Hello Greenplum

An Introduction to the World's First Open-Source & Massively Parallel Data Platform

Bradford D. Boyle & Andreas Scherbaum

Outline

1. What is Greenplum? Who is using it?
2. History: Where does it come from?
3. How does it work?
4. Demo
5. Where to get it?

Audience

If you

- don’t know what Greenplum is
- heard about it but don’t know the details
- are curious

Then this talk is for you!

Bradford D. Boyle

- Working for Pivotal since 2016
- Work on
  - GemFire-Greenplum Connector
  - Greenplum-Spark Connector
- Twitter: @BradfordDBoyle

Bradford Boyle
bradfordboyle

Add a bio

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Organizations

What is Greenplum?

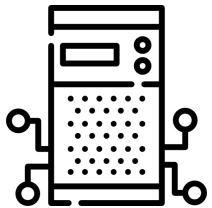
What is Greenplum

- Massively Parallel Processing (MPP)
- Shared Nothing
- Database

Massively Parallel Processing (MPP)

- Scales out from one system to dozens or possibly hundreds of servers
- Everything is one big database
- The software handles the data distribution and the query planning and execution

Little Bit of History



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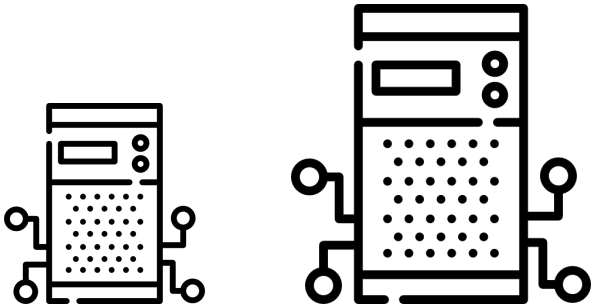

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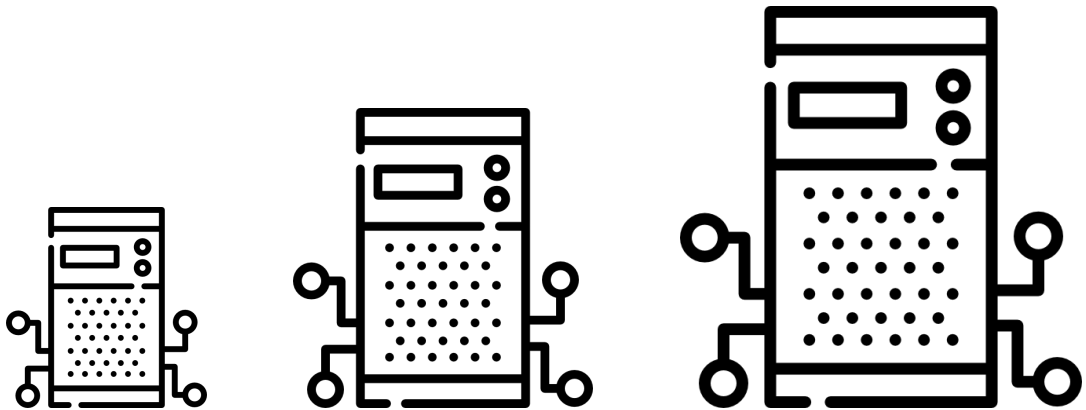
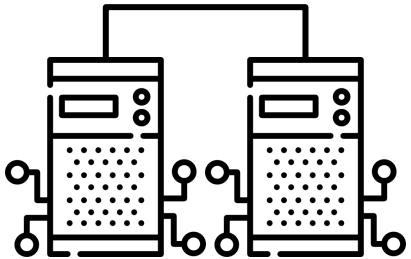


