Wallace Lim - Project Portfolio

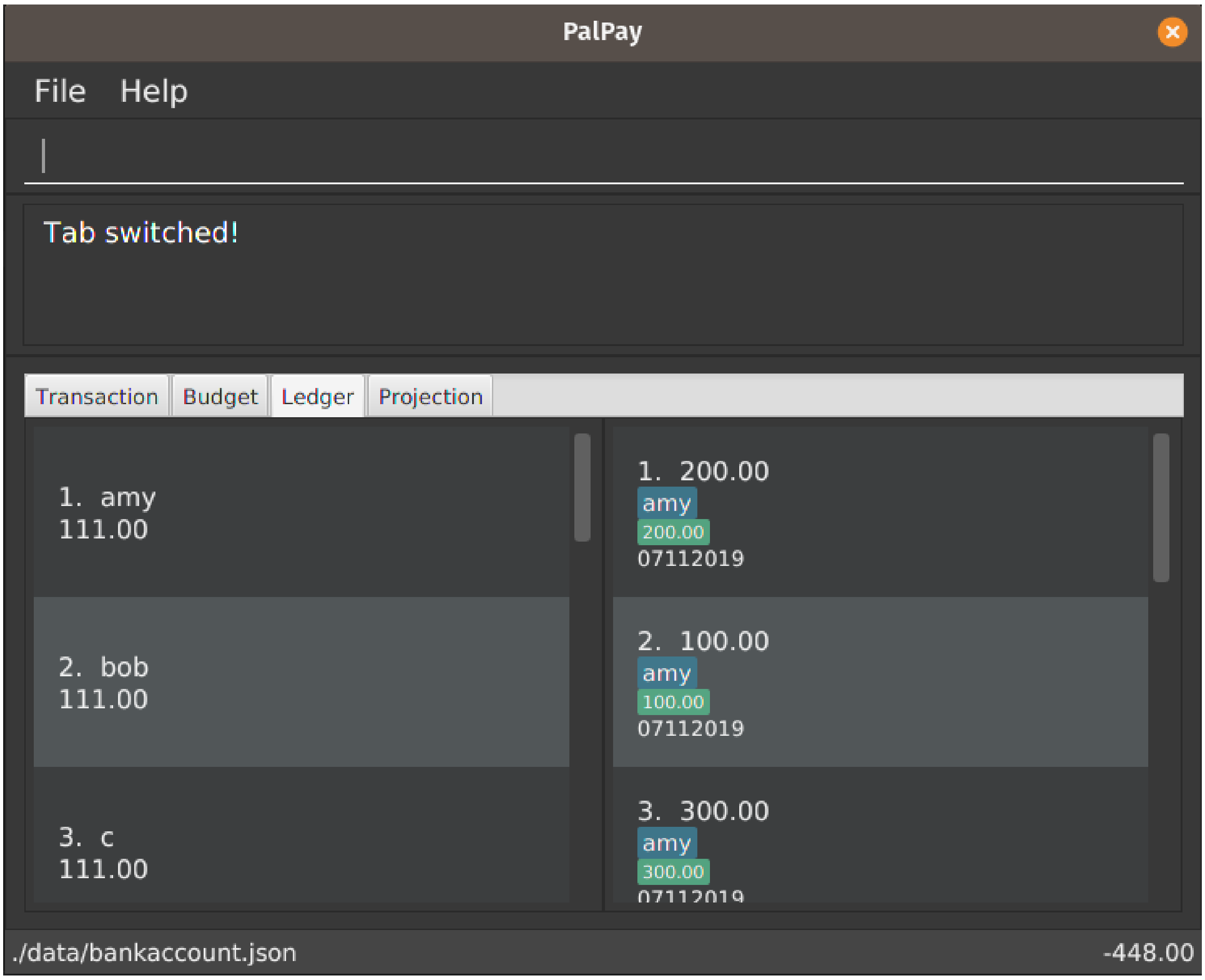
Overview

The purpose of this portfolio is to document my contributions to *PalPay*, a software engineering project under the module *CS2103T - Software Engineering*. PalPay is a personal finance management application. It is mostly written in Java, and has roughly 15,000 Lines of Code (LoC). Being a Command Line Interface (CLI) application, it is controlled mainly through the Command Line in the app, while displaying output through a Graphical User Interface (GUI) written in JavaFX.

My main role within the team was to implement the **Projection** feature, which utilises a machine learning algorithm to predict the user’s account balance and budget statuses at a specified point of time in the future. I was also in charge of implementing the **Display** feature, which further enhances the **Projection** feature by providing users with a graphical representation of their balance and budget states.

Summary of contributions

- **Code contributed**: My contributions to *PalPay* can be viewed here - RepoSense
- **Major enhancement**: Implemented the `Projection` feature, along with functions associated with it.
  - What it does:
    - Uses Gradient Descent to project the user’s account balance in the future
    - Allows users to predict if they will meet their budget goals based on past income/outflow trends
  - Justification: In our target demographic, many express that keep track of transactions between friends. Our application aims to solve this pain point by providing a simple way to keep track of debts.
  - Highlights: The `Ledger` tab has a split screen user interface, for the user to keep track of unpaid dollars and each transaction recorded between friends. The `Ledger` will only display people with outstanding balances on the left side of the screen, while transactions are listed on the right.



Tab switched!

