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.
  - See https://github.com/hackoregon/data-science-pet-containers/blob/master/containers/small.yml for the Docker compose file
  - 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

- Linux distributions ship with the version of PostgreSQL that was stable when their release process froze features.
- You'll still get security updates and bug fixes, but no new features.
- So the PostgreSQL Global Development Group (PGDG) maintains up-to-date binary repositories for all the major Linux distros.
- These binaries are as well tested and supported as those that ship with the Linux distros.
- Download page: https://www.postgresql.org/download/

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

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