

Upd-server.py

- Leader election: lowest ID leader default  
 leader sends periodic heartbeats to followers *send-heartbeats*  
 followers monitor heartbeats *process-heartbeat*  
 if none received within election timeout tries to become leader, but concedes if it receives heartbeat from lower id server
- Fault tolerance: persistent state saved to local json file  
 ∴ recover state upon restart  
 followers sync loc states and file updates from leader *sync-file*  
*notify-followers-lock-state*  
*-file-update* *sync-lock-state*
- Consistency and Safety:
  - Locking → grants lock to one client at a time  
 → enforces time based lock expiration  
 → queued clients
  - Duplicate requests: tracking client modifications to avoid processing duplicate commands  
*modif-requests*
- Message handling
  - Port 8080: Client-server communication *handle-requests*
    - acquire / release lock
    - append file
    - identify leader
    - client only communicates with leader
    - client request go to queue (client may check request queue status)
  - Port 8081: server-replica communication *handle-messages*
    - heartbeat
    - lock state: only granted by leader
    - file updates: only granted by leader
- Crash mitigations
  - Network: • heartbeat timeouts trigger leader re-election  
 • retry mechanisms for key actions
  - Client errors: • clients receive explicit responses for invalid requests  
 "You do not hold lock"  
 • queue request avoids race conditions
  - Server crash: • followers rely on leader for consistency  
 • leader election ensures there is always a leader

RPC\_connection.py

timeouts / retries / exponential backoffs

Distributed - Client + pg

1) Finds leader - only communicates with leader  
~~find-leader~~ other servers get sent replica commands from leader

2) Send task

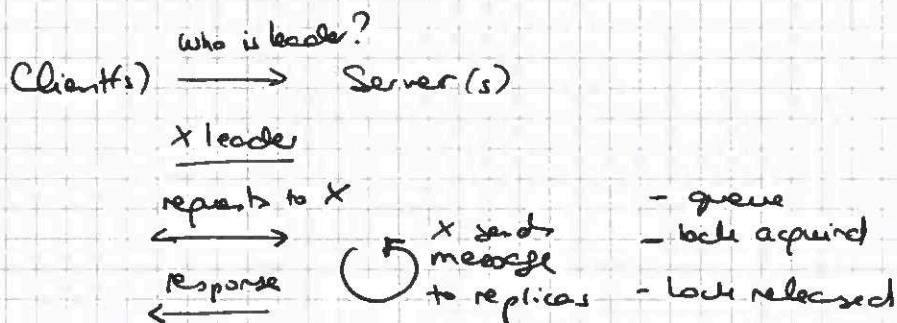
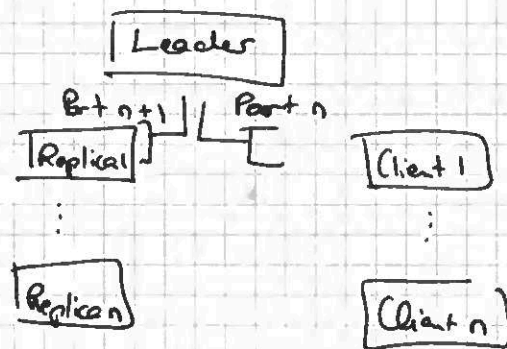
2.1) Acquire lock: sends request message, receives  
 (timeout and "wrong" leader reply also possible)  
 acquire lock  
 queue position  
 lock  
 ↓

2.2) Sends message: "append - file"  
~~sends~~ append - file

starts lock expiration  
 lock start - lease - timer

2.3) waits for reply

Heartbeat between client and server tracks lease.

Limitations:

I was not able to implement strong consistency for leader election, as such I cannot run the advanced test cases.