Scale Out, Not Up



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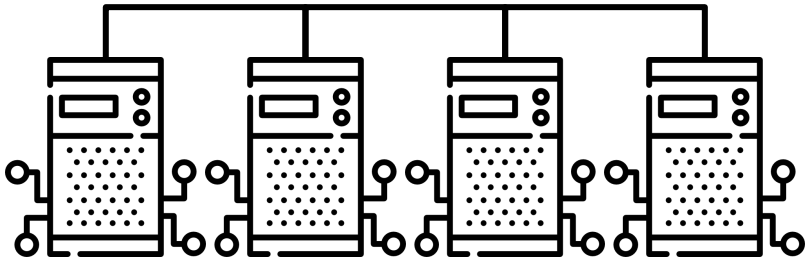
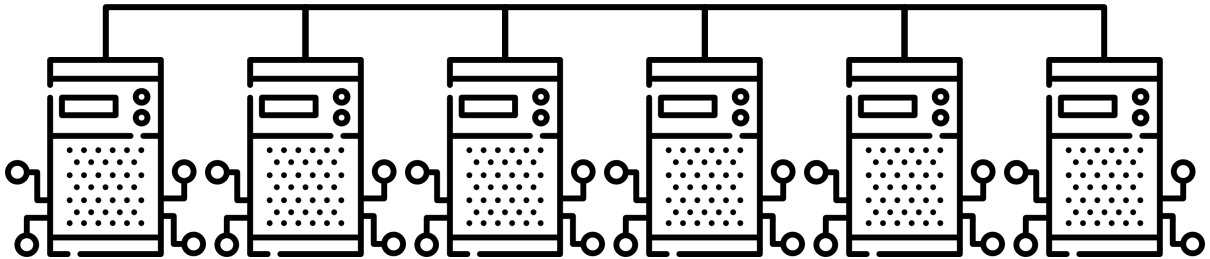
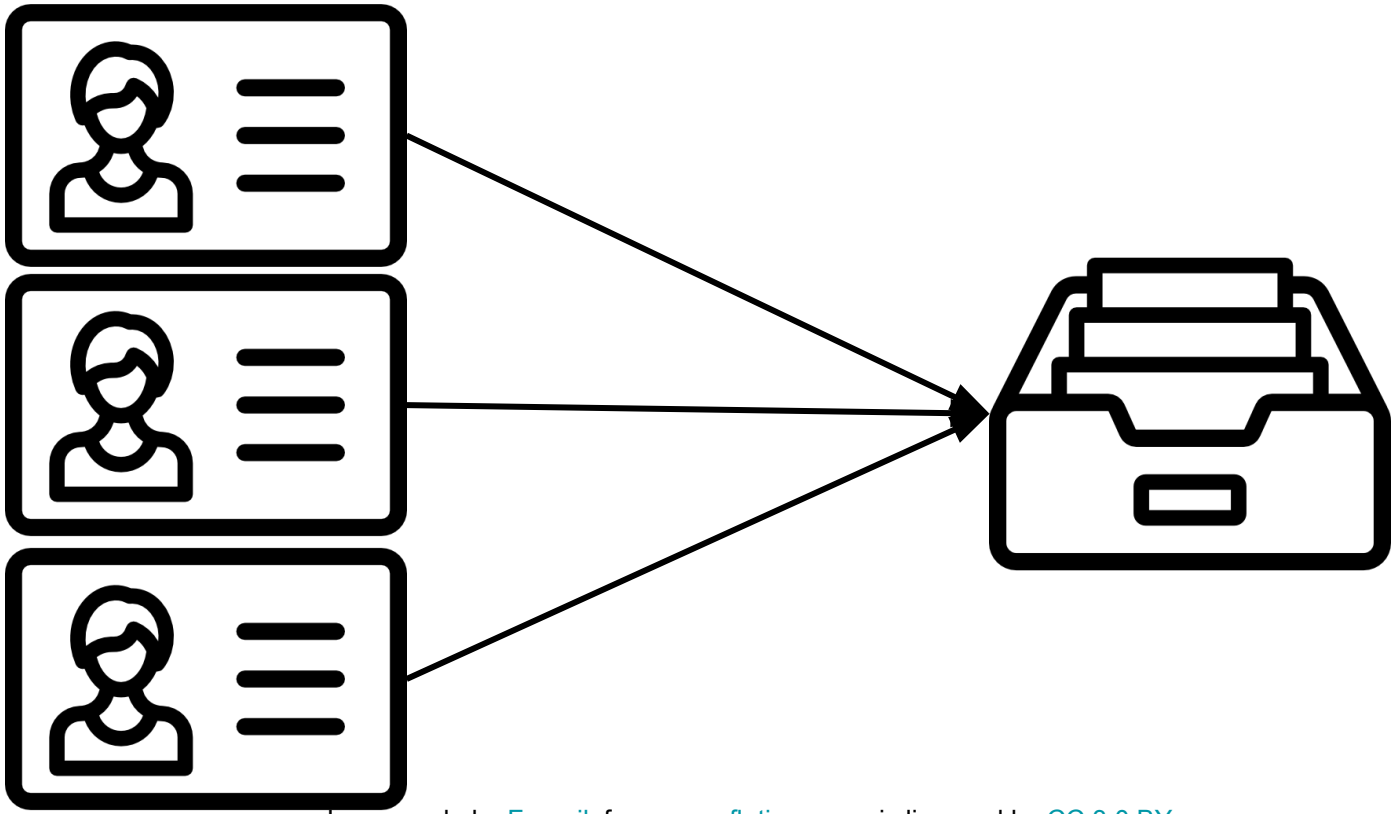


Scale Out, Not Up



A Brief Analogy



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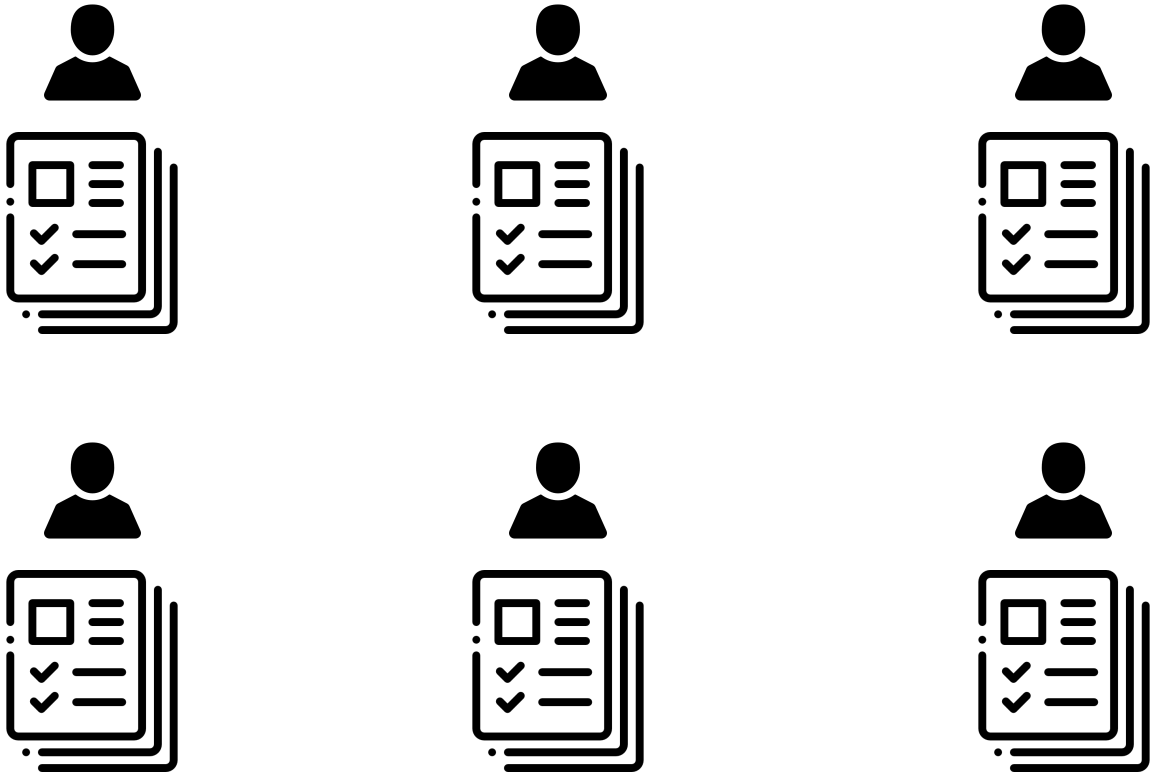


