TimeBook - Developer Guide

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1. Setting up

Refer to the guide here.

2. Design

2.1. Architecture

The ***Architecture Diagram*** given below explains the high-level design of the App:

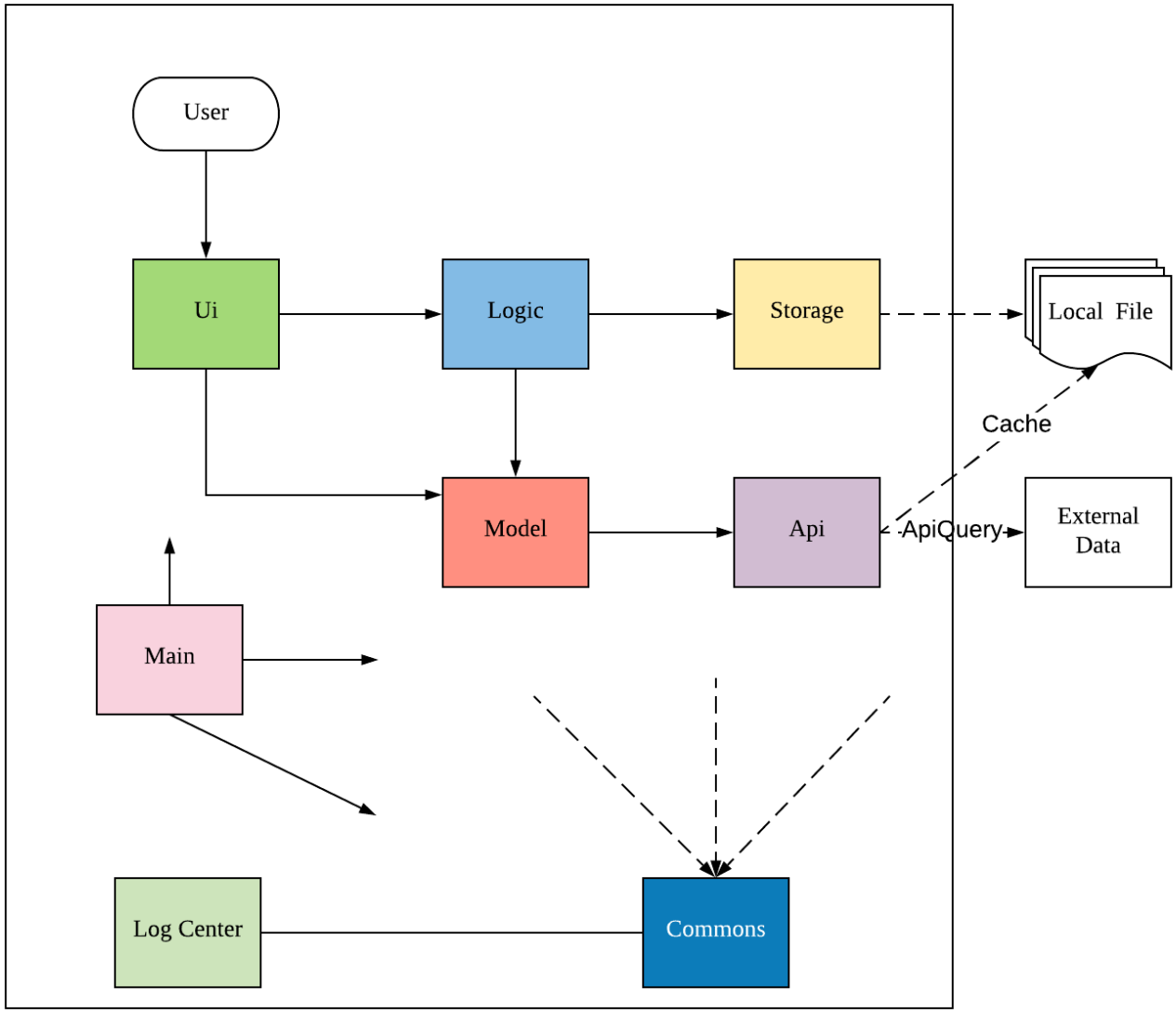


Figure 1. Architecture Diagram

Given below is a quick overview of each component.

TIP	The `.puml` files used to create diagrams in this document can be found in the diagrams folder. Refer to the Using PlantUML guide to learn how to create and edit diagrams.

`Main` has two classes called `Main` and `MainApp`. It is responsible for,

- At app launch: Initializes the components in the correct sequence, and connects them up with each other.
- At shut down: Shuts down the components and invokes cleanup method where necessary.

`Commons` represents a collection of classes used by multiple other components. The following class plays an important role at the architecture level:

- `LogsCenter` : Used by many classes to write log messages to the App's log file.

The rest of the App consists of five components.

- **`UI`**: The UI of the App.
- **`Logic`**: The command executor.
- **`Model`**: Holds the data of the App in-memory.
- **`Storage`**: Reads data from, and writes data to, the hard disk.
- **`Api`**: Make queries to external APIs, handles caching of API results to hard disk, and passes API data to other components.

Each of the five components

- Defines its *API* in an `interface` with the same name as the Component.
- Exposes its functionality using a `{Component Name}Manager` class.

For example, the `Logic` component (see the class diagram given below) defines it's API in the `Logic.java` interface and exposes its functionality using the `LogicManager.java` class.

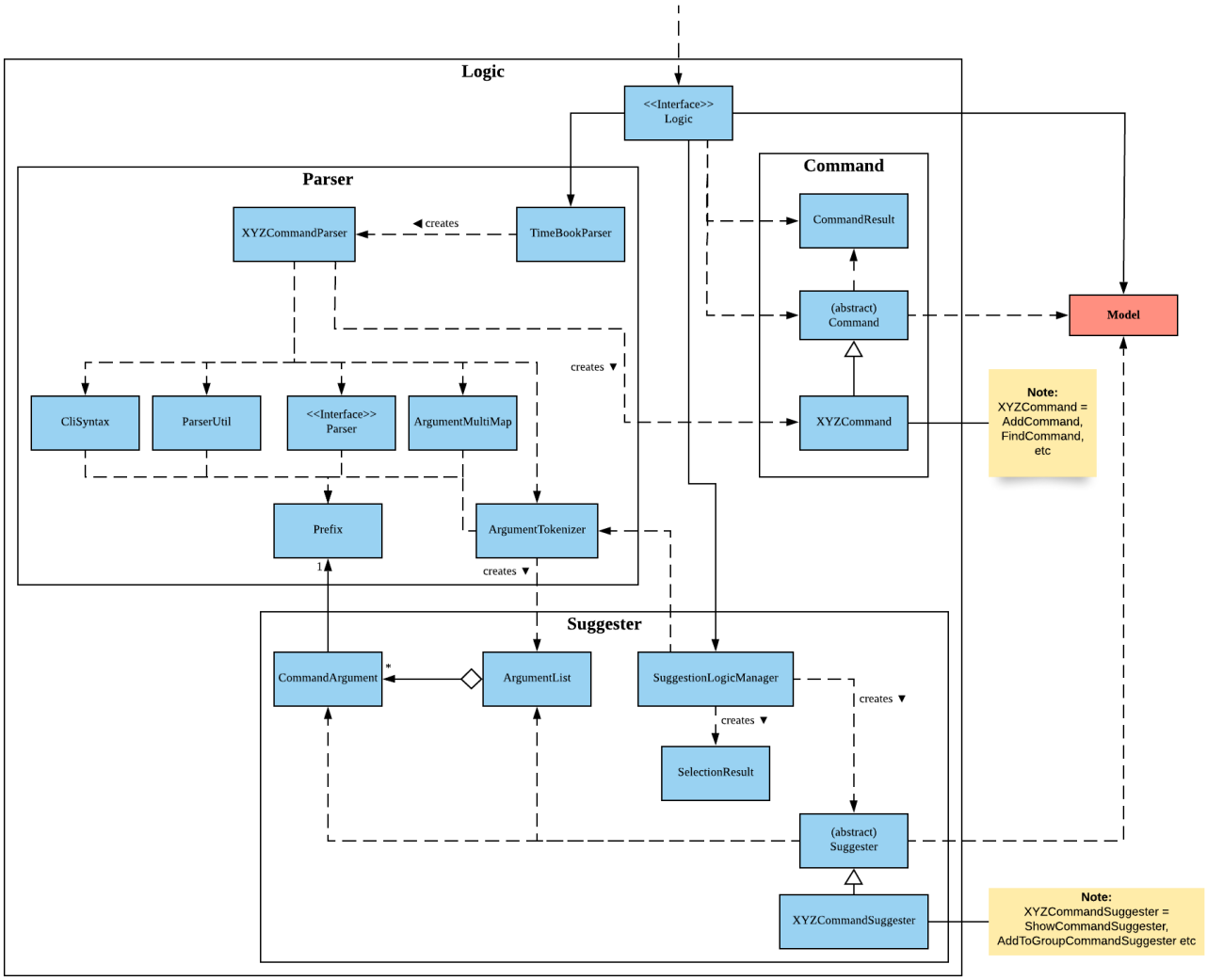


Figure 2. Class Diagram of the Logic Component

How the architecture components interact with each other

The *Sequence Diagram* below shows how the components interact with each other for the scenario where the user issues the command `addmod m/CS3230 cl/LEC:01`.

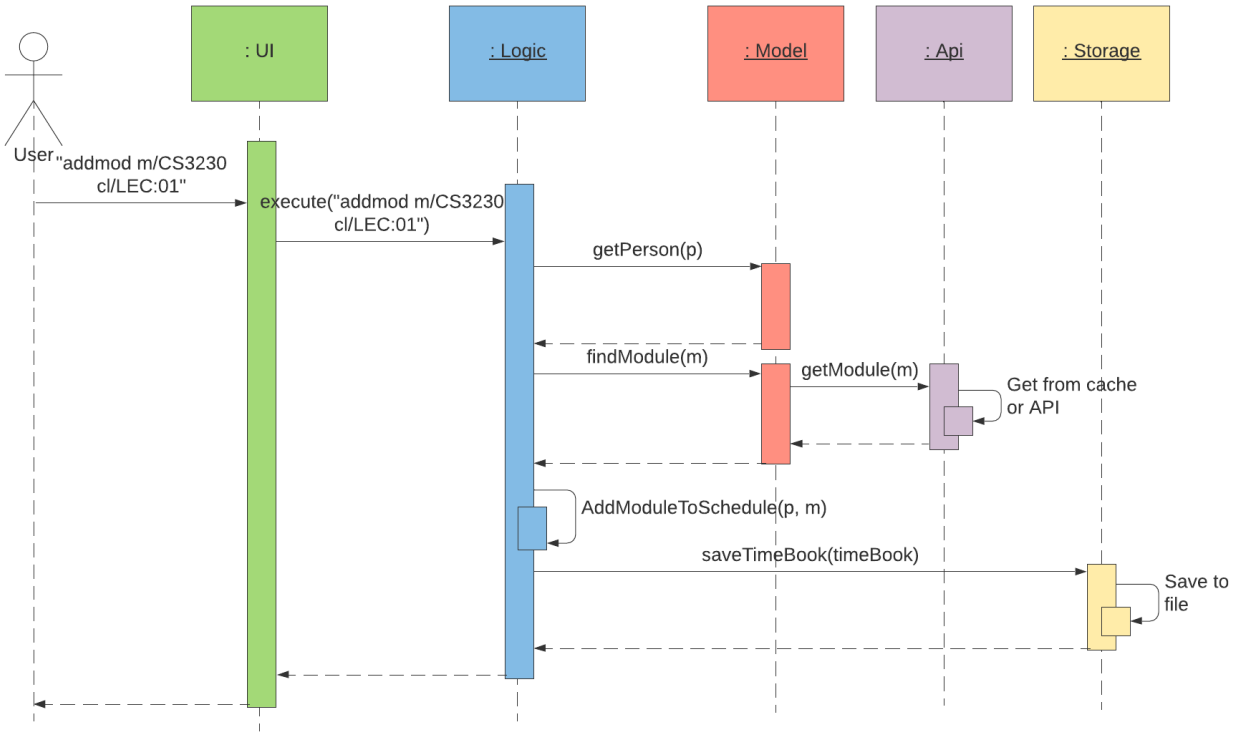


Figure 3. Component interactions for `addmod m/CS3230 cl/LEC:01` command

The sections below give more details of each component.

2.2. UI component

This section describes the various UI components that make up TimeBook's Graphical User Interface. The diagram below shows the full structure of the UI component.

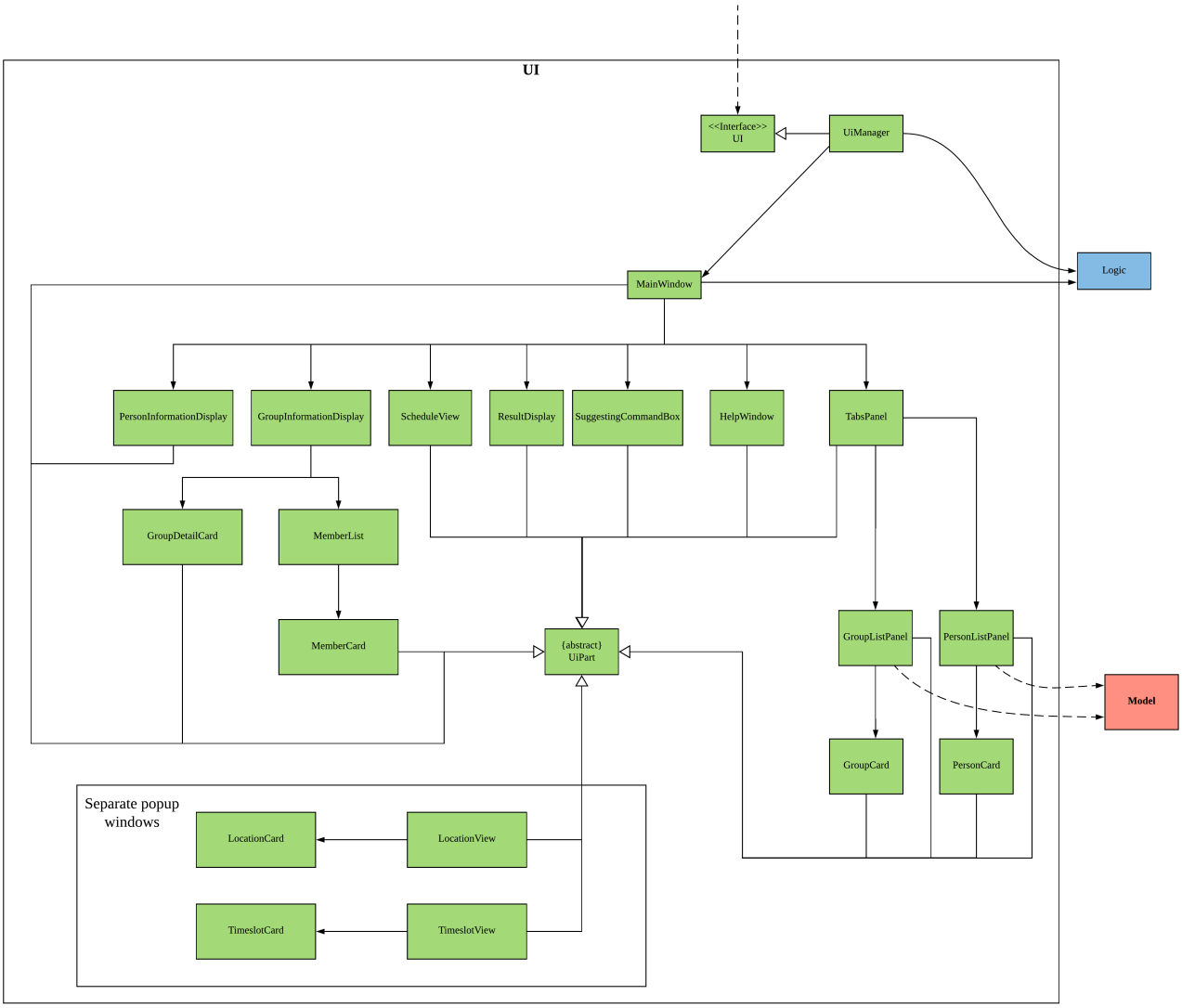


Figure 4. Structure of the UI Component

API : `Ui.java`

In general, TimeBook's UI consists of a `MainWindow` that is made up of the following main parts:

1. `CommandBox` — The box that users would key in commands to execute.
2. `ResultDisplay` — The box that would show response to the user after every command has been executed.
3. `TabPanel` — The tabs at the left side of the window. It displays the list of groups or persons that have been added to TimeBook.
4. `ScheduleView` — The display that contains the graphics of schedules belonging to individuals or groups.
5. `GroupInformationDisplay` — The display that contains in-depth information about the group.
6. `PersonInformationDisplay` — The display that contains in-depth information about the person.

Additionally, TimeBook also has a separate window for popups when users executes the `select` or `selectfreetime` commands. The major ui components for this separate window are `LocationView` and `TimeslotView`.

All these components, including the `MainWindow`, inherit from the abstract `UiPart` class. Note that not

all of these ui components are shown at any one point in time. For example, the TabPanel gets displaced with either GroupInformationDisplay or PersonInformationDisplay when a user executes commands such as `addgroup` or `addevent`. In a nut shell, the MainWindow will show different ui components depending on the command executed.

The `UI` component uses JavaFx UI framework. The layout of these UI parts are defined in matching `.fxml` files that are in the `src/main/resources/view` folder. For example, the layout of the `MainWindow` is specified in `MainWindow.fxml`

The `UI` component,

- Executes user commands using the `Logic` component.
- Listens for changes to `Model` data so that the UI can be updated with the modified data.

2.3. Logic component

The *Class Diagram* below shows the structure of the logic component:

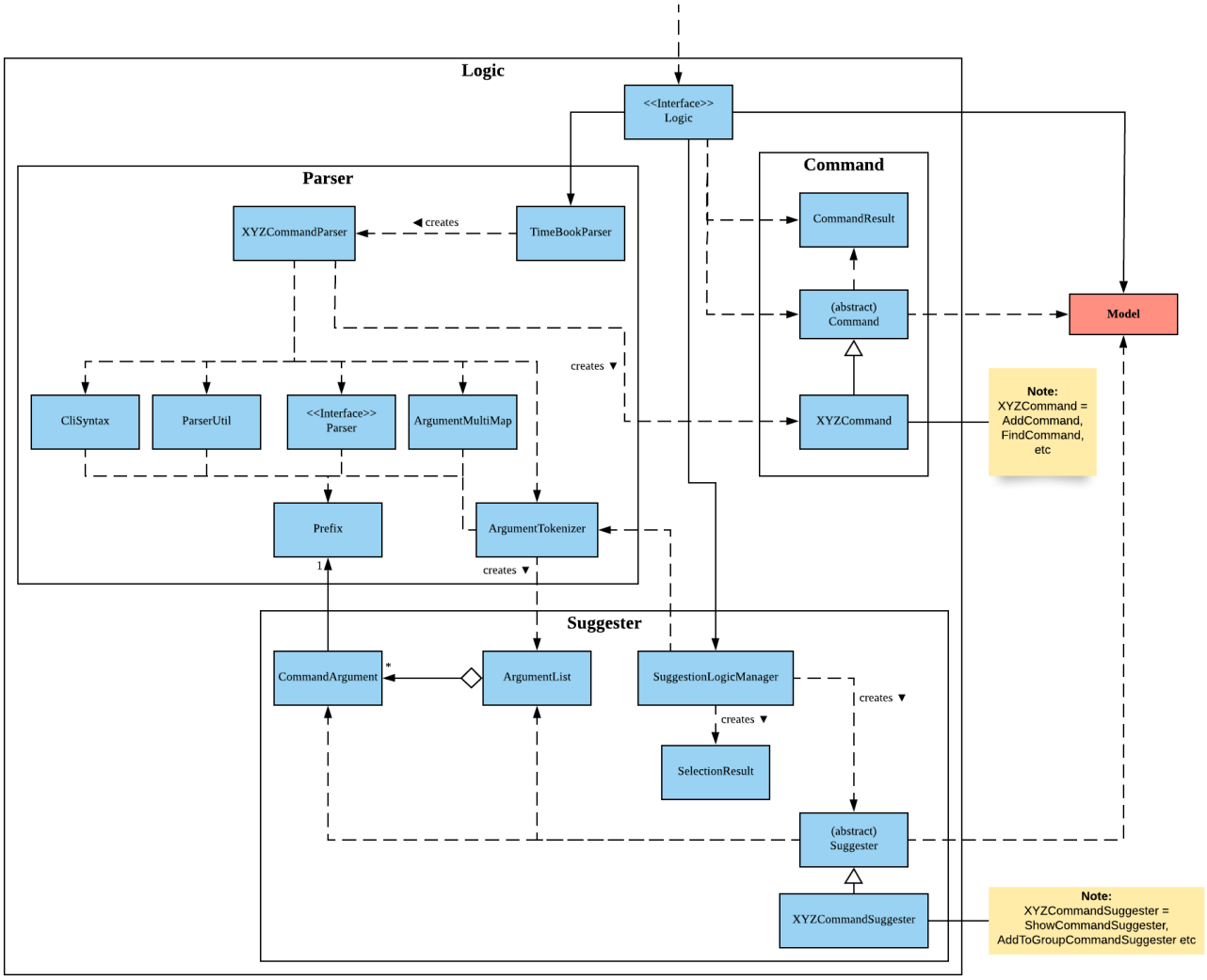


Figure 5. Structure of the Logic Component

API : `Logic.java`

1. `Logic` uses the `TimeBookParser` class to parse the user command.
2. This results in a `Command` object which is executed by the `LogicManager`.
3. The command execution can affect the `Model` (e.g. adding a person).
4. The result of the command execution is encapsulated as a `CommandResult` object which is passed back to the `Ui`.
5. In addition, the `CommandResult` object can also instruct the `Ui` to perform certain actions, such as displaying help to the user.

