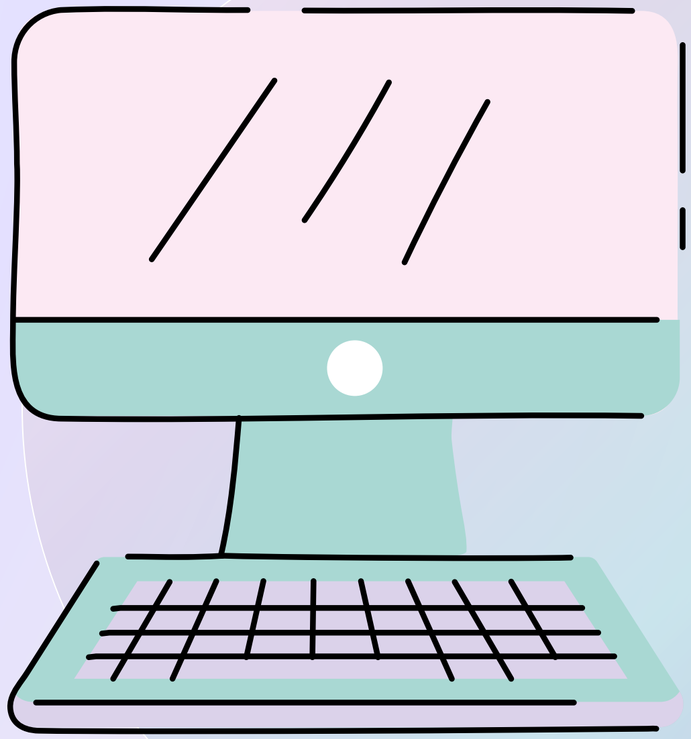
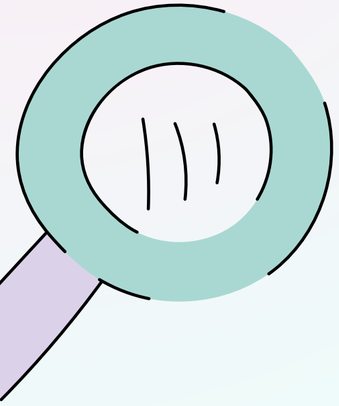
PROJECT:
PERSONAL FINANCE MANAGEMENT APPLICATION

GROUP 9



GROUP MEMBERS



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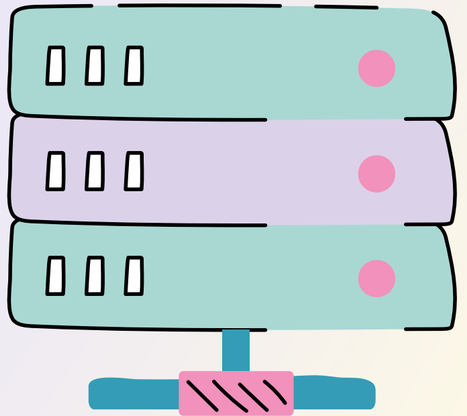

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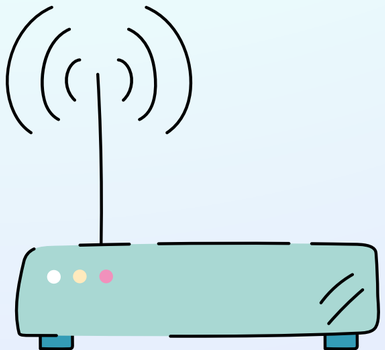
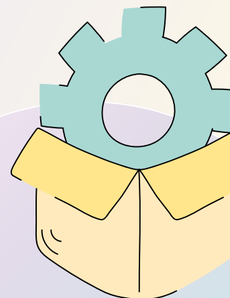




1. INTRODUCTION

1.1 THE REASON WHY WE CHOSE THIS TOPIC

Managing personal income and expenses is a very common need, but data is easily lost or misplaced, making it difficult to compile reports.

Aimed to practice Object-Oriented Programming (OOP) in a real-world project: modeling entities (accounts, transactions, loans), handling business logic, and generating financial summaries.

The project is broad enough to apply most of the knowledge learned in OOP: inheritance, polymorphism, encapsulation, collections + streams, exception handling, and File I/O.

1.2. Product Objectives

- Build a complete personal finance management system:

• Manage accounts (bank, e-wallet, cash, etc.).

• Manage transactions (income/expense) with categorization.

• Support internal transfers between accounts.

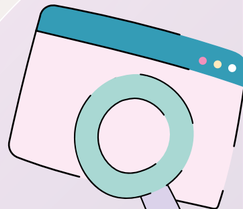
• Manage loans and lendings, track partial repayments.

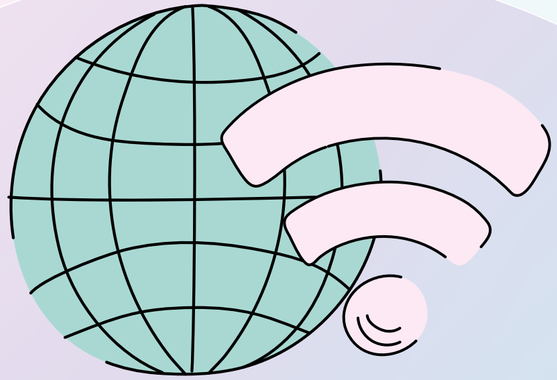
• Generate financial reports over selected time periods or accounts.

- Designed using a multi-layered architecture to allow future expansion (e.g., GUI interface, CSV export, database connection).

1.3 Core Features Implemented

- Account management: add/edit/delete, view balance, total balance.
- Transaction management: add/edit/delete, INCOME/EXPENSE type, assign Category.
- Internal transfer: record dual transactions between accounts.
- Loan/Lending management: add/edit/delete, track payments and remaining amount.
- Report generation: overview, income-expense by period, by account, by month (grouped).
- Input validation and custom business exceptions.





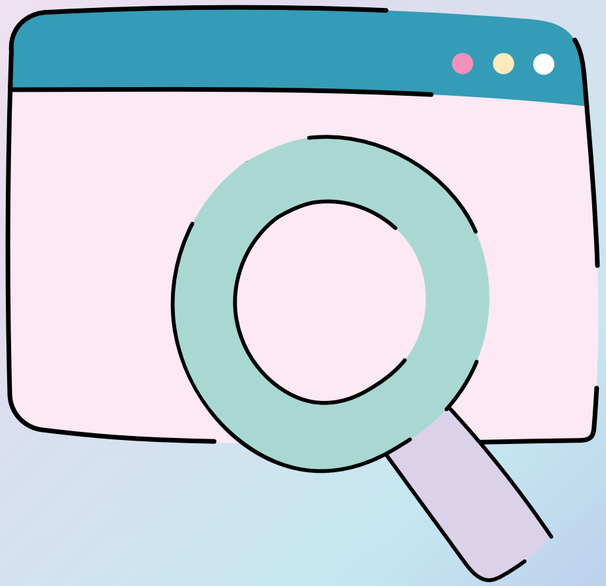
1.4 Target Users and Scope

-Target users: individual users, students, office workers.

-Demo version scope: console interface (CLI), temporary in-memory storage, CSV export currently prints to console (ready for implementation).

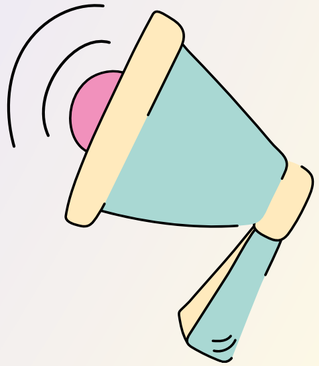
1.5 Knowledge and Skills Applied

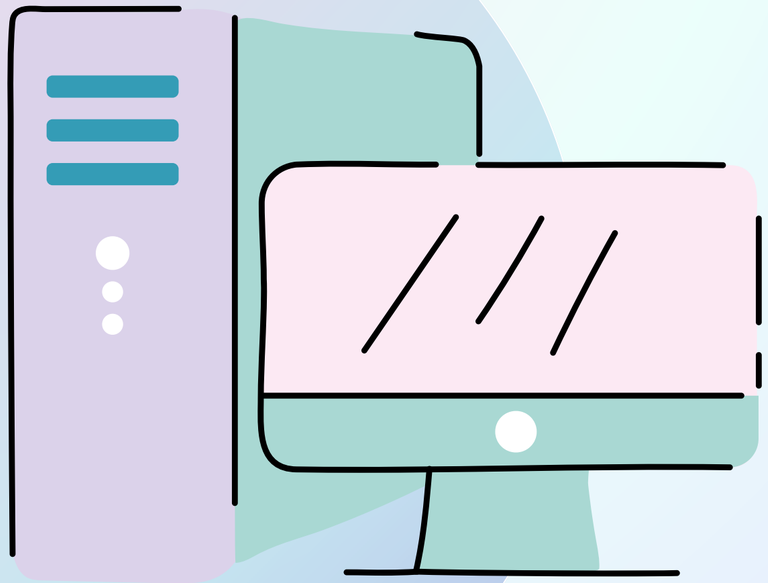
- OOP principles: class decomposition, use of interfaces/abstracts, data encapsulation.
- Java Collections & Streams: filter, group, aggregate; use of YearMonth for monthly grouping.
- Exception handling: domain-specific exceptions (e.g., insufficient balance, account not found).
- Validation: positive amounts, valid date ranges, category validation.
- Layered architecture: View (console) – Service – Model – Utility.
- Clean code practices: meaningful naming, modularization, DTO design, minimizing I/O in core logic.



1.6. Demo Evaluation Criteria

- Correct functionality (CRUD, transfers, loan tracking, etc.).
- Accurate and consistent report data, proper [from–to] date filtering.
- Readable, testable, and extensible code (ready for GUI/CSV upgrades).





2. SYSTEM DESIGN

2.1. Overall Architecture (Layered)

- UI (Console) ↔ Service (Business Logic) ↔ Model (Domain Layer) ↔ Utils/Validation.
- The Main class serves as the entry point that initializes the system and displays the feature menu.

```java
public class Main {
    private static FinanceManager financeManager = new FinanceManager();
    private static Scanner scanner = new Scanner(System.in);

    public static void main(String[] args) {
        displayWelcomeMessage();
        int choice;
        do {
            displayMainMenu();
            choice = getIntInput("Chon chuc nang: ");
            // ... handle user choice
        } while (choice != 5);
    }
}
```

Main.java

```java
public class ReportService {
    private AccountService accountService;
    private TransactionService transactionService;
    private LoanService loanService;

    public ReportService(AccountService accountService,
                         TransactionService transactionService,
                         LoanService loanService) {
        this.accountService = accountService;
        this.transactionService = transactionService;
        this.loanService = loanService;
    }
}
```

ReportService.java

2.2. Class Diagram (Main Entities and Relationships)

- Core entities: Account, Transaction, Category, Loan, Lending, Payment, TransactionType.
- Each Transaction links to one Account (via accountId) and optionally to one Category.

```java
public class Transaction {
    private String transactionId;
    private String accountId;
    private TransactionType type;
    private double amount;
    private LocalDateTime date;
    private String description;
    private Category category; // 0..1

    public String getFormattedDate() {
        DateTimeFormatter fmt = DateTimeFormatter.ofPattern("dd/MM/yyyy HH:mm:ss");
        return date.format(fmt);
    }
}
```

Transaction.java

```java
public enum TransactionType {
    INCOME("Thu nhập"),
    EXPENSE("Chi tiêu"),
    TRANSFER("Chuyển khoản");

    private final String vietnameseName;
    public String getVietnameseName() { return vietnameseName; }
}
```

Transaction.java

2.3. Typical Use Case Flows

- Add Transaction → create a Transaction → send to TransactionService → update and display report.
- Internal Transfer → verify accounts and sufficient balance → record paired transactions.
- Loan/Lending & Repayment → create Loan/Lending → add Payment → compute remaining and status.

