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ModuLight Developer Guide

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Setting up, getting started

Refer to the guide *Setting up and getting started*.

Design

Architecture

The ***Architecture Diagram*** given above explains the high-level design of the App.

Given below is a quick overview of main components and how they interact with each other.

Main components of the architecture

`Main` (consisting of classes `Main` and `MainApp`) is in charge of the app launch and shut down.

- At app launch, it initializes the other components in the correct sequence, and connects them up with each other.

- At shut down, it shuts down the other components and invokes cleanup methods where necessary.

The bulk of the app's work is done by the following four 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.

`Commons` represents a collection of classes used by multiple other components.

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` .

Each of the four main components (also shown in the diagram above),

- defines its *API* in an `interface` with the same name as the Component.
- implements its functionality using a concrete `{Component Name}Manager` class (which follows the corresponding API `interface` mentioned in the previous point).

For example, the `Logic` component defines its API in the `Logic.java` interface and implements its functionality using the `LogicManager.java` class which follows the `Logic` interface. Other components interact with a given component through its interface rather than the concrete class (reason: to prevent outside component's being coupled to the implementation of a component), as illustrated in the (partial) class diagram below.

The sections below give more details of each component.

UI component

The **API** of this component is specified in `Ui.java`

The UI consists of a `MainWindow` that is made up of parts e.g. `CommandBox` , `ResultDisplay` , `StudentListPanel` , `GradedComponentListPanel` , `StudentScoreListPanel` , `StatusBarFooter` etc. All these, including the `MainWindow` , inherit from the abstract `UiPart` class which captures the commonalities between classes that represent parts of the visible GUI.

The `UI` component uses the 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.
- keeps a reference to the `Logic` component, because the `UI` relies on the `Logic` to execute commands.
- depends on some classes in the `Model` component, as it displays `Student` , `GradedComponent` and `StudentScore` objects residing in the `Model` .

Logic component

API : `Logic.java`

Here's a (partial) class diagram of the `Logic` component:

The sequence diagram below illustrates the interactions within the `Logic` component, taking `execute("deleteStu 1")` API call as an example.

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

How the `Logic` component works:

1. When `Logic` is called upon to execute a command, it is passed to an `ModuLightParser` object which in turn creates a parser that matches the command (e.g., `DeleteStudentCommandParser`) and uses it to parse the command.
2. This results in a `Command` object (more precisely, an object of one of its subclasses e.g., `DeleteStudentCommand`) which is executed by the `LogicManager` .
3. The command can communicate with the `Model` when it is executed (e.g. to delete a student).
4. The result of the command execution is encapsulated as a `CommandResult` object which is returned back from `Logic` .

Note: There are three different model objects, namely the StudentBook, the StudentScoreBook and the GradedComponentBook. The command might interact with one or more model objects. For example, when a student is deleted, the command will communicate with the StudentBook to delete this student, as well as the StudentScoreBook, to delete all the student scores relevant to this student.

Here are the other classes in `Logic` (omitted from the class diagram above) that are used for parsing a user command:

How the parsing works:

- When called upon to parse a user command, the `ModuLightParser` class creates an `XYZCommandParser` (`XYZ` is a placeholder for the specific command name e.g., `AddCommandParser`) which uses the other classes shown above to parse the user command and create a `XYZCommand` object (e.g., `AddCommand`) which the `ModuLightParser` returns back as a `Command` object.
- All `XYZCommandParser` classes (e.g., `AddStudentCommandParser` , `DeleteStudentCommandParser` , ...) inherit from the `Parser` interface so that they can be treated similarly where possible e.g, during testing.

Model component

API : `Model.java`

Note that Student, StudentGrade and GradeComponent classes have similar structures and dependencies, thus, we use Ssc class to represent these three and their related classes in the class diagram above.

Here are the class diagrams for Ssc (Student, StudentGrade, GradedComponent) classes respectively.

The `Model` component,

- stores the ModuLight data i.e., all `Student` objects (which are contained in a `UniqueStudentList` object), all `StudentScore` objects (which are contained in a `UniqueStudentScoreList` object) and all `GradedComponent` objects (which are contained in a `UniqueGradedComponentList` object).
- stores the currently 'selected' `Student` , `StudentScore` and `GradedComponent` objects (e.g., results of a search query) as separate *filtered* lists respectively which are exposed to outsiders as unmodifiable `ObservableList<Student>` , `ObservableList<StudentScore>` and `ObservableList<GradedComponent>` 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.
- stores a `UserPref` object that represents the user’s preferences. This is exposed to the outside as a `ReadOnlyUserPref` objects.
- does not depend on any of the other three components (as the `Model` represents data entities of the domain, they should make sense on their own without depending on other components)

Note: For student and student score, an alternative (arguably, a more OOP) model is given below. It has a `Tag` list in the `Student` , which `Student` references. This allows `AddressBook` to only require one `Tag` object per unique tag, instead of each `Person` needing their own `Tag` objects.

