Summary of the topics.

- DBMS Modules (Elmasri Navathe Ch 2.4)
  - Use figure 2.3 To explain the various modules of a DBMS.
- Database Utilities
- Tools, Application Environments and Communication Facilities

Database Modules

- Database Files on Disk
- Database Metadata on Disk
- Database Background Processes
  - Database Writer
  - Log Writer
  - Checkpoint
  - …

- The database and the database catalog is stored as files on the disk.
- A part of the database is kept in the main memory (RAM) called the **Database Buffer**
  - The database files are organized into blocks or pages.
- Whenever a database user requests data by a SQL query,
  - The SQL is parsed for syntax
  - The SQL semantics is checked (whether the requested columns and tables exist)
  - An execution plan made up of individual operation like scanning an index or table is created and the execution plan is executed.
    - Check the execution plan of a SQL using EXPLAIN SELECT * FROM …. or EXPLAIN ANALYSE SELECT * FROM … in Postgres.
  - The database blocks (or pages) where the data resides are identified.
  - If the blocks are in the **Database Buffer (RAM)**, then data is made available to the user
  - If the blocks are not in the Database Buffer (RAM), they have to be fetched from the files on the disks and then placed in the Database Buffer (RAM)
  - If it is an update operation (say insert or update or delete statement), the record in the Database Buffer is modified.
  - The Database Buffer is of fixed size (say about 1 GB if the total RAM is 4 GB).
  - When database blocks or pages have to be fetched from the files in disks, the blocks or pages in the Database Buffer (RAM) have to be replaced with the blocks or pages in the files. This involves
    - A write operation (if the blocks were modified) to write the blocks to the files and
    - A read operation to read blocks from files and place them in memory
    - This task (of fetching blocks from the disk and writing blocks to the disk) is continuously performed by the dbwriter process. It uses the least recently used (LRU) method to replace less used blocks with new blocks from the disk.
  - A log record is written before a user gets a confirmation that the operation is completed (the database term is when the data is ***committed*** to the database).
  - The Redo log, or the Write Ahead Log (WAL) is a file that stores every transaction after every commit.
  - Note that database buffers may not be written to the disk on commit but the log file is always written into after every commit.
  - The log file must be placed in a very fast and reliable disk and preferably in multiple disks (to ensure that the database can be recovered from a CRASH).

Some practical experiments

On Ubuntu: type
ps – fu postgres

You must see some background processes of the databases
How may database processes are there?
What are their names?

Note: On Windows there is only one background process with the name of Postgres because the other processes are running as threads under this process.

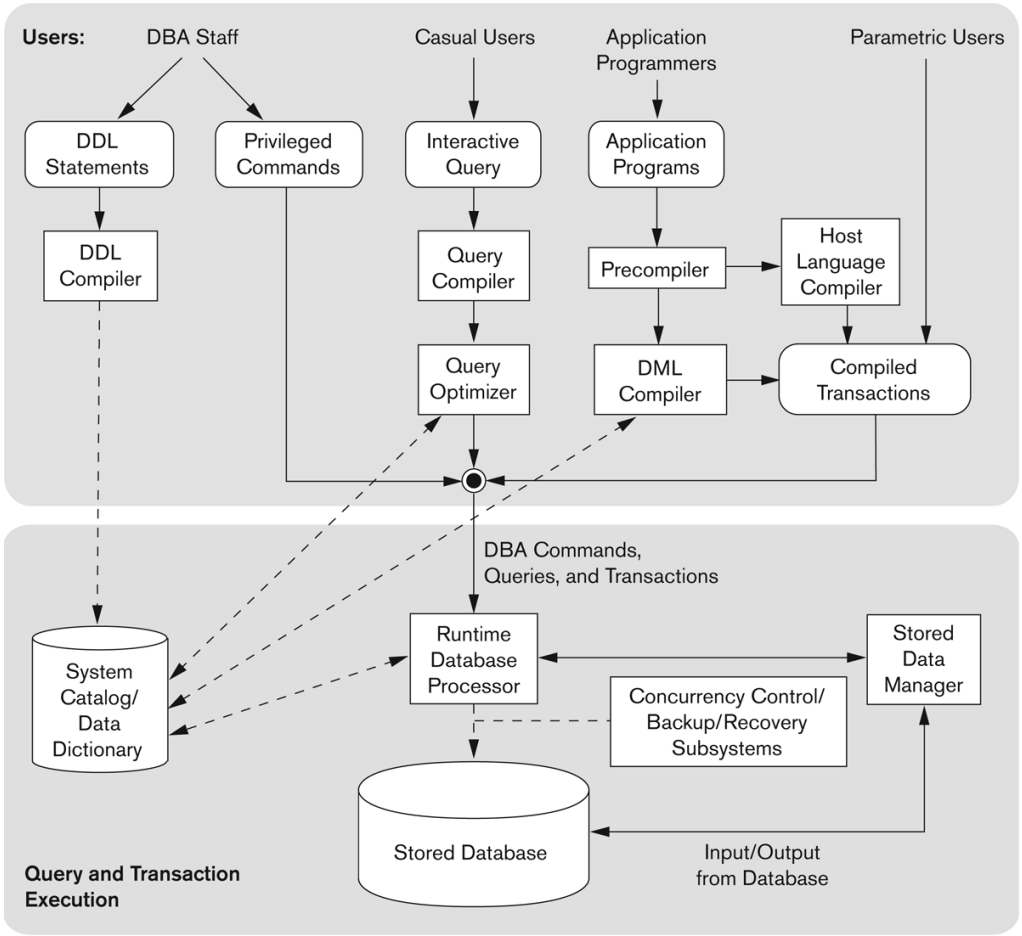
Run psql to connect to the database and then type
ps -fu postgres