2.3. Typical Use Case Flows

```java
// Internal account transfer
public boolean transferBetweenAccounts(String fromId, String toId, double amount)
        throws AccountNotFoundException, InsufficientBalanceException {

    Optional<Account> fromOpt = findAccountById(fromId);
    Optional<Account> toOpt   = findAccountById(toId);

    if (fromOpt.isEmpty()) throw new AccountNotFoundException("Khong tim thay tai khoan nguon: " + fromId);
    if (toOpt.isEmpty())   throw new AccountNotFoundException("Khong tim thay tai khoan dich: " + toId);

    // ... check balance, debit source, credit destination
}
```

AccountService.java

```java
public class LoanService {
    private List<Loan> loans = new ArrayList<>();
    private List<Lending> lendings = new ArrayList<>();

    // ADD: create a loan with term months (template ready)
    public void addLoan(String lender, double amount, double interest, /* ... */) {
        // ... initialize Loan and push to loans list
    }
}
```

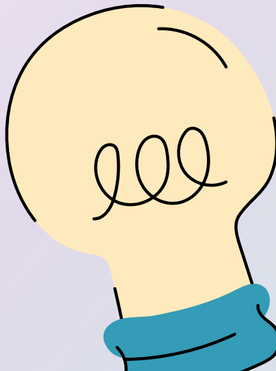
LoanService.java

2.4. Data Rules and Constraints

- Amount values are always positive; the transaction type determines whether to add or subtract from totals.
- Time filtering follows the inclusive range [from..to]; date and time formats are consistent.
- Category may be null → must always be checked before grouping or displaying data.
- Transfers: from != to, accounts must exist, and source balance must be sufficient.

```java
private static final DateTimeFormatter DATE_FORMATTER =
        DateTimeFormatter.ofPattern("dd/MM/yyyy");
private static final DateTimeFormatter DATE_TIME_FORMATTER =
        DateTimeFormatter.ofPattern("dd/MM/yyyy HH:mm:ss");

public static boolean isWithinRange(LocalDate d, LocalDate start, LocalDate end) {
    return d != null && start != null && end != null
            && !d.isBefore(start) && !d.isAfter(end); // inclusive
}
```

DateUtils.java

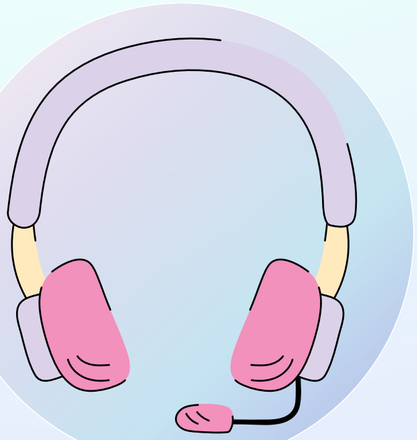


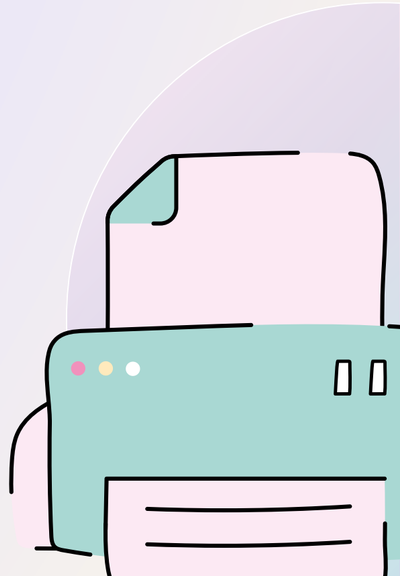
2.5. Testing and Quality Assurance

- Top-N largest transactions: sort by descending amount, limit(5) to verify boundary values.
- Avoid division by zero when total income = 0 → display “N/A”.
- Prevent NPE when Category == null.

```java
System.out.println("\nTOP 5 GIAO DICH LON NHAT:");
accountTransactions.stream()
    .sorted((t1, t2) -> Double.compare(t2.getAmount(), t1.getAmount()))
    .limit(5)
    .forEach(tx -> {
        String symbol = tx.getType() == TransactionType.INCOME ? "↑" : "↓";
        System.out.printf("  %s %-12s: %,.2f VND - %s\n",
                symbol, tx.getCategory().getName(), tx.getAmount(), tx.getDescription());
    });
```

ReportService.java



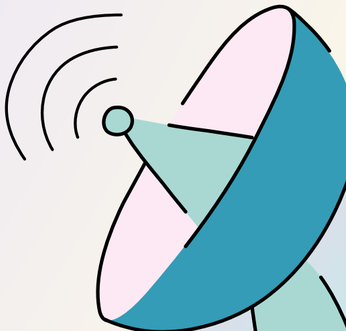


2.6. Future Enhancements (Short Roadmap)

- **CSV/Excel Export**: replace console output with proper file writing (RFC 4180 escaping).
- **GUI (Swing/JavaFX)**: charts for income/expense, date filters, and category selection.
- **Persistent storage**: replace in-memory with JSON or SQLite database.
- Loan reminders and simple/compound interest support.

```
System.out.println("\nXUAT DU LIEU (CSV Format):");
System.out.println("TAI_KHOAN_ID,TEN,LOAI,SO_DU");
accountService.getAllAccounts().forEach(acc → {
    System.out.printf("%s,%s,%s,%.2f\n",
            acc.getAccountId(), acc.getAccountName(), acc.getAccountType(), acc.getBalance());
});
// → Should be replaced with Files.newBufferedWriter(...) to write to an actual file.
```

ReportService.java

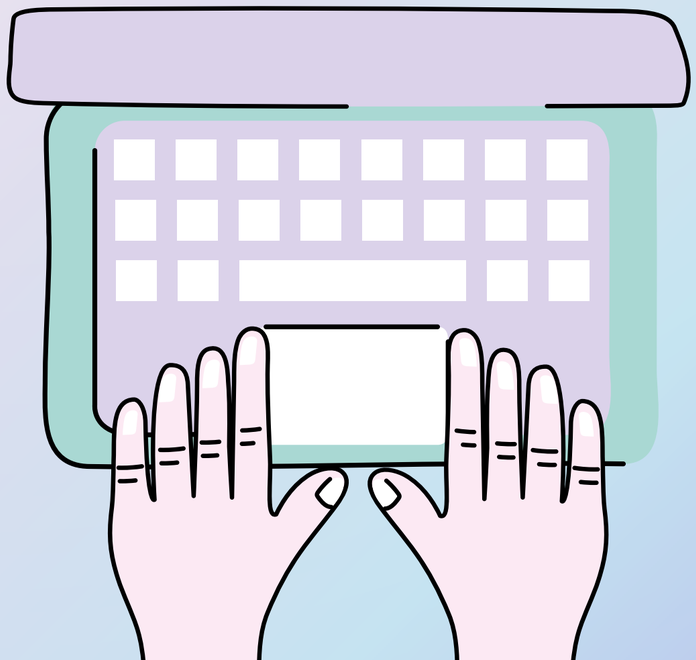


3. PRODUCT

3.1. OverView

Finance Manager is a comprehensive personal finance management application developed in Java, designed to help users track and organize their financial activities efficiently. The application follows a clear multi-layered architecture, features a user-friendly console interface, and provides full Vietnamese language support.

Key features



- Multi-account management (bank accounts, e-wallets, cash, etc.)
- Income and expense tracking with categorized transactions
- Loan and lending management with interest calculation
- Rich reporting and analytics system
- Financial validation and warning mechanisms

3.2. Detailed Feature Description

Account Management

Transaction Management

Loan & Lending Management

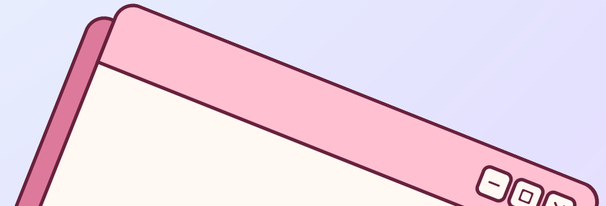
Reporting System

Account Management

Description: Allows users to create and manage multiple financial accounts.

Detail:

- Create new accounts
- View accounts
- Delete accounts
- Internal transfer
- Search accounts
- Top up



Create new accounts

Function: Create a new account with the following information: name, type, account number, initial balance.

Validation:

- Use Validator.validateAccount to check the validity of the name, account type, account number, and balance.
- Account name must be 2-50 characters long, containing only letters, numbers, and spaces.
- Account type must be one of the following values: BANK, WALLET, CASH, SAVINGS, CREDIT.
- Account number must contain only numbers, 5-30 characters long.
- Balance must not be negative

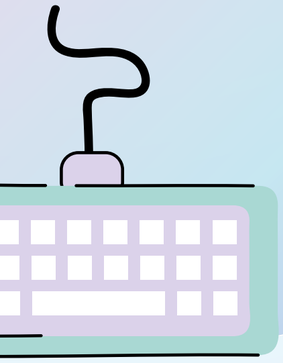
```java
//Account.java
public Account(String accountName, String accountType, String accountNumber, double initialBalance) {
    this.accountId = "ACC_" + UUID.randomUUID().toString().substring(0, 8);
    this.accountName = accountName;
    this.accountType = accountType;
    this.accountNumber = accountNumber;
    this.balance = initialBalance;
    this.currency = "VND";
}

//AccountService.java
public void addAccount(Account account) {
    if (account.isValid()) {
        accounts.add(account);
        System.out.println("Them tai khoan thanh cong: " + account.getAccountName());
    } else {
        System.out.println("Tai khoan khong hop le!");
    }
}
```

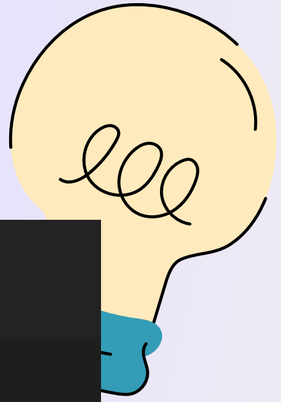
Processing:

- Automatically generate ID using UUID.
- Add the account to the list if valid

Create new accounts

Result





```
--- THEM TAI KHOAN MOI ---
Nhap ten tai khoan: Nhat
Nhap loai tai khoan (BANK/WALLET/CASH/SAVINGS/CREDIT): bank
Nhap so tai khoan: 123456
Nhap so du ban dau: 30000
Them tai khoan thanh cong: Nhat
```

View accounts

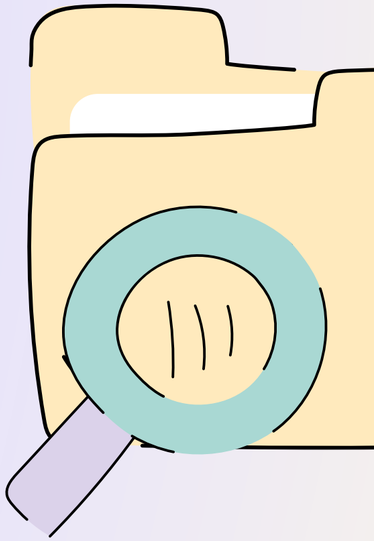
Function: Display all accounts with detailed information and total balance.

- **Display in a beautiful table format:** Show ID, name, type, account number, balance, using Unicode characters to create the frame.
- **Dynamic width calculation:** Automatically adjust table width based on content.
- **Balance aggregation:** Display the total balance of all accounts

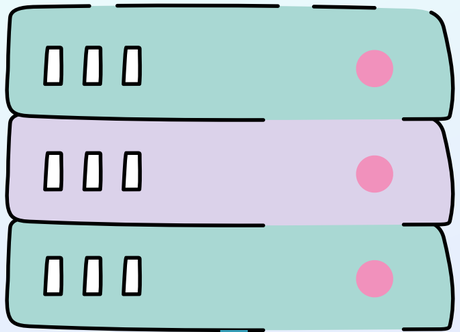
```java
// Account.java
public void displayInfo() {
    int maxWidth = calculateMaxWidth();
    String horizontalLine = "┌" + "─".repeat(maxWidth + 2) + "┐";
    String middleLine = "├" + "─".repeat(maxWidth + 2) + "┤";
    String bottomLine = "└" + "─".repeat(maxWidth + 2) + "┘";

    System.out.println(horizontalLine);
    System.out.printf("│ %-" + (maxWidth) + "s │\n", "THÔNG TIN TÀI KHOẢN");
    System.out.println(middleLine);
    System.out.printf("│ %-" + (maxWidth) + "s │\n", "ID: " + accountId);
    System.out.printf("│ %-" + (maxWidth) + "s │\n", "Tên: " + accountName);
    System.out.printf("│ %-" + (maxWidth) + "s │\n", "Loại: " + accountType);
    System.out.printf("│ %-" + (maxWidth) + "s │\n", "Số TK: " + accountNumber);
    System.out.printf("│ %-" + (maxWidth) + "s │\n",
            String.format("Số dư: %,.2f %s", balance, currency));
    System.out.println(bottomLine);
}
```

View accounts

Result



```
DANH SACH TAI KHOAN (1 tai khoan)
==========================================

  THÔNG TIN TÀI KHOẢN
  ID: ACC_1f4bbfa4
  Tên: Nhat
  Loại: BANK
  Số TK: 123456
  Số dư: 30.000,00 VND

TONG SO DU TAT CA TAI KHOAN: 30000,00 VND
```



Delete accounts

Function: Delete account based on ID

- **Existence verification:** Check if the account exists before deleting
- **Clear notification:** Notify success or reason for failure
- **Data safety:** No side effects when deleting a non-existent account

```java
public boolean deleteAccount(String accountId) {
    Optional<Account> accountOpt = findAccountById(accountId);
    if (accountOpt.isPresent()) {
        accounts.remove(accountOpt.get());
        System.out.println("Xoa tai khoan thanh cong!");
        return true;
    } else {
        System.out.println("Khong tim thay tai khoan voi ID: " + accountId);
        return false;
    }
}
```

Result

```
Nhap ID tai khoan can xoa: ACC_62057627
Xoa tai khoan thanh cong!
```

