# DEPARTMENT OF COMPUTER SCIENCE COLLEGE OF ENGINEERING TEXAS TECH UNIVERSITY

**CS5332 – Pattern-Based Software Development Fall 2021 Problem Definition:**

**Supermarket Software Product Line (SCSPL)**

There are various supermarket systems across the US where a checkout system processes customer checkout, and an inventory system controls the level of product stock in the supermarkets. A cashier or customer can use a supermarket checkout system to check out a customer’s items. A supermarket inventory system can trace the product stock level and make order products to maintain the proper product stock level in the supermarket.

The checkout systems contain a full-service and self-service systems:

* All supermarkets have a full-service checkout system, where a cashier checks out a customer’s order on behalf of the customer.
* Some supermarkets provide a self-service checkout system, where customer-self checks out their items to buy them.

The full-service checkout system consists of a *store computer* to which the *cash registers* are connected. Each cash register is equipped with its processor, a touch screen (containing numeric keys, function keys, and cash register display), an electronic *bar-code scanner*, a *scale*, a *customer order receipt printer*, a *credit/debit card reader*, a *check reader*, and a customer *display* where item and price information are shown to the customer. Each register has a holder for a *till* containing cash, checks, coupons, etc., which is automatically opened at the end of each customer transaction.

To check out an order, the cashier enters the *identification number* of each item. This is done either by scanning the item over the bar-code scanner or manually from the keypad. In the latter case, the cashier enters the number followed by the function key ITEM-ID. Based on the number, the cash register obtains ***product information* from the *product inventory***. The product information contains an *item description* to be displayed to the cash register and customer displays and printed on the receipt, price, and information on a *discount.* As items are being checked through, prices and item descriptions appear on the customer and cash register displays. The system also outputs the item description and price to the *customer order receipt printer*.

Some supermarkets provide memberships for loyal customers. When the first item is scanned, or the item’s ID is entered in each checkout, a customer is prompted to enter the phone number and member PIN (4 digits) via a card reader to verify the customer. If a customer is loyal, the credit points corresponding to the total price are added to the customer account. The credit points can be used to receive some gifts later from the supermarkets.

Some supermarkets provide a *store coupon* for some related product, which is triggered when the cash register obtains the product information and is immediately printed on a store-coupon printer.

**For bulk items, the product information indicates that the item must be weighed on the scale. The final weight is calculated when the cashier presses the SCALE button. The weight and price are displayed and printed on the receipt.**

Some supermarkets accept *discount coupons, including store coupons*. (Discount coupons are issued regularly by a supermarket, where store coupons are created when a customer buys an item.) The cashier either scans the coupon across the bar-code scanner or enters the amount manually and presses the COUPON function key. If the coupon is scanned automatically, the system verifies its expiration date and whether the discounted item has been bought.

After all the items in the order have been processed, the cashier presses the TOTAL function key. The cash register computes and displays the total price including tax. The tax and the total are also printed on the receipt. The TOTAL button can be pressed only once for each order. Once the TOTAL has been pressed, the order cannot be changed. When the total has been computed, the till is automatically opened.

After the total has been displayed, the cashier accepts payment. The payment amount is entered, followed by a payment type button. All supermarkets accept CASH, CHECK, and CREDIT/DEBIT, but some may also accept FOOD-STAMP. If cash is paid, the cashier is prompted to enters the amount displayed and printed on the receipt. If a check is used, the check is scanned by the check reader. The check is verified by the system. If the check is accepted, the cashier is prompted to place it in the receipt printer. A line containing the date, time, store identity, cashier identity, and order number is printed on the check.

For credit/debit card payment, the customer enters a card into the *credit/debit card reader*. For a debit card, a customer enters a PIN to the *credit/debit card reader*. A message is then sent to the appropriate credit/debit card authorization center. The card request is either accepted or rejected. If accepted, an authorization code is returned. The card number and authorization code are printed on the receipt. If a credit or debit card is not accepted and no other payment is offered, the order is canceled.

If a FOOD-STAMP is used, it is scanned by the food-stamp reader, being displayed on the displays, and printed on the receipt.

**When complete payment has been received, the cash register computes the amount of change, displays it, and prints it on the receipt. Finally, the receipt is fed out of the printer**. At this point, the cashier must close the till, which is automatically locked in position until the next customer transaction has been completed.

Each self-register in the self-service checkout system is equipped with its processor connected to the store computer, a touch screen (containing numeric keys, function keys, and customer

display), an electronic *bar-code scanner*, a *scale*, a *customer order receipt printer*, and a

*credit/debit card reader*.

