Getting Started with PostgreSQL

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Introduction: PostgreSQL in Context

Industry trends: NoSQL databases (Redmond and Wilson 2012)

- ▶ Graph databases
- ▶ Key-value stores
- ▶ JSON document stores
- ▶ In-memory databases

Industry trends: Backend frameworks (Apache/PHP, Ruby on Rails, Django)

- Work with *any* database (MySQL/MariaDB, SQLite, PostgreSQL)
- Just use the database for CRUD, application logic is all in PHP / Ruby / Python / JavaScript code!
- Wait - CRUD?
  - Create
  - Read (aka SELECT)
  - Update
  - Delete

If all you want . . .

- ▶ If all you want is an industrial-strength open-source permissive-licensed CRUD engine that
  - ▶ Is fully ACID compliant
  - ▶ Scales to huge installations
  - ▶ Has replication / failover / high availability as standard equipment
- ▶ Yeah, PostgreSQL's got that.

But if you also want . . .

- ▶ Full-text search
- ▶ Stored procedures in Python, Perl, Ruby, R, Tcl and Lua
- ▶ Foreign data (Text files, GIS data, MySQL/MariaDB, Redis)
  mapped into your database (foreign data wrappers)
- ▶ Key-value stores (hstore)
- ▶ JSON document stores (jsonb)
- ▶ Yeah, PostgreSQL's got that too!

Speaking of industrial strength . . .

- ▶ Geographic Information Systems (GIS)
- ▶ PostGIS
  - ▶ Read and write GIS data files
  - ▶ Process geometric, geographic and topology GIS data types
  - ▶ Both vector and raster data
  - ▶ Geocoding, reverse geocoding, address standardization
- ▶ pgRouting
  - ▶ Shortest / fastest / lowest cost routes from point A to point B
  - ▶ Traveling salesperson problem
  - ▶ Turn-by-turn directions for cars, bikes and pedestrians!
- ▶ Yeah, I want that CRUD too!

PostgreSQL on the Desktop - single user

Windows or Mac

- Go to EnterpriseDB download site
  https://www.enterprisedb.com/downloads/postgres-postgresql-downloads.
- Select the latest version (10.3)
- Select your operating system (Windows or Mac)
- Installation: install everything but don't run StackBuilder yet

Linux: use the PGDG repositories

- RHEL / CentOS / Fedora:
  https://www.postgresql.org/download/linux/redhat/
- Ubuntu: https://www.postgresql.org/download/linux/ubuntu/
  (probably works for Linux Mint)
- Debian: https://www.postgresql.org/download/linux/debian/
- Installation: install PostgreSQL 10.3 and pgAdmin 4 for
  desktop

Connecting with pgAdmin

- ▶ Reference: R. Obe and Hsu (2017b), chapter 4

Exploring the tree

Creating a database

Creating tables - DDL

Reading a CSV file into a table - COPY

Backing up a database

Restoring a database

Creating a query

PostgreSQL on a (Linux) Server

Two dialects of Linux

- Ubuntu 16.04.x LTS (most popular)
- RHEL 7 / CentOS 7

Docker container

- ► Debian stable - similar to Ubuntu
- ► Alpine - avoid this unless you want to do a lot of research
- ► I have a full PostgreSQL / PostGIS / pgRouting stack in a container at
  https://github.com/hackoregon/data-science-pet-containers.
  - ► The documentation's a bit sparse still
  - ► Native executables will perform better
  - ► Docker hosting on a desktop / laptop isn't exactly end-user friendly yet

The PGDG repositories

Configuring

- ► Initializing the cluster
- ► Enabling and starting the service

Listening address and port

Authentication

Fine-grained permissions and roles

Tablespaces

PostGIS

Reading in GIS data (Obe and Hsu 2015, chap. 4)

- Shapefiles
- "GDB" databases
- OpenStreetMap data

Tagging points with a geometry column

Geocoding (Obe and Hsu 2015, chap. 8)

- There's a demo using a Docker container at
  https://github.com/hackoregon/data-science-pet-
  containers/tree/master/examples/geocoding.
- This uses a container running Debian Linux with a full
  PostgreSQL / PostGIS / pgRouting stack.
- *I have not tested it on a Windows Docker host, just
  Linux. It undoubtedly needs some adjustments for the
  volumes mounted on host filesystems.*

Spatial joins

pgRouting - what it can do

Turn-by-turn directions

- Reference: (R. Obe and Hsu 2017a)

References

References

Obe, Regina O., and Leo S. Hsu. 2015. *PostGIS in Action, Second Edition*. Manning Publications Co. https://www.manning.com/books/postgis-in-action-second-edition.

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Redmond, Eric, and Jim R. Wilson. 2012. *Seven Databases in Seven Weeks*. The Pragmatic Programmers. https://pragprog.com/book/rwdata/seven-databases-in-seven-weeks.