Introduction to PostgreSQL

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Outline

1. Database environments
2. Comparing PostgreSQL
3. Installing PostgreSQL on Windows
4. The PostgreSQL Files and Programs

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1. Database environments

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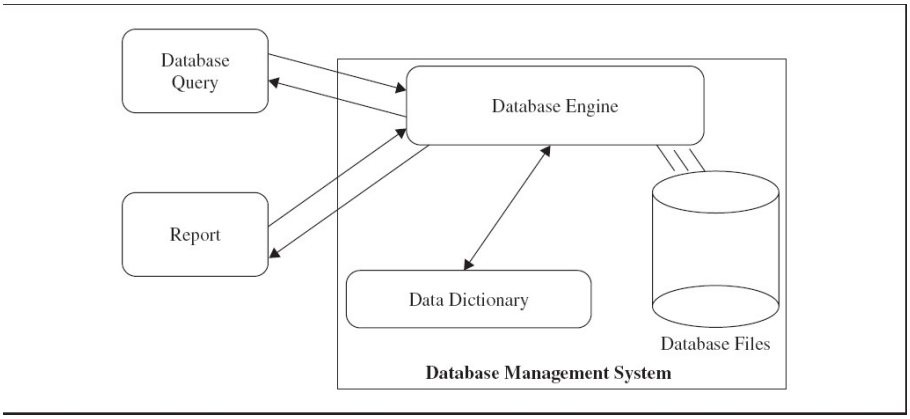
A Simple Database engine



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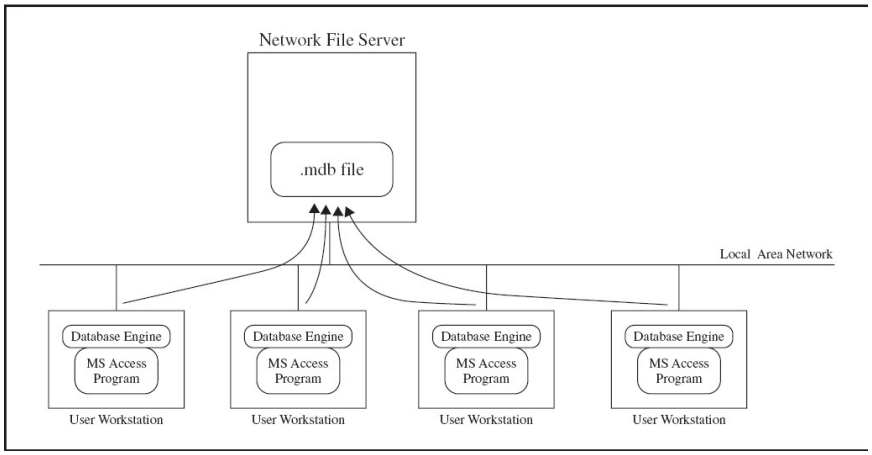
A shared Microsoft Access environment



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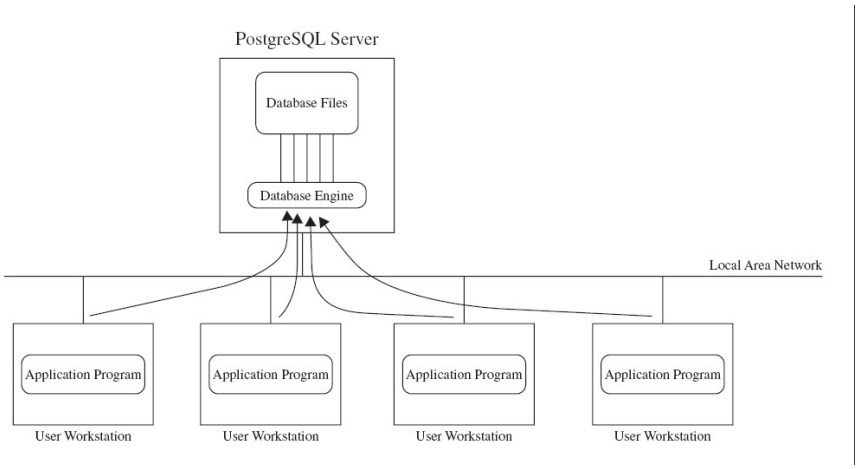
A multiuser PostgreSQL environment



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2. Comparing PostgreSQL

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PostgreSQL Versus Commercial DBMS Products

