

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 various functions associated with it.
 - What it does:
 - Uses [Gradient Descent](#) to project the user's account balance in the future
 - Allows users to predict whether they will meet their budget goals based on past income/outflow trends
 - Justification: While most finance tracking applications have relatively robust income/outflow tracking functions, few offer the ability to project future financial states - something which is sorely needed for effective financial planning
 - Highlights: By utilizing the Gradient Descent algorithm, the **Projection** feature is guaranteed to find the best-fit projection line graph based on past transactions, with an extremely minute error tolerance ($= 1E-11$). The feature also automatically adjusts all relevant projections whenever transactions or budgets are added, deleted or updated, offering considerable convenience to the user, who thus does not need to update them manually.
- **Minor enhancement:** Developed the **display** feature, which offers an elegant, graphical representation of the user's projections.
- **Other contributions:**
 - Project management:
 - Authored and assigned multiple issues. (Issues: [#82](#), [#84](#), [#17](#), [#19](#), [#20](#))
 - Reviewed and merged pull requests. (Pull requests: [#60](#), [#23](#))
 - Performed optimizations and fixed numerous bugs. (Examples: [#125](#), [#67](#))

- Enhancements to existing features:
 - Refactor `AddressBook` into `BankAccount` and `AddCommand` into `InCommand`, such that *PalPay* had its first entry point. (Pull requests: [#27](#))
 - Refactor various JSON-adapted files and enabled *PalPay*'s `Storage` functionality. (Pull request: [#27](#))
 - Extended Java's in-build `Date` class to support parsing and comprehensive checking, which currently supports all commands in *PalPay* (Pull request: [#86](#))
- Documentation:
 - Wrote comprehensive documentation for the following commands in both the User Guide and the Developer Guide:
 - `project`
 - `display`
 - Created UML diagrams to help in the explanation of the `project` and `display` commands in the Developer Guide.
- Community:
 - Reported bugs and suggestions for other teams in the module. (Examples: [W13-4 #147](#), [W13-4 #148](#), [W13-4 #149](#),)

Contributions to the User Guide

Given below are sections I contributed to the User Guide. They showcase my ability to write comprehensive and concise documentation for non-technical 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

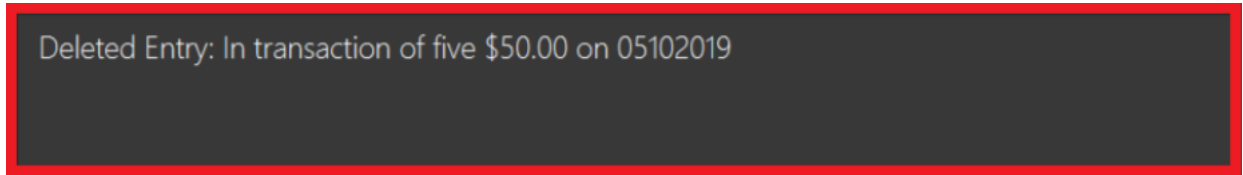
Figure 1. Five transactions under the projection tab



1.	150.00	[GENERAL]	20112019
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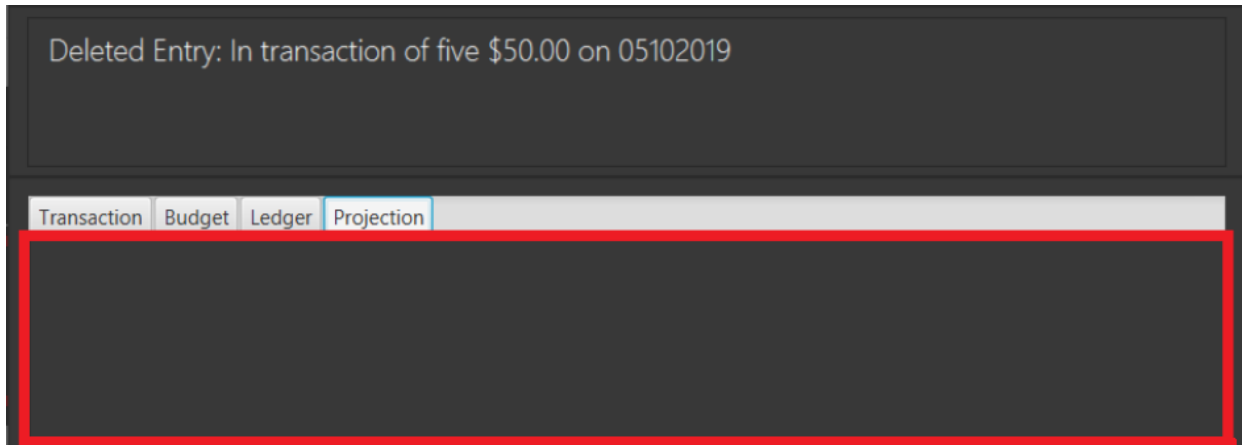
Figure 2. A projection which is cast based on the 5 transactions above

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 3. The fifth transaction has been deleted.



