Sahil S/O Sanjeev Gathani - Project Portfolio

Overview

This document serves as an overview of my contributions to the StudyBuddyPro project. This project was part of an introductory software engineering module known as **CS2103T**. Moreover, the document aims to highlight my technical competence and documentation skills by using the StudyBuddyPro project as an example.

StudyBuddyPro was developed by me, Samuel Lim, Chan Jun Ren, Chen Kai Bin and Jasmine Yeo Jia Min, all sophomore students from National University of Singapore (NUS) studying Computer Science.

Introduction

StudyBuddyPro is a desktop application designed for university students in computing-related fields to supplement their revision. StudyBuddyPro aims to consolidate commonly used studying tools into one integrated platform so the student does not have to fuss about switching between different applications. This prevents disorganisation and improves convenience.

StudyBuddyPro was developed for use through a Command Line Interface (CLI) to take advantage of the typing proficiency of computing students. However, a Graphical User Interface (GUI) is also provided for easier viewing, therefore providing the best of both worlds.

StudyBuddyPro has 3 main features: Flashcard, Notes and Cheatsheet. The purpose of each feature is summarized in the table below.

Table 1. Features table

Feature	**Purpose**
Flashcard	Create flashcards for quick revision and effective retention
Notes	Create general-purpose notes
Cheatsheet	Create and customize cheatsheets from relevant content found in Flashcard and Note features

Summary of contributions

This section provides an overview of the technical and non-technical contributions I made to the development of StudyBuddyPro. They highlight my ability to:
1) Design, model and implement features that are appropriate for our target users.
2) Work in a software development team setting and handle non-technical tasks.
3) Design test cases and write quality code that abides by software engineering principles.
You can find an overall summary of my contributions at my RepoSense.

- **Major Feature Enhancements**
  - Developed the Flashcard `Model`, `Logic` and `Storage` components. This enhancement provides the functionality for one of the three core features in the StudyBuddyPro application. Without it, the application would be missing a key revision tool that students could have used and the application would be less attractive to the target market.
    - What this enhancement included:
      - The `Flashcard` object model and its components such as `Question`, `Answer`, `Title` and `Statistics` objects.
      - Basic commands to use the flashcard model such as `add` and `list`. Advanced features such as the **remind** feature.
      - Saving to and reading from storage files.
    - **Depth**:
      - Implementing this enhancement required a deep technical understanding of the architecture of the software as it modified 3 out of the 4 major components.
    - **Completeness**:
      - The enhancement is fully functional and goes beyond the basic needs of the user.
      - Advanced features like the **remind** feature makes use of scientifically established spaced repetition techniques and automatic reminders so the user can effectively revise.
    - **Effort**:
      - The enhancement modified and improved existing commands, while also linking various commands which was very tricky to implement.
      - The quantity of features added in this enhancement made it very time-consuming.
- **Minor Feature Enhancements**
  - Added a `CommandHistory` class that stores all commands a user inputs while using StudyBuddyPro.
    - This class was used to develop the **remind** feature described earlier.
    - This class was later used by my teammates to improve the existing `delete` commands in all features. This provided an additional layer of safety for the user by preventing accidental deletions.
  - Added a **Flashcard Bank** that provides users with a set of useful flashcards when the application first starts up.
    - The flashcards contained helpful tips for computing students (our target demographic).

        - This feature was also used during the product demo of our application for the module.
    - Code quality
        - Refactored `CommandResult` that all other features used to have separate classes to make codebase more object-oriented. (Pull request #195)
        - Refactored `Storage` that all other features used to abide by the interface segregation principle. (Pull request #340)
        - Added more specific exceptions such as `DuplicateFlashcardQuestionException` and `DuplicateFlashcardTitleException` rather than generic exceptions such as `DuplicateFlashcardException`. This provided better logging for developers.
- **Other contributions**
    - Project Management
        - Set-up the GitHub developers page for our team.
        - Managed milestone v1.0 and v1.1 on GitHub. (2/5 milestones)
        - Managed the issue tracker for our project repository by assigning issues, cross-referencing pull requests with issues and closing issues when completed. (Pull request #340, Issue #301)
    - Testing
        - Wrote all test cases for Flashcard model. (Pull requests #321, #333, #337)
        - Wrote some test cases for Flashcard commands such as `add` and `remind`. (Pull request #321)
        - Wrote all test cases for overall StudyBuddyPro `Storage` component. (Pull request #340)
        - Overall, increased coverage by more than 5%.
        - Tools:
            - Integrated Travis CI, a continuous integration service, into our repository.

Contributions to the User Guide

> *Given below are sections I contributed to the User Guide. They showcase my ability to write clear and concise documentation that helps the non-technical end user use the application. I also took active effort to ensure my writing was as friendly and inviting as possible.*

Introduction

StudyBuddyPro is a student application that aims to simplify the hassle of revision by providing a suite of tools for effective revision.

StudyBuddyPro is optimized for students who prefer to work with a Command Line Interface (CLI) while still having the benefits of a Graphical User Interface (GUI).