To check out an order, the customer presses the start on the touch screen, scans the item over the bar-code scanner, or manually enters the *identification number* of each item using the numeric keys followed by the function key ITEM-ID. Based on the number, the customer obtains *product information* from the *product inventory*. The product information contains an *item description* to be displayed and printed on the receipt, price, and information on whether the item carries a *discount.* As items are being checked through, prices and item descriptions appear on the customer display. The system also outputs the item description and price to the *customer order receipt printer*. Bulk items are processed the same as the full-service checkout.

The self-service checkout system in some supermarkets can provide memberships for a loyal customer, prints store coupons for some items, or accepts discount coupons including store coupons, which are described in the full-service checkout system.

Some supermarkets can also record the customer checkout using a camera installed on the self- service checkout system for security. The camera is activated when the customer starts the checkout, and the recording is sent to the store computer.

The self-service checkout system in some supermarkets has equipped with an alarm to indicate whether the customer has paid for all the items. When the customer has not paid for the items, an alarm sounds, the video camera photographs the customer’s face, and the image is sent to the manager with an alert via a manager’s cell phone.

Some supermarkets provide self-service customers with an extra discount because they check out their items by themselves. The supermarkets apply to the TOTAL the extra discount, whose range is 5-10% of the TOTAL. **The value of the extra discount is determined when a member system is configured from the software product line**.

All supermarkets accept a CREDIT/DEBIT card in the self-service checkout system, but some may also accept CASH in the system. For cash payment, the self-register has a coin/cash reader device and a change return device.

The messages on the cashier and customer display can be shown in one language of English, Spanish, French, and Germany. English is the default language. Only one language is set to a supermarket system.

Some supermarkets have an inventory system that dynamically keeps track of the current numbers of items. When the number of an item goes below a certain threshold, an inventory message is created and stored in the system. Inventory orders with predefined quantities of products are automatically sent at night to the suppliers and are recorded in the system.

Instead of predefined numbers of products, the inventory systems of some supermarkets involve a future inventory prediction algorithm to determine the numbers of products in each order so that the supermarkets minimize the inventory maintenance cost. The supermarket manager runs the algorithm with the manager’s input (e.g., season and customer trend change) to get the quantities of products to be ordered.

# Assignments (50 pts)

**Phase 1 - Requirements modeling:**

Your task is to do a commonality/variability analysis on the Supermarket System Software Product Line and come up with a feature model, context model, use case model, and feature to use case relationship table for the Software Product Line. The deliverables for the requirements model are:

* 1. A product line context model depicted on a context diagram showing how the product line interfaces to the external environment. (2 pts)
  2. A use case model, consisting of a description of the actors and the use cases, including kernel, optional and alternative use cases, and use case variation points, which fully define the product line. Describe each use case in terms of the actors and their interactions with the system. (5 pts)
  3. A feature model identifying the reusable capabilities of the product line. Describe and classify the features and draw a feature model showing all features and feature relationships. (5 pts)
  4. A description of the feature to use case relationships, shown as a table (refer to table

5.1 on page 109 of the course textbook). (3 pts)

# Phase 2 - Analysis Modeling:

1. Develop interaction diagrams (using either communication diagrams or sequence diagrams) for each kernel, optional and variant use case. Identify the object structuring criteria used. The document briefly the message sequence descriptions. (6 pts)
2. Develop a statechart showing the different states of a (cash/customer) register. Make sure that the statechart is consistent with the appropriate interaction diagram(s). (6 pts)
3. Develop a feature/class dependency model showing the features and their relationships to optional and variant classes. (4 pts)

# Phase 3 - Design modeling (Architectural Design):

1. Design a distributed software architecture describing how the product line is decomposed into component-based subsystems and the message interfaces between

the subsystems (depicted on a concurrent communication diagram). It should also explain how the subsystems were determined. (4 pts)

1. A component-based software architecture showing the components and connectors, including ports and interfaces. (4 pts)

# Phase 4 – Implementation (Kernel Software Architecture)

a. Implement the component-based software architecture (phase 3) with kernel components in an object-oriented program language (e.g., Java) where a client subsystem and a server subsystem must be implement using separate threads. (7 pts)

# Phase 5 - Presentation (4 pts)

# Phase 1 :

# Solution a : A product line context model depicted on a context diagram showing how the product line interfaces to the external environment

# Draw the context line diagram from first pdf

# Diagram Description automatically generated

# Solution b: A use case model, consisting of a description of the actors and the use cases, including kernel, optional and alternative use cases, and use case variation points, which fully define the product line

# Analyzing commonality and variability in the functionality of the supermarket product line

# 

# Commonality: Two kernel use case, Full Service customer check out and Inventory management system, which all members of the product line must provide.