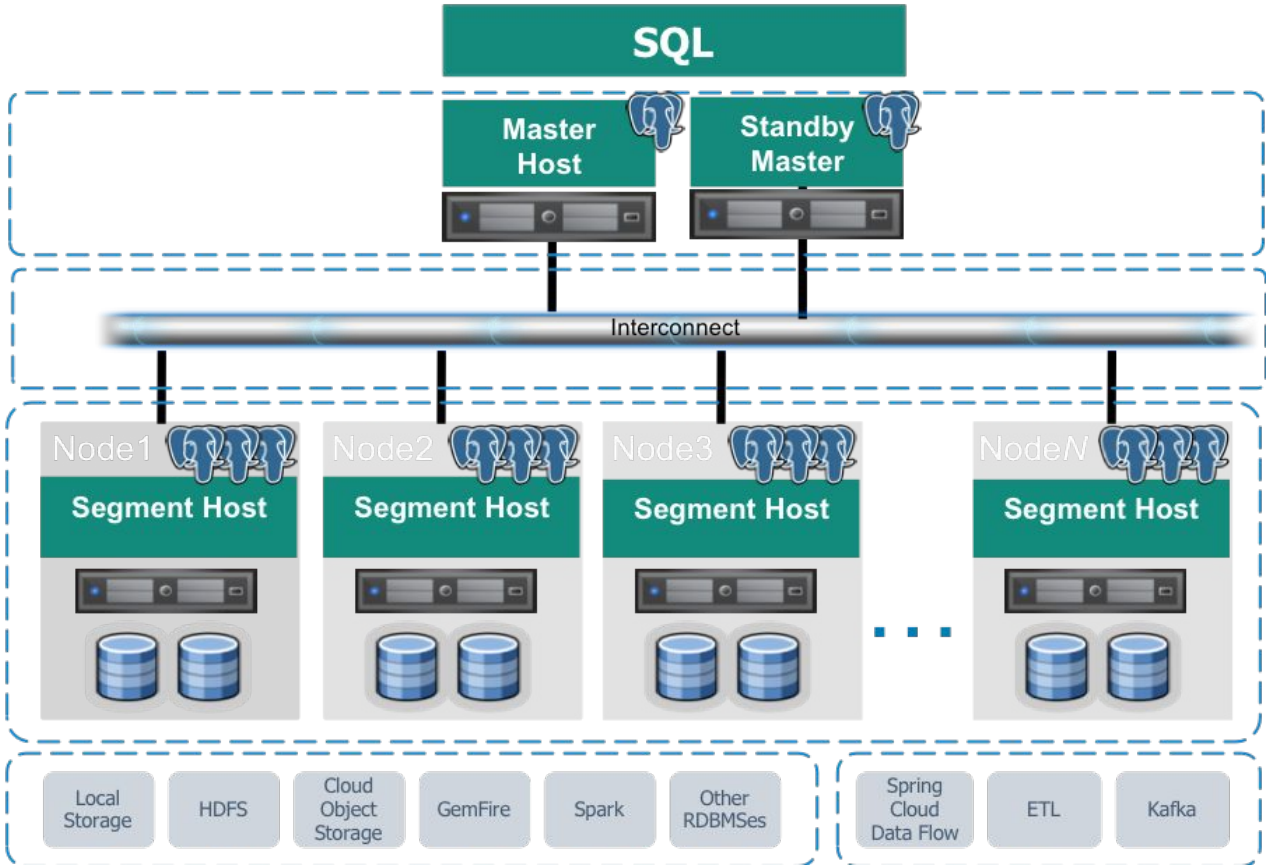
Greenplum is MPP for Analytics

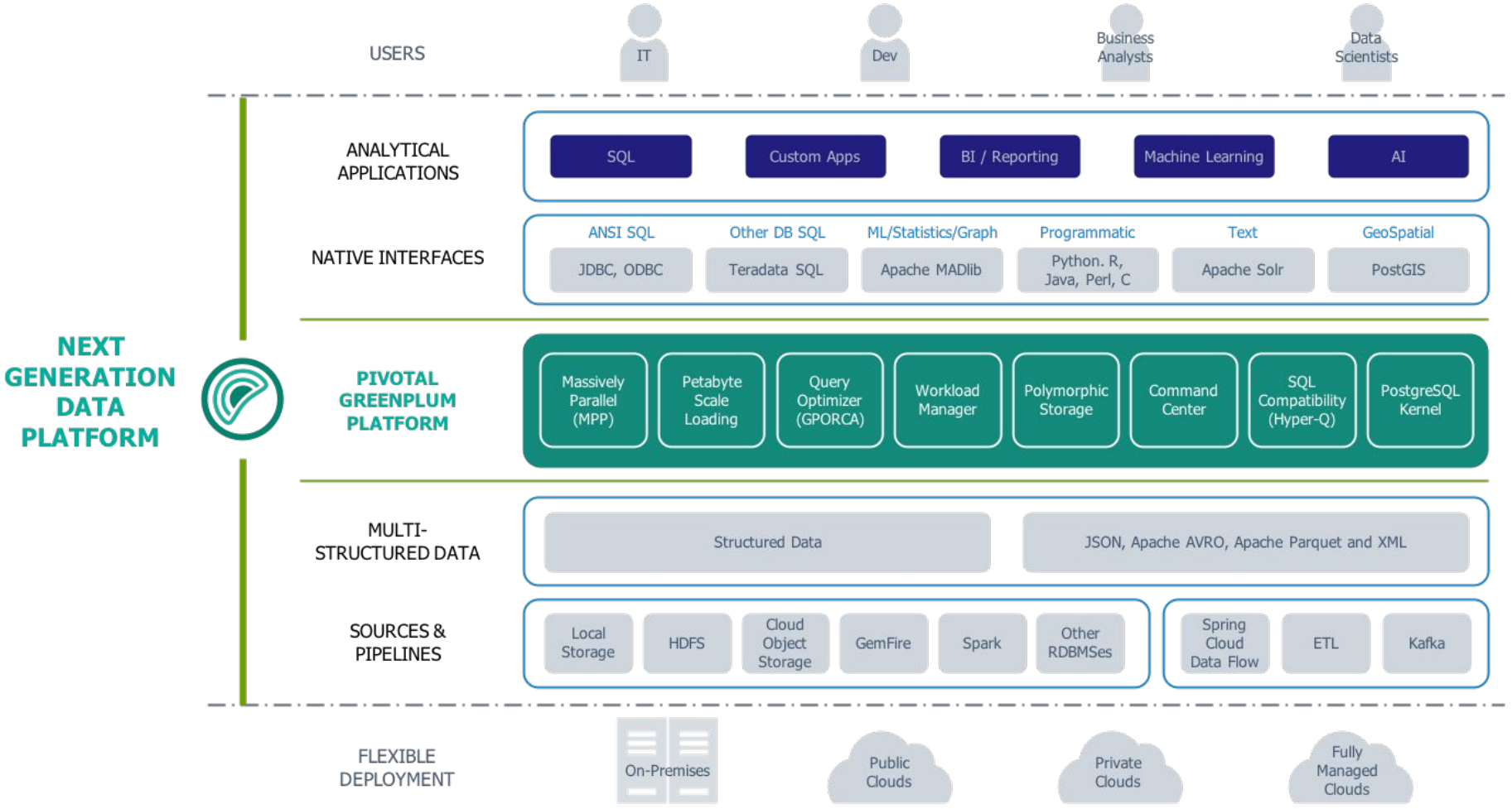
Master Server
Query planning & dispatch

Interconnect

Segment Servers
Query processing & data storage

External Resources
Parallel loading & streaming




USERS
IT
Dev
Business Analysts
Data Scientists
NEXT GENERATION DATA PLATFORM
ANALYTICAL APPLICATIONS
SQL
Custom Apps
BI / Reporting
Machine Learning
AI
NATIVE INTERFACES
ANSI SQL
JDBC, ODBC
Other DB SQL
Teradata SQL
ML/Statistics/Graph
Apache MADlib
Programmatic
Python. R, Java, Perl, C
Text
Apache Solr
GeoSpatial
PostGIS
PIVOTAL GREENPLUM PLATFORM
Massively Parallel (MPP)
Petabyte Scale Loading
Query Optimizer (GPORCA)
Workload Manager
Polymorphic Storage
