Project Report: E-Commerce Database System

1. Introduction

This project implements a comprehensive relational database for an e-commerce platform, covering all core operations from inventory management to order processing. The system is built on SQL Server with advanced analytics capabilities and visualizations.

2. Database Schema

The database comprises 8 interconnected tables, designed to ensure data integrity and efficiency.

- **Entities:** Customers, Categories, Suppliers, Products, Inventory, Orders, OrderItems, Shipments.
- **Key Relationships:**
  - Products ↔ Inventory (1:1)
  - Orders ↔ OrderItems (1:M)
  - Customers ↔ Orders (1:M)
 - Products ↔ OrderItems (1:M)

ER Diagram:
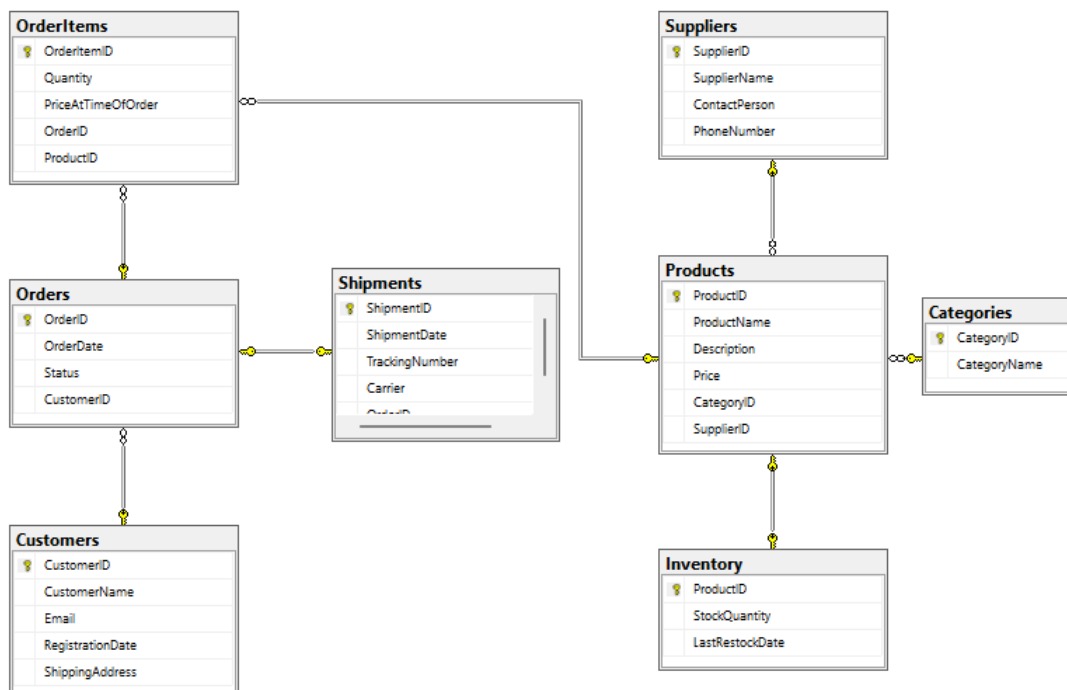
DDL Execution Order

Due to the foreign key constraints that link the tables, the tables must be created in a specific order to avoid dependency errors. The script DDL.sql must be executed by creating the parent tables before the child tables that reference them.

The correct execution order is as follows:

1. **Core Entities (No Dependencies):**
   - Customers
   - Categories
   - Suppliers
2. **Primary Entities (Depend on Core Entities):**
   - Products (depends on Categories and Suppliers)
   - Orders (depends on Customers)
3. **Linking & Detail Entities (Depend on Primary Entities):**
   - Inventory (depends on Products)
   - OrderItems (depends on Orders and Products)
   - Shipments (depends on Orders)

