CodeCampX - Developer Guide

By: Team CS2103-AY1920S2-CS2103-W14 Since: Jan 2020 Licence: MIT

1. Setting up

Refer to the guide here.

1.1. Architecture [Hieu]

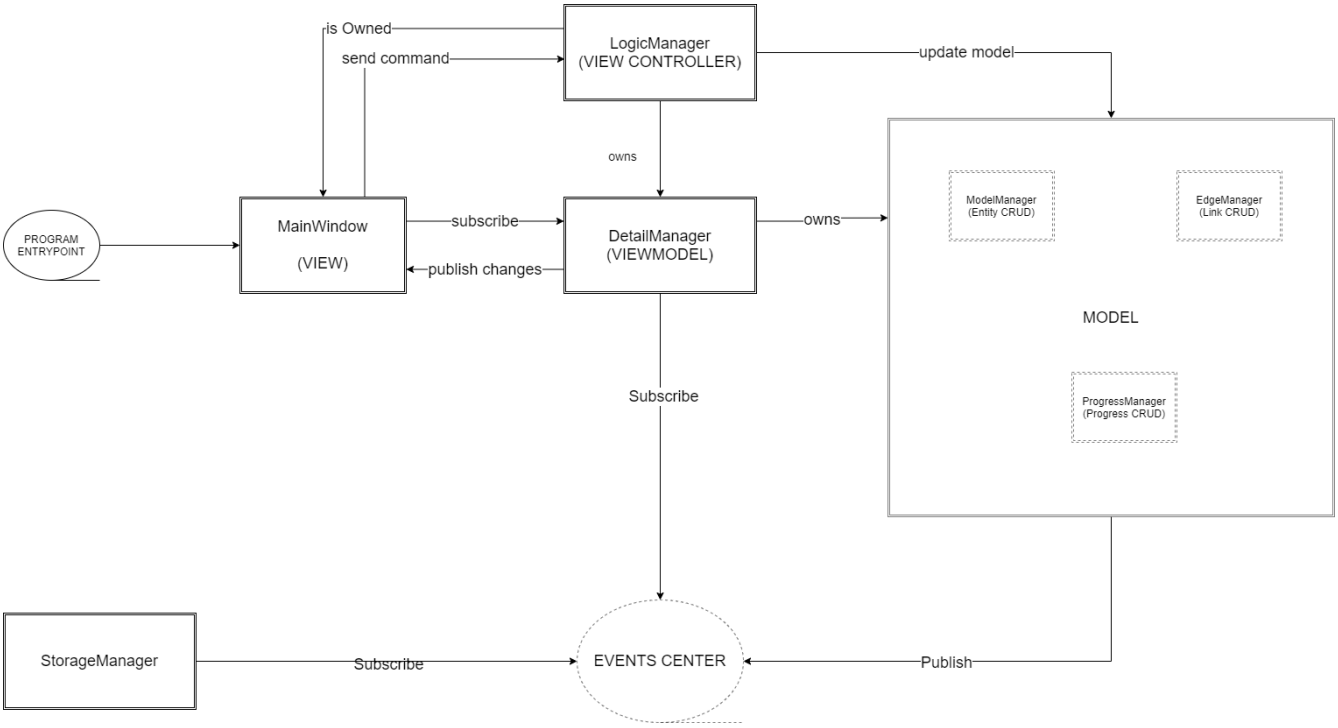

Figure 1. Architecture Diagram

The ***Architecture Diagram*** given above explains the high-level design of the App. Given below is a quick overview of each component.

1.1.1. Design Pattern and Control Flow

Two main design patterns were used in the design of our software.

Model - View - ViewModel (MVVM) Control Flow

Design Consideration between Model-View-Controller(MVC) and Model-View-ViewModel(MVVM) design:

- The original design was a standard MVC, where Controller is our LogicManager, and the Model is our ModelManager. Then components in the view will bind to the model objects, whenever there is an update to the model object the UI view will be updated automatically.
- However, the more UI custom views logic we decide, we might need to push more and more custom UI-specific logic to our Model and ViewController class, which is not very desirable. Or as the infamous quote, MVC becomes "Massive View Controller".
- Instead, we will adapt to MVVM design, where ViewModel will hold a list of observableMap

of data. Each custom view in our UI will have a one-to-one mapping with an observableMap, and to calculate those observableMap the ViewModel will make use of the Managers we define.

Event-Driven Design

We adopt event-driven design, where different components will try to communicate with each other through publishing events and subscribing to events, de-couple between components, and facilitate communication between components a lot.

- To separate responsibilities well between components, we divide them into multiple managers, all extending from the BaseManager class. The BaseManager will always hold refer to the EventsCenter (which is designed to be a singleton class in our case)
  - One is publishing managers (those in Model section, i.e EdgeManager, ProgressManager, etc). They can post events to the EventsCenterSingleton.
  - The other one is subscribing managers, one is the ViewModel (which is DetailManager) and StorageManager. Subscribing managers will have handler method that listen to the events and decide what to do.
- Different events types will extend from the BaseEvent. In our app we have
  - DataStorageChangeEvent: signals when model object changes
  - DeleteEntitySyncEvent: signals when the entity linking relationship is broken (e.g when a student is deleted, its link to course and progress and teacher, etc will be broken)

Here is an example of how a command to delete student with ID 1 will invoke different parts along the flow.

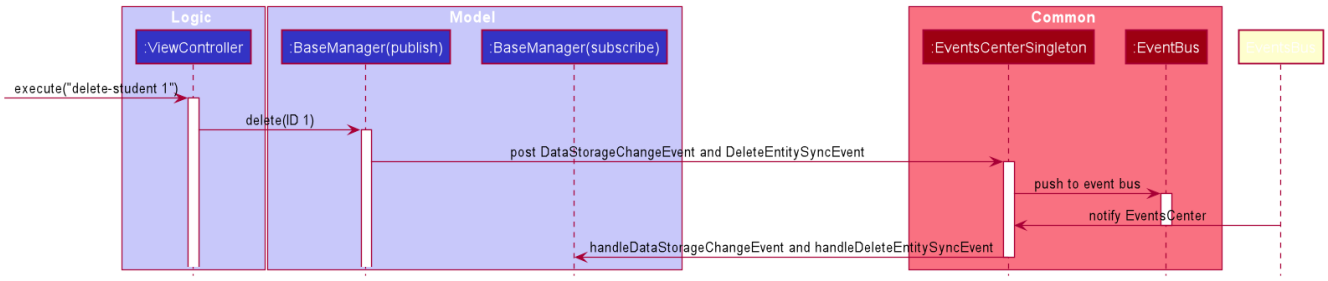

Figure 2. Sequence Diagram for Events Flow

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1. ViewController(i.e LogicManager) will invoke ModelManager.delete method (Note that ModelManager extends from BaseManager, and has the Publisher capacity)
2. ModelManager will invoke publishing of events to EventsCenterSingleton (which holds an EventBus), in this case postDataStorageChangeEvent and postDeleteEntitySyncEvent will be invoked.
3. Other BaseManagers will also hold this EventsCenterSingleton and listen to new publish events in the event bus. If the manager class has the handler function for that types of events, the method will be invoked.
4. In this case, StorageManager will have handler for both DataStorageChangeEvent and DeleteEntitySyncEvent, while ViewModel will have handler for DataStorageChangeEvent.

1.1.2. Architecture-Level Components

Overall, the App consists of five main components.

- `View`: The UI of the App. Represented by `UI` in our implementation.
- `ViewController`: The command executor. Represented by `Logic` in our implementation.
- `ViewModel`: Updates the model for UI to display.
- `Model`: Holds the data of the App in-memory.
- `Storage`: Reads data from, and writes data to, the hard disk.

In addition, `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.

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.

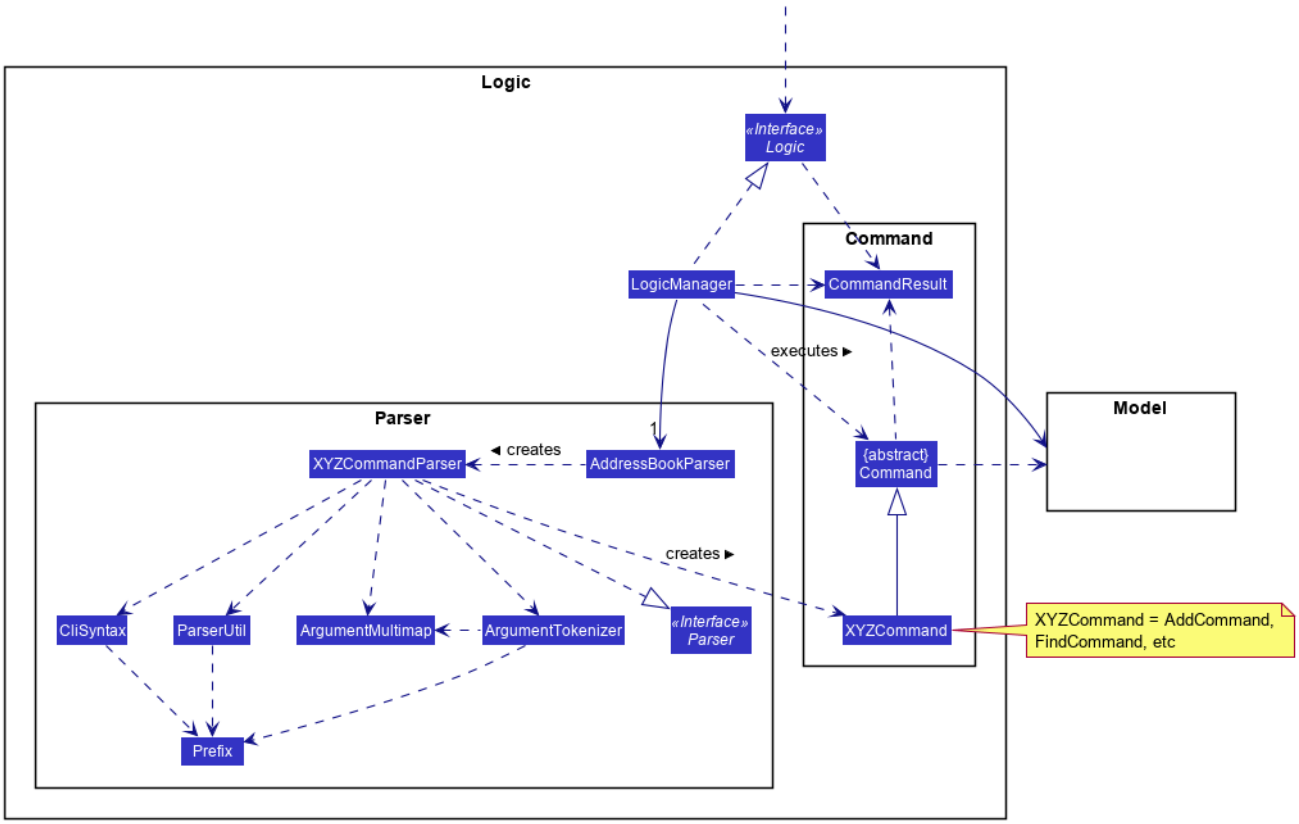


Figure 3. Class Diagram of the Logic Component

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 `delete 1`.

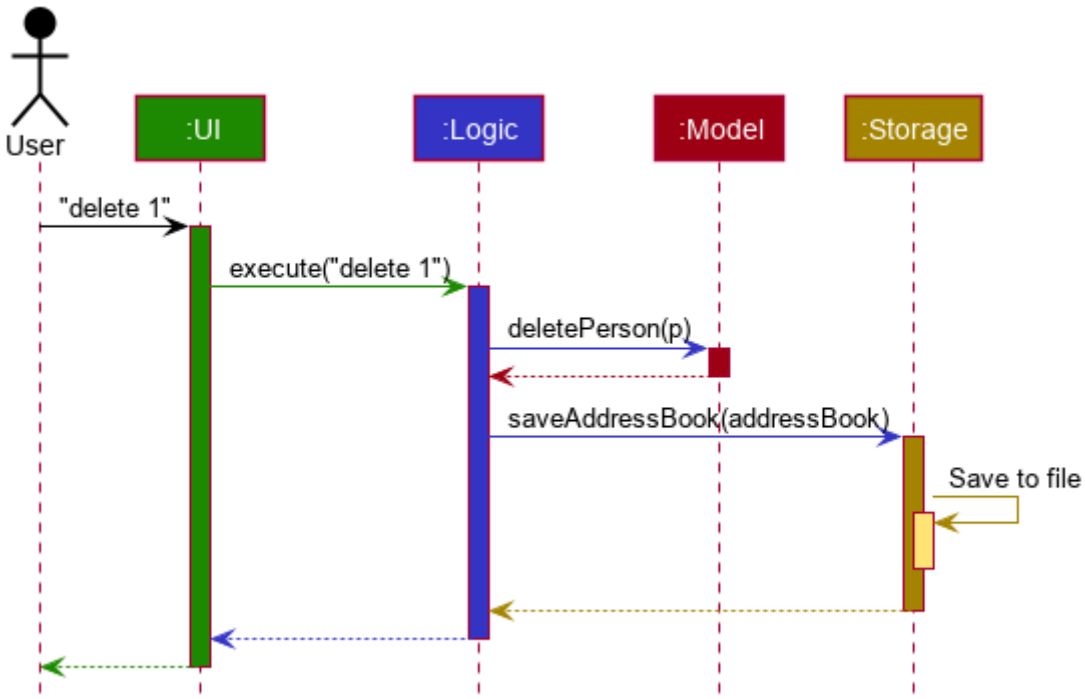


Figure 4. Component interactions for `delete 1` command

The sections below give more details of each component.

