Databases & Web Services Project 2024

Illia Shust & Kinlo Ephriam Tangier, Constructor University

2024-Sep-11

1 Project Overview

The **Sustainable Shopping Assistant** is a web service aimed at promoting eco-friendly shopping habits by providing users with environmental ratings of products. The service helps users make informed decisions by showing the carbon footprint, eco-ratings, and sustainability certifications of products in various categories ranging from electronics, groceries to clothing.

Functional Overview

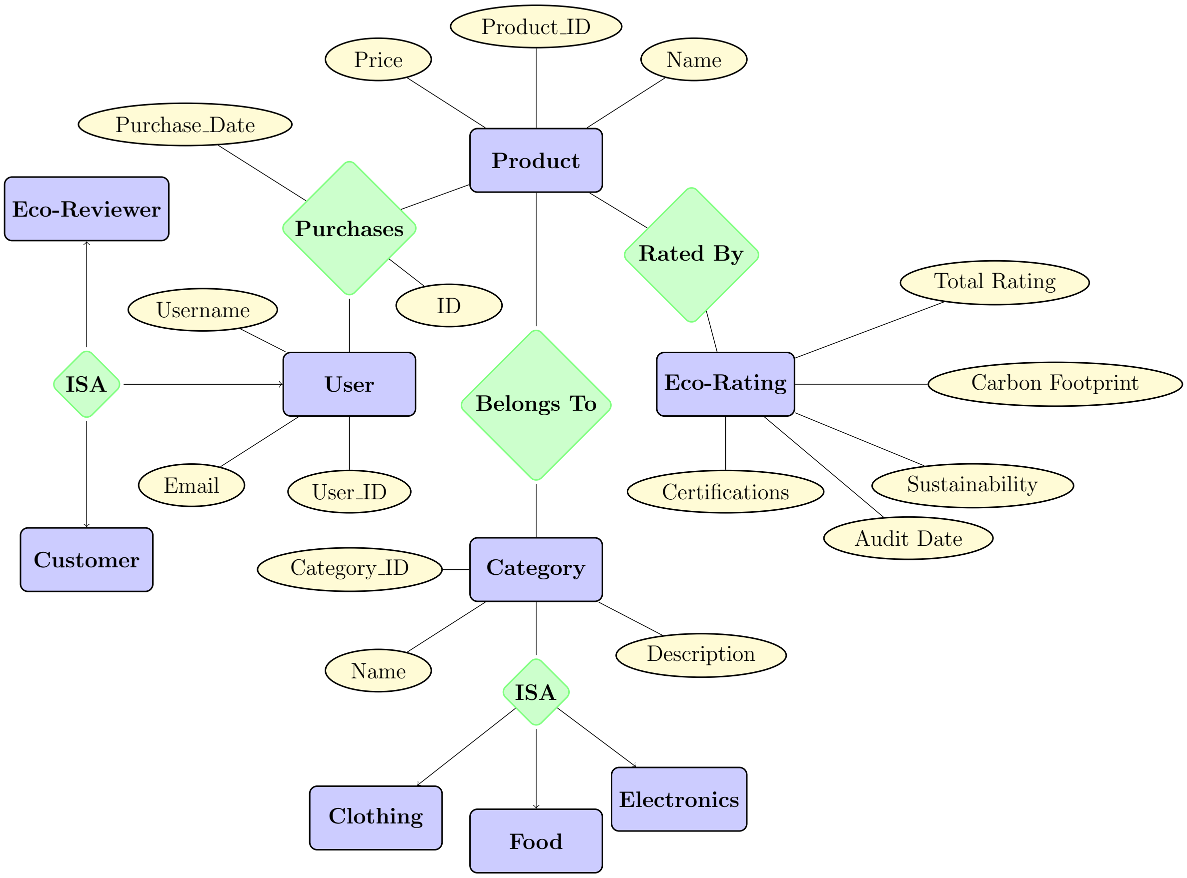
From the user's perspective, the system allows the following actions:

- **Search for products by category** (e.g., electronics, clothing, groceries).
- **View detailed eco-ratings**, including carbon footprint, environmental certifications, and sustainability scores.
- **Compare products** based on their environmental impact and find alternatives.
- **Set preferences** to receive suggestions for eco-friendly versions of desired products (e.g., plastic-free, organic).
- **Add products to a wishlist** and access seen eco-friendly alternatives.
- **Rate products** based on their perceived eco-friendliness.

The service aims to make the process of environmentally conscious shopping easier for the general public while encouraging sustainable consumer habits.

2 ER Diagram of the Miniworld

The ER diagram below includes the main entities involved in the system. For a team of two ($N = 2$), the system includes two "ISA" hierarchies: one for the products categories and another for users (customers and eco-reviewers).



3 User Interactions

Below is an outline of how the user will interact with the system:

- **Search Products**: Users can search for products by entering a keyword or filtering by categories (e.g., electronics, food, clothing, etc.).
- **View Eco-Scores**: When users view a product, they are presented with an overall "Eco-Score," which includes details like carbon footprint, sustainability certifications (e.g., Fair Trade, Organic), and material composition.
- **Set Preferences**: Users can input eco-friendly preferences, such as seeking products that are plastic-free, organic, or have a minimal carbon footprint. The system will recommend relevant options accordingly.
- **Add to Wishlist**: Users can add eco-friendly products to their wishlist for future reference.
- **Rate a Product**: Eco-reviewers can rate products they have used on a scale from 1-10 based on sustainability factors. Users with sufficient credibility can add reviews and scores.
- **Error Handling (Invalid Actions)**:
  - Searching for a non-existent product will result in a friendly message indicating no such product is found.

- Users attempting to unfairly rate a product multiple times will be shown a restriction message.
- Invalid eco-preference selections (e.g., choosing incompatible preferences) will prompt the user to adjust their input.