Deleted Entry: In transaction of five \$50.00 on 05102019
Transaction Budget Ledger Projection

Figure 4. 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

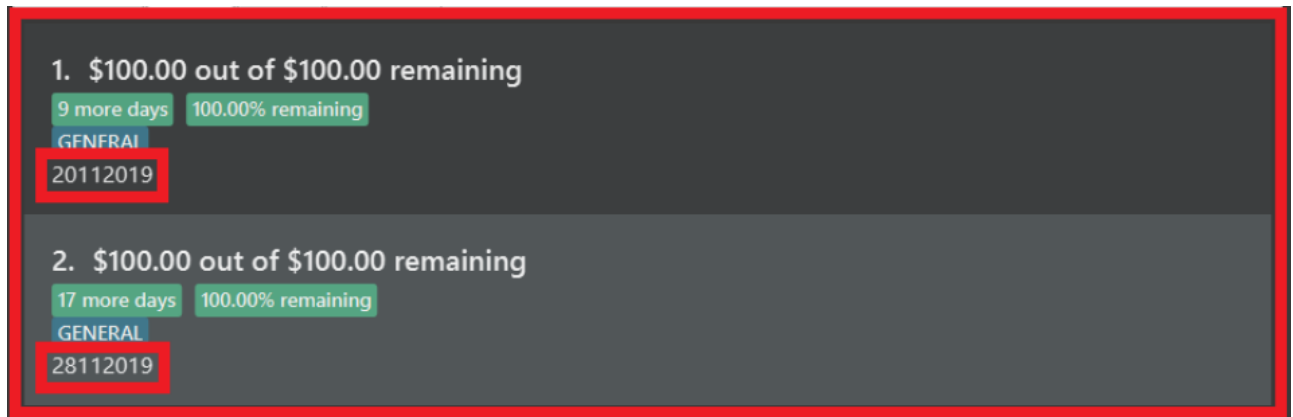


Figure 5. Two budgets with dates 20112019 and 28112019 in the "GENERAL" category

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.



Figure 6. 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.

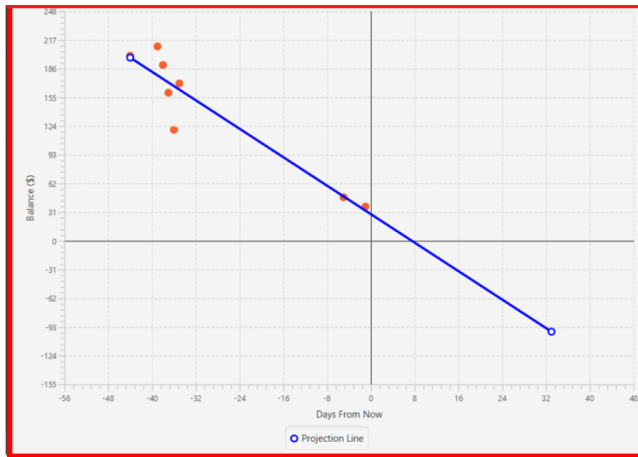
Format: **display** PROJECTION_ID

Example Usage

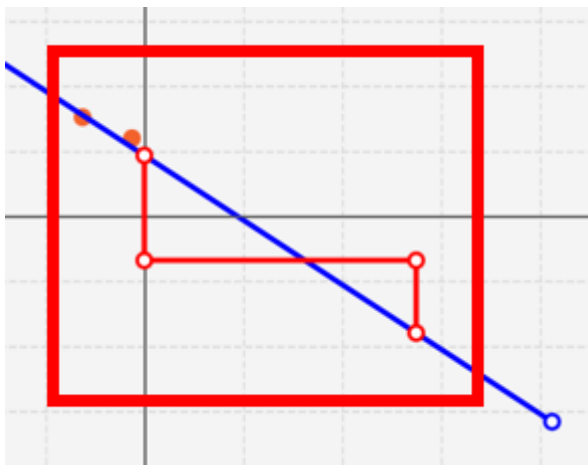
1. Type **display** PROJECTION_ID into the command box and press **Enter**. For instance:

```
display p1
```

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

- **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:

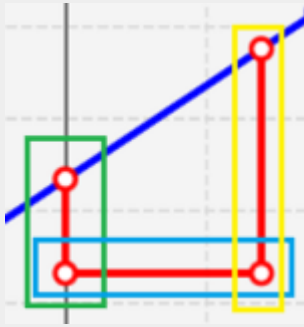


Figure 7. A budget line graph with its parts labelled by a green, blue and yellow box each

1. The line in the green box denotes the budget amount in dollars (\$).
2. The line in the blue box denotes the budget's duration lifetime in days.
3. The line in the yellow box denotes the budget's projected deficit or surplus.