1.2. View/UI component [Sim Sheng Xue]

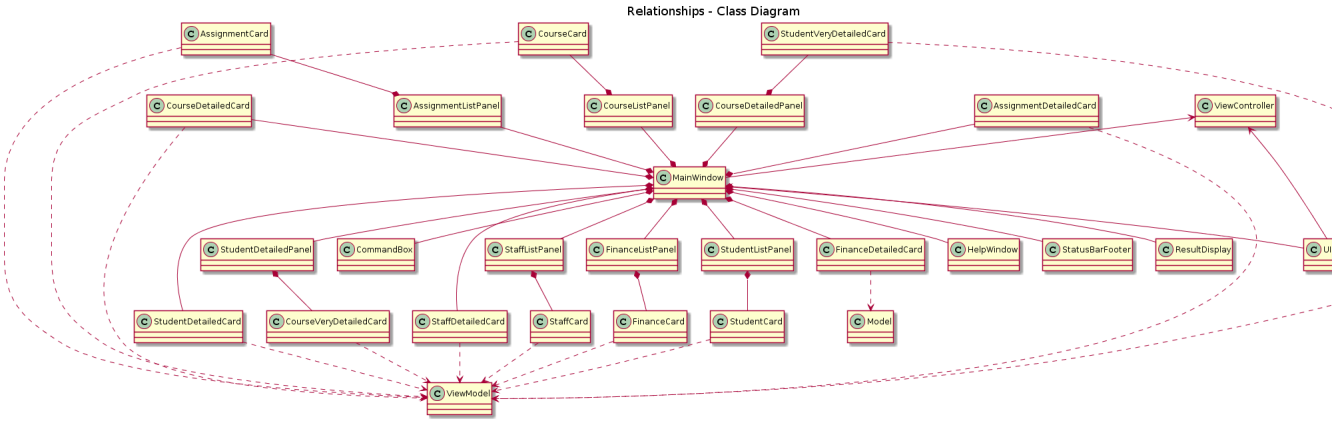


Figure 5. Structure of the UI Component

The UI consists of a `MainWindow` that is made up of parts e.g.`CommandBox`, `ResultDisplay`, `StatusBarFooter` etc. All these, including the `MainWindow`, inherit from the abstract `UiPart` class.

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.

The `UI` component,

- Executes user commands using the `ViewController` component.
- Listens for changes to `ViewModel` data so that the UI can be updated with the modified data. `ListPanel` objects store a list of `Card` objects.
  `DetailedPanel` objects store a list of `VeryDetailedCard` objects. For example, for the Student Tab:

The `StudentListPanel` is the top left panel. This stores a list of `StudentCard`, which only displays the basic information about the Student.

The `StudentDetailedCard` is the top right panel. This is viewed when a specific Student is selected using a command. This will show the detailed information about the Student, such as the courses assigned to this Student.

The `StudentDetailedPanel` is the bottom right panel. This stores a list of `CourseVeryDetailedCard`. Each `CourseVeryDetailedCard` displays the list of assignments assigned to the Course of this Student.

Only the Student and Course tabs contain `DetailedPanel`(bottom right panel). All tabs contain the `ListPanel` (top left panel) and `DetailedCard`(top right panel). This is because `ListPanel` is needed to show the basic information of each item, while `DetailedCard` is needed to show the detailed information of each selected item. `DetailedPanel` is only needed for Student to show list of Courses for a Student, and for Course to show list of Student for a Course.

1. As can be seen from the UI diagram above, each of the `Card`, `DetailedCard` and `VeryDetailedCard` will subscribe and listen to the `ViewModel` through the logic layers.
2. Each of these classes will correspond to the observableMap in `ViewModel`
3. When there is a change to the model, the `ViewModel` will update its observableMap
4. As each of these classes in `View` subscribe to the `ViewModel`, the UI will update automatically.

1.3. ViewController/Logic component [Sim Sheng Xue]

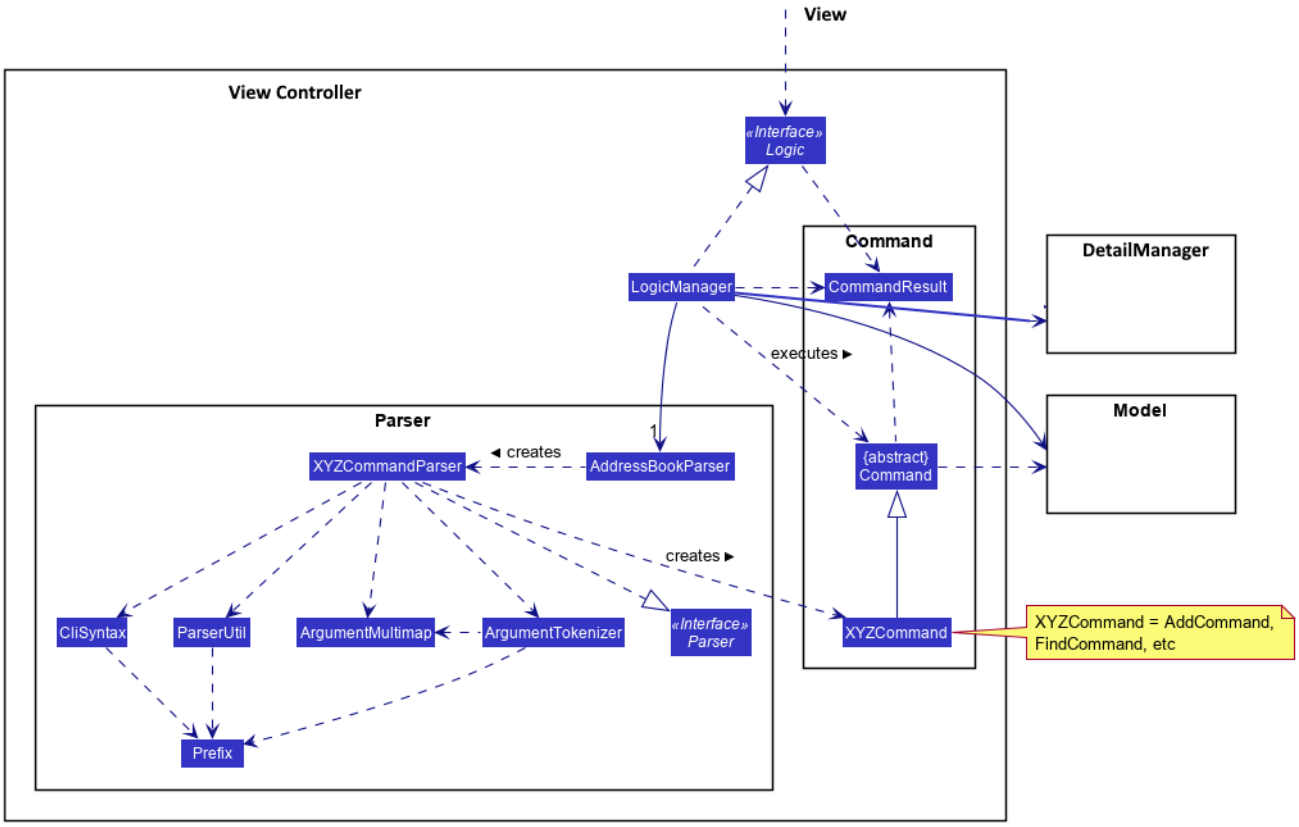
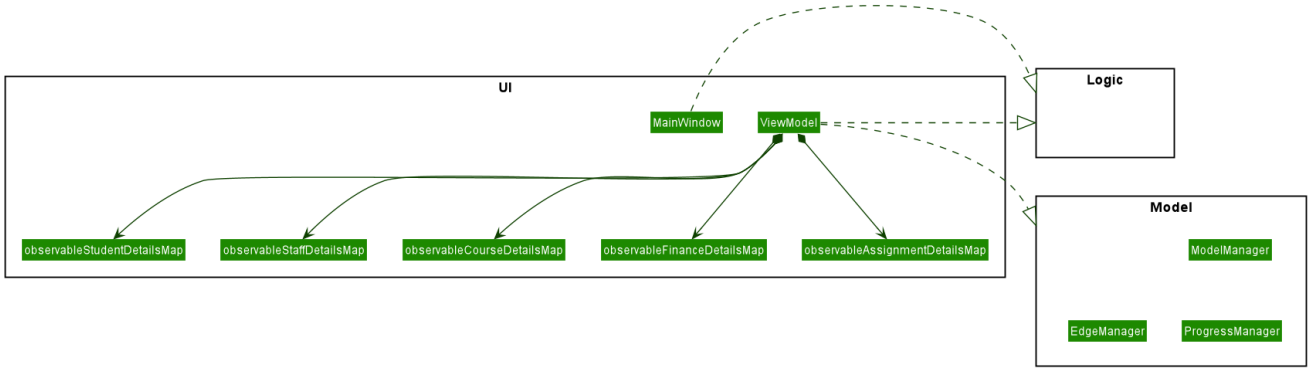


Figure 6. Structure of the View Controller Component

API : `Logic.java`

1. `ViewController` uses the `AddressBookParser` 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 student).
4. The `LogicManager` will invoke the relevant class located inside `Model`. For Entity CRUD commands, the `ModelManager` will be invoked. For Link CRUD commands, the `EdgeManager` will be invoked. For Progress CRUD commands, the `ProgressManager` will be invoked.
5. The Managers will post events to the `EventsCenterSingleton`. The subscribing managers `DetailManager` and `StorageManager` will listen to new publish events in the event bus. The `View` also subscribes to `DetailManager`. This allows for the commands executed by the `LogicManager` to moify both the View and Storage.
6. The result of the command execution is encapsulated as a `CommandResult` object which is passed back to the `View`.
7. In addition, the `CommandResult` object can also instruct the `View` to perform certain actions, such as displaying help to the user.

1.4. ViewModel component [Hieu]



API: `ViewModel.java`

The `ViewModel`,

- stores a list of `observableMap`, each map will corresponds to one `DetailPanel` in ui folder.
- Each `DetailPanel` (in MainWindow) will listen to the `ViewModel` through the Logic layer.
- the `ViewModel` will then query the managers from `Model` layer to update its observableMap, which in turn will automatically update the corresponding `DetailPanel` view.

1.5. Model component [Tee Jun Jie Ivan]

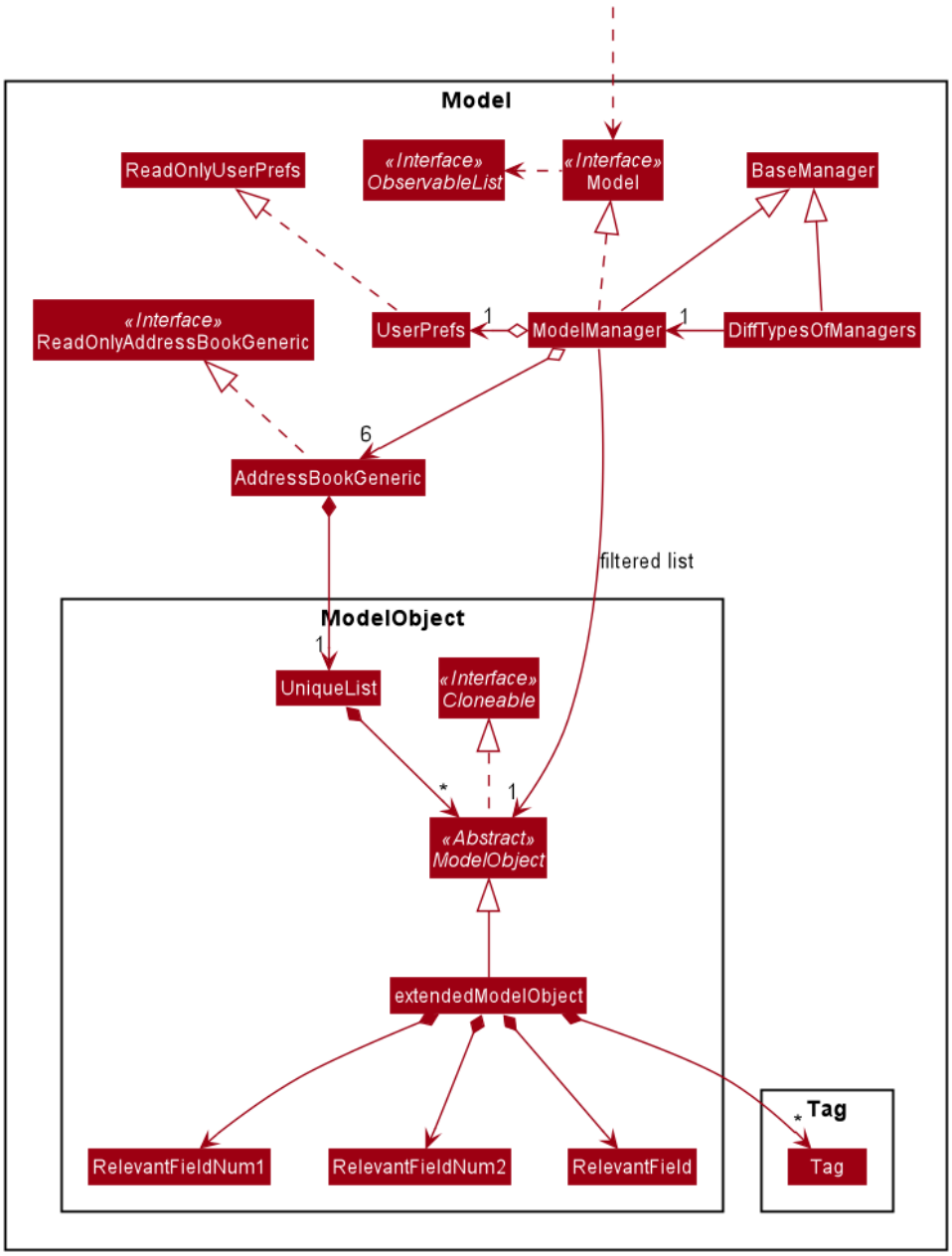


Figure 7. Structure of the Model Component

API : `Model.java`

The `Model`,

- stores a `UserPref` object that represents the user's preferences.
- stores the 6 AddressBookGeneric<K extends ModelObject>, each of which holds a different type of ModelObject. The 6 types are namely
  1. Student
  2. Course
  3. Staff
  4. Assignment
  5. Progress

6. Finance

- exposes an unmodifiable `ObservableList<K extends ModelObject>` that can be 'observed' e.g. the UI can be bound to this list so that the UI automatically updates when the data in the list change.
- does not depend on any of the other components.

Below is an example of the different types of RelevantFields that can be tied to an Assignment.