Moreover, StudyBuddyPro comes geared with pre-loaded features specially catered for computing

students. So whether you're a computing student getting used to a CLI for the first time or if you're a CLI expert who wants to reap the benefits of a fast typing speed, give StudyBuddyPro a try!

If you're interested, head over to the Quick Start section to get started!

Quick Start

NOTE	Please ensure you have Java 11 or above installed before proceeding!

1. Download the latest version of `StudyBuddyPro.jar` here.
2. Place the file in the folder you want to set as the home directory. All data and miscellaneous files associated with StudyBuddyPro will be placed in this folder.
3. Double-click `StudyBuddyPro.jar` to launch the application. The GUI should appear in a few seconds, and should look like the screen shown below. If not, please refer to the first question in the FAQ for help!

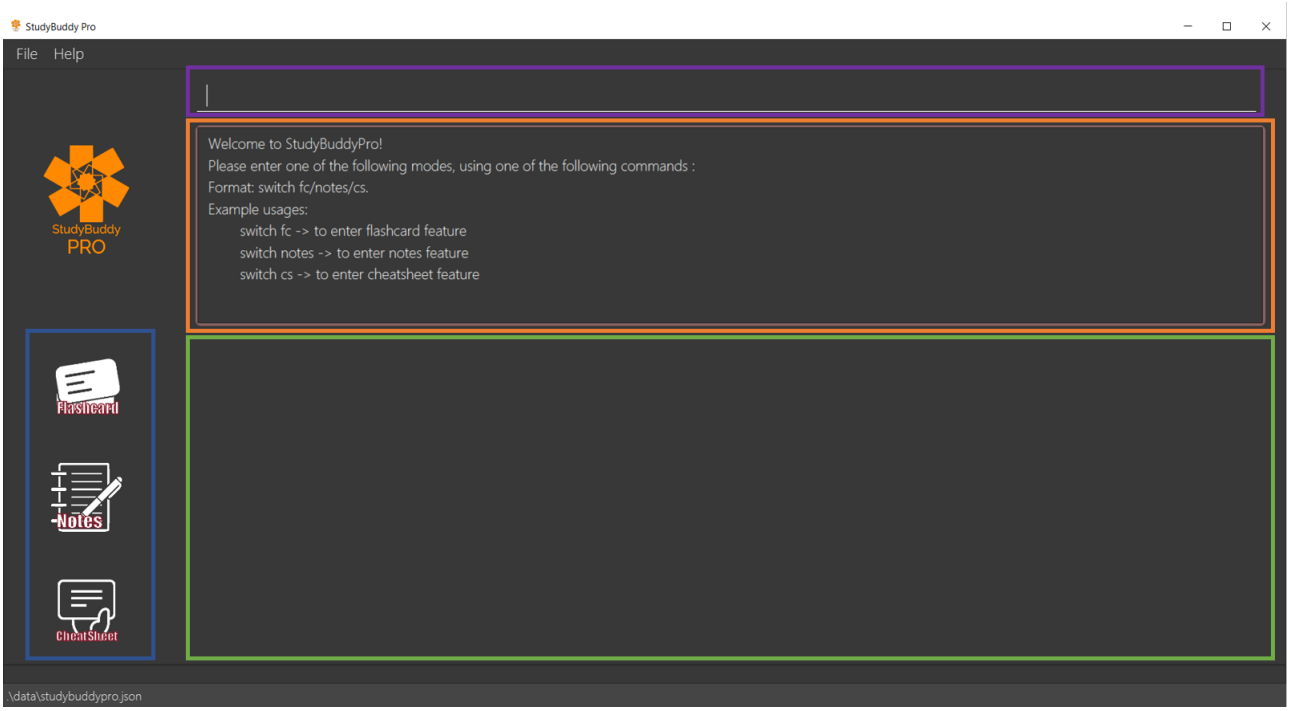


Figure 1. GUI of StudyBuddyPro application displayed on startup

4. Type a command in the command box execute it by pressing *Enter*. Typed commands will appear in the CLI highlighted in the purple box in the diagram above. Refer to the Command Summary section for a quick overview of all the available commands!

TIP	The blue box in the diagram above with the "Flashcards", "Notes" and "Cheatsheets" logo can be used to quickly check which mode you are in! Switching into a mode will highlight the relevant mode's logo in an orange circle, as shown in this figure.