Given below is the Sequence Diagram for interactions within the `Logic` component for the `execute("delete 1")` API call.

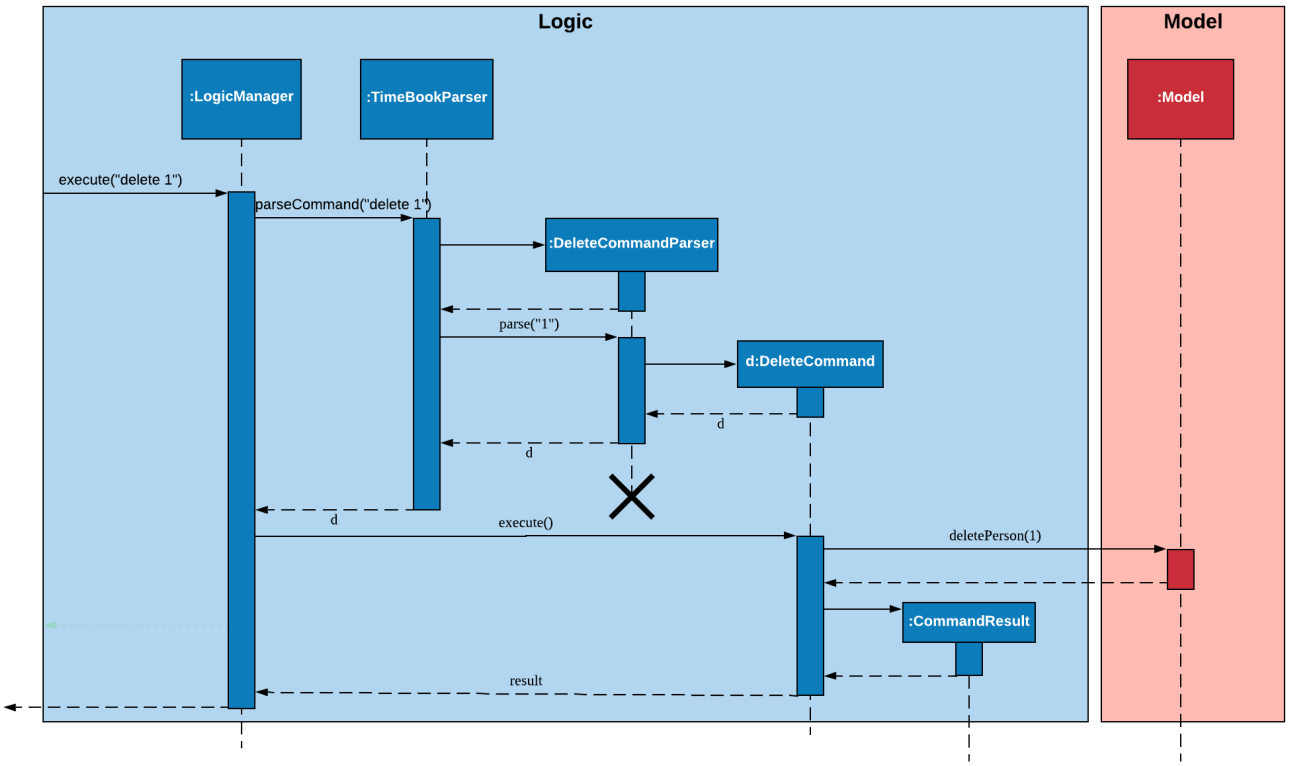


Figure 6. Interactions Inside the Logic Component for the `delete 1` Command

2.4. Model component

The following diagram provides a high-level overview of the Model component:

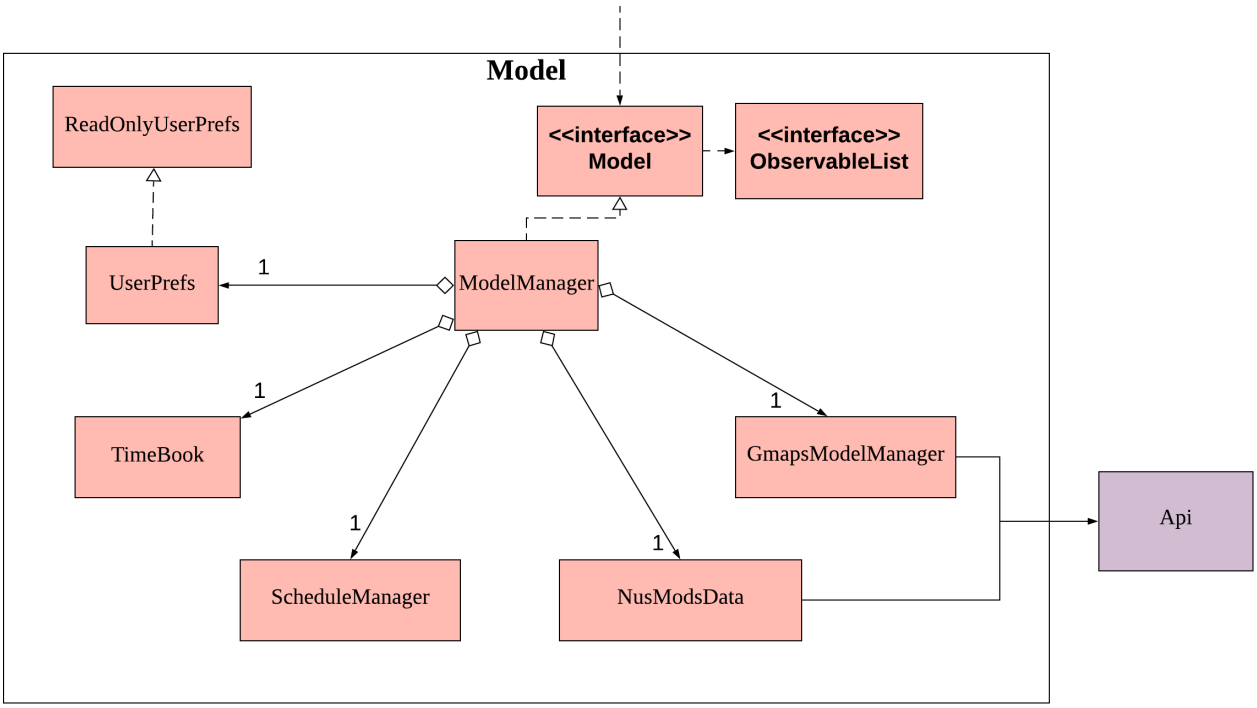


Figure 7. High-level structure of the Model Component

API : `Model.java`

The `Model`,

- stores a `UserPref` object that represents the user's preferences.
- stores a `TimeBook` object which contains data related to persons, groups and the mappings between them.
- stores a `ScheduleManager` object which contains data related to stateful UI.
- stores a `NusModsData` object which gets data related to NUSMods modules from the Api component and transforms them to be used by other components.
- stores a `GmapsModelManager` object which gets data related to Google Maps from the Api component and transforms them to be used by other components.

The following diagram provides a more detailed look into the `TimeBook` sub-component:

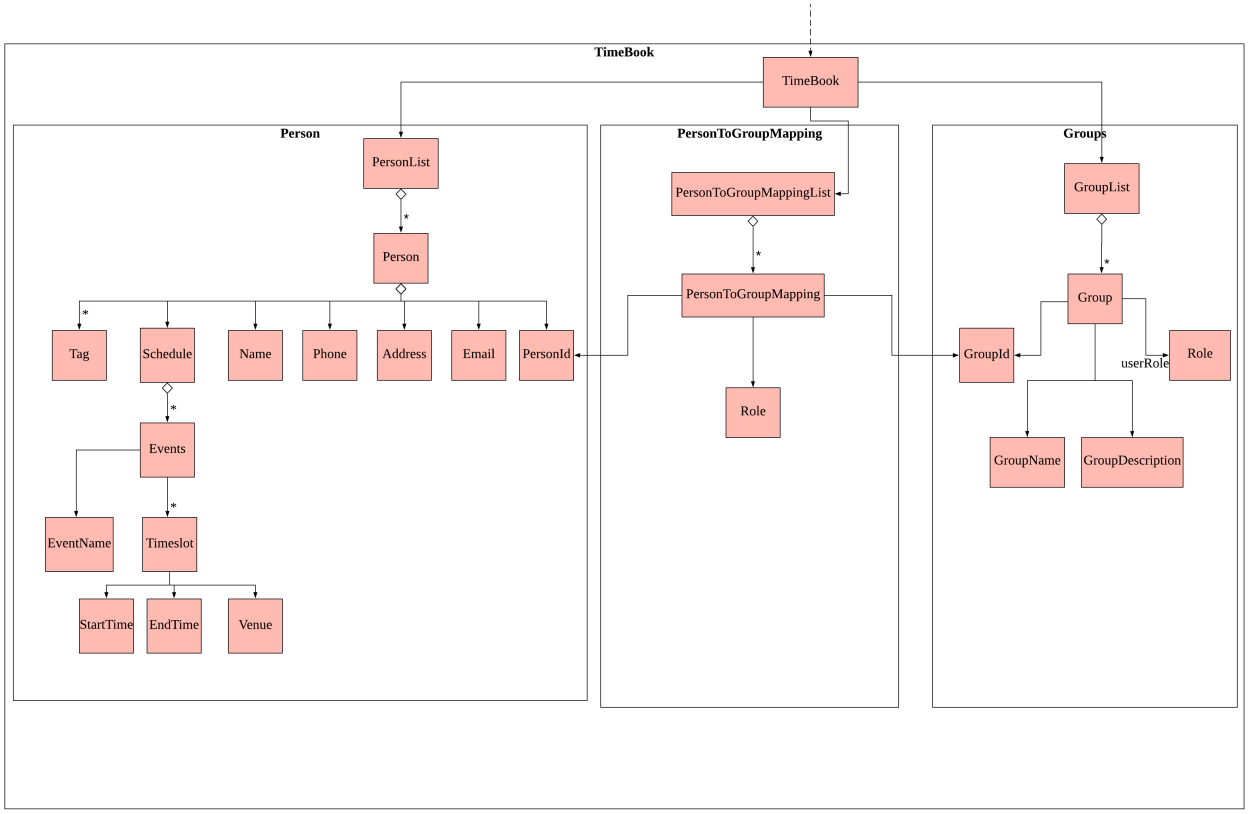


Figure 8. Structure of TimeBook sub-component

The following diagram provides a more detailed look into the `ScheduleManager` sub-component:

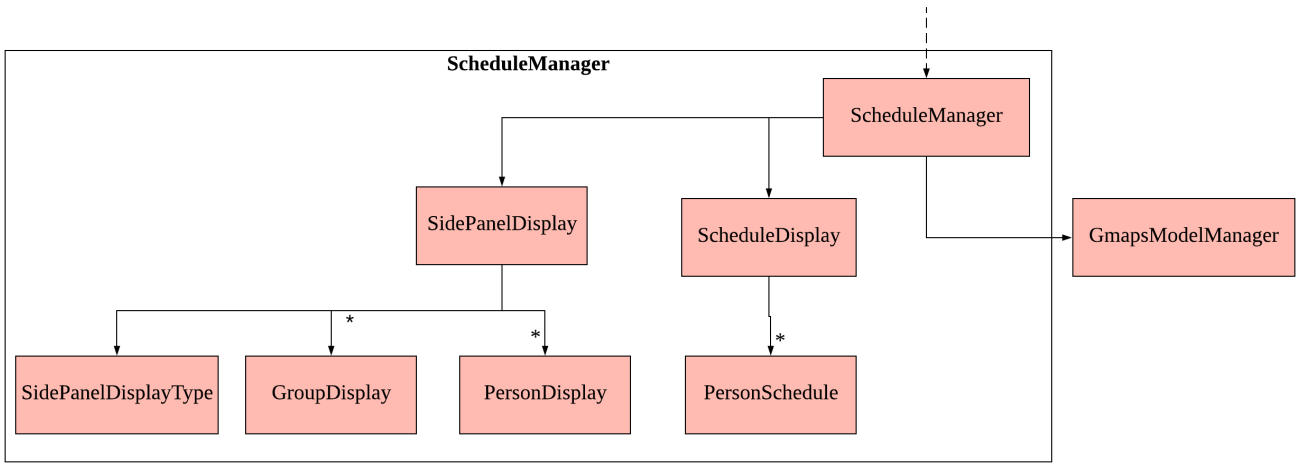


Figure 9. Structure of ScheduleManager sub-component

The following diagram provides a more detailed look into the `NusModsData` sub-component:

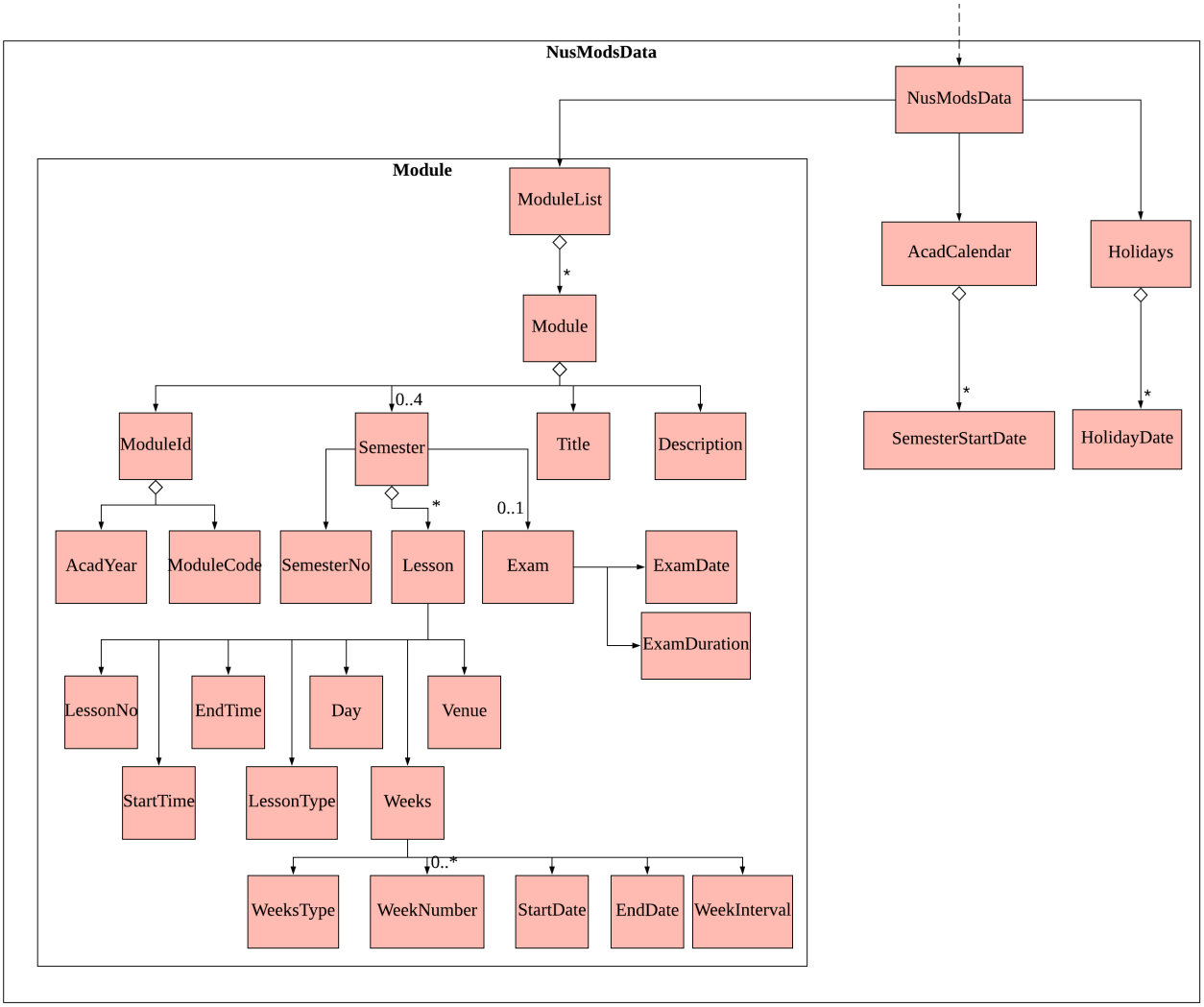


Figure 10. Structure of NusModsData sub-component

The following diagram provides a more detailed look into the `Gmaps` sub-component:

[GmapsModelManagerClassDiagram] | *model/GmapsModelManagerClassDiagram.png*

Figure 11. Structure of Gmaps sub-component

2.5. Storage component

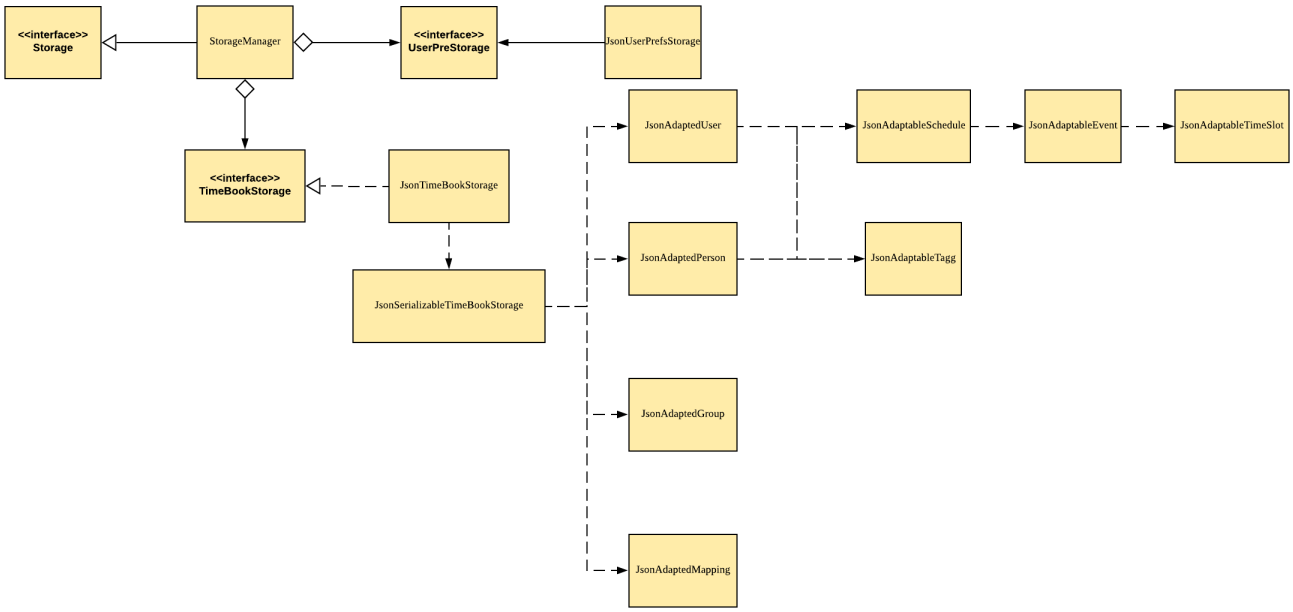


Figure 12. Structure of the Storage Component

API : `Storage.java`

The `Storage` component,

- can save `UserPref` objects in json format and read it back.
- can save the Time Book data in json format and read it back.