Database Product	CPU Limitation	Memory Limitation	Database Limitation
Microsoft SQL Server Express	1 CPU	1GB RAM	4GB
IBM DB2 Universal Database Express-C	2 CPUs	4GB RAM	Unlimited
Oracle Database 10*g* Express Edition	1 CPU	1GB RAM	4GB

Free Commercial Database Limitations

PostGreSQL:
- free open source
- No limitations: CPU, Memory, Database

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3. Installing PostgreSQL on Windows

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Download

http://www.postgresql.org/download/windows
http://www.enterprisedb.com/products-services-training/pgdownload#windows

(Lastest version 9.6)

- The graphical installer for PostgreSQL includes
  - the ***PostgreSQL server***
  - ***pgAdmin III***: a graphical tool for managing and developing your databases
  - and ***StackBuilder***: a package manager that can be used to download and install additional PostgreSQL applications and drivers

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Install and test

- Install
- Stop/start server (run as administrator)
- Connect to server from pgAdminIII

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Notes: Uninstall postgreSQL

- Uninstall
- Remove data directory

  C:\Program Files\PostgreSQL

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4. The PostgreSQL Files and Programs

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The PostgreSQL Files

- Default: C:\Program Files\PostgreSQL\9.x

Directory	Description
bin	The PostgreSQL main programs, utilities, and library files
data	PostgreSQL Data Dictionary, log files, and the transaction log
doc	Documentation on contrib modules, PgOleDb, and psqlODBC
include	C program header files for developing C programs for PostgreSQL (if the Development package was installed)
jdbc	Java JDBC library files for developing Java programs for PostgreSQL (if the JDBC package was installed)
lib	PostgreSQL library files for the executable programs
npgsql	Microsoft .NET library files for developing .NET programs for PostgreSQL (if the npgsql package was installed)
PgAdmin III	The pgAdmin III program documentation
share	Contrib modules and timezone information for PostgreSQL

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Database cluster Directory

- Default: C:\Program Files\PostgreSQL\9.x\data

Directory	Description
base	Contains a directory for each database
global	Contains system tables for the Data Dictionary
pg_clog	Contains status files on transaction commits
pg_log	Contains PostgreSQL system log files
pg_multixact	Contains multitransaction status information used for row locking
pg_subtrans	Contains subtransaction status information
pg_tblspc	Contains links to database tables
pg_twophase	Contains phase files for the two-phase transaction commit process
pg_xlog	Contains the transaction log files

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pg_log directory for Administrators

- Each started time, a new log file: *postgresl-year-month-day-time.log*
- Each row: a timestamp + the event

```
2006-06-29 20:13:45 FATAL:  database "test" does not exist
2006-06-29 20:24:01 LOG:  transaction ID wrap limit is 2147484148,
                          limited by database "postgres"
2006-06-29 20:25:05 LOG:  autovacuum: processing database "Test"
2006-06-29 20:26:05 LOG:  autovacuum: processing database "template1"
2006-06-29 20:27:05 LOG:  autovacuum: processing database "postgres"
2006-06-29 20:28:18 NOTICE:  ALTER TABLE / ADD PRIMARY KEY will create
                             implicit index "ItemID" for table "test"
```

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PostgreSQL Log Message Levels

Message Severity	Description
DEBUG	Program information for developers
INFO	Information requested by a database user from a database command
NOTICE	Information that may be useful to the database user regarding a submitted command
WARNING	Information about possible problems in a user session
ERROR	A minor error that caused a user command to abort
LOG	Information of interest for the administrator related to the PostgreSQL system
FATAL	A major error that caused a user session to abort
PANIC	A major error that caused the PostgreSQL system to abort

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Configuration Files

- How PostgreSQL behaves is controlled by three separate configuration files
  - *postgresql.conf* (C:\Program Files\PostgreSQL\9.4\data)
  - *pg_hba.conf*
  - *pg_ident.conf*
- Text files:
  - can be changed at any time
  - will not take effect until either the system is restarted or reloaded
  - Each entry in the configuration files is on a separate line
  - #: comment

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Changing configuration files

- Use text editor: notepad++
- Default values = standard values
- If a configuration line is commented out, PostgreSQL uses the default value for that entry
- Changing the default value = removing the comment symbol from the line, reloading or restarting system
- Reverting to the default value for an entry = puting the comment symbol back, stopping and restarting the PostgreSQL system (NOT reloading)