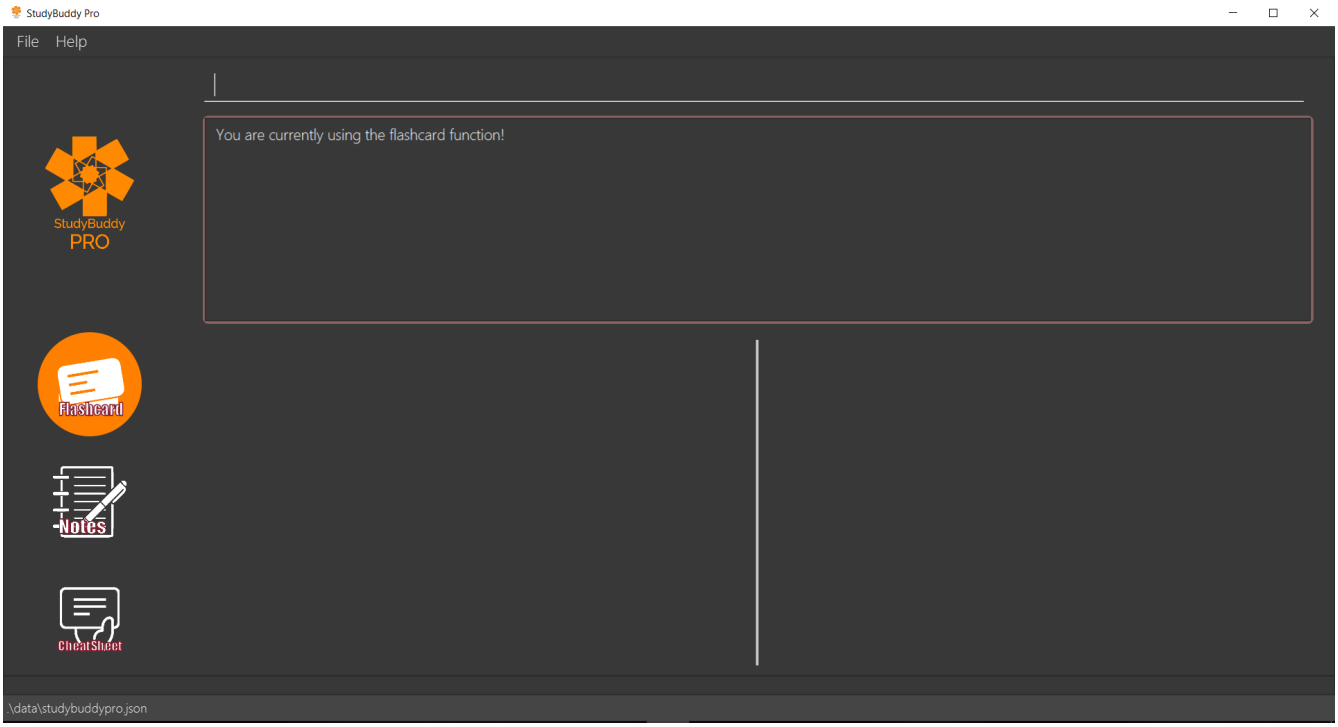
5. Output from the command will be shown in the boxes highlighted in orange and green in the diagram above. The green box is used to display a flashcard, note or cheatsheet while the orange box outputs feedback from commands.

Flashcard Feature

TIP	Good news - StudyBuddyPro comes with some preloaded flashcards, specially catered for you as a computing student! Be sure to take a look! Psst - here's a hint for our more tech-savvy users: You can delete your *flashcards.json* file in the StudyBuddyPro data folder to restore these default flashcards at any time. Of course, your current flashcards will be deleted as well!

Sick and tired of cramming all your revision at the last minute? Why not give our Flashcards feature a try! This feature can help you create your very own flashcards to help you consistently revise. With our built-in reminder features and timetrial modes to test yourself, use this feature and be on track to better revising habits today!

IMPORTANT	All the operations in this section assume that the user is in the *flashcard* mode. To be sure you are *flashcard* mode, please ensure you used the `switch fc` command before this. Your screen should now look like the one found in the screenshot below.



Find out what flashcards to revise today, or ones you may have missed: `remind`

This feature helps the user check which flashcards are due for revision today and which flashcards overdue for revision. StudyBuddyPro automatically sets the date the flashcard should next be viewed at for optimal learning. These increments also scale with time i.e. newer flashcards will have to be viewed more often.

TIP	Be sure to check in everyday to see which flashcards you have due!

NOTE	StudyBuddyPro only marks a flashcard as revised and removes it from the due and overdue flashcard list when you see the flashcard's *answer* not just its question! For example, simply using the `view` command without the `show` command to reveal the flashcard's answer will not trick the system. Sorry, it's for your own good!

Example usage:

```
remind
```

If no flashcards due for revision today and no overdue flashcards:

Expected output:

```
Well done - No due or overdue flashcards!
```

If there are flashcards due for revision today but no overdue flashcards:

Expected output:

```
Here are the flashcards due today:
1. Math Question 1 - What is 2 x 2?
```

If there are no flashcards due for revision today but there are overdue flashcards:

Expected output:

```
Here are your overdue flashcards:
1. Math Question 1 - What is 2 x 2? (Was due on 2019-10-30)
```

If there are both flashcards due for revision today and overdue flashcards:

Expected output:

```
Here are the flashcards due today:
1. Math Question 1 - What is 2 x 2?
Here are your overdue flashcards:
1. Math Question 2 - What is 3 x 2? (Was due on 2019-10-30)
```

Contributions to the Developer Guide

Given below are sections I contributed to the Developer Guide. They showcase my advanced technical knowledge through the depth of my contributions. They also showcase my ability to explain complicated technical information in an easy-to-read, digestible manner. This was achieved in a variety of ways, such as the use of examples and industry standard technical diagrams.

