FinBro Developer Guide

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Introduction

FinBro is a personal finance management application that operates through a Command Line Interface (CLI). This developer guide provides comprehensive information about the architecture, implementation, and design decisions behind FinBro to help developers understand the codebase and contribute effectively.

Setting Up the Development Environment

Prerequisites

- JDK 17
- Gradle 7.6.2 or higher
- IntelliJ IDEA (recommended)

Getting Started

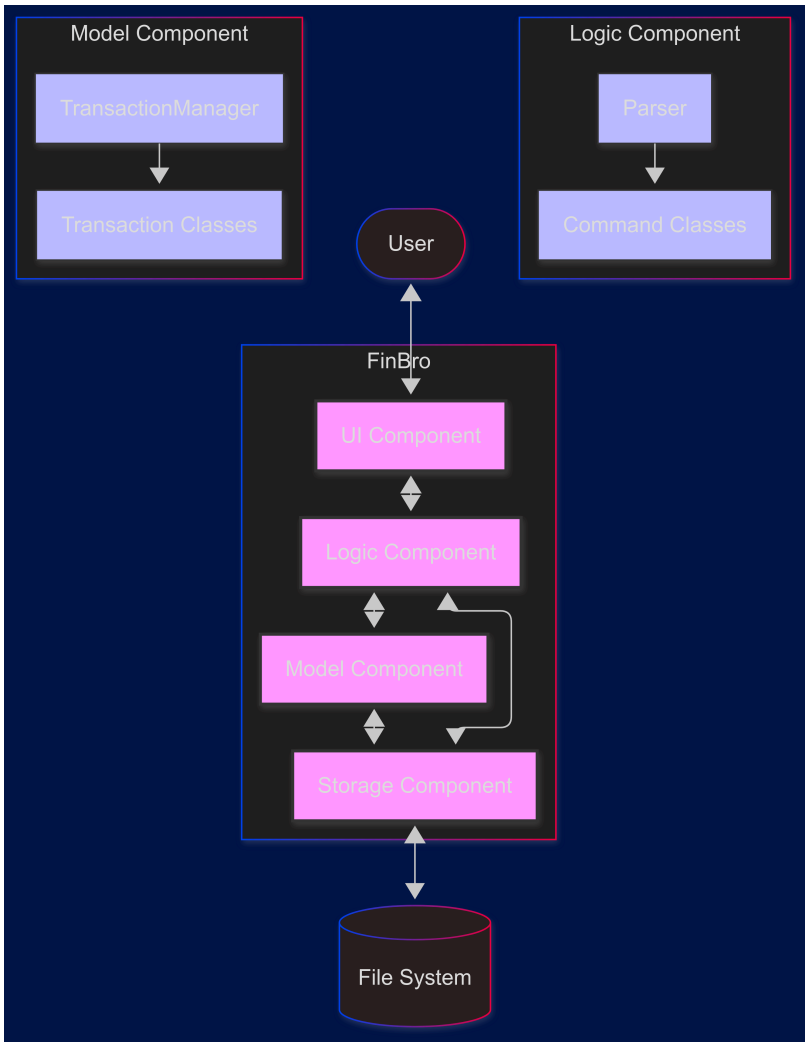
1. Clone the repository:

   ```
   git clone https://github.com/AY2425S2-CS2113-W13-3/tp.git
   ```

2. Import the project as a Gradle project in IntelliJ IDEA:
   - Open IntelliJ IDEA
   - Select "Import Project"
   - Navigate to the project directory and select the `build.gradle` file
   - Follow the prompts to complete the import
3. Verify the setup:
   - Run the tests: ▶ `./gradlew test`
   - Run the application: ▶ `./gradlew run`

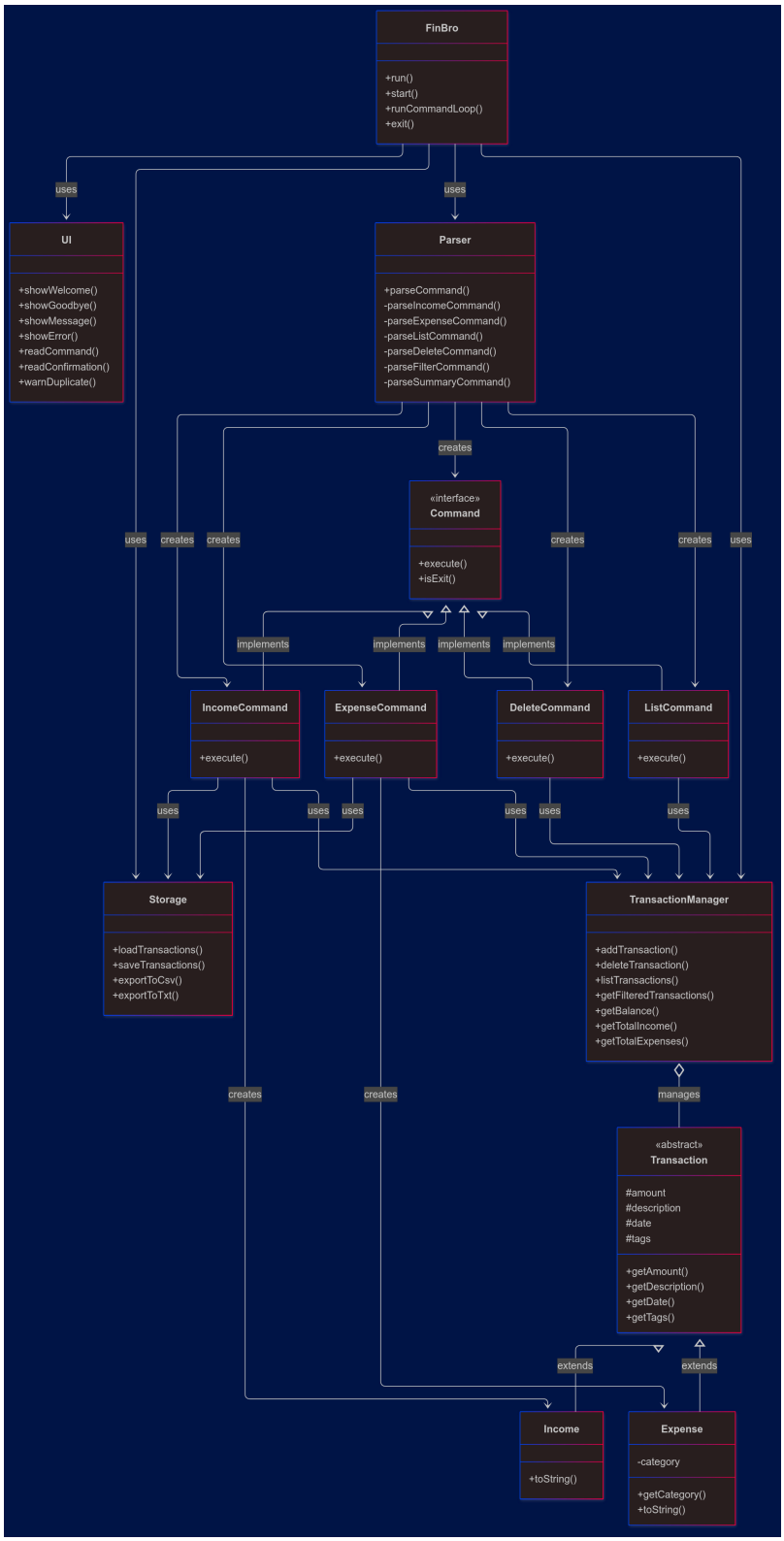
High-Level Architecture

FinBro follows a layered architecture pattern with clear separation of concerns:

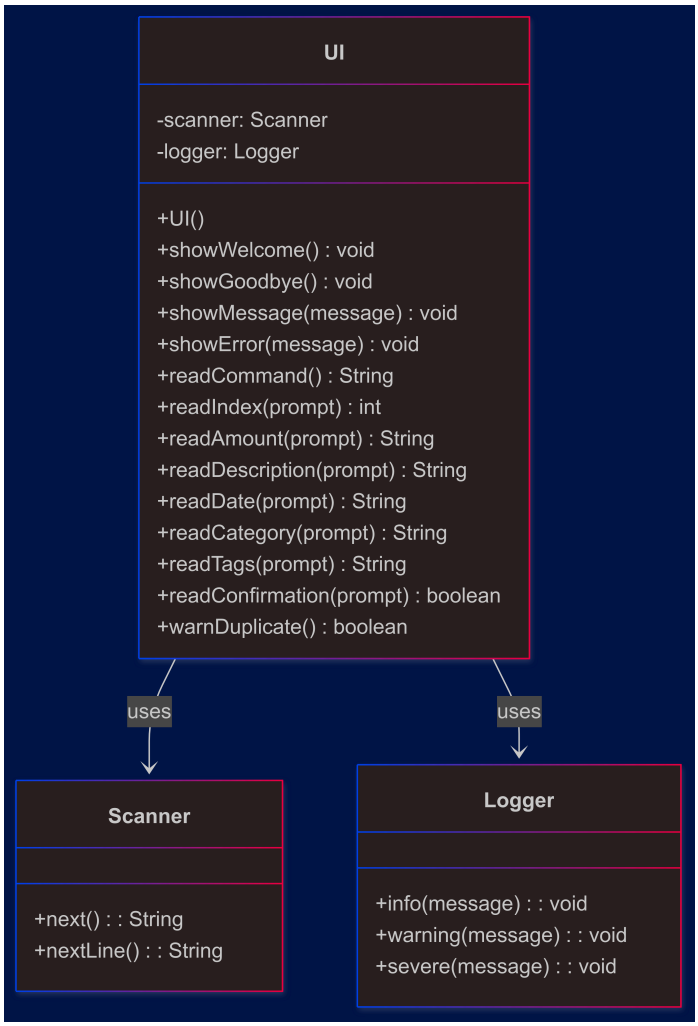


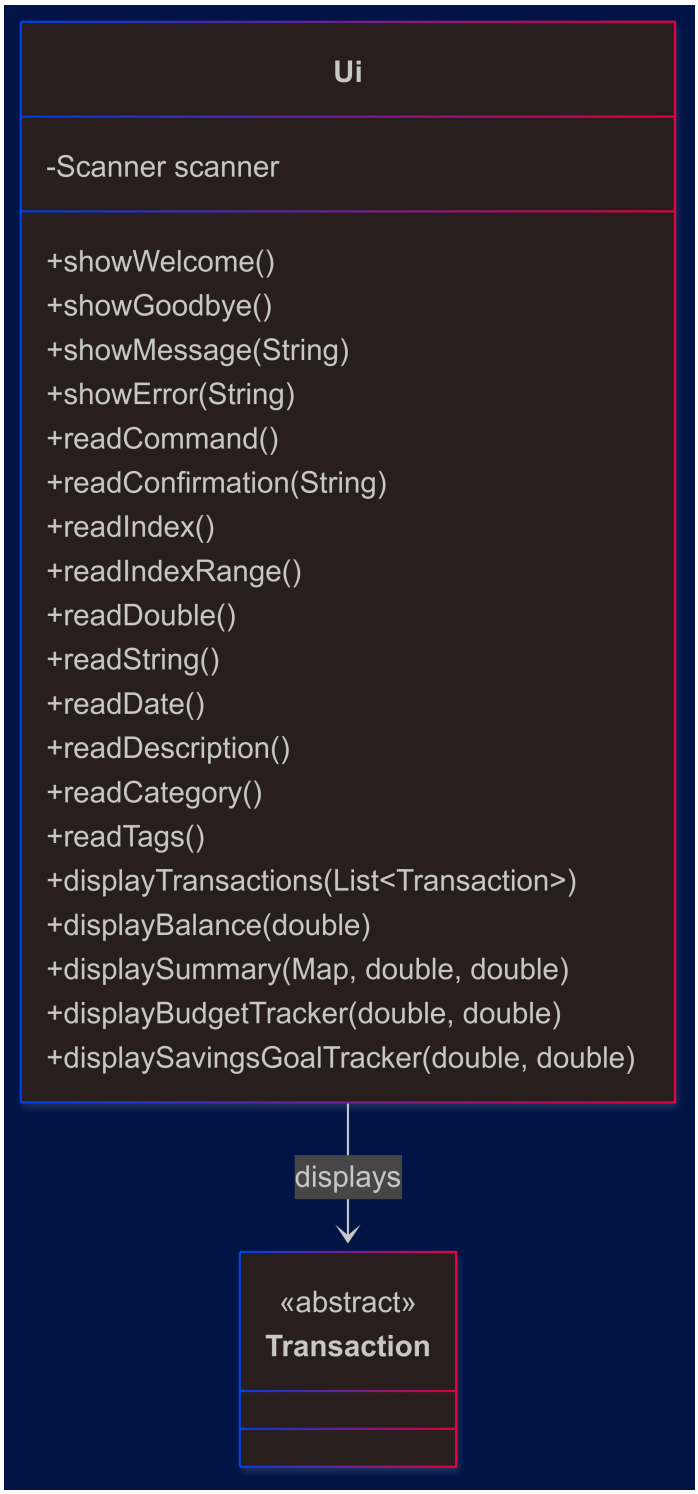
Component Details

Main Component



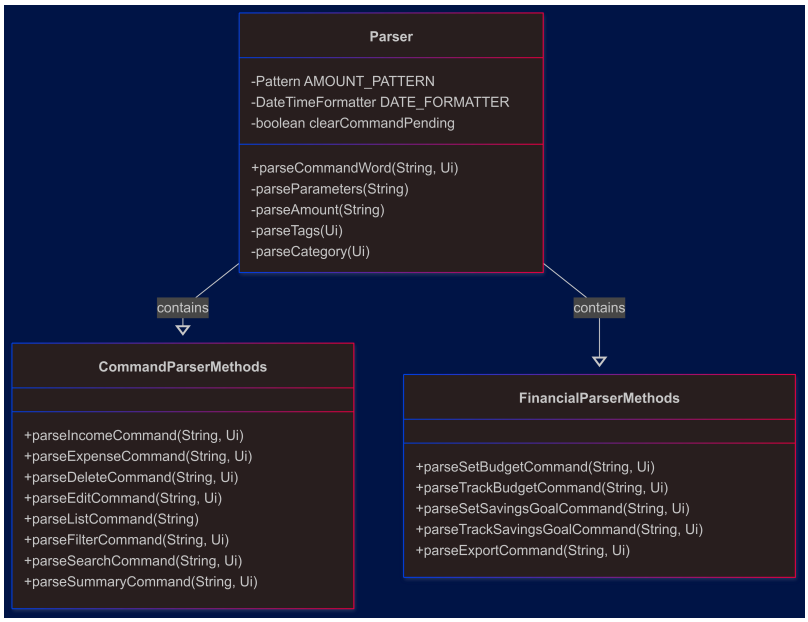
UI Component


UI
-scanner: Scanner
-logger: Logger
+UI()
+showWelcome() : void
+showGoodbye() : void
+showMessage(message) : void
+showError(message) : void
+readCommand() : String
+readIndex(prompt) : int
+readAmount(prompt) : String
+readDescription(prompt) : String
+readDate(prompt) : String
+readCategory(prompt) : String
+readTags(prompt) : String
+readConfirmation(prompt) : boolean
+warnDuplicate() : boolean
uses
uses
Scanner
+next() : : String
+nextLine() : : String
Logger
+info(message) : : void
+warning(message) : : void
+severe(message) : : void

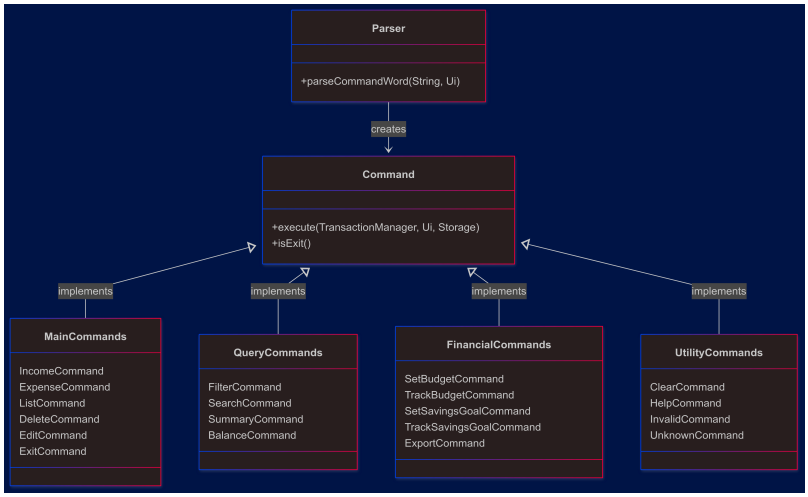


Logic Component

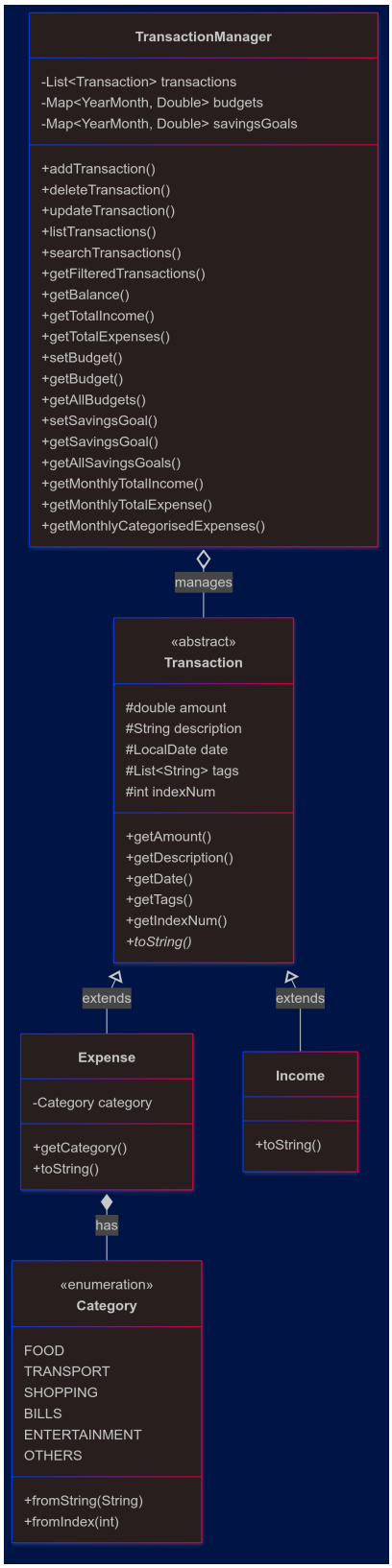

Parser
-logger: Logger
+Parser()
+parseCommand(userInput) : Command
-parseIncomeCommand(arguments) : Command
-parseExpenseCommand(arguments) : Command
-parseListCommand(arguments) : Command
-parseDeleteCommand(arguments) : Command
-parseFilterCommand(arguments) : Command
-parseSummaryCommand(arguments) : Command
-parseSearchCommand(arguments) : Command
-parseBalanceCommand(arguments) : Command
-parseEditCommand(ui) : Command
-parseExportCommand(arguments) : Command
-parseHelpCommand() : Command
-parseExitCommand() : Command
-extractAmount(arguments) : double
-extractDescription(arguments) : String
-extractDate(arguments) : LocalDate
-extractCategory(arguments) : Expense.Category
-extractTags(arguments) : List<String>
creates
«interface»
Command
+execute(transactionManager, ui, storage) : : String
+isExit() : : boolean