Internal transfer

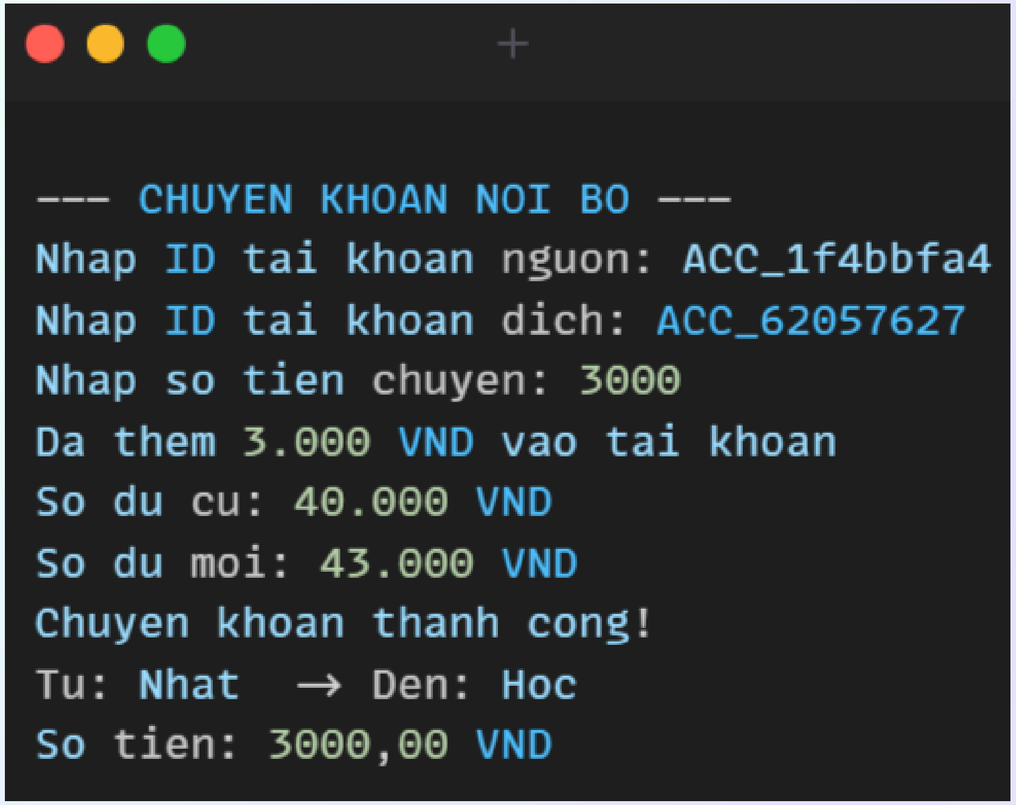
Function: Transfer money from a source account to a destination account.

- **Exception handling:** Use custom exceptions (AccountNotFoundException, InsufficientBalanceException)
- **Atomic operation:** Ensure either both accounts are updated, or nothing changes
- **Balance check:** Ensure the source account has sufficient funds
- **Detailed logging:** Record full transfer information

```java
public boolean transferBetweenAccounts(String fromAccountId, String toAccountId, double amount)
        throws AccountNotFoundException, InsufficientBalanceException {

    Optional<Account> fromAccountOpt = findAccountById(fromAccountId);
    Optional<Account> toAccountOpt = findAccountById(toAccountId);

    if (fromAccountOpt.isEmpty()) {
        throw new AccountNotFoundException("Khong tim thay tai khoan nguon: " + fromAccountId);
    }

    if (toAccountOpt.isEmpty()) {
        throw new AccountNotFoundException("Khong tim thay tai khoan dich: " + toAccountId);
    }

    Account fromAccount = fromAccountOpt.get();
    Account toAccount = toAccountOpt.get();

    if (fromAccount.getBalance() < amount) {
        throw new InsufficientBalanceException(
                "So du khong du! So du hien tai: " + fromAccount.getBalance());
    }

    // Perform transfer
    fromAccount.withdraw(amount);
    toAccount.deposit(amount);

    System.out.println("Chuyen khoan thanh cong!");
    System.out.printf("Tu: %s → Den: %s\n", fromAccount.getAccountName(), toAccount.getAccountName());
    System.out.printf("So tien: %.2f VND\n", amount);

    return true;
}
```

Internal transfer

Result



Search accounts

Function: Search for accounts whose names contain the input string (case-insensitive).

- **Case-insensitive search:** toLowerCase() for both query and data
- **Partial matching:** Search by substring
- **Display results:** Use the same format as the account list

```java
public void findAccountByName(String name) {
    accountService.getAllAccounts().stream()
            .filter(acc → acc.getAccountName().toLowerCase().contains(name.toLowerCase()))
            .forEach(Account::displayInfo);
}
```

Result

```
Nhap ten tai khoan can tim: Nhat
┌──────────────────────────────┐
│ THÔNG TIN TÀI KHOẢN          │
├──────────────────────────────┤
│ ID: ACC_1f4bbfa4             │
│ Tên: Nhat                    │
│ Loại: BANK                   │
│ Số TK: 123456                │
│ Số dư: 27.000,00 VND         │
└──────────────────────────────┘
```

Top up

Function: add funds to the account using an ID

- **Amount validation:**
  - Check for negative numbers
  - Check format (no leading zeros)
  - Maximum limit of 1 billion
- **Real-time update:** Balance is updated immediately
- **Currency format:** Display amount with separator (1,000,000)

```java
public void deposit(double amount) {
    if (amount > 0) {
        double oldBalance = this.balance;
        this.balance += amount;
        System.out.println("Da them " + String.format("%,.0f", amount) + " " + currency + " vao tai khoan");
        System.out.println("So du cu: " + String.format("%,.0f", oldBalance) + " " + currency);
        System.out.println("So du moi: " + String.format("%,.0f", this.balance) + " " + currency);
    } else {
        System.out.println("So tien them phai lon hon 0!");
    }
}
```

Result

```
Nhap ID tai khoan can them tien: ACC_1f4bbfa4
Nhap so tien can them: 300000
Da them 300.000 VND vao tai khoan
So du cu: 27.000 VND
So du moi: 327.000 VND
Them tien thanh cong!
Tai khoan: Nhat
So tien them: 300.000,00 VND
So du moi: 327.000,00 VND
```

Transaction Management

Description: Records and monitors all income and expense transactions.

Detail:

- Add transactions
- View transaction history
- View current balance
- View transactions by category

Add transactions

Function: Supports two types — INCOME and EXPENSE — with categorized entries

- **Flexible category system:**
  - Default categories: Salary, Bonus, Investment, Food, Transportation, etc.
  - Automatically create new categories if they don't exist
- **Real-time balance check:** Prevent transactions exceeding the balance
- **Automatic update:** Account balance is updated immediately after adding a transaction
- **Transaction integrity:** Ensure transaction integrity

```java
public void addTransaction(String accountId, TransactionType type, double amount,
                           String description, String categoryName) {

    Optional<Account> accountOpt = accountService.findAccountById(accountId);
    if (accountOpt.isEmpty()) {
        System.out.println("Khong tim thay tai khoan!");
        return;
    }

    Optional<Category> categoryOpt = categories.stream()
            .filter(cat → cat.getName().equalsIgnoreCase(categoryName))
            .findFirst();

    Category category;
    if (categoryOpt.isPresent()) {
        category = categoryOpt.get();
    } else {
        // Create new category
        category = new Category(categoryName, "Mo ta", type);
        categories.add(category);
    }

    Transaction transaction = new Transaction(accountId, type, amount, description, category);

    if (transaction.isValid()) {
        transactions.add(transaction);
        account.updateBalance(amount, type);
        System.out.println("Them giao dich thanh cong!");
        transaction.displayInfo();
    }
}
```

Add transactions

Result

income

```
--- THEM GIAO DICH MOI ---
Nhap ID tai khoan: ACC_1f4bbfa4
Nhap loai giao dich (income/expense): income
Nhap so tien: 3000
Nhap mo ta: tien luong
Nhap danh muc: luong
Them giao dich thanh cong!

ID: TRX_9746bfdc
Tai khoan: ACC_1f4bbfa4
Loai: Thu nhập
So tien: 3000,00
Danh muc: Luong
Mo ta: tien luong
Thoi gian: 22/10/2025 00:29:04
```

expense

```
--- THEM GIAO DICH MOI ---
Nhap ID tai khoan: ACC_1f4bbfa4
Nhap loai giao dich (income/expense): expense
Nhap so tien: 400
Nhap mo ta: tien an vat
Nhap danh muc: an vat
Them giao dich thanh cong!

ID: TRX_55f61cb6
Tai khoan: ACC_1f4bbfa4
Loai: Chi tiêu
So tien: 400,00
Danh muc: an vat
Mo ta: tien an vat
Thoi gian: 22/10/2025 00:32:12
```

View transaction history

Function: review all transactions that have been made

- **Structured display:** Each transaction in a separate frame
- **Full information:** ID, account, type, amount, category, description, time
- **Count:** Display total number of transactions

```java
public void displayAllTransactions() {
    if (transactions.isEmpty()) {
        System.out.println("Khong co giao dich nao!");
        return;
    }

    System.out.println("\nLICH SU GIAO DICH (" + transactions.size() + " giao dich)");
    System.out.println("========================================");

    for (Transaction transaction : transactions) {
        transaction.displayInfo();
        System.out.println();
    }
}
```

View transaction history

Result

View current balance

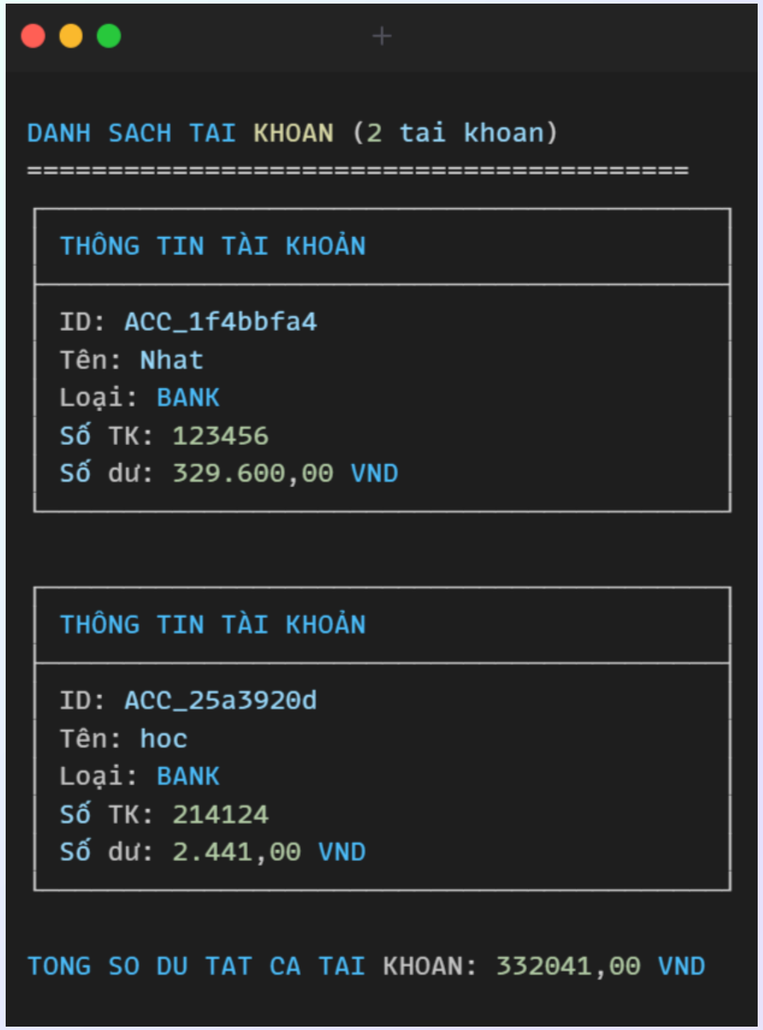
Function: Review account balances after making transactions

- **Multi-account aggregation:** Display individual account balances and total balance
- **Real-time data:** Balances are always updated to the latest
- **Consistency:** Ensure balances match transaction history

```java
public void displayAllAccounts() {
    if (accounts.isEmpty()) {
        System.out.println("Khong co tai khoan nao!");
        return;
    }

    System.out.println("\nDANH SACH TAI KHOAN (" + accounts.size() + " tai khoan)");
    System.out.println("=========================================");
    for (Account account : accounts) {
        account.displayInfo();
        System.out.println();
    }

    // Display total balance
    double totalBalance = getTotalBalance();
    System.out.printf("TONG SO DU TAT CA TAI KHOAN: %.2f VND\n", totalBalance);
}
```