1. amy
111.00

2. bob
111.00

3. c
111.00

1. 200.00
amy
200.00
07112019

2. 100.00
amy
100.00
07112019

3. 300.00
amy
300.00
07112019

./data/bankaccount.json
-448.00

Figure 1. The Ledger Interface

- **Minor enhancement**: added checks and improved error messages for handling `Amount`.
- **Other contributions**:
    - Project management:
        - Authored and assigned multiple issues. (Issues: #226, #199, #197, #136)
        - Reviewed and merged pull requests. (Pull requests: #70, #133)
        - Fixed numerous bugs. (Examples: #186, #185)
    - Enhancements to existing features:
        - Refactor `Transactions` into *Operations*, such that the `Model` can be overloaded to achieve polymorphism. (Pull requests: #95)
        - Refactor `VersionedBankAccount` into `VersionedUserState` that allows for the integration of the `Ledger` class, without associating the balances of `BankAccount` and `Ledger`. (Pull request: #133)
        - Wrote comprehensive unit test cases for the `Split` and `Receive` commmands and parsers. (Pull requests: #70, #114, #202, #205)
    - Documentation:
        - Reformatted the User Guide for a more sequential flow.

    - Wrote the details for the following commands in the User Guide.
        - Split
        - Receive
    - Created UML diagrams to help in the explanation of `split` and `receive` commands in the Developer Guide.
- Community:
    - Reported bugs and suggestions for other teams in the module. (Examples: T14-2 #194, T14-2 #195, T12-4 #208, T12-4 #207, T12-4 #202)

Contributions to the User Guide

Given below are sections I contributed to the User Guide. They showcase my ability to write documentation targeting end-users.

Projecting Future Balance and Budgets : `project`

Cast a projection on your future balance amount and budget statuses based on your transaction history.

Format: `project d/DATE [c/CATEGORY]`

NOTE If a `CATEGORY` is not specified, it will be set as `GENERAL` by default. `GENERAL` projections project upon **ALL** transactions, regardless of their categories.

Example Usage:

1. `project d/22072020`

```
Projected balance: $955.80
```

2. `project d/01012020 c/Food`

```
Projected balance: $188.04
You are on track to meeting your budget of $600 by 08122019, with a surplus of
$484.32!
```

Usage Constraints

Command Format

- `CATEGORY` must be preceded by its tag `c/`. A violation of any of the above will produce the following error message:

```
Invalid command format!
project: Project future balance based on past income/outflow.
Parameters: d/DATE [c/CATEGORY]
Example: project d/12122103 c/Food
```

Date Values

- `DATE` input must be set in the future. A violation of this constraint will produce the following error message:

```
Invalid command usage!
Date must be set in the future.
```

- `DATE` cannot be more than **720** days from the day of projection.
  A violation of this constraint will produce the following error message:

```
Projections should be a maximum of 2 years (730 days) from now.
```

Minimum Number of Transactions

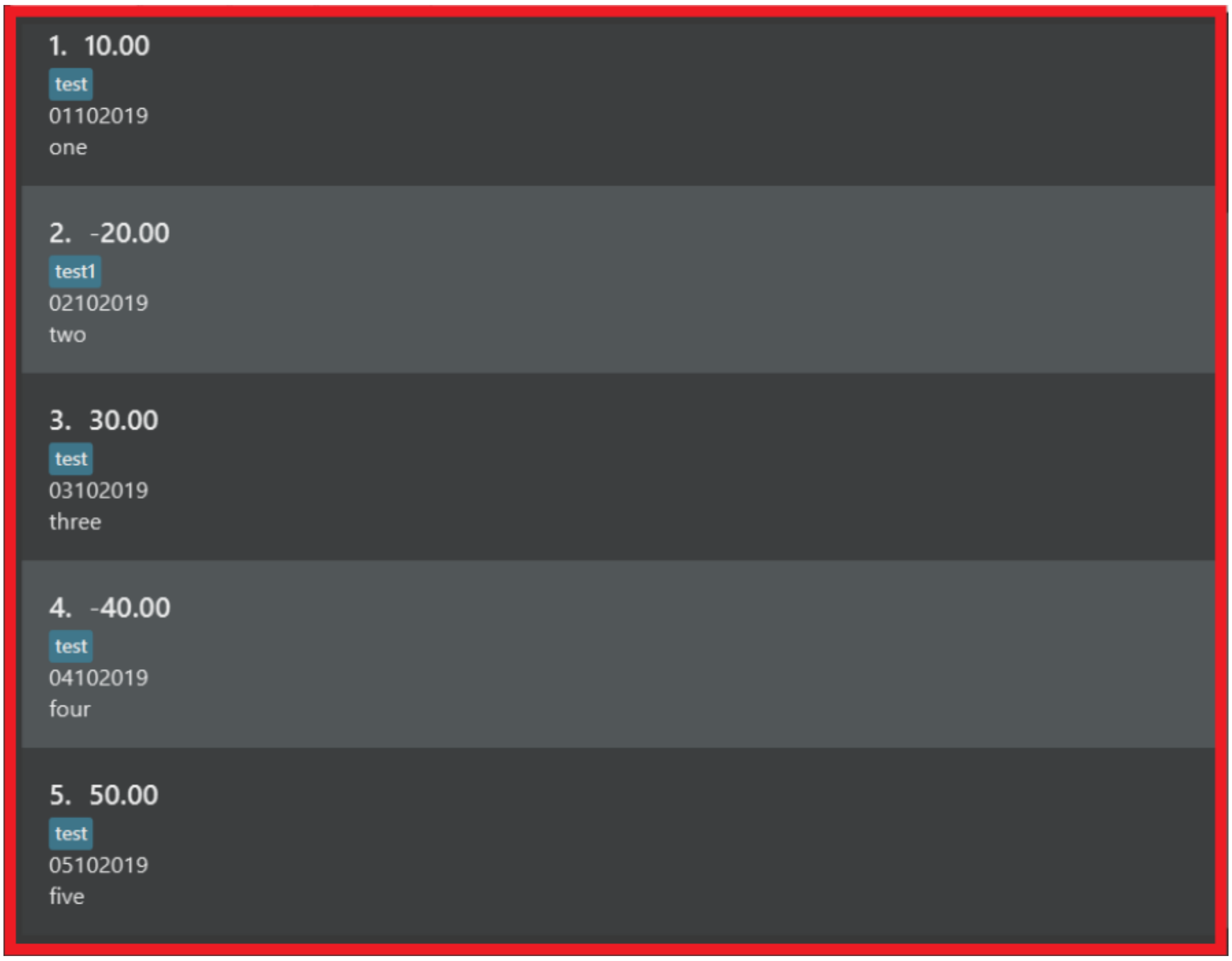
- There must be a minimum of **5** transactions in total, or in the specified `CATEGORY` for a projection to be successfully cast. Should the requirement above be unmet, the following error message will be produced:

```
There are no transactions in [CATEGORY]. It is impossible to cast a projection.
```