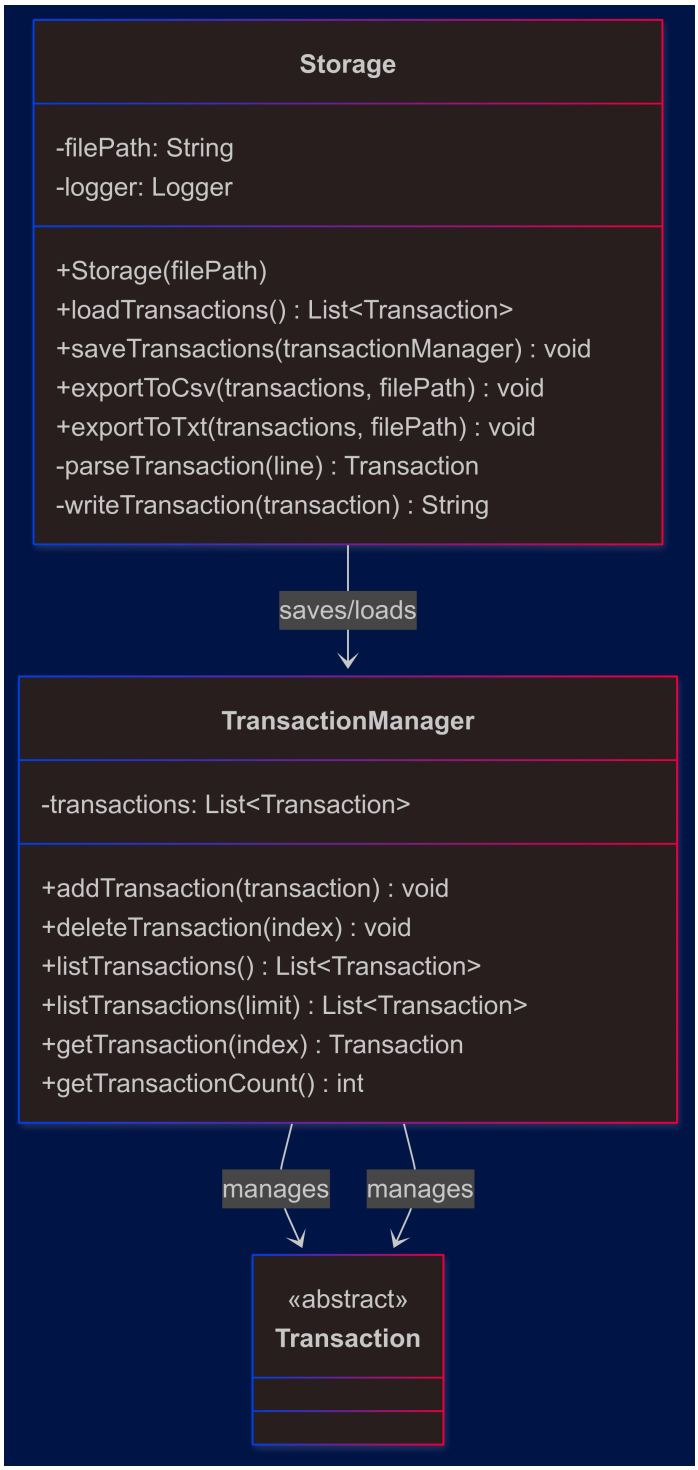
Parser to Command Relationships

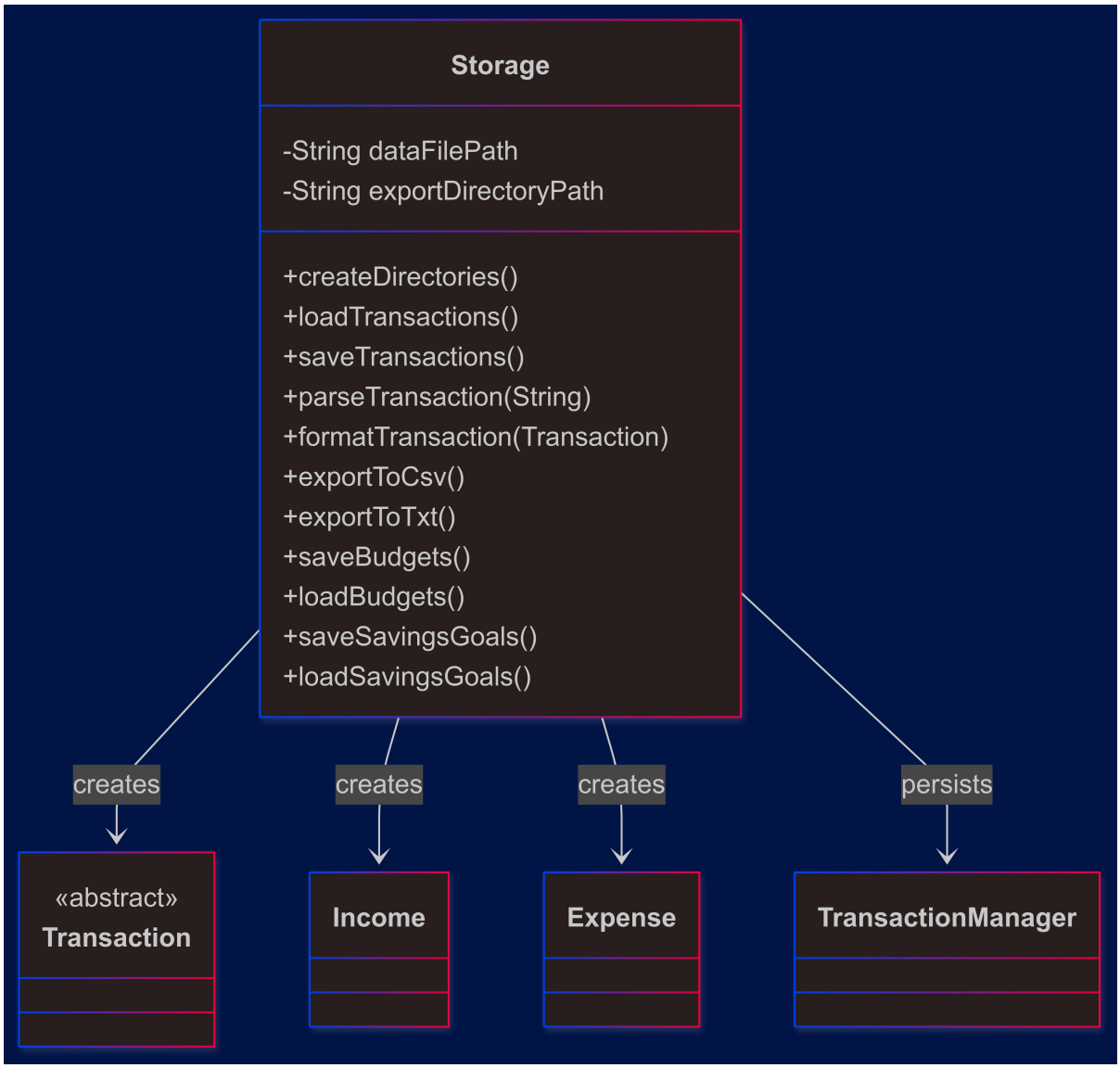


Model Component

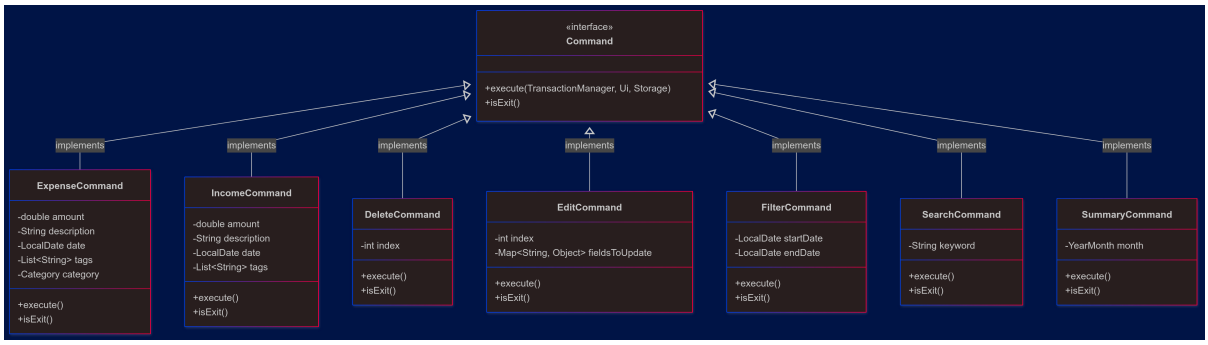


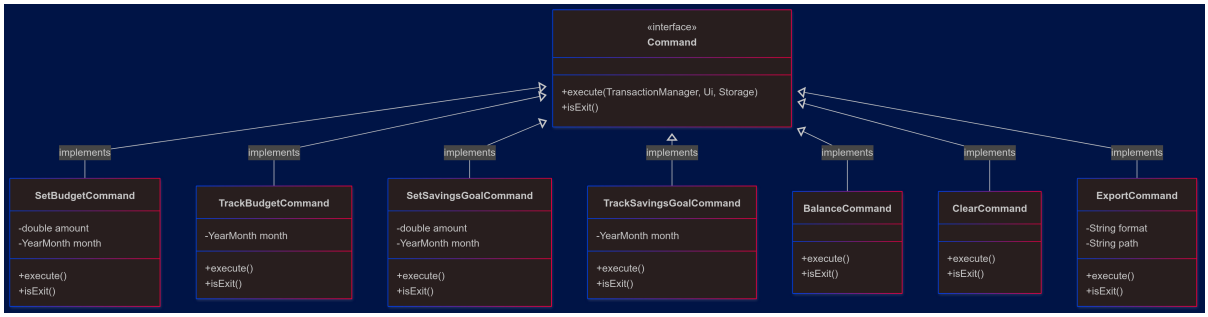
Storage Component


Storage
-filePath: String
-logger: Logger
+Storage(filePath)
+loadTransactions() : List<Transaction>
+saveTransactions(transactionManager) : void
+exportToCsv(transactions, filePath) : void
+exportToTxt(transactions, filePath) : void
-parseTransaction(line) : Transaction
-writeTransaction(transaction) : String
saves/loads
TransactionManager
-transactions: List<Transaction>
+addTransaction(transaction) : void
+deleteTransaction(index) : void
+listTransactions() : List<Transaction>
+listTransactions(limit) : List<Transaction>
+getTransaction(index) : Transaction
+getTransactionCount() : int
manages
manages
«abstract»
Transaction

