

BIL372 Database Systems - Interim Report

Physical Game and Console Sales Website

Project Group Members

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Project Subject and Domain Definition

This project aims to develop a comprehensive e-commerce platform for physical video game and gaming console sales. The system will serve as a B2C online retail platform, enabling customers to browse, purchase, and review gaming products while providing robust inventory management, supplier tracking, and multi-branch operations support.

The domain encompasses the complete lifecycle of gaming product retail, including product catalog management, customer interactions, order processing, inventory tracking across multiple branches, supplier relationships, and post-sale services such as returns and reviews. The platform will handle two primary product categories: video games (with platform-specific details) and gaming consoles (with hardware specifications).

Database Design Details

The database architecture consists of 19 interconnected entities designed to support comprehensive e-commerce operations. The design implements advanced database concepts including superclass-subclass relationships, composite attributes, weak entities, and multivalued attributes.

Core Entities and Relationships

CUSTOMER Entity

- Primary Key: customer_id
- Attributes: first_name, last_name, email (UNIQUE), password_hash, phone, registration_date, last_login_date, active_status
- Composite Attribute: address (full_address, city)
- Purpose: Stores registered user information with authentication credentials and contact details

Attribute Name	Data Type	Key/Constraint	Description
customer_id	INT	PK	Primary Key
first_name	VARCHAR(50)		First name
last_name	VARCHAR(50)		Last name
email	VARCHAR(100)	UNIQUE	Email address
password_hash	VARCHAR(255)		Hashed password
phone	VARCHAR(20)		Phone number
registration_date	DATE		Registration date
last_login_date	TIMESTAMP		Last login timestamp
active_status	BOOLEAN		Account status
address	COMPOSITE		(full_address, city)

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

PRODUCT Entity (Superclass)

- Primary Key: product_id
- Attributes: product_name, description, price (CHECK price > 0), release_date, product_type (discriminator), brand, status, weight, dimensions, stock_alert_level
- Purpose: Serves as the parent entity for all products with common attributes
- Specialization: Uses product_type as discriminator to differentiate between GAME and CONSOLE subclasses

Attribute Name	Data Type	Key/Constraint	Description
product_id	INT	PK	Primary Key (Superclass)
product_name	VARCHAR(200)		Product name
description	TEXT		Product description
price	DECIMAL(10,2)	CHECK > 0	Product price
release_date	DATE		Release date
product_type	VARCHAR(20)	DISCRIMINATOR	game/console
brand	VARCHAR(100)		Brand name
status	VARCHAR(20)		Product status
weight	DECIMAL(6,2)		Weight in kg
dimensions	VARCHAR(50)		Dimensions
stock_alert_level	INT		Alert threshold

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

GAME Entity (Subclass)

- Primary/Foreign Key: product_id REFERENCES PRODUCT
- Attributes: platform, developer, publisher, ESRB_rating, multiplayer, language_support, subtitle_languages
- Related Entities: GAME_GENRE (many-to-many relationship for multiple genres), PRODUCT_MEDIA (for images/videos)
- Purpose: Stores game-specific attributes including platform compatibility and content ratings

Attribute Name	Data Type	Key/Constraint	Description
product_id	INT	PK/FK	References PRODUCT
platform	VARCHAR(50)		Gaming platform
developer	VARCHAR(100)		Developer name
publisher	VARCHAR(100)		Publisher name
ESRB_rating	VARCHAR(10)		ESRB rating
multiplayer	BOOLEAN		Multiplayer support
language_support	TEXT		Supported languages
subtitle_languages	TEXT		Subtitle languages

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

CONSOLE Entity (Subclass)

- Primary/Foreign Key: product_id REFERENCES PRODUCT
- Attributes: manufacturer, model, storage_capacity, color, included_accessories, warranty_period
- Purpose: Stores console-specific hardware specifications and warranty information

