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| **TRƯỜNG ĐẠI HỌC TÔN ĐỨC THẮNG**  KHOA CÔNG NGHỆ THÔNG TIN  **---------------------------** | **ĐẶC TẢ DỮ LIỆU HỆ THỐNG**  ĐỒ ÁN MÔN HỌC |

# Service-Oriented Architecture (504070)

## Thông Tin Sinh Viên

Họ và tên SV1: MSSV:

Họ và tên SV2: MSSV:

Họ và tên SV3: MSSV:

## Đặc Tả Dữ Liệu Hệ Thống

**E-commerce Database ERD Specification**

* **1. Introduction**

This document provides a detailed specification of the Entity-Relationship Diagram (ERD) for an e-commerce system. The database schema encompasses customer management, product catalog, order processing, payment handling, content management, and promotional activities.

* **2. Entity Descriptions**

**2.1. Customer-Related Entities**

**2.1.1. CUSTOMERS**

**Description:** Stores information about registered users of the e-commerce platform. **Primary Key:** customer\_id (TEXT) **Attributes:**

* customer\_id (TEXT, PK): Unique identifier for each customer
* email (TEXT, UK): Customer's email address, must be unique
* password\_hash (TEXT): Encrypted password
* first\_name (TEXT): Customer's first name
* last\_name (TEXT): Customer's last name
* phone (TEXT): Contact phone number
* address (TEXT): General address information
* email\_verified (BOOLEAN): Flag indicating if email is verified
* created\_at (TIMESTAMP): When the account was created
* updated\_at (TIMESTAMP): When the account was last updated
* last\_login (TIMESTAMP): When the customer last logged in

**2.1.2. CUSTOMER\_SESSIONS**

**Description:** Tracks active user sessions for authentication purposes. **Primary Key:** session\_id (TEXT) **Attributes:**

* session\_id (TEXT, PK): Unique identifier for each session
* customer\_id (TEXT, FK): Reference to CUSTOMERS.customer\_id
* token (TEXT): Authentication token
* created\_at (TIMESTAMP): When the session was created
* expires\_at (TIMESTAMP): When the session expires

**2.1.3. VERIFICATION\_CODES**

**Description:** Stores verification codes for account actions like email verification or password reset. **Primary Key:** email (TEXT), code\_type (TEXT) **Attributes:**

* email (TEXT, PK): Email address associated with the code
* code\_type (TEXT, PK): Type of verification (e.g., "email\_verify", "password\_reset")
* code (TEXT): The actual verification code
* created\_at (TIMESTAMP): When the code was generated
* expires\_at (TIMESTAMP): When the code expires

**2.2. Cart-Related Entities**

**2.2.1. CARTS**

**Description:** Represents shopping carts for customers. **Primary Key:** cart\_id (TEXT) **Attributes:**

* cart\_id (TEXT, PK): Unique identifier for each cart
* customer\_id (TEXT, FK): Reference to CUSTOMERS.customer\_id
* created\_at (TIMESTAMP): When the cart was created
* updated\_at (TIMESTAMP): When the cart was last updated

**2.2.2. CART\_ITEMS**

**Description:** Items added to customer shopping carts. **Primary Key:** item\_id (TEXT) **Attributes:**

* item\_id (TEXT, PK): Unique identifier for each cart item
* cart\_id (TEXT, FK): Reference to CARTS.cart\_id
* product\_id (TEXT, FK): Reference to PRODUCTS.product\_id
* product\_name (TEXT): Name of the product (denormalized)
* quantity (INTEGER): Quantity of the product
* original\_price (REAL): Original price per unit
* has\_promotion (INTEGER): Flag indicating if a promotion is applied
* promotion\_id (TEXT, FK): Reference to PROMOTIONS.promotion\_id
* promotion\_name (TEXT): Name of the applied promotion (denormalized)
* discount\_type (TEXT): Type of discount (e.g., "percentage", "fixed")
* discount\_value (REAL): Value of the discount
* discounted\_price (REAL): Price after discount is applied
* added\_at (TIMESTAMP): When the item was added to cart

