Project 1
CSE4110 and AIE4055
Database Systems
Spring 2025

In this course project, you will design a **conceptual schema** for a **convenience store** enterprise using the **Entity-Relationship (E-R) model**. No implementation work (e.g., relational schema creation, coding, or database population) is required. This project focuses **exclusively** on developing a comprehensive E-R diagram.

Submission Rules

- Late submissions will not be accepted.
- Due date: Monday, April 21, 2025.
- Submit both a report (PDF) and the E-R diagram (PNG).
- Upload your submission to the assignment section on Cybercampus.

Goal

The goal of this project is to provide a realistic experience in the *conceptual design* of a relational database for a chain of convenience stores. You will work **individually** to create an E-R diagram that accurately models the operations of a convenience store chain. This includes modeling stores, products, vendors, (optionally) customers and their relationships.

Enterprise Description: Convenience Stores

You are modeling a convenience store chain. Each store sells various products (e.g., snacks, beverages, household items) and may operate 24/7. Below are some suggested entities and relationships to consider:

- **Stores:** Each convenience store has a store ID, name, address, and operating hours (e.g., 24 hours or specified open/close times). Some stores may be franchise-owned, while others are corporate-owned.
- **Products:** Items sold range from packaged snacks to beverages, toiletries, prepared foods, and more. Each product typically has a Universal Product Code (UPC), brand, package type, size, and price. Not all products are sold in every store.
- **Vendors:** Different vendors supply products. A vendor may supply multiple brands or product lines. You might record each vendor's name, contact information, and unique ID.
- **Inventory:** Each store maintains inventory for the products it sells. Restocking occurs when inventory runs low. You may capture reorder thresholds, reorder quantities, and recent order history.
- **Customers:** If desired, you may model a loyalty program or discount offerings. Customers might have a loyalty ID, personal information (name, phone, email), and a purchase history.
- **Sales Transactions:** For the conceptual design, you may include a sales entity that records the date/time, store location, items purchased, payment method, and total amount.

Sample Query Requirements (Natural Language)

Although you are not required to implement these queries in SQL, your E-R diagram should make it **possible** to answer the following (or similar) questions. These are stated in natural language:

1. **Product Availability:** *"Which stores currently carry a certain product (by UPC, name, or brand), and how much inventory do they have?"*
2. **Top-Selling Items:** *"Which products have the highest sales volume in each store over the past month?"*
3. **Store Performance:** *"Which store has generated the highest overall revenue this quarter?"*
4. **Vendor Statistics:** *"Which vendor supplies the most products across the chain, and how many total units have been sold?"*
5. **Inventory Reorder Alerts:** *"Which products in each store are below the reorder threshold and need restocking?"*
6. **Customer Purchase Patterns:** *"List the top 3 items that loyalty program customers typically purchase with coffee."*
7. **Franchise vs. Corporate Comparison:** *"Among franchise-owned stores, which one offers the widest variety of products, and how does that compare to corporate-owned stores?"*

Design your E-R diagram so that these (and similar) queries can be answered intuitively. This may influence your decisions regarding entities, attributes, and relationships.

Important Considerations for E-R Design

When designing your E-R diagram, consider the following:

- **Entities vs. Attributes:** Determine which concepts should be modeled as entities (e.g., *Store*, *Product*, *Vendor*) and which should be attributes (e.g., *brand name*, *product size*).
- **Primary Keys and Cardinalities:** Identify primary key attributes (such as *store_ID* or *product_UPC*) for each entity. Define relationship cardinalities (1:1, 1:N, M:N) based on business rules (e.g., "A vendor can supply many products; a product typically has one primary vendor").
- **M:N vs. 1:N Relationships:**
  - **1:N Example:** *One store may place many orders, but each order is linked to exactly one store.*
  - **M:N Example:** *A product can be sold in many stores, and each store carries many products.*
- **Optional vs. Mandatory Participation:**
  - If some stores may have zero products from a certain category, model that relationship as optional on the store side.
  - If at least one vendor must supply every product, reflect this constraint in the diagram.

Deliverables

By the due date, submit the following:

1. **Final E-R Diagram**
   Create a clear, well-labeled E-R diagram. Be sure to include:
   - Entities, attributes, primary keys, foreign keys
   - Relationships, mapping cardinality, and participation constraints
2. **Short Description / Business Rules**
   Write a brief (one to two paragraphs) summary of the key assumptions and rules that guided your design. For example, explain how you modeled store ownership (franchise vs. corporate), brand-to-product relationships, or inventory management.
3. **Coverage of Sample Queries**
   In 3–5 sentences, explain how your diagram supports the sample queries provided (e.g., "Since each store is related to the products it carries and includes an inventory level attribute, we can determine which stores stock a specific product.").

Report Specification

The submitted report must include the following components:

- **Entity and Relationship Justification:** Provide a detailed explanation of why each entity and relationship was defined as such in your E-R diagram. Discuss the design choices made and how they reflect the underlying business logic.
- **Mapping Cardinality Explanation:** Explain the cardinality assigned to each relationship (e.g., 1:1, 1:N, M:N). Justify your decisions based on real-world assumptions and constraints within a convenience store chain.
- **Query Support Description:** Describe how your E-R model enables processing of the sample queries listed in the project specification. Reference specific parts of your diagram to explain how each query could be answered conceptually.
- **Format:** There is no fixed format for the report. You are free to structure and format it as you see fit, as long as all required content is clearly addressed.

ERD Specification

The E-R diagram (ERD) you submit must adhere to the following guidelines:

- **Tool:** The ERD should be created using Lucidchart (https://www.lucidchart.com).
- **Single View:** Ensure that the entire ERD is visible on a single screen without the need for scrolling or zooming. Organize your layout clearly and compactly.
- **File Format:** Submit the ERD as a `.png` file. Other formats (e.g., PDF, JPG) will not be accepted.
- **Clarity:** All notations in the ERD are the same as those in the textbook. See slide 6.43.

Grading

Your submission will be evaluated based on the following criteria:

- **Accuracy and Completeness (40%)**
  - Does the E-R diagram include all major entities (stores, products, vendors, etc.)?
  - Are the relationships and cardinalities consistent with the business domain?
- **Ability to Address Queries (40%)**
  - Can the E-R model support the sample queries in principle?
  - Are appropriate entities and relationships present to answer those queries?
- **Clarity and Presentation (20%)**
  - Overall readability and structure of the E-R diagram
  - Use of consistent and accepted notation (e.g., crow's foot, Chen)
  - Clear and coherent explanation of the business rules

Note: Actual implementation (e.g., SQL scripts or database setup) is not required. This project focuses **solely** on conceptual design.