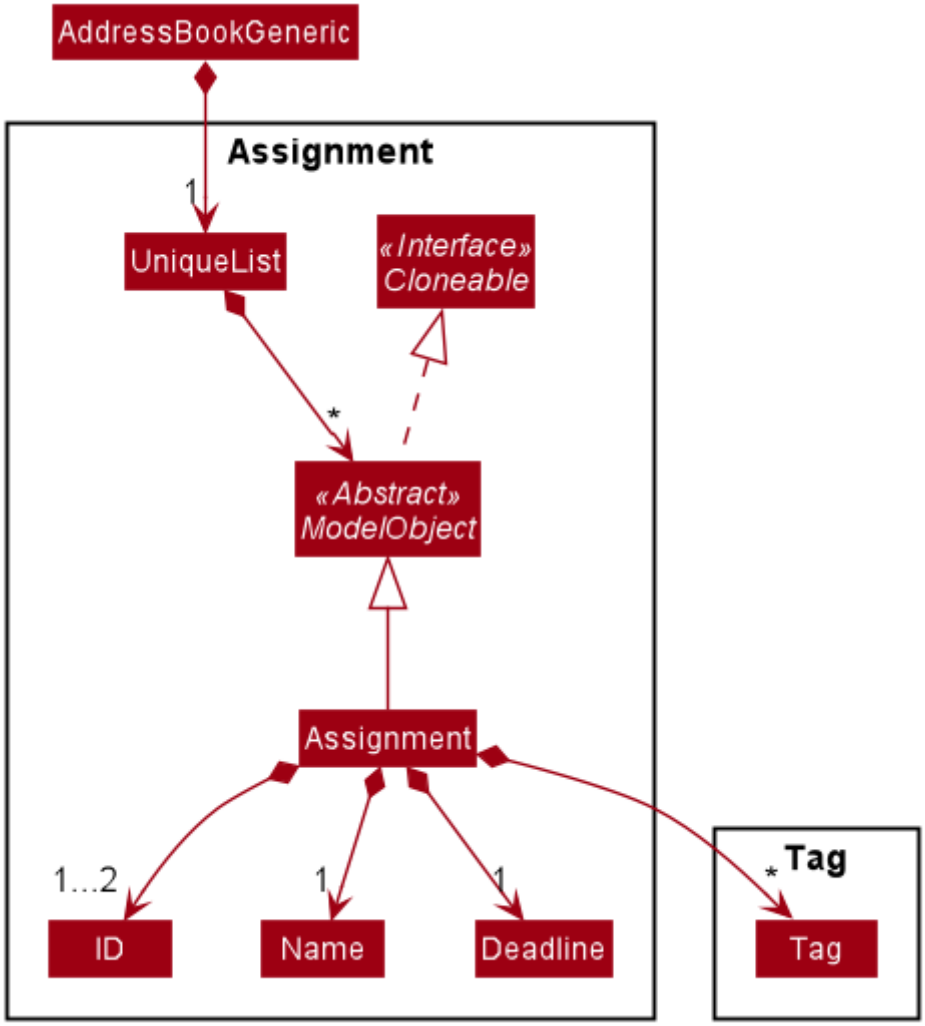


Figure 8. Class Diagram of Assignment

NOTE	The AddressBookGeneric in the diagram above is actually an AddressBookGeneric<Assignment>. The AddressBookGeneric has been made to accept any class that extends ModelObject. This cannot be shown due to limitations in PlantUML.

1.5.1. Notable Implementations in Model

1. By making use of `Generics` and `Polymorphism`, the group has made it such that `AddressBookGeneric<K extends ModelObject>` can hold any class that extends from ModelObject

   Benefits

   a. Allows for code optimization by having reusable code. There is significant decrease in workload when code can be reused for each others' benefit instead of having duplicated

code.

b. Allows for extension easily for future features. Future features that involve creating new AddressBooks can be developed very quickly and allow for faster development of future features.

2. All `ModelObjects` implement `Cloneable` so as to allow for Defensive Programming more easily.
   a. Please refer to `Step 2 of Section 2.2.2` for the team's rationale behind having ModelObject implement Cloneable.
3. All Non-Crud Commands such as `Assign`/`Un-assign`/`Done` are handled in `DiffTypesOfManagers` such as `EdgeManager` or `ProgressManager` instead of having all implementations being done in `ModelManager`

   Benefits

   a. Easier implementation since lower level implementations can be abstracted away
   b. More decoupling which will lead to be better testability and easier debugging

1.6. Storage component [Sim Sheng Xue]

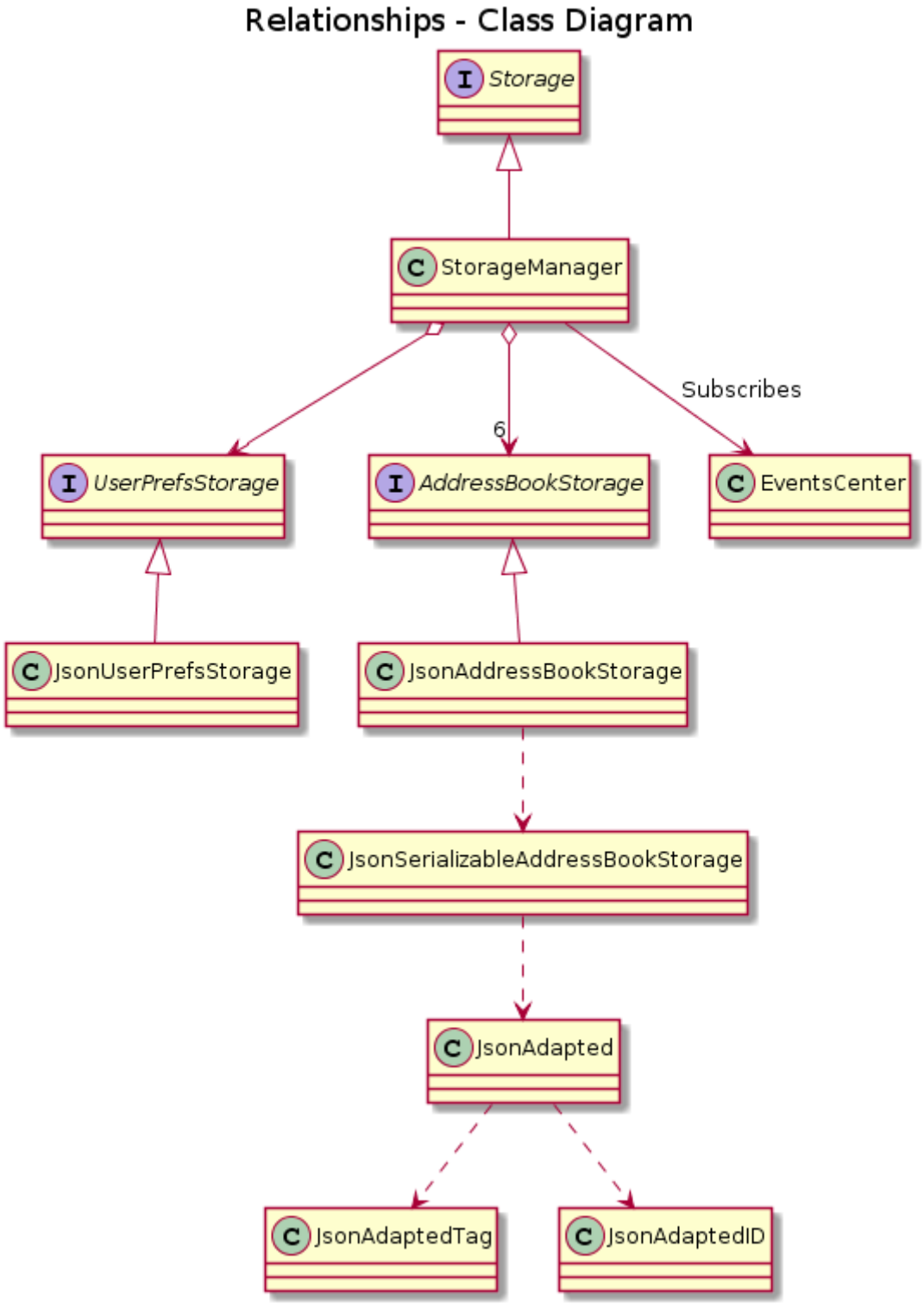


Figure 9. Structure of the Storage Component

The `Storage` component,

- can save `UserPref` objects in json format and read it back.
- can save the Address Book data in json format and read it back.
- The `StorageManager` subscribes to the `EventCenter`. It will listen to both DataStorageChangeEvent and DeleteEntitySyncEvent. DataStorageChangeEvent occurs when basic information about each object is changed, except for deletion. DeleteEntitySyncEvent occurs when an object is deleted, and the storage has to be update to maintain consistency. For example, when a Course

is deleted, the DeleteEntitySyncEvent will trigger the storage to remove the Course from every Student assigned to this Course.

1.7. Common classes

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

2. Implementation

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

2.1. Unique Identification of Entities [Sim Sheng Xue]

1. `UUID Manager` - Ensures ID of all entities are unique, allowing each object to be uniquely identifiable

2.1.1. UUID Manager

1. All ModelObjects have their own ID which is generated by UUID manager
2. For Progress objects, the ID is a composite ID of assignmentID and studentID

Consideration:
Each ModelObjects should have a ID generated that is unique among the entire application, across history. For example, not only can two Students not have the same ID, but a Student and a Staff cannot have the same ID. This design consideration is taken due to the existence of Finance.

The Finance object can represent a Student paying for a Course. When the Student is deleted, the Finance object is not deleted. This is due to the need to track the Finance of the coding camp, even though the Student has left the camp(and assuming there is no refund, if not the owner can delete the Finance object).

Hence, this means that if the ID is not unique among deleted objects, there may be inconsistent information located in the Finance objects.

2.2. Entity Linking - Assigning/Un-Assigning an Entity to/from a Course [Tee Jun Jie Ivan]

In order to allow the tracking of the students/assignments/teachers that are assigned to a course and vice versa, this required us to implement a structure which allowed us to obtain information from the aforementioned objects, without causing any circular referencing errors.

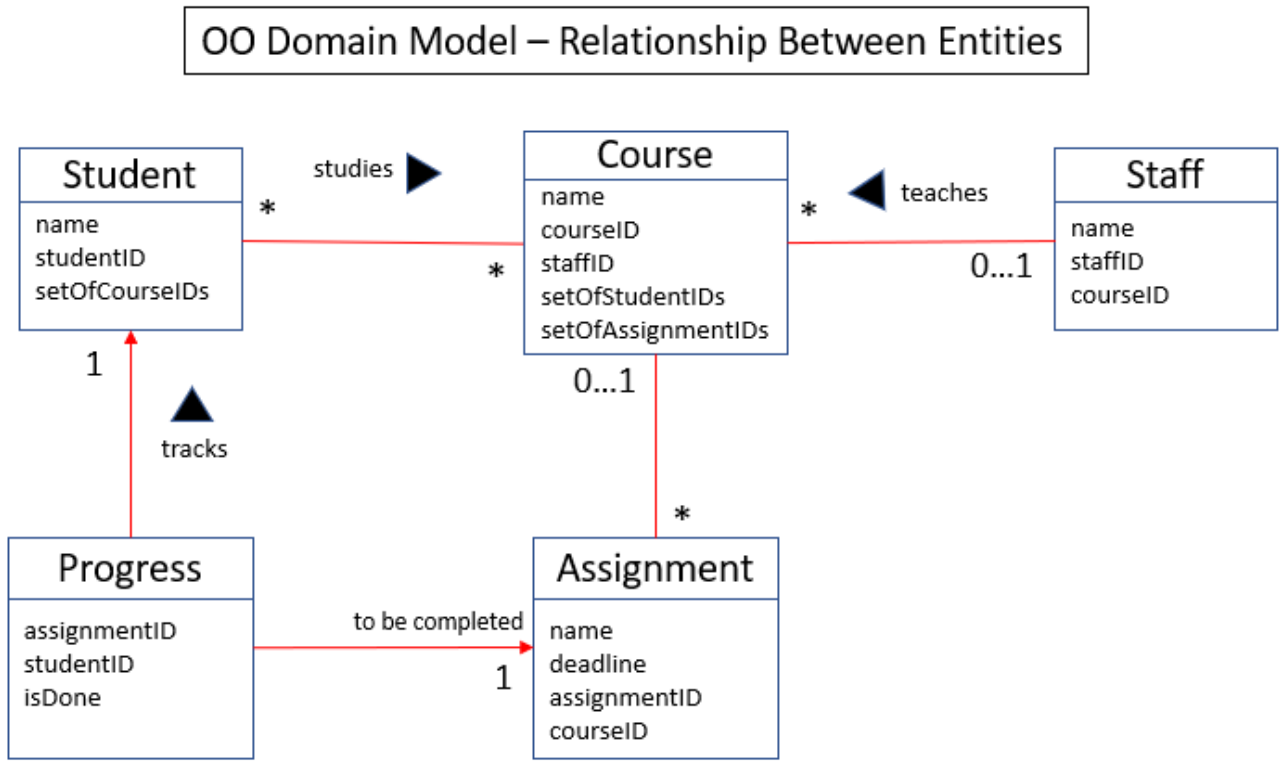


Figure 10. Relationship between Entities

The group came up with the structure above where we centralize most links around the `Course` object so as for easier management of entity links.

IMPORTANT

Notice that `Student` does **not** hold a `Course`, but a set of `CourseIDs`. Hence, there should be an association between `Student` and `ID` instead of `Student` and `Course`. However, the group found it much more **intuitive** to think of the associations to be from 2 modelObjects rather than to and from IDs. Every non-directed association between 2 objects ensures that both objects have each other's ID.

The only exception is `Progress` objects which are created via a composite ID of `studentID` and `assignmentID`. A more detailed explanation of Progress Management is explained in Section 2.3, "Student Progress Management [Tee Jun Jie Ivan]".

Entity Linking is managed exclusively by `Edge Manager`

- Ensures that links are maintained/removed properly during assign, un-assign, delete commands
  API : `EdgeManager.java`

2.2.1. Execution of Assign/Un-assign Command [Tee Jun Jie Ivan]

For the actual execution of an assign/un-assign command, 2 main steps are performed.

1. Pre-process the targeted entities to ensure consistent state - Via `PreprocessUndoCommand` method call

2. Add/Remove both object's ID into/from each other - Handled by `EdgeManager`

Step 1: Preprocess Entities

Rationale

Firstly, a `pre-processing step` must be performed before executing an undo-able assign/un-assign command to ensure that all entity links are in correct state before command execution. This means that either

1. Both targeted objects have each other's IDs or
2. They do not

There should be no instance where Course has an Assignment/Student/Staff's ID but they do not have the Course's ID or vice versa.

Current Implementation

Below is an activity diagram showing the pre-processing performed for assign commands. The diagram can be generalized for un-assign commands by checking if the course contains X and vice versa in the second stage instead.