# Some of the variability in PL: Variation points in the kernel use case, reflecting small variations.

# Large variations: which is the one optional use case Self-service customer check-out. Only some members of the product line provide these use cases.

# Use case model for the Full Service Customer Checkout Use case

# Draw use case diagram for full service

# Diagram Description automatically generated

# Full Service Checkout Customer Use Case Description:

# The Full-service customer check-out use case captures the common functionality of this product line, in particular through the description of the main sequence and alternatives.

# The cashier is the primary actor, and the customer and authorization center are the secondary actors.

# Use case name: Full service customer check-out.

# Reuse category: Kernel.

# Summary: cashier checks out a customer’s order on behalf of the customer.

# Actors: Cashier (primary), Customer, Authorization center(secondary).

# Precondition: Full-service checkout system is idle.

# Description:

# The cashier enters the *identification number* of each item.

# Product information entry is done either by scanning the item over the bar-code scanner or manually entering item-id from the keypad.

# Based on the product identification number, the cash register obtains product information from the product inventory.

# The product information is displayed to the cash register and customer displays. Price, and information on a discount are printed `on the receipt*.*

# Bulk items are weighed when the cashier presses the SCALE button.

# The price and weight information of bulky items are displayed and printed.

# After processing the items, the cashier presses the TOTAL function key.

# Total price including tax is displayed and printed on receipt.

# Cashier selects the payment type.

# Customer can pay through cash, check, credit /debit card and through food stamp in some supermarkets.

# Customer enters the card and PIN is validated and accepted or rejected by Authorization center.

# Cash register computes, prints the receipt and displays the amount of change after complete payment has been received(till alt).

# Alternatives:

# Line 2: If loyal customer membership option is available then the full service checkout system verifies if customer is loyal and the credit points corresponding to the total price are added to the customer account.

# Line 3:  If store Coupon is available , then it is triggered when cash register obtains product information. And immediately printed on a store-coupon printer. Full Service checkout System applies store coupon.

# Line 7: If Discount Coupon is applicable and cashier presses COUPON function key. Full Service checkout applies Discount Coupon.

# Line 7: When TOTAL is computed , till is automatically opened by Full Service checkout.

# Line 10: The Check is accepted when it is verified by the Full Service checkout.

# Line 10: If card payment is not accepted or no other payment is offered , Full Service checkout system cancels the order.

# Line 10 : If customer opts for Food-stamp , Full Service checkout system accepts, scans the food stamp, and displays.

# Postcondition: The customer is checked out.

# Variation Points in the Full-service customer check out Use Case

# The variation points represent optional or alternative requirements that are present in only some members of the product line. Each line number refers to the location in the main use case description where the variation point is inserted.

# Name: Display Language.

# Type of functionality: Mandatory alternative.

# Line number(s):4, 6, 8, 12.

# Description of functionality: There is a choice of language for displaying messages. The default is English. Alternative mutually exclusive languages are French, Spanish or German.

# Name: Payment Mode.

# Type of functionality: Mandatory alternative.

# Line number(s): 9, 10, 11.

# Description of functionality: Payment can be done through Cash, Cheque, DEBIT/CREDIT or food stamp. The order is cancelled when the payment id failed and no payment option is offered by the customer. Default is cash, cheque, debit/credit card. Alternative mutually exclusive variation is food stamp.

# Name: Product Entry.

# Type of functionality: Mandatory alternative.

# Line number(s): 1, 2, 3, 5.

# Description of functionality: The information of item can be entered either by scanning the barcode using a bar-code scanner or entering item id manually from the keyboard. Alternatives are bar-code scanning and manual entry.

# Name: Loyal customer membership.

# Type of functionality: Optional.

# Line number(s): 2.

# Description of functionality: Some supermarkets provide loyal customer membership. When the items are scanned after scanning the first item, a customer is prompted to enter the phone number and member pin via a card reader to verify the customer is loyal or not. If a customer is loyal the credit points corresponding to the total price are added to the customer account.

# Name: Store coupon.

# Type of functionality: Optional.

# Line number(s): 2, 3, 4.

# Description of functionality: Store coupon is triggered when the cash register obtains the product information and printed on the store coupon printed. If the coupon is scanned automatically the system verifies its expiration date and whether the discounted item has been bought by the customer.

# Name: Discount coupon.

# Type of functionality: Optional.

# Line number(s): 7.

# Description of functionality: Discount coupons are regularly issued by super markets; the cashier enters the coupon by scanning it or by manually entering the discount amount and presses the coupon function key.