Command Center
SQL Compatibility (Hyper-Q)
PostgreSQL Kernel
MULTI-STRUCTURED DATA
Structured Data
JSON, Apache AVRO, Apache Parquet and XML
SOURCES & PIPELINES
Local Storage
HDFS
Cloud Object Storage
GemFire
Spark
Other RDBMSes
Spring Cloud Data Flow
ETL
Kafka
FLEXIBLE DEPLOYMENT
On-Premises
Public Clouds
Private Clouds
Fully Managed Clouds

Shared Nothing

- Servers do not share infrastructure (like disks, CPU, or memory)
- Every server is autonomous
- All servers are connected through a high-speed network (interconnect)
- Data redistribution is handled by the software

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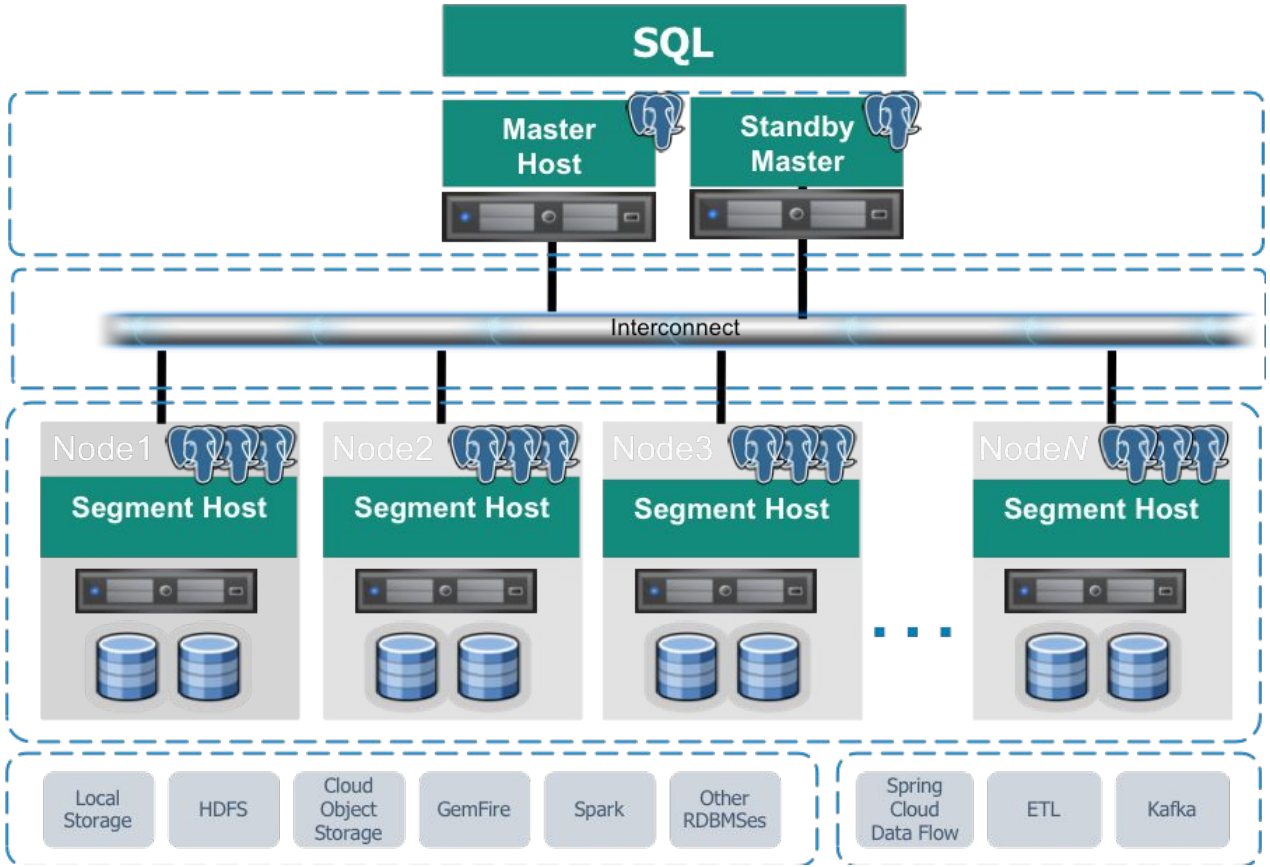
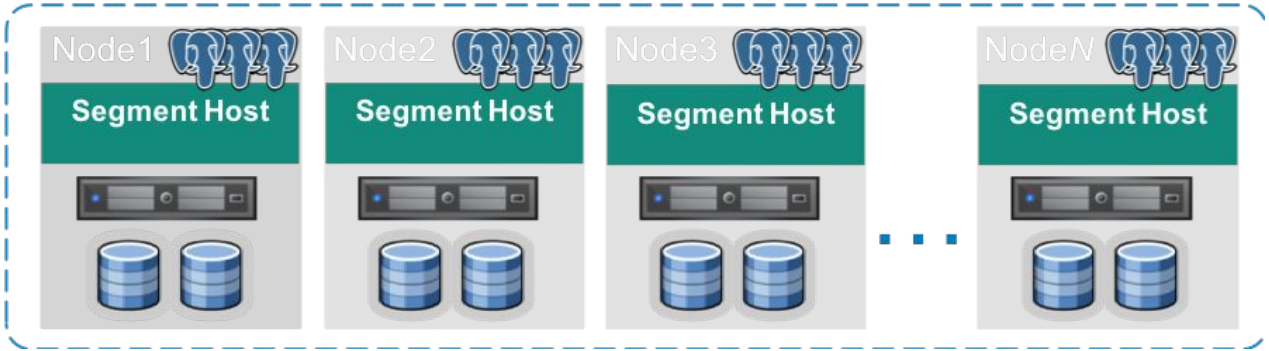


