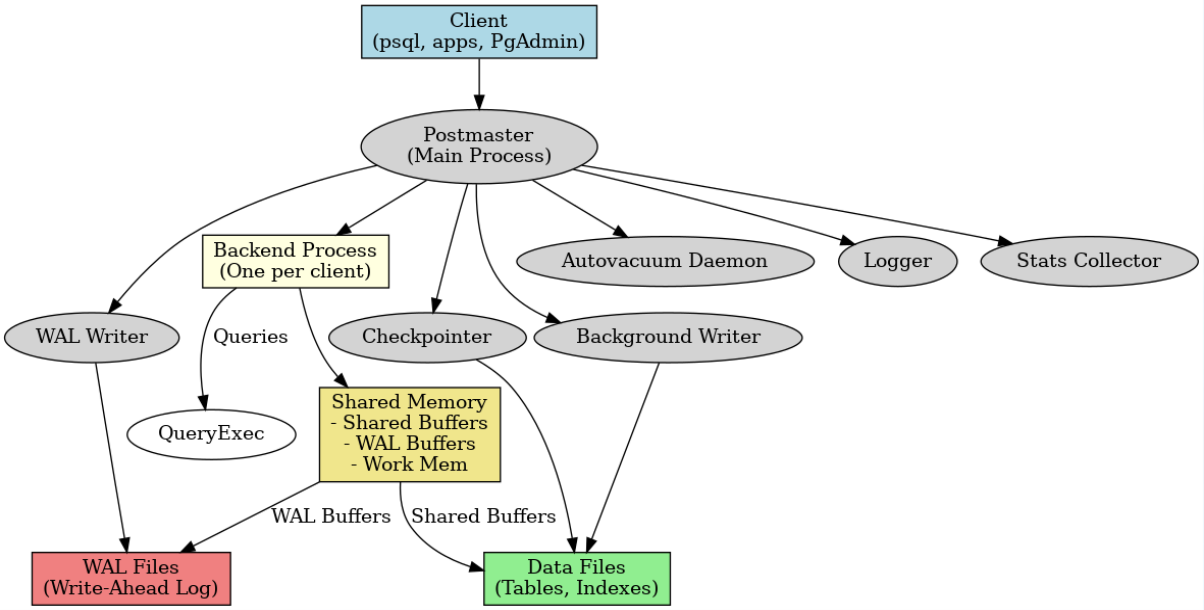

✅ PostgreSQL Architecture

PostgreSQL follows a **client-server architecture** with multiple background processes and memory components.

🔷 1. Client

- The application/user that connects to PostgreSQL.
- Sends SQL queries and receives results.
- Connects using tools like psql, PgAdmin, or application code (Python, Java, etc.)

🔷 2. Postmaster (Main Process)

- This is the **master/parent process**.
- Starts all background processes when PostgreSQL starts.
- Listens for new connections from clients.
- Launches a new process for each client.

🔷 3. Backend Process (Postgres Process)

- Created for **each client connection**.
- Handles all client queries (SELECT, INSERT, etc.).

- Terminates when the client disconnects.

🔷 4. Shared Memory (RAM Area)

Shared memory is used to store temporary and cache data to make the system faster.

🔶 A. Shared Buffers

- Holds copies of data pages from disk.
- Like **cache** in RAM to avoid frequent disk access.

🔶 B. WAL Buffers (Write-Ahead Logging)

- Temporarily stores changes before writing them to WAL log files.

🔶 C. Work Memory / Temp Buffers

- Used for sorting, joins, and temporary tables during query execution.

🔶 D. Background Writer Buffers

- Coordinates with the background writer to write dirty pages to disk.

🔷 5. Background Processes

PostgreSQL runs several important background processes:

🔶 A. Background Writer

- Periodically writes dirty (modified) pages from shared buffers to disk.

🔶 B. WAL Writer

- Writes WAL logs (change records) to WAL files for crash recovery.

🔶 C. Checkpointer

- Saves database state on disk at regular intervals (checkpoints).
- Helps in faster recovery.

🔶 D. Autovacuum Daemon

- Cleans up dead tuples (rows) and reclaims space (similar to garbage collection).
- Maintains table health and performance.

🔸 E. Stats Collector

- Collects statistics used by the query planner for optimization.

🔸 F. Logger

- Writes logs of database activities and errors.

🔹 6. WAL (Write-Ahead Log)

- Very important for **data durability**.
- Every change is written to WAL first before applying to the data files.
- Helps in crash recovery.

🔹 7. Data Files (Disk Storage)

- Stores actual table data, indexes, configuration files, logs, etc.
- Located in PostgreSQL **data directory** (e.g., `/var/lib/pgsql/data/`).

🔹 8. Query Executor & Planner

- Query **Planner**: Creates the best plan to execute a SQL query.
- Query **Executor**: Executes the plan and returns the result.

🔹 9. Catalog Tables (System Tables)

- PostgreSQL maintains internal tables like:
  - `pg_class` (tables info)
  - `pg_user` (users info)
  - `pg_database` (databases info)
- Stores metadata about schemas, tables, users, etc.

🧠 Summary Diagram (Text)

```arduino
Client ↔ Postmaster ↔ Backend Process ↔ Shared Memory
     [Query Planner/Executor, WAL, Data Files]
```

↕
[Checkpointer, WAL Writer, Autovacuum, Logger]

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