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The postgresql.conf File

- Format: *featurename = value*
- Example: port = 5432
- The main configuration file
  - File Locations Section
  - Connections and Authentication Section
  - Resource Usage Section
  - Write Ahead Log Section
  - Query Tuning Section
  - Error Reporting and Logging Section
  - Runtime Statistics Section
  - Autovacuum Parameters Section
  - Client Connection Defaults Section
  - Lock Management Section
  - Version/Platform Compatibility Section
  - Customized Options Section

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The pg_hba.conf File

- Configure:
  - Which network hosts are allowed to connect to PostgreSQL
  - Which PostgreSQL usernames can be used to connect from the network
  - What authentication method users must use to log into the system
  - Which PostgreSQL databases an authenticated client can connect to
- Format: *connection-type database user network-address login-method [options]*
- Example: host all all 127.0.0.1/32 md5

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The pg_hba.conf File

- Format: connection-type database user network-address login-method [options]
- Examples:
  - host all all 127.0.0.1/32 md5 : allows any client on the localhost to connect as any user to any database using md5 authentication
  - host all postgres 192.168.1.0/24 md5 : allows the *postgres* user account to connect any database from the local 192.168.1.0 subnetwork (192.168.1.0 to 192.168.1.255)

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The pg_ident.conf File

- Provides a method for you to map remote client user accounts to PostgreSQL user accounts
- Format: *map-name ident-name PostgreSQL-user-account*
- Example:
  - host all all 192.168.0.10/32 ident map=testhost All users from the host 192.168.0.10 will have access to all PostgreSQL databases. User accounts from this host are mapped to PostgreSQL user accounts using the testhost ident mapping.
  - testhost rich richard
  - testhost mike michael
  - testhost dan daniel

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Programs

- Most Unix administrators live and die by simple command-line programs
- Windows administrators will want to use the graphical tools available in the pgAdmin III application

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PostgreSQL Server Commands

- Location: C:\Program Files\PostgreSQL\9.4\bin
- **postgres:** the PostgreSQL database server
  - can be used to query, but not easy → **psql**
  - The utility command pg_ctl can be used to ***start and shut down the postgres server*** safely and comfortably

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PostgreSQL Server Commands

- **pg_ctl:** control the PostgreSQL system (stop, start, or reload the configuration files, kill a specified process)
  - using the -D commandline option
  - Example: **C:\>pg_ctl stop -D "c:\ProgramFiles\PostgreSQL\9.4\data"**

Document:

file:///C:/Program%20Files/PostgreSQL/9.4/doc/postgresql/html/app-pg-ctl.html

http://www.postgresql.org/docs/9.4/static/app-pg-ctl.html

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PostgreSQL Client Applications

- **psql:** a command-line interface to the PostgreSQL system
- **pg_config:** see the current configuration values used to compile and install the PostgreSQL package
- **pg_dump:** dump (or back up) the contents of a database on the PostgreSQL system to a file
  - Script: SQL files
  - Archived: compressed binary files (using **pg_restore** to restore)

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PostgreSQL Client Applications

- **pg_dumpall:** similar to the pg_dump program, except it dumps all of the databases to a file
- **pg_restore**

pgAdmin III: a fancy graphical interface for administering a PostgreSQL system
  - Open Source: www.pgadmin.org

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5. PostgreSQL on Ubuntu

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Intall

https://www.postgresql.org/download/linux/ubuntu/

https://help.ubuntu.com/community/PostgreSQL

http://suite.opengeo.org/docs/latest/dataadmin/pgGettingStarted/firstconnect.html

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Install

- Postgresql APT Repository:
  - Create the file /etc/apt/sources.list.d/pgdg.list and add a line for the repository:

deb http://apt.postgresql.org/pub/repos/apt/ YOUR_UBUNTU_VERSION_HERE-pgdg main

YOUR_UBUNTU_VERSION_HERE: trusty (ubuntu 14.04), xenial (ubuntu 16.04), bionic (ubuntu 18.04)

  - Import the repository signing key, and update the package lists:

wget -quiet -O - https://www.postgresql.org/media/keys/ACCC4CF8.asc | sudo apt-key add -

sudo apt-get update

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Install

- Install PostgreSQL on Ubuntu, use the apt-get command:

sudo apt-get install postgresql-10

(Installed packages: postgresql-10, postgresql-client-10, postgresql-client-common, postgresql-common, sysstat , …)