Shared Nothing

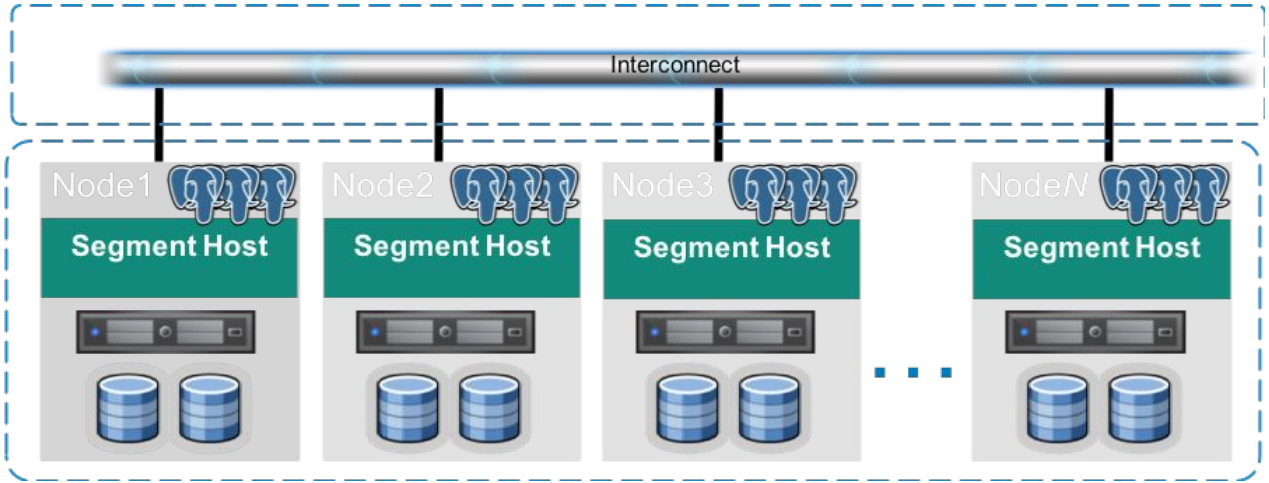
Segment Servers
Query processing & data storage



Shared Nothing

Interconnect

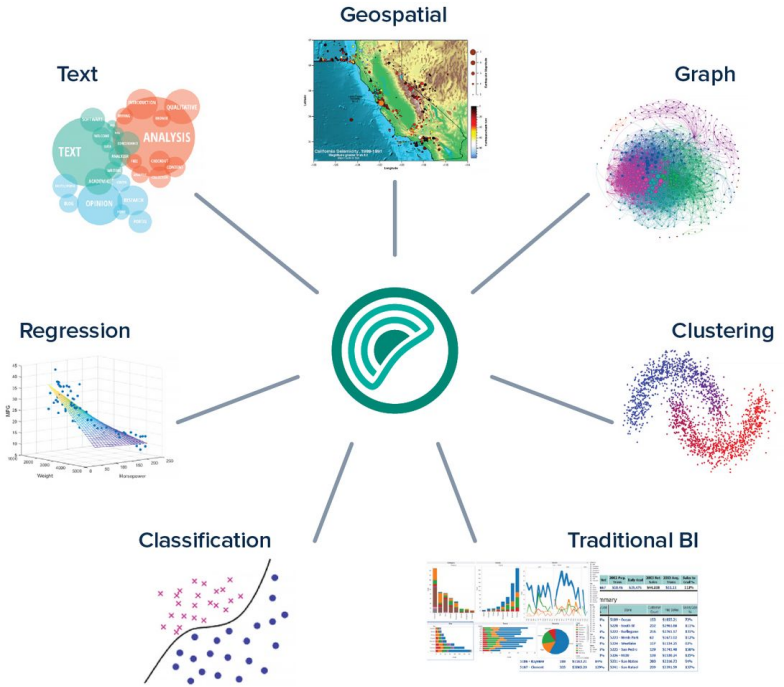
Segment Servers
Query processing & data storage



Who is Using Greenplum?