NOTE [GENERAL] will be displayed in place of [CATEGORY] if a `CATEGORY` is not specified. This is due to the auto-casting of uncategorised projections to the `GENERAL` category as explained here.

- Should the number of transactions in a `projection` fall below **5**, it will be automatically deleted, as shown below:

  1. Suppose there are **5** transactions, and a `GENERAL` projection, which projects upon them.


1. 10.00
test
01102019
one

2. -20.00
test1
02102019
two

3. 30.00
test
03102019
three

4. -40.00
test
04102019
four

5. 50.00
test
05102019
five

Figure 2. Five transactions under the projection tab

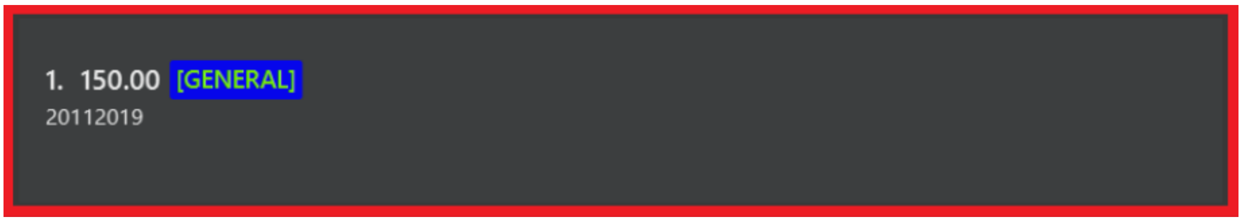

1. 150.00 [GENERAL]
20112019

Figure 3. A projection which is cast based on the 5 transactions above

2. If a transaction being deleted causes the number of transactions being projected upon to fall below 5, the corresponding projection will automatically be deleted.

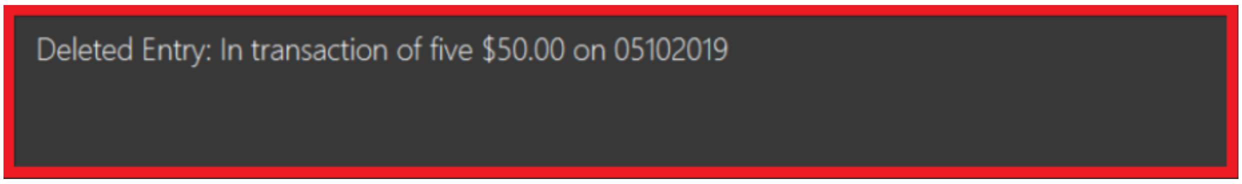

Deleted Entry: In transaction of five $50.00 on 05102019

Figure 4. The fifth transaction has been deleted.

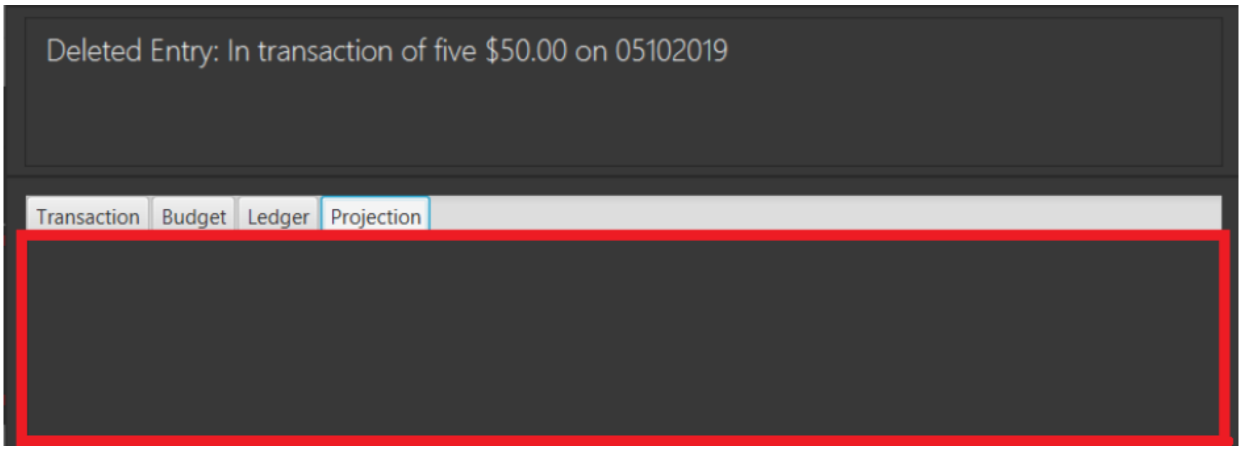
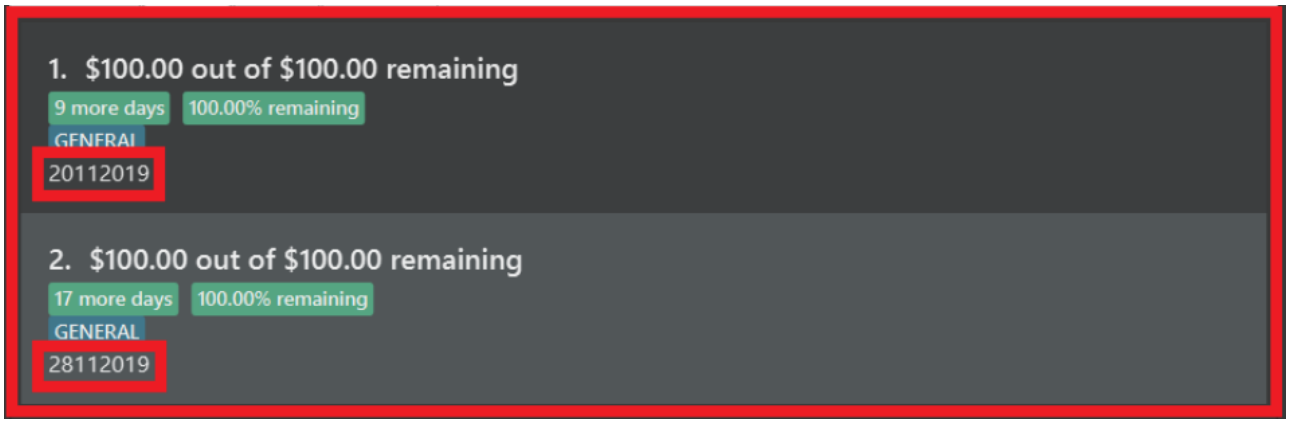