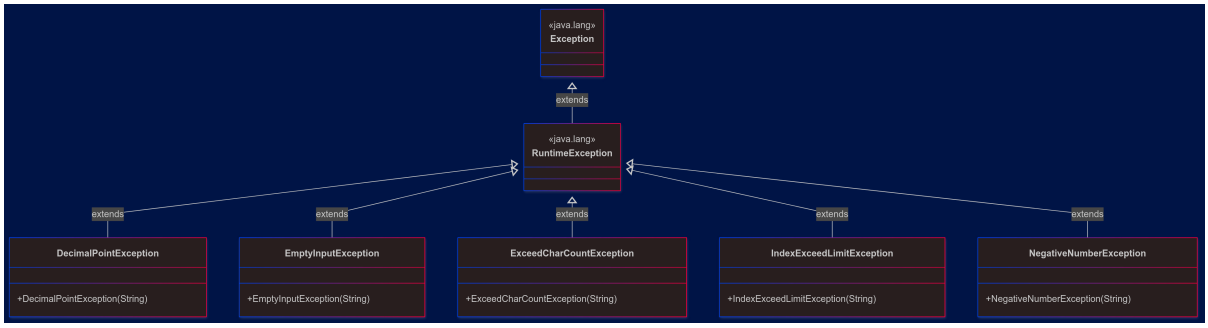


Command Classes





Exceptions Component



Class Structure

```
seedu.finbro/
├── FinBro.java                # Main class
├── logic/
│   ├── command/
│   │   ├── Command.java         # Command interface
│   │   ├── IncomeCommand.java
│   │   ├── ExpenseCommand.java
│   │   └── ...                  # Other command implementations
│   └── parser/
│       └── Parser.java          # Input parser
├── model/
│   ├── Transaction.java         # Abstract base class
│   ├── Income.java
│   ├── Expense.java
│   └── TransactionManager.java  # Business logic
├── storage/
│   └── Storage.java             # Data persistence
└── ui/
    └── Ui.java                  # User interface
```

Design Patterns

FinBro implements several design patterns to enhance maintainability and extensibility:

1. Command Pattern

All user actions are encapsulated as command objects implementing the `Command` interface. This allows for:

- Uniform handling of different commands
- Easy addition of new commands
- Support for operations like undo/redo (future enhancement)

2. Singleton Pattern

The `TransactionManager` is implemented as a singleton to ensure:

- Only one instance manages the transactions
- Consistent state across the application
- Centralized access to transaction data

3. Factory Method Pattern

The `Parser` class serves as a factory, creating appropriate command objects based on user input. Benefits include:

- Encapsulation of command creation logic
- Separation of command execution from creation
- Enhanced extensibility when adding new commands

4. Model-View-Controller (MVC)

The application follows an MVC-like structure:

- **Model**: `Transaction` classes and `TransactionManager`
- **View**: `Ui` class
- **Controller**: `Command` classes and `FinBro` class

Key Features and Implementation

Transaction Management Feature

Overview

The Transaction Management feature is a core component of FinBro that allows users to add, delete, search, and filter financial transactions. Transactions can be either income or expenses, each with different attributes and behaviors.

This section explains the design considerations and implementation details of the Transaction Management system, focusing on adding and deleting transactions.

Design Considerations

Transaction Hierarchy

The Transaction Management system uses inheritance to model different types of financial transactions:

- `Transaction` (abstract): Base class that defines common attributes and behaviors
  - `Income` : Extends Transaction, representing money received
  - `Expense` : Extends Transaction, representing money spent, with additional attributes like category

This approach provides several benefits:

1. Code reuse through inheritance of common attributes and methods
2. Polymorphism enabling operations on collections of different transaction types
3. Type safety provided by Java's type system

Alternative Designs Considered

1. Single Transaction Class with Type Enum

```
class Transaction {
    enum Type { INCOME, EXPENSE }
    private Type type;
    private Category category; // Only used for expenses
    // Other fields
}
```

This approach was rejected because:

- It would lead to optional fields that are only relevant for specific transaction types
- Type safety would rely on runtime checks rather than compile-time enforcement
- Would violate the Single Responsibility Principle by having one class handle multiple concerns

2. Composition-based Approach

```
class Transaction {
    private TransactionDetails details;
    // Common fields
}

interface TransactionDetails { }
class IncomeDetails implements TransactionDetails { }
class ExpenseDetails implements TransactionDetails { }
```

This approach was considered but not implemented because:

- Added complexity without significant benefits for our use case
- Inheritance provided a cleaner solution for the current requirements

Implementation Details

Adding a Transaction

The process of adding a transaction involves several components interacting together:

1. **UI** captures the user input
2. **Parser** interprets the command and creates the appropriate Command object
3. **Command** (e.g., IncomeCommand, ExpenseCommand) creates the transaction object
4. **TransactionManager** stores the transaction
5. **Storage** persists the transaction to disk

Duplicate Detection

The system checks for potential duplicate transactions based on amount and description:

```
public ArrayList<Transaction> getTransactionDuplicates(double amount, String description) {
    assert description != null : "Description cannot be null";
    assert amount > 0 : "Amount must be greater than zero";
    return transactions.stream()
```

```
        .filter(t -> (t.getDescription().equals(description) && t.getAmount() == amount ))
        .collect(Collectors.toCollection(ArrayList::new));
}
```

If duplicates are found, the user is warned and prompted to confirm before proceeding:

```
if (!transactionManager.getTransactionDuplicates(amount, description).isEmpty()) {
    if (!ui.warnDuplicate()) {
        return "Transaction cancelled by user";
    }
}
```

This helps prevent accidental duplication of transactions while still allowing intentional repetition.

Deleting a Transaction

Deleting a transaction follows a similar component interaction pattern:

1. **UI** captures the delete command with an index
2. **Parser** creates a DeleteCommand with the specified index
3. **DeleteCommand** removes the transaction from TransactionManager
4. **Storage** persists the updated transaction list

Implementation details:

```
public void deleteTransaction(int index) {
    assert index >= 0 : "Index must be non-negative";
    assert index < transactions.size() : "Index must be within the bounds of the transaction list";

    if (index < 1 || index > transactions.size()) {
        logger.warning("Attempt to delete transaction at invalid index: " + index);
        throw new IndexOutOfBoundsException("Transaction index out of range: " + index);
    }
    Transaction removed = transactions.remove(index - INDEX_OFFSET); // Convert from 1-based to 0-bas

    // Update the index numbers for all transactions after the deleted one
    for (int i = index; i < transactions.size(); i++) {
        transactions.get(i).indexNum -= INDEX_OFFSET;
    }

    logger.info("Deleted " + removed.getClass().getSimpleName() +
            " with amount $" + removed.getAmount() +
            " at index " + index);
}
```

The implementation maintains proper indexing by updating the index numbers of all transactions following the deleted one.

Viewing of Balance

The balance viewing feature follows this component interaction pattern:

1. **UI** captures the balance command with optional date parameters
2. **Parser** creates a BalanceCommand with specified date parameters
3. **BalanceCommand** requests balance calculation from TransactionManager
4. **TransactionManager** calculates balance based on all or filtered transactions
5. **BalanceCommand** formats and returns the balance information
6. **UI** displays the formatted balance to the user

Implementation Details

Date-Filtered Balance Calculation

```
public String execute(TransactionManager transactionManager, Ui ui, Storage storage) {
   assert transactionManager != null : "TransactionManager cannot be null";
   assert ui != null : "UI cannot be null";
   assert storage != null : "Storage cannot be null";

   logger.info("Executing balance command");

   double balance = transactionManager.getBalance();
   double totalIncome = transactionManager.getTotalIncome();
   double totalExpenses = transactionManager.getTotalExpenses();

   // Verify the relationship between balance, income, and expenses
   assert Math.abs((totalIncome - totalExpenses) - balance) < 0.001 :
           "Balance calculation error: " + balance + " != " + totalIncome + " - " + totalExpenses;

   String formattedBalance = CURRENCY_FORMAT.format(balance);
   String formattedIncome = CURRENCY_FORMAT.format(totalIncome);
   String formattedExpenses = CURRENCY_FORMAT.format(totalExpenses);

   return "Current Balance: " + formattedBalance + "\n" +
           "Total Income: " + formattedIncome + "\n" +
           "Total Expenses: " + formattedExpenses;
}
```

Key Design Features

1. Flexible date filtering: Users can view overall balance or balance from a specific date
2. Comprehensive information: Shows income, expenses, and net balance in a single view
3. Clean formatting: Presents financial information in a well-organized, readable format
4. Integration with budgeting: Displays budget status when applicable
5. Error handling: Validates date parameters and provides clear error messages
6. Separation of concerns: Calculation logic remains in TransactionManager while presentation is handled by BalanceCommand

This implementation provides users with a quick overview of their financial position, either overall or from a specific date forward, enhancing financial awareness.

