Case Study 1: Campus Café Checkout

Step 1:- Understanding the problem

The aim of this case study is to design and implement a point-of-sale system specifically for a campus café environment. Such a system should replicate the workflow of a real checkout counter, where a cashier first presents available items to the customer, then records their order into a system, and finally produces a receipt summarizing the transaction.

The program must therefore support multiple essential functions: displaying menu items with prices and categories, allowing users to add their selections to a digital cart, reviewing the cart before purchase, and generating a final receipt that includes details such as discounts, taxes, and the overall total. This ensures the program not only fulfills functional requirements but also simulates an authentic real-world scenario.

Step 2:- Inputs and Outputs

Inputs:

- Menu choice (string/integer) – The user selects options such as showing the menu, adding an item, viewing the cart, checking out, or exiting.
- Item number (string/integer) – When adding an item, the user specifies the corresponding item number from the menu.
- Student discount (y/n) – At checkout, the system asks whether the customer is a student. If yes, a discount is applied.

Outputs:

- Displayed menu – The café's items shown with names, categories, and prices.
- Cart summary – A list of items added by the customer along with a subtotal.
- Receipt – A formatted output showing each line item with price, subtotal, discount (if any), tax, and final total.

Step 3: Algorithm

The algorithm is a step-by-step description of how the program will process data and guide the user through interactions.

INPUT:

- User choice (menu option: show menu, add item, checkout, exit)
- Item number and quantity (integers)
- Discount code/student discount eligibility (y/n)

PROCESS:

- Initialize cart and prices
- Display menu items
- Ask user to select an item → validate item exists
- If valid: ask for quantity → add item and quantity to cart

- Ask if more items to add
- Compute subtotal → display subtotal
- Add tax to subtotal
- Check meal deal eligibility → apply if valid
- Ask for student discount → validate discount code (if any) → apply or skip
- Compute final total (subtotal + tax – discounts)
- Display final total
- Print receipt
- Save transaction to sales log
- Clear cart for next customer
- Repeat loop until user exits checkout

OUTPUT:

- Menu list with items and prices
- Cart summary with line items and subtotal
- Receipt including: subtotal, applied discounts, tax, and final total
- Confirmation message after checkout and exit message