Attribute Name	Data Type	Key/Constraint	Description
product_id	INT	PK/FK	References PRODUCT
manufacturer	VARCHAR(100)		Console manufacturer
model	VARCHAR(100)		Console model
storage_capacity	VARCHAR(20)		Storage capacity
color	VARCHAR(30)		Console color
included_accessories	TEXT		Accessories
warranty_period	INT		Warranty in months

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

ORDER Entity

- Primary Key: order_id
- Foreign Key: customer_id REFERENCES CUSTOMER
- Attributes: order_date, order_status, total_amount, shipping_fee, payment_method, payment_status, tracking_number, estimated_delivery_date, actual_delivery_date
- Composite Attributes: delivery_address (full_address, city), billing_address (full_address, city)
- Purpose: Manages customer orders with comprehensive tracking and payment information

Attribute Name	Data Type	Key/Constraint	Description
order_id	INT	PK	Primary Key
customer_id	INT	FK	References CUSTOMER
order_date	TIMESTAMP		Order date
order_status	VARCHAR(20)		Order status
total_amount	DECIMAL(10,2)		Total amount
shipping_fee	DECIMAL(6,2)		Shipping fee
payment_method	VARCHAR(30)		Payment method
payment_status	VARCHAR(20)		Payment status
tracking_number	VARCHAR(50)		Tracking number
estimated_delivery_date	DATE		Estimated delivery
actual_delivery_date	DATE		Actual delivery
delivery_address	COMPOSITE		(full_address, city)
billing_address	COMPOSITE		(full_address, city)

█ Primary Key (PK)
 █ Foreign Key (FK)
 █ Constraint
 █ Regular Attribute

ORDER_DETAIL Entity (Weak Entity)

- Primary Key: (order_id, line_no)
- Foreign Keys: order_id REFERENCES ORDER, product_id REFERENCES PRODUCT
- Attributes: quantity, unit_price
- Purpose: Stores individual line items for each order, existence-dependent on ORDER entity

Attribute Name	Data Type	Key/Constraint	Description
order_id	INT	PK/FK	References ORDER (Weak)
line_no	INT	PK	Line number
product_id	INT	FK	References PRODUCT
quantity	INT		Order quantity
unit_price	DECIMAL(10,2)		Unit price

█ Primary Key (PK)
 █ Foreign Key (FK)
 █ Constraint
 █ Regular Attribute

INVENTORY Entity

- Primary Key: inventory_id
- Foreign Keys: product_id REFERENCES PRODUCT, branch_id REFERENCES BRANCH
- Attributes: quantity (CHECK quantity >= 0), minimum_stock, maximum_stock, shelf_location, last_update_date
- Purpose: Tracks product stock levels across multiple branches with automatic alert thresholds

Attribute Name	Data Type	Key/Constraint	Description
inventory_id	INT	PK	Primary Key
product_id	INT	FK	References PRODUCT
branch_id	INT	FK	References BRANCH
quantity	INT	CHECK >= 0	Stock quantity
minimum_stock	INT		Minimum threshold
maximum_stock	INT		Maximum capacity
shelf_location	VARCHAR(50)		Shelf location
last_update_date	TIMESTAMP		Last update

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

BRANCH Entity

- Primary Key: branch_id
- Foreign Key: address_id REFERENCES ADDRESS
- Attributes: branch_name, phone, email, working_hours, manager_name, opening_date
- Purpose: Manages physical store locations with operational details

Attribute Name	Data Type	Key/Constraint	Description
branch_id	INT	PK	Primary Key
address_id	INT	FK	References ADDRESS
branch_name	VARCHAR(100)		Branch name
phone	VARCHAR(20)		Phone number
email	VARCHAR(100)		Email address
working_hours	VARCHAR(100)		Working hours
manager_name	VARCHAR(100)		Manager name
opening_date	DATE		Opening date

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

SUPPLIER Entity

- Primary Key: supplier_id
- Attributes: supplier_name, payment_terms, active_status
- Composite Attribute: contact_info (nested composite with address, phone, email)
- Purpose: Maintains supplier relationships for product procurement