Editing a Transaction

Editing a transaction also follows a similar component interaction pattern:

1. **UI** captures the edit command with a keyword and parameters to update

2. **Parser** creates an EditCommand with the specified keyword and parameters
3. **UI** asks for user confirmation before proceeding
4. **EditCommand** retrieves and updates the transaction at the specified index
5. **TransactionManager** updates the transaction in its collection
6. **Storage** persists the updated transaction list

Implementation Details

Index-Based Transaction Selection

We check for a valid index by these 2 checks:

```
if (index <= 0) {
        logger.warning("Invalid index: " + index + " (must be positive)");
                return new InvalidCommand("Invalid index. Index must be a positive number.");
            }
```

```
if (index > transactions.size()) {
    logger.warning("Invalid index: " + index + " (out of range)");
    return "Invalid index. Please provide an index between 1 and " + transactions.size() + ".";
}
```

User Confirmation via UI

WIthin parseEditCommand method in Parser.java, there is a confirmation step:

```
boolean isConfirmed = ui.readConfirmation("Do you want to edit transaction at index " + index + "?");
if (!isConfirmed) {
   logger.fine("User cancelled edit operation");
   return new Command() {
        @Override
        public String execute(TransactionManager transactionManager, Ui ui, Storage storage) {
        return "Edit operation cancelled.";
        }

        @Override
        public boolean isExit() {
            return false;
        }
   };
}
```

Transaction Update Logic

The selective field update approach is retained:

1. Amount Update

```
String amountStr = ui.readAmount("Enter new amount (press Enter to skip):\n> ");
if (!amountStr.isEmpty()) {
    try {
        double amount = Double.parseDouble(amountStr);
        if (amount <= 0) {
            return "Amount must be positive.";
        }
        parameters.put("a", amountStr);
    } catch (NumberFormatException e) {
        return "Invalid amount format.";
    }
}
```

2. Description Update

```
String description = ui.readDescription("Enter new description (press Enter to skip):\n> ");
if (!description.isEmpty()) {
parameters.put("d", description);
}
```

3. Date Update

```
String dateStr = ui.readDate("Enter new date (YYYY-MM-DD) (press Enter to skip):\n> ");
if (!dateStr.isEmpty()) {
    try {
        LocalDate.parse(dateStr, DateTimeFormatter.ofPattern("yyyy-MM-dd"));
        parameters.put("date", dateStr);
    } catch (DateTimeParseException e) {
        return "Invalid date format. Please use YYYY-MM-DD.";
    }
}
```

4. Category Update

```
String categoryInput = ui.readCategory(
                "Enter new category (press Enter to skip, 'y' to select from menu):\n> "
);
if (!categoryInput.isEmpty()) {
    if (categoryInput.toLowerCase().startsWith("y")) {
        Expense.Category category = parseCategory(ui);
        parameters.put("c", category.toString());
    } else {
        try {
            Expense.Category category = Expense.Category.fromString(categoryInput);
            parameters.put("c", category.toString());
        } catch (IllegalArgumentException e) {
            return "Invalid category.";
        }
    }
}
```

5. Tags Update

```
String tagsInput = ui.readTags("Enter new tags (comma separated, press Enter to skip, 'y' to select):\
if (!tagsInput.isEmpty()) {
    if (tagsInput.toLowerCase().startsWith("y")) {
        List<String> tags = parseTags(ui);
        if (!tags.isEmpty()) {
            parameters.put("t", String.join(",", tags));
        }
    } else {
        List<String> tags = Arrays.stream(tagsInput.split(","))
                .map(String::trim)
                .filter(tag -> !tag.isEmpty())
                .collect(Collectors.toList());
        if (!tags.isEmpty()) {
            parameters.put("t", String.join(",", tags));
        }
    }
}
```

If no parameters were to be changed:

```
if (parameters.isEmpty()) {
    return "No changes were specified. Transaction remains unchanged.";
}
```

If transaction is updated successfully, updates the storage as such:

```
boolean success = transactionManager.updateTransaction(originalTransaction, updatedTransaction);
if (success) {
    storage.saveTransactions(transactionManager);
    return "Transaction updated successfully:\n" + updatedTransaction;
} else {
    return "Failed to update transaction.";
}
```

Key Design Features

1. Direct index reference: Uses explicit index numbers for unambiguous transaction targeting
2. User confirmation: Prevents accidental edits through a confirmation prompt
3. Type preservation: Maintains the original transaction type (Income or Expense)
4. Selective updates: Only modifies fields explicitly specified in the edit command
5. Robust validation: Handles invalid indices, amounts, dates, and categories
6. 1-based user indexing: Presents user-friendly 1-based indexing while using 0-based indexing internally

This implementation balances user experience with data integrity and provides clear feedback throughout the editing process.

Class Diagram of Transaction Component

```
Transaction (abstract)
    |
```

```
    ├── Income
    └── Expense
        └── Category (enum)
```

The Transaction class provides common attributes and methods:

- `amount` : The monetary value
- `description` : Text description of the transaction
- `date` : When the transaction occurred
- `tags` : Optional categorization labels
- `getAmount()` , `getDescription()` , etc.: Accessor methods
- `toString()` : Abstract method implemented by subclasses

Storage Considerations

Transactions are persisted to disk in a text file format where fields are separated by a pipe character ('|'):

```
INCOME|2025-03-15|1000.00|Salary|work
EXPENSE|2025-03-16|50.00|Groceries|FOOD|essential
```

When saving and loading transactions, the system performs conversion between the object model and this text representation. This approach was chosen for its simplicity and human readability, while still providing adequate structure for reliable parsing.

Defensive Programming Aspects

The Transaction Management system uses several defensive programming techniques:

1. **Assertions**: Pre-conditions and post-conditions are verified using assertions

```
assert amount > 0 : "Expense amount must be greater than zero";
```

2. **Logging**: Key operations are logged for debugging and auditing

```
logger.info("Added " + transaction.getClass().getSimpleName() +
        " with amount $" + transaction.getAmount());
```

3. **Immutability**: Transaction objects are immutable once created, preventing accidental state changes

```
public List<String> getTags() {
    return new ArrayList<>(tags); // Return a copy to prevent modification
}
```

4. **Null checks**: Methods verify parameters are valid before proceeding

```
if (tags != null) { ... }
```

These techniques enhance the robustness of the system and make debugging easier.

Command Parsing

The `Parser` class converts user input into appropriate command objects through several phases:

1. Tokenization of input
2. Extraction of command word
3. Parameter parsing
4. Command object creation

Implementation Example:

```
public Command parseCommand(String userInput) {
   String[] parts = userInput.split("\\s+", 2);
   String commandWord = parts[0].toLowerCase();
   String arguments = parts.length > 1 ? parts[1] : "";

   switch (commandWord) {
      case "income":
         return parseIncomeCommand(arguments);
      case "expense":
         return parseExpenseCommand(arguments);
      // ... other commands
   }
}
```

Data Persistence

The `Storage` class manages saving and loading of transaction data using a custom text-based format.

File formats:

- **Internal storage**: Text file with fields separated by '|' delimiter
- **Export formats**: CSV and TXT

Implementation:

- Transactions are serialized to text format for persistence
- Data is loaded into memory at application startup
- Changes are saved to disk after each transaction modification

Financial Summaries

The `SummaryCommand` generates financial reports with the following capabilities:

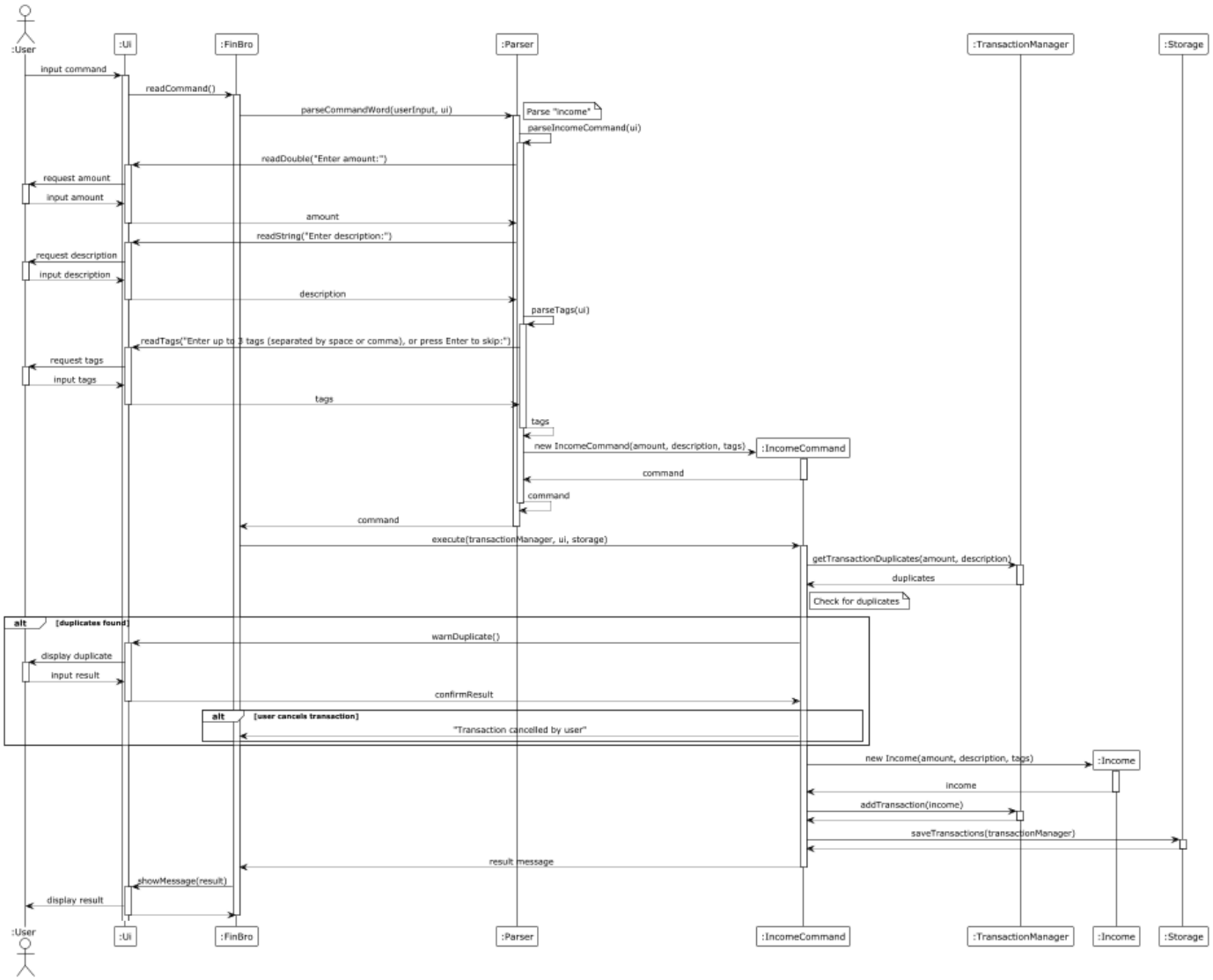
- Filtering by time period (month/year)
- Categorized expense breakdown
- Tag-based transaction analysis