Deleted Entry: In transaction of five $50.00 on 05102019

Figure 5. The project earlier seen in Figure 19 has been automatically deleted.

Valid Budget Start Dates and Deadlines

A projection will only project upon budgets with deadlines set before or equal to the projection `DATE`. An example is depicted below:

1. Suppose there is currently a general `BUDGET` with a deadline set for 28th November 2019


1. $100.00 out of $100.00 remaining
9 more days 100.00% remaining
GENERAL
20112019

2. $100.00 out of $100.00 remaining
17 more days 100.00% remaining
GENERAL
28112019

Figure 6. Two budgets with dates 20112019 and 28112019 in the "GENERAL" category

2. If a general `PROJECTION` is cast to 20th November 2019, it will contain the budget with deadline 20112019 but not 28112019, since the projection’s `DATE` is earlier than 28112019.

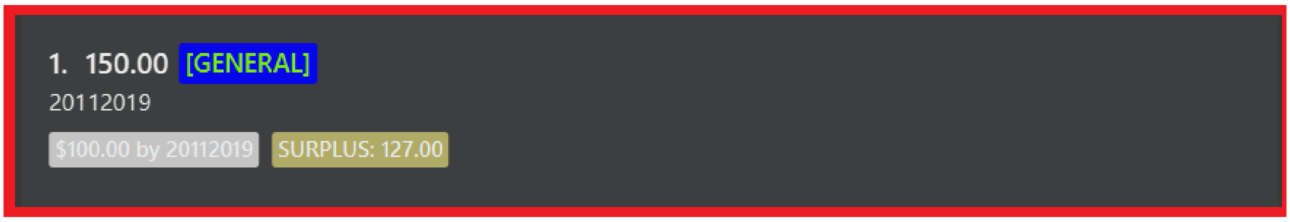

1. 150.00 [GENERAL]
20112019
$100.00 by 20112019 SURPLUS: 127.00

Figure 7. The projection only contains the budget with deadline 20112019

Backward Projections

While it is possible in *PalPay*, projecting your balance amount backwards in time is not guaranteed to produce sensible results. It is generally not advisable to do so.

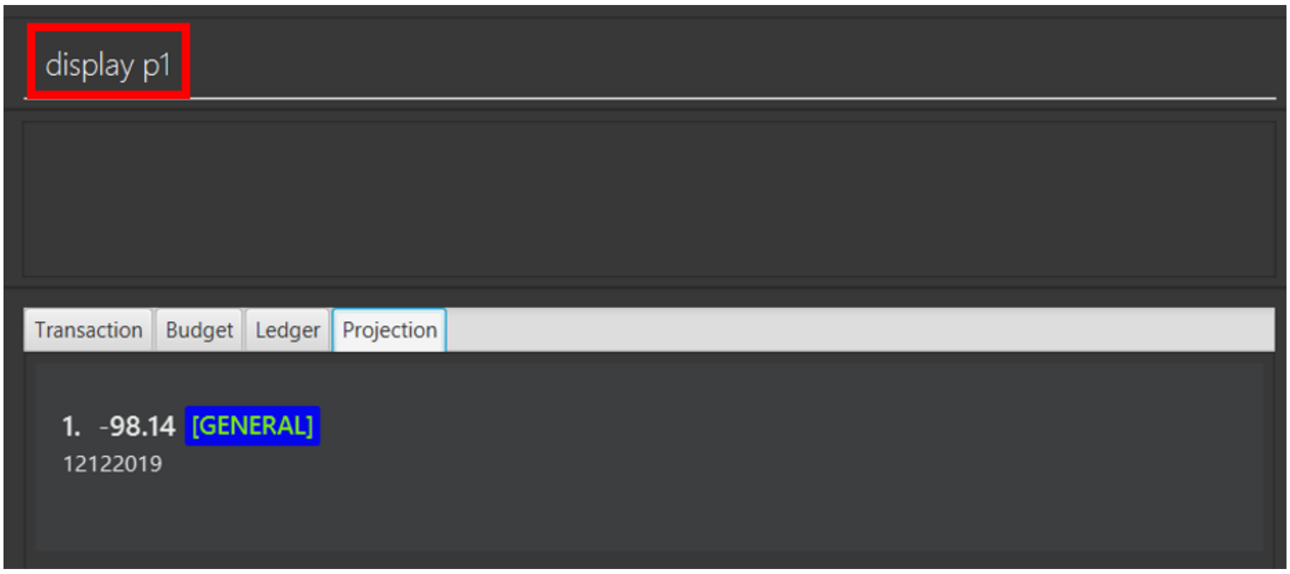
Display a Projection Graph: `display`

Display a graphical representation of a `projection` in a new window.