**2.3. Order-Related Entities**

**2.3.1. ORDERS**

**Description:** Customer orders placed in the system. **Primary Key:** order\_id (TEXT) **Attributes:**

* order\_id (TEXT, PK): Unique identifier for each order
* customer\_id (TEXT, FK): Reference to CUSTOMERS.customer\_id
* transaction\_id (TEXT, FK): Reference to TRANSACTIONS.transaction\_id
* payment\_method\_id (TEXT, FK): Reference to PAYMENT\_METHODS.payment\_method\_id
* address\_id (TEXT, FK): Reference to DELIVERY\_ADDRESSES.address\_id
* total\_amount (REAL): Total order amount
* status (TEXT): Current order status
* tracking\_number (TEXT): Shipping tracking number
* carrier (TEXT): Shipping carrier
* notes (TEXT): Additional order notes
* created\_at (TIMESTAMP): When the order was created
* updated\_at (TIMESTAMP): When the order was last updated
* estimated\_delivery (TIMESTAMP): Estimated delivery date

**2.3.2. ORDER\_ITEMS**

**Description:** Individual items within an order. **Primary Key:** order\_item\_id (TEXT) **Attributes:**

* order\_item\_id (TEXT, PK): Unique identifier for each order item
* order\_id (TEXT, FK): Reference to ORDERS.order\_id
* product\_id (TEXT, FK): Reference to PRODUCTS.product\_id
* product\_name (TEXT): Name of the product (denormalized)
* product\_image (TEXT): Image URL for the product
* quantity (INTEGER): Quantity ordered
* price (REAL): Final price per unit
* discount (REAL): Discount amount applied
* original\_price (REAL): Original price before discount
* has\_promotion (INTEGER): Flag indicating if a promotion was applied
* promotion\_id (TEXT, FK): Reference to PROMOTIONS.promotion\_id
* added\_at (TIMESTAMP): When the item was added to the order

**2.3.3. ORDER\_STATUS\_HISTORY**

**Description:** Tracks the history of status changes for orders. **Primary Key:** history\_id (TEXT) **Attributes:**

* history\_id (TEXT, PK): Unique identifier for each status history entry
* order\_id (TEXT, FK): Reference to ORDERS.order\_id
* status (TEXT): Order status value
* notes (TEXT): Additional notes about the status change
* created\_at (TIMESTAMP): When the status was updated

**2.4. Payment-Related Entities**

**2.4.1. PAYMENT\_METHODS**

**Description:** Customer payment methods stored in the system. **Primary Key:** payment\_method\_id (TEXT) **Attributes:**

* payment\_method\_id (TEXT, PK): Unique identifier for each payment method
* customer\_id (TEXT, FK): Reference to CUSTOMERS.customer\_id
* method\_type (TEXT): Type of payment method (e.g., "credit", "debit")
* card\_number (TEXT): Masked card number
* card\_type (TEXT): Card brand/type
* card\_holder\_name (TEXT): Name on the card
* expiry\_date (TEXT): Card expiration date
* billing\_address (TEXT): Billing address for the card
* is\_default (BOOLEAN): Flag indicating if this is the default method
* created\_at (TIMESTAMP): When the payment method was added
* updated\_at (TIMESTAMP): When the payment method was last updated

**2.4.2. DELIVERY\_ADDRESSES**

**Description:** Customer shipping addresses. **Primary Key:** address\_id (TEXT) **Attributes:**

* address\_id (TEXT, PK): Unique identifier for each address
* customer\_id (TEXT, FK): Reference to CUSTOMERS.customer\_id
* name (TEXT): Recipient name
* address\_line1 (TEXT): First line of address
* address\_line2 (TEXT): Second line of address
* city (TEXT): City
* state (TEXT): State/province
* country (TEXT): Country
* postal\_code (TEXT): ZIP/postal code
* phone\_number (TEXT): Contact phone number
* is\_default (BOOLEAN): Flag indicating if this is the default address
* created\_at (TIMESTAMP): When the address was added
* updated\_at (TIMESTAMP): When the address was last updated