Step 4:-Pseudocode and Flowchart

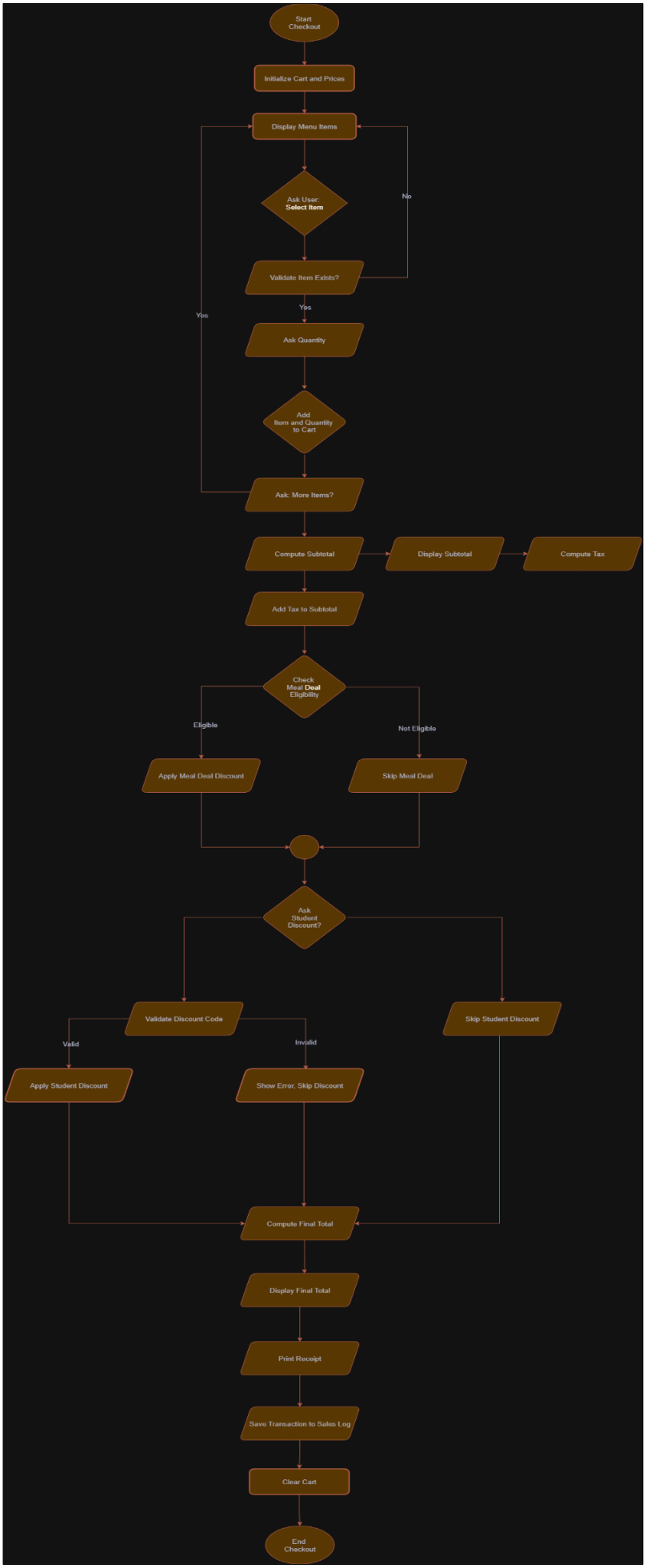
Pseudocode:

```
# Constants
TAX_RATE = 0.10
STUDENT_DISCOUNT = 0.05

# Initialize
cart = []
prices = {"Coffee": 2.50, "Sandwich": 4.00, "Tea": 1.50, "Juice": 3.00}
meal_deals = [("Coffee", "Sandwich")]   # example combo

# Start Checkout Loop
while True:
   print("1. Show Menu")
   print("2. Add Item")
   print("3. View Cart")
   print("4. Checkout")
   print("5. Exit")

   choice = input("Enter your choice: ")

   # ---- SHOW MENU ----
   if choice == "1":
      for item, price in prices.items():
         print(item, ":", price)

   # ---- ADD ITEM ----
   elif choice == "2":
```

```
    item = input("Select item: ")
    if item not in prices:
        print("Invalid item!")
    else:
        qty = int(input("Enter quantity: "))
        cart.append((item, qty))
        print(qty, item, "added to cart")

# ---- VIEW CART ----
elif choice == "3":
    if not cart:
        print("Cart is empty")
    else:
        subtotal = sum(prices[i] * q for i, q in cart)
        print("Cart:", cart)
        print("Subtotal =", subtotal)

# ---- CHECKOUT ----
elif choice == "4":
    if not cart:
        print("Nothing to checkout")
    else:
        subtotal = sum(prices[i] * q for i, q in cart)
        print("Subtotal =", subtotal)

        # Apply tax
        tax = subtotal * TAX_RATE
        total = subtotal + tax

        # Check meal deal eligibility
        for deal in meal_deals:
            if all(any(i == d for i, _ in cart) for d in deal):
                print("Meal deal applied!")
                total *= 0.9   # example 10% meal deal discount
                break

        # Student discount
        student = input("Apply student discount? (y/n): ")
        if student.lower() == "y":
            total -= total * STUDENT_DISCOUNT

        # Final receipt
        print("Final Total =", round(total, 2))
        print("Receipt printed.")
        print("Transaction saved.")
        cart.clear()

# ---- EXIT ----
```

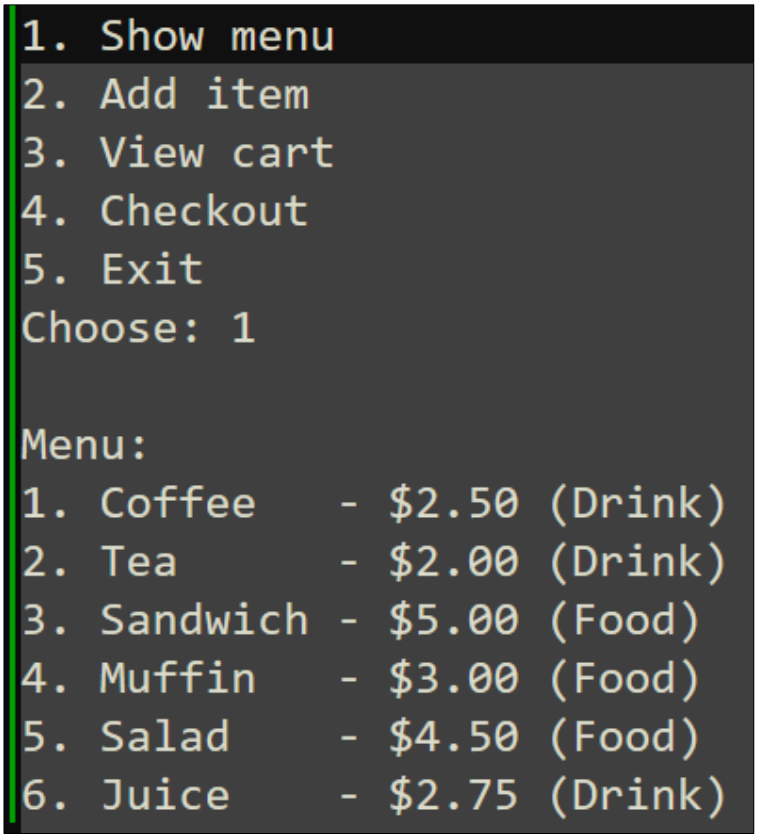
```
elif choice == "5":
    print("Exiting checkout. Thank you!")
    break

else:
    print("Invalid choice")
```