# Self-service customer check-out Optional Use Case Description:

# The Self-service customer check-out use case captures the optional functionality of this product line, in particular through the description of the main sequence and alternatives.

# The customer is the primary actor, and the authorization center are the secondary actors.

# Use case model for the self Service Customer Checkout Use case

# Draw use case diagram for self service

# Diagram Description automatically generated

# Use case name: Self-service customer check-out.

# Reuse category: Optional.

# Summary: Customer checks out himself.

# Actors: Customer(primary).

# Precondition: Self-service customer checkout system is idle.

# Description:

# The customer presses the Start on the touch screen.

# Customer scans the item over the bar code scanner or manually enters the identification number of each item using numeric keys followed by function key ITEM

# Based on the product identification number, the customer obtains product information from the product inventory.

# The product information along with discount information if any, is displayed to the customer display and printed on the receipt*.*

# Bulk items are weighed when the customer presses the SCALE button.

# The price and weight information of bulky items are displayed and printed

# After processing the items, total price of items is calculated.

# Customer selects the payment type.

# Customer can pay through credit /debit card or through cash in some supermarkets.

# Total price along with discount if any is displays through Customer display and printed through customer order receipt printer

# Alternatives:

# Line 2: If loyal customer membership option is available then the self service checkout system verifies if customer is loyal and the credit points corresponding to the total price are added to the customer account.

# Line 3:  If store Coupon is available , then it is triggered when cash register obtains product information. And immediately printed on a store-coupon printer. Self Service checkout System applies store coupon.

# Line 7: If Discount Coupon is applicable and customer presses COUPON function key. Self Service checkout applies Discount Coupon.

# Line 1 : If camera is available , it is activated when customer starts the checkout and is recorded and sent to the store computer.

# Line 9 :If alarm system is available , it is activated when the customer checks out without paying. When Alarm sounds , Video camera photographs the customer’s face and image is sent to the manager with an alert via manager’s cell phone.

# Line : 7: If Extra Discount is provided by Supermarket, it is applied to the total whose range is 5 is 10 % of the Total.

# Postcondition: The customer is checked out.

# Variation Points in the Self service customer check out Use Case

# Name: Display Language.

# Type of functionality: Mandatory alternative.

# Line number(s): 1,4, 6, 8, 10.

# 

# Description of functionality: There is a choice of language for displaying messages. The default is English. Alternative mutually exclusive languages are French, Spanish or German.

# Name: Payment Mode.

# Type of functionality: Mandatory alternative.

# Line number(s):  8, 9.

# Description of functionality: Payment can be done through DEBIT/CREDIT or Cash. The order is cancelled when the payment is failed and no payment option is offered by the customer. Default is debit/credit card. Alternative mutually exclusive variation is cash.

# Name: Product Entry.

# Type of functionality: Mandatory alternative.

# Line number(s):  2.

# Description of functionality: The information of item can be entered either by scanning the barcode using a bar-code scanner or entering item id manually from the keyboard. Alternatives are bar-code scanning and manual entry.

# Name: Loyal customer membership.

# Type of functionality: Optional.

# Line number(s): 2.

# Description of functionality: Some supermarkets provide loyal customer membership. When the items are scanned after scanning the first item, a customer is prompted to enter the phone number and member pin via a card reader to verify the customer is loyal or not. If a customer is loyal the credit points corresponding to the total price are added to the customer account.

# Name: Store coupon.

# Type of functionality: Optional.

# Line number(s):  2,3

# Description of functionality: Store coupon is triggered when the cash register obtains the product information and printed on the store coupon printed. If the coupon is scanned automatically the system verifies its expiration date and whether the discounted item has been bought by the customer.

# Name: Discount coupon.

# Type of functionality: Optional.

# Line number(s): 7.

# Description of functionality: Discount coupons are regularly issued by super markets, the customer enters the coupon by scanning it or by manually entering the discount amount and presses the coupon function key.

# Name: Camera

# Type of functionality: Optional.

# Line number(s):  1, 9

# Description of functionality: Supermarkets have cameras which are used to record the customer checkout for security. When the customer starts the checkout , the camera is activated and the recording is sent to the store computer.

# Name: Alarm System.

# Type of functionality: Optional.

# Line number(s):  9

# Description of functionality: Supermarkets are equipped with Alarm system such that it indicates whether the customer has paid for all the items and when the customer does not pay for the items, the alarm sounds and the camera photographs the customer’s face and image is sent to the manager with an alert.