View current balance

Result



View transactions by category

Function: Review transactions made by category

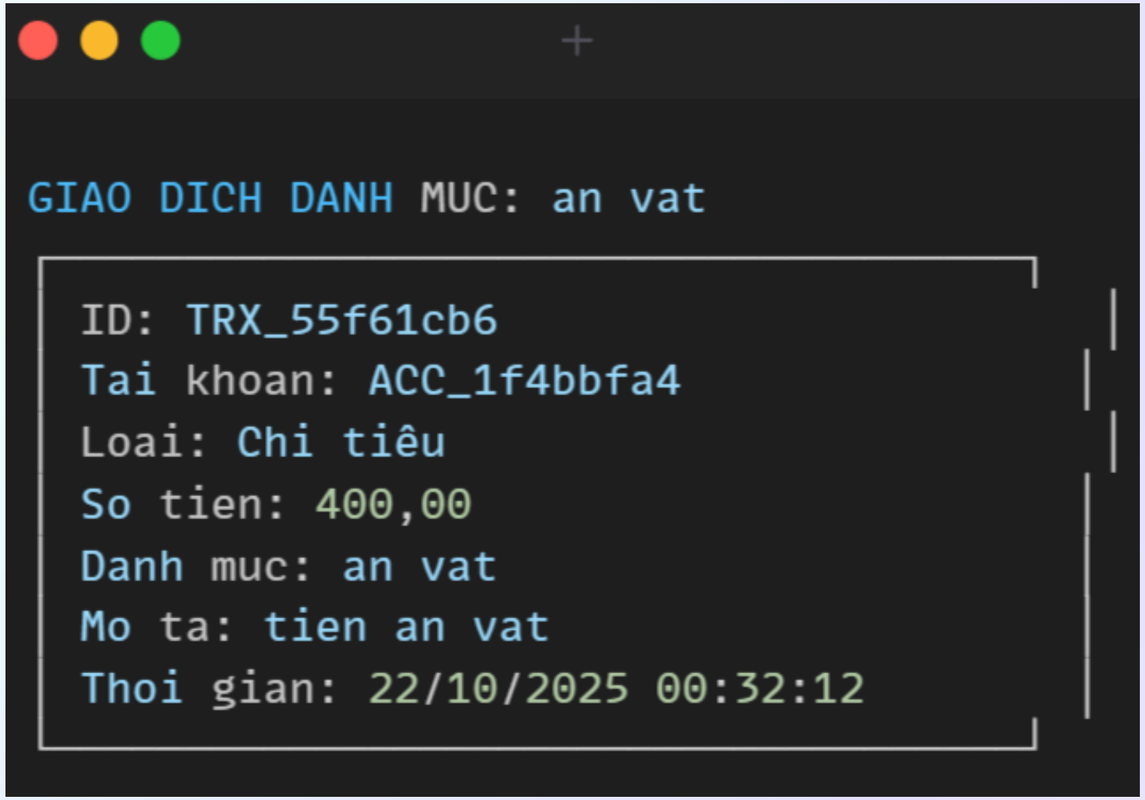
- **Powerful filtering:** Use Stream API to filter by category
- **Case-insensitive:** equalsIgnoreCase()
- **Handle no results:** Clearly notify when there are no transactions

```java
public List<Transaction> getTransactionsByCategory(String categoryName) {
    return transactions.stream()
            .filter(transaction → transaction.getCategory().getName().equalsIgnoreCase(categoryName))
            .collect(Collectors.toList());
}

public void displayTransactionsByAccount(String accountId) {
    List<Transaction> accountTransactions = transactions.stream()
            .filter(transaction → transaction.getAccountId().equals(accountId))
            .collect(Collectors.toList());

    if (accountTransactions.isEmpty()) {
        System.out.println("Khong co giao dich nao cho tai khoan nay!");
        return;
    }

    System.out.println("\nGIAO DICH TAI KHOAN " + accountId);
    System.out.println("=======================================");

    for (Transaction transaction : accountTransactions) {
        transaction.displayInfo();
        System.out.println();
    }
}
```

```java
// FinanceManager.java - Phương thức gọi từ menu chính
public void displayTransactionsByCategory(String category) {
    List<Transaction> transactions = transactionService.getTransactionsByCategory(category);
    if (transactions.isEmpty()) {
        System.out.println(" Khong co giao dich nao trong danh muc: " + category);
        return;
    }
    System.out.println("\n GIAO DICH DANH MUC: " + category);
    transactions.forEach(Transaction::displayInfo);
}
```

View transactions by category

Result

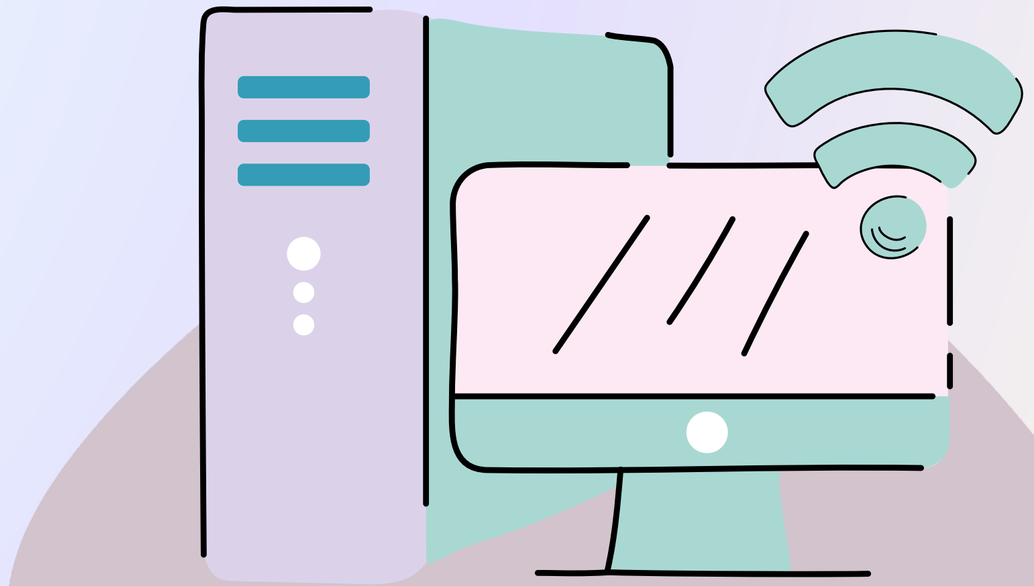


Loan and Lending Management

Description: Manages both borrowing (loans taken) and lending (loans given)

Detail:

- Create a new loan
- Create a new lending
- View loan list
- View lending list
- Repay loan
- Collect loan payment



Create a new loan

Function: Create a new loan with the following information: lender, amount, interest rate, number of months, description

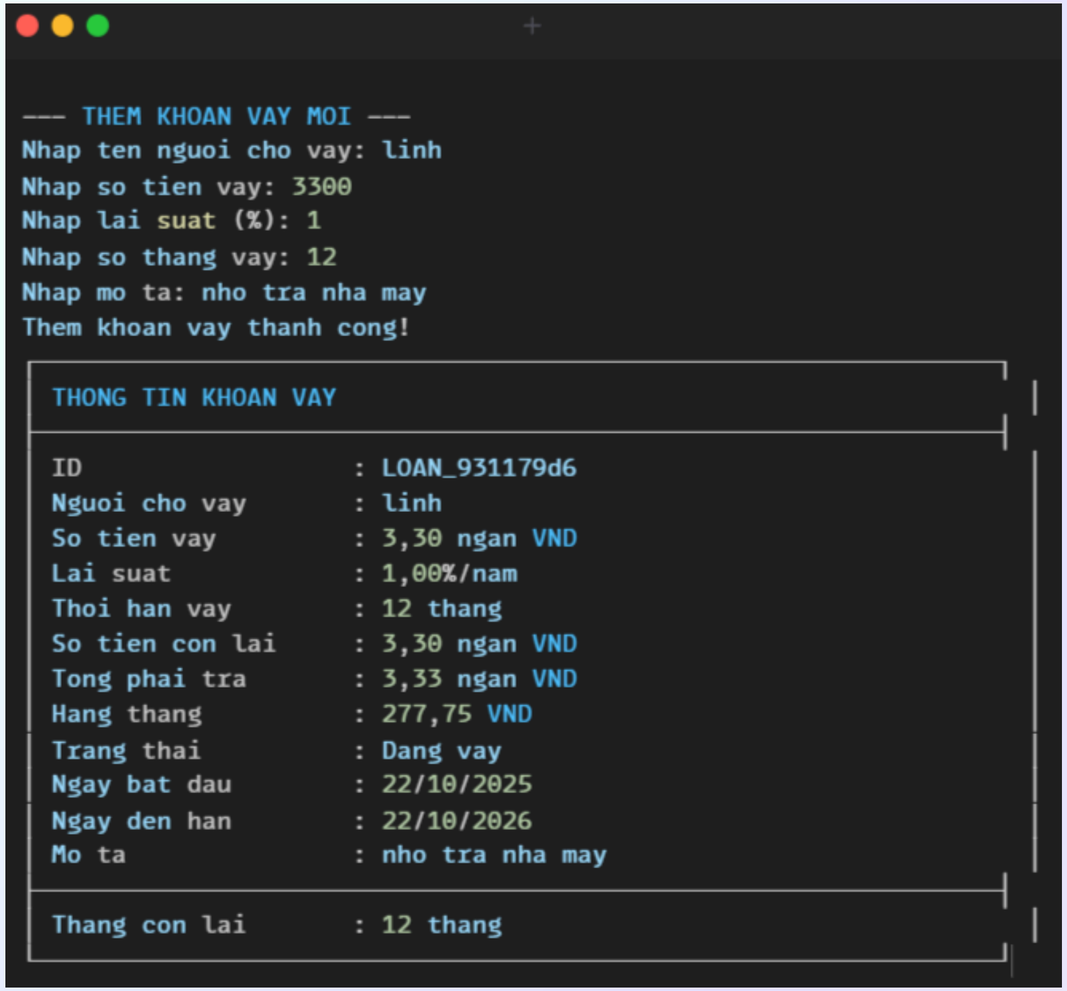
- **Validation:**
  - Amount, interest rate, number of months must be greater than 0.
  - Lender's name cannot be empty.
- **Processing:**
  - Automatically generate ID.
  - Calculate maturity date.
  - Initialize "ACTIVE" status.

```java
//LoanService.java
public void addLoan(String lender, double amount, double interest,
                    int months, String description) {
    try {
        Loan loan = new Loan(lender, amount, interest, months, description);
        if (loan.isValid()) {
            loans.add(loan);
            System.out.println("Them khoan vay thanh cong!");
            loan.displayInfo();
        }
    } catch (IllegalArgumentException e) {
        System.out.println("Loi: " + e.getMessage());
    }
}
```

```java
//Loan.java
public Loan(String lenderName, double principalAmount, double interestRate,
            int loanMonths, String description) {
    if (principalAmount <= 0) {
        throw new IllegalArgumentException("So tien vay phai lon hon 0");
    }
    if (interestRate < 0) {
        throw new IllegalArgumentException("Lai suat khong duoc am");
    }
    if (loanMonths <= 0) {
        throw new IllegalArgumentException("So thang vay phai lon hon 0");
    }
    this.loanId = "LOAN_" + java.util.UUID.randomUUID().toString().substring(0, 8);
    this.lenderName = lenderName;
    this.principalAmount = principalAmount;
    this.interestRate = interestRate;
    this.loanMonths = loanMonths;
    this.remainingAmount = principalAmount;
    this.description = description;
    this.status = "ACTIVE";
    this.startDate = LocalDateTime.now();
    this.dueDate = startDate.plusMonths(loanMonths);
    this.paymentHistory = new ArrayList<>();
}
```

