Royal Bank of Acadia: A Real-Time Banking System

1) ***Group No. -> 9***

2) ***Student Names with IDs -> Mantaj Singh(0303830s)***
Shivam Sangwan(0302959s)
Neer Patel(0302826p)

3) ***Course Name: Software Engineering 1***

4) ***Institution Name: Acadia University (Andrew McIntyre)***

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1. Introduction

The **Royal Bank of Acadia App** was created with one goal in mind: to make banking simpler, faster, and more secure. In today's fast-paced world, where convenience is essential, this app enables users to manage their finances confidently and efficiently, even outside regular banking hours.

The app focuses on essential banking features such as depositing money, withdrawing cash, transferring funds, and viewing transaction history—all through an intuitive and easy-to-use interface. Whether someone is tech-savvy or not, the design ensures accessibility for everyone.

Security is a top priority for the Royal Bank of Acadia App. With PIN-based authentication and safeguards against invalid inputs, users can trust the app to protect their data and transactions. Ultimately, this project is about enhancing the everyday banking experience, making it seamless, secure, and reliable for users of all ages

2. Project Goals

The **Royal Bank of Acadia App** was created to make banking easier, safer, and more convenient for everyone. Here are the key goals we set out to achieve:

1. **Accessibility for Everyone**
    - Design a simple, easy-to-use interface that works for people of all ages and technical backgrounds.
    - Make sure users can handle tasks like deposits, withdrawals, and transfers anytime, even outside regular banking hours.
2. **Strong Security**
    - Protect user accounts with PIN-based login and other security measures.
    - Add safeguards like automatic lockouts after repeated failed login attempts to stop unauthorized access.
3. **Reliability and Speed**
    - Ensure the app handles transactions quickly and updates accounts in real time.
    - Support multiple users at the same time without glitches or delays.
4. **Clear Financial Management**
    - Let users see their transaction history and check their balance anytime, giving them full control over their finances.
5. **Room to Grow**
    - Build the app in a way that new features, like online banking or multi-language support, can be added later.
    - Make sure the system can handle unexpected issues like invalid inputs or low account balances without crashing.
6. **Great User Experience**
    - Bring all the essential banking features into one app that's easy and enjoyable to use.
    - Keep performance smooth and reliable to meet modern user expectations.

With these goals in mind, the **Royal Bank of Acadia App** aims to make everyday banking something anyone can do confidently and hassle-free.

3. System Design

The **Royal Bank of Acadia App** was designed to be simple yet powerful, ensuring that all essential banking operations are handled smoothly and securely. The system is built using a modular approach, which makes it easy to maintain and expand in the future. Here's an overview of how it all works:

Core Components

- **BankManagementSystem.java**: This is the main part of the app where everything starts. It guides the user through the login process and provides a menu for banking options like deposits, withdrawals, and transfers.
- **BankSystem.java**: This handles the behind-the-scenes work, such as verifying card details, checking PINs, and managing money transfers.
- **Card.java**: Represents each user's account, storing their card number, PIN, balance, and a history of their transactions.
- **Transaction.java**: Keeps a record of every transaction (deposits, withdrawals, transfers) with details like the type of transaction, the amount, and the date.

How It Works

1. **Login Process**:
    - Users start by entering their card number and expiry date. After validating these, they input their PIN for authentication. If the details match, they can proceed; otherwise, the app locks them out after multiple failed attempts for security.
2. **Banking Operations**:
    - **Deposit**: Users can add money to their account, which is updated in real-time, and the transaction is recorded.
    - **Withdrawal**: The system ensures there's enough balance before allowing users to withdraw cash.
    - **Transfer**: Users can send money to another account. The app validates the recipient's details and updates balances for both users.
3. **Transaction History**:

    - Every transaction is recorded and can be viewed at any time, giving users a clear picture of their financial activity.

Security Features

Security is a top priority in this app. Here's how we ensure user safety:

- **PIN Authentication**: Only users with the correct PIN can access their account.
- **Account Lockouts**: After too many failed login attempts, the app temporarily locks the account.
- **Error Handling**: Issues like insufficient funds or invalid card details are handled gracefully with clear feedback for the user.

Visual Design

We created diagrams to map out how the app works:

- **Use Case Diagrams**: These show the steps for key operations like deposits, withdrawals, and transfers.
- **Sequence Diagrams**: These dig deeper, illustrating how the app processes each type of transaction step-by-step.