Format: `display PROJECTION_ID`

Example Usage

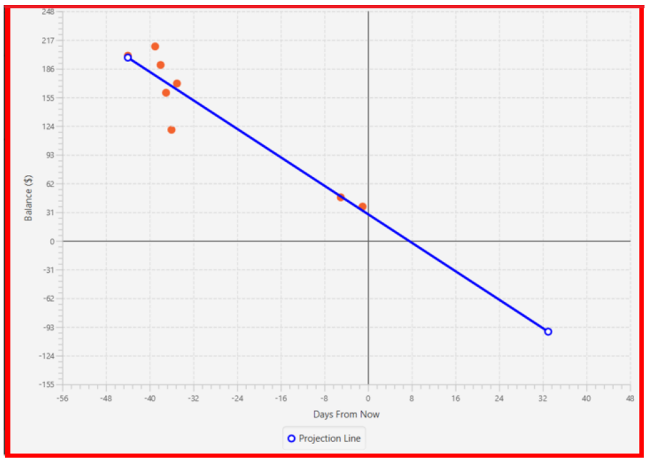
1. Type **display PROJECTION_ID** into the command box and press `Enter`.



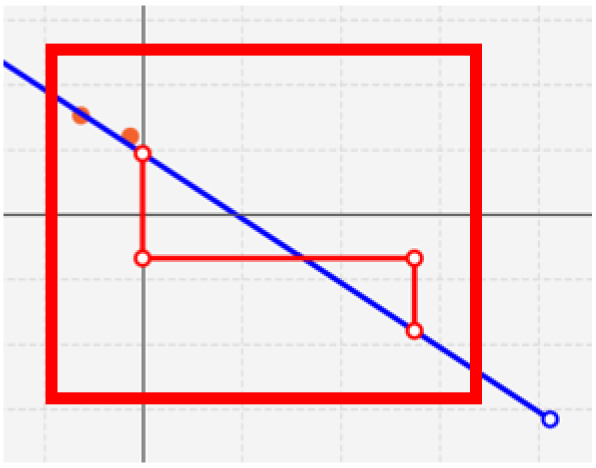
```
display p1
```

1. -98.14 [GENERAL]
12122019

2. A new window containing a graphical representation of the specified projection will pop up.



If there are any budgets associated with the projection, a corresponding graphical representation of the budget will be additionally displayed.



Interpreting the Projection graph

Here is a typical projection graph.