Remind Feature

NOTE For this section, a *due flashcard* refers to a flashcard that is due for revision today. In other words, the current date (according to the user's system date) matches the date the flashcard was next supposed to be viewed for optimum revision. Similarly, an *overdue flashcard* refers to a flashcard whose view date for optimum revision was *before* the current date. Further details on how the optimum revision date is calculated is provided in this section.

NOTE For this section the `remind` command refers specifically to the command itself, while the remind feature encompasses the entire feature and all the relevant classes.

Overview

This feature aims to help the user stay on track with the user's revision schedule through two other sub-features. The first sub-feature is the `remind` command which helps the user keep track of which flashcards are due or overdue for revision. The second sub-feature is integrated with the `exit` command and is illustrated in the activity diagram below. For example, a typical user may use the `exit` command to exit the application without realizing they still had due or overdue flashcards left to revise. StudyBuddyPro will automatically warn the user about these unrevised flashcards after which the user can decide if they wish to revise these flashcards or proceed to exit StudyBuddyPro anyway.

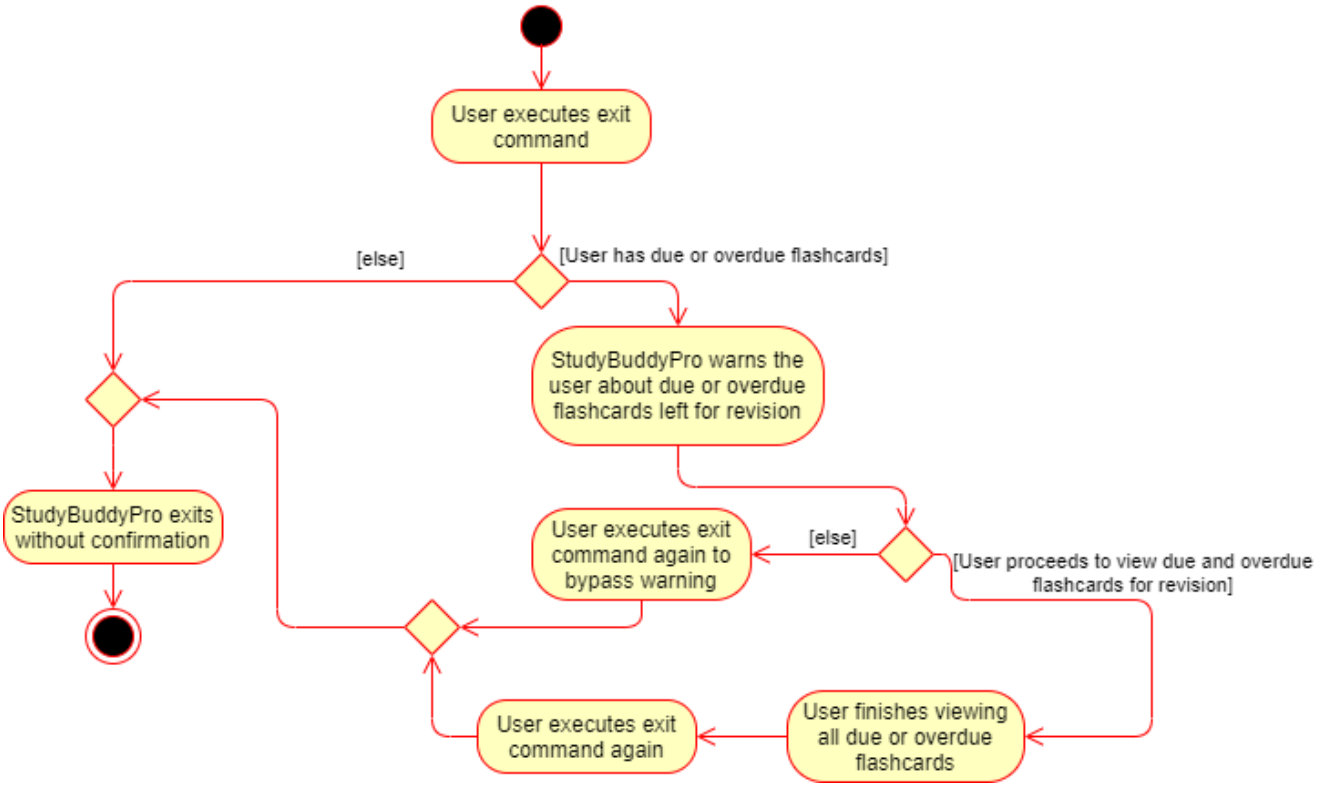


Figure 2. Activity diagram of user trying to exit StudyBuddyPro through the `exit` command

Implementation of `Statistics` class

In order to fully understand how the remind feature was implemented, it is important to understand how a flashcard stores the relevant data fields it needs such as its last viewed date. All the relevant statistics pertaining to each flashcard is contained within a `Statistics` object. Each `Statistics` object also has a `ScheduleIncrement`, which helps keep track of when the flashcard should be next viewed for optimum spaced repetition learning. The relationships between the `Flashcard`, `Statistics` and `ScheduleIncrement` classes are summarized in the class diagram below.