# Name: Extra Discount.

# Type of functionality: Optional.

# Line number(s): 7

# Description of functionality: Some supermarkets provide self-service customers with an extra discount because they check out their items by themselves. The supermarkets apply to the TOTAL the extra discount, whose range is 5-10% of the TOTAL

# Inventory System Kernel Use Case Description:

# Inventory System use case captures the kernel functionality of this product line, in particular through the description of the main sequence and alternatives.

# The Inventory System is the primary actor, secondary actor is Supplier, Manager

# Use case model for the Inventory Management System Use case

# Draw use case diagram for inventory

# Diagram Description automatically generated

# Use case name: Inventory Management System

# Reuse category: Kernel

# Summary: Controls the level of Product Stock in the Supermarket

# Actors: Inventory System, Supplier, Manager

# Precondition: Inventory system is idle.

# Description:

# Traces the product stock level

# Make to order products, to maintain the proper product stock level in the supermarket

# Provides product information when Item ID is scanned or entered manually

# Alternatives:

# Line 1: When the Product stock level is above a certain threshold, an inventory message is not created.

# Postcondition: Product stock level is maintained

# Variation Points in the Inventory System Use Case

# Name: Dynamic Inventory System

# Type of functionality: Optional

# Line number(s): 1, 2

# Description of functionality:  It dynamically, keeps track of current number of items when the number of items goes below certain threshold, an inventory message is created and stored in the system. Inventory orders predefined quantities of products are automatically sent at night to the suppliers and are recorded in the system.

# Name: Algorithmic Inventory System

# Type of functionality: optional

# Line number(s):  1, 2

# Description of functionality: It has future inventory prediction algorithm that determines the number of products in each order so that the supermarkets minimize the inventory maintenance costs. The manager runs the algorithm with Manager’s input to get the quantities of products to be ordered.

# Use case model for the Super Market software product line

# Draw final use case diagram

# Diagram Description automatically generated

# Solution C : A feature model identifying the reusable capabilities of the product line. Description and classification of the features .Feature model showing all features and feature relationships

# Feature Modeling

# Feature Modeling: Common, optional, and alternative features are determined.

# Common features: Common functionality in product line, as specified by the kernel use cases (Full-Service customer checkout, Inventory system).

# Optional and Alternative features: Variability in the product line as specified by the optional use cases and the variation points. Optional Feature (The Self-checkout feature) , Alternative Features(Display language, payment mode, product entry, etc.,)

# Commonality/variability analysis in which features are categorized as common, optional, or alternative. Feature groups are also determined.

# Super market kernel is a common feature which is formed by grouping kernel use cases i.e., full service customer checkout and Inventory system.

# Commonality Analysis

# The common requirements are all determined from the problem description and the Full-service customer checkout and Inventory use cases; they describe the functionality that every supermarket product line must have:

# Product entry: Every supermarket product line has a product entry system. Customer order processing can be done only when the product is entered.

# Payment mode: Every supermarket product line has a payment system. Order can be processed only when the payment is done via selected payment mode else order is cancelled.

# Display: Every supermarket has a display to show the product information, as well as any discounts and total amount along with taxes.

# Store computer: Every supermarket has a store computer to which cash register is connected.

# Cash register: Every supermarket has a cash register which is equipped with touch screen, scale, bar-code scanner, customer receipt printer, credit/debit card reader, customer display, and till.

# Touch screen: Every supermarket has a touch screen which has numeric keys function keys and a cash register display.

# Scale: Every supermarket has a scale to weight the bulky items which is indicated when the items are scanned.

# From a reuse perspective, these common requirements are grouped into one common feature called Supermarket Kernel.

# Optional Features

# Variability Analysis: Variation points in the Full-service customer checkout and inventory system use cases, and to analyze the optional use cases (Self-Service customer checkout)

# The variability analysis determines the optional and alternative features.

# Some features depend on other prerequisite features.

# Optional functional features: Optional variability described in the variation points of the Full-service customer checkout use case

# «optional feature» Loyal customer membership: This optional feature is determined from the variation point in the Full-service customer checkout and self-service customer checkout use cases. If the loyal membership is available, then the credit points corresponding to the total price are added to the customer account.

# «optional feature» Store coupon: If the store coupon option is selected, the discount is calculated automatically when the product is scanned.

# «optional feature» Discount coupon: If the discount coupon option is selected, the discount is calculated for the total.

# «optional feature» Dynamic inventory system: The dynamic inventory system keeps track of the system. When the number of an item goes below a certain threshold. Inventory message is created and stored in the system.

# «optional feature» Algorithmic inventory system: A future inventory prediction algorithmic method is used to determine the number of products in each order thus minimizing the inventory maintenance cost.