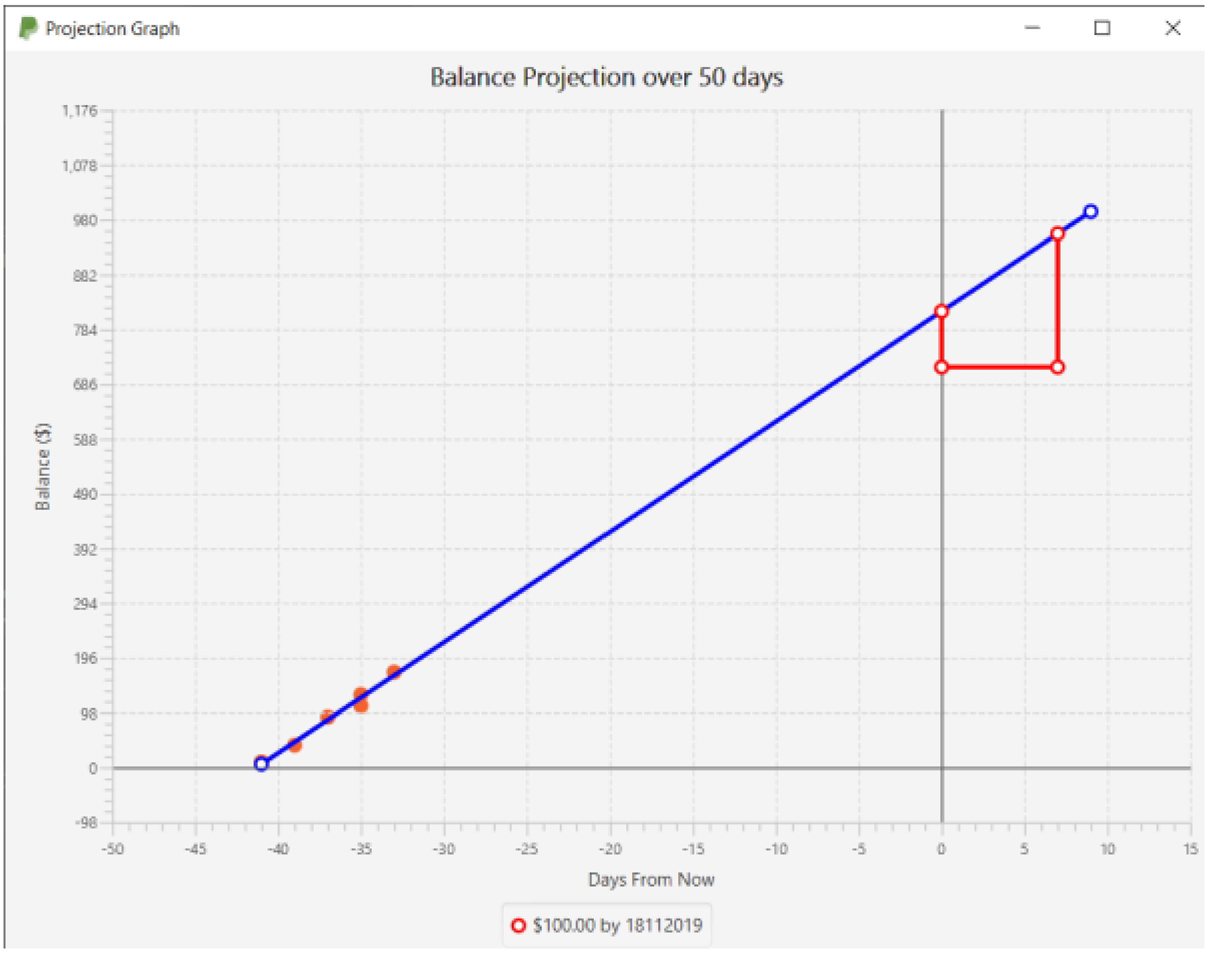


Figure 8. A typical projection graph

- The X-Axis
  The X-Axis denotes your balance in dollars ($).
- The Y-Axis
  The Y-Axis denotes the number of days from now, with today being Y = 0.
- Red Points
  The red points on the graph each represent your account balance (denoted by the X-value) at a particular point of time (denoted by the Y-value).

- Blue Line Graph
  The blue line graph represents the projection line, with each point along it representing a prediction of your account balance (denoted by the X-value) at a certain point of time (denoted by the Y-value).
- All Other Coloured Line Graphs
  All other coloured line graphs represent various budgets which fall within the `CATEGORY` and `DATE` range of the `PROJECTION`. Each of these line graphs have three parts:

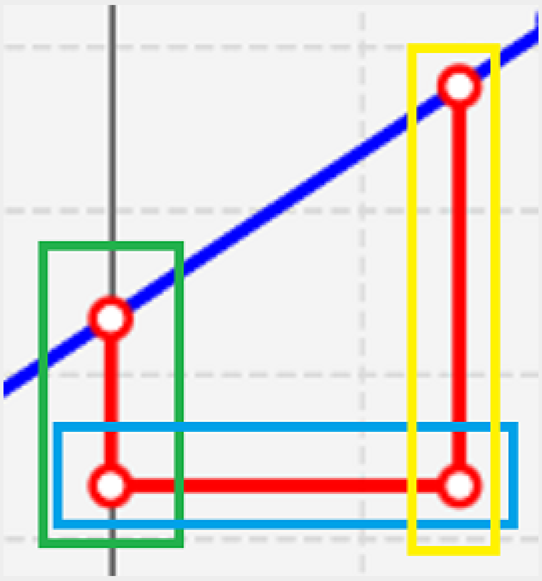


Figure 9. A budget line graph with its parts labelled by a green, blue and yellow box each

1. The line in the green box denotes the budget amount in dollars ($).
2. The line in the blue box denotes the budget duration (i.e. the number of days from its inception to its deadline)
3. The line in the yellow box denotes the projection deficit or surplus, at the point of its deadline.

Usage Constraints

Valid Projection Index

- A `Projection` with `PROJECTION_ID` must exist. Attempting to display a non-existent `PROJECTION` will result in the following error message:

```
The projection index provided is invalid.
```

Static Graph Rendering

- `Projection` graphs do not update automatically when a new `Transaction` or `Budget` is added or removed. Instead, they are statically rendered upon the `display` command.

NOTE

Due to the static nature of projection graphs, commands should **NOT** be executed while a projection graph is open, lest the behaviour of PalPay become unpredictable.
Consequently, a `display` command should **ALWAYS** be followed by closing the projection graph window, before any other actions are performed within *PalPay*.

Contributions to the Developer Guide

Given below are sections I contributed to the Developer Guide. They showcase my ability to write technical documentation and the technical depth of my contributions to the project.

Project Feature: `project`

This feature allows users to *project* their balance amount and budget statuses based on past income and outflows as manifest in their *TransactionHistory* by using the command `project DATE [CATEGORY]`.

Current Implementation

The `project` command is facilitated by the Logic and Model components of the application, *PalPay*.

The sequence diagram below demonstrates how the `project DATE [CATEGORY]` command is handled by the application. If a `CATEGORY` is not specified by the user, it will be set as `GENERAL` by default.