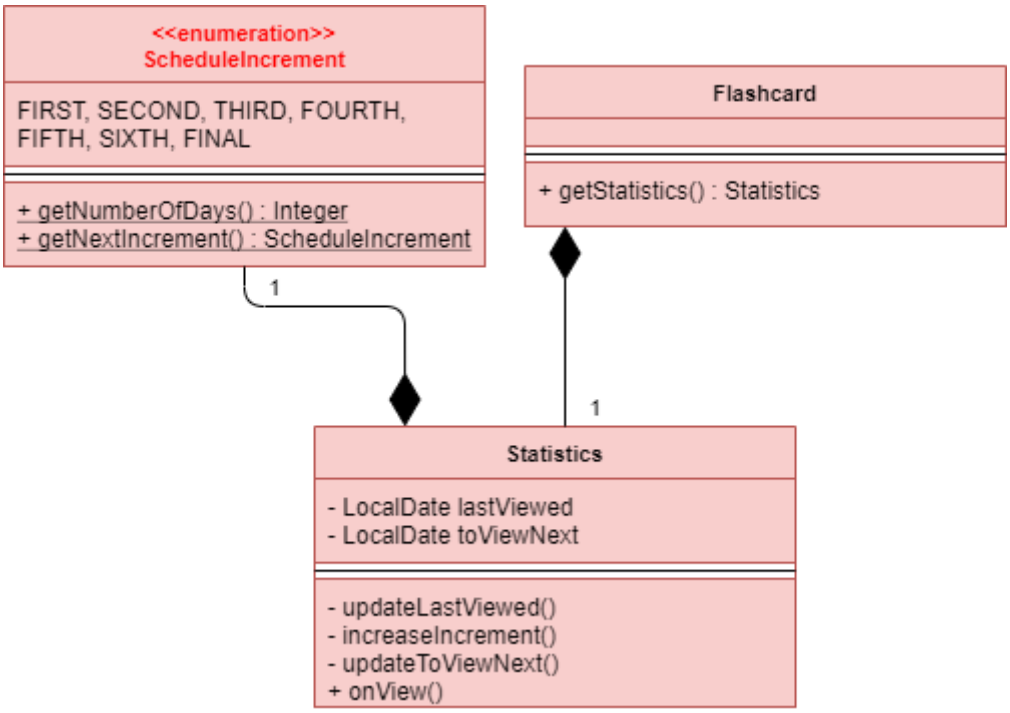


Figure 3. Class diagram of `Flashcard`, `Statistics` and `ScheduleIncrement` classes

TIP	There are currently 7 `ScheduleIncrements` implemented in StudyBuddyPro, each with a corresponding integer value. This integer values represent the number of days the flashcard should next be viewed (based on spaced repetition principles).

The interactions between the relevant classes can be illustrated through the following scenario:

Today's date is 10/10/2019. Jim decides to view a flashcard which was previously viewed on 7/10/2019 and was scheduled to be viewed on 8/10/2019.

Step 1. Jim views the flashcard, either through a `timetrial` or by specifically finding the relevant flashcard and viewing the flashcard's answer using the `view` and `show` commands.

Step 2. When the relevant command is called, the `Flashcard` object's `Statistics#onView()` method is invoked to update its statistics.

Step 3. The `onView()` method calls its helper functions in the specific order shown in the code snippet below. The order is significant as calling the `updateToViewNext()` method before the `increaseIncrement()` method would result in the wrong `ScheduleIncrement` being used to update the `toViewNext` attribute.

```
/**
 * Updates all fields from the described methods. To be used when a {@link Flashcard} is viewed.
 * Ensures lastViewed and toViewNext will never conflict and be the same date
 */
public void onView() {
    LocalDate currentDate = LocalDate.now();
    if (toViewNext.isEqual(currentDate) || toViewNext.isBefore(currentDate)) {
        updateLastViewed();
        increaseIncrement();
        updateToViewNext();
    } else {
        updateLastViewed();
    }
}
```

Figure 4. Code snippet of `Statistics#onView()`

Step 4. In this case, the "if" clause of the code snippet above is triggered since the `toViewNext` date *(8/10/2019)* was **before** the current date *(10/10/2019)*.

Step 5. The various helper methods execute their relevant functions to update their respective fields. For example, the `lastViewed` date is now updated to 10/10/2019.

Implementation of `remind` command

IMPORTANT	The following commands assume that the user is in the *flashcard* mode.

The `remind` command is facilitated by the `RemindFeatureUtil` class and extends the abstract `Command` class as summarized in the class diagram below. This diagram also provides a summary of the `Logic` components of the `remind` command.