- Income vs. expense comparison

Sequence Diagrams for Key Operations

Adding a Transaction

This sequence diagram illustrates the process when a user adds a new transaction:



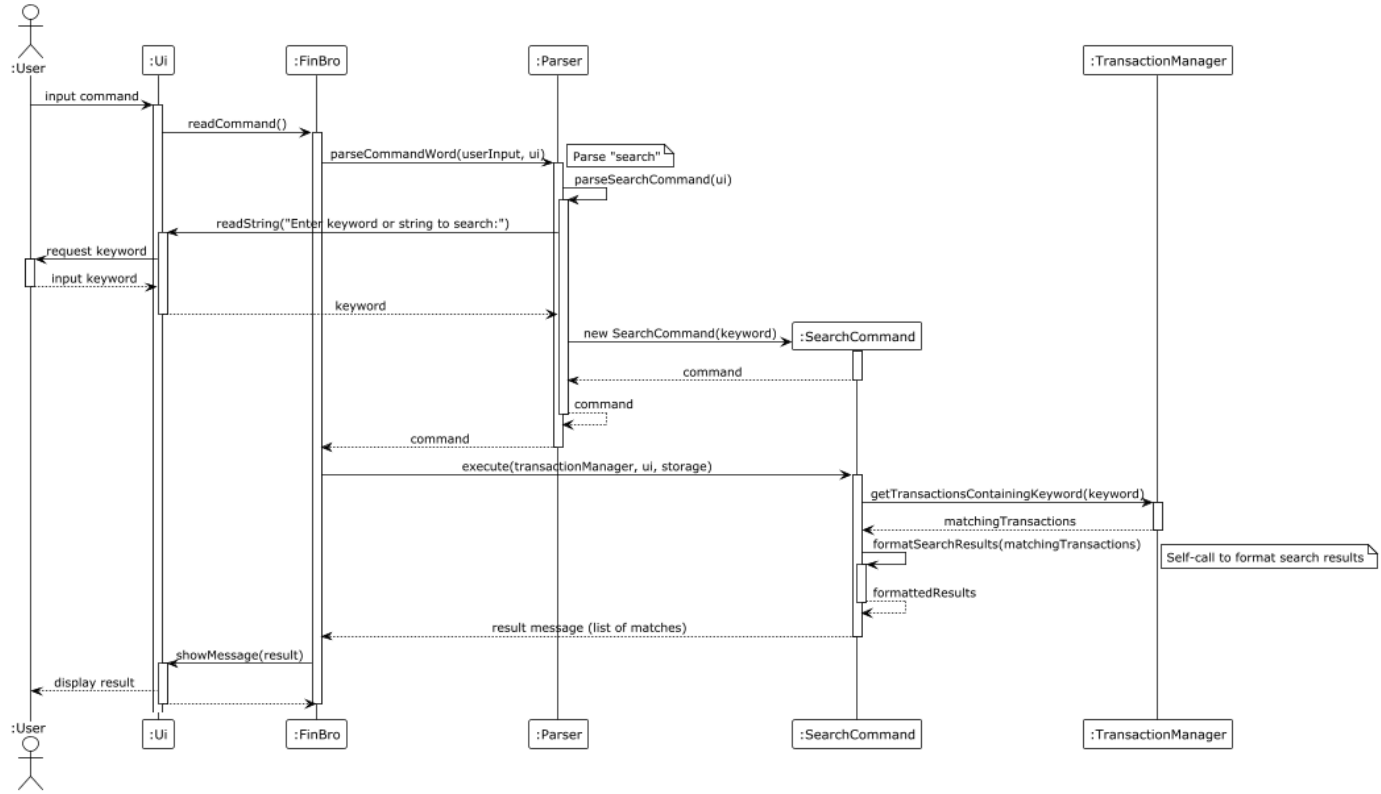
The general steps are as follows:

1. User Input: The user inputs the command to add a transaction.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. UI Interaction: The Parser interacts with the UI to read the transaction details (amount, description, tags).
5. Command Creation: The Parser creates a new IncomeCommand or ExpenseCommand object based on the user input.
6. Command Execution: The FinBro component executes the command.
7. Duplicate Check: The command checks for duplicate transactions using the TransactionManager.

8. User Confirmation: If duplicates are found, the UI warns the user and asks for confirmation.
9. Transaction Addition: The command creates a new transaction and adds the transaction to the TransactionManager.
10. Data Storage: The Storage component saves the updated transaction list.
11. Result Display: The FinBro component sends the result message to the UI to display the confirmation to the user.

Searching for a Transaction

This sequence diagram illustrates the process of searching for transactions:

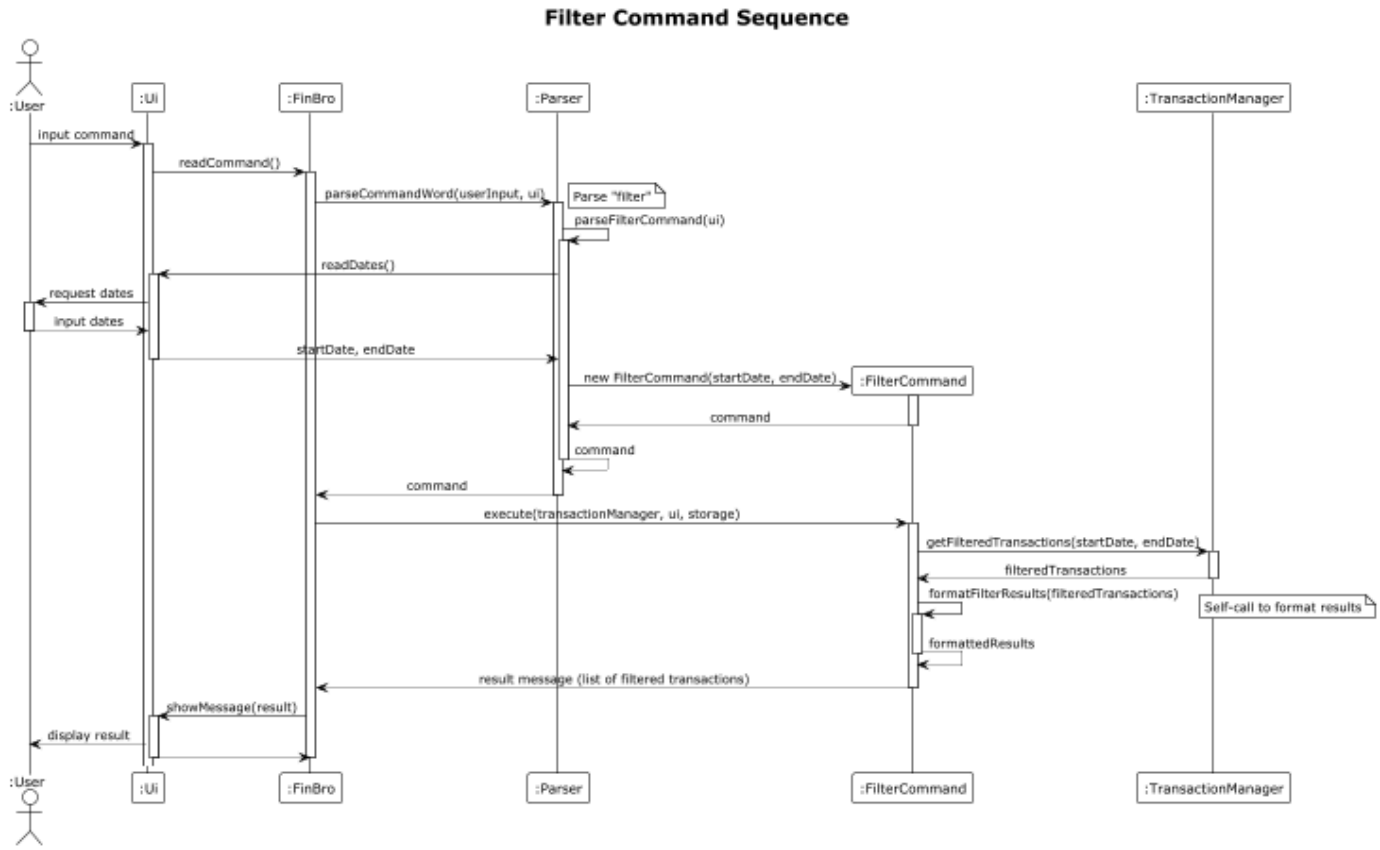


The general steps are as follows:

1. User Input: The user inputs the command to search for transactions.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. UI Interaction: The Parser interacts with the UI to read the search criteria (keyword).
5. Command Creation: The Parser creates a new SearchCommand object based on the user input.
6. Command Execution: The FinBro component executes the command.
7. Transaction Search: The command searches for transactions in the TransactionManager based on the keyword.
8. Transaction Formatting: The command formats the search results.
9. Result Display: The FinBro component sends the search results to the UI to display to the user.