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 design and implement complex features through code, as well as my technical competencies in Java.

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.

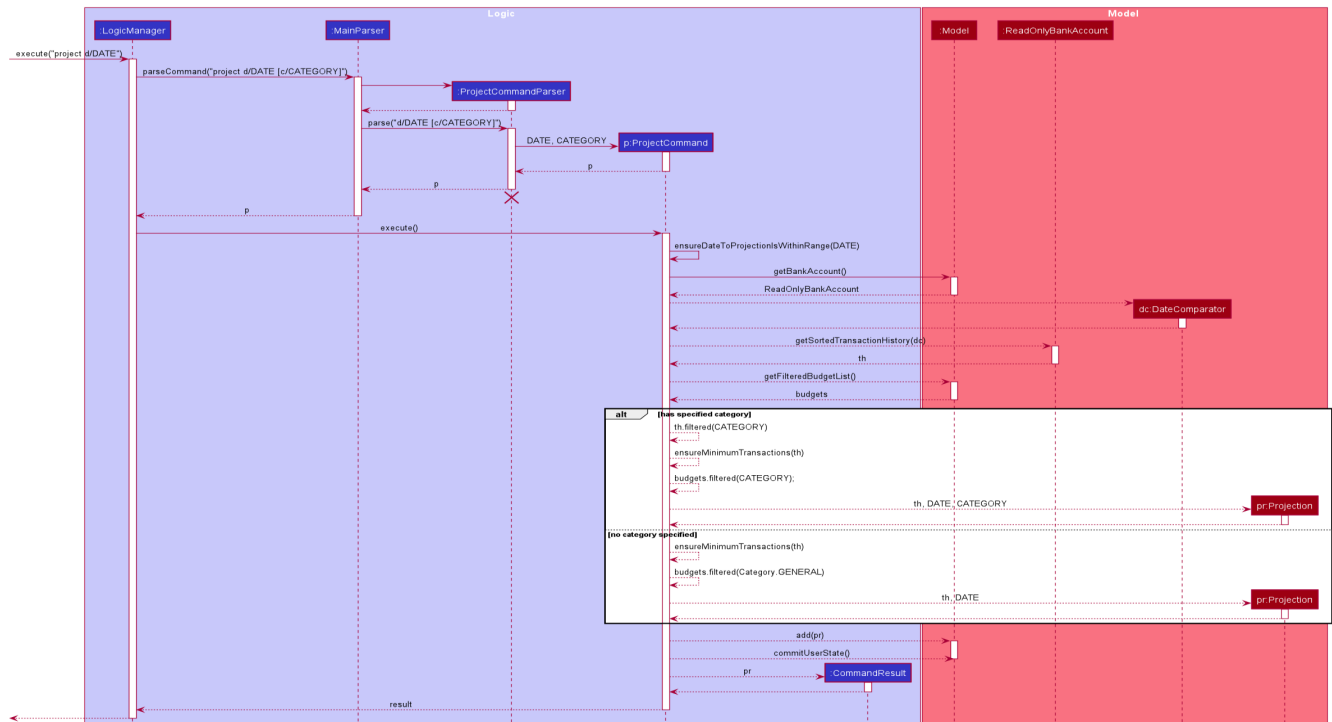


Figure 8. Sequence Diagram of the Project Command

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. ===== Activity Diagram

The activity diagram below depicts how a projection is made.