Create a new loan

Result



Create a new lending

Function: Similar to a loan, but for lending to other

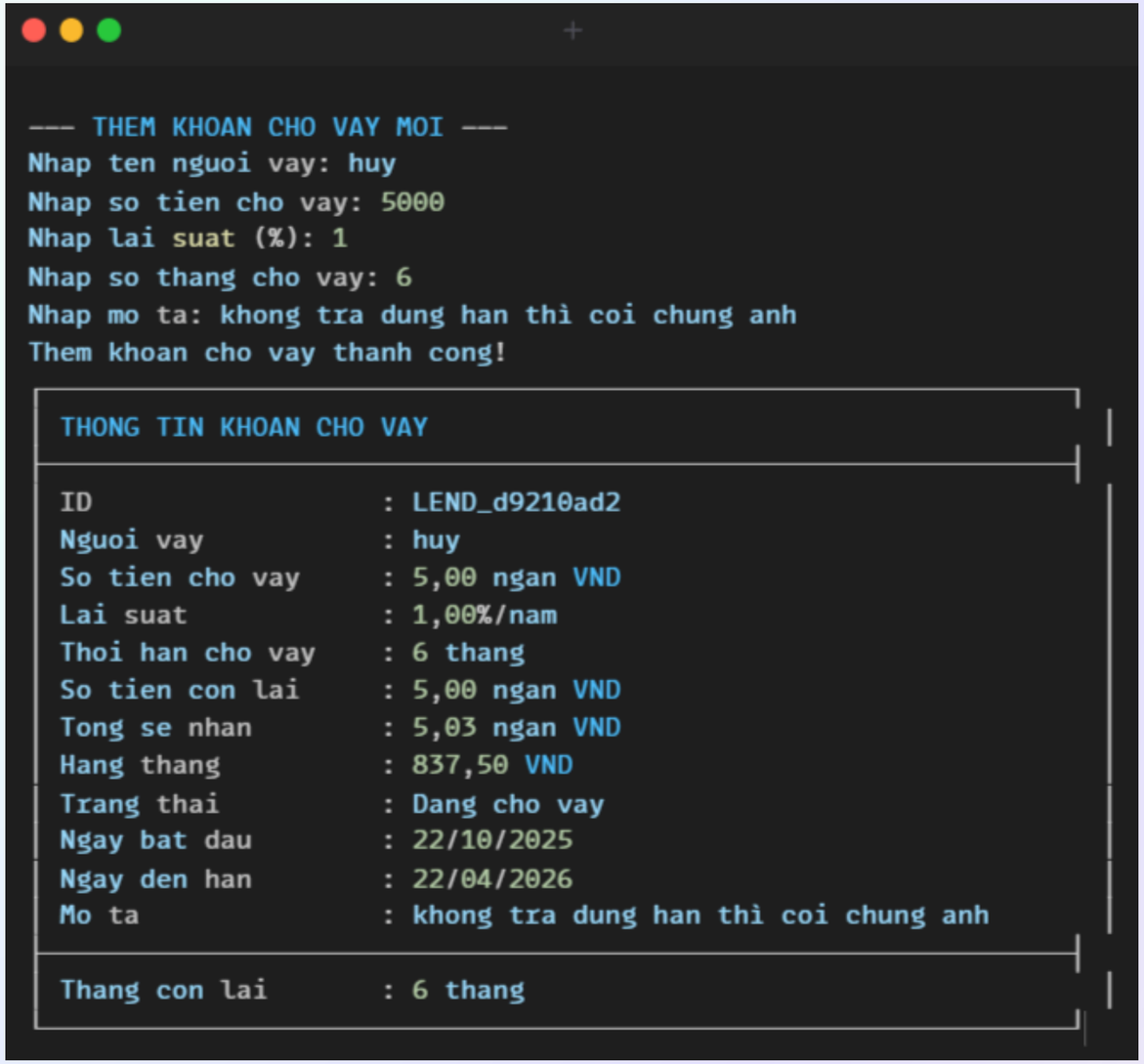
- **Automatic calculation:**
  - Total interest: principalAmount * (interestRate / 100) * (months / 12.0)
  - Total amount: Principal + Interest
  - Monthly payment: Total / months
- **Comprehensive validation:**
  - Amount > 0
  - Interest rate ≥ 0
  - Number of months > 0
  - Name cannot be empty
- **Automatic time setting:** Start date (current), due date (startDate + months)

```java
//LoanService.java
public void addLending(String borrower, double amount, double interest,
                       int months, String description) {
    try {
        Lending lending = new Lending(borrower, amount, interest, months, description);
        if (lending.isValid()) {
            lendings.add(lending);
            System.out.println("Them khoan cho vay thanh cong!");
            lending.displayInfo();
        }
    } catch (IllegalArgumentException e) {
        System.out.println("Loi: " + e.getMessage());
    }
}
```

```java
//Lending.java - Constructor
public Lending(String borrowerName, double principalAmount, double interestRate,
               int lendingMonths, String description) {
    if (principalAmount <= 0) throw new IllegalArgumentException("So tien cho vay phai lon hon 0");
    if (interestRate < 0) throw new IllegalArgumentException("Lai suat khong duoc am");
    if (lendingMonths <= 0) throw new IllegalArgumentException("So thang cho vay phai lon hon 0");
    if (borrowerName == null || borrowerName.trim().isEmpty()) {
        throw new IllegalArgumentException("Ten nguoi vay khong duoc de trong");
    }
    this.lendingId = "LEND_" + java.util.UUID.randomUUID().toString().substring(0, 8);
    this.borrowerName = borrowerName;
    this.principalAmount = principalAmount;
    this.interestRate = interestRate;
    this.lendingMonths = lendingMonths;
    this.remainingAmount = principalAmount;
    this.description = description;
    this.status = "ACTIVE";
    this.startDate = LocalDateTime.now();
    this.dueDate = startDate.plusMonths(lendingMonths);
    this.repaymentHistory = new ArrayList<>();
}
```

Create a new lending

Result



```
--- THEM KHOAN CHO VAY MOI ---
Nhap ten nguoi vay: huy
Nhap so tien cho vay: 5000
Nhap lai suat (%): 1
Nhap so thang cho vay: 6
Nhap mo ta: khong tra dung han thì coi chung anh
Them khoan cho vay thanh cong!

THONG TIN KHOAN CHO VAY

ID                  : LEND_d9210ad2
Nguoi vay           : huy
So tien cho vay     : 5,00 ngan VND
Lai suat            : 1,00%/nam
Thoi han cho vay    : 6 thang
So tien con lai     : 5,00 ngan VND
Tong se nhan        : 5,03 ngan VND
Hang thang          : 837,50 VND
Trang thai          : Dang cho vay
Ngay bat dau        : 22/10/2025
Ngay den han        : 22/04/2026
Mo ta               : khong tra dung han thì coi chung anh

Thang con lai       : 6 thang
```

View loan list

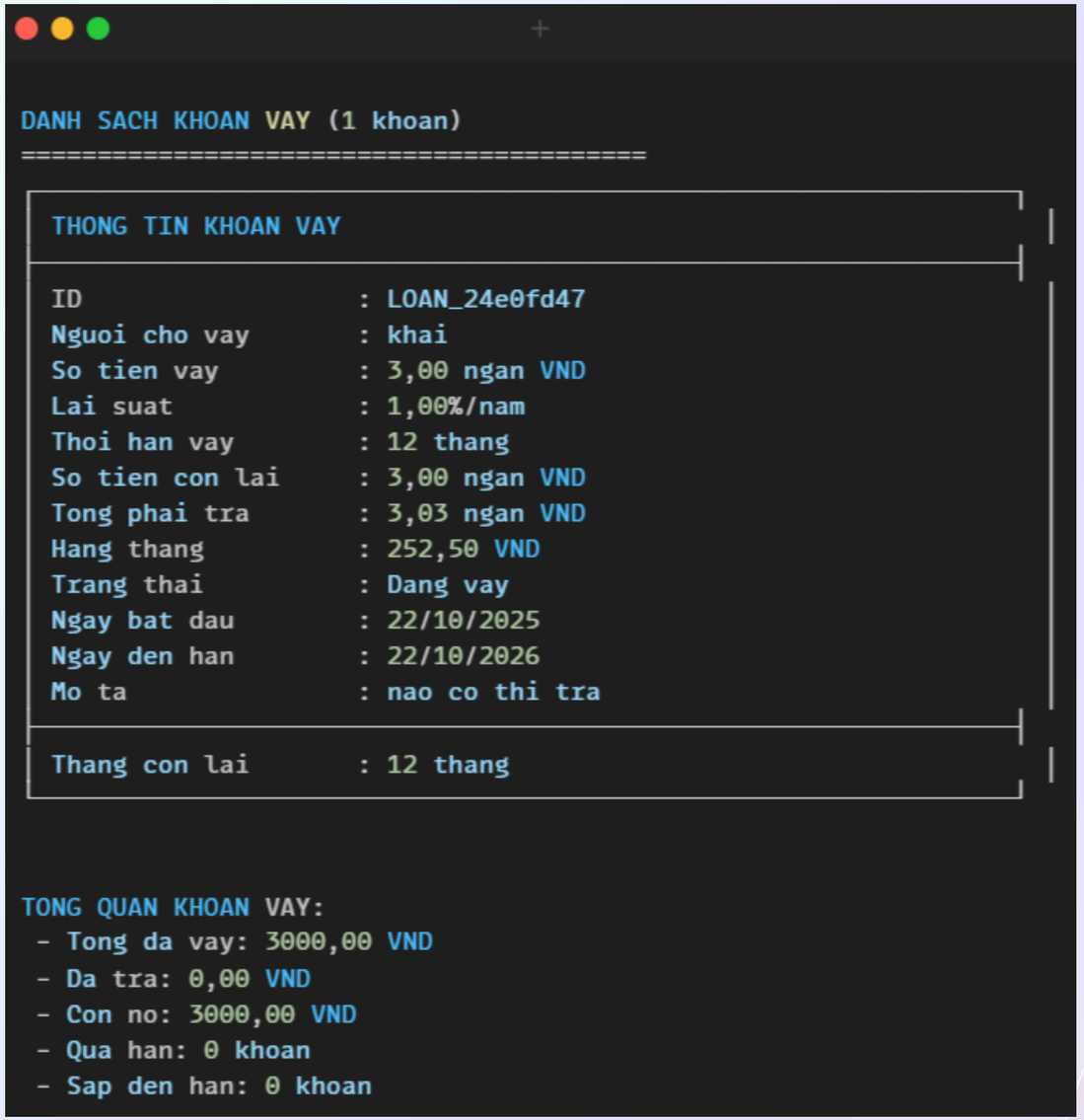
Function: Display all loans with detailed information and overview.

- **Detailed overview:** Display aggregated statistics as well
- **Visual warnings:** Colors and icons for statuses
- **Smart currency formatting:** Automatically convert to millions, billions when needed

```java
public void displayAllLoans() {
    if (loans.isEmpty()) {
        System.out.println("Khong co khoan vay nao!");
        return;
    }

    System.out.println("\nDANH SACH KHOAN VAY (" + loans.size() + " khoan)");
    System.out.println("========================================");

    for (Loan loan : loans) {
        loan.displayInfo();
        System.out.println();
    }

    // THÊM: Hiển thị tổng quan
    displayLoanSummary();
}

private void displayLoanSummary() {
    double totalBorrowed = loans.stream().mapToDouble(Loan::getPrincipalAmount).sum();
    double totalRemaining = loans.stream().mapToDouble(Loan::getRemainingAmount).sum();
    double totalPaid = totalBorrowed - totalRemaining;
    long overdueLoans = loans.stream().filter(Loan::isOverdue).count();
    long dueSoonLoans = loans.stream().filter(Loan::isDueSoon).count();

    System.out.println("\nTONG QUAN KHOAN VAY:");
    System.out.printf(" - Tong da vay: %.2f VND\n", totalBorrowed);
    System.out.printf(" - Da tra: %.2f VND\n", totalPaid);
    System.out.printf(" - Con no: %.2f VND\n", totalRemaining);
    System.out.printf(" - Qua han: %d khoan\n", overdueLoans);
    System.out.printf(" - Sap den han: %d khoan\n", dueSoonLoans);
}
```

View loan list

Result



```
DANH SACH KHOAN VAY (1 khoan)
========================================

┌──────────────────────────────────────────────────────────┐
│ THONG TIN KHOAN VAY                                      │
├──────────────────────────────────────────────────────────┤
│ ID                  : LOAN_24e0fd47                      │
│ Nguoi cho vay       : khai                               │
│ So tien vay         : 3,00 ngan VND                      │
│ Lai suat            : 1,00%/nam                          │
│ Thoi han vay        : 12 thang                           │
│ So tien con lai     : 3,00 ngan VND                      │
│ Tong phai tra       : 3,03 ngan VND                      │
│ Hang thang          : 252,50 VND                         │
│ Trang thai          : Dang vay                           │
│ Ngay bat dau        : 22/10/2025                         │
│ Ngay den han        : 22/10/2026                         │
│ Mo ta               : nao co thi tra                     │
├──────────────────────────────────────────────────────────┤
│ Thang con lai       : 12 thang                           │
└──────────────────────────────────────────────────────────┘


TONG QUAN KHOAN VAY:
 - Tong da vay: 3000,00 VND
 - Da tra: 0,00 VND
 - Con no: 3000,00 VND
 - Qua han: 0 khoan
 - Sap den han: 0 khoan
```