2.6. Api component

The following diagram explains the design of the API component:

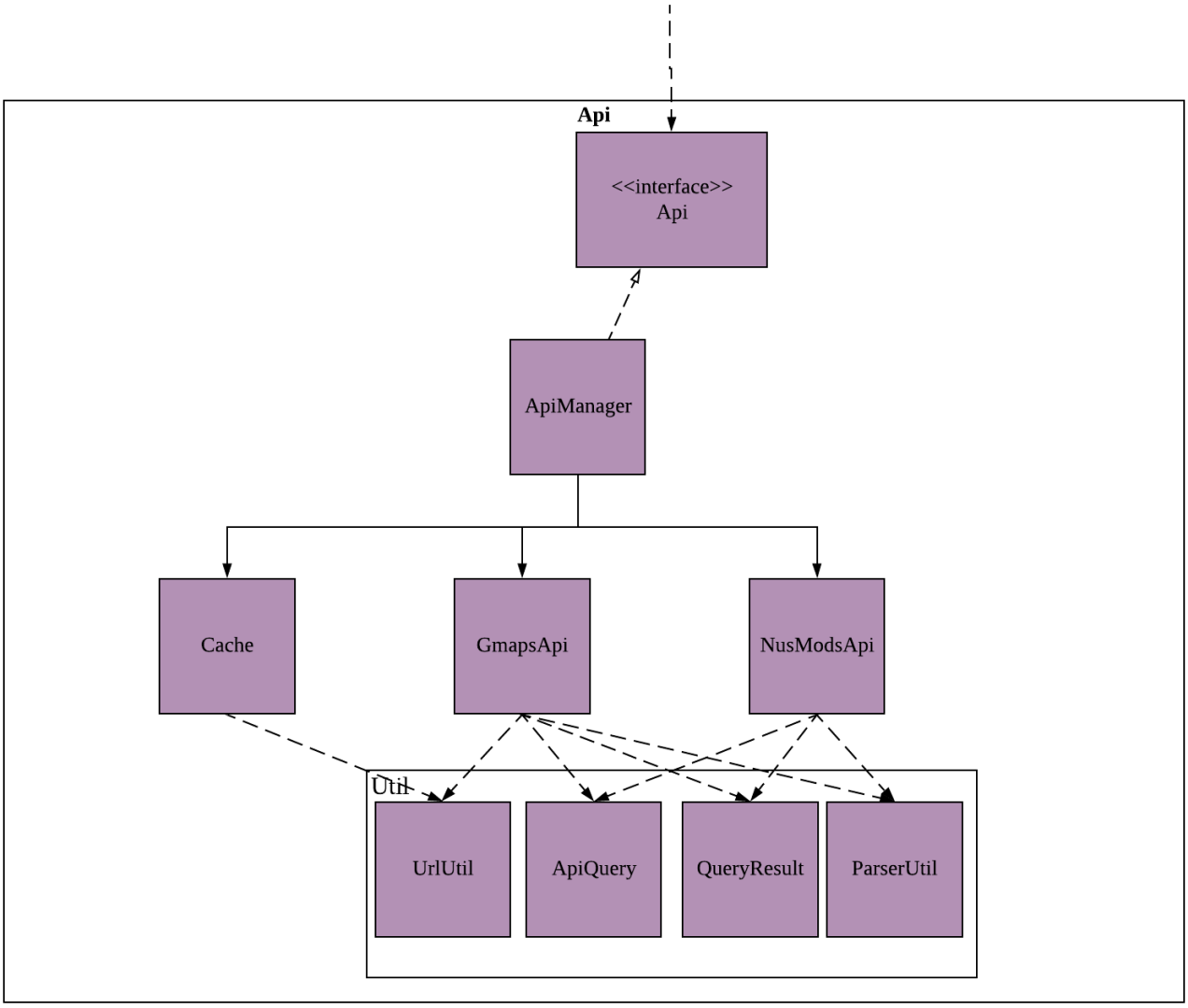


Figure 13. Expected structure of API Component in `v2.0`.

NOTE	Currently there is no `Api` interface or `ApiManager` to manage the external interactions with other components. Other components are directly accessing static methods in the `xxxApi` classes and `Cache` class for accessing API data. We intend to refactor the component to make it more OOP as shown in the figure above in `v2.0`.

The `Api`,

- handles queries to external APIs such as Google Maps and NUSMods.
- handles caching of API results for limited connectivity support.

2.7. Api component

The following diagram explains the design of the API component:

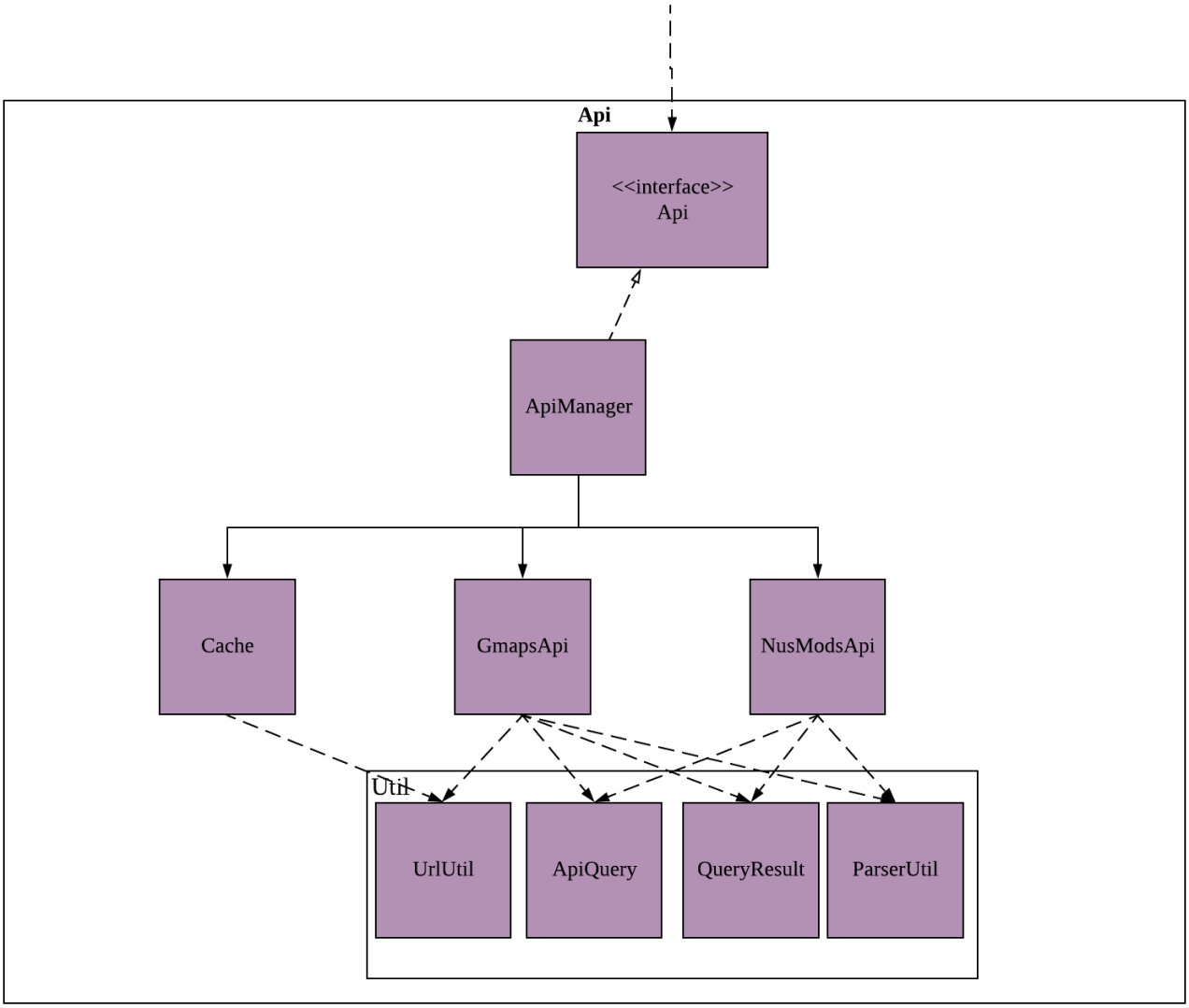


Figure 14. Expected structure of API Component in `v2.0`.

NOTE	Currently there is no `Api` interface or `ApiManager` to manage the external interactions with other components. Other components are directly accessing static methods in the `xxxApi` classes and `Cache` class for accessing API data. We intend to refactor the component to make it more OOP as shown in the figure above in `v2.0`.

The `Api`,

- handles queries to external APIs such as Google Maps and NUSMods.
- handles caching of API results for limited connectivity support.

2.8. Common classes

Classes used by multiple components are in the `seedu.addressbook.commons` package.

3. Implementation

This section describes some noteworthy details on how certain features are implemented.

3.1. Schedule Generator

The Schedule Generator feature allows users to generate a combined schedule of any number of people. It combines these schedules together, generates the common free time slots and packages it into a visual representation for the user.

This allows the user to quickly identify the common free time slots among the user and the members of the group.

3.1.1. Implementation

The Schedule Generator feature is facilitated by `ScheduleManager`. It implements the following operations:

- `ScheduleManager#updateScheduleWithPerson()`
  - This method takes in the following as inputs:
    - `Person` person: the schedule of the person to be generated
    - `LocalDateTime` time: The start date and time of the schedule to be generated from
    - `ScheduleState` type: The type of schedule to be generated
  - Generates a `ScheduleDisplay` of `type` of the `person`, spanning from `time` to 4 weeks later
  - Updates the ScheduleDisplay with the generated schedule
- `ScheduleManager#updateScheduleWithUser()`
  - This method takes in the following as inputs:
    - `User` user: The schedule of the user to be generated
    - `LocalDateTime` time: The start date and time of the schedule to be generated from
    - `ScheduleState` type: The type of schedule to be generated
  - Generates a `ScheduleDisplay` of `type` of the `user`, spanning from `time` to 4 weeks later
  - Updates the ScheduleDisplay with the generated schedule
- `ScheduleManager#updateScheduleWithGroup()`
  - This method takes in the following as inputs:
    - `Group` group: The schedule of the group to be generated
    - `ArrayList<Person>` persons: The list of Person in the group
    - `ArrayList<PersonToGroupMapping>` mappings: Represents the role of each Person in the group
    - `LocalDateTime` time: The start date and time of the schedule to be generated from
    - `ScheduleState` type: The type of schedule to be generated
  - Generates a `ScheduleDisplay` of `type` of the `group`, spanning from `time` to 4 weeks later
  - Generates the `FreeSchedule` of the `group`
  - Updates the ScheduleDisplay with the generated schedule

- `ScheduleManager#updateScheduleWithPersons()`
  - This method takes in the following as inputs:
    - `ArrayList<Person>` persons: The list of Person to generate the schedule from
    - `LocalDateTime` time: The start date and time of the schedule to be generated from
    - `ScheduleState` type: The type of schedule to be generated
  - Generates a `ScheduleDisplay` of `type` of the list of `person`, spanning from `time` to 4 weeks later
  - Generates the `FreeSchedule` of the list of `person`
  - Updates the ScheduleDisplay with the generated schedule

`ScheduleDisplay` is an object that contains all the schedule information to be shown to the user.

There are 3 types of `ScheduleDisplays` that extends from `ScheduleDisplay`. The type of `ScheduleDisplay` that is generated is based on the `ScheduleState`.

- `PersonScheduleDisplay`:
  - A `ScheduleDisplay` object that only shows the Schedule of a singular `Person`
- `HomeScheduleDisplay`:
  - A `ScheduleDisplay` object that shows the Schedule of the `User` object
- `GroupScheduleDisplay`:
  - A `ScheduleDisplay` object that shows the Schedule of a group of `Persons` including the `User`
  - It contains a `FreeSchedule` object that tells the user the common `FreeTimeslots` among the `Persons` in the group

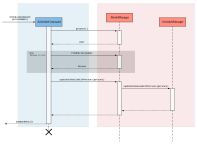
3.1.2. Usage Scenario

Given below is an example usage scenario of how the ScheduleManager behaves when a schedule command is executed.

- `Step 1`: User enters command
  - User enters a command: `schedule n/NAME1 n/NAME2`
- `Step 2`: LogicManager parses the command
  - The `TimeBookParser#parseCommand` is called would parse the input and create a new `ScheduleCommandParser` object and calls the `ScheduleCommandParser#parse` method to parse the command arguments
  - The `ScheduleCommandParser` would parse the arguments into a List of `Name` objects (i.e. NAME1, NAME2) and create a new `ScheduleCommand` with the List of `Names`.
  - The `ScheduleCommandParser` then and returns the `ScheduleCommand` to `LogicManager`
- `Step 3`: Execute the command
  - `LogicManager` calls `ScheduleCommand#execute` method
  - `ScheduleCommand` creates a new List of `Persons`

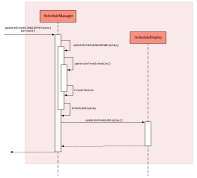
- `ModelManager#getUser` method is called to get the `User` object and `ScheduleCommand` adds it to the List of `Persons`
- For each `Name` is the List of `Names`, `ModelManager#findPerson` is called by supplying a `Name` object to get the `Person` object specified by the `Name` object.
- `ScheduleCommand` then adds the `Person` into the List of `Persons`
- `ScheduleCommand` calls the `ModelManager#updateScheduleWithPersons` method with the List of `Persons`

The following sequence diagram shows how the ScheduleCommand is executed:



- `Step 4`: Generate the Schedule
  - `ModelManager` calls the `ScheduleManager#updateScheduleWithPersons` method with the List of `Persons`
  - The `ScheduleManager` now generates the combined schedules of the List of `Persons` as well as the free time slots and packages it into a `GroupScheduleDisplay`
    - This is done by first extracting the schedule and details of each person to generate a list of `PersonSchedule`
    - With the list of `PersonSchedule`, the `#generateFreeSchedule` method is called and it will generate a `FreeSchedule`. A `FreeSchedule` will contain all the details of each `FreeTimeslot` such as previous location data of each person, start time and end time.
    - The `ScheduleManager` then packages all these information into a `GroupScheduleDisplay`
- `Step 5`: Update the ScheduleDisplay
  - `ScheduleManager` now updates the current `ScheduleDisplay` to be shown to the user

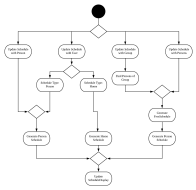
The following sequence diagram shows how the `ScheduleDisplay` is generated:



- `Step 6`: Return feedback to user
  - The `ScheduleCommand` has finished executing and returns a `CommandResult` with the feedback to user to `LogicManager`

Apart from generating a `GroupScheduleDisplay`, the `ScheduleManager` is also able to generate Schedules of a `Person` or a `User` as well.

The following activity diagram summarizes what happens when the `ScheduleManager` is invoked to generate a `ScheduleDisplay`:



3.1.3. Design Considerations

Aspect: How the `ScheduleDisplay` is generated and stored

- **Alternative 1 (current choice):** Generates the `ScheduleDisplay` in runtime only when the application needs to show a schedule to the user.
  - Pros: Saves memory space, and does not need to compute the `ScheduleDisplay` of every group and person upon startup.
  - Cons: May have performance issues in runtime as the `ScheduleDisplay` is only generated when required.
- **Alternative 2:** Upon startup, generate each Group's `ScheduleDisplay` and store them within the `Group` object.
  - Pros: Better runtime performance as the `ScheduleDisplay` is already generated.
  - Cons: Will have perfomance issues in terms of memory usage. Each Group's and Person's `ScheduleDisplay` will also have to be generated and stored in memory.

3.2. [Proposed] Undo/Redo feature

3.2.1. Proposed Implementation

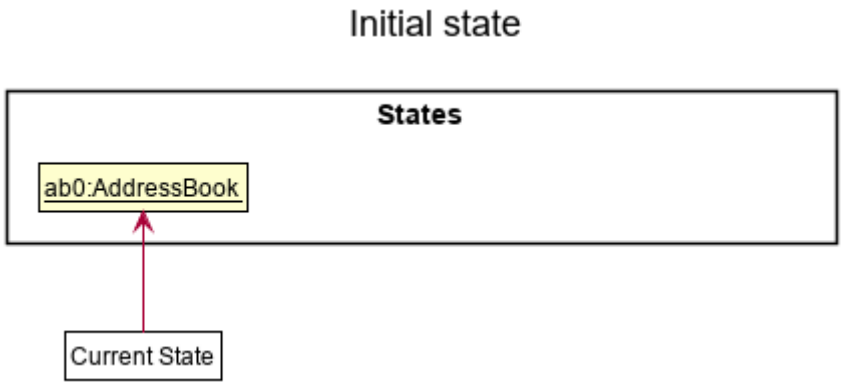
The undo/redo mechanism is facilitated by `VersionedAddressBook`. It extends `AddressBook` with an undo/redo history, stored internally as an `addressBookStateList` and `currentStatePointer`. Additionally, it implements the following operations:

- `VersionedAddressBook#commit()` — Saves the current address book state in its history.
- `VersionedAddressBook#undo()` — Restores the previous address book state from its history.
- `VersionedAddressBook#redo()` — Restores a previously undone address book state from its history.

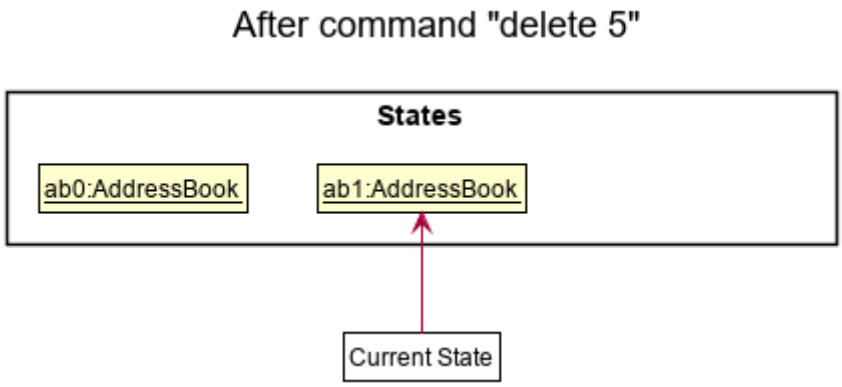
These operations are exposed in the `Model` interface as `Model#commitAddressBook()`, `Model#undoAddressBook()` and `Model#redoAddressBook()` respectively.

Given below is an example usage scenario and how the undo/redo mechanism behaves at each step.