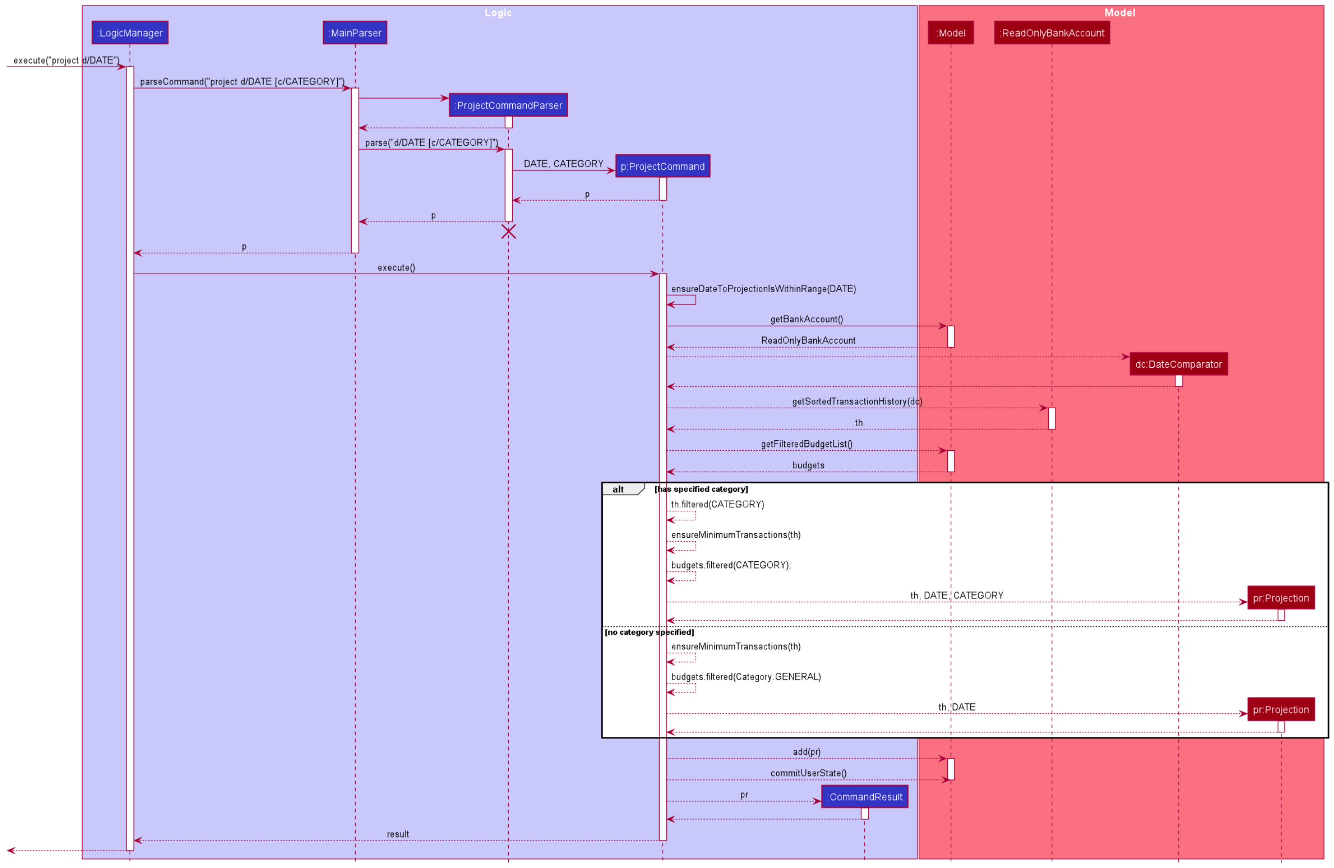


Figure 10. Sequence Diagram of the Project Command

Projection by Date

When projecting by date alone, all transactions in the *user*'s transaction list will be taken into account, regardless of their categories. On the other hand, only budgets without categories (thus belonging to the `GENERAL` category by default) will be projected upon.

Projection by Date and Category

When projecting by date and category, all transactions tagged by the specified category will be taken into account. Similarly, all budgets tagged with the specified category will be projected upon.

Budget Projections

Projections on budgets are made by first projecting the *user*'s balance amount at the point when the budget was set. Then, it compares the *user*'s projected balance amount at the point of the budget’s deadline, with the budget’s amount. A surplus is indicated when the former is greater than the latter, and a deficit is indicated when the former is smaller than the latter.

Given below is an example usage scenario and how the project command executes at each step.

Step 1. The user launches the application.

Step 2. If the user does not have at least **5** transactions, he / she adds transactions until there are sufficient transactions to project upon. Then, the user executes the `project` command.

Step 3. Upon executing the command, `LogicManager` uses `MainParser#parse()` to parse the input from the user.

Step 4. `MainParser` determines which command is being used and creates `ProjectCommandParser` to further parse the input from the user.

Step 5. `ProjectCommandParser` parses the argument and checks if a valid date and category was provided.

- If an invalid date or category was provided, or if no date was provided, `ProjectCommandParser` throws an exception and terminates.
- Otherwise, it returns a `ProjectCommand`, which contains a `Date` and possibly a `Category` specified by the user.

Step 6. `LogicManager` uses `ProjectCommand#execute()` to project the user's balance and budget states at the time of the specified `Date`.

Step 7. `ProjectCommand` uses `Model#commitUserState()` to save the latest state of the application. It then returns a `CommandResult` to the `LogicManager` and the result will be displayed to the user at the end.

Activity Diagram

The activity diagram below depicts how a projection is made.

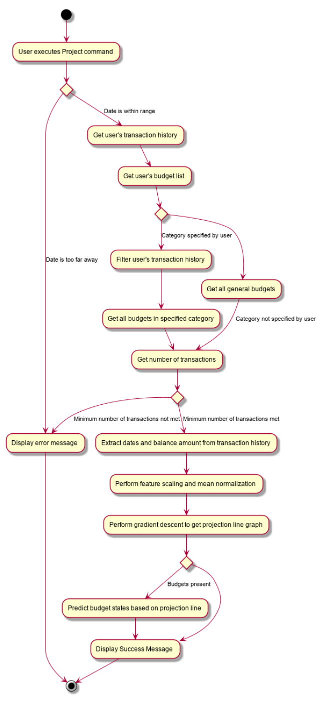

User executes Project command
Date is within range
Get user's transaction history
Get user's budget list
Category specified by user
Date is too far away
Filter user's transaction history
Get all general budgets
Get all budgets in specified category
Category not specified by user
Get number of transactions
Minimum number of transactions not met
Minimum number of transactions met
Display error message
Extract dates and balance amount from transaction history
Perform feature scaling and mean normalization
Perform gradient descent to get projection line graph
Budgets present
Predict budget states based on projection line
Display Success Message

Figure 11. Activity Diagram of the Project Command

Graphical Representation

A graphical representation of the *user*'s projections may be rendered using the `display` command.

Future Enhancements

Polynomial Regression

For simplicity of logic and design, the current implementation performs linear regression (via gradient descent), projecting user balance and budget states using a best-fit straight line. Ultimately, income and spending trends may not be best represented by a straight line, but rather by a polynomial equation. In future updates, the `projection` feature will choose a value, *n*, and perform a *n-th* degree polynomial regression, such that the user's balance and budget states can be more accurately projected.

NOTE	Currently, the GradientDescent class implements feature scaling and mean normalisation. Although this is not entirely necessary for the current implementation (which uses linear regression), it is meant for optimizing polynomial regression in future updates.