Flowchart:

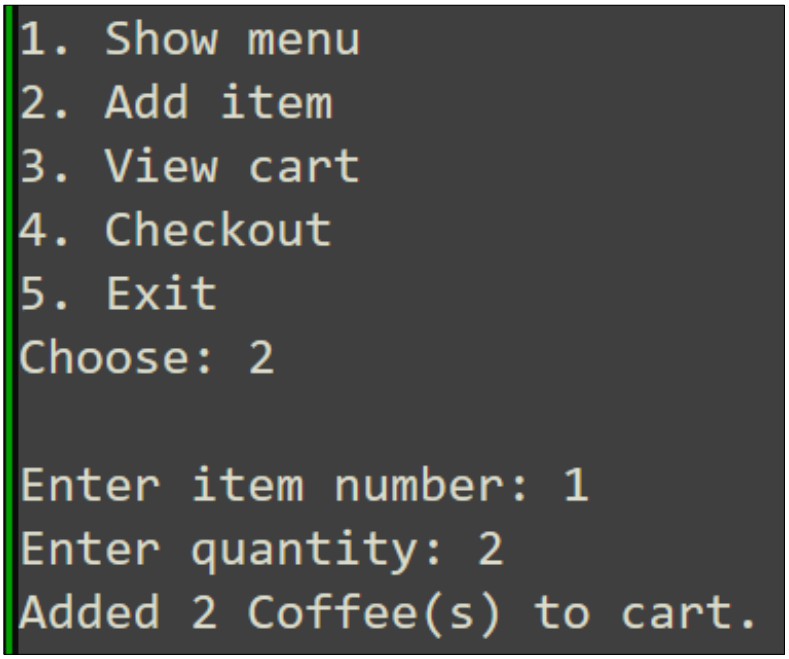

Start Checkout
Initialize Cart and Prices
Display Menu Items
Ask User: Select Item
No
Validate Item Exists?
Yes
Yes
Ask Quantity
Add Item and Quantity to Cart
Ask: More Items?
Compute Subtotal
Display Subtotal
Compute Tax
Add Tax to Subtotal
Check Meal Deal Eligibility
Eligible
Not Eligible
Apply Meal Deal Discount
Skip Meal Deal
Ask Student Discount?
Validate Discount Code
Skip Student Discount
Valid
Invalid
Apply Student Discount
Show Error, Skip Discount
Compute Final Total
Display Final Total
Print Receipt
Save Transaction to Sales Log
Clear Cart
End Checkout