Attribute Name	Data Type	Key/Constraint	Description
supplier_id	INT	PK	Primary Key
supplier_name	VARCHAR(150)		Supplier name
payment_terms	VARCHAR(100)		Payment terms
active_status	BOOLEAN		Active status
contact_info	COMPOSITE		(address, phone, email)

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

SALE Entity

- Primary Key: sale_id
- Foreign Keys: customer_id, order_id, branch_id
- Attributes: transaction_date, transaction_amount, cost, profit, sale_type (online/in-store)
- Purpose: Records completed sales transactions with profit tracking

Attribute Name	Data Type	Key/Constraint	Description
sale_id	INT	PK	Primary Key
customer_id	INT	FK	References CUSTOMER
order_id	INT	FK	References ORDER
branch_id	INT	FK	References BRANCH
transaction_date	TIMESTAMP		Transaction date
transaction_amount	DECIMAL(10,2)		Sale amount
cost	DECIMAL(10,2)		Cost
profit	DECIMAL(10,2)		Profit
sale_type	VARCHAR(20)		online/in-store

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

RETURN Entity

- Primary Key: return_id
- Foreign Keys: customer_id, order_id, product_id
- Attributes: transaction_date, quantity, refund_amount, return_reason, return_status, refund_date
- Purpose: Manages product returns and refund processing

Attribute Name	Data Type	Key/Constraint	Description
return_id	INT	PK	Primary Key
customer_id	INT	FK	References CUSTOMER
order_id	INT	FK	References ORDER
product_id	INT	FK	References PRODUCT
transaction_date	TIMESTAMP		Return date
quantity	INT		Return quantity
refund_amount	DECIMAL(10,2)		Refund amount
return_reason	TEXT		Return reason
return_status	VARCHAR(20)		Return status
refund_date	DATE		Refund date

█ Primary Key (PK)
 █ Foreign Key (FK)
 █ Constraint
 █ Regular Attribute

PURCHASE Entity

- Primary Key: purchase_id
- Foreign Keys: supplier_id, product_id
- Attributes: transaction_date, quantity, unit_cost, total_cost, payment_status, payment_date, invoice_no
- Purpose: Tracks inventory purchases from suppliers

Attribute Name	Data Type	Key/Constraint	Description
purchase_id	INT	PK	Primary Key
supplier_id	INT	FK	References SUPPLIER
product_id	INT	FK	References PRODUCT
transaction_date	TIMESTAMP		Purchase date
quantity	INT		Purchase quantity
unit_cost	DECIMAL(10,2)		Unit cost
total_cost	DECIMAL(10,2)		Total cost
payment_status	VARCHAR(20)		Payment status
payment_date	DATE		Payment date
invoice_no	VARCHAR(50)		Invoice number

█ Primary Key (PK)
 █ Foreign Key (FK)
 █ Constraint
 █ Regular Attribute

REVIEW Entity

- Primary Key: review_id
- Foreign Keys: customer_id, product_id
- Attributes: rating (CHECK 1-5), review_title, review_text, review_date, helpful_count, approved
- Purpose: Stores customer product reviews with moderation capability

Attribute Name	Data Type	Key/Constraint	Description
review_id	INT	PK	Primary Key
customer_id	INT	FK	References CUSTOMER
product_id	INT	FK	References PRODUCT
rating	INT	CHECK 1-5	Rating (1-5)
review_title	VARCHAR(200)		Review title
review_text	TEXT		Review text
review_date	TIMESTAMP		Review date
helpful_count	INT		Helpful votes
approved	BOOLEAN		Approval status

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

CART Entity (Many-to-Many)

- Primary Key: (customer_id, product_id)
- Attributes: quantity, added_date
- Purpose: Maintains shopping cart state for active users

(Associative Entity - Many-to-Many)

Attribute Name	Data Type	Key/Constraint	Description
customer_id	INT	PK/FK	References CUSTOMER
product_id	INT	PK/FK	References PRODUCT
quantity	INT		Cart quantity
added_date	TIMESTAMP		Date added