**2.4.3. TRANSACTIONS**

**Description:** Payment transactions for orders. **Primary Key:** transaction\_id (TEXT) **Attributes:**

* transaction\_id (TEXT, PK): Unique identifier for each transaction
* order\_id (TEXT, FK): Reference to ORDERS.order\_id
* amount (REAL): Transaction amount
* payment\_gateway (TEXT): Payment processor used
* status (TEXT): Transaction status
* gateway\_transaction\_id (TEXT): ID from payment gateway
* gateway\_response (TEXT): Response from payment gateway
* created\_at (TIMESTAMP): When the transaction was processed

**2.5. Product-Related Entities**

**2.5.1. PRODUCTS**

**Description:** Products available in the store. **Primary Key:** product\_id (TEXT) **Attributes:**

* product\_id (TEXT, PK): Unique identifier for each product
* name (TEXT): Product name
* price (REAL): Product price
* description (TEXT): Product description
* category (TEXT): Product category
* manufacturer (TEXT): Product manufacturer/brand
* stock\_quantity (INTEGER): Available stock
* image\_url (TEXT): Primary image URL
* created\_at (TEXT): When the product was added
* updated\_at (TEXT): When the product was last updated

**2.5.2. PRODUCT\_IMAGES**

**Description:** Images associated with products. **Primary Key:** image\_id (TEXT) **Attributes:**

* image\_id (TEXT, PK): Unique identifier for each image
* product\_id (TEXT, FK): Reference to PRODUCTS.product\_id
* filename (TEXT): Image filename
* path (TEXT): Image file path
* alt\_text (TEXT): Alternative text for accessibility
* is\_primary (INTEGER): Flag indicating if this is the primary image
* width (INTEGER): Image width in pixels
* height (INTEGER): Image height in pixels
* size\_kb (INTEGER): File size in kilobytes
* mime\_type (TEXT): Image MIME type
* sort\_order (INTEGER): Display order
* created\_at (TEXT): When the image was added

**2.5.3. PROMOTIONS**

**Description:** Product promotions and discounts. **Primary Key:** promotion\_id (TEXT) **Attributes:**

* promotion\_id (TEXT, PK): Unique identifier for each promotion
* product\_id (TEXT, FK): Reference to PRODUCTS.product\_id
* name (TEXT): Promotion name
* description (TEXT): Promotion description
* discount\_type (TEXT): Type of discount (e.g., "percentage", "fixed")
* discount\_value (REAL): Value of the discount
* start\_date (TEXT): Promotion start date
* end\_date (TEXT): Promotion end date
* is\_active (INTEGER): Flag indicating if the promotion is active
* created\_at (TEXT): When the promotion was created
* updated\_at (TEXT): When the promotion was last updated

**2.6. Communication-Related Entities**

**2.6.1. EMAIL\_LOGS**

**Description:** Logs of emails sent by the system. **Primary Key:** email\_id (TEXT) **Attributes:**

* email\_id (TEXT, PK): Unique identifier for each email
* recipient (TEXT): Email recipient
* subject (TEXT): Email subject
* email\_type (TEXT): Type of email (e.g., "order\_confirmation")
* status (TEXT): Delivery status
* sent\_at (TIMESTAMP): When the email was sent
* error\_message (TEXT): Error message if delivery failed

**2.7. Content Management Entities**

**2.7.1. ARTICLES**

**Description:** Content articles published on the site. **Primary Key:** article\_id (TEXT) **Attributes:**

* article\_id (TEXT, PK): Unique identifier for each article
* title (TEXT): Article title
* content (TEXT): Article body content
* summary (TEXT): Brief summary of the article
* type (TEXT): Article type (e.g., "news", "blog")
* author (TEXT): Author name
* published\_date (TEXT): Publication date
* status (TEXT): Publication status (e.g., "draft", "published")
* featured (INTEGER): Flag indicating if the article is featured
* featured\_image\_id (TEXT): ID of the featured image
* view\_count (INTEGER): Number of views
* created\_at (TEXT): When the article was created
* updated\_at (TEXT): When the article was last updated