Step 6:- Testing Code

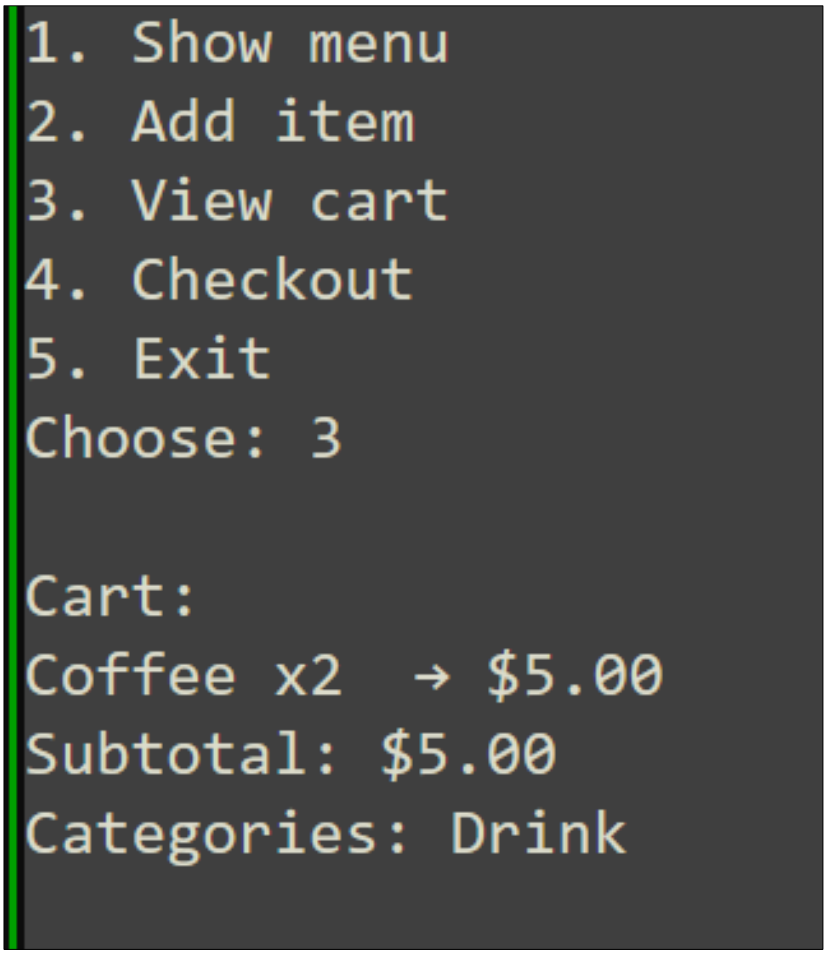
1. **Test Case 1: Show Menu**
   - Input: User selects option 1 (Show Menu).
   - Processing: The system should iterate through the menu dictionary and print all items with their prices and categories.
   - Expected Output: A formatted list of available items (e.g., “Coffee – $2.50, Sandwich – $4.00, Tea – $1.50, Juice – $3.00”).
   - Purpose: Verifies that menu data is displayed correctly.



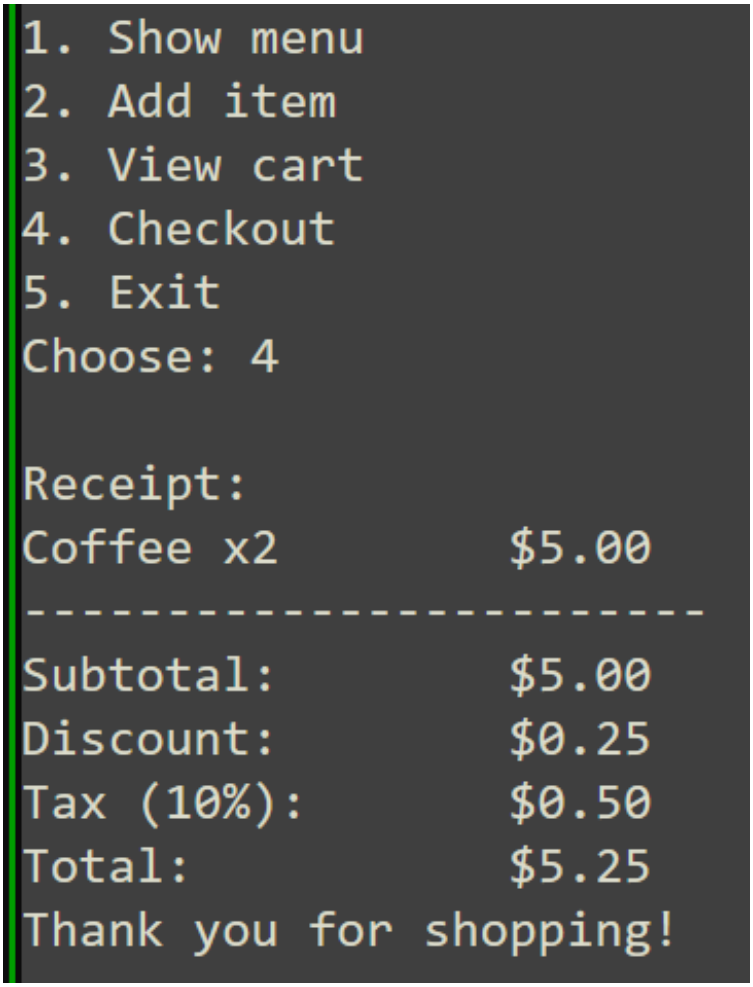
2. **Test Case 2: Add Item to Cart**
   - Input: User selects option 2, enters Coffee as the item, and chooses quantity 1.
   - Processing: The program validates that “Coffee” exists, then appends (Coffee, 1) to the cart.
   - Expected Output: Message → “1 Coffee added to cart.”
   - Purpose: Confirms that adding items updates the cart correctly.