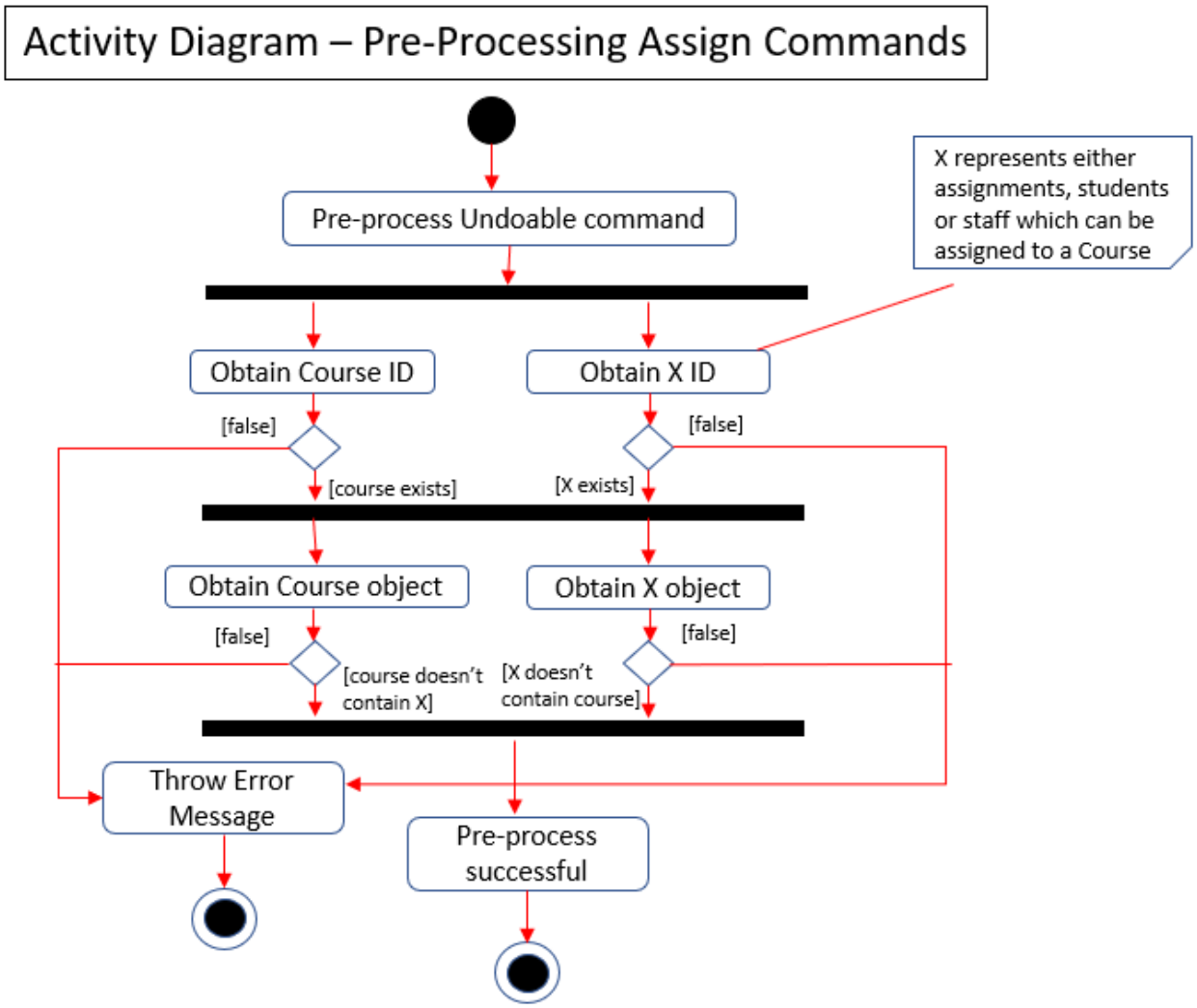


Figure 11. Activity Diagram of Pre-processing for Assign/Un-assign commands

Notice that there are 2 main exit points in the activity diagram.

1. The success case is straightforward and will lead to a the program continuing to execute the actual assign/un-assign command.
2. For the failure case, should any of the conditions fail, this means that either that the
    - specified objects does `not exist`,
    - both entities are `already assigned` to each other or,
    - most importantly, that the model is in an `inconsistent state` where one entity is assigned to the other but not vice versa.

Step 2: Assign IDs via EdgeManager

Rationale

After the necessary checks have been performed, respective IDs need to be added to the targeted course and targeted object in order to ensure correct and consistent assigning of objects.

Current Implementation

Below is a sequence diagram of how EdgeManager adds the IDs to the two objects involved.

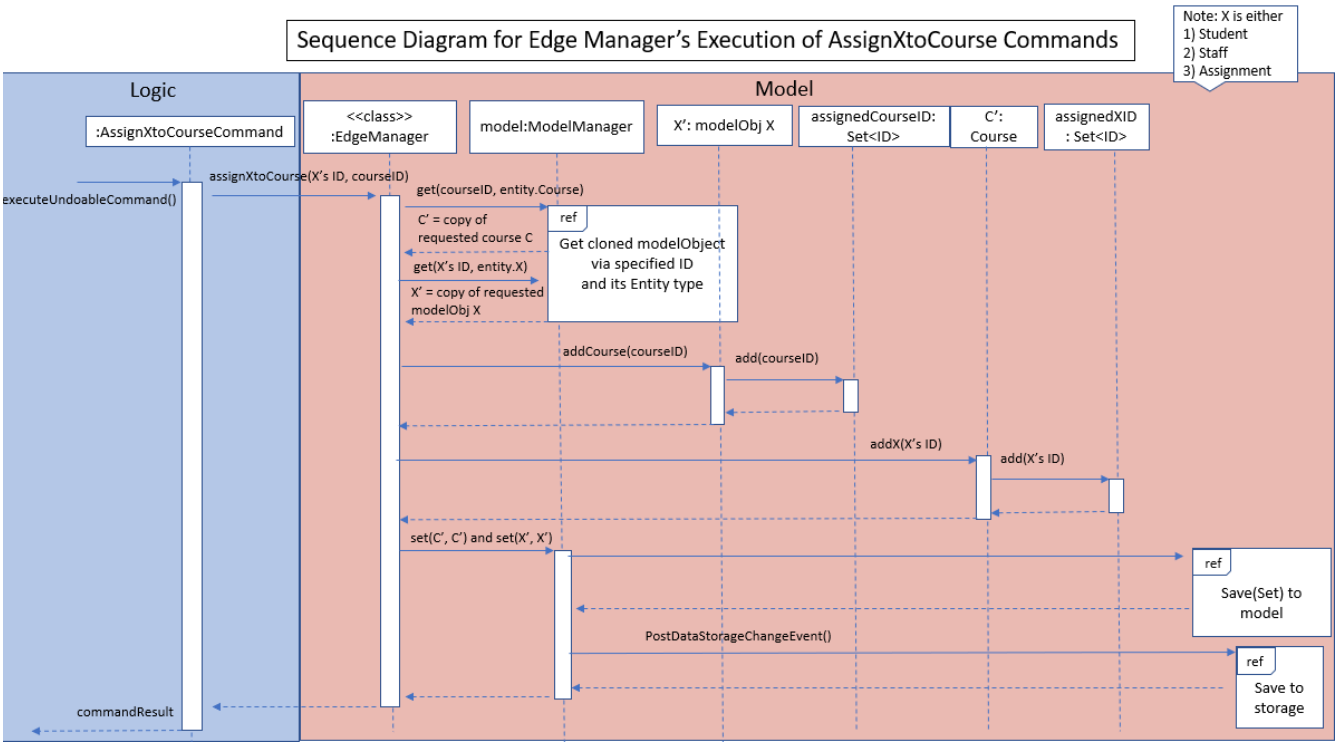


Figure 12. Sequence Diagram of EdgeManager's AssignXtoCourse commands

The flow of an assign command is as follows:

1. Obtain a copy of the requested `modelObjects` from `ModelManager`
    a. One of which must be a `Course` modelObject, the other being either a `Student`/`Staff`/`Assignment` modelObject

2. For object X', add the `courseID` into the assignedCourseIDs in X`
    a. For assignments, every assignment can only be assigned to at most **one course**. Hence, it'll hold just an assignedCourseID instead of a set of Course IDs.
3. For Course C', add `X's ID` into assignedXIDs in C'
    a. For courses, every course may only have at most **one teacher**. Hence, course will have an assignedTeacherID instead of a set of Teacher IDs.
4. Update the 2 affected models by executing `set(targetObj, editedObj)` in modelManager for both changed modelObjects
5. Update the storage by running postDataStorageChangeEvent() - ref to `Figure 2` to understand how storage save is triggered

NOTE	This sequence diagram can be generalized for `un-assign command` as well. Instead of adding IDs, un-assign will remove each other's ID from the respective objects.

Design Considerations

1. Manipulating the `actual` modelObjects by having modelManager#get() return referenced variable of the actual `modelObjectTags`.

    Pros

    a. Simpler implementation since any changes to the model will change the actual object directly

    b. Faster execution since any changes is done to the actual modelObject

    Cons

    a. Might allow for unintentional changes to the actual modelObject

2. (Current Implementation) Manipulate a `cloned` modelObject by having modelManager#get() return a copy of actual modelObject.

    Pros

    a. Prevents unintentional modifications of the shared object

    Cons

    a. Extra processing required. For example, a method is required to replace the old modelObject with the new model object. Also, requires all ModelObject classes to implement a clone() method.

    b. More memory intensive and can hurt overall program performance.

Overall, the second option was chosen since the program is very dependent on maintaining a `consistent state`, where either 2 modelObjects have each other's ID or they do not. Some performance can be sacrificed in order to ensure that the links between objects cannot be modified by mistake.

Summary of Entity Linking

Overall, in order to ensure successful entity linking, the role that `EdgeManager` plays is crucial. The table below shows the method calls made to `EdgeManager` during an `Assign`/`Un-assign` command.

Command	Method Call within the Command	EdgeManager method call
AssignStudentToCourse	PreprocessUndoableCommand() Is executed for all Commands to ensure consistent state	assignStudentToCourse()
AssignTeacherToCourse		assignTeacherToCourse()
AssignAssignmentToCourse		assignAssignmentToCourse()
Un-assignStudentFromCourse		unassignStudentFromCourse()
Un-assignTeacherFromCourse		unassignTeacherFromCourse()
Un-assignAssignmentFromCourse		unassignAssignmentFromCourse()

Figure 13. Table Summary of EdgeManager's involvement during Assign/Un-assign Commands

2.3. Student Progress Management [Tee Jun Jie Ivan]

The `Progress` of students is managed exclusively by the `ProgressManager` class.

API : `ProgressManager.java`

2.3.1. Student Progress Creation/Removal

Rationale

New `Progress` objects must be created in 2 main scenarios.

1. If a `Student` has been added to a `Course`, the `Student` will need to complete all `Assignments` that have already been assigned to the `Course`.
2. If an `Assignment` has been added to a `Course`, all `Students` currently taking the `Course` must now complete that `Assignment`.

The rationale is similar when un-assigning either `Student` or `Assignment` from a `Course`. `Progress` objects need to be removed instead.

Current Implementation

Below is a sequence diagram illustrating how the ProgressManager adds Progress objects into the ProgressAddressBook when a `AssignStudentToCourse` command is run.

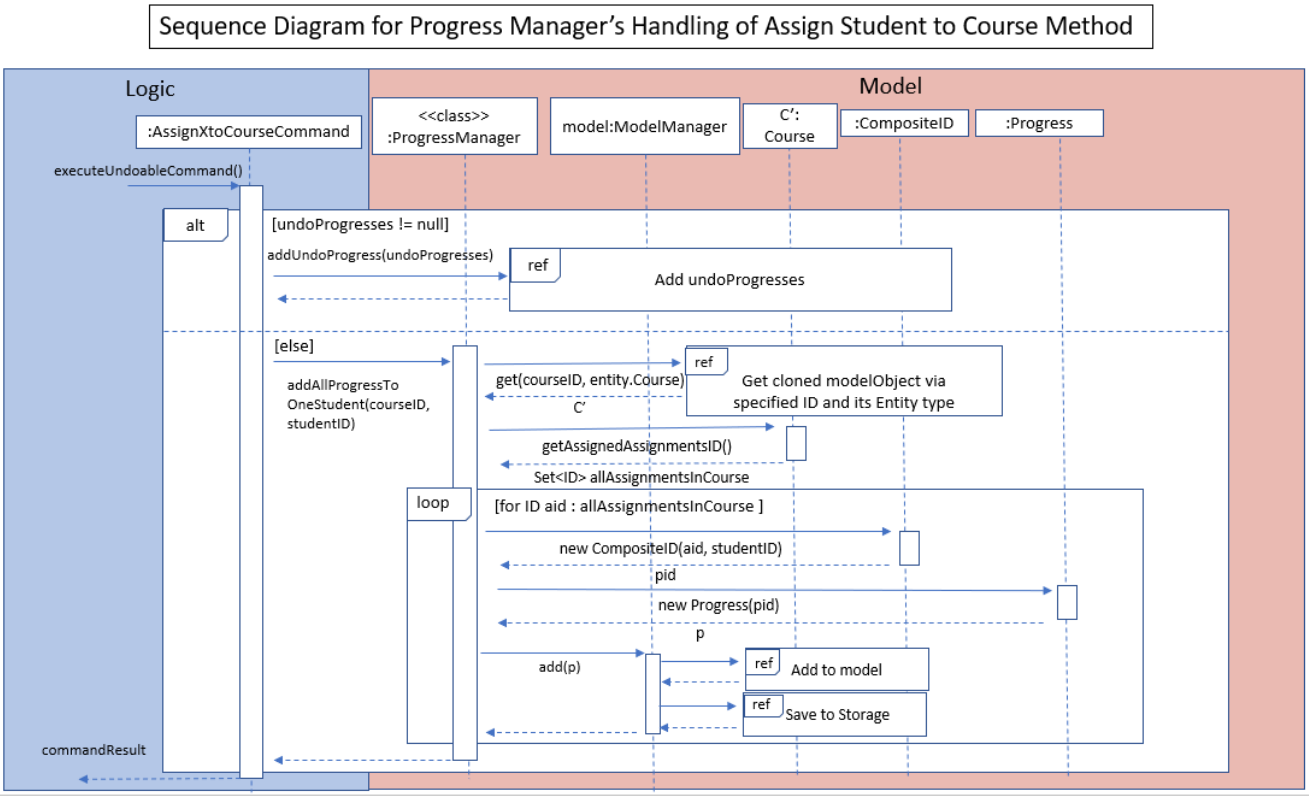


Figure 14. Activity Diagram for creating Progress objects when assigning a Student to a Course

The flow of adding Progress objects in a AssignStudentToCourse is as follows

1. If there are `Progress` objects that were previously in ProgressAddressBook but were removed due to an `Un-assign/Delete` command, add those `Progress` objects back in.
    a. This only occurs when undo-ing an `Un-assign/Delete` command. Refer to Section 2.4.2, "Opposite command for assign/ un-assign [Tee Jun Jie Ivan]" for more information.
2. Else, i.e. if this is an entirely new AssignStudentToCourse command,
    a. Obtain **C'**, a copy of the targeted `Course`
    b. From **C'**, obtain all assignmentIDs that are assigned to it.
    c. For each of the obtained assignmentIDs, create a new CompositeID of assignmentID and studentID
    d. Create a `Progress` object using each of the `CompositeID`
    e. Finally, add these `Progress` objects into the `ProgressAddressBook`.