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

ADDRESS Entity

- Primary Key: address_id
- Foreign Key: customer_id
- Attributes: address_type, city, district, neighborhood, full_address, postal_code, default_address
- Purpose: Stores multiple delivery addresses per customer

Attribute Name	Data Type	Key/Constraint	Description
address_id	INT	PK	Primary Key
customer_id	INT	FK	References CUSTOMER
address_type	VARCHAR(20)		Address type
city	VARCHAR(100)		City
district	VARCHAR(100)		District
neighborhood	VARCHAR(100)		Neighborhood
full_address	TEXT		Full address
postal_code	VARCHAR(10)		Postal code
default_address	BOOLEAN		Default flag

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

GENRE Entity

- Primary Key: genre_id
- Attributes: genre_name, description
- Purpose: Defines game genres for classification

Attribute Name	Data Type	Key/Constraint	Description
genre_id	INT	PK	Primary Key
genre_name	VARCHAR(50)		Genre name
description	TEXT		Genre description

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

GAME_GENRE Entity (Associative)

- Primary Key: (product_id, genre_id)
- Purpose: Implements many-to-many relationship between games and genres

Attribute Name	Data Type	Key/Constraint	Description
product_id	INT	PK/FK	References GAME
genre_id	INT	PK/FK	References GENRE

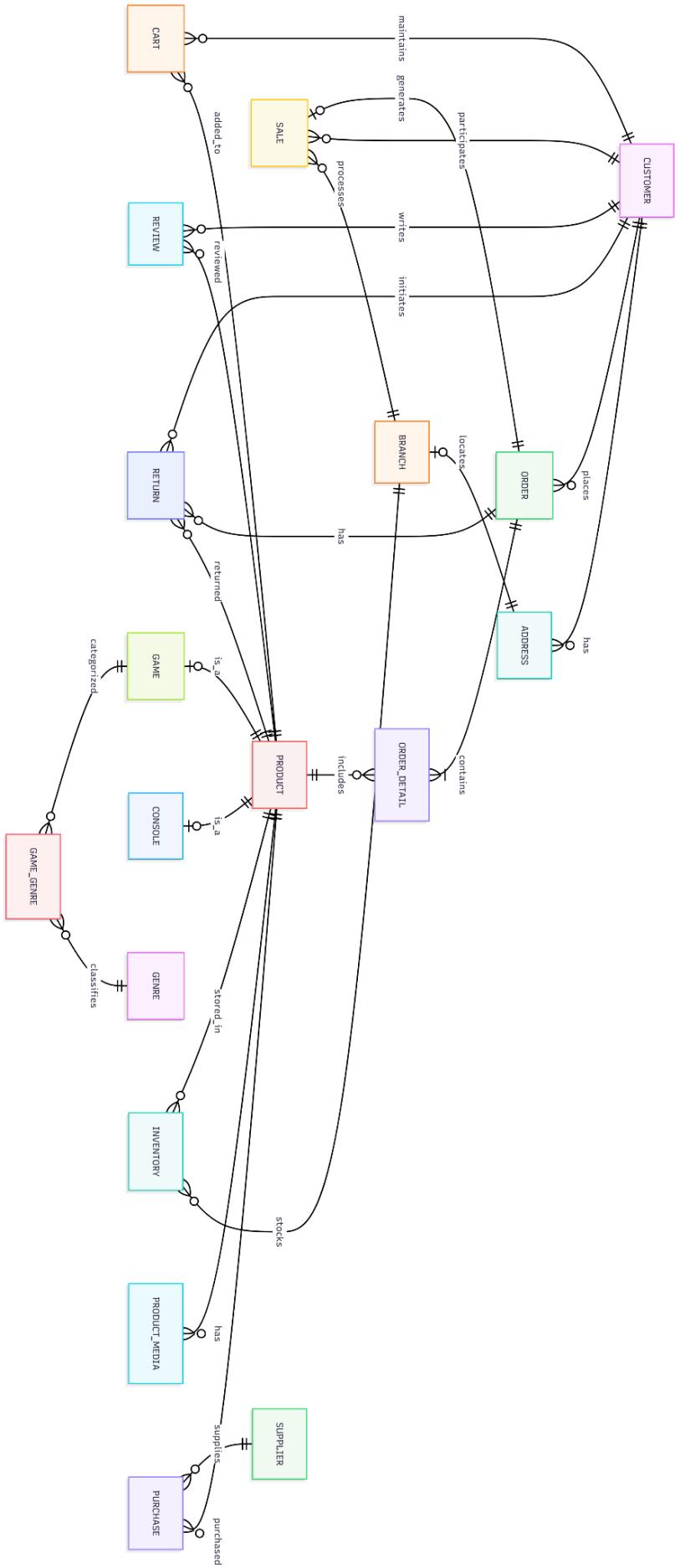
■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute

PRODUCT_MEDIA Entity

- Primary Key: media_id
- Foreign Key: product_id
- Attributes: media_type (video/photo), media_url, order_no, main_image
- Purpose: Manages product images and videos for display

Attribute Name	Data Type	Key/Constraint	Description
media_id	INT	PK	Primary Key
product_id	INT	FK	References PRODUCT
media_type	VARCHAR(10)		video/photo
media_url	VARCHAR(500)		Media URL
order_no	INT		Display order
main_image	BOOLEAN		Main image flag

■ Primary Key (PK) ■ Foreign Key (FK) ■ Constraint ■ Regular Attribute



Key Database Constraints

Integrity Constraints:

- CHECK constraint on PRODUCT.price ensuring positive values
- CHECK constraint on INVENTORY.quantity preventing negative stock
- CHECK constraint on REVIEW.rating limiting values between 1-5
- UNIQUE constraint on CUSTOMER.email preventing duplicate accounts

Referential Integrity:

- All foreign keys maintain referential integrity with CASCADE or RESTRICT options
- Weak entity ORDER_DETAIL cannot exist without parent ORDER entity

Domain Constraints:

- Discriminator attribute product_type restricted to 'game' or 'console'
- sale_type limited to 'online' or 'in-store'
- media_type restricted to 'video' or 'photo'

Planned Application Features and Functions

The web application will provide comprehensive functionality for both customers and administrators

Customer-Facing Features

Product Browsing and Search

- Browse games by platform, genre, publisher, and ESRB rating
- Browse consoles by manufacturer, storage capacity, and color
- Advanced search with filters for price range, release date, and availability
- Product detail pages with images, videos, descriptions, and specifications
- Customer review display with rating aggregation and helpful vote sorting

Shopping and Checkout

- Add products to shopping cart with quantity selection
- View and modify cart contents before checkout
- Secure checkout process with delivery and billing address selection
- Multiple payment method support (credit card, debit card, online payment)
- Order confirmation with tracking number generation

Account Management

- User registration and authentication
- Profile management with password change functionality
- Multiple address management with default address selection
- Order history viewing with status tracking
- Return request submission with reason selection

Review System

- Submit product reviews with 1-5 star ratings
- Write review titles and detailed text
- View own submitted reviews
- Mark helpful reviews to assist other customers

Administrative Features

Inventory Management

- Real-time stock level monitoring across all branches
- Automatic stock alert notifications when quantities fall below thresholds
- Stock transfer between branches
- Product addition and modification with full attribute management
- Bulk product upload functionality

Order Processing

- Order status management (pending, processing, shipped, delivered, cancelled)
- Shipping label generation with tracking number assignment
- Payment status verification and update
- Return processing and refund approval

Supplier Management

- Supplier information maintenance
- Purchase order creation and tracking
- Invoice management and payment recording
- Supplier performance reporting

Sales Analytics

- Revenue reports by product, category, and time period
- Profit margin analysis per transaction
- Best-selling product identification
- Branch performance comparison
- Customer purchase pattern analysis

Branch Operations

- Branch information management
- Branch-specific inventory reports
- In-store sale recording
- Employee assignment and manager designation

Content Management

- Product media upload and management
- Review moderation and approval
- Genre management for game classification
- Product status updates (active, discontinued, coming soon)