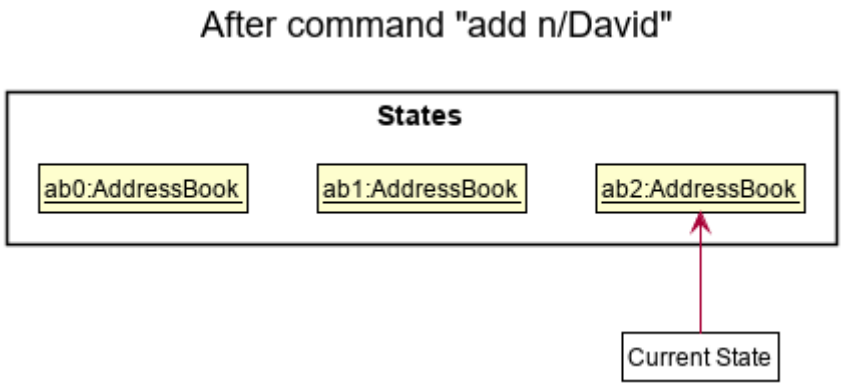
Step 1. The user launches the application for the first time. The `VersionedAddressBook` will be initialized with the initial address book state, and the `currentStatePointer` pointing to that single address book state.



Step 2. The user executes `delete 5` command to delete the 5th person in the address book. The `delete` command calls `Model#commitAddressBook()`, causing the modified state of the address book after the `delete 5` command executes to be saved in the `addressBookStateList`, and the `currentStatePointer` is shifted to the newly inserted address book state.

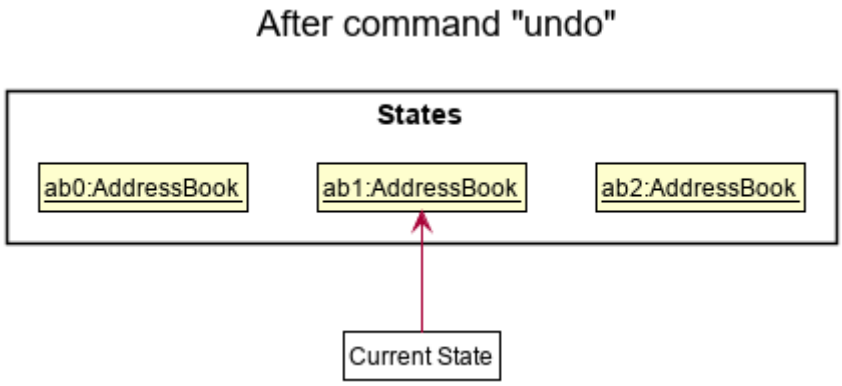


Step 3. The user executes `add n/David …` to add a new person. The `add` command also calls `Model#commitAddressBook()`, causing another modified address book state to be saved into the `addressBookStateList`.



NOTE If a command fails its execution, it will not call `Model#commitAddressBook()`, so the address book state will not be saved into the `addressBookStateList`.

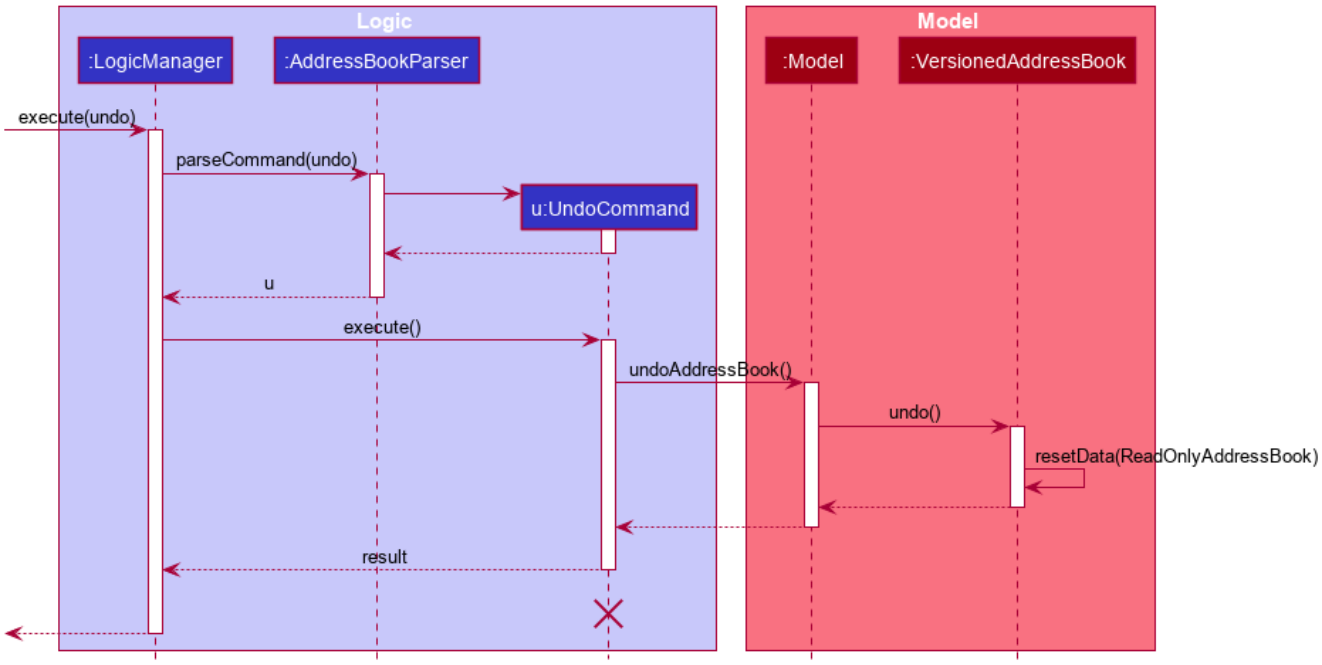
Step 4. The user now decides that adding the person was a mistake, and decides to undo that action by executing the `undo` command. The `undo` command will call `Model#undoAddressBook()`, which will shift the `currentStatePointer` once to the left, pointing it to the previous address book state, and restores the address book to that state.



NOTE

If the `currentStatePointer` is at index 0, pointing to the initial address book state, then there are no previous address book states to restore. The `undo` command uses `Model#canUndoAddressBook()` to check if this is the case. If so, it will return an error to the user rather than attempting to perform the undo.

The following sequence diagram shows how the undo operation works:



NOTE

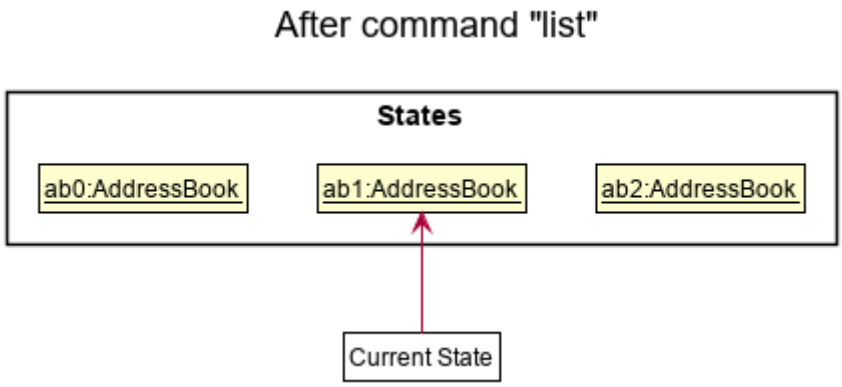
The lifeline for `UndoCommand` should end at the destroy marker (X) but due to a limitation of PlantUML, the lifeline reaches the end of diagram.

The `redo` command does the opposite — it calls `Model#redoAddressBook()`, which shifts the `currentStatePointer` once to the right, pointing to the previously undone state, and restores the address book to that state.

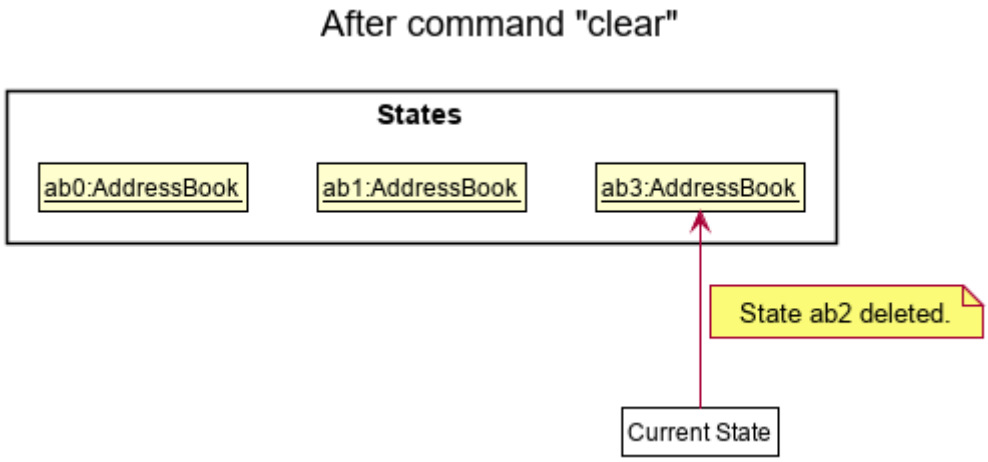
NOTE

If the `currentStatePointer` is at index `addressBookStateList.size() - 1`, pointing to the latest address book state, then there are no undone address book states to restore. The `redo` command uses `Model#canRedoAddressBook()` to check if this is the case. If so, it will return an error to the user rather than attempting to perform the redo.

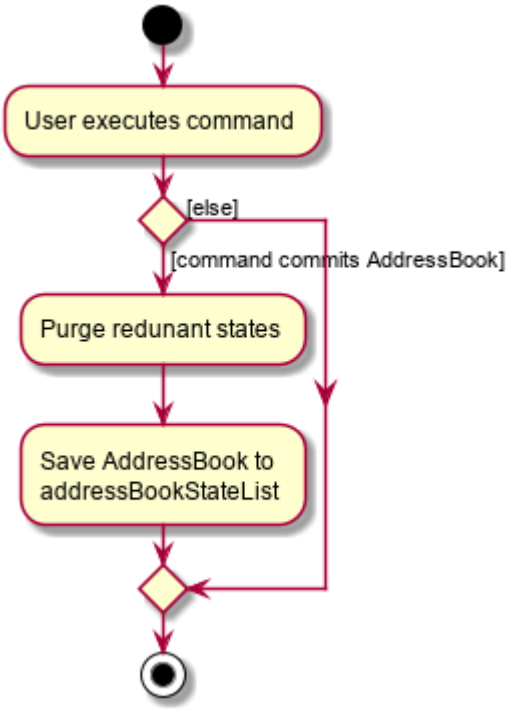
Step 5. The user then decides to execute the command `list`. Commands that do not modify the address book, such as `list`, will usually not call `Model#commitAddressBook()`, `Model#undoAddressBook()` or `Model#redoAddressBook()`. Thus, the `addressBookStateList` remains unchanged.



Step 6. The user executes `clear`, which calls `Model#commitAddressBook()`. Since the `currentStatePointer` is not pointing at the end of the `addressBookStateList`, all address book states after the `currentStatePointer` will be purged. We designed it this way because it no longer makes sense to redo the `add n/David …` command. This is the behavior that most modern desktop applications follow.



The following activity diagram summarizes what happens when a user executes a new command:



3.2.2. Design Considerations

Aspect: How undo & redo executes

- **Alternative 1 (current choice):** Saves the entire address book.
  - Pros: Easy to implement.
  - Cons: May have performance issues in terms of memory usage.
- **Alternative 2:** Individual command knows how to undo/redo by itself.
  - Pros: Will use less memory (e.g. for `delete`, just save the person being deleted).
  - Cons: We must ensure that the implementation of each individual command are correct.

Aspect: Data structure to support the undo/redo commands

- **Alternative 1 (current choice):** Use a list to store the history of address book states.
  - Pros: Easy for new Computer Science student undergraduates to understand, who are likely to be the new incoming developers of our project.
  - Cons: Logic is duplicated twice. For example, when a new command is executed, we must remember to update both `HistoryManager` and `VersionedAddressBook`.
- **Alternative 2:** Use `HistoryManager` for undo/redo
  - Pros: We do not need to maintain a separate list, and just reuse what is already in the codebase.
  - Cons: Requires dealing with commands that have already been undone: We must remember to skip these commands. Violates Single Responsibility Principle and Separation of Concerns as `HistoryManager` now needs to do two different things.

3.3. Command Suggestions feature

3.3.1. Implementation

The command suggestions mechanism is facilitated by `SuggestionLogic`. Through user-interface events provided by `SuggestingCommandBox`, it parses the command that was entered to provide context-sensitive suggestions.

It does this by identifying the `commandWord` (e.g. `deleteperson`, `addperson`, etc.) and `arguments` provided (e.g. `n/Alice`, `g/CS2103T`) and by using the caret position, provides command suggestions if the caret is located within the `commandWord` section or provides argument-specific suggestions by delegating to the `Suggester` registered for the specific `commandWord`.

Given below is an example usage scenario and how the command suggestions mechanism behaves at each step. Ultimately, this is what the user will see:

Figure 15. Example of the command suggestions mechanism

Step 1. The user types in the command `deleteperson n/|` and the `SuggestingCommandBox` UI class passes the command text (i.e. `deleteperson n/`) and the caret position index (i.e. 15) to `SuggestionLogic`.

NOTE

The vertical line/pipe character (i.e. `|`) denotes the position of the caret and is not part of the entered command itself.
So for the above example, the command entered is `deleteperson n/` with the caret at the end of the command.

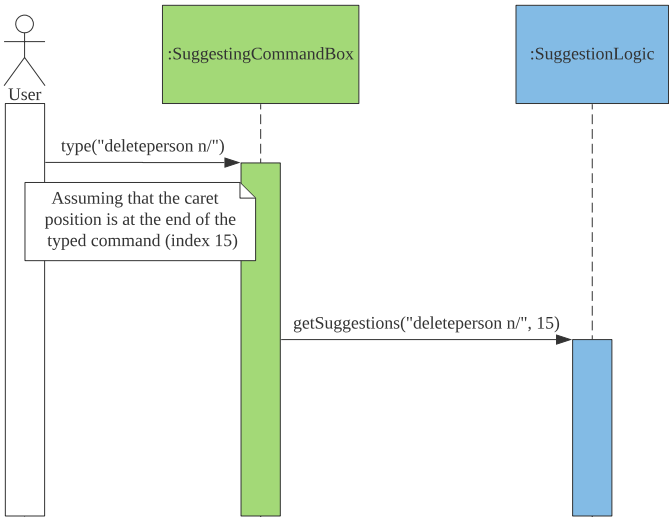


Figure 16. The `SuggestingCommandBox` UI class passing UI data to the `SuggestionLogic` class to obtain suggestions.

Step 2. The `SuggestionLogic` asks the `TimeBookParser` to tokenize the command text into its two parts:

the commandWord and the arguments. This is needed so the SuggestionLogic knows which Suggester to use later.

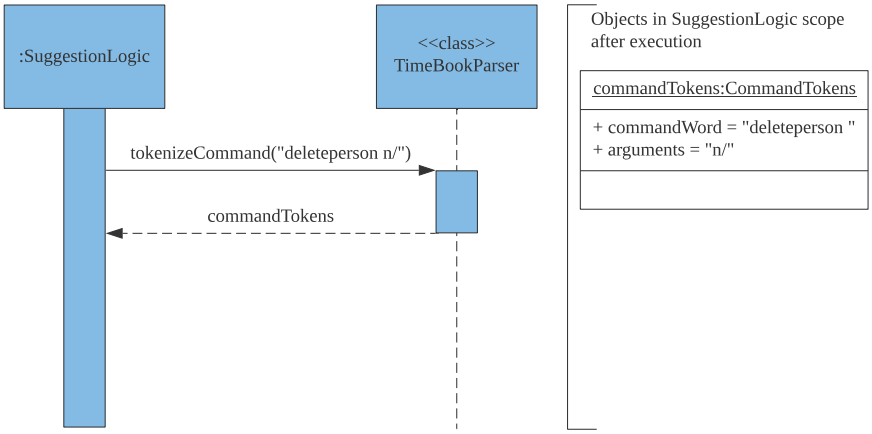


Figure 17. Tokenization of the command entered by the user

Step 3. The SuggestionLogic then checks where the caret is currently positioned, either within the commandWord or within the arguments section. In this case, the caret is placed after the n/ so it is within the arguments section. To read how the behaviour changes if the caret was placed within the commandWord section, click here.

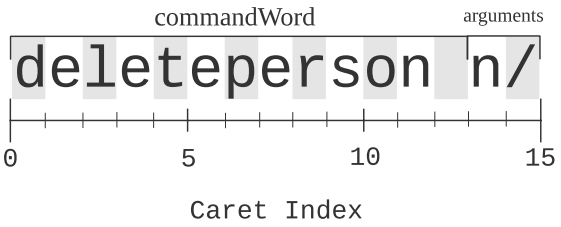


Figure 18. The tokenized command and its caret indices

Step 4. The SuggestionLogic asks the static Suggester class which Prefixes are supported by the current commandWord (i.e. deleteperson) for tokenizing the arguments. This list of supported Prefixes, together with the command arguments, are passed to the static ArgumentTokenizer to parse it into an ArgumentList containing CommandArguments. Each CommandArgument contains the type of Prefix and the user-entered value.

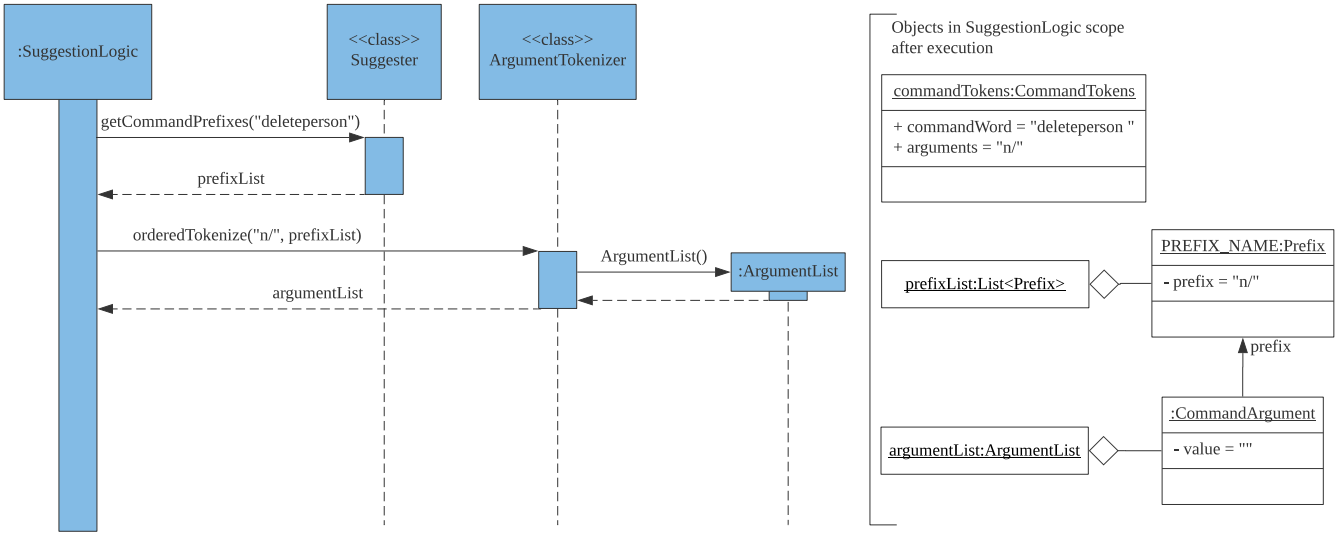


Figure 19. Tokenizing the given arguments

Step 5. The SuggestionLogic then asks the static Suggester class to create the relevant Suggester object based on the commandWord. In this case, the static Suggester class returns a new DeletePersonCommandSuggester because the commandWord is deleteperson.