Notes

- The flow is largely the same for AssignAssignmentToCourse! Instead, we want every `Student` that is currently studying in course **C'** to complete the particular `Assignment`. Hence, rather than obtain all assignmentIDs, we will need to obtain all `studentIDs` that are studying **C'**, and create a `Progress` object so that we can track whether those students have completed the assignment.
- The flow is also largely the same for UnassignCommands! Instead, we are looking to remove Progress objects rather than adding them back in.

- Notice that we have hidden all access to `Progress` objects behind `ProgressManager`. Hence, the user cannot, and should not, be able to create their own `Progress` objects.

The table below shows the summary of method calls from `ProgressManager` for each variant of `Assign`/`Un-assign` command.

Command	ProgressManager method call	
	no UndoProgresses	have UndoProgresses
AssignStudentToCourse	addAllProgressToOneStudent()	addUndoProgress()
AssignTeacherToCourse	X	
AssignAssignmentToCourse	addOneProgressToAllStudent()	addUndoProgress()
Un-assignStudentFromCourse	removeAllProgressFromOneStudent	X
Un-assignTeacherFromCourse	X	
Un-assignAssignmentFromCourse	removeOneProgressFromAllStudents()	X

Figure 15. Table Summary of ProgressManager method calls() for Assign/Un-assign Commands

2.3.2. Marking Progress as `Done`/`Undone`

Rationale

When a `Student` finishes an `Assignment` that is allocated to him, you want to be able to mark his work as `Done`.

Similarly, if an `Assignment` has been mistakenly marked as `Done` or is actually `Undone`, you want to be able to mark the `Assignment` as `Undone`.

Current Implementation

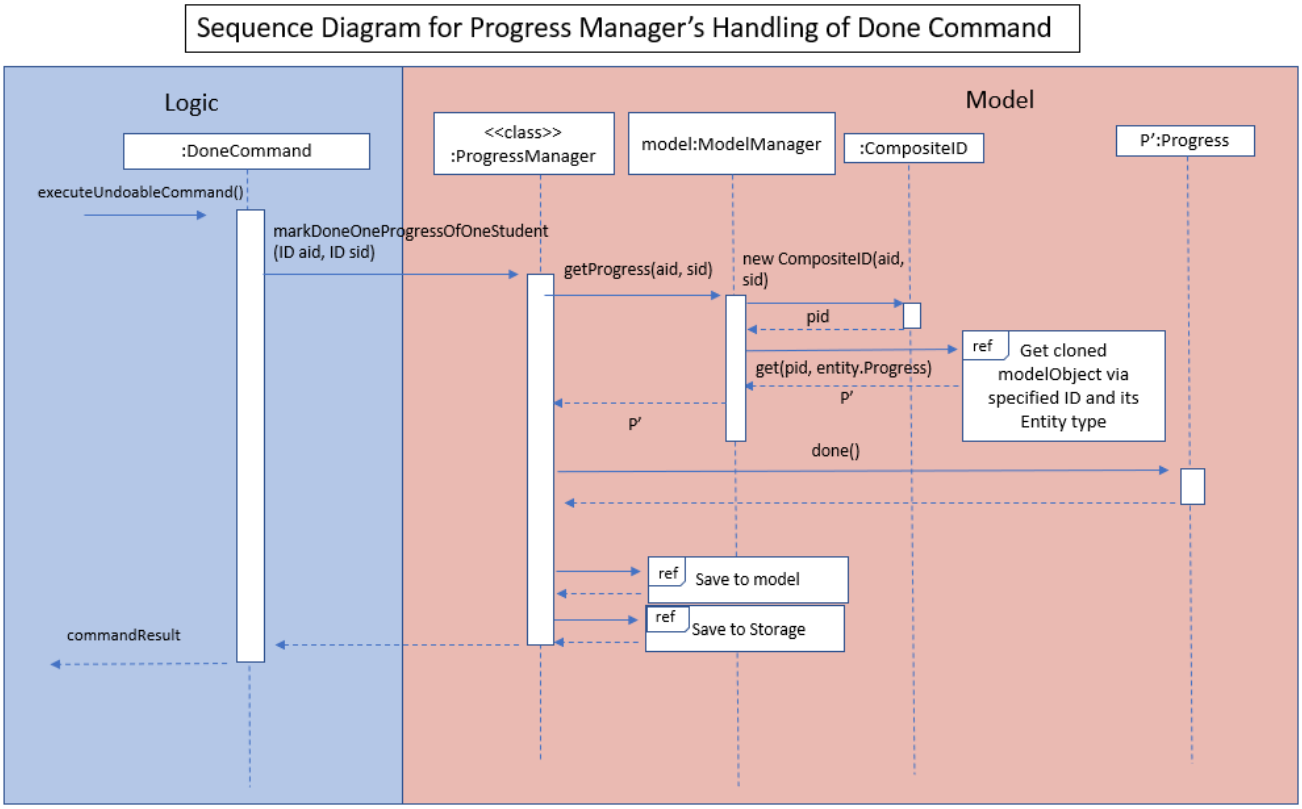


Figure 16. Sequence Diagram for Progress Manager's Handling of Done Command

The implementation of `Done` command is very straight-forward. Only 2 parameter is needed - assignmentID (aid) and studentID (sid).

1. Create the CompositeID of `Progress` objects using the aid and sid
2. Using this newly created compositeID, call modelManager#get(ID id, entity.type)
    a. This returns a `copy` of the `Progress` object - P'.
3. Execute `P'#done()`
    a. If `P'` is already done, an exception will be thrown
    b. Else, `P'` will be set its internal boolean isDone to be true.
4. Save the edited `Progress` object to model
5. Save the edited `Progress` object to storage

With this, the implementation of `Undone` command is about the same, we just have to call `P'#undone()` instead.

Design Consideration

There is 1 main considerations when implementing `Progress` objects.

1. Is there a need to separate `Assignment` and `Progress`?
    1. Implementation 1 - Have `Assignment` hold 1 `StudentID` and a 1 `isDone` boolean

    Pros

        a. Simple to implement

Cons

a. Memory-intensive since every student can have up to N number of `Assignments`

b. Suppose that a field in the `Assignment` needs to be updated, the program needs to loop through every single `Assignment` object to update that particular field, resulting in high computational costs.

c. With an additional link from `Assignment` to `Student`, it will be require more work to maintain the correctness of the linking.

   i. In `Section 2.3`, the decided implementation was to **centralize all links around `Course`**.

   ii. Hence, if another type of link was to be introduced, another `manager` will need to be implemented.

2. Implementation 2 (Current Implementation) - Separate the logic of `Assignment` and `Progress`. `Assignments` just need to hold its ID, name and deadline while `Progress` will handle whether a `Student` has completed that `Assignment` or not.

Pros

a. Intuitive and simple to understand

   i. In-line with Object Oriented Programming since it can be modelled as a real world object.

   ii. As most people have been through school, they can understand that when given a homework/assignment in school, there is actually only **1** `Assignment` that **every** `Student` has to complete. This idea is basically what we have implemented.

b. Solves the first disadvantage of Implementation 1. Any time the details of the `Assignment` is changed, the details will be automatically changed for all `Progress` objects.

c. Works well with current implementation of AddressBookGeneric which has `getters` and `setters` via `ID` since every `Progress` object will have its own `ID`

Cons

a. Also very memory intensive

2.4. Undo/Redo [Hieu]

Currently we only support undo/redo for commands that modify the storage (or state of the app). I.e add / delete, assign / un-assign, edit commands.

View Controller (LogicManager) will hold UndoRedoStack class, which stores the undoStack and redoStack which will be explained below.

Those commands listed above will inherit from UndoableCommand abstract class. UndoableCommand will extends from Command class.

UndoableCommand will contain the general algorithm flow for doing undo/ redo, while there will be some details delegated to the actual command class. This technique is also known as template

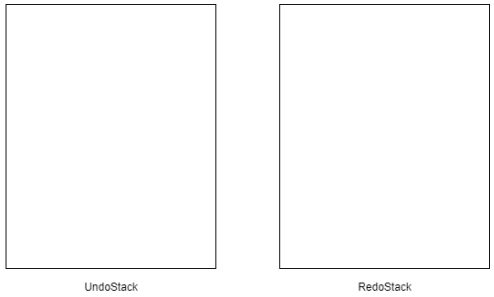
pattern.

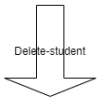
```
public abstract class UndoableCommand extends Command {
    public abstract void preprocessUndoableCommand() {}

    public abstract void generateOppositeUndoableCommand();

    public CommandResult executeUndoableCommand();
    @Override
    public CommandResult execute() {
        preprocessUndoableCommand();
        generateOppositeUndoableCommand();
        return executeUndoableCommand();
    }
}
```

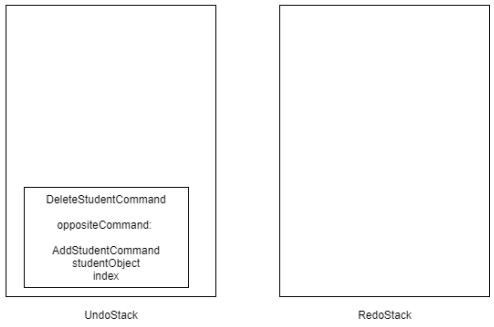
Note that for each UndoableCommand, before execution, it needs to save some information (through the preprocessUndoableCommand) then generate (and store) the opposite corresponding command (through generateOppositeUndoableCommand)

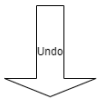
Let's go through the example in diagram below. - The user first executes a new UndoableCommand delete-student. Before this delete command is executed, we preprocessUndoableCommand to get the to-be-deleted student object, as well as the current index of this student object in list.

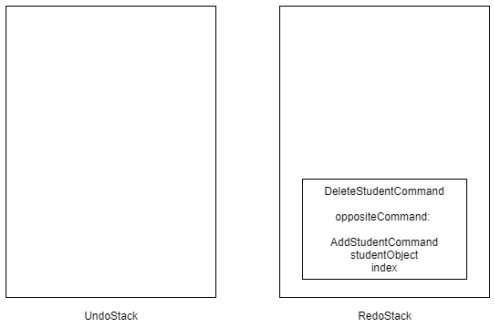
- Then we will generate a AddStudentCommand (which is opposite of this DeleteStudentCommand) with this studentObject and index and push it to undoStack
- When undo command is executed, the top of undoStack is popped out, then pushed to redoStack. Then the oppositeCommand of it will be excecuted (in this case AddStudentCommand will be invoked)
- When redo command is executed, the top of redoStack is popped out, then pushed to undoStack. Then the originalCommand will be executed (again) (in this case it will be DeleteStudentCommand again).

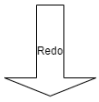

UndoStack
RedoStack

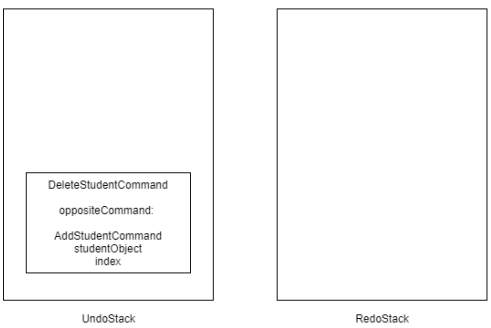

Delete-student


DeleteStudentCommand
oppositeCommand:
AddStudentCommand
studentObject
index
UndoStack
RedoStack


Undo


DeleteStudentCommand
oppositeCommand:
AddStudentCommand
studentObject
index
UndoStack
RedoStack


Redo


DeleteStudentCommand
oppositeCommand:
AddStudentCommand
studentObject
index
UndoStack
RedoStack

- Design Considerations: 1/ How Undo and Redo works: Option A: Save the entire app state after every command. Pros: Very easy implementation. Cons: Serious memory performance issue when storing the whole address book at every time step.

Option B (Current choice): Each (undoable) command will know how to generateOpposite command itself. Pros: Reduce a lot of memory issue.

Cons: Harder to implement

2.4.1. Opposite Command for edit [Dat]

In EditCommand class, method `preprocessUndoableCommand` to get the toEdit Object and edited Object.

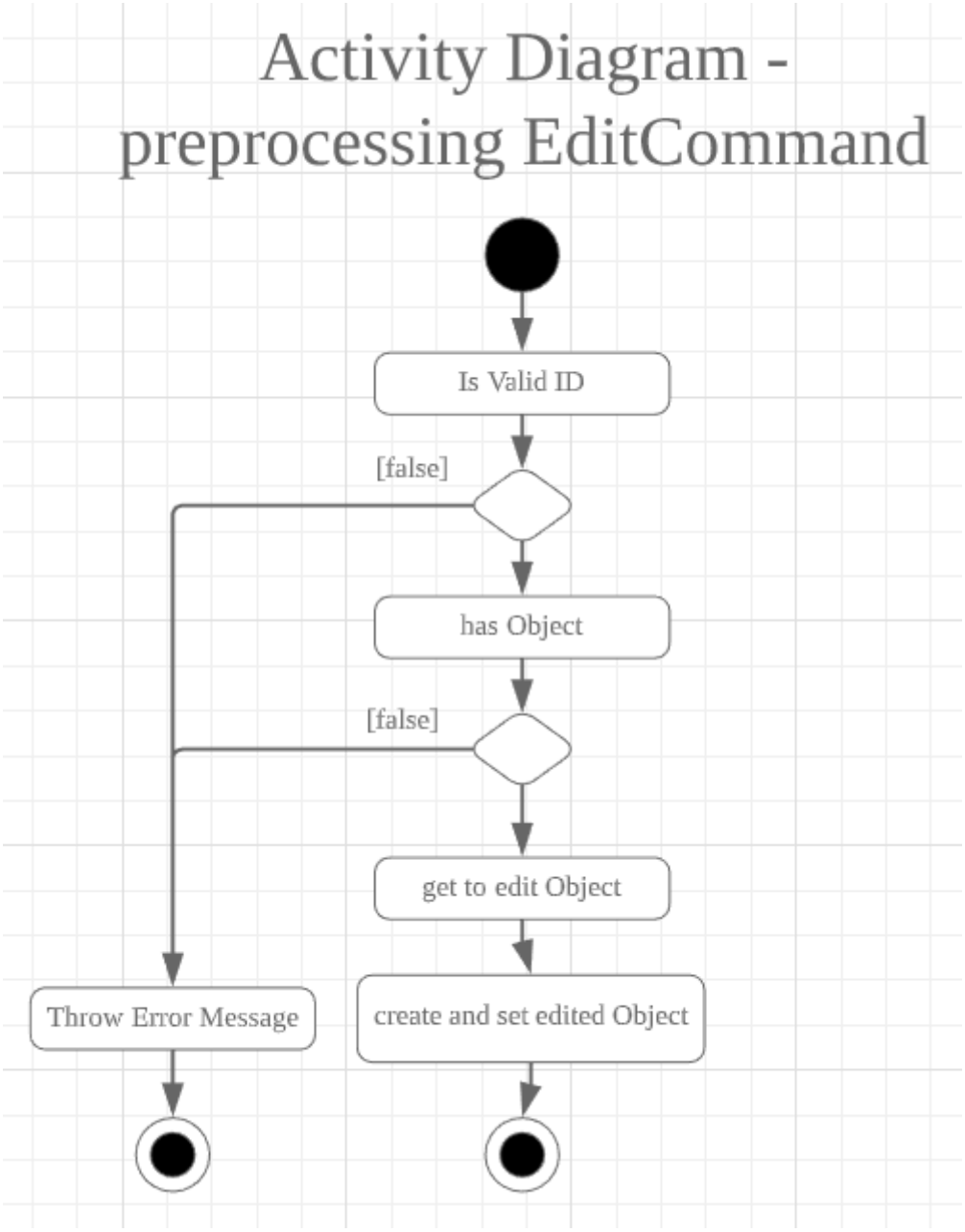


Figure 17. Activity Diagram of Pre-processing for Edit commands

Method `executeUndoableCommand` will set the toEdit Object in the ObjectAddressBook to the edited Object.