# «optional feature» Camera: Supermarkets have cameras which are used to record the customer checkout for security. When the customer starts the checkout, the camera is activated and the recording is sent to the store computer.

# «optional feature» Alarm system: Supermarkets are equipped with Alarm system such that it indicates whether the customer has paid for all the items and when the customer does not pay for the items, the alarm sounds and the camera photographs the customer’s face and image is sent to the manager with an alert.

# «optional feature» extra discount: Extra discount is provided because customer checks out the items themselves, and is applied to the total whose range is 5 to 10 % of the total.

# Alternative Features and Feature Groups

# Alternative features and the feature groups in which they participate correspond to variation points in the Full-service customer checkout, inventory system and self service use cases,

# «exactly-one-of feature group» Display Language {default = English, alternative = French, Spanish, German}.

# The default language for displaying information is English. Alternative languages are French, Spanish, German.

# «at least-one-of feature group» Product Entry {default = Barcode Scanning, alternative = Manual Entry}.

# The default weight sensor is Barcode Scanning; the alternative is Manual Entry. Alternative Feature is Manual entry.

# «exactly-one-of feature group» Payment Mode {default = Cash, Credit/Debit,cheque, alternative= food stamp}. The default Payment mode is Cash,Credit/debit card,Cheque: The alternative is Food stamp.

# «exactly-one-of feature group» Self Payment Mode {default = Credit/Debit card, alternative= cash}. The default Payment mode is Credit/debit card. The alternative is Cash.

# Feature group information can also be presented in tabular format

# Draw feature group table

|  |  |  |  |
| --- | --- | --- | --- |
| **Feature Group Name** | **Feature Group Category** | **Features in Feature-Group** | **Feature category** |
| Display Language | exactly-one-of | English | default |
|  |  | French | alternative |
|  |  | Spanish | alternative |
|  |  | German | alternative |
| Payment Mode | exactly-one-of | Cash, cheque, card | default |
|  |  | Food stamp | alternative |
| Product entry | atleast-one-of | Barcode scanning | default |
|  |  | Manual entry | alternative |
| Self-payment mode | Exactly-one-of | Credit/Debit Card | default |
|  |  | Cash | alternative |

# Optional Features with Prerequisite and Mutually Inclusive Features

# The following optional features have other features as prerequisites or as mutually inclusive features.

# Loyal Customer membership; This optional feature requires the item’s ID to be scanned or manually entered followed by customer being prompted to enter the phone and pin.

# «optional feature» Loyal Customer membership {prerequisite = Barcode Scanning, manual product entry}

# This feature corresponds to the variation point called Loyal Customer membership in Full-service customer checkout and self-service customer checkout use case.

# Camera: This optional feature is activated when customer opts for Self-service customer checkout. Camera is not activated until Self Service is selected.

# «optional feature» Camera {prerequisite = Self Service checkout}

# This feature corresponds to the Self-Service Customer Checkout use case.

# Extra Discount:  This optional feature is provided only for self service customer checkout use case, when this feature is selected, self-service checkout feature is implicitly chosen.

# «optional feature» Extra Discount {mutually includes = self-service customer checkout}

# This feature corresponds to the Self-Service Customer checkout use case

# Feature dependency diagram for the Supermarket software product line

# Draw Feature Dependency Diagram

# Diagram Description automatically generated

# Solution D : Description of the feature to use case relationships, shown as a table

# The relationships between the features and the use cases for Super market product line

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Feature Name | Feature Category | Use Case Name | Use Case Category/Variation Point (vp) | Variation Point Name |
| Supermarket kernel | common | Full Service customer checkout/ Inventory system | kernel |  |
|  |  | Inventory system | kernel |  |
| Self service checkout | Optional | Self-service customer checkout | optional |  |
| Loyal customer membership | Optional | Full-service customer checkout | vp | Loyal customer membership |
| Store coupon | Optional | Full-service customer checkout | vp | Store coupon |
| Discount Coupon | Optional | Full-service customer checkout | vp | Discount coupon |
| Dynamic inventory system | Optional | Inventory system | vp | Dynamic inventory system |
| Algorithmic inventory system | Optional | Inventory system | vp | Algorithmic inventory system |
| English | Default | Full-service customer checkout | vp | Display language |
| French | Alternative | Full-service customer checkout | vp | Display language |
| Spanish | Alternative | Full-service customer checkout | Vp | Display language |
| German | Alternative | Full-service customer checkout | Vp | Display language |
| Cash | Default | Full-service customer checkout | Vp | Payment Mode |
| Cheque | Default | Full-service customer checkout | Vp | Payment Mode |
| Credit/Debit | Default | Full-service customer checkout | Vp | Payment Mode |
| Food stamp | alternative | Full-service customer checkout | vp | Payment Mode |
| Bar-code scanning | alternative | Full-service customer checkout | vp | Product entry |
| Manual entry | alternative | Full-service customer checkout | vp | Product entry |
| Camera | Optional | Self-service customer checkout | Vp | Camera |
| Alarm | Optional | Self-service customer checkout | Vp | Alarm system |
| Extra discount | Optional | Self-service customer checkout | Vp | Extra discount |
| Debit/Credit card | Default | Self-service customer checkout | Vp | Self Payment mode |
| Cash | Alternative | Self-service customer checkout | Vp | Self Payment mode |