4 SQL Schema

4.1 Product Table

```
CREATE TABLE Product (
    product_id INT PRIMARY KEY AUTO_INCREMENT,
    price DECIMAL(10, 2),
    name VARCHAR(255)
);
```

This table stores product details. Each product has a unique product_id, a price, and a name.

4.2 User Table

```
CREATE TABLE User (
    user_id INT PRIMARY KEY AUTO_INCREMENT,
    username VARCHAR(255),
    email VARCHAR(255),
    role ENUM('Customer', 'EcoReviewer') NOT NULL
);
```

The User table includes both customers and eco-reviewers. The role field determines the user type. This is part of our inheritance strategy (explained below).

4.3 Category Table

```
CREATE TABLE Category (
    category_id INT PRIMARY KEY AUTO_INCREMENT,
    name VARCHAR(255),
    description VARCHAR(255),
    category_type ENUM('Clothing', 'Food', 'Electronics') NOT NULL
);
```

This table defines categories for products, with category_type distinguishing between different product types.

4.4 EcoRating Table

```
CREATE TABLE EcoRating (
    eco_rating_id INT PRIMARY KEY AUTO_INCREMENT,
    total_rating INT CHECK (total_rating BETWEEN 1 AND 100),
    certification VARCHAR(255),
    audit_date DATE,
    sustainability INT,
    carbon_footprint INT
);
```

The EcoRating table stores sustainability-related metrics for products.

4.5 Purchases Table

```
CREATE TABLE Purchases (
    purchase_id INT PRIMARY KEY AUTO_INCREMENT,
    purchase_date DATE,
    user_id INT,
    product_id INT,
    FOREIGN KEY (user_id) REFERENCES User (user_id),
    FOREIGN KEY (product_id) REFERENCES Product (product_id)
);
```

This table records purchases made by users. The many-to-many relationship between users and products is captured by linking user_id and product_id.

4.6 Rated By Table

```
CREATE TABLE RatedBy(
    product_id INT UNIQUE,
    total_rating INT,
    PRIMARY KEY(product_id, total_rating),
    FOREIGN KEY (product_id) REFERENCES Product (product_id),
    FOREIGN KEY (total_rating) REFERENCES EcoRating (total_rating)
);
```

This table handles the many-to-one relationship between products and eco-ratings, where each product can have only one eco-rating.

4.7 Belongs To Table

```
CREATE TABLE BelongsTo(
    product_id INT UNIQUE,
    category_id INT,
    PRIMARY KEY (product_id, category_id),
    FOREIGN KEY (product_id) REFERENCES Product (product_id),
    FOREIGN KEY (category_id) REFERENCES Category (category_id)
);
```

This table defines the many-to-one relationship between products and categories. Each product belongs to exactly one category.

5 Inheritance Strategy: Alt 3 (One Big Relation)

In this design, we adopted **Alt 3: One Big Relation** for handling inheritance. Instead of creating separate tables for the Customer and EcoReviewer, we used a single User table with an ENUM field, role, to distinguish between the two types. This approach was chosen for the following reasons:

1. All users, regardless of their type, are stored in a single table. This reduces the complexity of queries, as there is no need for joins between multiple user tables.
2. Since most operations (like purchases) involve both customers and eco-reviewers, this strategy eliminates the overhead of joins and simplifies data retrieval.
3. While some inheritance strategies may introduce many NULL fields in a large table, our design minimizes this by ensuring that all users share common fields, and the role column handles user type distinctions.

6 Mapping Approach

- **One-to-Many (1:n) Relationship:** Many products can belong to the same category, but each product belongs to exactly one category. This is captured by the BelongsTo table.
- **Many-to-One (n:1) Relationship:** Each product can have only one eco-rating, but multiple products can share the same eco-rating. This is represented by the RatedBy table.
- **Many-to-Many (n:n) Relationship:** Many users can purchase many products. The Purchases table captures this relationship between User and Product.

7 Useful queries

1. **Joining Product with EcoRating:**

```
 SELECT Product.product_id, Product.name, RatedBy.eco_rating_id,
EcoRating.total_rating
 FROM Product
 INNER JOIN RatedBy ON Product.product_id = RatedBy.product_id
 INNER JOIN EcoRating ON RatedBy.eco_rating_id = EcoRating.
eco_rating_id;
```

2. **Joining Product with Category:**

```
 SELECT Product.product_id, Product.name, BelongsTo.category_id,
Category.name
 FROM Product
 INNER JOIN BelongsTo ON Product.product_id = BelongsTo.product_id
 INNER JOIN Category ON BelongsTo.category_id = Category.category_id;
```

3. **All products with an eco-rating higher than 80:**

```
SELECT Product.name, EcoRating.total_rating
FROM Product
INNER JOIN RatedBy ON Product.product_id = RatedBy.product_id
INNER JOIN EcoRating ON RatedBy.eco_rating_id = EcoRating.
eco_rating_id
WHERE EcoRating.total_rating > 80;
```

4. **Get the minimum total rating and certification grouped by audit date:**

```
SELECT MIN(total_rating), certification
FROM EcoRating
GROUP BY audit_date;
```

5. **Get the sum of prices grouped by product name:**

```
SELECT SUM(price), name
FROM Product
GROUP BY name;
```

6. **Count the number of products for each category that have been purchased:**

```
SELECT COUNT(Purchases.product_id) AS total_purchases, Category.name
FROM Product
INNER JOIN Purchases ON Product.product_id = Purchases.product_id
INNER JOIN BelongsTo ON Product.product_id = BelongsTo.product_id
INNER JOIN Category ON BelongsTo.category_id = Category.category_id
GROUP BY Category.name
HAVING COUNT(Purchases.product_id) > 2;
```