Method `generateOppositeCommand()` will generate another `EditCommand` (which is opposite to this EditCommand) with editing information of the original toEdit Object and push it to undoStack.

When `undo` and `redo` commands are executed, the process is carried out as described above.

2.4.2. Opposite command for assign/ un-assign [Tee Jun Jie Ivan]

Generating of opposite commands for assign and un-assign commands is very intuitive. The opposite of assign is un-assign and vice versa.

The **tricky** part comes after you un-assign a Student/Assignment from a Course and have removed the affected `Progress` objects. When you want to undo the un-assign command, you need to add back those particular `Progress` objects which were just removed instead of adding new **`undone Progress objects`**. This is because those removed `Progress` objects may or may not be `done`.

This is achieved by 3 simple, additional steps.

1. When pre-processing an un-assign command as per **`Step 1 of Section 2.2.2`**, you'll need to assign all `Progress` objects that are about to be removed to a variable.
2. When `GenerateOppositeCommand` is called, via an overloaded constructor, you will need to instantiate a new `Assign` using the `Progress` objects that you have saved:

   ```
   public AssignAssignmentToCourseCommand(AssignDescriptor assignDescriptor, Set
   <Progress> undoProgresses)
   ```

   a. This allows the opposite command to add back the removed `Progress` objects
3. Finally, when `executeUndoableCommand` is executed, seeing that the undoProgresses is not null, the `Assign` Command will add those `Progress` objects back. Please see the activity diagram below for a better understanding of when the Undo Progress will be added back in.

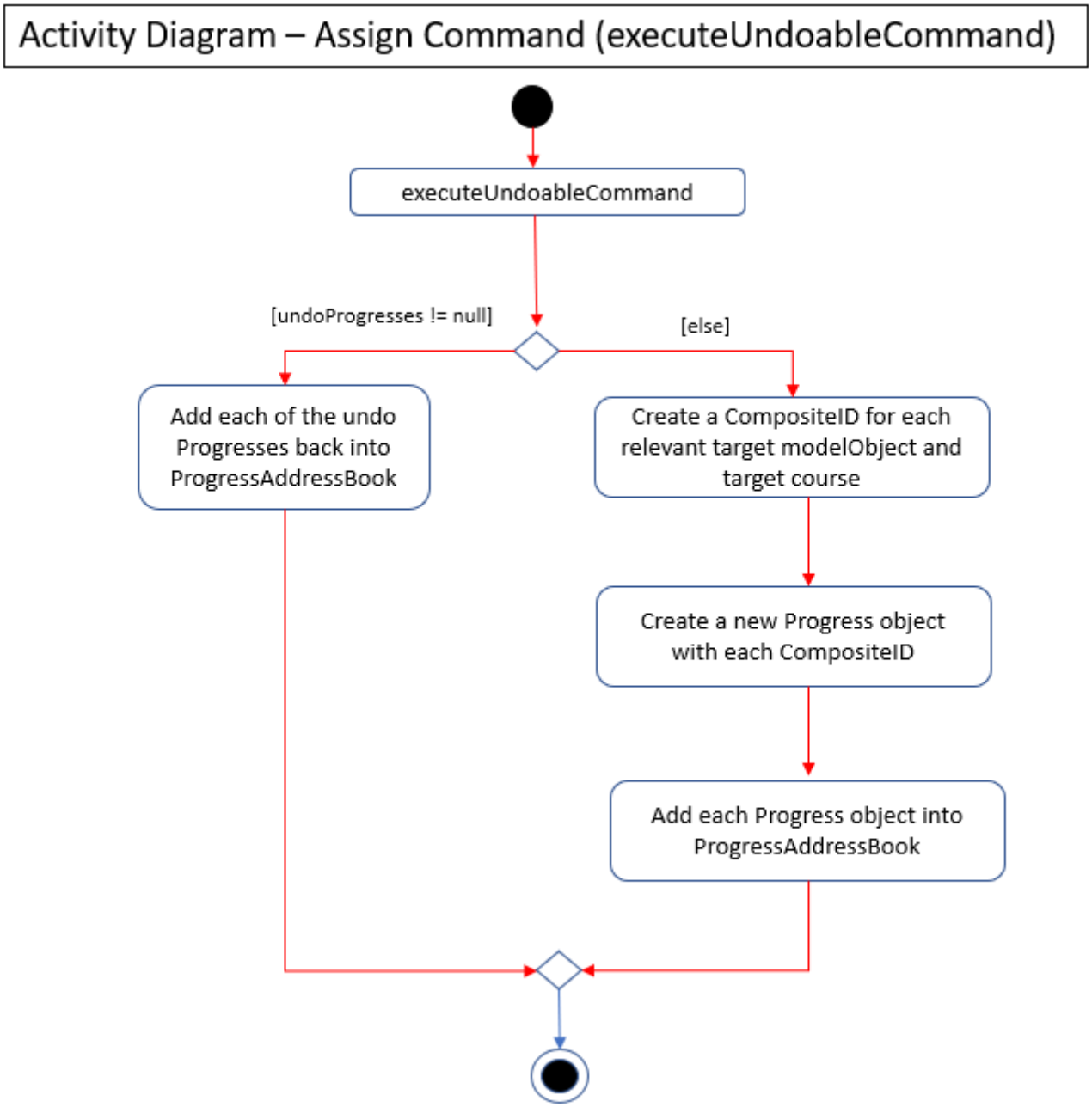


Figure 18. Activity Diagram of executing executeUndoableCommand of Assign Commands

This results in the **correct** `Progress` objects, which may or may not be `Done`, to be added back in instead of completely new `Progress` objects that are all `Undone`.

You can also notice that this is a faster implementation since we do not need to re-create a `CompositeID` and the actual `Progress` object itself when we are just adding back the UndoProgresses.

2.4.3. Opposite command for add/ delete (and maintain the corresponding links between entities)

`AddCommand` and `DeleteCommand` extends from abstract class UndoableCommand. Thus, user can undo/ redo this command.

In `AddCommand` class, method `preprocessUndoableCommand` get the toAdd Object and an index (if available).

Method `executeUndoableCommand` will add the toAdd Object to the ObjectAddressBook.

Method `generateOppositeCommand()` will generate a `DeleteCommand` (which is opposite to this AddCommand) with toDelete Object is a clone of toAdd Object and push it to undoStack.

In `DeleteCommand` class, method `preprocessUndoableCommand` get the toDelete Object and its index.

Method `executeUndoableCommand` will delete this toDelete Object from the ObjectAddressBook.

Method `generateOppositeCommand()` will generate an `AddCommand` (which is opposite to this DeleteCommand) with toAdd Object is a clone of toDelete Object and push it to undoStack.

When `undo` and `redo` commands are executed, the process is carried out as described above.

For `DeleteCommand`, it is important to ensure that entity links are removed properly. For `AddCommand` generated by `generateOppositeCommand()`, it is important to restore all the entity links properly. Therefore, in order to ensure undo/redo successfully, all 3 managers must be involved to manage all entity links.

When an object is deleted (Student/Teacher/Course/Assignment), `EdgeManager` will invoke a `DeleteEntitySyncEvent` signal and a `DataStorageChangeEvent` signal to be handled by `StorageManager`. `generateOppositeCommand()` will generate an add-command with a clone object of deleted object and stacked into undoStack.When an `undo` command is executed, this `add-command` is pop out from the stack and executed, adding the cloned object with all the information of the deleted object. The flow after add-command called now can be generalized as the previous delete-command. All the entities links are restored.

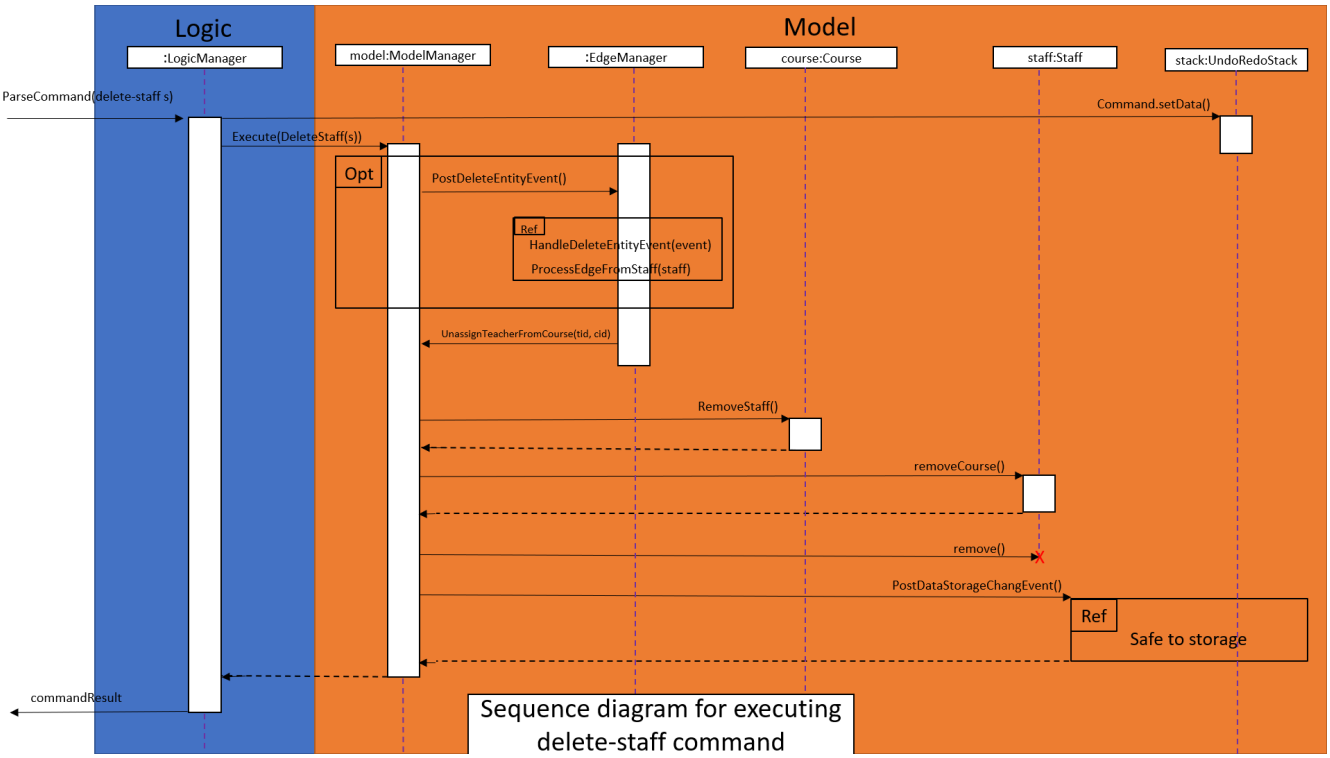
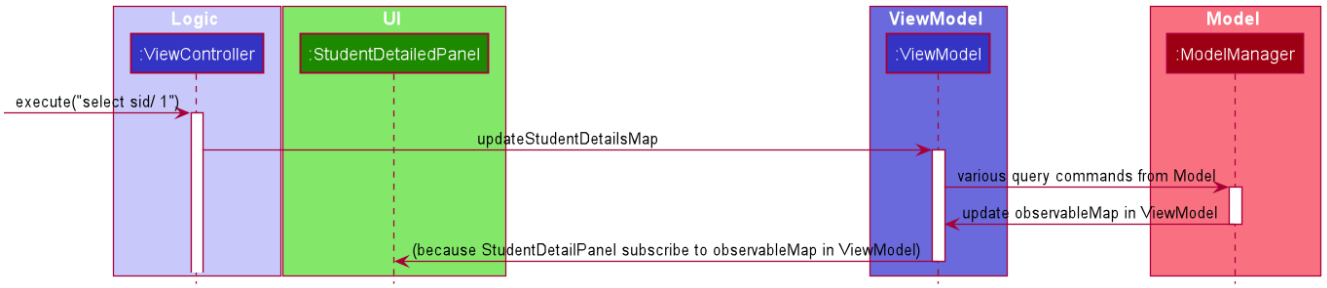


Figure 19. Sequence Diagram of Delete Staff (teacher)

2.5. View Switching [HIEU]

To see sub-view details of each section we can issue a select command. Let's see an example of how selecting sub-view data of a student 1 works.



1. `select sid/ 1` command is issued to `ViewController`
2. `ViewController` will call `ViewModel` method `updateStudentDetailsMap`
3. In turn, that method will invoke managers from `Model` layer, for example `ModelManager`, to update `observableStudentDetailMap` inside `ViewModel`
4. Because `StudentDetailsMap` implements an `onChange` function that listen to update in `observableStudentDetailMap`, the UI part will be updated correspondingly with data of this student 1.

