RELATIONAL SCHEMA

1. Trader (trader_id, name, state, initial_account_balance)

- Primary Key: trader_id

BCNF Proof:

- The primary key trader_id uniquely identifies each row.
- There are no other functional dependencies; all non-key attributes (name, state, initial_account_balance) depend fully on the primary key trader_id. Therefore, this table satisfies BCNF.

2. Stocks (stock_symbol, exchange_name, stock_name, sector, market_share_percentage, face_value)

- Primary Key: stock_symbol

BCNF Proof:

- The primary key stock_symbol uniquely identifies each stock.
- All non-key attributes (exchange_name, stock_name, sector, market_share_percentage, face_value) are fully dependent on the stock_symbol.
- There are no partial or transitive dependencies, meaning the relation is in BCNF.

3. Watchlist (watchlist_id, watchlist_name, *trader_id*)

- Primary Key: watchlist_id
- Foreign Key: trader_id (Reference – Trader)

BCNF Proof:

- The primary key watchlist_id uniquely identifies each watchlist.
- The non-key attributes watchlist_name and trader_id are fully dependent on watchlist_id.

- There are no transitive dependencies (e.g., watchlist_name is not dependent on trader_id), so the table is in BCNF.

4. Includes (watchlist_id, *stock_symbol*)

- Primary Key: watchlist_id
- Primary Key: stock_symbol
- Foreign Key: watchlist_id (Reference – Watchlist)
- Foreign Key: stock_symbol (Reference – Stocks)

BCNF Proof:

- The composite primary key (watchlist_id, stock_symbol) uniquely identifies each row in this table.
- There are no non-key attributes, so there cannot be any functional dependencies violating BCNF.
- Therefore, the table satisfies BCNF.

5. Transactions (transaction_id, *stock_symbol*, timestamp, quantity, type_of_trade, price, *trader_id*)

- Primary Key: transaction_id
- Foreign Key: stock_symbol (Reference – Stocks)
- Foreign Key: trader_id (Reference – Trader)

BCNF Proof:

- The primary key transaction_id uniquely identifies each transaction.
- All non-key attributes (stock_symbol, timestamp, quantity, type_of_trade, price, trader_id) are fully functionally dependent on transaction_id.
- No partial or transitive dependencies exist, meaning the table satisfies BCNF.

6. Portfolios (portfolio_id, *transaction_id*)

- Primary Key: portfolio_id
- Foreign Key: transaction_id (Reference – Transactions)

BCNF Proof:

- The primary key portfolio_id uniquely identifies each portfolio.
- The non-key attribute transaction_id is fully dependent on portfolio_id.
- No other functional dependencies exist, so the table is in BCNF.

Explanation of the Schema:

1. **Trader** table contains information about individual traders.
2. **Stocks** table stores stock information, where stock_symbol is the unique identifier for each stock.
3. **Watchlist** is a list of stocks that a particular trader is interested in, linked through trader_id.
4. **Includes** is the junction table representing the relationship between **Watchlist** and **Stocks**. It links a specific watchlist to one or more stocks.
5. **Transactions** table records each trade transaction made by a trader for a particular stock, linking to both the **Stocks** and **Trader** tables.
6. **Portfolios** records the transaction associated with a particular portfolio.

Summary:

All relations satisfy BCNF because:

1. Each non-key attribute is fully dependent on the primary key.
2. No partial dependencies (where a non-key attribute is dependent on part of a composite primary key) or transitive dependencies (where a non-key attribute is dependent on another non-key attribute) are present.