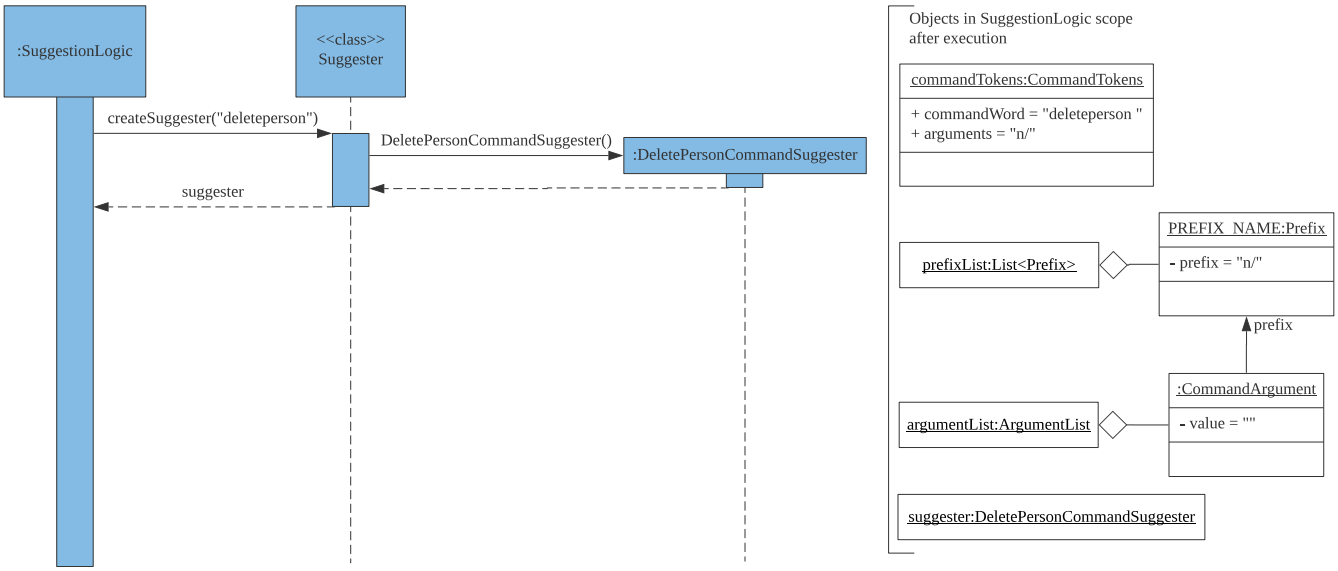


Figure 20. Creating the relevant Suggester

Step 6. The SuggestionLogic asks the ArgumentList object which CommandArgument is currently selected based on the user's caret position. In this case, it is the CommandArgument with the Prefix of PERSON_NAME and value of an empty string because the caret is positioned within the n/ text and no value has been entered.

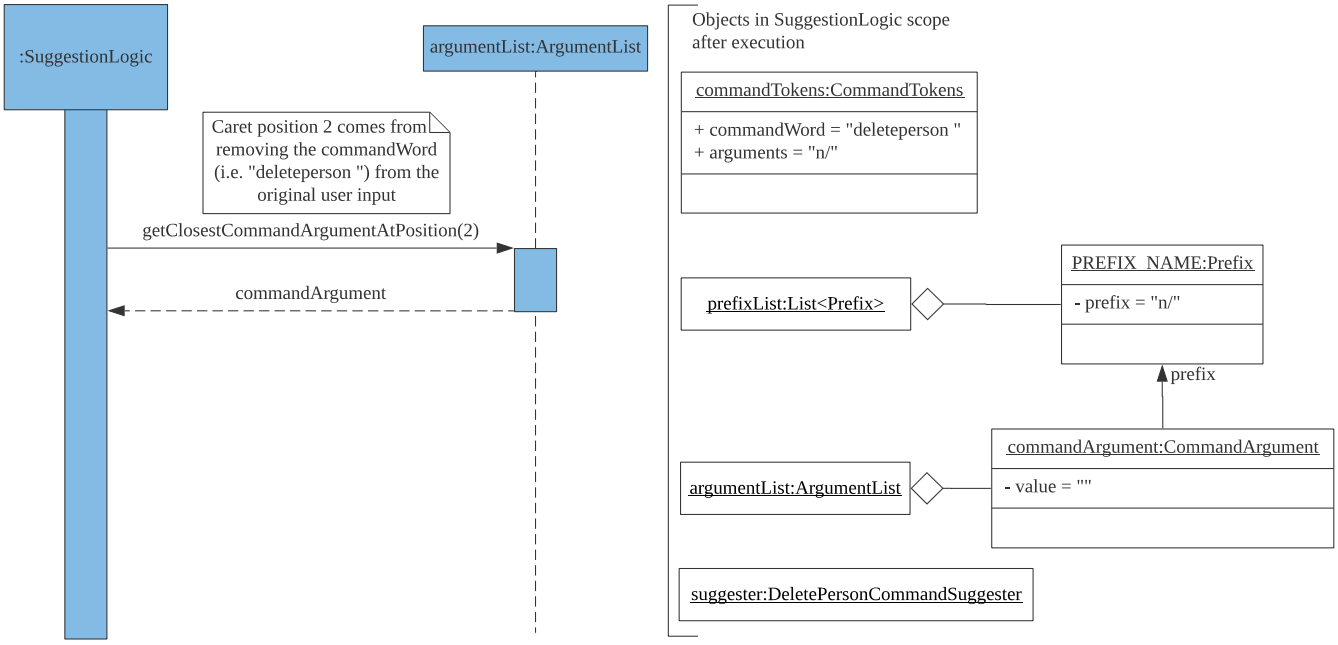


Figure 21. Calculating which CommandArgument is currently selected

Step 7. The SuggestionLogic asks for the suggestions from the DeletePersonCommandSuggester by providing three things to it. First, the current Model object, second the previously parsed ArgumentList object and finally, the CommandArgument to provide suggestions for. After obtaining the list of suggestions, the SuggestionLogic class returns it to the SuggestingCommandBox UI class for display.

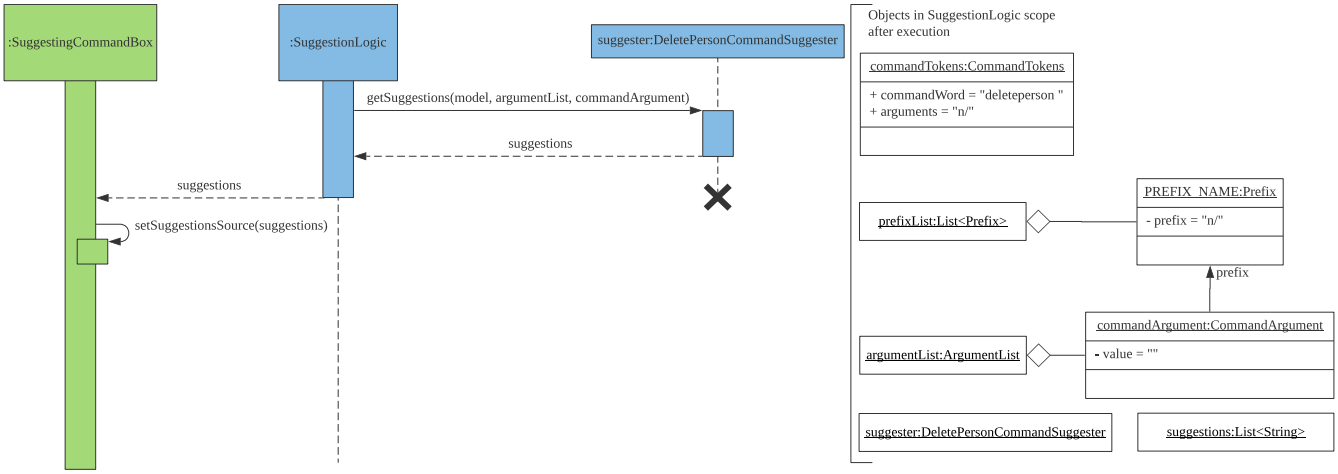
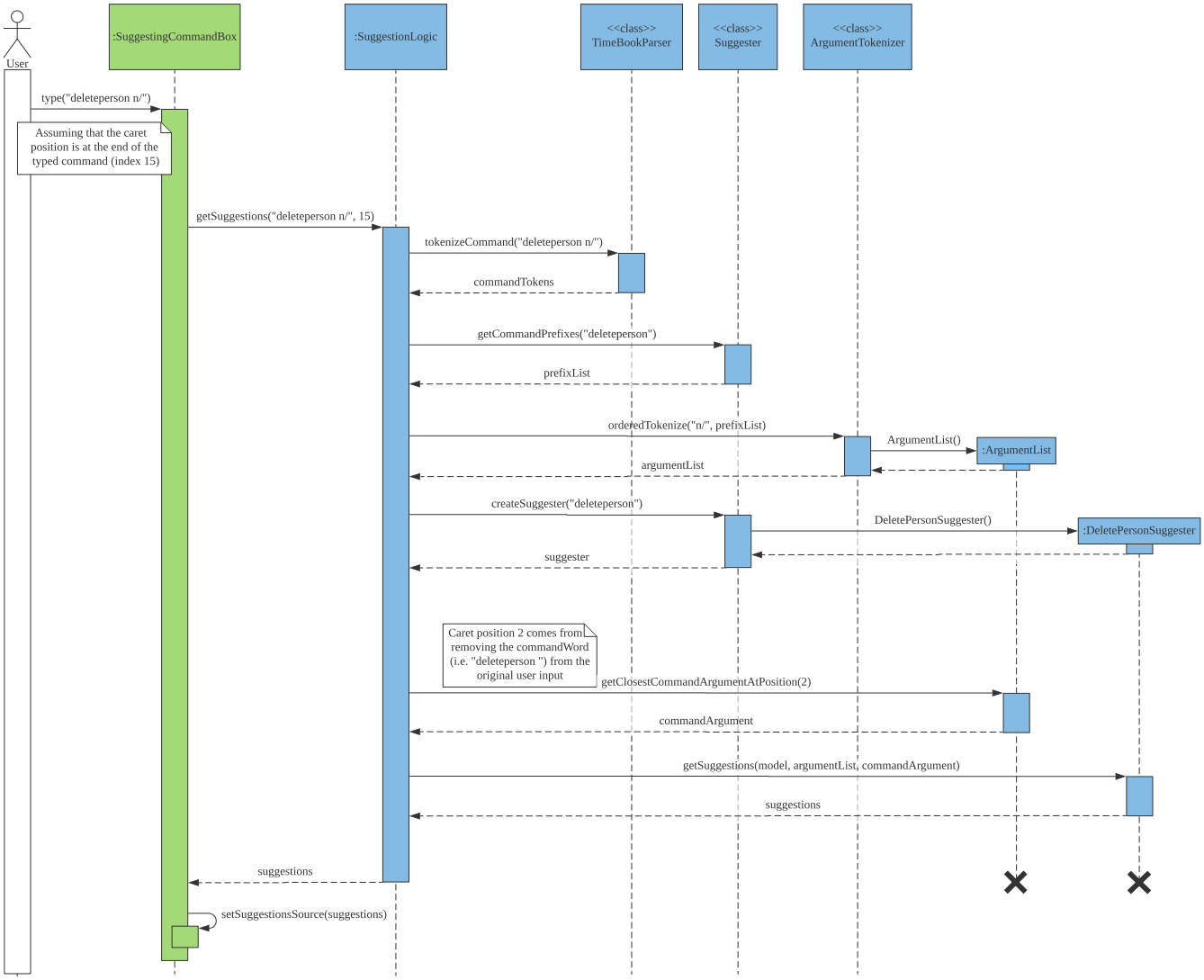


Figure 22. Obtaining and displaying suggestions

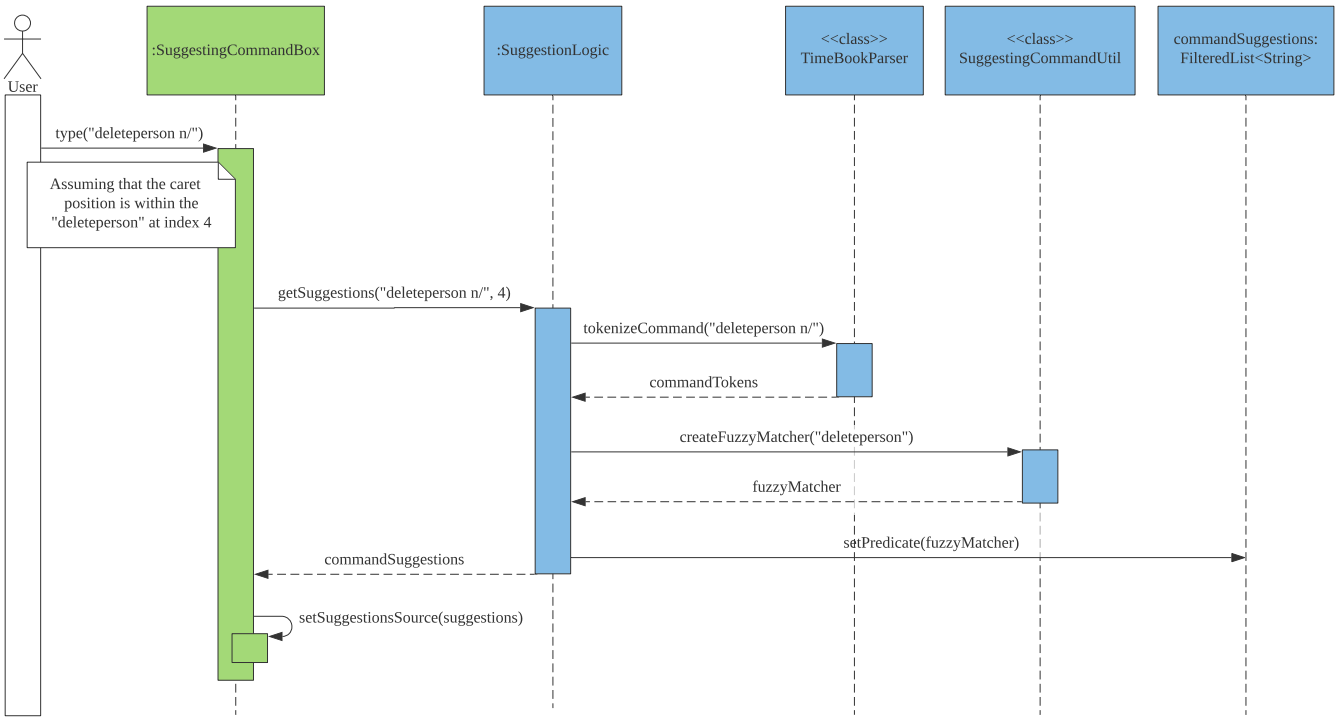
The following sequence diagram condenses all the above diagrams into one, given the input `deleteperson n/|`:

Full sequence diagram for input `deleteperson n/|`



The `SuggestionLogic` behaves differently when the caret position is within the `commandWord` section. The sequence diagram below shows the behaviour for the case of `find|person n/`. To read how the behaviour changes if the caret was placed within the `arguments` section, click here.

Sequence diagram for when the caret position is within the `commandWord` section



The result is the following:

Figure 23. What users see when the caret is placed within the `commandWord` section

The following activity diagram summarizes what happens when a user interacts with the command input box:

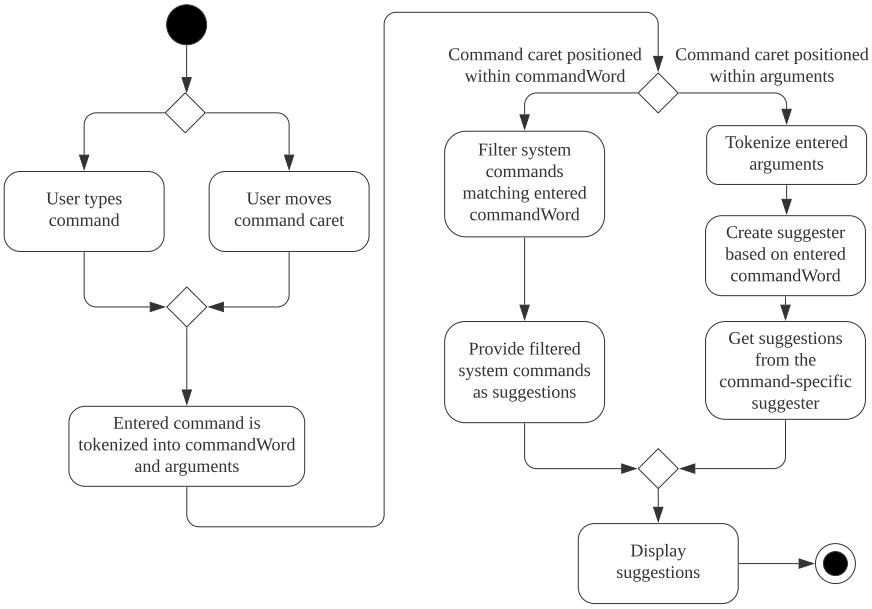


Figure 24. Activity diagram showing how Command Suggestions decides what to show

3.3.2. Design Considerations

Aspect: How command suggestions gets its suggestions

- **Alternative 1 (current choice):** Ask `Suggester`s for suggestions every time anything changes
  - Pros: Easy to implement.
  - Cons: May have performance issues in terms of CPU and memory usage as `Suggester`s are created and run every time the command changes or the caret is moved.
- **Alternative 2:** Cache suggestions based on entered command and caret position
  - Pros: Will use less CPU, may use less memory.
  - Cons: Difficult to properly account for all the conditions that should cause a cache invalidation/recalculation of suggestions.

Aspect: Data structure to pass around the command arguments

- **Alternative 1 (current choice):** Create an `ArgumentList` to store the ordered sequence of arguments.
  - Pros: Provides `Suggester`s with flexibility in providing suggestions since the relative ordering of arguments is preserved. For example, it is possible to suggest different values for each `class/` argument based on the left-closest `mod/` argument for the following command: `addmod n/Alice mod/CS2103T class/ mod/CS2101 class/`.
  - Cons: Increased complexity in extracting command arguments for simpler `Suggester`s.
- **Alternative 2:** Reuse `ArgumentMultimap`
  - Pros: We do not need to maintain a separate data structure due to reuse, and developers familiar with how `ArgumentTokenizer.tokenize()` works for writing a `Command` can transfer their knowledge when writing `Suggester`s for their own commands.
  - Cons: `Suggester`s are restricted in terms of the flexibility of their suggestions, as they lack info about the relative ordering of all the arguments.

3.4. [Proposed] Data Encryption

{Explain here how the data encryption feature will be implemented}

3.5. Logging

We are using `java.util.logging` package for logging. The `LogsCenter` class is used to manage the logging levels and logging destinations.

- The logging level can be controlled using the `logLevel` setting in the configuration file (See Section 3.6, “Configuration”)
- The `Logger` for a class can be obtained using `LogsCenter.getLogger(Class)` which will log messages according to the specified logging level
- Currently log messages are output through: `Console` and to a `.log` file.

Logging Levels

- `SEVERE` : Critical problem detected which may possibly cause the termination of the application
- `WARNING` : Can continue, but with caution
- `INFO` : Information showing the noteworthy actions by the App
- `FINE` : Details that is not usually noteworthy but may be useful in debugging e.g. print the actual list instead of just its size

3.6. Configuration

Certain properties of the application can be controlled (e.g user prefs file location, logging level) through the configuration file (default: `config.json`).

3.7. Visual Representation of individual's or group's schedule feature

The visual representation refers to the graphics you see when you view a group or an individual's schedule in TimeBook. We will first describe how the graphics are created. All of these graphics are created in the `ScheduleView` class. The object oriented domain model below illustrates the problem domain of the `ScheduleView` class in TimeBook.

