

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

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>.

Obe, Regina, and Leo Hsu. 2017a. *PgRouting: A Practical Guide*. Locate Press LLC. <https://locatepress.com/pgrouting>.

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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>.