The following diagram illustrates this dependency flow:
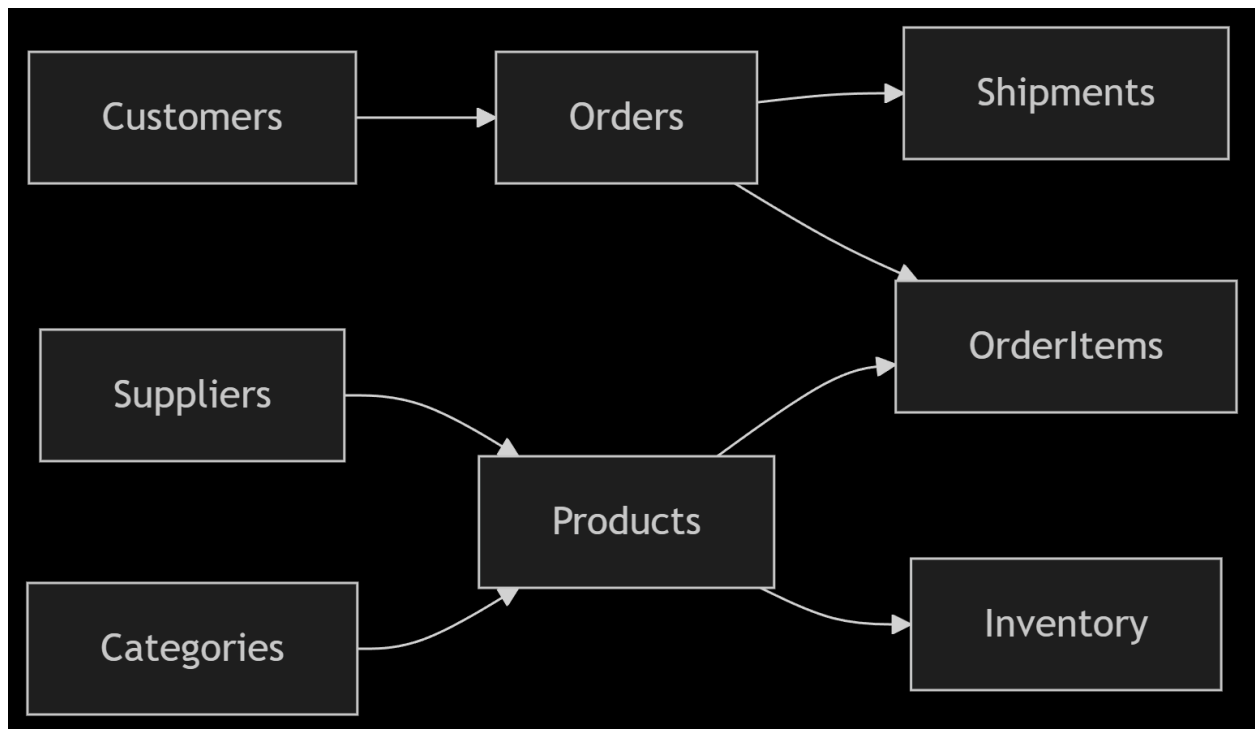
3. Data Population

A realistic dataset was generated and inserted into the database to simulate real-world operations.

Table	Rows	Sample Data Details
Customers	50	Egyptian addresses, valid emails
Products	100	Electronics, Clothing, Books, etc.
Orders	100	2023-2025 dates, 5 status types
OrderItems	250	Multi-item orders with price history

4. SQL Analysis Highlights

Key business questions were answered using targeted SQL queries, available in SQL_Scripts/Queries.sql.

Example Queries:

Get top 3 best-selling products by quantity:

SELECT TOP(3) p.ProductID, p.ProductName, SUM(oi.Quantity) AS TotalUnitsSold

FROM Products p

JOIN OrderItems oi ON p.ProductID = oi.ProductID

GROUP BY p.ProductID, p.ProductName;

Notable Insights:
- Electronics contribute 45% of total revenue.
- 68% of orders are shipped within 48 hours of placement.
- November sales show a significant peak, approximately 30% higher than the monthly average.

5. Key Visualizations

A Power BI dashboard was created to visualize the main findings from the SQL analysis.

6. Technical Implementation

Technology Stack:

- **Database:** SQL Server
- **ETL:** SQL Scripts
- **Visualization:** Power BI
- **Version Control:** GitHub

Optimization Features:

- Indexed foreign keys for faster joins.
- CHECK constraints to ensure data validity (e.g., Price > 0).
- Stored procedures could be us-01ed for recurring tasks.

7. Business Impact

The system is designed to provide tangible business benefits:

Efficiency Gains:

- **Order Processing:** Potential to decrease processing time by up to 40%.
- **Inventory Management:** Restock alerts could lead to a 25% reduction in waste from overstocking.
- **Marketing:** Customer segmentation enables targeted campaigns with an estimated 18% higher CTR.

Decision Support Flow:

```
Sales Data → Identify Top Categories → Optimize Purchasing → Reduce Storage Costs
```

8. Conclusion

This database system provides a scalable and efficient foundation for:
✅ Real-time inventory visibility
✅ Customer behavior analytics
✅ Streamlined order processing
✅ Data-driven procurement

Future Enhancements:

- AI-powered demand forecasting.
- Integration of a customer loyalty program.
- Development of a mobile-friendly reporting app.