Filtering Transactions

This sequence diagram illustrates the process of filtering transactions based on a date range:

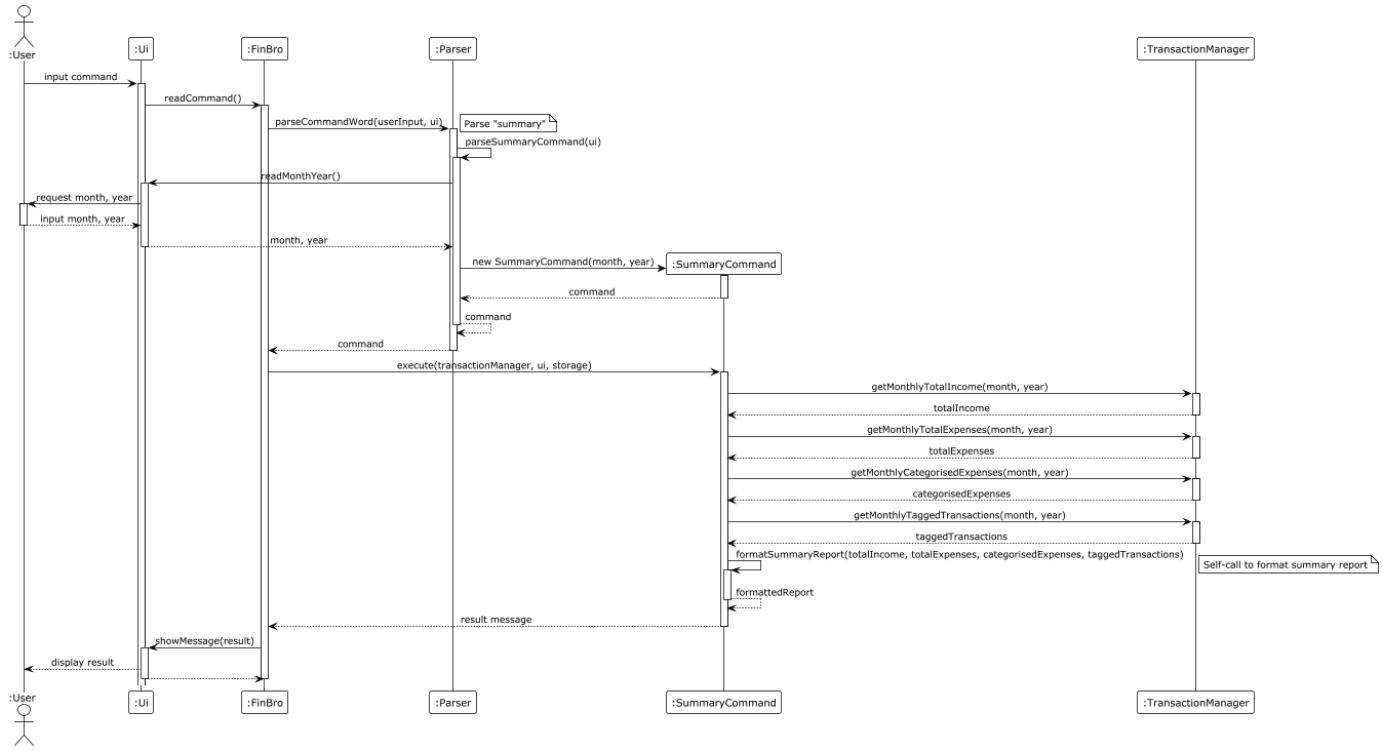


The general steps are as follows:

1. User Input: The user inputs the command to filter transactions.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. UI Interaction: The Parser interacts with the UI to read the filter criteria (start date, end date).
5. Command Creation: The Parser creates a new FilterCommand object based on the user input.
6. Command Execution: The FinBro component executes the command.
7. Transaction Filtering: The command filters transactions in the TransactionManager based on the date range.
8. Transaction Formatting: The command formats the filtered transactions results.
9. Result Display: The FinBro component sends the filtered transactions to the UI to display to the user.

Obtaining a Monthly Financial Summary

This sequence diagram illustrates the process of obtaining a monthly financial summary:

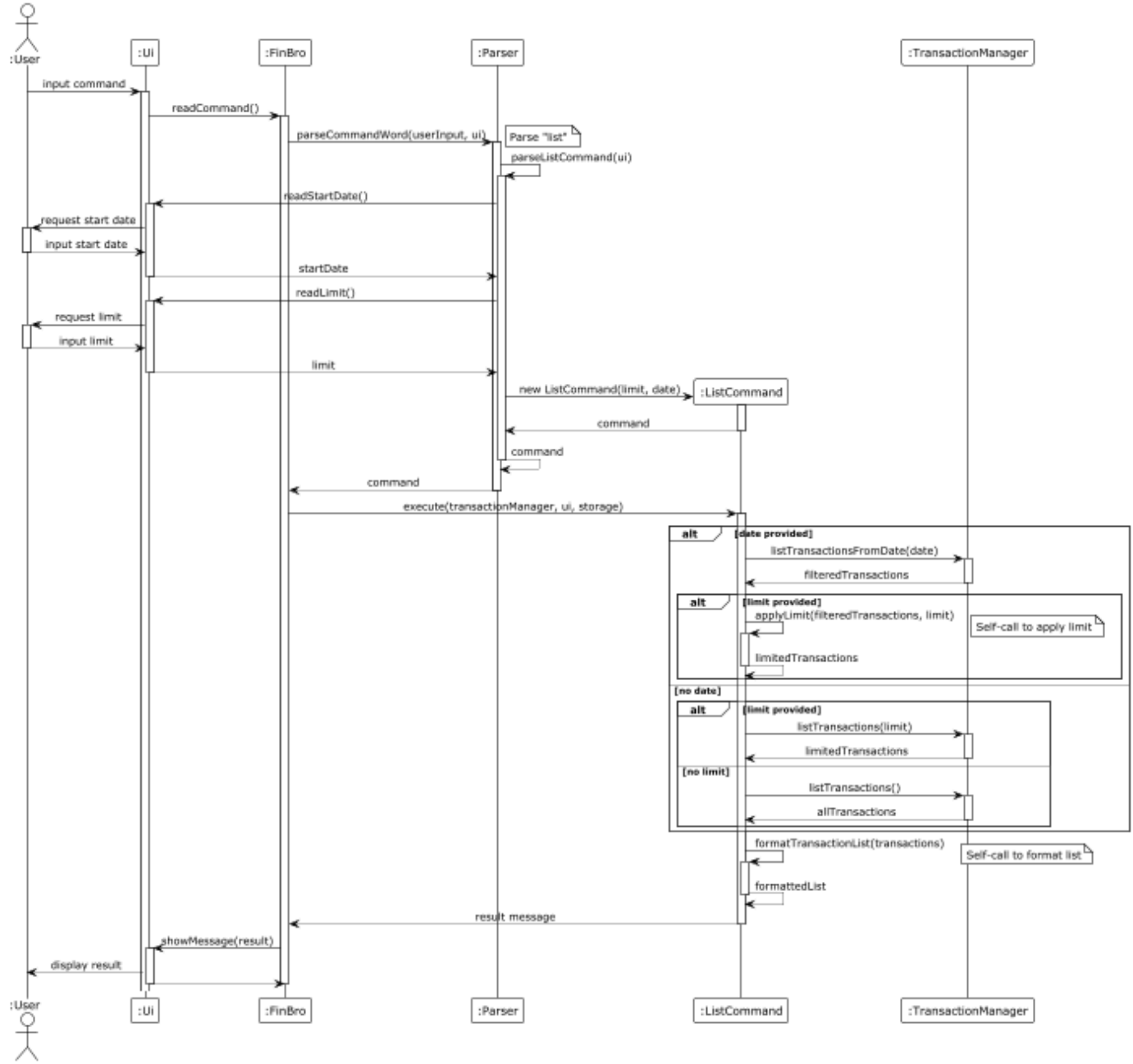


The general steps are as follows:

1. User Input: The user inputs the command to obtain a monthly financial summary.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. UI Interaction: The Parser interacts with the UI to read the month and year for the summary.
5. Command Creation: The Parser creates a new SummaryCommand object based on the user input.
6. Command Execution: The FinBro component executes the command.
7. Transaction Summary: The command retrieves the total income, total expenses, all expenses sorted by categories and all transactions sorted by tags from the TransactionManager for the specified month and year.
8. Summary Formatting: The command formats the summary results.
9. Result Display: The FinBro component sends the summary results to the UI to display to the user.