# Phase 2:

# Solution a : communication diagrams for each kernel, optional and variant use case

# object structuring criteria used

# message sequence descriptions

# Dynamic Modeling : Object and Class Structuring Criteria

# The kernel classes are all determined by consideration of the Full-Service Customer Checkout and Inventory Management system use cases which are determined by object and class structuring criteria

# The kernel input device interface classes are determined by consideration of the kernel external device classes on the product line context diagram

# Kernel Input device Interface classes

# Barcode Scanner interface

# Touch Screen Interface

# Scale interface

# Cheque reader interface

# Card reader Interface

# Kernel Output device Interface classes

# Touch Screen interface

# Customer Display interface

# Customer order receipt printer Interface

# Control Classes

# Full Service Checkout System control

# Supermarket Inventory System Control

# Entity Classes

# Display prompts

# Product

# Sever Classes

# Product inventory Server

# Situations in which there is a choice of classes

# Barcode Scanner Interface

# English Display prompts

# Cash, Cheque, Credit/Debit card

# Communication Diagram for Full Service Customer Checkout Kernel use case :

# Communication diagram for full service

# Graphical user interface, application, Teams Description automatically generated

# Communication diagram inventory management system(kernel).

# Diagram Description automatically generated

# Impact Analysis of Loyal Customer Membership Feature:

# «optional feature» Loyal Customer Membership

# Optional object:  Customer Account entity

# Affected object:  Full Service customer checkout system , because it controls when to start check for loyal customer membership. It prompts the customer to enter the phone number and pin and verifies for the loyal customer eligibility

# Communication diagram for loyal customer full service

# Diagram Description automatically generated

# Impact Analysis of Store Coupon Feature:

# «optional feature» Store Coupon

# Optional object:  Store coupon printer Interface to interface store coupon printer

# Affected object:  Full Service customer checkout system , because it controls when to apply store coupon. It prompts the store coupon printer to print the store coupon

# Communication diagram for store coupon

# Diagram, engineering drawing Description automatically generated

# 

# Impact Analysis of Discount Coupon Feature:

# «optional feature» Discount Coupon

# Optional object:  Touch Screen Interface to interface touch Screen Display

# Customer display Interface to interface Customer Display

# Affected object:  Full Service customer checkout system , because it controls when to apply discount coupon. It prompts the Touch screen and customer display to display the discounted amount.

# Communication diagram for discount coupon

# Diagram Description automatically generated

# Impact analysis for the Dynamic Inventory Feature

# «optional feature» Dynamic Inventory Feature

# Optional object:  Product Inventory Server, belowThresholdMessage entity, Predefined Order status entity

# Affected object:  Supermarket Inventory System, because it keeps maintains the product stock level by keeping track of count of products in product inventory and creates order for supplier.

# Communication diagram for dynamic inventory

# 

# Diagram Description automatically generated

# Impact analysis for the Algorithmic Inventory Feature

# «optional feature» Algorithmic Inventory Feature

# Optional object: Product Inventory Server

# Store computer interface to interface Store Computer

# 

# Affected object:  Supermarket Inventory System, because it gets the inputs from the algorithm and orders the corresponding products.

# Communication diagram for algorithmeic inventory

**Diagram

Description automatically generated**

# Impact analysis for the Food stamp reader Feature:

# The payment mode feature affects only one object: cash/card/cheque

# The Cash/card/cheque object is replaced by one of the alternative Food stamp object such as food stamp payment.

* **«exactly-one-of feature group» Display Language {default = cash,cheque,card alternative = Foodstamp}**

**«alternative feature» Food stamp**

**Variant object:**Food stamp reader, for food stamp payment instead of cash, card or cheque payment.

# 

# Communication diag for food stamp reader

# Impact analysis of Display language Feature

# The Display Language feature affects only one object: Display Prompts.

# The English Display Prompts object is replaced by one of the alternative Display Prompts objects, such as Spanish Display Prompts or French Display Prompts or German Display Prompts.

