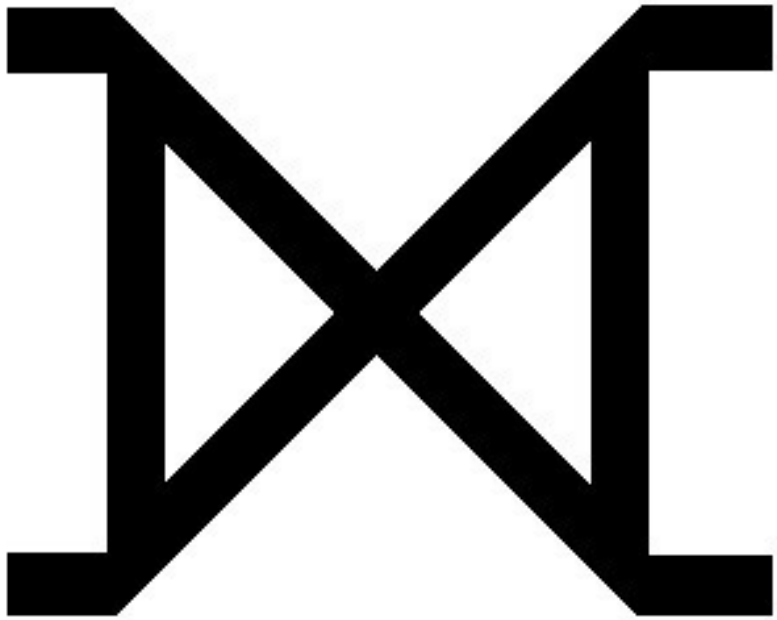
```
 bucket |   range   | freq  |                bar
--------+-----------+-------+-----------------------------------
      1 | [10,15)   |    52 |
      2 | [15,20)   |  1363 | **
      3 | [20,25)   |  8832 | **********
      4 | [25,30)   | 20917 | ********************************
      5 | [30,35)   | 20681 | ********************************
      6 | [35,40)   |  9166 | **********
      7 | [40,45)   |  2093 | ***
      8 | [45,50)   |   247 |
      9 | [50,54)   |    20 |
     10 | [54,55)   |     1 |
(10 rows)

Time: 53.570 ms
```

Writeable CTE

```
with queue as (
   insert into queue (extension)
        select id
          from extension
         where shortname = $1
  returning id, extension
)
select q.id, e.id as ext_id,
       e.fullname, e.uri, e.description
  from      queue q
       join extension e on q.extension = e.id;
```

PostgreSQL Joins



PostgreSQL Joins

```
WITH upd AS (
    UPDATE target t
       SET counter = t.counter + s.counter,
      FROM source s
     WHERE t.id = s.id
 RETURNING s.id
)
INSERT INTO target(id, counter)
     SELECT id, sum(counter)
       FROM source s LEFT JOIN upd t USING(id)
      WHERE t.id IS NULL
   GROUP BY s.id
   RETURNING t.id
```

PostgreSQL Lateral Joins

Fetch the 10 most recent news for each topic (**Top-N**)

```
SELECT n.*
  FROM subscriptions s
  JOIN LATERAL (SELECT *
                  FROM news n
                 WHERE n.topic = s.topic
                 ORDER BY n.created DESC
                 LIMIT 10
               ) top_news ON (true)
 WHERE s.user_id = ?
 ORDER BY n.created DESC
 LIMIT 10
```

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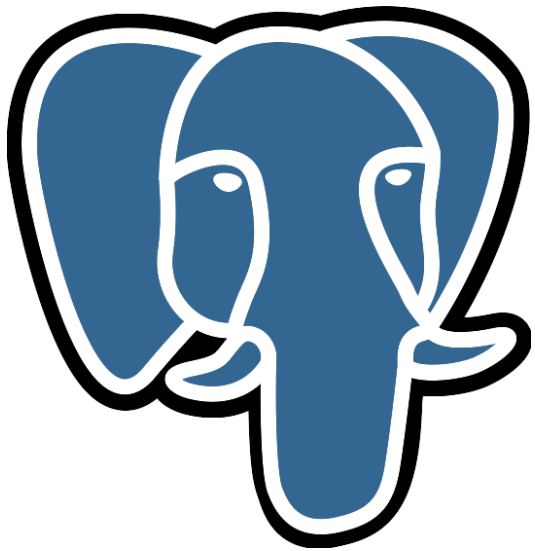

Questions?

Now is the time to ask!