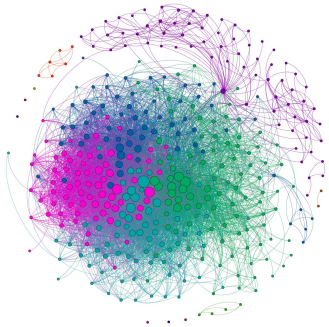
Greenplum Integrated Analytics

- Traditional & Advanced In-Database Analytics



Greenplum Analytics: Graph

- Designed for very large graphs (billions of vertices/edges)
- No need to move data & transform for external graph engine
- Support for most popular graph algorithms
- Familiar SQL interface



```
SELECT madlib.pagerank(
                        'vertex',              -- Vertex table
                        'id',                  -- Vertix id column
                        'edge',                -- Edge table
                        'src=src, dest=dest',  -- Comma delimted string of edge arguments
                        'pagerank_out',        -- Output table of PageRank
                        NULL,                  -- Default damping factor (0.85)
                        NULL,                  -- Default max iters (100)
                        0.00000001,            -- Threshold
                        'user_id');            -- Grouping column name
```

Vertex Table

Vertex	Vertex Params	...
0	...	
1	...	
2	...	
3	...	

Edge Table

Source Vertex	Dest Vertex	Edge Weight	Edge Params	...
0	3	1.0	...	
1	0	5.0	...	
1	2	3.0	...	
2	3	8.0	...	
3	0	3.0	...	
3	1	2.0	...	

Greenplum Analytics: Text

Use cases

- Communications compliance & monitoring
- Customer sentiment analysis
- Document search & query
- Social media processing, etc.

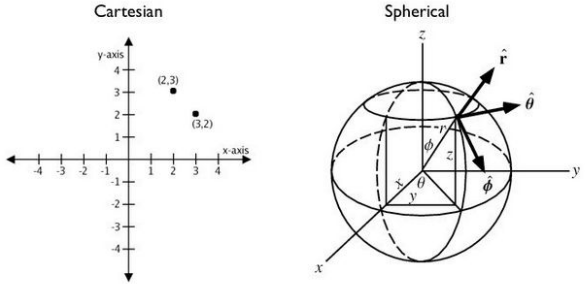
GPText

- Leverages Apache Solr & Greenplum
- Python & Java integration for natural language processing (NLP)
- Apache MADlib for machine learning on text data

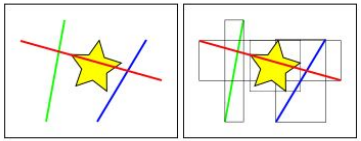
Greenplum Analytics: GeoSpatial

- Points, Lines, Polygons, Perimeter, Area
- Intersections, Contains, Distance, Longitude & Latitude

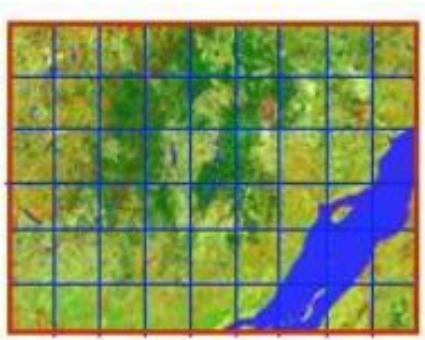
Round earth calculations



Spatial indexes & bounding boxes



Raster support



Greenplum Analytics: R & Python Libraries

gensim

MCMCpack

NumPy

TensorFlow

pyLDAvis

scikit learn

LIFELINES

spaCy

XGBoost

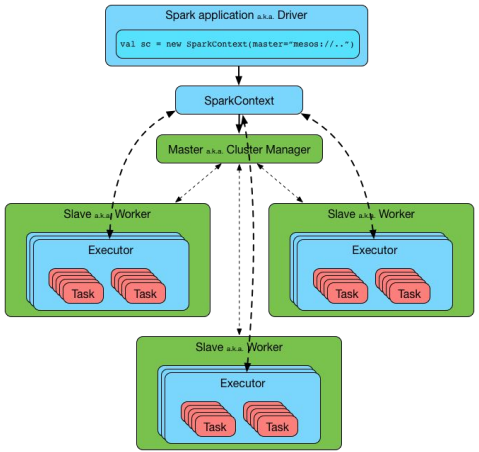
SM

BeautifulSoup

Greenplum Analytics: Spark

- Provide data access to Greenplum data
- Leverage Spark background of data engineers & data scientists
- Utilize off-cluster compute resources for computations
- Persists results to Greenplum

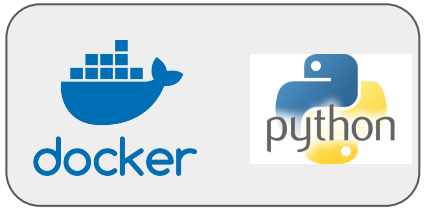
In-memory processing



Greenplum-Spark connector

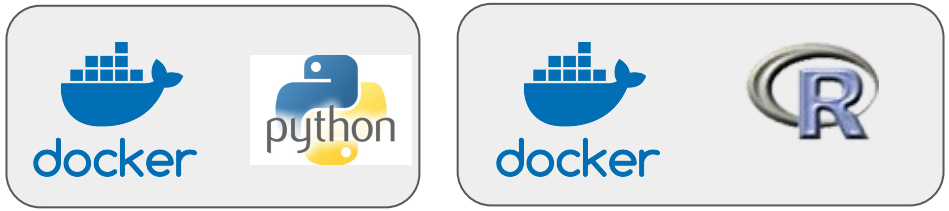
Greenplum Analytics: Language Agnostic

- Interfaces
  - User defined types
  - User defined functions
  - User defined aggregates
- Foundational work containerized Python & R comput environments