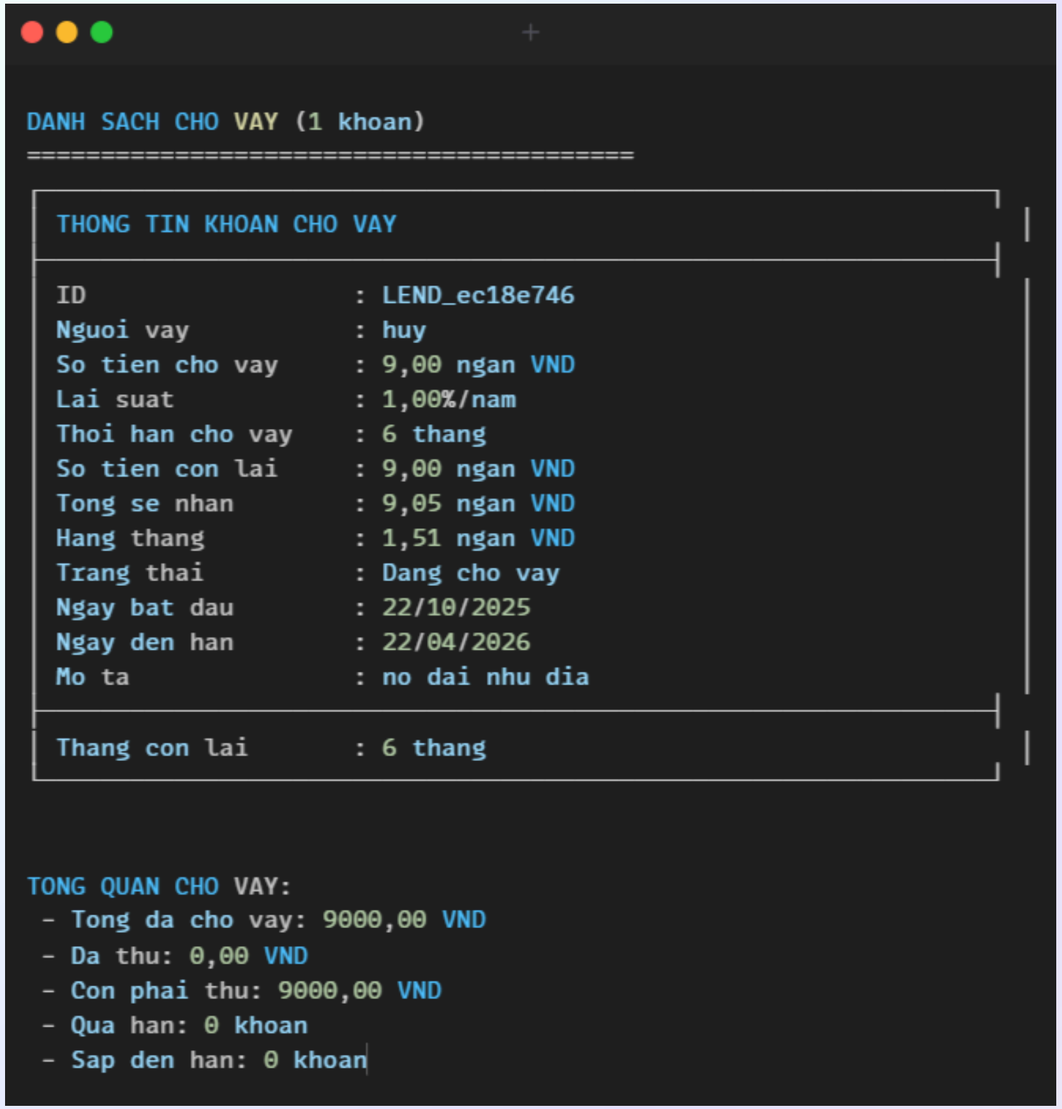
View lending list

Function: Similar to viewing the loan list.

```java
public void displayAllLendings() {
    if (lendings.isEmpty()) {
        System.out.println("Khong co khoan cho vay nao!");
        return;
    }

    System.out.println("\nDANH SACH CHO VAY (" + lendings.size() + " khoan)");
    System.out.println("========================================");

    for (Lending lending : lendings) {
        lending.displayInfo();
        System.out.println();
    }

    // THÊM: Hiển thị tổng quan
    displayLendingSummary();
}

private void displayLendingSummary() {
    double totalLent = lendings.stream().mapToDouble(Lending::getPrincipalAmount).sum();
    double totalRemaining = lendings.stream().mapToDouble(Lending::getRemainingAmount).sum();
    double totalCollected = totalLent - totalRemaining;
    long overdueLendings = lendings.stream().filter(Lending::isOverdue).count();
    long dueSoonLendings = lendings.stream().filter(Lending::isDueSoon).count();

    System.out.println("\nTONG QUAN CHO VAY:");
    System.out.printf(" - Tong da cho vay: %.2f VND\n", totalLent);
    System.out.printf(" - Da thu: %.2f VND\n", totalCollected);
    System.out.printf(" - Con phai thu: %.2f VND\n", totalRemaining);
    System.out.printf(" - Qua han: %d khoan\n", overdueLendings);
    System.out.printf(" - Sap den han: %d khoan\n", dueSoonLendings);
}
```

View lending list

Result



Repay loan

Function: Make partial or full loan payments.

- **Payment validation:**
  - Amount > 0
  - Does not exceed the remaining amount
  - Does not pay off an already paid-off amount
- **Real-time update:** Remaining amount and status are updated immediately
- **Payment history:** Records all payment transactions

```java
//LoanService.java
public boolean repayLoan(String loanId, double amount) {
    Optional<Loan> loanOpt = findLoanById(loanId);
    if (loanOpt.isPresent()) {
        Loan loan = loanOpt.get();

        if (amount <= 0) {
            System.out.println("So tien tra no phai lon hon 0!");
            return false;
        }

        if (amount > loan.getRemainingAmount()) {
            System.out.println("So tien tra no vuot qua so tien con lai!");
            return false;
        }

        if (loan.getStatus().equals("PAID")) {
            System.out.println("Khoan vay da duoc tra het!");
            return false;
        }

        loan.addPayment(amount);
        System.out.printf("Tra no thanh cong! So tien con lai: %.2f VND\n", loan.getRemainingAmount());
        return true;
    } else {
        System.out.println("Khong tim thay khoan vay!");
        return false;
    }
}
```

```java
//Loan.java - Xử lý thanh toán
public void addPayment(double amount) {
    if (amount <= 0) {
        throw new IllegalArgumentException("So tien thanh toan phai lon hon 0");
    }
    if (amount > remainingAmount) {
        throw new IllegalArgumentException(
                String.format("So tien thanh toan (%.2f) vuot qua so tien con no (%.2f)",
                        amount, remainingAmount));
    }

    remainingAmount -= amount;
    Payment payment = new Payment(amount);
    paymentHistory.add(payment);
    updateStatus();

    System.out.printf("Da thanh toan: %.2f VND. Con no: %.2f VND\n", amount, remainingAmount);
}
```

Repay loan

Result

Collect loan payment

Function: Similar to repayment, but it's collecting debt from the borrower.

- **Validation:**
  - The amount must be greater than 0 and not exceed the outstanding debt.
  - The loan must not have been fully repaid.

- **Processing:**
  - Deduct the payment amount from the outstanding debt.
  - Add to payment history.
  - Update status (if fully repaid, change to "PAID").

```java
//LoanService.java
public boolean collectLending(String lendingId, double amount) {
    Optional<Lending> lendingOpt = findLendingById(lendingId);
    if (lendingOpt.isPresent()) {
        Lending lending = lendingOpt.get();

        if (amount <= 0) {
            System.out.println("So tien thu no phai lon hon 0!");
            return false;
        }

        if (amount > lending.getRemainingAmount()) {
            System.out.println("So tien thu no vuot qua so tien con lai!");
            return false;
        }

        if (lending.getStatus().equals("PAID")) {
            System.out.println("Khoan cho vay da duoc thu het!");
            return false;
        }

        lending.addRepayment(amount);
        System.out.printf("Thu no thanh cong! So tien con lai: %.2f VND\n", lending.getRemainingAmount());
        return true;
    } else {
        System.out.println("Khong tim thay khoan cho vay!");
        return false;
    }
}
```

```java
//Lending.java - Xử lý thu nợ
public void addRepayment(double amount) {
    if (amount <= 0) throw new IllegalArgumentException("So tien tra phai lon hon 0");
    if (amount > remainingAmount) {
        throw new IllegalArgumentException(
                String.format("So tien tra (%.2f) vuot qua so tien con no (%.2f)", amount, remainingAmount));
    }

    remainingAmount -= amount;
    Payment payment = new Payment(amount);
    repaymentHistory.add(payment);
    updateStatus();

    System.out.printf("Da nhan tra no: %.2f VND. Con no: %.2f VND\n", amount, remainingAmount);
}
```

Collect loan payment

Result:

Reporting System

Description: Provides detailed and summary financial reports.

Detail:

- Account report
- Financial overview report
- Income and expenditure report
- Loan and lending report
- Monthly report
- Export CSV data

Account report

Function: Generate detailed reports for an account, including overview, categorization by category, recent transactions

- **Multi-dimensional analysis:**
  - Overview: Balance, income, expenses, net cash flow
  - Categorization by category
  - Top 5 largest transactions
- **Visualization:** Use icons and table format

```java
public void generateAccountReport(String accountId) {
    Optional<Account> accountOpt = accountService.findAccountById(accountId);
    if (accountOpt.isEmpty()) {
        System.out.println("Khong tim thay tai khoan!");
        return;
    }

    Account account = accountOpt.get();
    List<Transaction> accountTransactions = transactionService.getAllTransactions().
            .filter(tx -> tx.getAccountId().equals(accountId))
            .collect(Collectors.toList());

    System.out.println("\nBAO CAO TAI KHOAN: " + account.getAccountName());
    System.out.println("========================================");

    account.displayInfo();

    double accountIncome = accountTransactions.stream()
            .filter(tx -> tx.getType() == TransactionType.INCOME)
            .mapToDouble(Transaction::getAmount)
            .sum();

    double accountExpense = accountTransactions.stream()
            .filter(tx -> tx.getType() == TransactionType.EXPENSE)
            .mapToDouble(Transaction::getAmount)
            .sum();

    System.out.printf("\nTONG THU: %,.2f VND\n", accountIncome);
    System.out.printf("TONG CHI: %,.2f VND\n", accountExpense);
    System.out.printf("SO GIAO DICH: %d\n", accountTransactions.size());

    // Top 5 giao dịch lớn nhất
    System.out.println("\nTOP 5 GIAO DICH LON NHAT:");
    accountTransactions.stream()
            .sorted((t1, t2) -> Double.compare(t2.getAmount(), t1.getAmount()))
            .limit(5)
            .forEach(tx -> {
                String symbol = tx.getType() == TransactionType.INCOME ? "↑" : "↓";
                System.out.printf("  %s %-12s: %,.2f VND - %s\n",
                        symbol, tx.getCategory().getName(),
                        tx.getAmount(), tx.getDescription());
            });
}
```

View lending list

Result:

```
================================================================================
TAI KHOAN ID: ACC_60f7071b - nhat
================================================================================
============================================================
| BAO CAO TAI KHOAN: nhat                                  |
------------------------------------------------------------
| TONG QUAN TAI KHOAN                                      |
| +----------------------------------------------------+   |
| | So du hien tai: 48.300,00 VND                      |   |
| | Tong thu nhap:  300,00 VND                         |   |
| | Tong chi tieu:  4.000,00 VND                       |   |
| | Luong tien rong: -3.700,00 VND                     |   |
| +----------------------------------------------------+   |
------------------------------------------------------------
|  PHAN LOAI THEO DANH MUC                                 |
| THU NHAP:                                                |
|   - Luong          : 300,00 VND                          |
| CHI TIEU:                                                |
|   - xay dung co ngoi : 4.000,00 VND                      |
------------------------------------------------------------
| GIAO DICH GAN DAY (5 giao dich moi nhat)                 |
| [-] 22/10/2025 xay dung co ngoi : 4.000,00 mua nha       |
| [+] 22/10/2025 Luong          : 300,00 thu nhap hang thang   |
============================================================
================================================================================
KET THUC BAO CAO TAI KHOAN: ACC_60f7071b
================================================================================


================================================================================
TAI KHOAN ID: ACC_00ed0ebe - khai
================================================================================
Khong co giao dich nao cho tai khoan nay!
================================================================================
```

Financial overview report

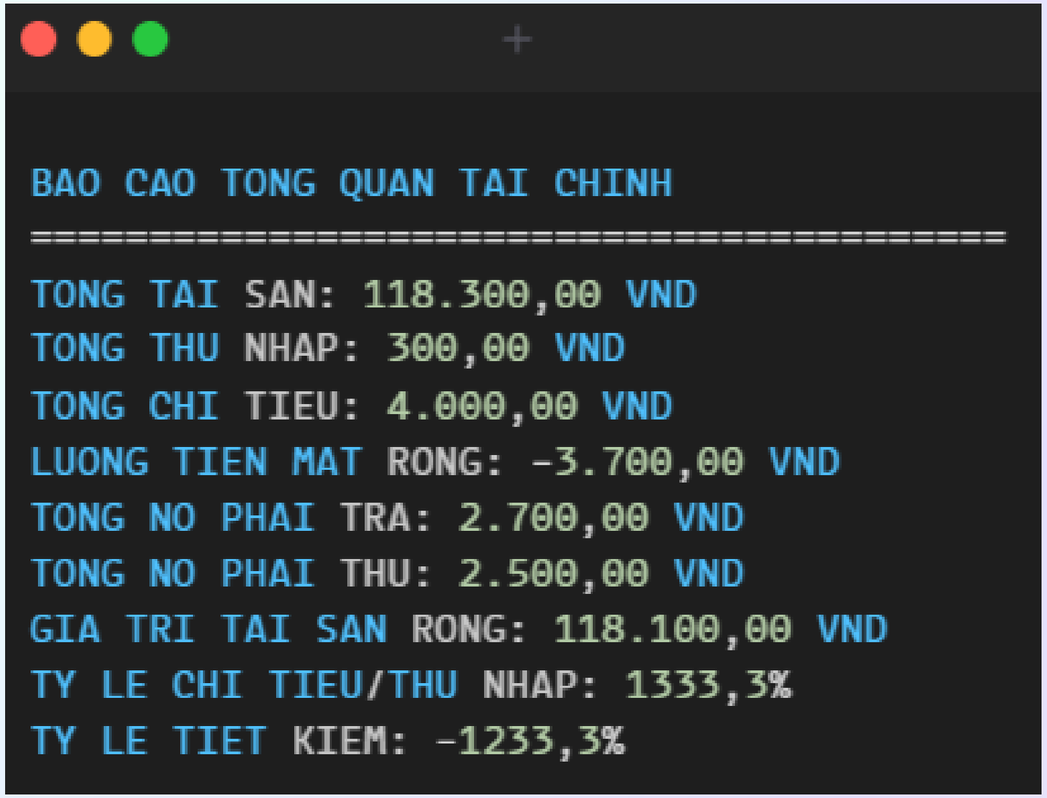
Function: Summarizes total assets, income, expenses, and cash flow