Design considerations:

1. Automatically updating the UI sub-view when the app state changes. Let's say the current sub-view shown in the UI is of the details of student 1, then some information of the course of that student is changed, or the student is removed from the course, the UI should update immediately without the need to issue the click command again. To support that, our `ViewModel` will listen to `EventsCenter` , then whenever an event of `DataStorageChangeEvent` or `DeleteEntitySyncEvent` happens, it will check which `observableMap` (which corresponds to different `DetailedView`) is active then do the query again.
2. Lazy loading: For example, when seeing details of the students, we only want to show the courses that the students have without the progresses of this course that the student currently have. To query that, after executing `select sid/ student_id`, the user needs to run `select sid/ student_id cid/ course-id` as well

2.6. Managing Staff Feature [Dat]

2.6.1. Implementation

This feature is implemented with the main classes - `Staff`, with a permission level specifying `Teacher` and `Admin`.

```
public class Staff extends ModelObject {
    public enum Level {
        TEACHER,
        ADMIN
    }
    //...
}
```

One of the features is to display all the `courses` that a `teacher` is teaching.

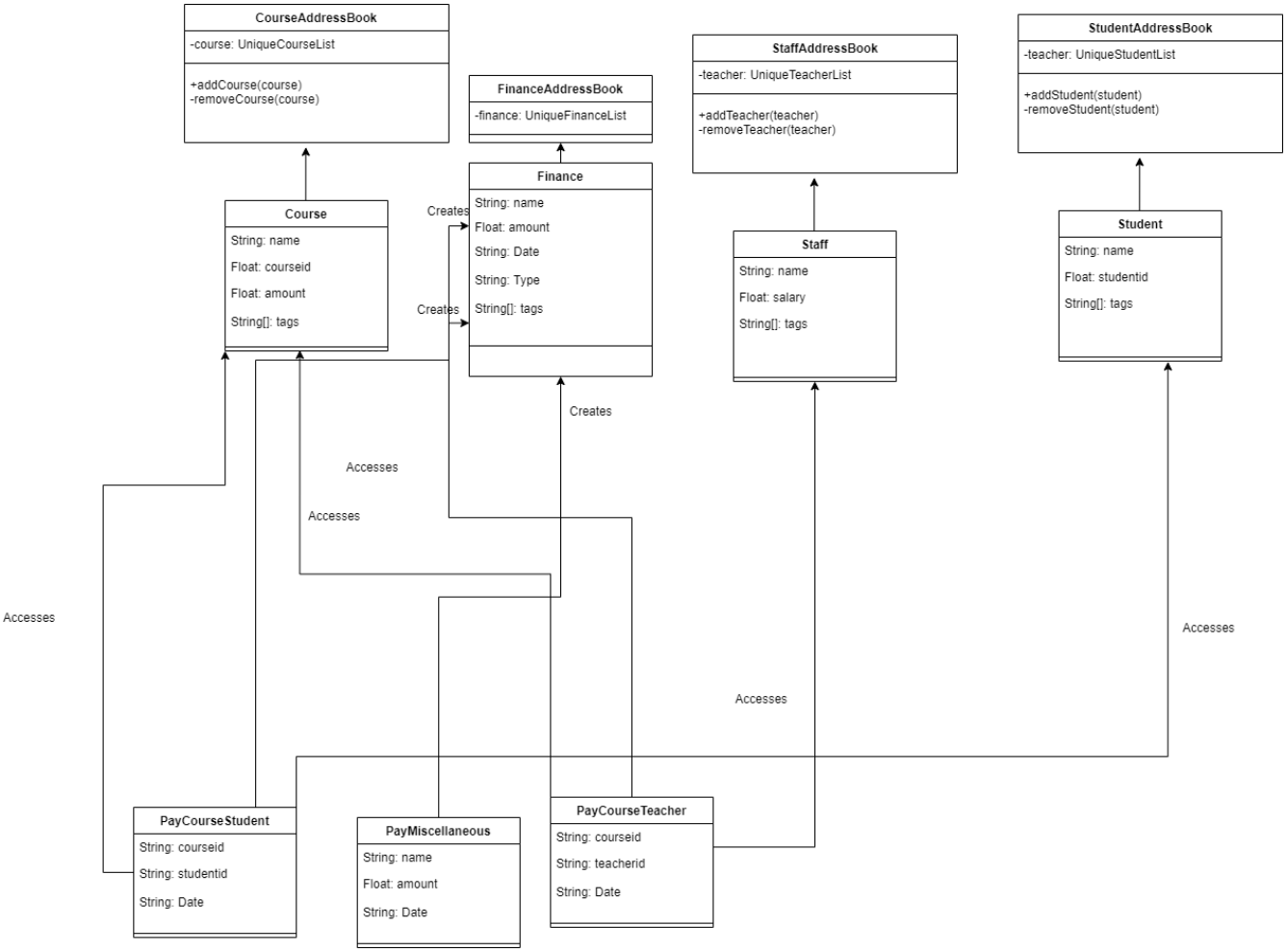
Another feature is to keep track of salary payment for `teacher`. A `teacher` is paid by teaching a course and the amount is taken from the salary of the teacher. The payment will automatically have records of respective course and teacher ID.

To pay for `admin`, user has to do it manually using miscellaneous `FinanceType`.

Certain approaches have some certain pros and cons. It depends on how the user want to keep track of payment and method to pay to `teacher` and `admin`.

2.7. Tracking Miscellaneous Payments/Earnings, Teacher Payments and Student earnings [Sim Sheng Xue]

2.7.1. Implementation



Finance type `Miscellaneous` or `m` add command will add a `Finance` with a given Name (description) from the user. The amount is sign sensitive, meaning miscellaneous can take in a positive amount or a negative amount corresponding to earning or expense depending on the user.

Miscellaneous transactions can either be payments or earnings, such as purchases of stationary or advertisement revenue. Teacher payments are tracked by courses, where the teacher is paid for each course taught. Student earnings are also tracked by courses, where the student pays for each course taken.

Finance type `Miscellaneous` or `m` will create a Miscellaneous transaction, where the `Amount` is specified by the user.

Finance type `CourseTeacher` or `ct` add command will access `CourseAddressBook` and `StaffAddressBook` to ensure `Course` and `Staff` exist and make sure this staff is teaching this course. The `Amount` is set to the amount of the `Course` (student fee).

Finance type `CourseStudent` or `cs` add command will access `CourseAddressBook` and `StudentAddressBook` to ensure `Course` and `Student` exist and make sure this student is taking this course. The `Amount` is set to the amount of the `Course` (student fee).

All three Finance types will create a `Finance` object to store the transaction, which will be saved in the `FinanceAddressBook`.

2.8. Navigation among command history in the command box [Sim Sheng Xue]

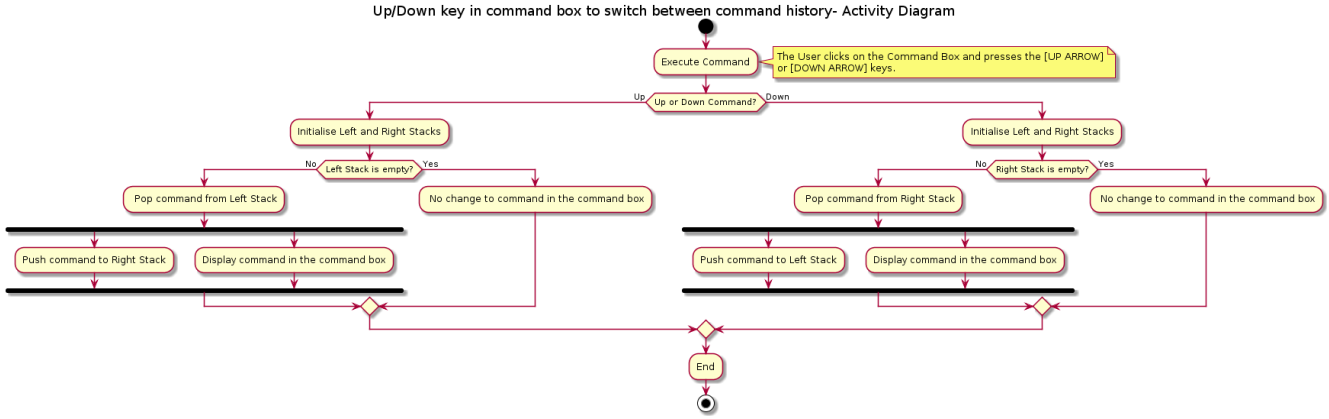


Figure 20. Activity diagram of Command History

Coding Camp X supports quick navigation among command history in the command box. Whenever the user executes a command, it will be added to a stack. If the command fails to execute or is exactly the same as the previous command executed, it will not be added to the stack.

The user can click the [UP ARROW] or [DOWN ARROW] keys in the command box to navigate through the executed command history. Since the implementation for [UP ARROW] is similar(as seen in the activity diagram), this guide will explain [DOWN ARROW] in details.

When the user clicks the [DOWN ARROW], the application will check if the Right Stack is empty. If the Right Stack is empty, this means that there is no commands below to navigate to. In this case, the command box will still show the initial command.(No change)

Else if the Right Stack is not empty, the next command will be popped from the top of the Right Stack. Now, two actions will occur in parallel. The command will be added to the Left Stack, and this command will also be shown in the command box. This allows the user to navigate back to the command after with an [UP ARROW] key command. The process will then come to an end.

2.9. 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 2.10, “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

2.10. 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. Documentation

Refer to the guide here.

4. Testing

Refer to the guide here.

5. Dev Ops

Refer to the guide here.

Appendix A: Product Scope

Target user profile (Coding camp owners):

- need to manage a significant number of teachers, students, courses, assignemnts and finances
- assign teachers to specific courses
- assign students to suitable schedules
- keep track of the courses available
- keep track of the student's progress and assignments
- manage course earnings and staff spending
- ---
- prefer desktop apps over other types
- can type fast
- prefers typing over mouse input
- is reasonably comfortable using CLI apps

Value proposition:

- Manage the addition and removal of students quickly
- Manage the addition and removal of courses quickly

- Manage the addition and removal of assignments and progress quickly
- Check the financial status of courses
- Track student progress for courses quickly

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 assignment with a deadline	
* * *	user	list all assignment tasks	
* *	user	list all assignment to be done for a course	
* * *	user	find a particular assignment	locate the details of the assignment without going through the whole list of all assignments
* * *	user	edit a assignment's detail	quickly change the details of the assignment without creating a new entry and deleting the old one
* * *	user	assign a assignment to course	

Priority	As a …	I want to …	So that I can…
* * *	user	assign a list of assignment to course	quickly add all assignments to a course without going through them one by one
* * *	user	for every student added to a course, assign a list of progress items to them automaticall y based on the assignment for the course	make it more convenient for the administrative staff to assign students to courses
* * *	user	track the progress of an individual student	to ensure that students are caught up on study materials
* * *	user	track the progress of all students in a particular course	to get an overview understanding of all students' progress in a course
* * *	user	mark as done the assignment of a student	
* * *	user	mark as done the assignment of a few/all students for a particular week	quickly mark students' assignment as done without iterating through all of the assignment

Priority	As a …	I want to …	So that I can…
* *	user	get notified if there is a student with too many undone assignment	help to easily inform the teachers on the student progress
* *	user	automate the spendings of the tuition centre due to the salary of the staff	do not need to manually deduct the savings from the salary at the end of the month
* * *	user	automate the income generated by each of the students according to the course fees payable by the students	do not need to manually add the income generated at the end of the month
* * *	user	able to know how much we are spending by adding the name and price of the items or services bought	keep track of the expenses of the tuition centre

Priority	As a …	I want to …	So that I can…
* * *	user	be able to know how much we are earning by adding the various sources of income such as through students course fees, or miscellaneous sources like textbook sales	keep track of the earnings of the tuition centre
* * *	user	tag each of the spendings of the tuition centre with the priority levels, such as “must-have”, “nice-to-have”, or “not-needed”	evaluate the necessity of the spendings of the tuition centre
* * *	user	be able to tag each of the spendings with the department that they are from	better understand which department is spending on what types of goods and services
* *	user	view the statistics of the finances at periods such as day, week of month	better plan ahead

Priority	As a …	I want to …	So that I can…
* *	user	be able to track the payment status of each customer	ensure that all customers have paid on time

{More to be added}

Appendix C: Use Cases

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

Use Case 1: Adding a assignment

MSS

1. User inputs an 'add assignment' command with name and deadline
2. CCX adds the assignment into the system + Use case ends.

Extensions

1a. No name/deadline is provided.

1a1. CCX shows an error message.

Use case ends.

- 1b. The Date deadline is wrongly formatted.

1b1. CCX shows an error message.

Use Case 2: Listing all assignment

MSS

1. User requests to see all assignment
2. CCX outputs all assignment in its database

Use case ends.

Extensions

1a. List is empty.

Use case ends.

Use Case 3: Deleting a assignment

MSS

1. User sees all assignment using UC2
2. User requests to delete assignment using its respective assignmentID
3. CCX finds the assignment using UC4
4. CCX removes the assignment from the system
5. CCX outputs a success message with the details for the assignment

   Use case ends.

Extensions

2a. assignmentID does not exist.

- 2a1. CCX shows an error message.

  Use case ends.

Use Case 4: Finding an assignment by assignmentID

MSS

1. User sees all assignment using UC2
2. User requests to view a assignment using its respective assignmentID
3. CCX searches the the system for the relevant assignment
4. CCX outputs a success message with the details for the assignment

   Use case ends.

Extensions

2a. assignmentID does not exist.

- 2a1. CCX shows an error message.

  Use case ends.

Use Case 5: Edit a assignment using assignmentID

MSS

1. User sees all assignment using UC2
2. CCX outputs the whole list of assignment
3. User requests to edit a assignment using its respective assignmentID

4. CCX finds for the specific assignment using UC4
5. CCX changes the details of the assignment
6. CCX outputs a success message with the updated details for the assignment

   Use case ends.

Extensions

   3a. assignmentID does not exist.

   3a1. CCX shows an error message.

   Use case ends.

   - 3b. New deadline provided is not properly formatted.

   3b1. CCX shows an error message.

   Use case ends.

   - 3c. No new details are provided.

   3c1. CCX shows an error message.

   Use case ends.

Use Case 6: Assign a assignment to a course

MSS

1. User requests to see assignment using UC2
2. CCX outputs the whole list of assignment
3. User requests to see all courses using **UC20**
4. User requests to assign a assignment to a course using their respective IDs
5. CCX adds the assignmentID into the course's list of assignment
6. CCX outputs a success message with the successful addition of assignment

   Use case ends.

Extensions

   4a. assignmentID does not exist.

   4a1. CCX shows an error message.

