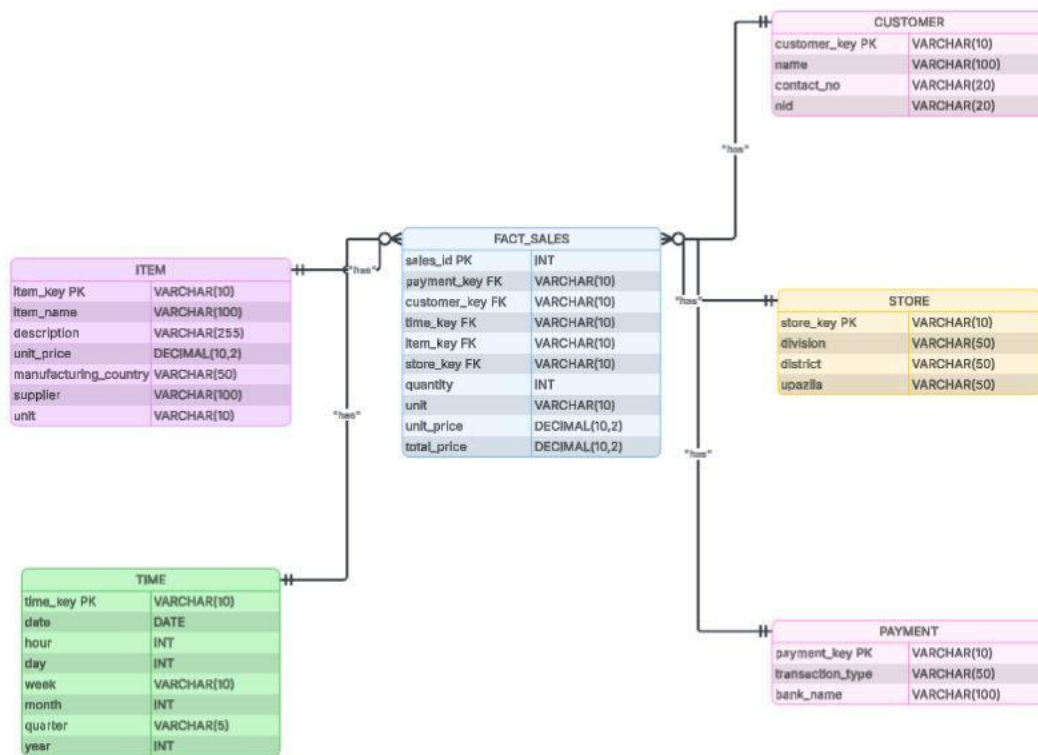# Stage 2: ER Diagram and Database Design

1. Overview of the ER Diagram

The database is designed to support a Retail Sales Performance Analysis System.
The ER Diagram follows a Star Schema structure, where a central fact table records sales transactions, and multiple dimension tables provide descriptive context for analysis.

This design enables efficient analytical queries, time-based analysis, and performance measurement across different business dimensions such as customers, products, stores, time, and payment methods.

2. Entities and Attributes

2.1 Fact_Sales (Fact Table)

Description:
This table represents individual sales transactions and serves as the core of the analytical model.

Attributes:
- sales_id (Primary Key)
- customer_key (Foreign Key)
- item_key (Foreign Key)
- store_key (Foreign Key)
- time_key (Foreign Key)
- payment_key (Foreign Key)
- quantity
- unit
- unit_price
- total_price

Purpose:
The Fact_Sales table stores measurable business data (measures) such as quantity and revenue, which are used for aggregation, comparison, and trend analysis.

2.2 Customer (Dimension Table)

Description:
Stores customer-related information used to analyze purchasing behavior.

Attributes:
- customer_key (Primary Key)
- name
- contact_no
- nid

2.3 Item (Dimension Table)

Description:
Stores detailed information about products sold.

Attributes:
- item_key (Primary Key)
- item_name
- description
- unit_price
- manufacturing_country
- supplier
- unit

2.4 Store (Dimension Table)

Description:
Stores geographical information about stores.

Attributes:
- store_key (Primary Key)
- division
- district
- upazila

2.5 Time (Dimension Table)

Description:
Stores detailed time-related attributes to support time-based analysis.

Attributes:
- time_key (Primary Key)
- date
- hour
- day
- week
- month
- quarter
- year

2.6 Payment (Dimension Table)

Description:
Stores payment-related information for transactions.

Attributes:
- payment_key (Primary Key)
- transaction_type
- bank_name

3. Relationships Between Entities

- Each Customer can be associated with multiple sales transactions, but each sale is linked to only one customer.
- Each Item can appear in multiple sales transactions, but each sale refers to only one item.
- Each Store can have multiple sales transactions, but each sale occurs in one store.
- Each Time record can be associated with multiple sales transactions, but each sale occurs at one specific time.
- Each Payment method can be used in multiple sales transactions, but each sale uses one payment method.

All relationships between dimension tables and the fact table are One-to-Many (1:M).

4. Keys and Constraints

- Each dimension table uses a Primary Key to uniquely identify records.
- The Fact_Sales table includes Foreign Keys that reference the primary keys of all dimension tables.
- This ensures referential integrity and consistent linkage between transactional and descriptive data.

5. Normalization and Design Justification

- All dimension tables are designed following Third Normal Form (3NF) to eliminate redundancy.
- The fact table contains only foreign keys and measurable attributes, avoiding duplication of descriptive data.
- The Star Schema design was chosen to optimize analytical performance, simplify complex joins, and support advanced SQL operations such as aggregations and window functions.

6. Design Benefits

- Simplifies complex analytical queries
- Supports performance analysis, trend analysis, and ranking
- Enables efficient time-based insights
- Suitable for OLAP-style data analysis