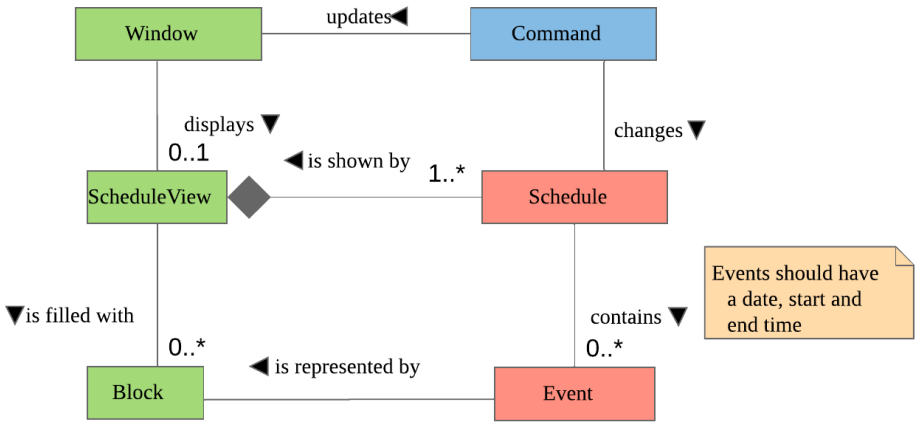


Figure 25. Object oriented domain model for `ScheduleView`.

The `ScheduleView` class in TimeBook follows the above model closely. Let's walk you through how the graphics are created.

1. Following the model, we have a class `PersonTimeslot` that behaves like an event time slot. Each `PersonTimeslot` object thus have a date, a start time and an end time.
2. Separate the given `PersonTimeslot` objects into lists by dates and sort the time slots according to start times. Each list acts as a `Schedule` for a particular date.
3. For each date, create a **VBox** (a container to to stack `Block` objects vertically). Eventually, each **VBox** will contain all the time slot blocks for the a particular date.
    a. Condition: If the first `PersonTimeslot` in the list starts after 8am (TimeBook's schedule start time), stack an empty `Block` in the **VBox** with the same height as the duration between 8am

and the start time of this `PersonTimeslot` object to represent the initial offset region.

4. Loop through each `PersonTimeslot` object in the list, stack a coloured `Block` in the same **VBox**. Each of the `Block` should have the same height as the duration between the start and end time of its corresponding `PersonTimeslot` object.
5. Stack in empty `Block` to fill the gaps between the end time of the current `PersonTimeslot` and the start time of the next `PersonTimeslot` in the list.

Now that you have seen how the graphics for TimeBook are created, the next step would be to control what graphics to show. As such, we made use of an abstract class `ScheduleViewManager` to control the creation of `ScheduleView` objects. The two classes that extend from `ScheduleViewManager` are `IndividualScheduleViewManager` and `GroupScheduleViewManager`.

The following methods are implemented in `ScheduleViewManager` to control the schedules displayed in the window.

- `ScheduleViewManager#getInstanceOf(ScheduleDisplay)` — Instantiates the `ScheduleViewManager` with a given `ScheduleDisplay` object. The `ScheduleDisplay` object contains all the information needed to generate a schedule view.
- `ScheduleViewManager#scrollNext()` — Scrolls the schedule shown down. Once it reaches the bottom, it will start back at the top.
- `ScheduleViewManager#toggleNext()` — Modifies the schedule shown to show the next week's schedule. The schedule shown can at most show up to 4 weeks in advance. Once the fourth week is reached, it will start back at the first week.
- `ScheduleViewManager#filterPerson(List<Name>)` Filters the schedule shown to the given list of names. This method only works when the schedule shown belongs to group.

A sample usage of the ScheduleViewManager is described below.

Step 1. The user wants to view a group called "Three musketeers" consisting of 3 members, Alice, Ben and Carl in TimeBook and executes the command `show g/Three musketeers` in the command line. The state of `ScheduleViewManager` will be initialised to show only the group's schedule for the first week as shown in the object diagram below.

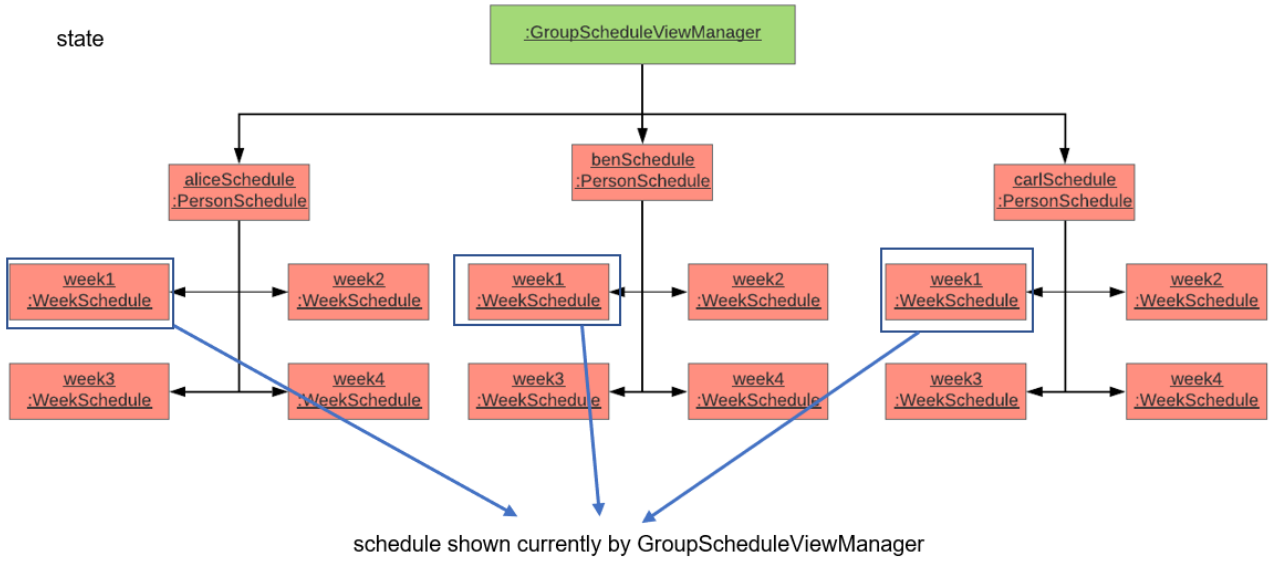


Figure 26. Initial state of GroupScheduleViewManager after the `show` command is executed.

Step 2. Suppose the user thinks that arranging a group meeting on the first week is too rushed, so he executes the `togglenext` command to view the group's schedule for the next week. The state of `ScheduleViewManager` is then modified to show the second week of the group's schedule as shown in the diagram below.

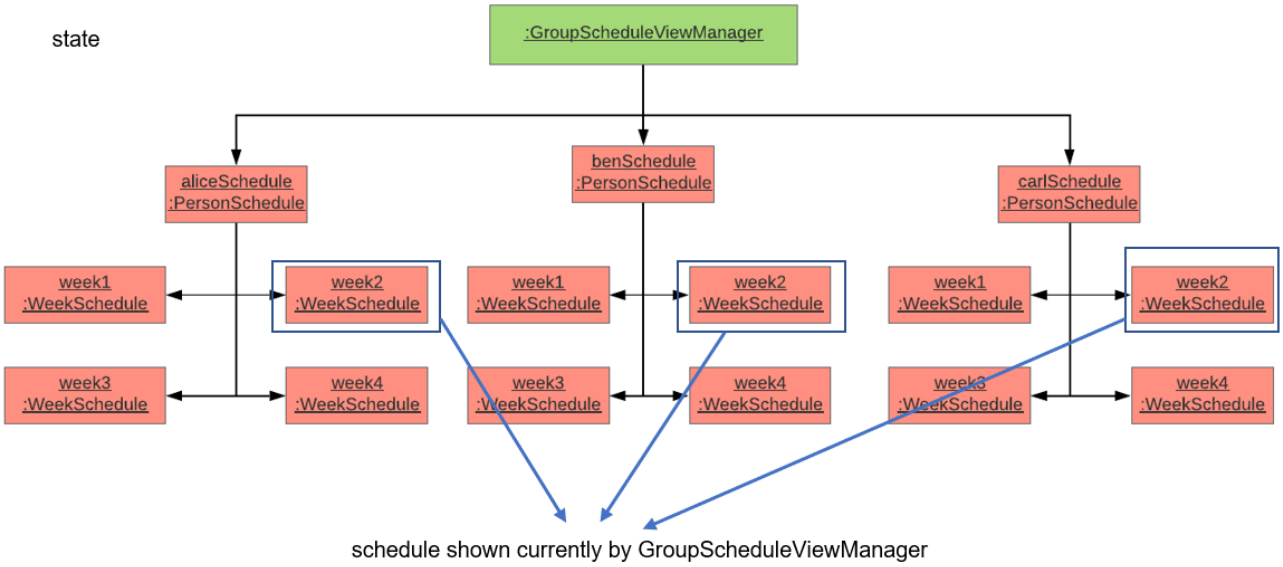


Figure 27. State of GroupScheduleViewManager after the `togglenext` command is executed.

Step 3. Suppose the user now wants to inspect some of his group members' schedules, and he executes the `lookat` command to inspect Alice's and Carl's schedules. The state of `ScheduleViewManager` is once again modified to only show the specified group members' schedules in the object diagram below.

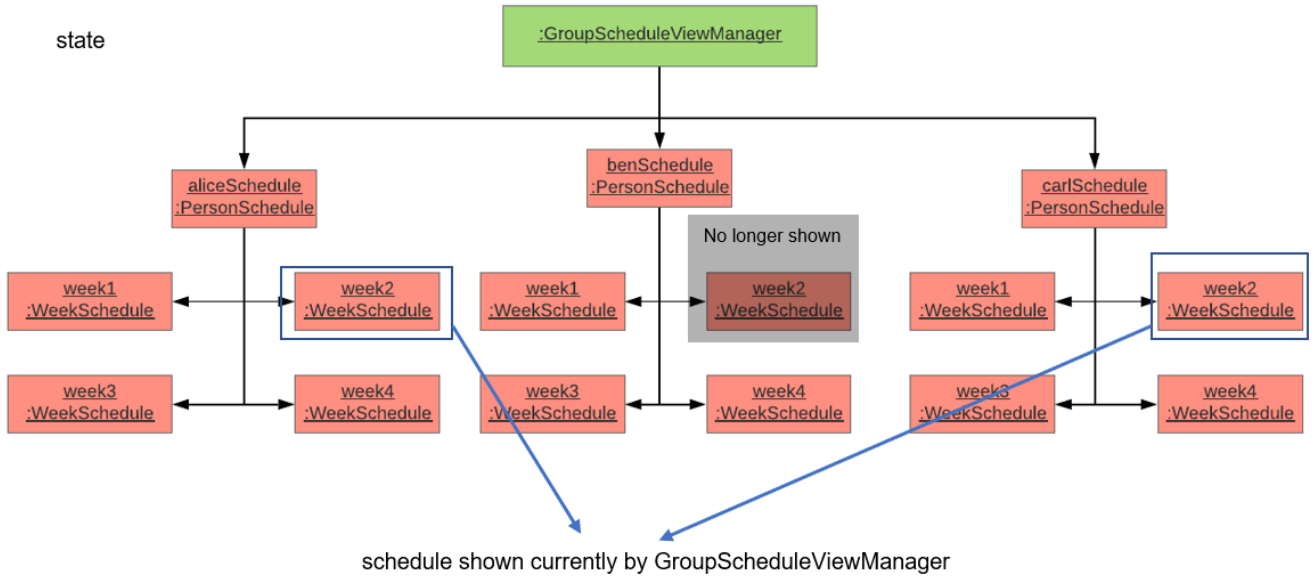


Figure 28. State of the GroupScheduleViewManager after the `lookat` command is executed.

Now that we have the full picture of how the graphics are created and controlled, we are ready to show how the user obtain a visual representation of a person or group's schedule using the `show` command. The following sequence diagram shows the sequence of events that lead to changes in the UI when an example of the `show` command is executed for a group called **CS2103**.

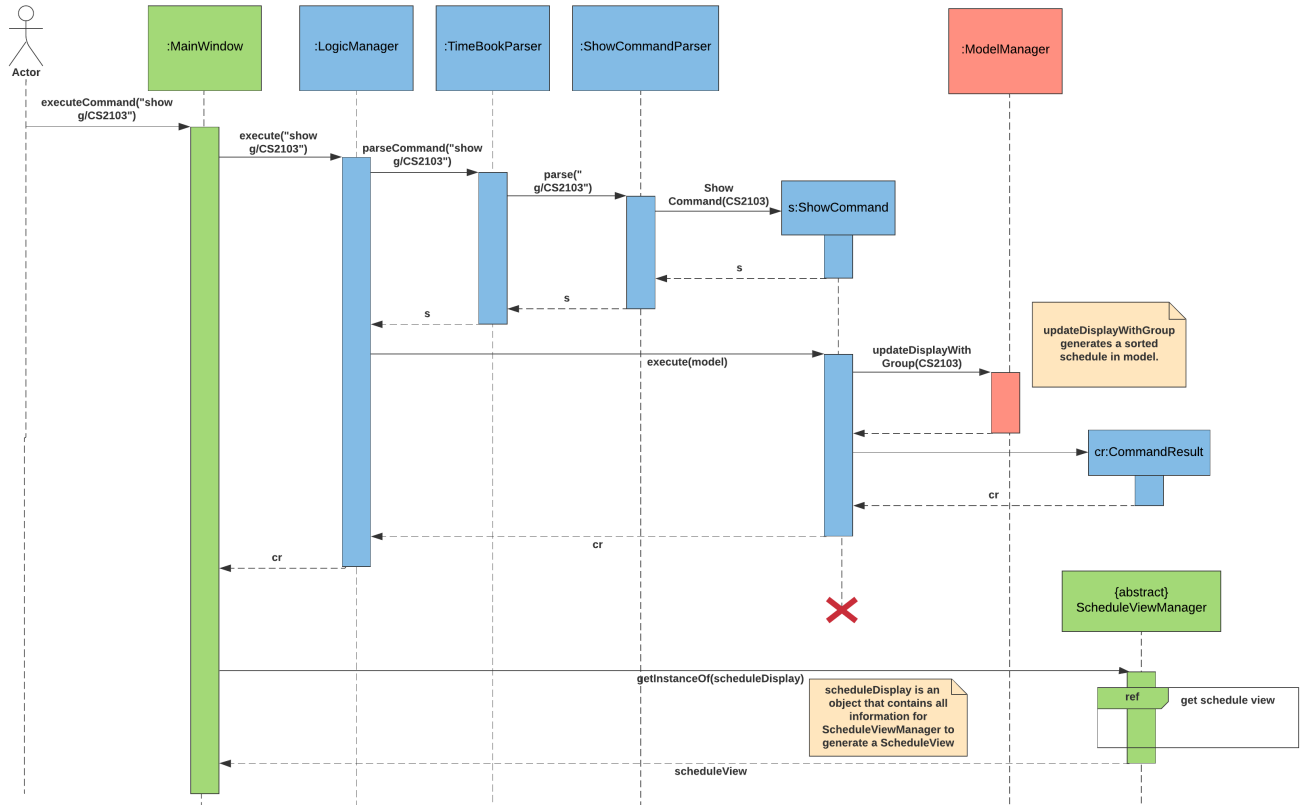


Figure 29. Sequence diagram for the `show` command.

In order to make the diagram look less messy, a reference diagram shown below is created to show what happens in the **get schedule view** frame.

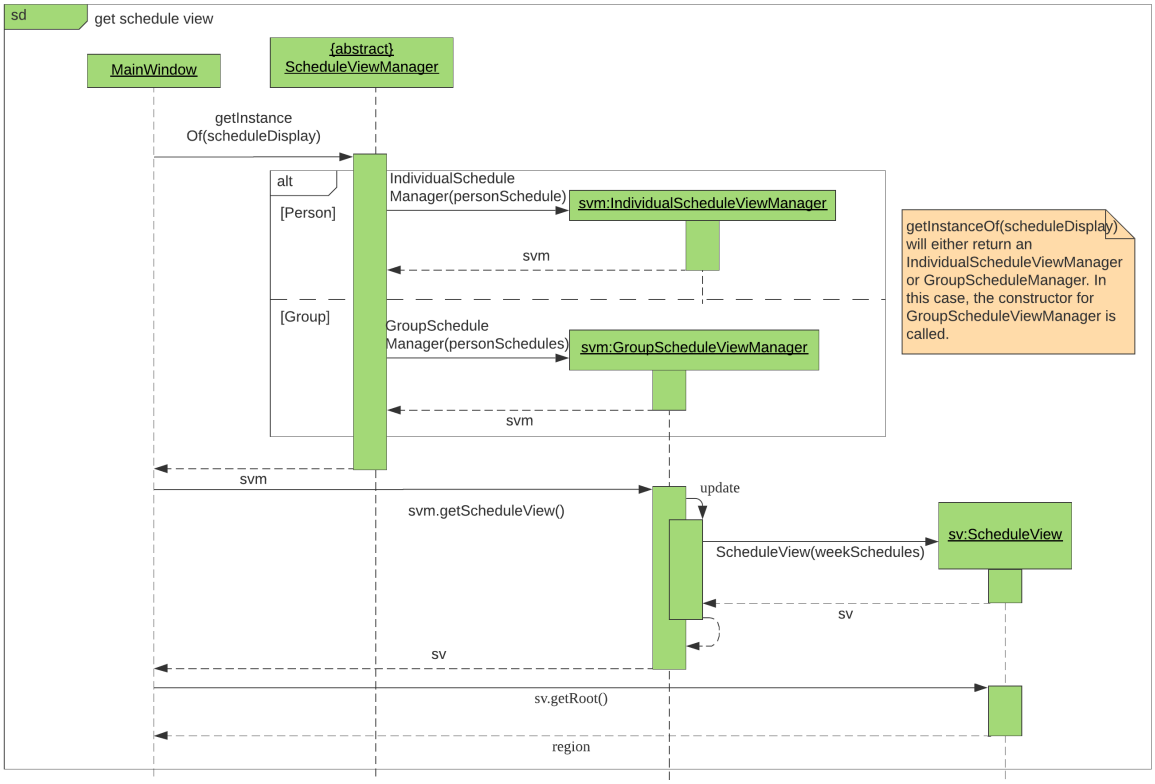


Figure 30. Reference frame that was omitted from the sequence diagram.

Details of how the graphics are created within the `ScheduleView` have been described above and thus, are omitted in the diagram.

3.7.1. Design Considerations

Aspect:	Choice	Pros	Cons
Amount of detail present in schedule view.	1. Enable users to see schedules up to 1 week in advance.	1. Easy to implement. 2. Less likely for bugs when invoking other commands such as select and popup.	1. Users may experience difficulty to plan meetings 2 or more weeks in advance.
	2. Enable users to see schedules up to 4 weeks in advance. **(Current choice)**	1. Most users should be able to plan most of their meetings.	1. Slightly more challenging to implement. 2. Slower as each request will take 4 times as long.
	2. Enable users to see schedules up to an indefinite weeks in advance.	1. Every users should be able to plan their meetings.	1. Slow requests as every query will regenerate a new set of graphics.

We chose to allow users to see schedules up to 4 weeks in advance mainly due to usability. We recognise that most group meetings do not happen within a short period of 1 week as it may seem rushed for everyone in a group. We also found that it is unnecessary to enable users to see their schedules after the 1 month mark since it is most likely to not have been updated yet. Thus, showing schedules for up to 4 weeks should be sufficient for our design.