The number of processes increased by 2
One is the psql process and another is a background process that connects to the database server process and memory(Database buffers).

To connect to a Postgres database,
The client psql requests a connection
If connected, the postgres database server creates a background process to pass data to psql client.

Database Utilities

A database has many utilities to manage the database operations. Here two utilities one for backup and one for restore are given as examples:
(Example:
pg_dump https://www.postgresql.org/docs/9.3/app-pgdump.html
pg_dump is a utility for backing up a PostgreSQL database. It makes consistent backups even if the



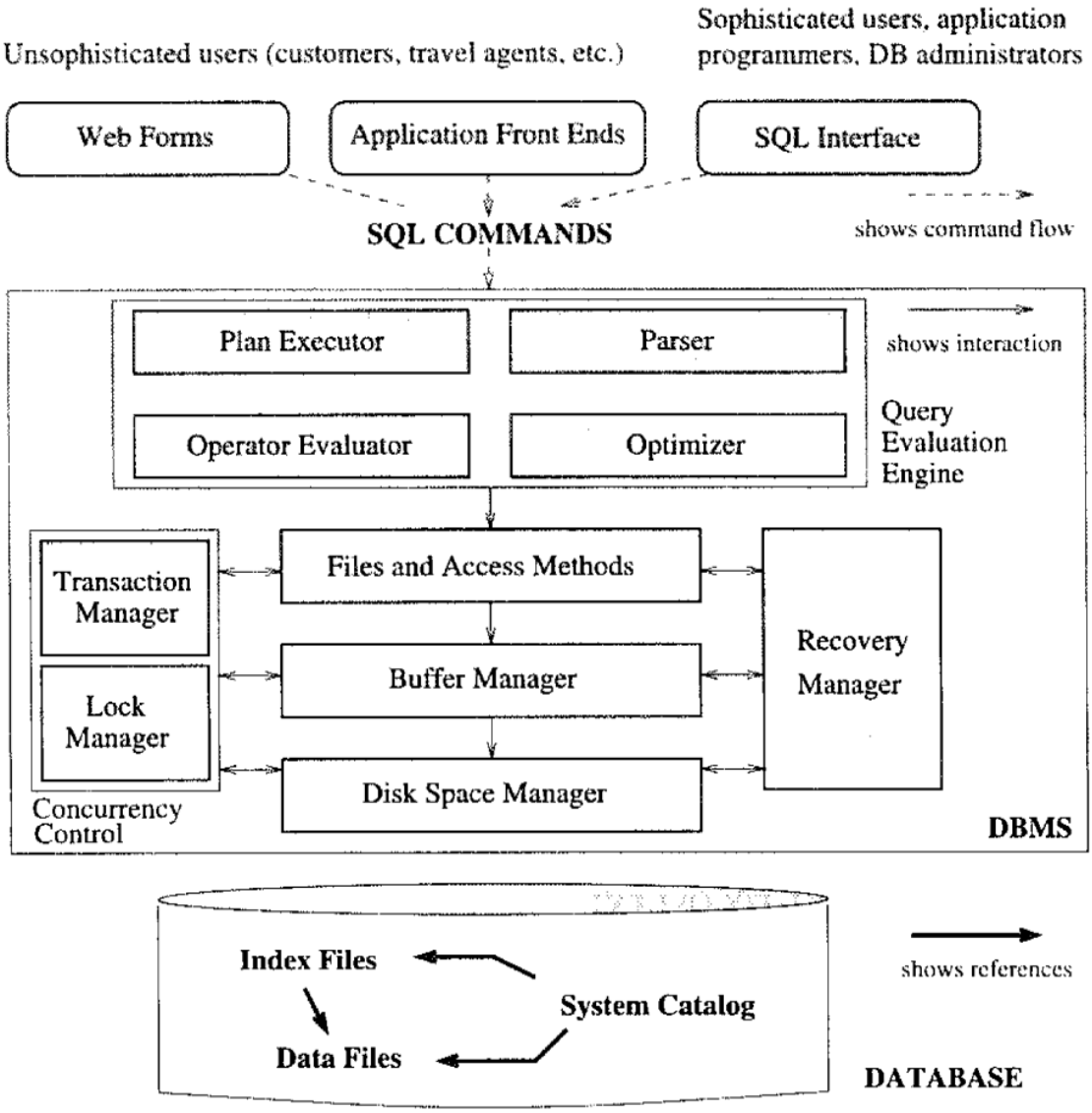
ing the database

ed by pg_dump in
ıstruct the database
:tore to be selective
archive files are

Postgres databases.

Figure 2.3
Component modules of a DBMS and their interactions.

Picture from Raghu Ramakrishnan



Picture from Silberschatz & Korth

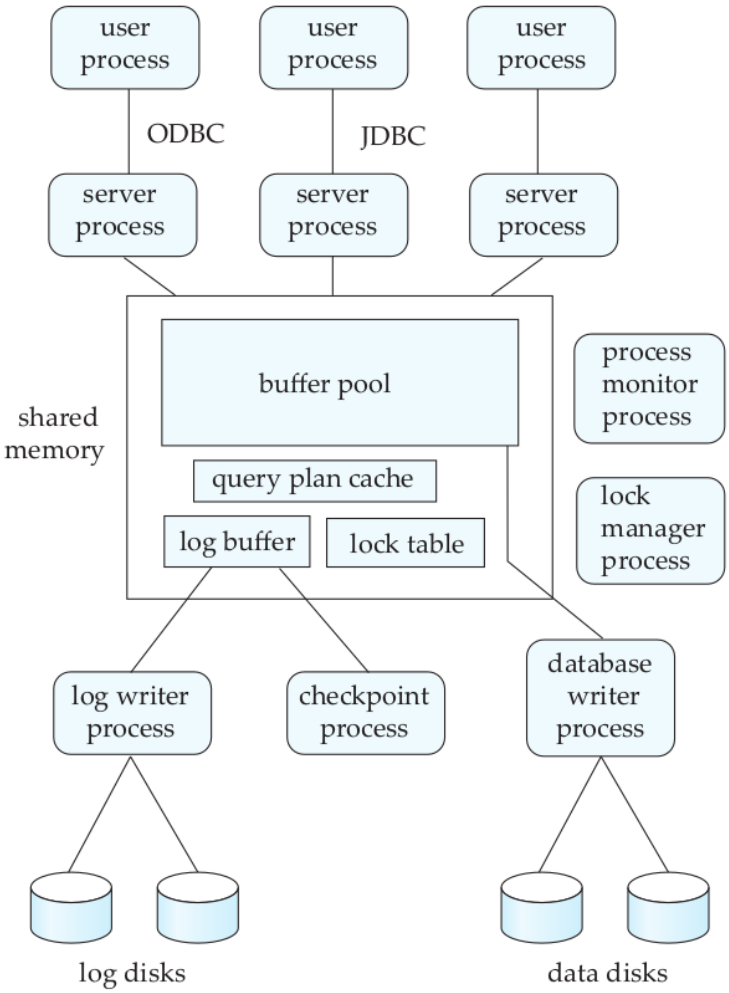


Figure 17.4 Shared memory and process structure.