- **Key financial indicators:**
  - Total assets
  - Net cash flow (Income - Expenses)
  - Net worth (Assets + Receivables - Payables)
  - Spending/income ratio
  - Savings rate

```java
public void generateFinancialOverview() {
    System.out.println("\nBAO CAO TONG QUAN TAI CHINH");
    System.out.println("========================================");

    double totalBalance = accountService.getTotalBalance();
    double totalIncome = transactionService.getTotalIncome();
    double totalExpense = transactionService.getTotalExpense();
    double netCashFlow = totalIncome - totalExpense;
    double totalLoans = loanService.getTotalLoanAmount();
    double totalLendings = loanService.getTotalLendingAmount();
    double netWorth = totalBalance + totalLendings - totalLoans;

    System.out.printf("TONG TAI SAN: %,.2f VND\n", totalBalance);
    System.out.printf("TONG THU NHAP: %,.2f VND\n", totalIncome);
    System.out.printf("TONG CHI TIEU: %,.2f VND\n", totalExpense);
    System.out.printf("LUONG TIEN MAT RONG: %,.2f VND\n", netCashFlow);
    System.out.printf("TONG NO PHAI TRA: %,.2f VND\n", totalLoans);
    System.out.printf("TONG NO PHAI THU: %,.2f VND\n", totalLendings);
    System.out.printf("GIA TRI TAI SAN RONG: %,.2f VND\n", netWorth);

    // Phân tích tỷ lệ
    if (totalIncome > 0) {
        double expenseRatio = (totalExpense / totalIncome) * 100.0;
        double savingsRatio = 100.0 - expenseRatio;
        System.out.printf("TY LE CHI TIEU/THU NHAP: %.1f%%%n", expenseRatio);
        System.out.printf("TY LE TIET KIEM: %.1f%%%n", savingsRatio);
    } else {
        System.out.println("TY LE CHI TIEU/THU NHAP: N/A (khong co du lieu thu nhap)");
        System.out.println("TY LE TIET KIEM: N/A (khong co du lieu thu nhap)");
    }
}
```

Financial overview report

Result:



Income and expenditure report

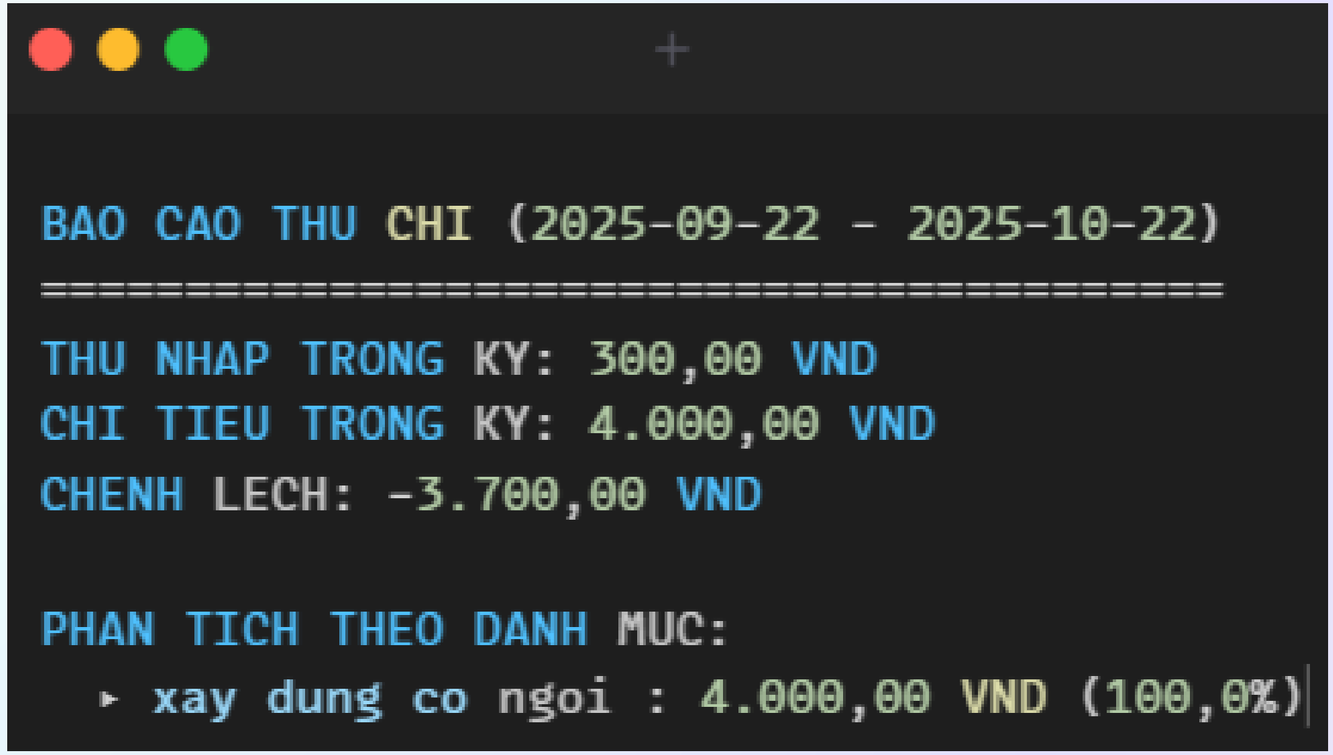
Function: Consolidates all loan-related entries.

- **Track over time:** Can select specific time periods
- **Category analysis:** Shows % of spending for each category
- **Income-expense comparison:** Clearly shows the difference

```java
// Báo cáo thu nhập và chi tiêu theo khoảng thời gian
public void generateIncomeExpenseReport(LocalDate startDate, LocalDate endDate) {
    System.out.println("\nBAO CAO THU CHI (" + startDate + " - " + endDate + ")");
    System.out.println("========================================");

    List<Transaction> transactions = transactionService.getAllTransactions().stream()
            .filter(tx -> !tx.getDate().toLocalDate().isBefore(startDate) &&
                    !tx.getDate().toLocalDate().isAfter(endDate))
            .collect(Collectors.toList());

    double periodIncome = transactions.stream()
            .filter(tx -> tx.getType() == TransactionType.INCOME)
            .mapToDouble(Transaction::getAmount)
            .sum();

    double periodExpense = transactions.stream()
            .filter(tx -> tx.getType() == TransactionType.EXPENSE)
            .mapToDouble(Transaction::getAmount)
            .sum();

    System.out.printf("THU NHAP TRONG KY: %,.2f VND\n", periodIncome);
    System.out.printf("CHI TIEU TRONG KY: %,.2f VND\n", periodExpense);
    System.out.printf("CHENH LECH: %,.2f VND\n", periodIncome - periodExpense);

    // Phân tích theo danh mục
    System.out.println("\nPHAN TICH THEO DANH MUC:");
    Map<String, Double> expenseByCategory = transactions.stream()
            .filter(tx -> tx.getType() == TransactionType.EXPENSE)
            .collect(Collectors.groupingBy(
                    tx -> tx.getCategory().getName(),
                    Collectors.summingDouble(Transaction::getAmount)
            ));

    expenseByCategory.entrySet().stream()
            .sorted(Map.Entry.<String, Double>comparingByValue().reversed())
            .forEach(entry -> {
                double percentage = (entry.getValue() / periodExpense) * 100;
                System.out.printf("  • %-15s: %,.2f VND (%.1f%%)\n",
                        entry.getKey(), entry.getValue(), percentage);
            });
}
```

Income and expenditure report

Result



Loan and lending report

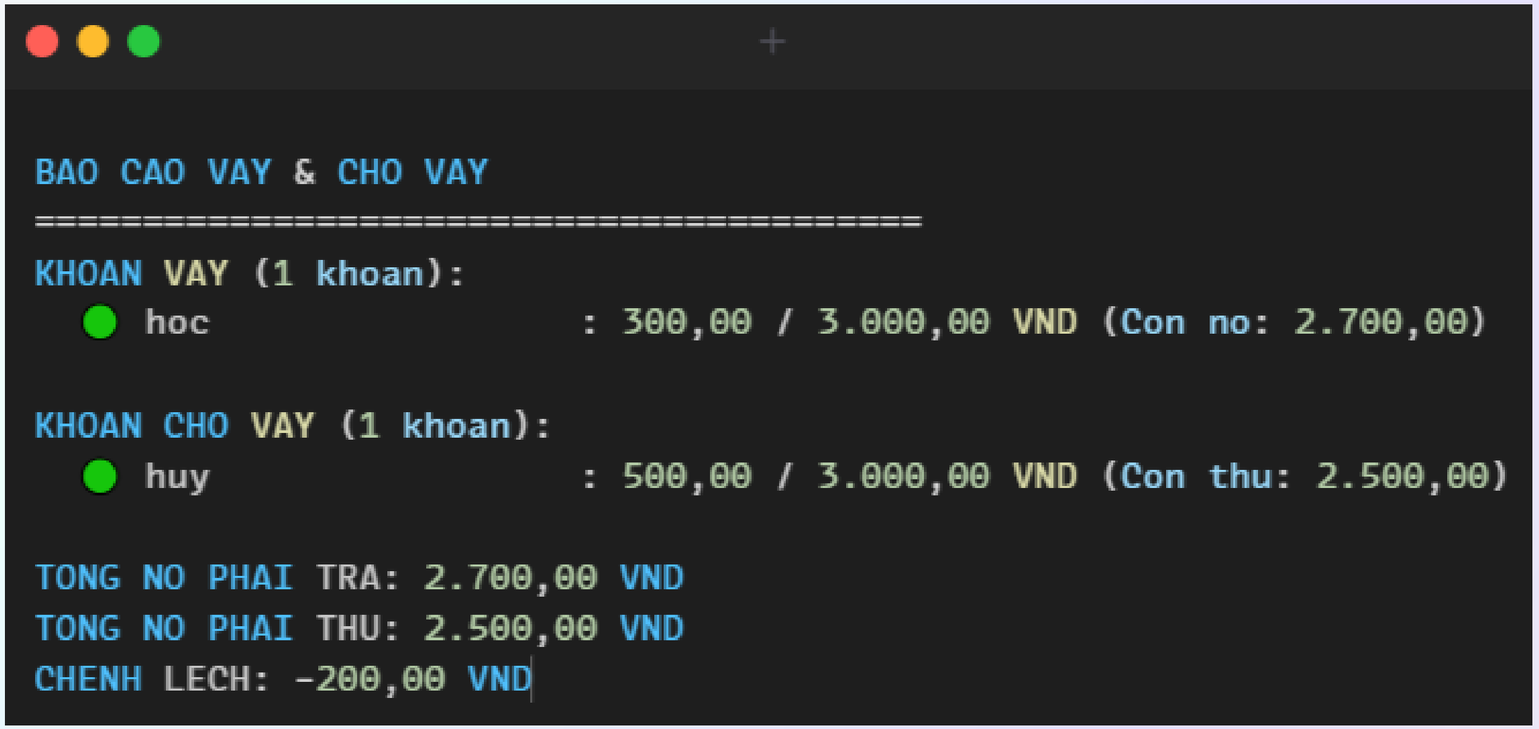
Function: Display an overview of loans and borrowings, including status and remaining amounts

- **Visual status:** Red/green icon for overdue/active
- **Payment progress:** Display amount paid/total amount
- **Risk summary:** Count of overdue accounts

```java
// Báo cáo khoản vay và cho vay
public void generateLoanReport() {
    System.out.println("\nBAO CAO VAY & CHO VAY");
    System.out.println("=====================================");

    // Khoản vay
    List<Loan> loans = loanService.getAllLoans();
    System.out.println("KHOAN VAY (" + loans.size() + " khoan):");
    loans.forEach(loan → {
        String statusIcon = loan.isOverdue() ? "🔴" : "🟢";
        System.out.printf("  %s %-20s: %,.2f / %,.2f VND (Con no: %,.2f)\n",
                statusIcon, loan.getLenderName(),
                loan.getPrincipalAmount() - loan.getRemainingAmount(),
                loan.getPrincipalAmount(), loan.getRemainingAmount());
    });

    // Khoản cho vay
    List<Lending> lendings = loanService.getAllLendings();
    System.out.println("\nKHOAN CHO VAY (" + lendings.size() + " khoan):");
    lendings.forEach(lending → {
        String statusIcon = lending.isOverdue() ? "🔴" : "🟢";
        System.out.printf("  %s %-20s: %,.2f / %,.2f VND (Con thu: %,.2f)\n",
                statusIcon, lending.getBorrowerName(),
                lending.getPrincipalAmount() - lending.getRemainingAmount(),
                lending.getPrincipalAmount(), lending.getRemainingAmount());
    });

    // Tổng hợp
    double totalDebt = loanService.getTotalLoanAmount();
    double totalReceivable = loanService.getTotalLendingAmount();
    System.out.printf("\nTONG NO PHAI TRA: %,.2f VND\n", totalDebt);
    System.out.printf("TONG NO PHAI THU: %,.2f VND\n", totalReceivable);
    System.out.printf("CHENH LECH: %,.2f VND\n", totalReceivable - totalDebt);
}
```

Loan and lending report

Result



```
BAO CAO VAY & CHO VAY
=====================================
KHOAN VAY (1 khoan):
  🟢 hoc                  : 300,00 / 3.000,00 VND (Con no: 2.700,00)

KHOAN CHO VAY (1 khoan):
  🟢 huy                  : 500,00 / 3.000,00 VND (Con thu: 2.500,00)

TONG NO PHAI TRA: 2.700,00 VND
TONG NO PHAI THU: 2.500,00 VND
CHENH LECH: -200,00 VND
```

Monthly report

Function: Report income and expenses and daily balance fluctuations within the month.