**2.7.2. IMAGES**

**Description:** Images used in articles. **Primary Key:** image\_id (TEXT) **Attributes:**

* image\_id (TEXT, PK): Unique identifier for each image
* article\_id (TEXT, FK): Reference to ARTICLES.article\_id
* filename (TEXT): Image filename
* path (TEXT): Image file path
* alt\_text (TEXT): Alternative text for accessibility
* caption (TEXT): Image caption
* width (INTEGER): Image width in pixels
* height (INTEGER): Image height in pixels
* size\_kb (INTEGER): File size in kilobytes
* mime\_type (TEXT): Image MIME type
* order\_index (INTEGER): Display order
* created\_at (TEXT): When the image was added

**2.7.3. TAGS**

**Description:** Tags for categorizing articles. **Primary Key:** tag\_id (TEXT) **Attributes:**

* tag\_id (TEXT, PK): Unique identifier for each tag
* name (TEXT): Tag name
* slug (TEXT): URL-friendly version of the name
* description (TEXT): Tag description
* created\_at (TEXT): When the tag was created

**2.7.4. ARTICLE\_TAGS**

**Description:** Junction table linking articles to tags. **Primary Key:** article\_id (TEXT), tag\_id (TEXT) **Attributes:**

* article\_id (TEXT, PK, FK): Reference to ARTICLES.article\_id
* tag\_id (TEXT, PK, FK): Reference to TAGS.tag\_id
* **3. Relationship Descriptions**

**3.1. Customer Relationships**

1. **CUSTOMERS to CUSTOMER\_SESSIONS (1:N)**
   * A customer can have multiple active sessions
   * Relationship: CUSTOMERS ||--o{ CUSTOMER\_SESSIONS : has
2. **CUSTOMERS to CARTS (1:1)**
   * A customer owns exactly one cart
   * Relationship: CUSTOMERS ||--|| CARTS : owns
3. **CUSTOMERS to VERIFICATION\_CODES (1:N)**
   * A customer can have multiple verification codes
   * Relationship: CUSTOMERS ||--o{ VERIFICATION\_CODES : uses
4. **CUSTOMERS to ORDERS (1:N)**
   * A customer can place multiple orders
   * Relationship: CUSTOMERS ||--o{ ORDERS : places
5. **CUSTOMERS to PAYMENT\_METHODS (1:N)**
   * A customer can have multiple payment methods
   * Relationship: CUSTOMERS ||--o{ PAYMENT\_METHODS : has
6. **CUSTOMERS to DELIVERY\_ADDRESSES (1:N)**
   * A customer can have multiple delivery addresses
   * Relationship: CUSTOMERS ||--o{ DELIVERY\_ADDRESSES : has

**3.2. Cart and Order Relationships**

1. **CARTS to CART\_ITEMS (1:N)**
   * A cart can contain multiple items
   * Relationship: CARTS ||--o{ CART\_ITEMS : contains
2. **ORDERS to ORDER\_ITEMS (1:N)**
   * An order can contain multiple items
   * Relationship: ORDERS ||--o{ ORDER\_ITEMS : contains
3. **ORDERS to ORDER\_STATUS\_HISTORY (1:N)**
   * An order can have multiple status history entries
   * Relationship: ORDERS ||--o{ ORDER\_STATUS\_HISTORY : tracks
4. **ORDERS to TRANSACTIONS (1:N)**
   * An order can have multiple transactions (e.g., payment, refund)
   * Relationship: ORDERS ||--o{ TRANSACTIONS : processes

**3.3. Payment and Shipping Relationships**

1. **PAYMENT\_METHODS to ORDERS (1:N)**
   * A payment method can be used for multiple orders
   * Relationship: PAYMENT\_METHODS ||--o{ ORDERS : used\_in
2. **DELIVERY\_ADDRESSES to ORDERS (1:N)**
   * A delivery address can be used for multiple orders
   * Relationship: DELIVERY\_ADDRESSES ||--o{ ORDERS : shipped\_to