Obtaining the Current List of Transactions

This sequence diagram illustrates the process of obtaining the current list of transactions:

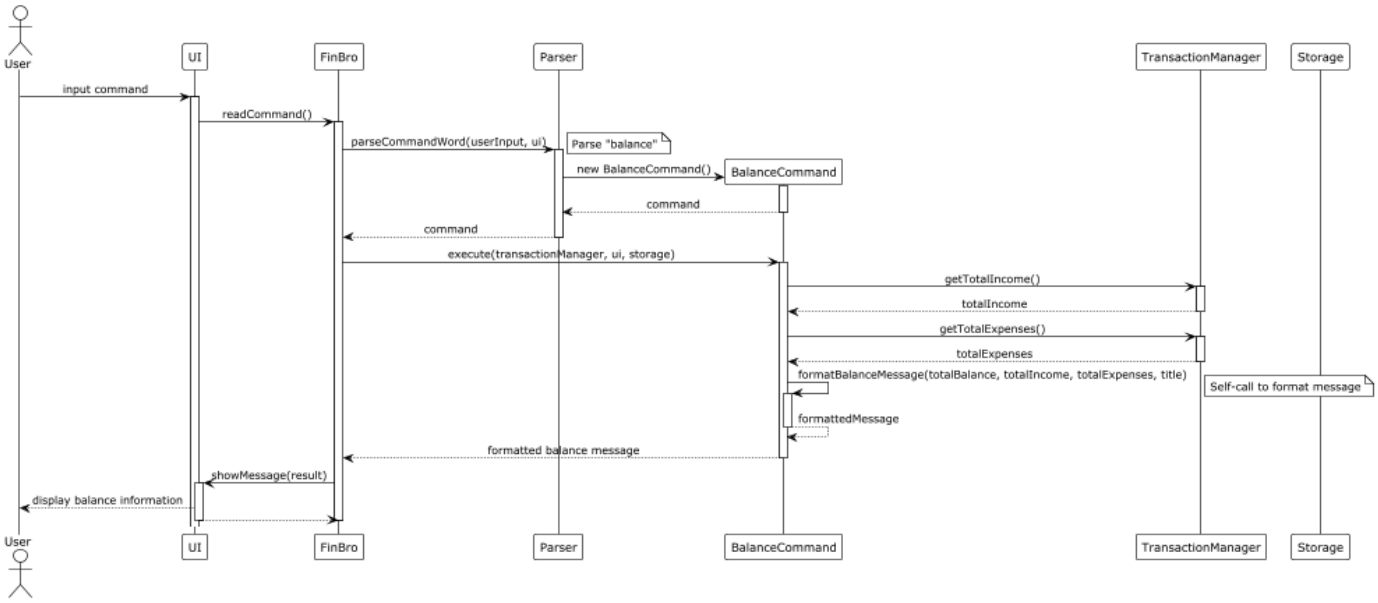


The general steps are as follows:

1. User Input: The user inputs the command to obtain the current list of transactions.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. UI Interaction: The Parser interacts with the UI to read the list criteria (start date, limit for number of transactions to display).
5. Command Creation: The Parser creates a new ListCommand object based on the user input.
6. Command Execution: The FinBro component executes the command.
7. Transaction Retrieval: If start date and/or limit are specified, the command retrieves a filtered list of transactions from the TransactionManager. Otherwise, it retrieves all transactions.
8. Transaction Formatting: The command formats the list of transactions.
9. Result Display: The FinBro component sends the current list of transactions to the UI to display to the user.

Viewing Balance

This sequence diagram illustrates the process of viewing the current balance:

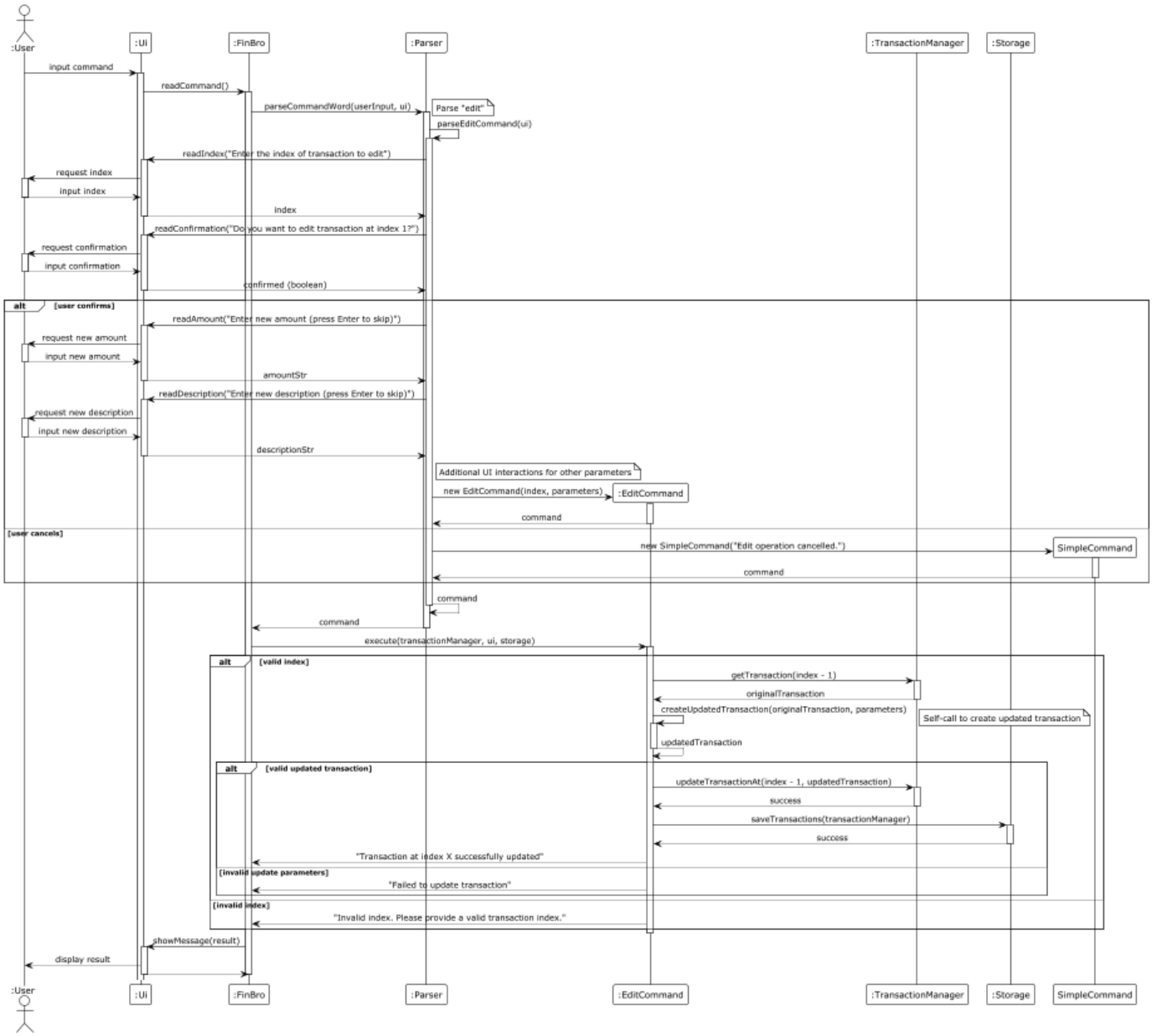


The general steps are as follows:

1. User Input: The user inputs the command to view the current balance.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. Command Creation: The Parser creates a new BalanceCommand object.
5. Command Execution: The FinBro component executes the command.
6. Balance Calculation: The command retrieves the total income, total expenses, and calculates the current balance from the TransactionManager.
7. Balance Formatting: The command formats the balance results.
8. Result Display: The FinBro component sends the balance results to the UI to display to the user.

Editing a Transaction

This sequence diagram illustrates the process of editing a transaction:



The general steps are as follows:

1. User Input: The user inputs the command to edit a transaction.
2. UI Interaction: The UI component reads the command from the user.
3. Command Parsing: The FinBro component sends the user input to the Parser to parse the command.
4. UI Interaction: The Parser interacts with the UI to read the transaction index.
5. User Confirmation: The UI asks the user for confirmation to edit the transaction.
6. UI Interaction: The Parser interacts with the UI to read the new transaction details (amount, description, date, category, tags).
7. Command Creation: The Parser creates a new EditCommand object based on the user input.
8. Command Execution: The FinBro component executes the command.
9. Transaction Update: The command retrieves the transaction from the TransactionManager and updates it with the new details.
10. Data Storage: The Storage component saves the updated transaction list.
11. Result Display: The FinBro component sends the result message to the UI to display the confirmation to the user.

Testing

Structure

Tests are organized following the same package structure as the main code:

```
test/java/seedu/finbro/
├── logic/
│   ├── command/
│   │   ├── IncomeCommandTest.java
│   │   └── ...
│   └── parser/
│       └── ParserTest.java
├── model/
│   ├── TransactionTest.java
│   └── TransactionManagerTest.java
└── storage/
    └── StorageTest.java
```

Running Tests

Run all tests:

```
./gradlew test
```

Run a specific test:

```
./gradlew test --tests "seedu.finbro.model.TransactionTest"
```

Text UI Testing

Text UI testing verifies application behavior by comparing output against expected results:

1. Run tests:

```
cd text-ui-test
./runtest.sh
```

2. The script compares the actual output against predefined expected output.

Future Enhancements

Planned Features

1. **Recurring Transactions**
    - Automatic addition of regular income/expenses
    - Customizable recurrence patterns
2. **Budget Management**
    - Setting spending limits by category
    - Alerts when approaching budget thresholds
    - Visual budget utilization indicators
3. **Data Visualization**
    - Text-based charts for spending patterns
    - Trend analysis for income/expenses over time
    - Category distribution visualization
4. **Multiple Accounts**
    - Support for tracking different financial accounts
    - Transfer operations between accounts
    - Consolidated and per-account reporting
5. **Investment Tracking**
    - Basic portfolio management
    - Investment performance metrics
    - Asset allocation tracking

Appendix

Glossary

- **CLI**: Command Line Interface
- **Transaction**: Any financial event (income or expense)
- **Tag**: User-defined label for categorizing transactions
- **Category**: Predefined classification for expenses

References

- Java SE 17 Documentation
- JUnit 5 User Guide
- Gradle User Manual