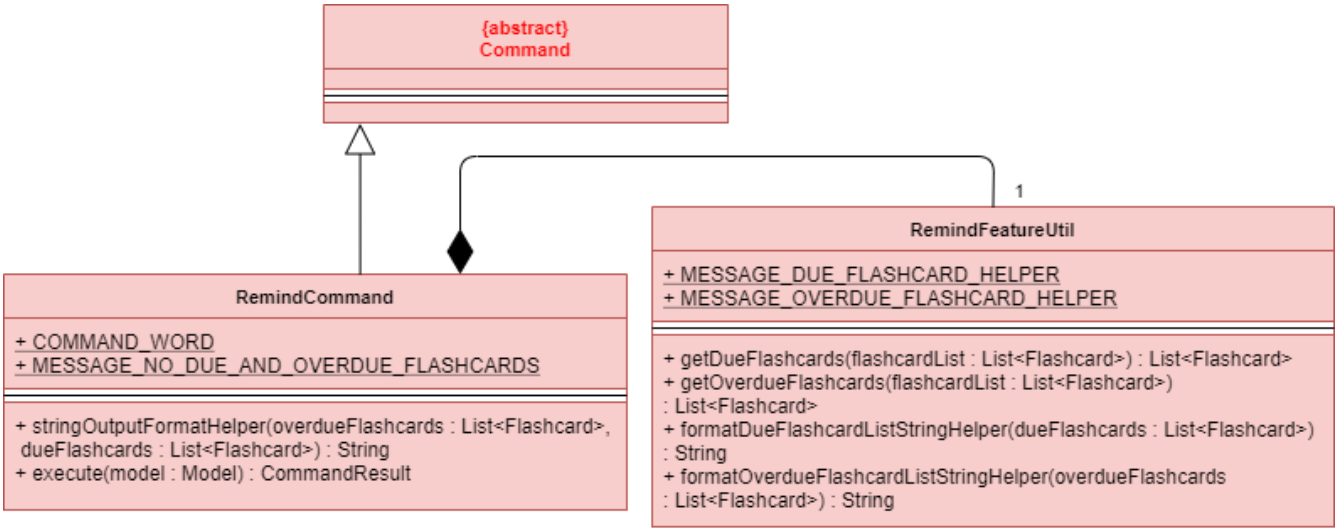


Figure 5. Class diagram of `RemindCommand`

The `remind` command also interacts with the `Model` component, specifically through indirect interactions with each `Flashcard` object currently in `StudyBuddyPro`. This was explained earlier through Figure 3.

The following example serves to provide an overview of the high-level architecture involved for the `remind` command.

Step 1. The user types "remind" and executes the command to check what flashcards the user has due.

Step 2. `MainWindow` would call `LogicManager#execute()` to hand over control flow to the `Logic` component.

Step 3. `LogicManager` parses the user input to determine which command is being called. After determining that a `remind` command is being executed, the relevant `RemindCommand` object is created.

Step 4. The `RemindCommand` object determines which flashcards are due and overdue, if any, and returns the output packaged in a `FlashcardCommandResult` object.

Step 5. `MainWindow` extracts the relevant output to be shown to the viewer from the `FlashcardCommandResult` and displays it.

These steps are illustrated in further detail in the sequence diagram below.

NOTE	As is standard in this Developer Guide, red classes are part of the `Model` package, blue classes are part of the `Logic` package, and green classes are part of the `UI` package.