   Use case ends.

   - 4b. courseID does not exist.

4b1. CCX shows an error message.

Use case ends.

Use Case 7: Assign several assignment to a course

MSS

1. User requests to see assignment using UC2
2. CCX outputs the whole list of assignment
3. User requests to see all courses using **UC20**
4. User requests to assign a list of assignment to a course using their respective IDs
5. CCX adds the list of assignmentID into the course's list of assignment
6. CCX outputs a success message with the successful addition of assignment

Use case ends.

Extensions

4a. Any one of the assignmentID does not exist.

4a1. CCX shows an error message.

Use case ends.

- 4b. courseID does not exist.

4b1. CCX shows an error message.

Use case ends.

Use Case 8: Signup a student to a course

MSS

1. User requests to see all students using **UC21**
2. CCX outputs the whole list of students
3. User requests to see all courses using **UC20**
4. User requests to signup a student to a course using their respective IDs
5. CCX finds all assignment assigned to the course
6. CCX creates a Progress object for each assignment and ties it to the student ID
7. CCX adds the Progress object into the system
8. CCX outputs a success message

Use case ends.

Extensions

4a. studentID does not exist.

4a1. CCX shows an error message.

Use case ends.

- 4b. courseID does not exist.

4b1. CCX shows an error message.

Use case ends.

Use Case 9: View progress for a particular student, for a certain course

MSS

1. User requests to see all students using **UC21**
2. CCX outputs the whole list of students
3. User requests to see all courses using **UC20**
4. User requests to view the progress for a student, for a course using their respective IDs
5. CCX finds all Progress objects using the courseID and studentID
6. CCX outputs all the respective Progress objects

Use case ends.

Extensions

4a. studentID does not exist.

4a1. CCX shows an error message.

Use case ends.

- 4b. courseID does not exist.

4b1. CCX shows an error message.

Use case ends.

- 4c. Student is not assigned to the course.

4c1. CCX shows an error message.

Use case ends.

Use Case 10: View progress for all students, for a certain course

MSS

1. User requests to see all courses using **UC20**
2. User requests to view the progress for all students for a course using their respective IDs using UC9
3. CCX finds all Progress objects using the courseID and studentID
4. CCX outputs all the respective Progress objects

Use case ends.

Extensions

2a. courseID does not exist.

2a1. CCX shows an error message.

Use case ends.

Use Case 11: Mark a student’s Progress object as done

MSS

1. User requests to see a student’s Progress for a certain course using UC9
2. User requests to view the mark a particular Progress as 'Done' using the progressID
3. CCX outputs a success message with the updated Progress object

Use case ends.

Extensions

2a. progressID does not exist.

2a1. CCX shows an error message.

Use case ends.

Use Case 12: Adding a finance

MSS

1. User inputs an 'add finance' command with name and amount
2. CCX adds the finance into the system + Use case ends.

Extensions

1a. No name/amount is provided.

1a1. CCX shows an error message.

Use case ends.

- 1b. The amount is wrongly formatted (such as containing a non-number character).

1b1. CCX shows an error message.

Use Case 13: Listing all finance

MSS

1. User requests to see all finance
2. CCX outputs all finance in its database

Use case ends.

Extensions

1a. List is empty.

Use case ends.

Use Case 14: Deleting a finance

MSS

1. User sees all finance using UC13
2. User requests to delete finance using its respective financeID
3. CCX finds the finance using UC15
4. CCX removes the finance from the system
5. CCX outputs a success message with the details for the finance

Use case ends.

Extensions

2a. financeID does not exist.

- 2a1. CCX shows an error message.

Use case ends.

Use Case 15: Finding a finance by financeID

MSS

1. User sees all finance using UC13
2. User requests to view a finance using its respective financeID
3. CCX searches the the system for the relevant finance
4. CCX outputs a success message with the details for the finance

Use case ends.

Extensions

2a. financeID does not exist.

- 2a1. CCX shows an error message.

Use case ends.

Use Case 16: Edit a finance using financeID

MSS

1. User sees all finance using UC13
2. CCX outputs the whole list of finance
3. User requests to edit a finance using its respective financeID
4. CCX finds for the specific finance using UC15
5. CCX changes the details of the finance
6. CCX outputs a success message with the updated details for the finance

Use case ends.

Extensions

3a. financeID does not exist.

3a1. CCX shows an error message.

Use case ends.

- 3b. New finance provided is not properly formatted (such as containing a non-number character).

3b1. CCX shows an error message.

Use case ends.

- 3c. No new details are provided.

3c1. CCX shows an error message.

Use case ends.

Use Case 17: View details for a particular student

MSS

1. User request to see a student’s details
2. CCX outputs a success message with student’s detail with name, description and payment list

Extensions

1a. studentID does not exist

1a1. CCX shows an error message

Use Case 18: Mark a student’s course payment object as paid

MSS

1. User requests to see a student’s payment list using UC12
2. User requests to mark a particular unpaid payment as 'Paid' using the paymentID
3. CCX outputs a success message with the updated payment list object
   Use case end

Extensions

1a. studentID does not exist

1a1. CCX shows an error message

- 2a. no payments exists

2a1. CCX shows a message saying no payment list found

Use Case 19: Edit a student info using studentID

MSS

1. User requests to see a student info using UC17
2. User requests to edit the student’s information and provide edit information
3. CCX outputs a success message with the updated student description

Use case ends

Extensions

1a. studentID does not exist

1a1. CCX shows an error message

Use Case 20: View all on going courses

MSS

1. User requests to see all on going courses
2. CCX outputs a success message with a list of all on going courses
   Use case ends

Extensions

1a. No on going courses available

1a1. CCX shows an empty list of courses

Use Case 21: View all students

MSS

1. User request to see all the students
2. CCX outputs a success message with a list of all students
   Use case ends

Extensions

1a. No student in the database

- 1a1. CCX shows an empty list of students

Use Case 22: Adding a new Student

MSS

1. User request to add a new Student
2. User input student's name and other information
3. CCX outputs a success message with student object and studentID
   Use case ends

Use Case 23: Adding a new Teacher

MSS

1. User request to add a new teacher
2. User input teacher's name and other information
3. CCX outputs a success message with teacher object and teacherID
   Use case ends

Use Case 24: Adding a new Staff

MSS

1. User request to add a new staff
2. User input teacher's name and other information
3. CCX outputs a success message with staff object and staffID
   Use case ends

Use Case 25: Adding a new course

MSS

1. User request to add a new course
2. User input course's name and other information
3. CCX outputs a success message with course object and courseID
   Use case ends

{More to be added}

Appendix D: Non Functional Requirements

1. The `CCX` program should work on any mainstream OS as long as it has Java 11 or above installed.
2. The `CCX` program 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 `CCX` program supports one-shot command - command that are executed using only one single line of user input.
5. User must ensure to have a free disk space of at least 100 Megabytes (MBs) in the drive to store the program.
6. The `CCX` program should be able to run with or without internet connection.
7. The `CCX` program should work for a single user only.
8. The `CCX` program should not require user to make any software installments.
9. The `CCX` program should support English language only.

10. The `CCX` program Graphic User Interface (GUI) should support screen resolution of 1920 x 1080 or higher. *{More to be added}*

Appendix E: Glossary

Student

A student that has a studentID and description

Teacher

A teacher that has a teacherID and description

Staff

A staff that has a staffID and description

Course

A course that contains a list of attended students, a teacher and a list of assignments

Assignment

A task that is to be done before a certain date

Progress

An object that contains a assignment, a isDone boolean and is tied to student.

Signup

Officially adds a paying student to a course

Finance

An object that contains payments, and whether it is an earning or expense

Payment

An object that contains the amount, a deadline to pay and pay date

Appendix F: Product Survey

Product Name

Author: ...

Pros:

- ...
- ...

Cons:

- ...
- ...

Appendix G: 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.

G.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. *{ more test cases … }*

G.2. Deleting a student

1. Deleting a student while all students are listed
   a. Prerequisites: List all students using the `list` command. Multiple students in the list.
   b. Test case: (example) `delete-student 16100`
      Expected: Student with ID 16100 is deleted from the list. Details of the deleted student shown in the status message. Status bar is updated. Related information, such as course student 16100 was taking, updated accordingly.
   c. Test case: `delete-student 0`
      Expected: No student is deleted. Error details shown in the status message. Status bar remains the same.
   d. Other incorrect delete commands to try: `delete-students`, `delete-student x` (where x is a number not matching any student IDs) *{give more}*
      Expected: Similar to previous.

{ more test cases … }

G.3. Assign a student to a course

1. Assign a student to a course that has several assignments
   a. Prerequisites: List all courses using the `list-course` command. Select to view a course, multiple assignments are assigned to that course.

b. Test case: (example) `assign sid/16100 cid/55160`
Expected Student with ID 16100 is assigned to course 55160. Details of the student will be added to the course. The student is assigned all the assignments in the course (the progresses are created). Status bar is updated accordingly.

c. Test case: (example) `assign sid/16100 cid/49273`
Expected: Error message throws saying no course ID matches with this course (Assumed this course ID does not exist). Error details shown in the status message. Status bar remains the same.

d. Other incorrect delete commands to try: `assign sid/16100 cid/55160`, (where student 16100 is already assigned to course 55160) *{give more}*
Expected: Similar to previous, but error message throws saying this student is already assigned to this course.

{ more test cases … }

G.4. Undo deleting a student

1. Undo a command deleting a student that in several courses and having several progresses.

   a. Prerequisites: List all courses using the `list-course` command. Select to view the course that have student intended to be deleted.

   b. Test case: (example) `delete-student 16100` + `undo`
   Expected Student with ID is deleted and then added back to courses that he enrolled before. Details of the student will be added back to the course. The student is assigned all the assignments in the course. (All of the progresses of the student are restored). Status bar is updated accordingly.

   c. Test case: `delete-student 0` + `undu`
   Expected: No student is added back. Error details shown in the status message. Status bar remains the same.

   d. Other incorrect undo/redo commands to try: `undo`, `redo` (try these commands immediately after turn on the application) *{give more}*
   Expected: Error throws saying no commands that are redo/undoable. (No CRUD commands used before to undo/redo)

G.5. Assign a staff to a course

1. Assign a staff to teach a course.

   a. Prerequisites: List all course using the `list-course` command. Select to view the course that is supposed to be assigned a Staff.

   b. Test Case: (Example) `assign tid/16100 cid/55160`
   Expected ID 16100 of Staff is added into Assigned Staff field of the course and the course ID 55160 is added into Assigned Course field of Staff. Status bar is updated accordingly.

   c. Test case: `assign tid/17100 cid/55160` (Staff ID 17100 level is Admin)
   Expected no Staff is assigned to teach the course. Error details show in the status message saying admin Staff cannot teach a course. Status bar remains the same.

d. Other incorrect commands to try: `assign` a Teacher Staff to a course that already have another teacher assigned *{give more}*
Expected: no Staff is assigned to teach this course. Error details show in the status message saying a course can only have 1 Staff assigned. Status bar remains the same.

{ more test cases … }

G.6. UnAssign a student from a course

1. Unassign a student from a course.

   a. Prerequisites: List all course using the `list-course` command. Select to view the course that is supposed to be assigned a Staff.

   b. Test Case: (Example) `unassign sid/16100 cid/55160`
   Expected ID 16100 of Student is removed from Assigned Students in Course and ID 55160 of Course is removed from Assigned Course in Student. Moreover, all the assignments (progresses) assigned to Student 16100 that belongs to Course 55160 are also removed. Status bar is updated accordingly.

   c. Test case: `unassign sid/17100 cid/55160` (Student 17100 is not enrolled in course 55160)
   Expected no student is unassigned from a course. Error details show in the status message saying no such student is assigned to this course. Status bar remains the same.

   d. Other incorrect commands to try: `unassign` a student from a course that does not exist. Error details show in the status message saying cannot find a course with such ID. Status bar remains the same.

{ more test cases … }

Appendix H: Effort

Overall, the level of effort required by this project is high due to many factors which I will point out.

The first and most obvious is that, AB3 only deals with one entity type, however, our program deals with 6 entity types. While this is not that impressive by itself since the code base can be copy and pasted to form 6 different yet very, very similar addressbooks, we have refactored AddressBook into AddressBookGeneric<K extends ModelObject> and made it such that AddressBookGeneric can take in any entity which extends from modelObject, thereby saving on a lot of unnecessary work and repeated code. This also makes it immensely simpler for extension of code in the future should we decide to implement other entities.

Secondly, with the increase in the number of AddressBooks, the amount of work for the UI has also increased drastically. Almost every entity except for Progress has it's own Tab in the UI. Not only that, each page is broken up to 3 different sections, each showing different levels of details which we think is more intuitive for the user. Moreover, we have made it such that for certain commands such as find and list that the UI will automatically change to the Tab that is affected. Furthermore, we have made it such that the user is able to switch between tabs very easily and can even specify certain sections in the tabs that they want to specifically view. A huge portion of work is put into

not only beautifying the UI, but also make it work seamlessly with the program while making it intuitive enough for the user to use.

Thirdly, the entity linking aspect is a very tedious and tricky part of the program that the group has put numerous hours into perfecting. In AB3, there is only 1 entity - person. However, in our program, we have up to 6 different entities, 5 of which has relationships to one another. We needed to think of a way to allow different entities to hold references to each other while making sure that there was no circular referencing errors. Hence, we decided to implement an ID to every different entity, except Progress which can be identified by a CompositeID of assignmentID and studentID. This also meant that we needed to implement methods in ModelManager such that we are able to get and set entities via the ID instead of index. Ultimately, we decided to centralize all links around course so as to standardize all linking. Moreover, a lot of work was put into ensuring that the program is in a **consistent state** at any point in time, meaning that if entity X had entity Y's ID, Y should have X's ID as well. There should be no point in time where X had Y's ID but not vice versa. This also includes maintaining of Progress objects so as to allow for tracking of student's progress. Every time an assign/unassign/delete command is run we need to keep track of the Progress objects created and destroyed also.

Lastly, the team has attempted to implement Undo and redo for most of our commands. Whilst it is easier to implement for smaller commands such as add and edit, but it is not trivial for bigger commands such as un-assign and delete. In those cases, we ad to implement Managers to ensure that the undo and redo commands are handled successfully. One of the more challenging portions was when undo-ing an unassign command, we needed to put the recently removed Progress objects, which may or may not be done, back into AddressBook. Hence, we needed to implement a way to check for this case as well. Undo and redo really increased the difficulty of the program significantly especially when we need to maintain correct entity linking.

Overall, we felt that our project was sufficiently more complex and more difficult as compared to AB3.