- **Daily fluctuations:** Track balances day by day
- **Focus on the month:** Automatically calculate the first/last day of the month

```java
// Báo cáo hàng tháng
public void generateMonthlyReport(int year, int month) {
    LocalDate startDate = LocalDate.of(year, month, 1);
    LocalDate endDate = startDate.withDayOfMonth(startDate.lengthOfMonth());

    System.out.println("\nBAO CAO THANG " + month + "/" + year);
    System.out.println("========================================");

    generateIncomeExpenseReport(startDate, endDate);

    // Thống kê hàng ngày
    System.out.println("\nBIEN DONG HANG NGAY:");
    Map<LocalDate, Double> dailyBalance = new TreeMap<>();

    // Tính toán số dư hàng ngày (đơn giản)
    double runningBalance = accountService.getTotalBalance();
    for (int day = startDate.lengthOfMonth(); day >= 1; day--) {
        LocalDate currentDate = LocalDate.of(year, month, day);
        dailyBalance.put(currentDate, runningBalance);
        // Giả lập biến động (trong thực tế cần tính toán chính xác)
        runningBalance -= 100000; // Giả định mỗi ngày giảm 100k
    }

    dailyBalance.entrySet().stream()
            .limit(10) // Hiển thị 10 ngày đầu
            .forEach(entry -> {
                System.out.printf("  %s: %,.2f VND\n", entry.getKey(), entry.getValue());
            });
}
```

Monthly report

Result

```
BAO CAO THANG 10/2025
========================================

BAO CAO THU CHI (2025-10-01 - 2025-10-31)
========================================
THU NHAP TRONG KY: 300,00 VND
CHI TIEU TRONG KY: 4.000,00 VND
CHENH LECH: -3.700,00 VND

PHAN TICH THEO DANH MUC:
  ▸ xay dung co ngoi : 4.000,00 VND (100,0%)

BIEN DONG HANG NGAY:
  2025-10-01: -2.881.700,00 VND
  2025-10-02: -2.781.700,00 VND
  2025-10-03: -2.681.700,00 VND
  2025-10-04: -2.581.700,00 VND
  2025-10-05: -2.481.700,00 VND
  2025-10-06: -2.381.700,00 VND
  2025-10-07: -2.281.700,00 VND
  2025-10-08: -2.181.700,00 VND
  2025-10-09: -2.081.700,00 VND
  2025-10-10: -1.981.700,00 VND
```

Export CSV data

Function: Export account and transaction data to CSV format.

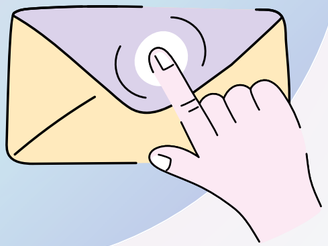
- **Standard format:** CSV easily importable into Excel/Google Sheets
- **Complete data:** Both account and transactions
- **Clear structure:** Header + consistent data forma

```java
// Xuất dữ liệu đơn giản (có thể mở rộng để xuất file)
public void exportToCSV() {
    System.out.println("\nXUAT DU LIEU (CSV Format):");
    System.out.println("====================================");

    // Xuất danh sách tài khoản
    System.out.println("TAI_KHOAN_ID,TEN,LOAI,SO_DU");
    accountService.getAllAccounts().forEach(acc -> {
        System.out.printf("%s,%s,%s,%.2f\n",
                acc.getAccountId(), acc.getAccountName(),
                acc.getAccountType(), acc.getBalance());
    });

    // Xuất danh sách giao dịch
    System.out.println("\nGIAO_DICH_ID,TAI_KHOAN,LOAI,SOTIEN,DANHMUC,NGAY");
    transactionService.getAllTransactions().forEach(tx -> {
        System.out.printf("%s,%s,%s,%.2f,%s,%s\n",
                tx.getTransactionId(), tx.getAccountId(),
                tx.getType().name(), tx.getAmount(),
                tx.getCategory().getName(), tx.getFormattedDate());
    });
}
```

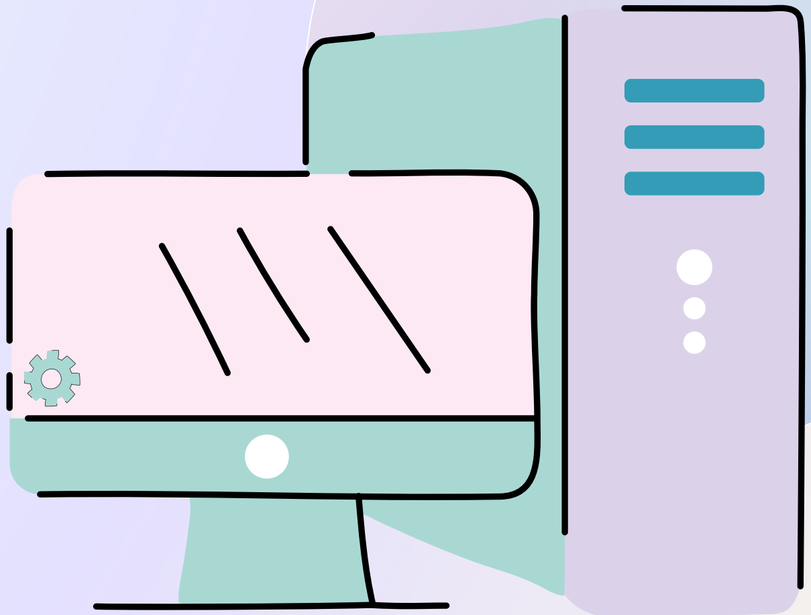
Export CSV data

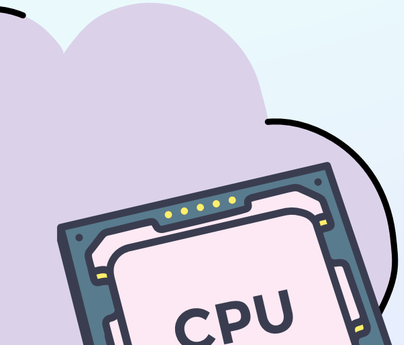
Result

```
XUAT DU LIEU (CSV Format):
========================================
TAI_KHOAN_ID,TEN,LOAI,SO_DU
ACC_60f7071b,nhat,BANK,48300,00
ACC_00ed0ebe,khai ,SAVINGS,70000,00

GIAO_DICH_ID,TAI_KHOAN,LOAI,SOTIEN,DANHMUC,NGAY
TRX_3b305507,ACC_60f7071b,INCOME,300,00,Luong,22/10/2025 14:53:42
TRX_954bf5fe,ACC_60f7071b,EXPENSE,4000,00,xay dung co ngoi ,22/10/2025 14:54:39
```



4. Summary

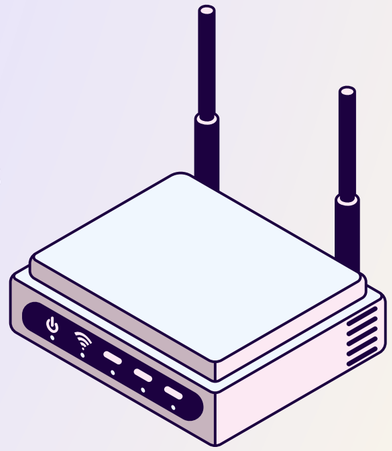




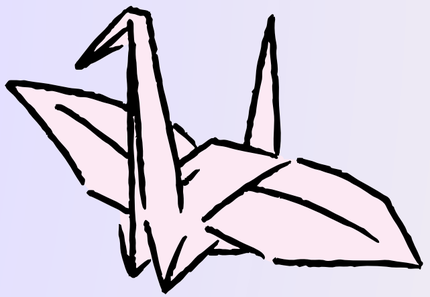
4.1. Self-Assessment

Strengths:

- Clear architecture: MVC-based package structure, easy to maintain and extend
- Feature completeness: Covers most core personal finance features
- Robust error handling: Custom exception mechanisms
- User-friendly interface: Aesthetic console layout using Unicode characters
- Strong validation: Comprehensive input verification
- Vietnamese support: Full Vietnamese UI and notifications
- Accurate calculations: Reliable financial and interest computations

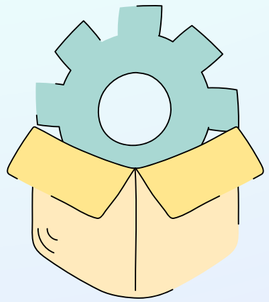


4.1. Self-Assessment



Limitations:

- Data persistence: No file/database storage yet
- Interface: Console-only, no GUI support
- Security: No encryption for sensitive data
- Performance: Not optimized for large data volumes
- Missing advanced features: Budgeting, financial goals, automated alerts



4.2. Future Developmen

Short Term

1. Data Storage:

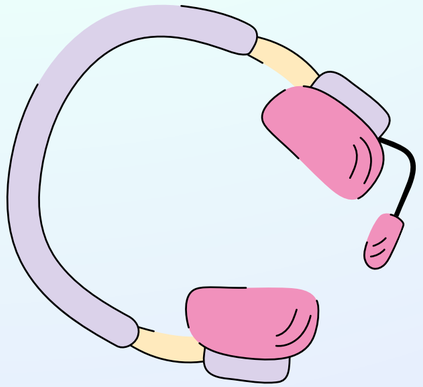
- Database integration: MySQL/PostgreSQL for persistent storage
- File storage: Support for JSON/XML or embedded DB (SQLite)

2 Interface Improvements:

- Desktop GUI: JavaFX/Swing for improved UX
- Web application: Spring Boot + React/Angular

3 New Features:

- Budget management
- Payment reminders
- Trend analysis & visualization
- Multi-currency support
- Bank statement import (CSV/OFX)



4.2. Future Developmen

medium term

1. Enhanced Security:

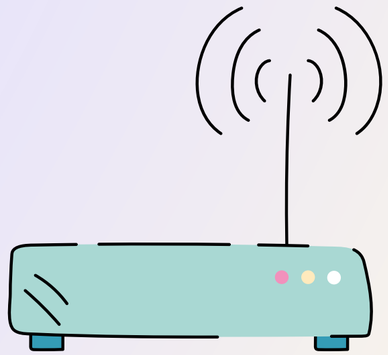
- User authentication & access control
- Data encryption

2. Analytics:

- Spending trend charts
- Financial forecasting
- Behavior analysis

3. Cross-platform:

- Web-based version (Spring Boot)
- Mobile app (Android)



4.2. Future Developmen

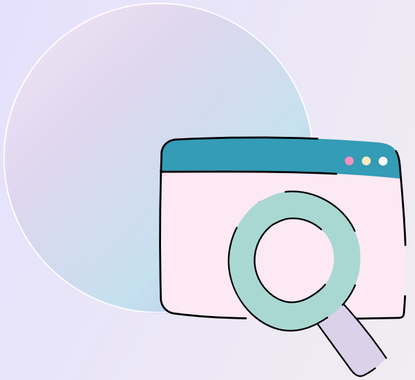
Long Term

1. Smart Features:

- AI-based transaction categorization
- Financial optimization suggestions
- Smart alerts

2. External Integration:

- Public API for third-party systems
- Plugin ecosystem
- Bank statement import automation



3. Community Features:

- Expense benchmarking against average users
- Knowledge sharing and saving tips

Thank You