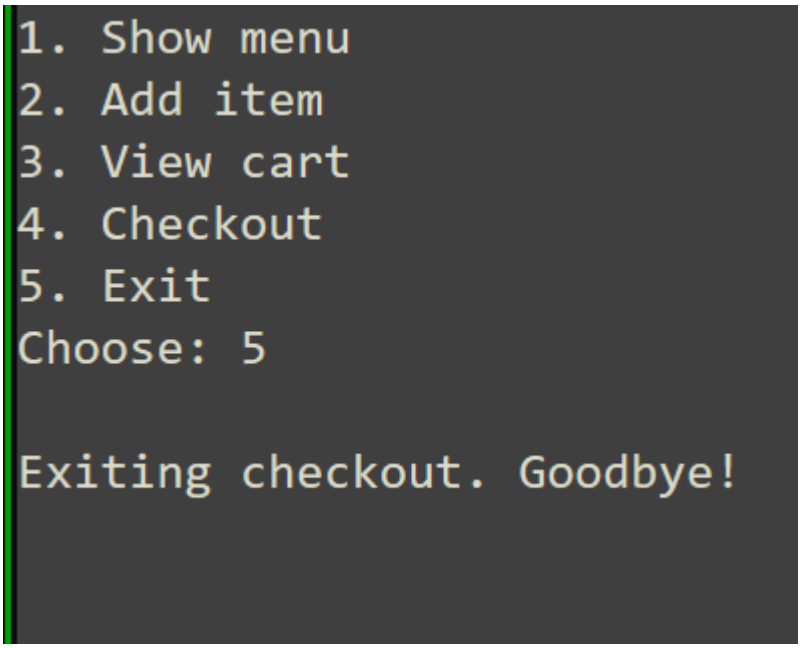
3. **Test Case 3: View Cart**
    - Input: User selects option 3.
    - Processing: The program iterates through the cart list and computes the subtotal.
    - Expected Output: List of all items in cart with subtotal (e.g., “Cart: Coffee ×1, Subtotal = $2.50”).
    - Purpose: Ensures cart contents and subtotal calculation are correct.



4. **Test Case 4: Checkout with Student Discount**
    - Input: Add Coffee ($2.50), then select Checkout (4), and answer “yes” for student discount.
    - Processing:
    - Subtotal = $2.50
    - Tax = $2.50 × 10% = $0.25
    - Student Discount = 5% of ($2.50 + $0.25) = $0.14
    - Final Total = $2.61



5. **Test Case 5: Invalid Input Handling**
    - Input: User selects option 9.
    - Processing: The system checks against valid menu options and rejects invalid entry.
    - Expected Output: “Invalid choice. Please try again.”
    - Purpose: Verifies robust error handling for invalid inputs.



Step 7:- Refinement via GenAI:

After initial implementation, the program was refined with the help of Generative AI (GenAI) to improve readability, user experience, and code quality.

Prompts I've Used with GenAI:

- "Check if my pseudocode is correct or can be simplified for clarity."
- "Suggest a better way to structure test cases in a template."
- "How can I make the receipt format clearer and professional?"
- "How do I avoid rounding issues in tax and discount calculations?"

What I've Changed After Refinement:

- Pseudocode Improvements – Long steps were broken down into concise structured blocks, making it easier to follow. Loops and conditions were rewritten in a cleaner format.
- Testing Framework – A consistent test-case template was introduced (Input → Processing → Expected Output → Purpose). This made testing structured and repeatable.
- Receipt Formatting – Instead of plain text, the receipt output was reformatted with aligned columns (item name, price, quantity, subtotal), which looks more like a professional bill.
- Discount & Rounding Handling – Suggested using round(value, 2) for monetary calculations, ensuring totals are always shown correctly to two decimal places.
- User Experience Enhancements – Clearer prompts ("Enter quantity for Coffee:") and confirmation messages ("Your cart has been updated") were added to improve usability.

Justification for Changes:

- The refinements made the program easier to understand (clean pseudocode).
- The testing became standardized and rigorous.
- The receipt output looked professional and user-friendly.
- The program became more robust against errors and rounding inconsistencies.