**3.4. Product Relationships**

1. **PRODUCTS to PRODUCT\_IMAGES (1:N)**
   * A product can have multiple images
   * Relationship: PRODUCTS ||--o{ PRODUCT\_IMAGES : has
2. **PRODUCTS to PROMOTIONS (1:1)**
   * A product can have one promotion
   * Relationship: PRODUCTS ||--|| PROMOTIONS : has
3. **PRODUCTS to CART\_ITEMS (1:N)**
   * A product can appear in multiple cart items
   * Relationship: PRODUCTS ||--o{ CART\_ITEMS : referenced\_in
4. **PRODUCTS to ORDER\_ITEMS (1:N)**
   * A product can appear in multiple order items
   * Relationship: PRODUCTS ||--o{ ORDER\_ITEMS : referenced\_in

**3.5. Promotion Relationships**

1. **PROMOTIONS to CART\_ITEMS (1:N)**
   * A promotion can be applied to multiple cart items
   * Relationship: PROMOTIONS ||--o{ CART\_ITEMS : applied\_to
2. **PROMOTIONS to ORDER\_ITEMS (1:N)**
   * A promotion can be applied to multiple order items
   * Relationship: PROMOTIONS ||--o{ ORDER\_ITEMS : applied\_to

**3.6. Content Management Relationships**

1. **ARTICLES to IMAGES (1:N)**
   * An article can contain multiple images
   * Relationship: ARTICLES ||--o{ IMAGES : contains
2. **ARTICLES to ARTICLE\_TAGS (1:N)**
   * An article can have multiple tags
   * Relationship: ARTICLES ||--o{ ARTICLE\_TAGS : has
3. **TAGS to ARTICLE\_TAGS (1:N)**
   * A tag can be referenced by multiple article tags
   * Relationship: ARTICLE\_TAGS }o--|| TAGS : references

* **4. Design Considerations**

**4.1. Normalization**

The database schema generally follows third normal form (3NF) principles with some strategic denormalization:

1. **Denormalization Examples:**
   * Product information (name, price) is denormalized in CART\_ITEMS and ORDER\_ITEMS to preserve historical data
   * Promotion information is denormalized in CART\_ITEMS to maintain a record of the promotional terms at the time of addition

**4.2. Data Integrity**

1. **Foreign Key Constraints:**
   * All relationships are enforced through foreign key constraints
   * Cascade operations should be carefully configured based on business requirements
2. **Data Validation:**
   * Email addresses must be unique
   * Boolean flags (is\_default, is\_active) ensure consistent state

**4.3. Performance Considerations**

1. **Indexing Strategy:**
   * Primary keys should be indexed
   * Foreign keys should be indexed to optimize joins
   * Consider additional indexes on frequently queried columns (e.g., order status)
2. **Query Optimization:**
   * The denormalized fields in CART\_ITEMS and ORDER\_ITEMS reduce the need for complex joins
   * Consider materialized views for complex reporting queries

* **5. Data Dictionary**

A comprehensive list of all data types and constraints:

**5.1. Data Types**

* **TEXT**: Variable-length character data, used for most string fields
* **INTEGER**: Whole number values
* **REAL**: Floating-point numeric values for prices and amounts
* **BOOLEAN**: True/false values for flags
* **TIMESTAMP**: Date and time values

**5.2. Constraints**

* **PK**: Primary Key constraint
* **FK**: Foreign Key constraint
* **UK**: Unique Key constraint
* **6. Summary**

This ERD specification defines a comprehensive database schema for an e-commerce system. The design supports all core e-commerce functions including customer management, product catalog, shopping cart, order processing, payment handling, content management, and promotions.

The schema balances normalization principles with practical considerations for performance and data integrity. The design allows for efficient querying while maintaining historical data consistency through strategic denormalization.

## Lược Đồ ERD