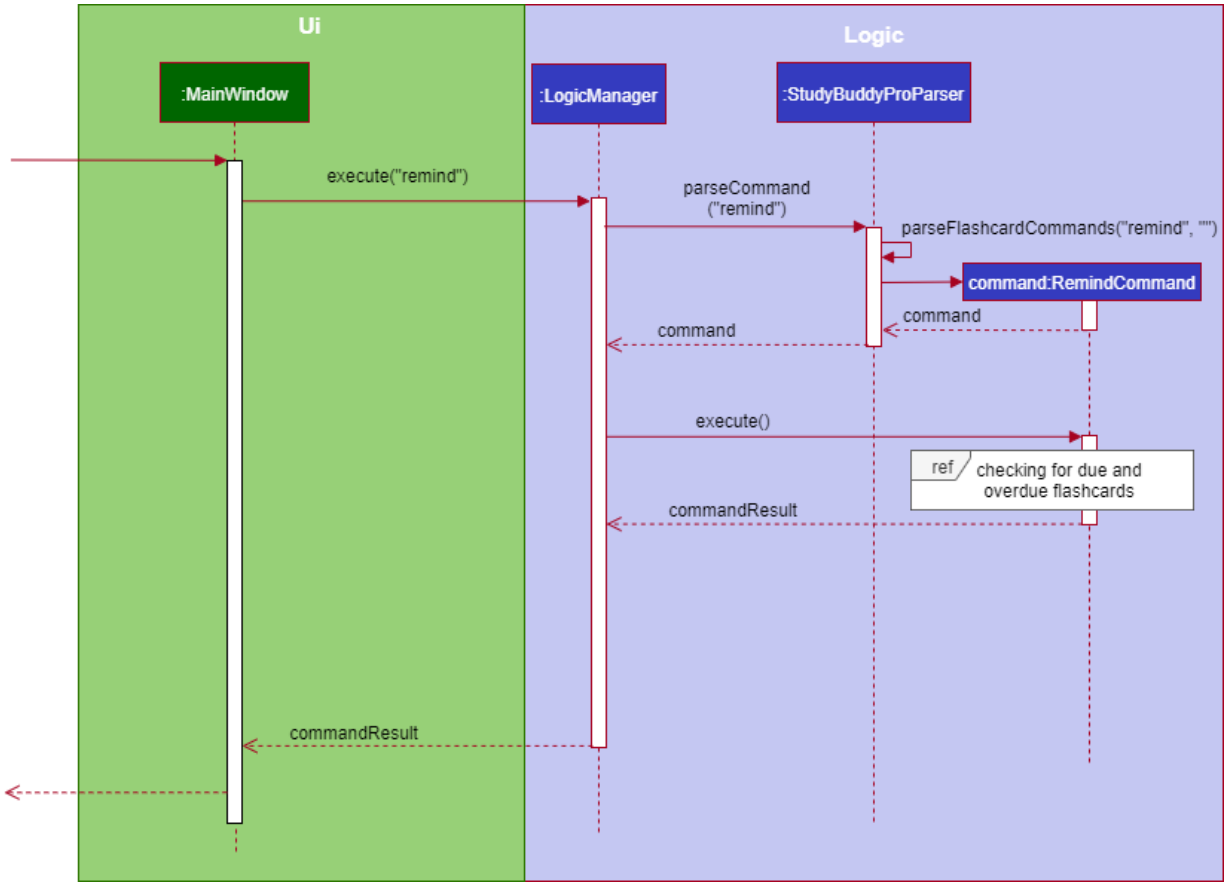


Figure 6. Sequence diagram of high-level overview of how the `remind` command works

With reference to **Step 4** above, the implementation of how the `RemindCommand` object determines which flashcards are due or overdue can be further examined. A broad overview is provided in the sequence diagram below and explained in further detail below the diagram.