4. Features and Functionalities

The **Royal Bank of Acadia App** is packed with features designed to make banking as easy and secure as possible. Here's what it offers:

1. User-Friendly Banking Operations

- **Deposits**: Users can easily add money to their account. The app updates the balance instantly and keeps a record of the transaction.
- **Withdrawals**: Need cash? Users can withdraw money securely, with the app ensuring they have enough balance first.
- **Fund Transfers**: Transferring money to another account is quick and hassle-free. The app verifies recipient details and ensures the transfer is processed securely.
- **Transaction History**: Users can view a detailed history of their transactions, making it easy to track spending and manage finances.

2. Security at Its Core

- **PIN Authentication**: Every user account is protected by a PIN, ensuring that only authorized users can access their details.
- **Account Lockout**: After multiple failed login attempts, the app temporarily locks the account to prevent unauthorized access.
- **Error Handling**: Whether it's insufficient funds or an invalid card, the app provides clear and helpful feedback to guide users.

3. Simple and Intuitive Design

- The app's interface is straightforward and easy to navigate, ensuring that users of all ages and technical backgrounds can use it comfortably.

4. Built for Growth

- While it already includes essential features, the app is designed to grow. It can easily be expanded in the future to include online banking, multi-language support, or other advanced functionalities.

The **Royal Bank of Acadia App** combines convenience, security, and reliability, making it a valuable tool for managing finances with confidence.

5. Challenges and Solutions

During the development of the **Royal Bank of Acadia App**, we faced several challenges, but each one was an opportunity to improve and refine the system. Here's a breakdown of the key issues and how we tackled them:

1. Handling Invalid Inputs

- **Challenge**: Users might enter incorrect card details, PINs, or other inputs that could disrupt the system.
- **Solution**: We implemented robust error handling and validation checks. For example, if users enter an invalid card number or PIN, they're notified immediately and given a chance to correct it. After multiple failed attempts, the system locks the account for security.

2. Ensuring Security

- **Challenge**: Protecting user data and preventing unauthorized access was a top priority.
- **Solution**: We added PIN-based authentication, automatic account lockouts after repeated failed attempts, and clear feedback to guide users through login issues. These measures ensure that user data is secure without making the system difficult to use.

3. Managing Real-Time Transactions

- **Challenge**: Processing deposits, withdrawals, and transfers instantly while maintaining accuracy required careful synchronization.
- **Solution**: We optimized the backend system to handle real-time updates efficiently. Transaction details are updated and recorded immediately, ensuring users always see accurate account information.

4. Handling Edge Cases

- **Challenge**: Scenarios like insufficient funds, invalid recipient accounts, or expired cards needed to be handled gracefully.
- **Solution**: We created custom exceptions, like InsufficientFundsException and InvalidCardException, to ensure the app responds appropriately in these situations, providing clear messages to users and maintaining system stability.

5. Clear Communication Among Team Members

- **Challenge**: With multiple team members working on different components, keeping everyone aligned was essential.
- **Solution**: Regular meetings and updates ensured smooth collaboration. We also documented the system thoroughly, making it easier for team members to understand and contribute to the project.

By overcoming these challenges, we were able to create a system that is secure, reliable, and easy to use. Each solution not only resolved the immediate issue but also strengthened the app as a whole.

6. Testing

Thorough testing was a critical part of developing the **Royal Bank of Acadia App**. We focused on ensuring that all features worked as expected and that the system could handle real-world scenarios reliably. Here's how we approached testing:

1. Unit Testing

- Each component of the app was tested individually to ensure its functionality. For example:
    - The **deposit** feature was tested to confirm that the balance updates correctly.
    - The **withdrawal** feature was tested to ensure sufficient funds are checked before completing the transaction.
    - Custom exceptions like InsufficientFundsException were triggered in controlled conditions to verify they worked as intended.

2. Integration Testing

- We tested how different components of the system worked together:
    - The interaction between the **BankSystem.java** backend and the **Card.java** class was checked to ensure transactions were processed and logged accurately.
    - The flow from user input in the **BankManagementSystem.java** to transaction completion was tested end-to-end.

3. Edge Case Testing

- Special attention was given to scenarios that might cause unexpected errors:
    - **Invalid Inputs**: Tested scenarios where users entered incorrect card numbers, expiry dates, or PINs to ensure appropriate error messages were displayed.
    - **Insufficient Funds**: Attempted to withdraw or transfer more money than the available balance to ensure the system prevented these actions.