* **«exactly-one-of feature group» Display Language {default = English, alternative = French, Spanish, German}**

**«alternative feature» French**

**Variant object:**FrenchDisplayPrompts, to store display prompts in French instead of the default language, English.

**«alternative feature» Spanish**

**Variant object:**SpanishDisplayPrompts, to store display prompts in Spanish.

**«alternative feature» German**

**Variant object:**GermanDisplayPrompts, to store display prompts in German.

Communication diagram for display prompt French / English.

Diagram

Description automatically generated

**Self Service Customer Checkout Use case :**

# The optional classes are all determined by consideration of the Self-Service Customer Checkout which is determined by object and class structuring criteria

# Input device Interface classes

# Barcode Scanner interface

# Touch Screen Interface

# Scale interface

# Card reader Interface

# Output device Interface classes

# Touch Screen interface

# Customer order receipt printer Interface

# Control Classes

# Self Service Checkout System control

# Entity Classes

# Display prompts

# Product

# Sever Classes

# Product inventory Server

# Situations in which there is a choice of classes

# Barcode Scanner Interface

# English Display prompts

# Credit/Debit card

**Communication Diagram for Self Service Customer Checkout use case :**

**Communication Diagram for Self Service Customer Checkout use case**

**Diagram, schematic

Description automatically generated**

# Impact Analysis of Loyal Customer Membership Feature:

# «optional feature» Loyal Customer Membership

# Optional object:  Customer Account entity

# Affected object:  Self Service customer checkout system , because it controls when to start check for loyal customer membership. It prompts the customer to enter the phone number and pin and verifies for the loyal customer eligibility

# Communication diagram for loyal customer self service

# Diagram Description automatically generated

# Impact Analysis of Store Coupon Feature:

# «optional feature» Store Coupon

# Optional object:  Store coupon printer Interface to interface store coupon printer

# Affected object:  self Service customer checkout system , because it controls when to apply store coupon. It prompts the store coupon printer to print the store coupon

# Communication diagram for store coupon self service

# Diagram Description automatically generated

# 

# Impact Analysis of Discount Coupon Feature:

# «optional feature» Discount Coupon

# Optional object:  Touch Screen Interface to interface touch Screen Display

# Customer display Interface to interface Customer Display

# Affected object:  self Service customer checkout system , because it controls when to apply discount coupon. It prompts the Touch screen display to display the discounted amount.

# Communication diagram for discount coupon self service

# Diagram Description automatically generated

# Impact Analysis of Camera Feature:

# «optional feature» Camera

# Optional object:  Camera Interface to interface Camera

# Store Computer Interface to interface Store Computer

# Affected object:  Self Service customer checkout system, because it controls when to activate the camera. It prompts the camera to record the video of checkout and send to store computer

# Communication diagram for camera self service

# Diagram Description automatically generated

# Impact Analysis of Alarm Feature:

# «optional feature» Alarm

# Optional object:  Alarm Interface to interface Alarm

# Manager cell phone to interface Manager

# Affected object:  Self Service customer checkout system, because it controls when to activate the alarm. It prompts the alarm to photograph the customer’s face and send to manager when customer has not paid.

# Communication diagram for alarm self service

# Diagram Description automatically generated

# Impact Analysis of Extra Discount:

# «optional feature» Extra Discount

# Optional object:  touch screen interface to interface touch screen

# 

# Affected object:  Self Service customer checkout system, because it controls when to apply the extra discount. It prompts the alarm to photograph the customer’s face and send to manager when customer has not paid.

# Communication diagram for extra discount.

# Diagram Description automatically generated

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Feature Name | Feature Category | Class name | Class category | Class parameter |
| Supermarket kernel | Common | Product entry interface | kernel |  |
|  |  | Product entry interface | Kernel-abstract-vp |  |
|  |  | Touch screen interface | Kernel-param-vp |  |
|  |  | Scale interface | Kernel-param-vp |  |
|  |  | Customer display interface | Kernel-param-vp |  |
|  |  | Till | Kernel-param-vp |  |
|  |  | Card reader interface | Kernel-param-vp |  |
|  |  | Check reader interface | Kernel-param-vp |  |
|  |  | Customer order receipt printer interface | Kernel-param-vp |  |
|  |  | Display prompt | Kernel-abstract-vp |  |
|  |  | Full-service system control | Kernel-param-vp |  |
|  |  | Product | Kernel-param-vp |  |
|  |  | Authorization center interface | Kernel-param-vp |  |
|  |  | Product inventory | Kernel-param-vp |  |
|  |  |  |  |  |