Aspect:	Choice	Pros	Cons
Viewing some group member's schedule in a group using the `lookat` command.	1. Filter, but do not recalculate the free time slot to the filtered group members from the command. **(Current choice)**	1. Easier to implement.. 2. User can still keep track of the entire group's schedule.	1. Users may be misled to think that the `lookat` command is not working as it does not update the displayed free time slots.
	2. filters, recalculate and display the common free time slot for the filtered members.	1. There will not be any misleading empty blocks in a group's schedule.	1. Difficult to implement. 2. Each query will take a lot longer to process the locations data.
We understand that users may want to inspect the schedules of some of his or her group members while still keeping track of the entire group's common free time slots. This would be useful for users who want to organise partial group meetings with some of his or her group members before or after the official group meeting (where everyone attends). Furthermore, filtering a group member can easily be done by just creating a new group and adding group members to it.			

3.8. Closest Common Location

Closest common location utilises Google Maps API to get the best center location to meet for a group project meeting. We define this location as Closest Common Location. Below is an example of this feature.

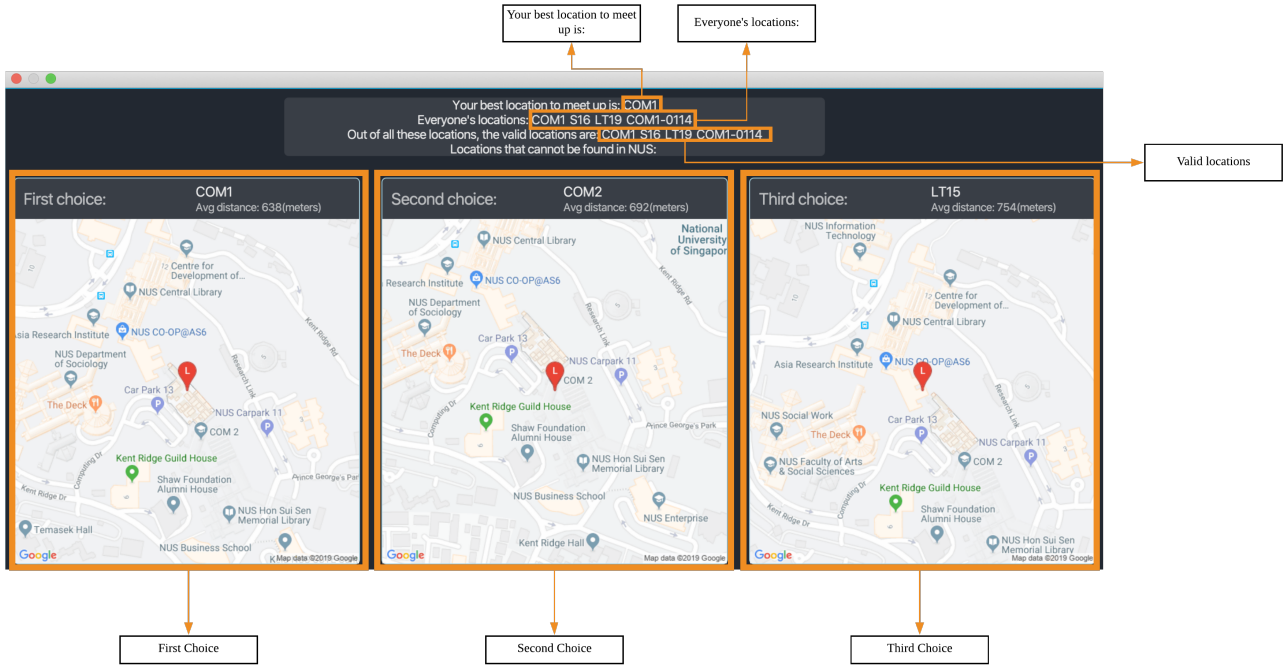


Figure 31. Popup for the closest common location.

3.8.1. Definition

- Due to connectivity constraints, we cannot support location outside of NUS. View User Guide for the full list of location we support.
- The closest location is the location that has the least average travelling distance by car from the various sources.
- All invalid locations are omitted and will not be considered in the computation of the closest common locations.

3.8.2. Algorithm

1. Create a complete graph where the vertices are the different locations in NUS and edges are the respective travelling distance by car from location `u` to `v`
2. Represent this graph in a v x v matrix where `i` represent the source location and `j` represent destination location and `distanceMatrix[i][j]` represents the time needed to travel from `i` to `j`
3. To get the closest common location of S1 … Sn:
    a. Get the rows i = l1 … ln
    b. Sum the values of the rows to a new row `totalDistance`
    c. The smallest value in the row is the closest common location

Below is an example of how the algorithm is applied on arbitrary locations `l1⋯ln` with arbitrary travelling distance to compute the closest common location for `l2,ln-2 and ln1`.

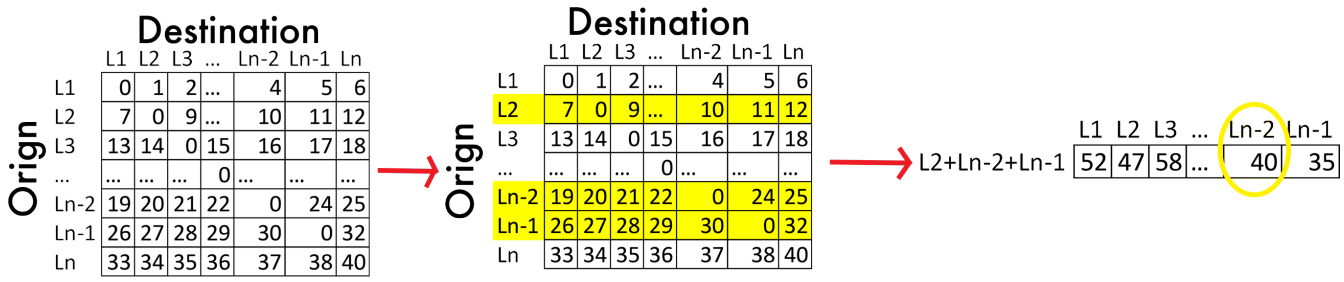


Figure 32. Example of how the algorithm is used. The closest common location for this instance is `ln-2`.

3.8.3. Implementation

Consideration

1. Google Maps API charges USD$10-USD$20 per 1000 call.
2. Google Maps Distance Matrix Api has a limit of 100 elements for every API call.
3. Google Maps Api has bug
    a. Inconsistency in identifying locations. Example
        i. `NUS_LT17` is identified as the correct location and `LT17` is not.
        ii. `NUS_AS6` is not identified as the correct location but `AS6` is identified as the correct location.
    b. Certain locations are not supported by Google Maps
        i. `S4` and `S6` are identifiable but `S5` is not.
    c. Some locations are valid on Google Maps Places Api but not on Google Maps Distance Matrix Api.
4. Not all venues on NUSMods are identifiable on Google Maps API.
5. Some venues on NUSMods are in the same building(ie AS6-0213 and AS6-0214).

Implementation

The image below represents the Class Diagram for Closest Common Location component of TimeBook

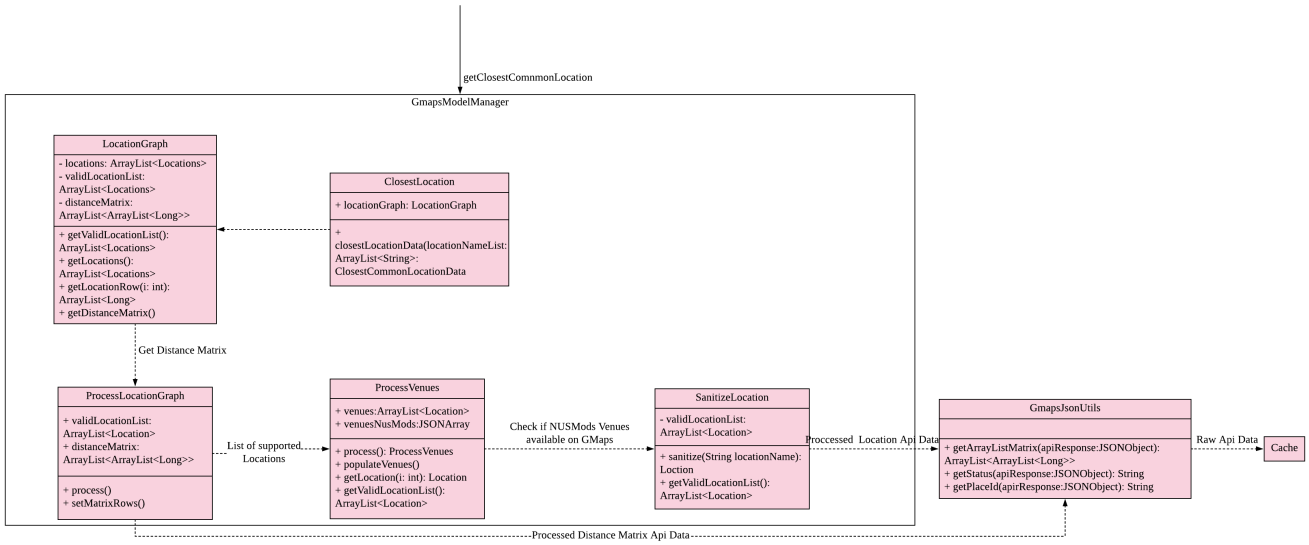


Figure 33. Class Diagram for Closest Common Location Component

There are 3 main aspects to the implementation of this component.

1. External API
2. Creating the matrix
3. Getting the closest location

External API

To support the limited internet connection, we preprocess the relevant data and save it into the resources directory (See External APIs).

Constructing the graph matrix

Below is the sequence diagram for the creation of the matrix.

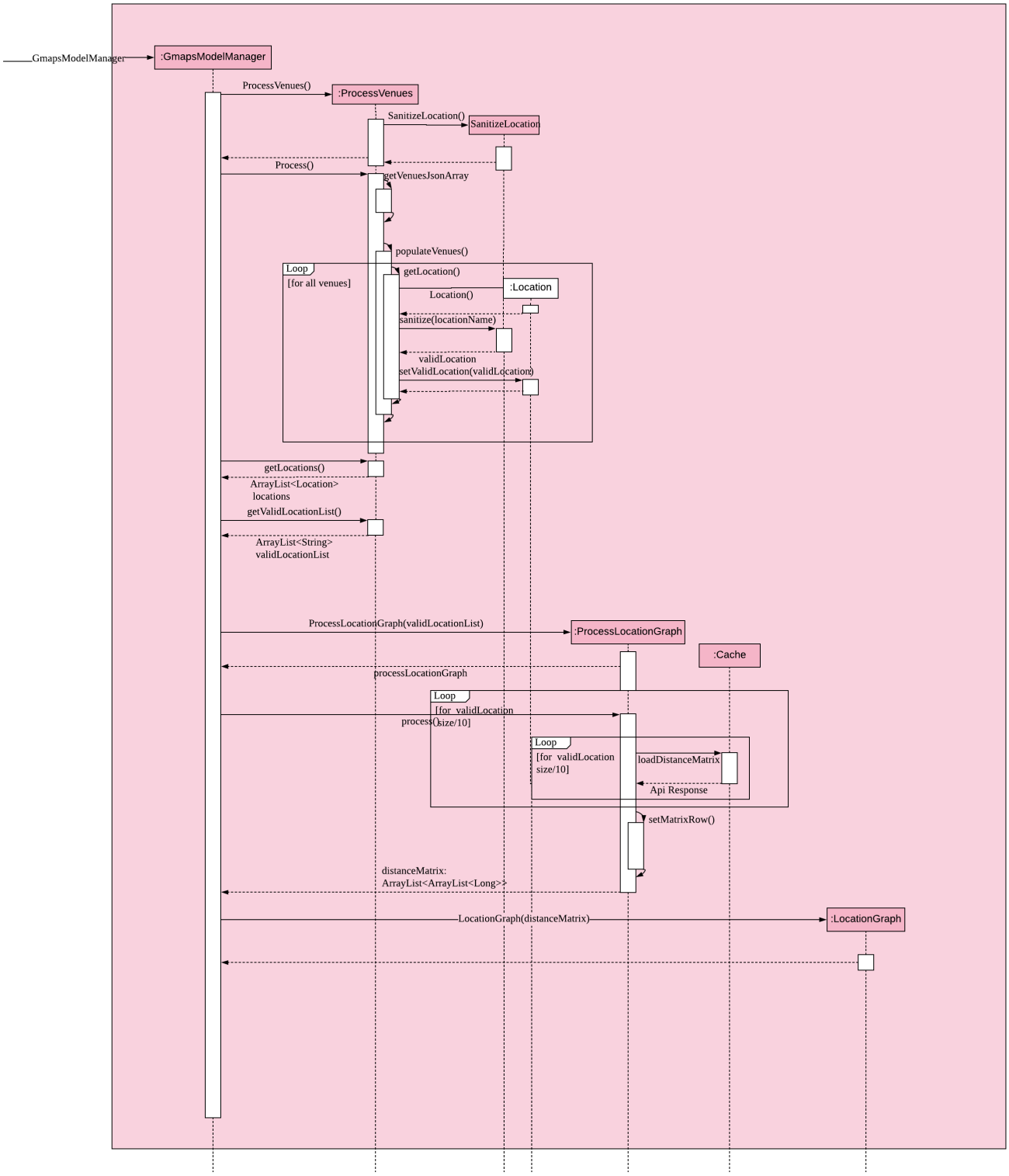


Figure 34. Sequence diagram for the construction of the graph matrix

Brief overview The initialising of the matrix is broken into 2 steps. The first step is to get the list of locations in NUSMods and checking against Google Maps API if that location is identifiable by Google. The second step is to use the identifiable location to construct the matrix.

Steps

1. Check if the name of the location in NUSMods is identifiable on Google Maps. `ProcessVenues#process` is the driver for this step.
    a. Call NUSMods API with `Cache#loadVenues` to get an array of Venues in NUS,

b. Iterate through each venue and sanitize it to Google Maps Identifiable location.

   i. Sanitizes the location name given by NUSMods by appending `NUS_` to the front and removing any characters after `-` or `/` as the room in the building does not matter. This will help to reduce the cost of Google Maps API calls.

   ii. `UrlUtil#conditionalLocationName` maps the location name that are not supported on Google Maps to a valid location name.

   iii. Each venue in the array will have a `validLocationName` and `placeId` mapped to it in the `Location` class. This will help with the generation of Google Maps Distance Matrix API and retrieving of the location image from Google Maps Maps Static API

2. Construct matrix. `ProcessLocationGraph#process` is the driver for this step.

   a. Get the list of valid location with the relevant data(`placeId` and `validLocationName`)

   b. Divide this list into blocks of 10 to keep under the 100 element limit of Google Maps.

   c. Call Google Maps Distance Matrix Api for all the blocks in the list.

   d. Combine the API response into a single 2-Dimensional array where `distanceMatrix: ArrayList<ArrayList<Long>>`.

   e. Use the constructed 2-Dimensional to instantiate `LocationGraph` which would be utilised to compute all the closest common location.

3.8.4. Getting closest location

`ClosestLocation#closestLocationData` executes algorithm above to compute the closest common location. Similar to how `JSON` is used to transfer data in `HTTP APIs`, `ClosestCommonLocationData` is used to transfer the relevant data to the `UI` to display the popup.

3.8.5. Design Considerations

Aspect: Limited Connectivity Support

Current choice: we chose alternative 2 as we have limited Google Maps API calls and to reduce the time and space complexity of the application.

- **Alternative 1:** Get the distance of the location directly from the NUSMods.
  - Pros: Simplify the code base as we can directly call Google Maps API after calling NUSMods API.
  - Cons: Bad time complexity as there would be quadratically more data to process. Prone to error as Google Maps might identify `AS6-0114` but not `AS6-0223`.
- **Alternative 2:** Sanitize the Locations on NUSMods API according to their buildings(ie `AS6-0114` → `AS6`)
  - Pros: Save time and space complexity as the number of venues will decrease by a factor of 10.
  - Cons: Increase in complexity of the code base as an additional step of processing will be required.

3.9. Add NUSMods To Schedule

3.9.1. Implementation

This feature allows users to add their NUSMods timetable (using the `AddNusModsCommand` or `AddNusModCommand`) to their TimeBook schedules.

The `AddNusModsCommand` can be executed by the user through the CLI with the following syntax `addmods n/NAME link/NUSMODS_SHARE_LINK`. The share link contains semester number, module codes, class types and class numbers, which are used for creating and adding events to the person's schedule.

The `AddNusModCommand` can be executed by the user through the CLI with the following syntax `addmod n/NAME m/MODULE_CODE cl/CLASS_TYPE_1:CLASS_NUMBER_1,CLASS_TYPE_2:CLASS_NUMBER_2,⋯`. This allows the user to add individual modules but requires the user to manually specify the class type and class numbers.

Since the `AddNusModsCommand` is less complex than `AddNusModsCommand` as it only adds 1 module at a time and does not require URL validation and parsing, we will walk through the implementation of the latter instead. The following sequence diagram shows what happens when `AddNusModsCommand` is executed:

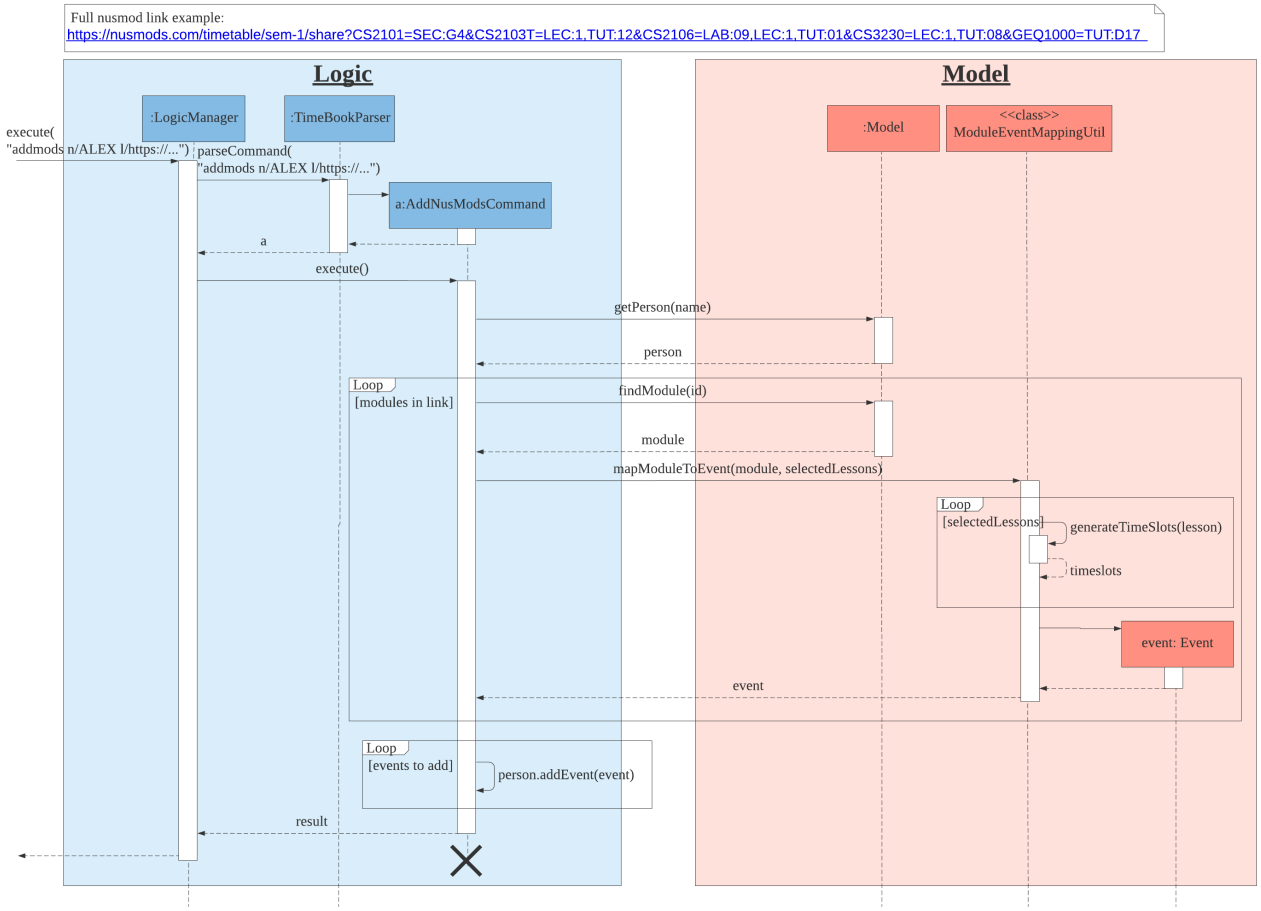


Figure 35. Sequence diagram of executing the AddNusModsCommand

1. User enters `addmods n/NAME link/https//nusmods.com/⋯`. The command string will be passed to `LogicManager` which calls `TimeBookParser` for parsing into an `AddNusModsCommand` object.

