Store Loyalty System Documentation

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1. System Overview

The Store Loyalty System is a simple, modular solution for managing customer transactions, invoicing, and loyalty points. This system supports both member and non-member customers, with the flexibility to handle different payment methods. It is designed using object-oriented principles to maintain a clear separation of concerns, making it easy to extend and maintain.

2. System Architecture

2.1 Core Components

- **Customer Management**: Manages customer details including customer number and membership status.
- **Invoice Processing**: Handles transaction data, calculates loyalty points, and displays invoice information.
- **Payment Processing**: Supports different payment methods like cash and card.
- **Loyalty Points**: Calculates and tracks loyalty points for member customers.

2.2 Class Structure

Payment

- Represents a payment method and contains the payment type.
- Provides a method for retrieving payment details.

Invoice

- Stores transaction details such as invoice amount and payment method.
- Calculates loyalty points for member customers and provides invoice details.

Customer

- Represents a customer and stores attributes such as customer number and membership status.
- Manages a list of invoices and provides methods for adding invoices and retrieving customer details.

`calculate_loyalty_points` Function

- A function that handles user input, creates instances of `Customer`, `Invoice`, and `Payment`, and displays information about the transaction and loyalty points.

3. Implementation Details

3.1 Design Patterns Used

1. **Strategy Pattern**
    - Used for the payment method implementation to allow easy addition of new payment types and encapsulation of payment processing logic.
2. **Abstract Factory (Conceptual)**
    - Facilitates the creation of different customer types, enabling flexible handling of member and non-member logic.
3. **Facade Pattern**
    - The `calculate_loyalty_points` function acts as a facade to coordinate the creation and interaction between `Customer`, `Invoice`, and `Payment` classes.

3.2 Key Features

1. **Modular Design**
    - Each class has a single responsibility, making the code easy to maintain and extend.
    - Clear separation of concerns ensures that each component is easy to manage and modify.
2. **Robust Validation**
    - Input validation is implemented for customer data and invoice processing.
    - Comprehensive error handling and messaging for seamless user interaction.
3. **Flexible Architecture**
    - The system can be extended to include additional payment methods.
    - Easy to add new customer types or modify existing logic for more complex use cases.
    - Scalable points calculation for more comprehensive loyalty programs.

4. Testing Strategy

4.1 Test Coverage

- **Unit Tests**: Covering the core methods of `Payment`, `Invoice`, and `Customer` classes.

- **Integration Tests**: Ensuring that the `calculate_loyalty_points` function interacts correctly with all components.
- **Edge Case Handling**: Testing with non-standard inputs to ensure system stability.
- **Error Condition Testing**: Validating error handling for invalid user input and unexpected scenarios.

4.2 Test Cases

1. **Customer Registration**: Verify customer creation with valid and invalid data.
2. **Purchase Processing**: Ensure invoices are created and payment methods are applied correctly.
3. **Points Calculation**: Validate the calculation of loyalty points for member and non-member customers.
4. **Payment Method Handling**: Test different payment methods to verify payment processing.
5. **Error Handling**: Simulate incorrect inputs and check if the system provides appropriate error messages.
6. **Edge Cases**: Test with boundary values, such as zero or extremely high invoice amounts.

5. System Usage

5.1 Basic Operations

```
# Initialize the system
calculate_loyalty_points()

# Example usage:
# Enter customer number: C123
# Is the customer a member? (Yes/No): Yes
# Enter the invoice amount: 1000
# Enter the payment method (Cash/Card): Card

# Output:
# Customer Info:
# Customer Number: C123, Member: Yes
# Invoice Amount: 1000.0, Payment Method: Card
# Loyalty Points Added: 10
```

5.2 Common Workflows

1. **Member Purchase**: Process a purchase and calculate loyalty points for a member.
2. **Non-member Purchase**: Process a purchase for a non-member without loyalty points.
3. **Points Calculation**: Calculate and display loyalty points for member customers based on invoice amount.
4. **Payment Processing**: Verify that the payment method is correctly applied to the invoice.

6. Maintenance and Extension

6.1 Adding New Features

- **Create new customer types**: Extend the `Customer` class to include additional behavior for different customer categories.
- **Add payment methods**: Introduce new payment methods by extending the `Payment` class.
- **Modify points calculation**: Update the `calculate_loyalty_points` method to support more complex point systems.
- **Extend validation rules**: Implement additional validation checks for more robust input handling.

6.2 System Monitoring

- **Logging**: Ensure that important system events are logged for debugging and performance monitoring.
- **Transaction Tracking**: Implement tracking of transactions for historical analysis.
- **Error Monitoring**: Set up error monitoring tools to alert on unexpected failures.
- **Performance Metrics**: Regularly measure and optimize the system for better performance.

7. Conclusions and Recommendations

7.1 System Strengths

- **Robust Architecture**: Modular and maintainable design with clear separation of responsibilities.
- **Comprehensive Testing**: Includes unit, integration, and edge case testing for reliable performance.
- **Clear Documentation**: Detailed documentation that makes it easy for developers to understand and modify the system.
- **Extensible Design**: The code is structured in a way that allows easy addition of new features and payment methods.

7.2 Future Improvements

- **Database Integration**: Implement a database to store customer and invoice data for persistence.
- **API Development**: Create an API to enable interactions with other systems.
- **User Interface**: Develop a UI to provide a more user-friendly experience.
- **Advanced Reporting**: Add reporting features to track customer purchase history, loyalty points, and system performance.