R/Python Containerization on Greenplum

- PL/Container
  - Deploy custom R & Python developer environments in the cluster
  - Execute functions in isolated, secure containers
  - Deploy code & functions as non-superuser
  - Package and custom Python or R modules in the deployment
  - Pre-configured for data science or customized images by users
  - Multiple developer environments on same cluster



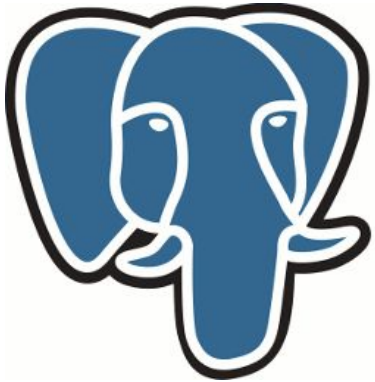
SQL Containerization

- Greenplum Resource Groups
  - Resource isolation for multi-tenancy & mixed analytical SQL workloads
  - Enhance stability & manageability
  - Leverages Linux cgroups

Where Does Greenplum Come From?

Where Does Greenplum Come From?

- Greenplum is based on PostgreSQL



PostgreSQL

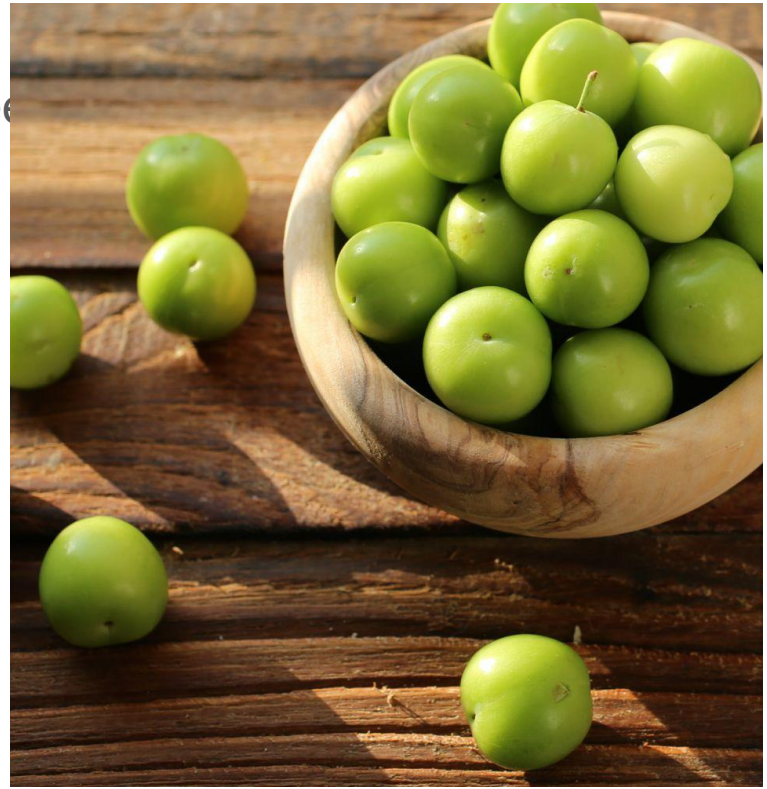
the world's most advanced open source database

PostgreSQL History

- 1985: Postgres in born at Berkeley University
  - First registered domain name
- 1989: Postgres 2.0 (still no SQL)
  - First commercial ISP
- 1990: First website at CERN
- 1994: Netscape browser, Yahoo! born
- 1995: Postgres95
- 1997: PostgreSQL
  - Netflix founded (renting DVD by mail)
- 1998: Google founded, IPv6 introduced
- 2018: PostgreSQL v11 (30th major release)

Greenplum History

- 2003: Metapa acquires Didera, founds Gree
  - MySpace & Skype founded
- 2005: Greenplum releases *Bizgres*
  - YouTube launches
- 2010: Acquired by EMC
  - Digital storage reached the Zetta
- 2015: Greenplum is open-sourced
  - Internet-of-Things (IOT)
- 2017: Greenplum v5 released



Greenplum’s Futures

- Greenplum v4 based on a fork of PostgreSQL 8.2.x
- Greenplum v5 based on 8.3.x
- Current development is based 9.1
- Code & features flow in both directions

How Does Greenplum Work?