2. The `TimeBookParser` delegates the parsing to `AddNusModsCommandParser`. The name parameter will be parsed into a `Name` object, while the link parameter will be passed `NusModsShareLink#parseLink`, which validates and parses the link to create an `NusModsShareLink` object containing the `SemesterNo`, each module's `ModuleCode`, and their corresponding lessons' `LessonType` and `LessonNo`. The `AddNusModsCommandParser` then creates an `AddNusModsCommand`, which takes in the `Name` and `NusModsShareLink` objects, and passes the command back to `LogicManager`.
3. The `AddNusModsCommand#execute` is then called by the `LogicManager`. In the `AddNusModsCommand#execute` method,
    a. `AddNusModsCommand#getPerson` is called to get from the model the `Person` whose schedule will be added with the modules.
    b. `AddNusModsCommand#mapModulesToEvents` is then called to map each module to an event. Each `Module-LessonType-LessonNo` entry in the `NusModsShareLink` is iterated through and the following is executed,
        i. Call `model#findModule` to get the `Module` with the given module code.
        ii. Pass the `Module` and pairs of `LessonType-LessonNo` to `ModuleEventMappingUtil#mapModuleToEvent` to generate an `Event` based on the module and lesson type-number pair. One `Module` is mapped to one `Event`, and each `Lesson` in the module is used to generate multiple `Timeslots` for an event.
    c. The created events will then be iterated through and executed with `person#addEvent` to add the events to the person's schedule.
4. The command result is returned to `LogicManager` and feedback is displayed to user.

The following class diagram shows the `Module` class and its associated classes. The structure follows closely to the data retrieved from NUSMods API with some changes to suit the needs of our application.

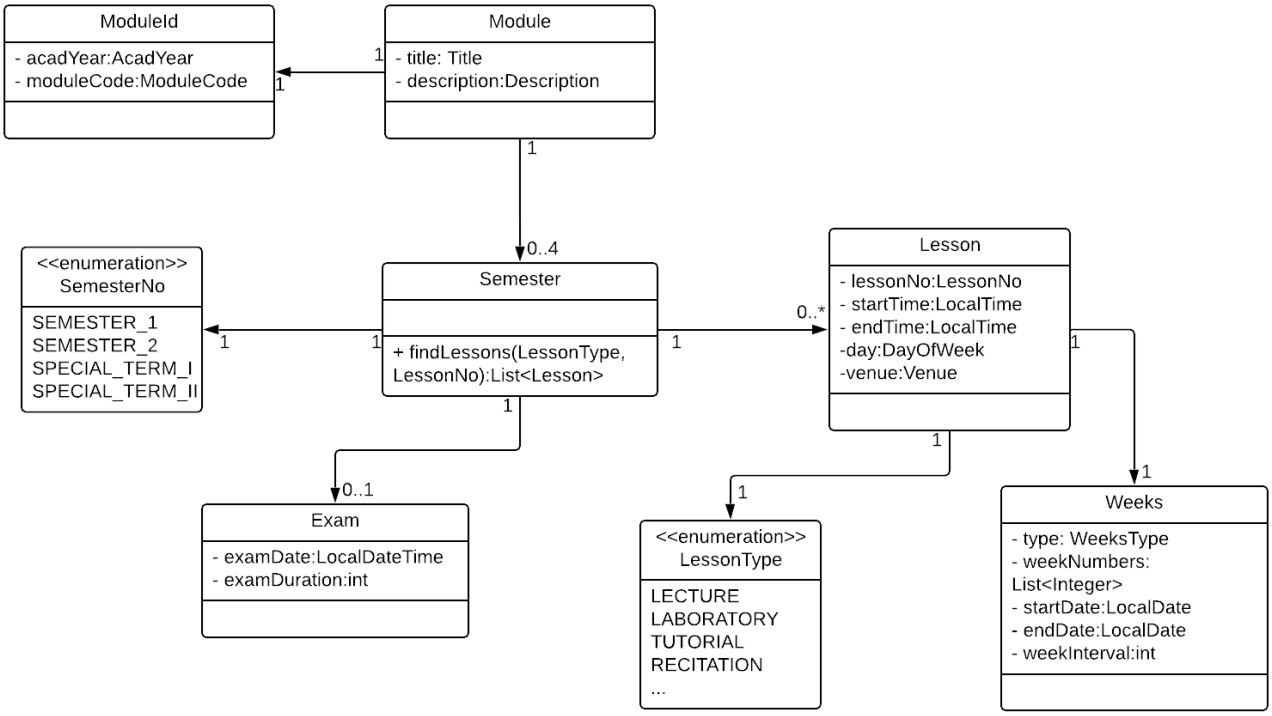


Figure 36. Class diagram of `Module` and associated classes

The following class diagram shows the `Event` class and its associated classes relevant in the context of this feature.

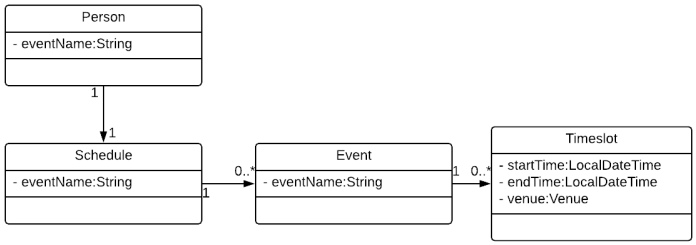


Figure 37. Class diagram of `Event` and associated classes

3.9.2. Design Considerations

Aspect:	Choice	Pros	Cons

Ease of use	1. Allow user to add modules individually	Easier to implement.	Tedious for user, as user has to specify the module code, lesson types and lesson numbers in the command.
	2. Allow user to add modules via NUSMods share link **(current choice)**	User can easily get the NUSMods share link of his/her existing NUSMods timetable and copy/paste the link into the command.	Require implementation of complex URL validation and parsing.
	3. Allow user to import the downloaded iCalendar file from NUSMods	Opens up the possibility of importing generic iCalendar files.	Harder to implement, need to deal with file IO and .ics file format parsing. Also, user is unlikely to get the iCalendar files of his/her group members (due to tediousness)
We chose to implement choice 2 as it is the most user-friendly one. The bonus is that choice 1 has been implemented as well as it is easy to adapt what we have already implemented for choice 2 to make choice 1 work.			

3.10. External APIs

The application requires data from the NUSMods API for the Add NUSMods To Schedule feature and data from the Google Maps API for the Closest Common Location feature. The following subsections describe the implementation of the Api component:

3.10.1. APIs

We have implemented an `Api` component to contain the logic of interfacing with external APIs, the architecture diagram of this component can be seen in Design → Api component.

The `websocket.NusModsApi` class contains methods for querying different endpoints of the NUSMods API and parsing the query results into `JSONObject` or `JSONArray` objects.

The `websocket.GmapsApi` class contains methods for querying different endpoints of the Google Maps API and parsing the query results into `JSONObject` or `JSONArray` objects.

The `websocket.Cache` class handles the saving and loading of cached API results in the resources folder.

The `websocket.util` folder contains various utility classes for querying external APIs.

3.10.2. Caching API Results

To support limited connectivity in our application, the results of all API queries are preprocessed and saved into the resources directory. This is managed by the `Cache` class. The following activity diagram shows how the caching feature works when external data is required for the execution of a certain command:

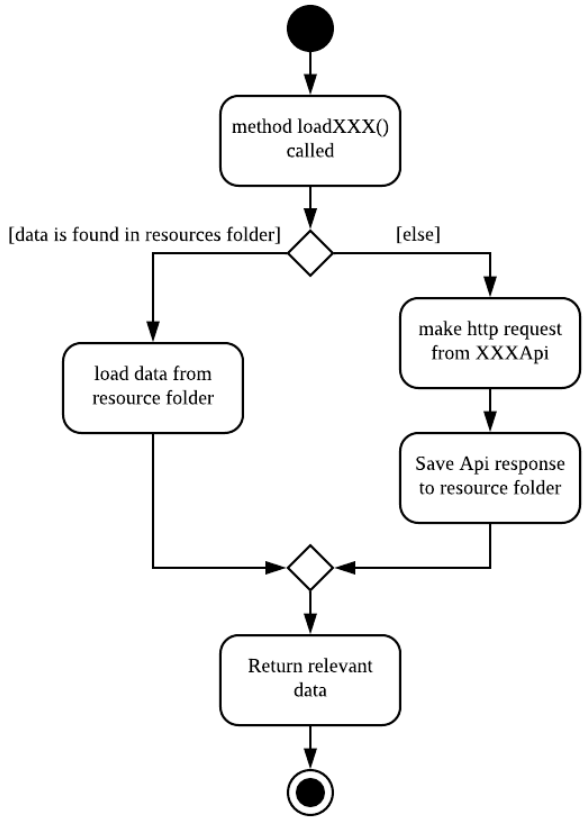


Figure 38. Activity diagram showing decision flow for `loadXXX` methods

3.10.3. Preprocessing NUSMods API

We preprocess the data collected from NUSMods API so that we can cache the data for offline usage and perform some early computation steps (e.g. validation, parsing) to reduce the computation cost during actual use in the application.

Notably, the key information that we require for each NUS module is the timetable information. However, there is no available API endpoint which provides the timetable information of all modules at once. Rather, there is only an endpoint which provides the timetable information of one module per query. Thus, we developed a small program in `logic.internal.nusmods.ImportMods`, which is executed prior to the main application itself, to query the timetable info for every module and save the data in the resources folder.

3.10.4. Preprocessing Google Maps API

All preprocessing of raw API data for Google Maps are done in the `GmapsJsonUtils` class.

3.10.5. Design Considerations

Aspect:	Choice	Pros	Cons
Limited Connectivity Support	1. Preprocessing API results and storing it in resources folder.	Can achieve complete offline support, also avoids the issue of providing API keys in production **(current choice)**.	Have to run the preprocessing programs in `logic.internal` from time to time to update data files, e.g. for modules in new academic year or new locations else features will not work.
	2. Caching Query Results	Achieves limited connectivity support (call once and save result, then use saved result for future calls). Also, needs less work to support future data/API changes.	Not so useful in cases where a large number of queries is required to be preprocessed first in order to handle a single user command, e.g. finding common location requires building a `LocationGraph` after getting the locations data from Google Maps.
	3. Direct API queries	Easy to implement, minimal work to support future data/API changes.	No limited connectivity support.
The choice of implementation was progressive - it was initially choice 3 for prototyping, then enhanced to choice 2, and finally adapted to choice 1. Choice 1 suits our needs the best as it can achieve complete offline support and avoid handling API keys in production. Additionally, the cons of choice 1 is manageable. However, a mix of choice 1 and 2 will be required moving forward if we intend to support non-NUS locations or multiple academic semesters.			

4. Documentation

Refer to the guide here.

5. Testing

Refer to the guide here.

6. Dev Ops

Refer to the guide here.

Appendix A: Product Scope

Target user profile:

- has a need to coordinate meetings with many groups/projects
- prefer desktop apps over other types
- can type fast
- prefers typing over mouse input
- is reasonably comfortable using CLI apps

Value proposition: find a common time and venue amongst group members to schedule meetings faster

Appendix B: User Stories

Priorities: High (must have) - * * *, Medium (nice to have) - * *, Low (unlikely to have) - *

Priority	As a …	I want to …	So that I can…
* * *	new user	see usage instructions	refer to instructions when I forget how to use the App
* * *	user	add a new person	
* * *	user	delete a person	remove contacts that I no longer need
* * *	user	find a person by name	locate details of persons without having to go through the entire list
* * *	user	add a new group	create a group for scheduling meetings
* * *	user	add person to group	

Priority	As a …	I want to …	So that I can…
* * *	user	delete a group	remove groups that I no longer need
* * *	user	find a group by name	locate details of groups without having to go through the entire list
* * *	user	import my current schedule	do not have to manually add my calendar events
* * *	user	import my friends' schedule easily	do not have to manually add their calendar events
* * *	user	view my schedule	see what's on my schedule
* * *	user	find a common free time between multiple schedules	schedule a meeting between multiple people quickly
* * *	user	schedule meetings with different intervals (multiple times a week, every week, biweekly)	arrange more regular meetings
* * *	user	import my current schedule	do not have to manually add my calendar events
* * *	user	add ad-hoc events	can de-conflict
* * *	user	export/share scheduled meetings	share it with other members of the group/project

Priority	As a …	I want to …	So that I can…
* * *	user	savable data	share it with other members of the group/project
* *	user	know the best meeting location	arrange the meeting at a convenient place for all members
* *	user	know which bus to take	get to the meeting location
* *	experienced user	only use the keyboard	get things done faster
* *	user	tab complete	type my commands faster
* *	forgetful user	have guidance when typing	complete my commands easily
* *	careless user who type wrong commands frequently	undo my commands	do not have to manually reverse my mistakes
* *	inexperienced user	group people’s timetables	complete my commands easily
* *	user	generate email invite	notify other members of the group/project about the scheduled meeting
*	user	have a change log	view past changes

Appendix C: Use Cases

(For all use cases below, the **System** is the `AddressBook` and the **Actor** is the `user`, unless specified otherwise)

Use case: Delete person

MSS

1. User requests to list persons
2. TimeBook shows a list of persons
3. User requests to delete a specific person in the list
4. TimeBook deletes the person

   Use case ends.

Extensions

2a. The list is empty.

Use case ends.

3a. The given index is invalid.

3a1. AddressBook shows an error message.

Use case resumes at step 2.

Use case: Schedule a meeting

Preconditions: meeting group is created.

MSS

1. User requests to arrange a meeting for a group
2. TimeBook searches for common free timeslots between all group members' schedules
3. User chooses a free timeslot to schedule a meeting
4. TimeBook adds the scheduled meeting to all members' schedules

Extensions

Appendix D: Non Functional Requirements

1. Should work on any mainstream OS as long as it has Java 11 or above installed.
2. Should be able to hold up to 1000 persons without a noticeable sluggishness in performance for typical usage.
3. A user with above average typing speed for regular English text (i.e. not code, not system admin commands) should be able to accomplish most of the tasks faster using commands than using the mouse.
4. The application should be user-friendly to novices who have not used a command line interface

before.

5. The application should primarily cater to NUS students who already uses NUSMods to find free time.
6. The UI design of the application should be intuitive to users to navigate.
7. The application size should not be too big.
8. The application should save data real time and not require users to invoke save manually.
9. Our code should allow other developers to add new features in the application easily.

Appendix E: Glossary

Mainstream OS

Windows, Linux, Unix, OS-X

API

Application Programming Interface

Appendix F: Instructions for Manual Testing

Given below are instructions to test the app manually.

NOTE	These instructions only provide a starting point for testers to work on; testers are expected to do more *exploratory* testing.

F.1. Launch and Shutdown

1. Initial launch
   a. Download the jar file and copy into an empty folder
   b. Double-click the jar file
   Expected: Shows the GUI with a set of sample contacts. The window size may not be optimum.
2. Saving window preferences
   a. Resize the window to an optimum size. Move the window to a different location. Close the window.
   b. Re-launch the app by double-clicking the jar file.
   Expected: The most recent window size and location is retained.

F.2. Deleting a person

1. Deleting a person while all persons are listed
   a. Prerequisites: Populate TimeBook with person `addperson`.
   b. Test case: `deleteperson n/NAME` (Where NAME is the name of the person you added)

Expected: The person name will be removed from the list on the left of GUI and the feedback box will show `Delete person success: NAME deleted`

F.3. Getting closest common location

1. Get closest common location
    a. Prerequisites: Populate TimeBook with your group and group members with `addtogroup` and `addperson`. Subsequently, Show group schedule `show g/GROUP_NAME`. Expected: Show a group schedule with common free time.
    b. Test case: `selectfreetime i/x`
    Expected: A popup with the closest location will appear.
    c. Other incorrect select free time commands to try: `selectfreetime i/0.1`, `selectfreetime i/x` (where x is the free time slot id on the display)
2. Invalid `ID`.
    a. Prerequisites: Show group schedule `show g/GROUP_NAME` Expected: Show a group schedule with common free time.
    b. Test case: `selectfreetime i/0`
    Expected: Invalid time slot ID: 0. Please enter a valid id as shown in the GUI.
    c. Other incorrect select free time commands to try: `selectfreetime i/0.1`, `selectfreetime i/x` (where x is larger than the id on the display)

F.4. Graphic for schedules in TimeBook

1. Adding events to the schedules TimeBook can be tested with a given list of events.
    a. Each event should fit into the time table cell properly without overlapping with one another.
    b. Events that overlap in time slots should not be allowed to be added into TimeBook.
2. Resizing the window should not distort the schedule graphics displayed.
3. Ensure that the first column of the schedule graphic is always today's date.

F.5. Adding NUSMods timetable to a person's schedule

1. Adding via NUSMods link to a new person with an empty schedule.
    a. Prerequisites: A new person John is added with the `addperson n/John` command.
    b. Test case 1: `addmods link/https://nusmods.com/timetable/sem-1/share?CS2101=&CS2103T=LEC:G05&CS3230=LEC:1,TUT:08&CS3243=TUT:07,LEC:1&GEQ1000=TUT:D17`
    Expected: John's schedule is successfully updated with the all the lesson times and exam times for the module classes specified in the link.
    c. Test case 2: Enter `addmods link/https://nusmods.com/timetable/sem-1/share?CS2101=&CS2103T=LEC:G05&CS3230=LEC:1,TUT:08&CS3243=TUT:07,LEC:1&GEQ1000=TUT:D17` twice consecutively.
    Expected: No lessons are added to John's schedule. Error message shows up due to a clash in

timings between events in current schedule and the modules you are adding.

d. Other incorrect addmods commands to try: `addmods`, `addmods n/John link/random_string`, `addmods n/John link/https//randomurl.com`, `addmods n/John link/https://nusmods.com/timetable/sem-1/share?INVALIDMODULE=LEC:G05`, `addmods n/John link/https://nusmods.com/timetable/sem-1/share?CS2103T=INVALIDCLASSTYPE:G05`, `addmods n/John link/https://nusmods.com/timetable/sem-1/share?CS2103T=LEC:INVALIDCLASSNUMBER`
No lessons are added to John's schedule. Error details are shown in the feedback display.

F.6. Adding an NUS module's lessons to a person's schedule

1. Adding CS2100 lecture 1, lab 15 and tutorial 08 to a new person with an empty schedule.

   a. Prerequisites: A new person John is added with the `addperson n/John` command.

   b. Test case 1: `addmod n/John m/CS2100 cl/TUT:08,LAB:15,LEC:1`
   Expected: John's schedule is successfully updated with CS2100 lecture 1, lab 15, tutorial 08 and exam timeslots.

   c. Test case 2: Execute `addmod n/John m/CS2100 cl/TUT:08,LAB:15,LEC:1` twice.
   Expected: No lessons will be added to John's schedule. Error message shows up due to a clash in timings between events in current schedule and the module you are adding.

   d. Other incorrect addmod commands to try: `addmod`, `addmod n/John m/random_string`, `addmod n/John m/CCS2100 cl/random_string`.