PostgreSQL

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Objectives

- The lecture will:
  - Provide *a taste of* the **PostgreSQL** DBMS
  - Give you enough information about **PostgreSQL** to:
    - Help you decide if you want to use it in your project
    - Help you get started with it

PostgreSQL

- **Who**: Michael Stonebreaker, UC Berkeley
- **When**: 1996
- **Why**:
  - Successor to *Ingres*
  - Add the fewest features needed to completely support data types

Motivation

- Why study PostgreSQL?
  - Popular
    - Preferred by Render & Heroku
  - Different
    - Contrasts with SQLite
    - More typical DBMS
      - Runs as a **process** that is distinct from the application process
  - Reasonable for COS 333 project
    - Used by many project teams

Options

- Options for using PostgreSQL
  - (1) On a cloud service
    - Render, or Heroku
    - Shown in lectures later in the course
  - (2) Locally
    - Described here

Installing PostgreSQL

- Linux (Debian, Ubuntu)
  - At a bash shell prompt:
    - `sudo apt-get install postgresql`

Installing PostgreSQL

- Mac
  - Install Homebrew
    - Browse to https://brew.sh/ and follow instructions
  - At a bash shell prompt:
    - `brew install postgresql@16`

Installing PostgreSQL

- Mac (cont.)
  - Optionally, to enforce passwords
    - Edit file:
      - `$(brew --prefix)/var/postgresql@16/pg_hba.conf`

```
# TYPE   DATABASE        USER            ADDRESS                 METHOD
local    all             rdondero                                trust
local    all             all                                     password
host     all             all             127.0.0.1/32            password
host     all             all             ::1/128                 password
local    replication     all                                     password
host     replication     all             127.0.0.1/32            password
host     replication     all             ::1/128                 password
```

Substitute your Mac username for rdondero

Installing PostgreSQL

- MS Windows
  - Use a browser to download the latest version of PostgreSQL from `postgresql.org/download`
  - In File Manager double click on `postgresql-someversion-windows-x64.exe`
    - Use default settings
    - For “password for the database supervisor (postgres)” enter `xxx`.

Installing PostgreSQL

- MS Windows (cont.)
  - Add `C:\Program Files\PostgreSQL\`*`someversion`*`\bin` to your `PATH` environment variable

Starting the PostgreSQL Server

- Linux
  - At a bash shell prompt
    - `service postgresql start`
- Mac
  - At a bash shell prompt
    - `brew services start postgresql@16`
- MS Windows
  - PostgreSQL server is started automatically

Starting the PostgreSQL Server

- By default, DBMS listens for connections at default port 5432

Creating a User and a Database

- Linux
  - At a bash shell prompt
    - `sudo -u postgres psql postgres`
  - At `psql` prompt
    - `CREATE ROLE someusername LOGIN PASSWORD 'somepassword';`
    - `CREATE DATABASE bookstore WITH OWNER = someusername;`
    - `\q`

Creating a User and a Database

- Mac
  - At a bash shell prompt
    - `psql postgres`
  - At `psql` prompt
    - `CREATE ROLE someusername LOGIN PASSWORD 'somepassword';`
    - `CREATE DATABASE bookstore WITH OWNER = someusername;`
    - `\q`

Creating a User and a Database

- MS Windows
  - In Command Prompt window
    - `psql -U postgres`
      - Enter `xxx` when prompted for password
  - At `psql` prompt
    - `CREATE ROLE someusername LOGIN PASSWORD 'somepassword';`
    - `CREATE DATABASE bookstore WITH OWNER = someusername;`
    - `\q`