Normal Equation

Currently, the gradient descent algorithm is used to plot the projection graph, which is used for predicting the *user*'s balance and budget states at specified point in time. For smaller data sets, analytically computing the normal equation to find the best-fit line graph may have result in a faster runtime. In future updates, the normal equation method will be used in place of the gradient descent algorithm, for projections with less than a set number (e.g. 500) of transactions.

Design Considerations

Display Feature: `display`

This feature provides a graphical view of an existing projection to the *user*.

Current Implementation

Given below is an example usage scenario and how the display command executes at each step.

Step 1. The user launches the application.

Step 2. If the user does not have any existing projections, he / she creates one or more projections. Then, the user executes the `display` command.

Step 3. Upon executing the command, `LogicManager` uses `MainParser#parse()` to parse the input from the user.

Step 4. `MainParser` determines which command is being used and creates `DisplayCommandParser` to further parse the input from the user.

Step 5. `DisplayCommandParser` parses the argument and checks if a valid type and index was provided.

- If an invalid type or index was provided, or if no type or index was provided, `DisplayCommandParser` throws an exception and terminates.
- Otherwise, it returns a `DisplayCommand`, which contains a `Type` and an `Index` specified by the user.

Step 6. `LogicManager` uses `ProjectCommand#execute()` to display the specified `projection` in a new window.

Step 7. `DisplayCommand` returns a `CommandResult` to the `LogicManager` and the result will be displayed to the user at the end.

The following activity diagram depicts how the `display` command is executed.

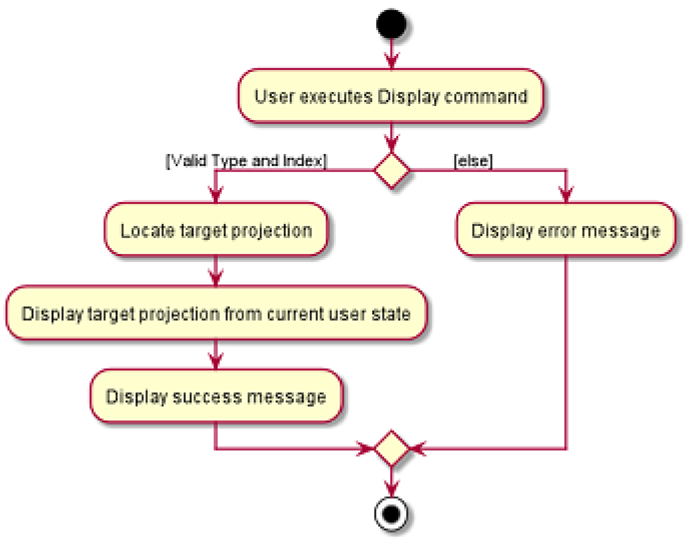


Figure 12. Activity Diagram of the Display Command

For a more concrete illustration of how the `display` command is handled by *PalPay*, a sequence diagram is provided below.

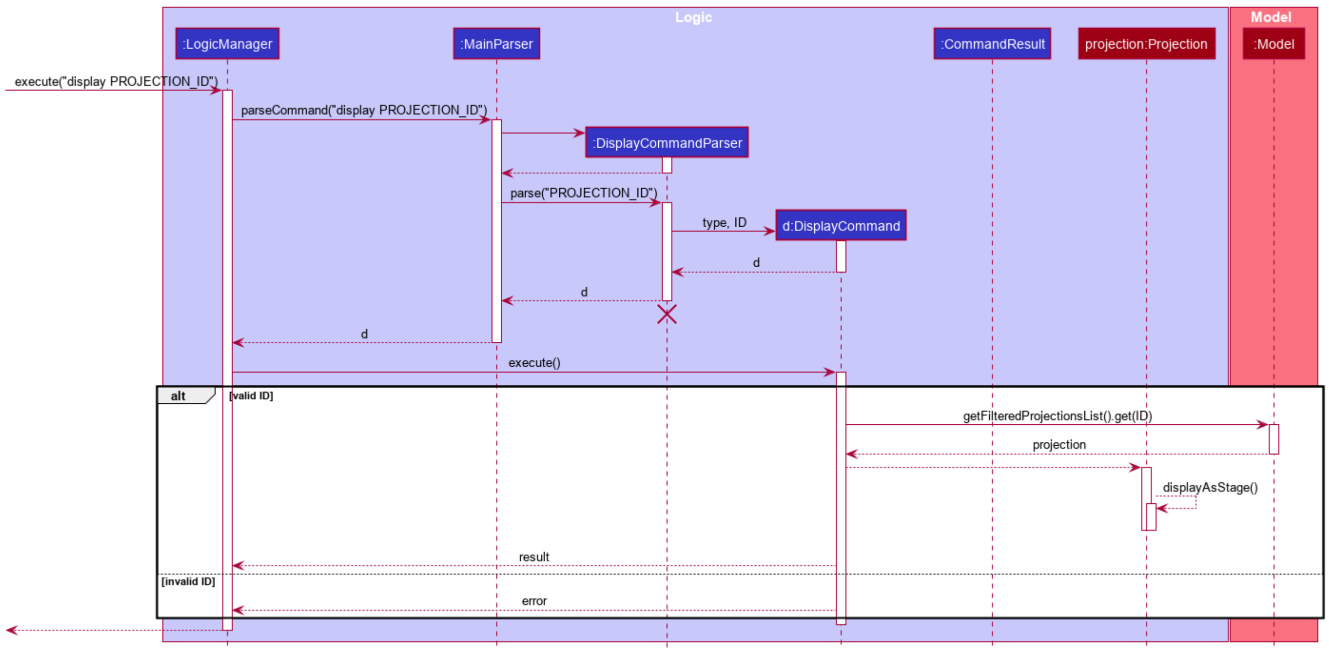


Figure 13. Sequence Diagram of the Display Command