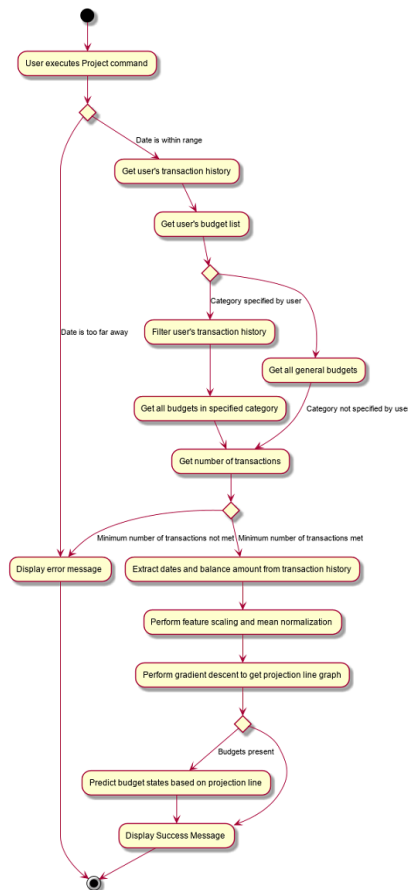


Figure 9. Activity Diagram of the Project Command

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

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

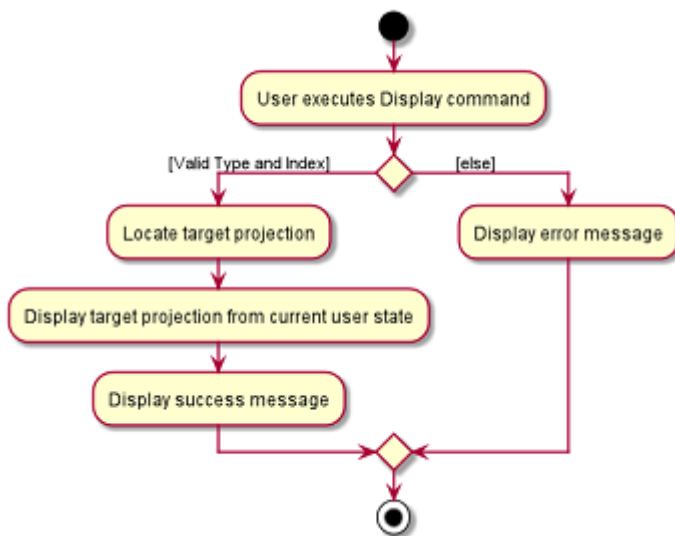


Figure 10. Activity Diagram of the Display Command

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

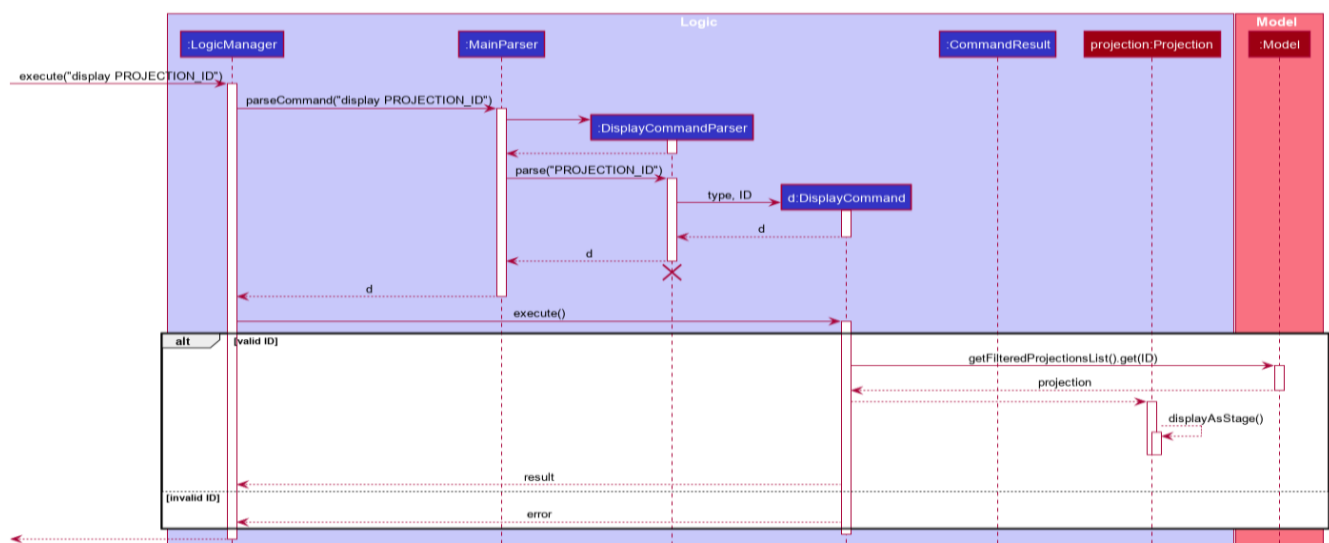


Figure 11. Sequence Diagram of the Display Command