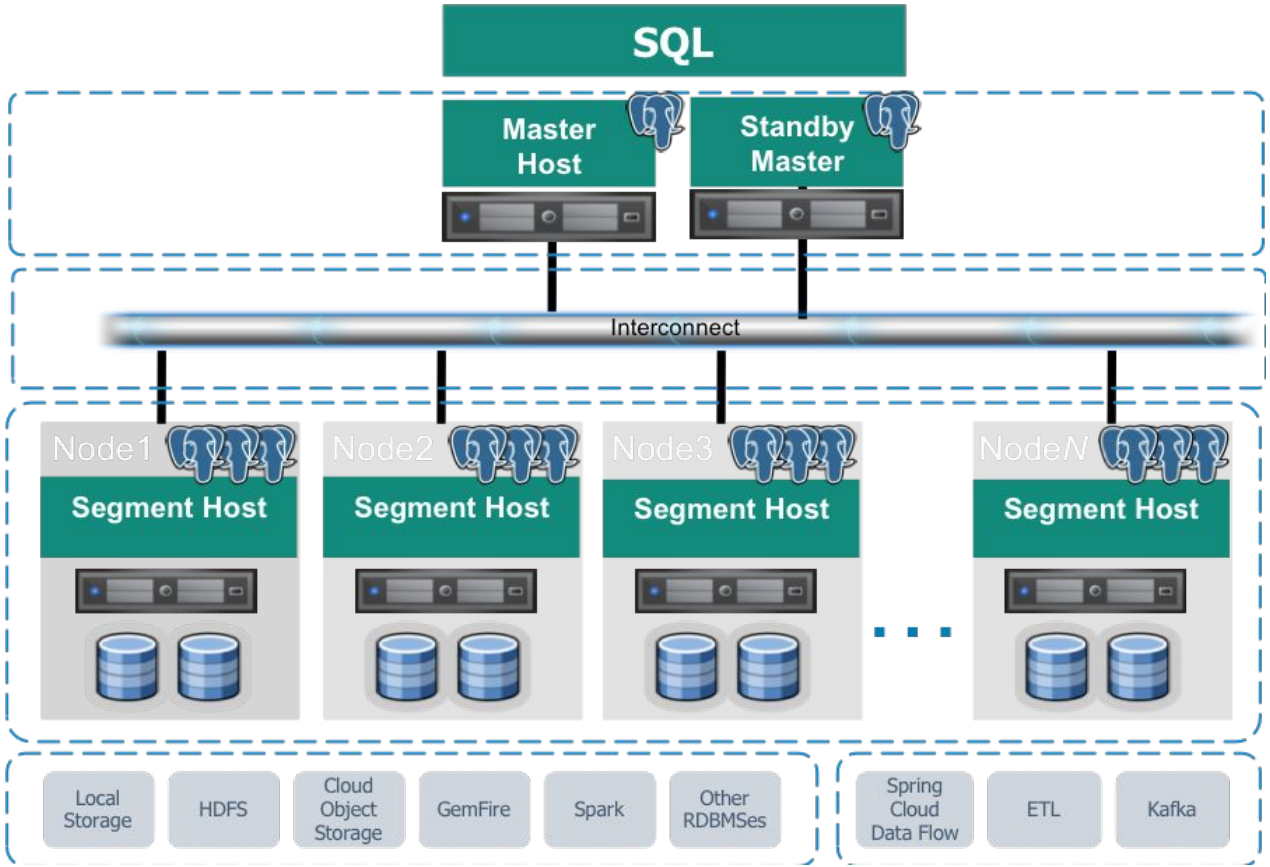
Greenplum is MPP for Analytics

Master Server
Query planning & dispatch

Interconnect

Segment Servers
Query processing & data storage

External Resources
Parallel loading & streaming



Software Installation

- Greenplum is installed once per host
- Install Greenplum OSS on Ubuntu
  - https://greenplum.org/install-greenplum-oss-on-ubuntu/
- Download & build from source
  - https://greenplum.org/download/
- Download & install from Pivotal Network
  - https://network.pivotal.io/products/pivotal-gpdb/
  - https://gpdb.docs.pivotal.io/510/install_guide/install_guide.html

Initialize Segments & Master

- Data directories are separate PostgreSQL-like installations
- Every master & segment is hosted in its own directory
  - Can reside on different file systems

```
gpadmin@greenplum-singlenode:~$ tree -L 2 -pugD data
data
├── [drwxr-xr-x gpadmin  gpadmin  Sep  7  1:39]  master
│   └── [drwx------ gpadmin  users  Sep  7  1:39]  gpsne-1
├── [drwxr-xr-x gpadmin  gpadmin  Sep  7  1:39]  seg0
│   └── [drwx------ gpadmin  users  Sep  7  1:39]  gpsne0
└── [drwxr-xr-x gpadmin  gpadmin  Sep  7  1:39]  seg1
      └── [drwx------ gpadmin  usersSep  7  1:39]  gpsne1

6 directories, 0 files
```

Initialize Segments & Master

```
gpadmin@greenplum-singlenode:~$ tree -L 1 -pugD data/master/gpsne-1
data/master/gpsne-1
├── [drwx------ gpadmin  usersSep  7  1:39]  base
├── [drwx------ gpadmin  usersSep  7  1:39]  global
├── [-r-------- gpadmin  usersSep  7  1:39]  gp_dbid
├── [drwxr-xr-x gpadmin  usersSep  7  1:39]  gpperfmon
├── [-rw-r--r-- gpadmin  usersSep  7  1:39]  gpssh.conf
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_changetracking
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_clog
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_distributedlog
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_distributedxidmap
├── [-rw-r--r-- gpadmin  usersSep  7  1:39]  pg_hba.conf
├── [-rw------- gpadmin  usersSep  7  1:39]  pg_ident.conf
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_log
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_multixact
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_stat_tmp
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_subtrans
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_tblspc
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_twophase
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_utilitymodedtmredo
├── [-rw------- gpadmin  usersSep  7  1:39]  PG_VERSION
├── [drwx------ gpadmin  usersSep  7  1:39]  pg_xlog
├── [-rw------- gpadmin  usersSep  7  1:39]  postgresql.conf
├── [-rw------- gpadmin  usersSep  7  1:39]  postmaster.opts
└── [-rw------- gpadmin  usersSep  7  1:39]  postmaster.pid

15 directories, 8 files
```

Run SQL Queries

- Greenplum uses TCP 5432 (from PostgreSQL)
- Drivers & many tools are compatible

```
gpadmin=# SELECT VERSION();
                                 version
-------------------------------------------------------------------------
 PostgreSQL 8.3.23 (Greenplum Database 5.10.2 build b3c02f3-oss) on x86
 _64-pc-linux-gnu, compiled by GCC gcc (Ubuntu 5.4.0-6ubuntu1~16.04.10)
  5.4.0 20160609, 64-bit compiled on Aug 10 2018 08:54:39
(1 row)
```

Demo

Demo

- Using simple “world” database from the PostgreSQL project
  - Includes cities, countries, & language codes
- Show “psql”, “data import” using “copy”, “file://”, and “gpfdist://”
- Run some queries
- Follow along
  - https://github.com/bradfordboyle/pgsv2018-hello-greenplum

Where to Get Greenplum

Where to Get Greenplum

- greenplum.org
- GitHub
- Pivotal (w/ support & services)
- Apache BigTop
- Docker
- Pivotal Cloud Foundry
- Amazon AWS
- Microsoft Azure

Collaboration

- gpdb-users & gpdb-dev mailing lists
  - https://greenplum.org/mailing-lists
  - Development happens here
- Greenplum Slack
  - https://greenplum.slack.com
- Greenplum @ Twitter
  - https://twitter.com/greenplum

The End

Contact

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- Pivotal Engineering
  - https://engineering.pivotal.io/
- This talk
  - https://github.com/bradfordboyle/pgsv2018-hello-greenplum