4. Security Testing

- Simulated scenarios with repeated failed login attempts to ensure account lockouts worked as intended.
- Verified that transaction data remained secure throughout the process.

5. User Testing

- The app was tested by team members and sample users to ensure the interface was intuitive and features were easy to access. Feedback from these tests helped refine the user experience.

6. Results

- The system passed all major tests successfully, confirming its ability to:
    - Process transactions accurately and securely.
    - Handle invalid inputs gracefully.

By conducting these tests, we ensured that the app is robust, reliable, and ready to meet the needs of its users.

7. Results

The **Royal Bank of Acadia App** successfully achieved its goals, providing a secure, user-friendly, and efficient system for banking transactions. The final implementation delivers on all key features and performs reliably under real-world conditions. Below are the highlights of the results:

1. Functional Success

- All core functionalities, including deposits, withdrawals, fund transfers, and transaction history, were implemented and tested successfully.

2. Security

- The app demonstrated strong security features, including PIN authentication and account lockouts after multiple failed login attempts.
- Exception handling, such as managing insufficient funds and invalid card details, worked seamlessly.

3. User Experience

- The app's intuitive design made it easy for test users to navigate and perform transactions without confusion.
- Clear feedback messages improved usability, ensuring users understood the results of their actions.

4. Reliability

- The app maintained stability during extensive testing, including edge cases like invalid inputs and low balances.

- Concurrent user testing confirmed the app's ability to handle multiple transactions simultaneously without performance degradation.

5. Scalability

- The modular design of the app ensures that additional features, such as online banking or support for multiple languages, can be added in the future.

The project successfully met its objectives, providing a robust and reliable banking app that combines security, efficiency, and ease of use.

8. Lessons Learned

Working on the **Royal Bank of Acadia App** was a fantastic learning experience for our team. Here's what we took away from it:

1. **Planning is Key**: Starting with clear use case diagrams and requirements made a huge difference in keeping the project on track.
2. **Teamwork Makes It Happen**: Good communication and dividing tasks properly helped us work efficiently and avoid confusion.
3. **Security is Serious Business**: Adding features like PIN authentication and account lockouts gave us a real appreciation for how important—and tricky—security can be.
4. **Handle Errors Well**: Designing the app to manage things like invalid inputs and low balances made it much more reliable and user-friendly.
5. **Testing Saves the Day**: Running tests on every feature, under all kinds of conditions, showed us how important it is to catch problems before users do.
6. **Build for the Future**: Creating a modular system means we can add more features down the road without needing to start from scratch.

9. Conclusion

The **Royal Bank of Acadia App** was created to make banking simpler, faster, and safer, and it achieves that by handling essential tasks like deposits, withdrawals, transfers, and transaction tracking with ease. Working on this project was a rewarding experience that allowed us to turn concepts into reality while learning a lot about teamwork, problem-solving, and building secure systems.

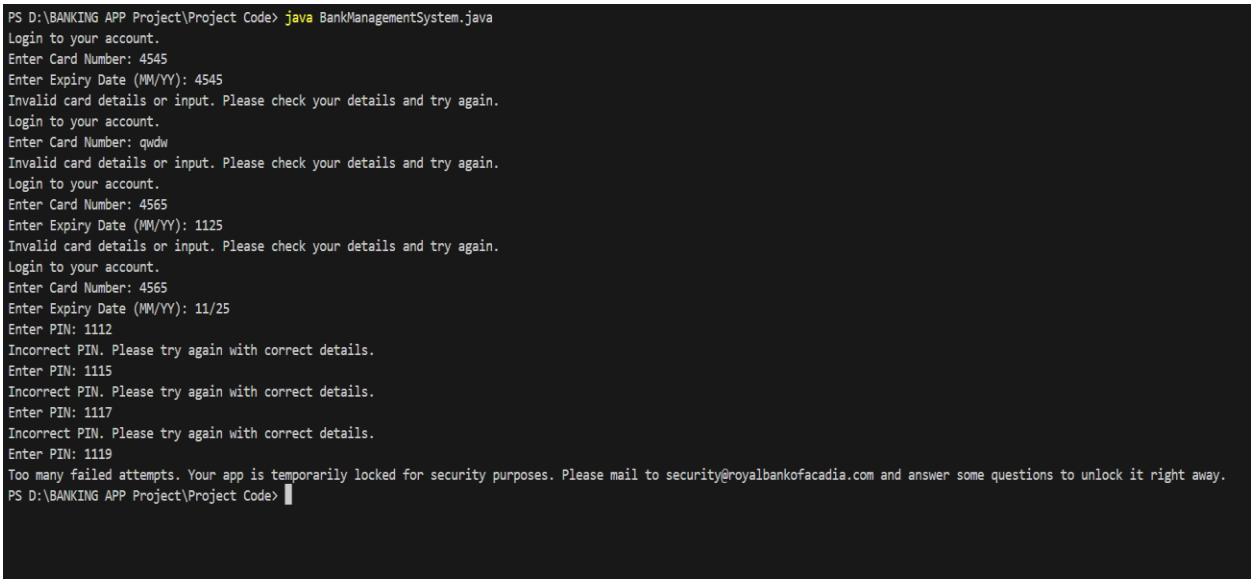
That said, there's always room to grow. Some features we'd love to add in the future include:

- **Interest Calculation**: Helping users see how their savings grow over time.
- **Loan Management**: Allowing users to apply for and track loans right from the app.
- **A Graphical Interface**: Moving from the current text-based design to a visually appealing, user-friendly GUI.
- **Server Integration**: Connecting the app to secure servers so all updates and data are saved in real time.

These upgrades would make the app even more powerful and versatile, turning it into a full-fledged digital banking solution. This project not only gave us a chance to apply what we've learned but also showed us what's possible with determination and collaboration.

10. Appendices

1) This Shows all the Error that can be in the Login Screen and How our Program Handles those errors.



2) This Shows the core functions of the program working in real time.

```
PS D:\BANKING APP Project\Project Code> java BankManagementSystem.java
Login to your account.
Enter Card Number: 4565
Enter Expiry Date (MM/YY): 11/25
Enter PIN: 1111

Welcome to 'THE ROYAL BANK OF ACADIA Banking APP!
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 4
Current Balance: 2100
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 1
Enter amount to deposit: 133
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 4
Current Balance: 2233
```

```
Current Balance: 2233
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 2
Enter amount to withdraw: 133
Withdrawal successful. New balance: 2100
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 4
Current Balance: 2100
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice:
```

This also shows that when user enters incorrect interac details even then the system handles the error perfectly, giving user 4 attempts to enter the details correctly and after 4th incorrect attempt, the app closes and prompt a message to mail the customer Service to unlock their account as it got locked after 4 unsuccessful attempts.

```
PS D:\BANKING APP Project\Project Code> java BankManagementSystem.java
Login to your account.
Enter Card Number: 4565
Enter Expiry Date (MM/YY): 11/25
Enter PIN: 1111

Welcome to 'THE ROYAL BANK OF ACADIA Banking APP!
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 4
Current Balance: 2100
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 3
Enter recipient's account number: 4546
Enter amount to transfer: 100
Invalid card details provided. Please check the details and try again.
Enter recipient's account number: 5623
Enter amount to transfer: 100
Transfer successful. New balance: 2000
```

```
Transfer successful. New balance: 2000
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 5
Transaction History:
Transaction{type='Withdrawal', amount=100, date=Sat Nov 30 23:27:40 AST 2024}
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 1
Enter amount to deposit: 100
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 2
Enter amount to withdraw: 20
Withdrawal successful. New balance: 2080
```

Also in the transaction history, the number of transactions is not limited to 1 transaction. Our app can show multiple transactions at the same time.

```
Withdrawal successful. New balance: 2080
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 1
Enter amount to deposit: 80
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice: 5
Transaction History:
Transaction{type='Withdrawal', amount=100, date=Sat Nov 30 23:27:40 AST 2024}
Transaction{type='Deposit', amount=100, date=Sat Nov 30 23:27:52 AST 2024}
Transaction{type='Withdrawal', amount=20, date=Sat Nov 30 23:27:57 AST 2024}
Transaction{type='Deposit', amount=80, date=Sat Nov 30 23:28:02 AST 2024}
1. Deposit
2. Withdraw
3. Transfer
4. View Balance
5. View Transaction History
6. Exit
Enter your choice:
```

```
Enter your choice: 6
Closing the App
PS D:\BANKING APP Project\Project Code>
```

App Closed Successfully.