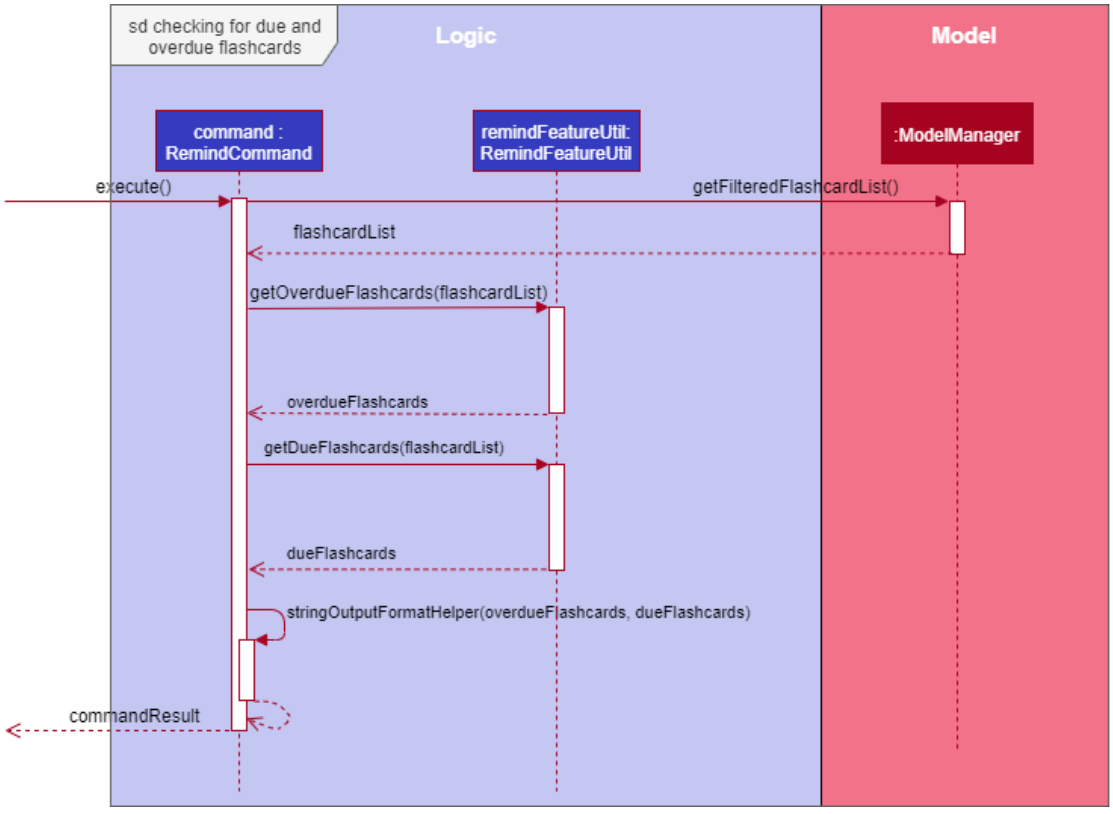


Figure 7. Sequence diagram of checking for due and overdue flashcards

- Whenever a `RemindCommand` object is created, it creates its own `RemindFeatureUtil` object.
- The `RemindCommand` object communicates directly with the `ModelManager` object through the exposed `Model` interface by calling upon the `ModelManager#getFilteredFlashcardList()` to get the current list of flashcards in the application.
- The `RemindCommand` passes the list of flashcards to its helper `RemindFeatureUtil` class which retrieves due and overdue flashcards through the `RemindFeatureUtil#getDueFlashcards()` and `RemindFeatureUtil#getOverdueFlashcards()` respectively.
- As seen from the code snippet below, overdue flashcards are collected by iterating through the entire flashcard list and checking if each flashcard's `toViewNext` attribute is before the current system date. The `toViewNext` attribute is not stored in the `Flashcard` object itself but rather in the flashcard's `Statistics` object. A similar approach is adopted to check for due flashcards.

```
/**
 * Gets flashcards that are overdue for revision from a given list of flashcards.
 * @param flashcardList list of flashcards to be checked
 * @return list of flashcards containing flashcards overdue for revision
*/
public List<Flashcard> getOverdueFlashcards(List<Flashcard> flashcardList) {
    List<Flashcard> overdueFlashcards = new ArrayList<>();
    LocalDate currentDate = LocalDate.now();

    //Gets overdue flashcards
    for (Flashcard f : flashcardList) {
        if (f.getStatistics().getToViewNext().isBefore(currentDate)) {
            overdueFlashcards.add(f);
        }
    }
```

Figure 8. Method to collect overdue flashcards from a given list of flashcards

- The two lists of due and overdue flashcards are formatted into a String and passed back through the `FlashcardCommandResult` object created.

Implementation of the `exit` command

TIP	The `exit` command is a global command and can be used in any mode, not just in the *flashcard* mode.

The `exit` command is implemented in a similar fashion to the `remind` command described above. Each `ExitCommand` also contains a `RemindFeatureUtil` object it uses to check which flashcards are due and overdue.

In addition, the `ExitCommand` object calls upon the `CommandHistory` object to check if the last command inputted was an `exit` command through the `CommandHistory#getLastCommand()` method. This was added to allow the double confirmation feature before the user can exit StudyBuddyPro while still having flashcards due or overdue for revision.

Design and Implementation Considerations

The following describe two major considerations

Implementation Consideration: How to keep track of when a `Flashcard` object was last viewed?

- **Alternative 1 (current choice):** Design a new `Statistics` class and make a `Flashcard` object store a `Statistics` object. The `Statistics` object then keeps track of the flashcard's last viewed date.
    - Pros: Using a separate `Statistics` class is more in line with Object-Oriented Programming (OOP) practices and means the same class can be adapted and used to track statistics of other objects in StudyBuddyPro in the future.
    - Cons: Additional class adds additional maintenance and issues such as difficulty converting this class into a format that can be saved and read.
- **Alternative 2:** Use an integer attribute field in each `Flashcard` object to keep track of how many times it was viewed.
    - Pros: Easier to maintain: The addition of a new class increases overall coupling compared to adding a single new attribute field.
    - Cons: Bad OOP practice and makes it difficult to implement future changes. It may be unclear what the integer value represents and makes debugging more difficult.

Design Consideration: Should the user be given the option to toggle the `exit` command reminder?

- **Alternative 1 (current choice):** User is not given the toggle option.
    - Pros: More in-line with target market. Since StudyBuddyPro is a revision tool the target market is likely to always want this feature and probably will not need to toggle it off.
    - Cons: Some users may face additional inconvenience when trying to exit StudyBuddyPro if they use StudyBuddyPro for other than its intended purpose. For example, a user that only wants to use the cheatsheet auto-generation feature may not care for the automatic reminder.
- **Alternative 2:** User is provided with the toggle option.
    - Pros: More flexibility and customizability of StudyBuddyPro to suit each individual user's needs.
    - Cons: Extra work required to implement the toggle feature. A user may toggle the reminder off when first using the application, and forget about the feature since it is now out of sight. Even if the user requires such an automatic reminding functionality in the future, they may have forgotten this feature existed.

[Proposed] Future improvements

- Improve the formula used for determining when flashcards should be revised.
    - We could take into account other factors such as user confidence level or number of times flashcard was answered correctly or incorrectly to create a more dynamic reminding

schedule.

- Introduce desktop notifications for the user.
    - As a user may not open StudyBuddyPro everyday, StudyBuddyPro can be integrated with the desktop system calendar to provide notifications when flashcards are due for revision.