- If pagadmin4 (a graphical administration utility) is not installed, use the apt-get command:

sudo apt-get install pgadmin4

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Client installation

- If you only wish to connect to an external PostgreSQL server, install only the PostgreSQL client package:
  - Client installation

    sudo apt-get install postgresql-client

  - Connect to the server:

    psql -h server.domain.org database user

    Example: psql -h server.domain.org postgres postgres

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Basic Server Setup

- If set the password of the PostgreSQL user (role) called "postgres"
  - Connect as a role with the same name as the local user (i.e. postgres) to the database "postgres"

    sudo -u postgres psql postgres

  - Set a password for the "postgres" database role:

    \password postgres and then give your password when prompted

  - Exit the psql prompt: \q
- Create the first database

  sudo -u postgres createdb mydb

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Basic Server Setup

- **Allowing local connections**
  - By default, local connections are not allowed for the postgres user
  - As a super user, open /etc/postgresql/9.6/main/pg_hba.conf (Ubuntu) in a text editor
  - Scroll down to the line that describes local socket connections like this:

```
local   all         postgres                peer
local   all         all                     peer
```

  - Change the "peer" method to "md5"
  - To allow connections using pgAdmin, find the line that describes local loopback connections over IPv6:

```
host    all         all         ::1/128     ident
```

  - Change the "ident" method to "md5"
  - Save and close the file
- Restart postgresql : sudo service postgresql restart
  - To test your connection using psql: psql -U postgres -W
  - To test your connection using pgAdmin, connect to the database at localhost:5432 using the user name postgres and the password supplied

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PostgreSQL Files

- **Configuration files:**

  /etc/postgresql/9.x/main/
- **Data directory:**

  /var/lib/postgresql/9.x/main/

  (can use this command : ps auxw|grep postgres|grep -- -D)

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Stop / start/ reload server

sudo service postgresql {start|stop|restart|reload|force-reload|status}

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Create superuser

- Create a database superuser, same name as login name:

sudo -u postgres createuser --superuser $USER

sudo -u postgres psql

postgres=# \password $USER

- Create a new database:

sudo -u postgres createdb database_name

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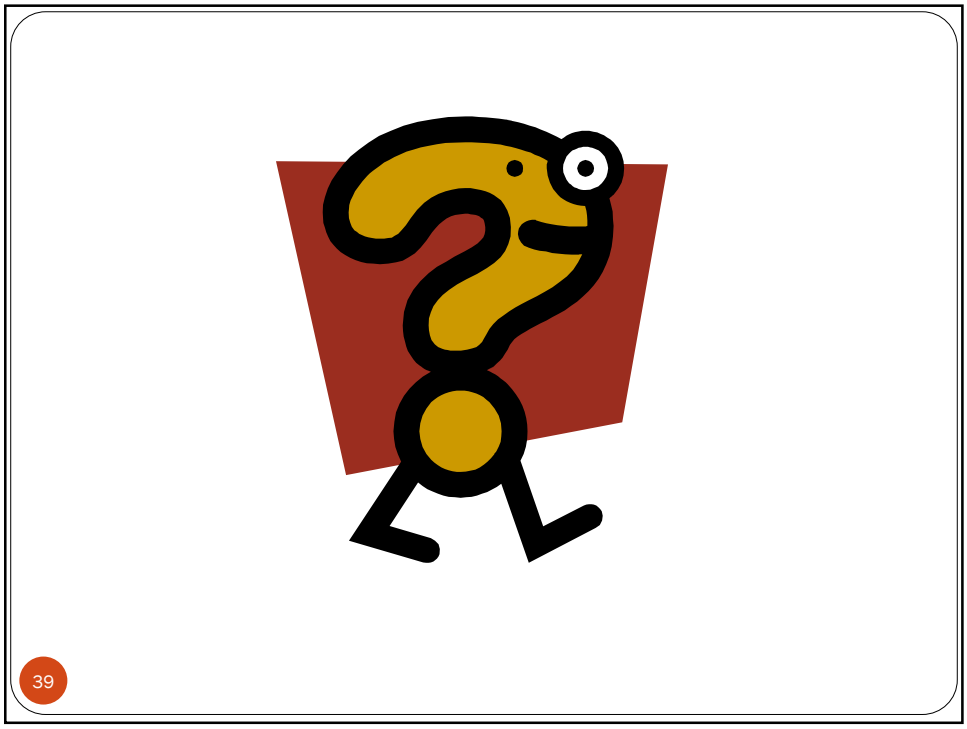

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