Design Reasoning Document – Futures & Options Trading Database

1. Introduction
This document explains the design decisions behind a scalable relational database built to store and analyze high-volume Futures & Options (F&O;) trading data from Indian exchanges such as NSE, BSE, and MCX. The schema is designed using real-world NSE F&O; data containing over 2.5 million records and is scalable beyond 10 million rows.

2. Normalization & Schema Design
The database follows Third Normal Form (3NF) to avoid redundancy and ensure data consistency. Exchange data, instrument metadata, and expiry-related attributes are separated into individual tables. The trades table acts as the fact table, storing OHLC prices, volume, and open interest.

3. Why Star Schema Was Avoided
Star schemas were avoided because they duplicate dimension data and are not ideal for ingestion-heavy trading systems. A normalized design offers better performance, lower storage cost, and improved maintainability for continuous data ingestion.

4. Expiry Table Design
A separate expiry table handles expiry dates, strike prices, and option types. This approach efficiently manages dense option chains and avoids repeating expiry-strike combinations across millions of trade records.

5. Data Types & Constraints
Numeric data types are used for prices to avoid floating-point precision issues. Bigint is used for volume and open interest. Foreign key constraints enforce referential integrity across tables.

6. Performance Optimizations
Indexes were created on frequently queried columns such as trade_date, symbol, and exchange. A BRIN index was used for timestamp-based queries to optimize large time-series scans. Trades were partitioned by exchange to reduce scan size and improve query performance.

7. Scalability
The design supports scaling beyond 10 million records and allows new exchanges or instruments to be added without schema changes. The structure is suitable for real-time ingestion and analytical workloads.

8. Conclusion
This database design provides a robust, scalable, and efficient foundation for F&O; trading analytics while maintaining strong data integrity and performance.