The psql Program

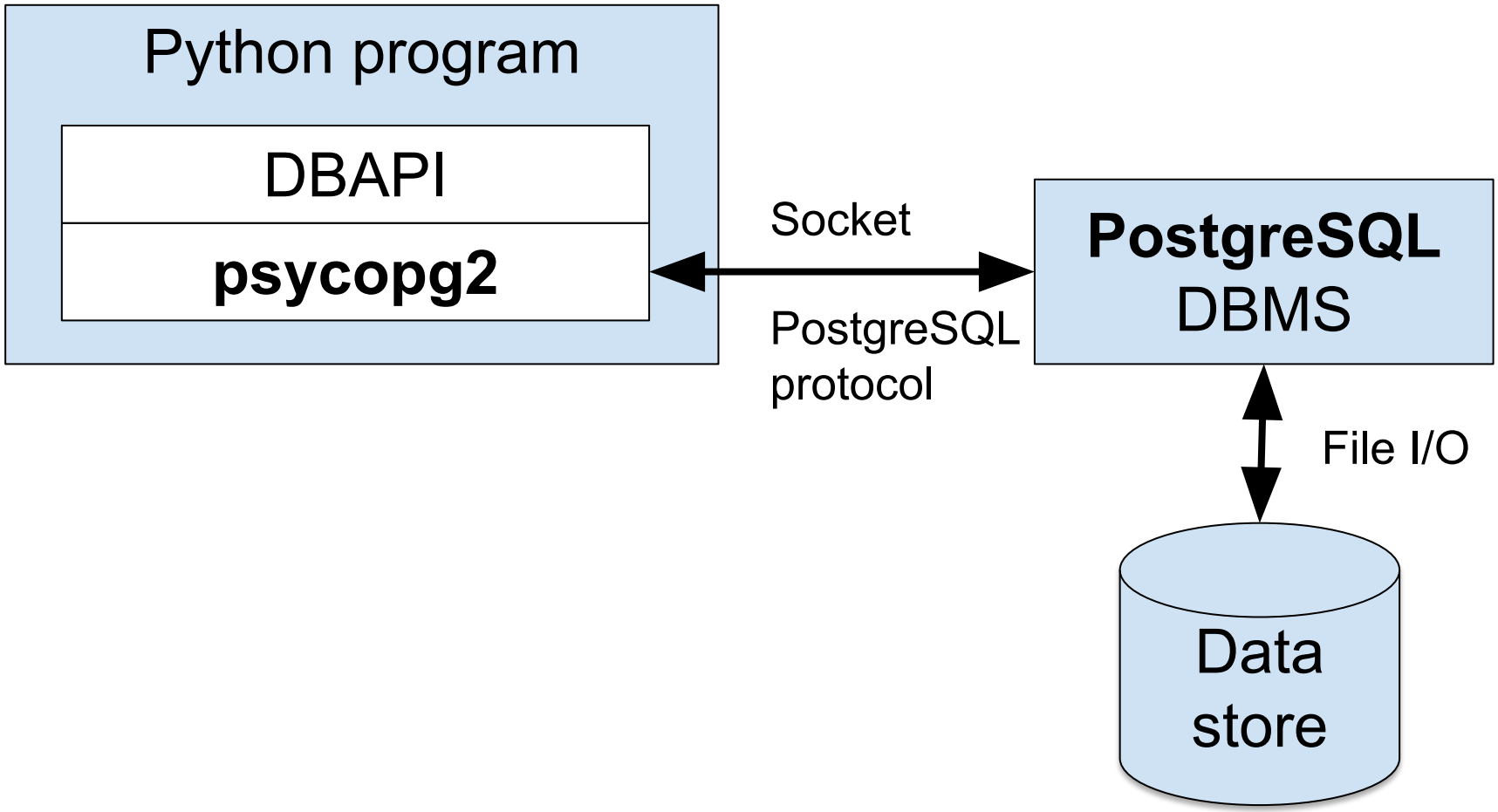
- At bash prompt or in Command Prompt window
  - `psql postgresql://someusername:somepassword@localhost/bookstore`
    - Enter password if prompted
- At `psql` prompt
  - `\i bookstore.sql`
  - `SELECT * FROM books;`
  - …
  - `\q`

The psql Program

Some `psql` commands

psql Command	sqlite3 Command
`\h`	`.help`
`\q`	`.quit`
`\list`	`(list databases)`
`\d`	`.tables`
`\d` *table*	`.schema` *table*
`\i` *file*	`.read` *file*

PostgreSQL via Python



Installing PostgreSQL Driver

- Linux, Mac, and MS Windows
  - At a bash shell prompt:
    - Activate your cos333 virtual env
    - `python –m pip install psycopg2`
    - If that doesn't work:
    - `python -m pip install psycopg2-binary`

PostgreSQL Pgmming in Python

To run the following programs:

Mac & Linux:

```
$ export DATABASE_URL=\
postgresql://someusername:somepassword@localhost/bookstore
$ python create.py
$ python display.py
…
```

MS Windows

```
$ set DATABASE_URL=^
postgresql://someusername:somepassword@localhost/bookstore
$ python create.py
$ python display.py
…
```

PostgreSQL Pgmming in Python

- See **PostgreSQL/create.py**
  - No database file!
  - DBMS runs as a distinct process on a specified computer (localhost)
  - DBMS listens for connections at a known port (5432)

PostgreSQL Pgmming in Python

- See **PostgreSQL/display.py**
  - PostgreSQL uses standard SQL
- See **PostgreSQL/authorsearch.py**
  - PostgreSQL uses standard SQL
- See **PostgreSQL/order.py**
  - PostgreSQL uses standard SQL

PostgreSQL Pgmming in Python

- See **PostgreSQL/authorsearchprep.py**
  - PostgreSQL supports prepared statements
  - Note placeholder syntax
- See **PostgreSQL/orderprep.py**
  - (Much the same)

PostgreSQL Pgmming in Python

- See **PostgreSQL/purchase.py**
  - PostgreSQL supports transactions
- See **PostgreSQL/recovery.py**
  - Transactions work in PostgreSQL!

Stopping the PostgreSQL Server

- Linux
  - At a bash shell prompt
    - `service postgresql stop`
- Mac
  - At a bash shell prompt
    - `brew services stop postgresql@16`
- MS Windows
  - PostgreSQL server is stopped when computer shuts down

PostgreSQL Assessment

- PostgreSQL assessment (vs. SQLite)
  - (con) Setup is much more complex
  - (con) Programmatic use is a little more complex
  - (pro) Production-quality
    - Distinct process
    - Authentication
    - Row-level (vs. database-level) locking
    - …
  - (pro) Preferred by Render, Heroku

Summary

- The lecture has:
  - Provided *a taste of* the **PostgreSQL** DBMS
  - Given you enough information about **PostgreSQL** to:
    - Help you decide if you want to use it in your project
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