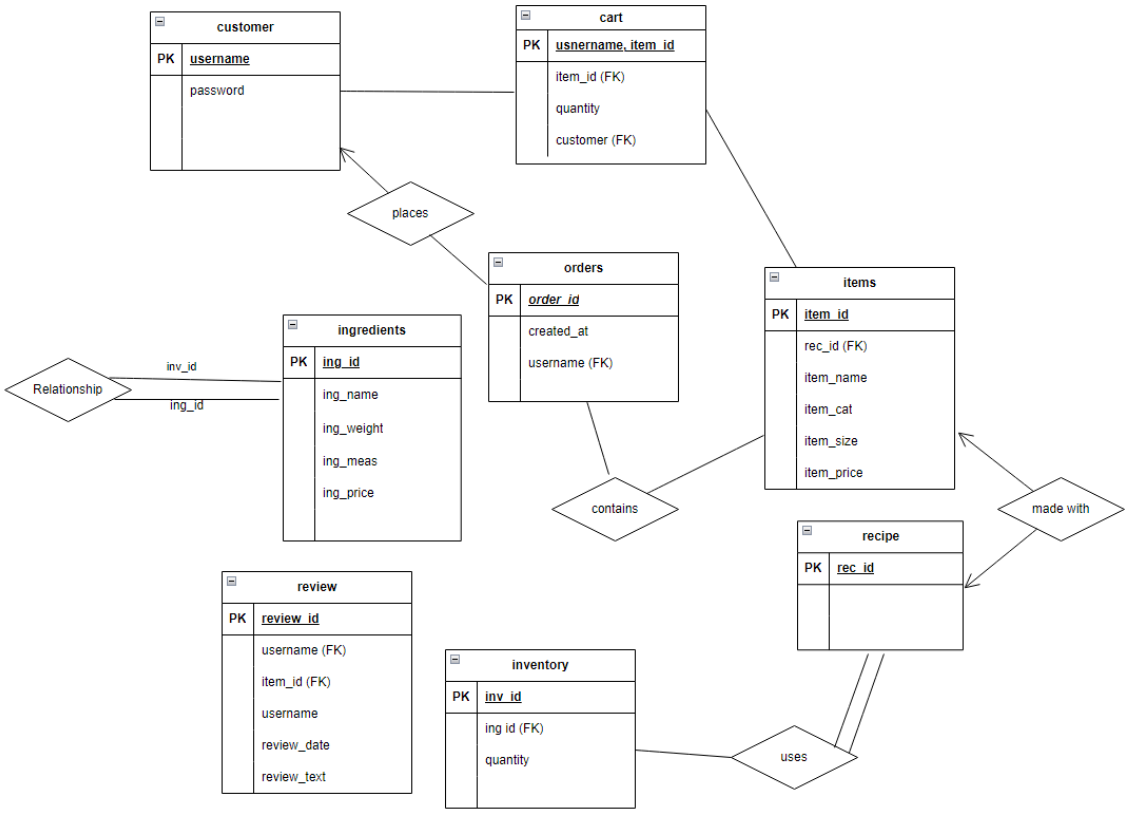
Used draw.io website.



Tables and Their Attributes:

customer

username: Primary key, Unique

password

orders

order_id: Primary key, Auto-increment

created_at

username: Foreign key referencing customer(username)

recipe

rec_id: Primary key

ingredients

ing_id: Primary key

ing_name

ing_weight

ing_meas

ing_price

recipe_ingredients

rec_id: Foreign key referencing recipe(rec_id), Part of composite primary key

ing_id: Part of composite primary key

quantity

items

item_id: Primary key

rec_id: Foreign key referencing recipe(rec_id)

item_name

item_cat

item_size

item_price

items_orders

order_id: Foreign key referencing orders(order_id), Part of composite primary key

item_id: Foreign key referencing items(item_id), Part of composite primary key

quantity: Part of composite primary key

cart

username: Foreign key referencing customer(username), Part of composite primary key

item_id: Foreign key referencing items(item_id), Part of composite primary key

quantity

inventory

inv_id: Primary key

ing_id: Foreign key referencing ingredients(ing_id)

quantity

review

review_id: Primary key, Auto-increment

username: Foreign key referencing customer(username)

item_id: Foreign key referencing items(item_id)

review_date

review_text

Functional Dependencies:

customer: username -> password

orders: order_id -> created_at, username

recipe: rec_id -> (all attributes of recipe are directly determined by rec_id)

ingredients: ing_id -> ing_name, ing_weight, ing_meas, ing_price

recipe_ingredients: (rec_id, ing_id) -> quantity

items: item_id -> rec_id, item_name, item_cat, item_size, item_price

items_orders: (order_id, item_id, quantity) -> (no additional attributes beyond keys)

cart: (username, item_id) -> quantity

inventory: inv_id -> ing_id, quantity

review: review_id -> username, item_id, review_date, review_text

Normalization

Let's perform BCNF decomposition to verify all functional relationships have been identified and are in violation of BCNF.

BCNF Normalization Process

Initial Relation R and Functional Dependencies:

R = (username, password, order_id, created_at, rec_id, recipe_specific_attributes, ing_id, ing_name, ing_weight, ing_meas, ing_price, quantity_recipe, item_id, item_name, item_cat, item_size, item_price, inv_id, quantity_items, quantity_cart, quantity_inventory, review_id, review_date, review_text)

Functional Dependencies:

username -> password

order_id -> created_at, username

rec_id -> recipe_specific_attributes

ing_id -> ing_name, ing_weight, ing_meas, ing_price

(rec_id, ing_id) -> quantity_recipe

item_id -> rec_id, item_name, item_cat, item_size, item_price

(order_id, item_id, quantity_items) -> none (Trivial dependency)

(username, item_id) -> quantity_cart

inv_id -> ing_id, quantity_inventory

review_id -> username, item_id, review_date, review_text

Step-by-Step Decomposition for BCNF:

Step 1: Decompose using username -> password:

R1 = (username, password)

R2 = R - {password}

Step 2: Decompose using order_id -> created_at, username:

R3 = (order_id, created_at, username)

R4 = R2 - {created_at, username}

Step 3: Decompose using rec_id -> recipe_specific_attributes:

R5 = (rec_id, recipe_specific_attributes)

R6 = R4 - recipe_specific_attributes

Step 4: Decompose using ing_id -> ing_name, ing_weight, ing_meas, ing_price:

R7 = (ing_id, ing_name, ing_weight, ing_meas, ing_price)

R8 = R6 - {ing_name, ing_weight, ing_meas, ing_price}

Step 5: Decompose using item_id -> rec_id, item_name, item_cat, item_size, item_price:

R9 = (item_id, rec_id, item_name, item_cat, item_size, item_price)

R10 = R8 - {rec_id, item_name, item_cat, item_size, item_price}

Step 6: Decompose using review_id -> username, item_id, review_date, review_text:

R11 = (review_id, username, item_id, review_date, review_text)

R12 = R10 - {username, item_id, review_date, review_text}

Step 7: Decompose using inv_id -> ing_id, quantity_inventory:

R13 = (inv_id, ing_id, quantity_inventory)

R14 = R12 - {ing_id, quantity_inventory}

Final BCNF Relations:

R1 = (username, password)

R3 = (order_id, created_at, username)

R5 = (rec_id, recipe_specific_attributes)

R7 = (ing_id, ing_name, ing_weight, ing_meas, ing_price)

R9 = (item_id, rec_id, item_name, item_cat, item_size, item_price)

R11 = (review_id, username, item_id, review_date, review_text)

R13 = (inv_id, ing_id, quantity_inventory)