Storage component

API : `Storage.java`

Here are the complete class diagrams of StudentBook Storage, StudentScoreBook Storage and GradedComponentBook Storage.

The `Storage` component,

- can save student data, student score data, graded component data and user preference data in JSON format, and read them back into the corresponding objects.
- inherits from `StudentBookStorage` , `GradedComponentBookStorage` , `StudentScoreBookStorage` and `UserPrefsStorage` , which means it can be treated as any of the one (if only the functionality of only one is needed).
- depends on some classes in the `Model` component (because the `Storage` component's job is to save/retrieve objects that belong to the `Model`)

Common classes

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

Implementation

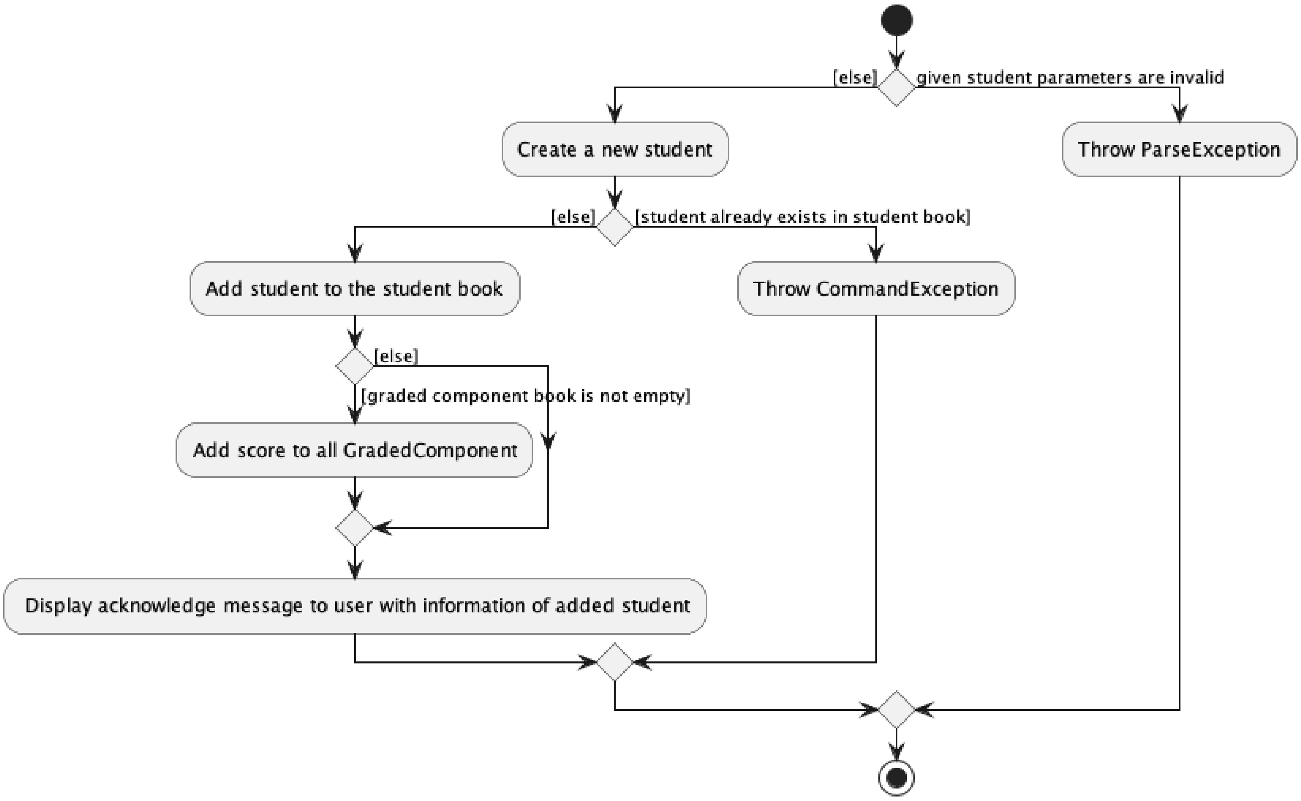
This section describes some noteworthy details on how certain features are implemented.

Add Student

The addStu function allows the user to add a new student to the database. ModuLight maintains a UniqueStudentList to make sure that there is no duplicates. The new Student object will be added to the StudentBook . An empty StudentScore related to this Student will be added to all existing GradedComponent .

The student can only be added if the user entered valid inputs for its name, student id, email, tutorial group(optional) and tag(optional). Otherwise, a ParseException will be thrown and error message will be displayed. A default TutorialGroup with value T00 will be assigned to the student if the user did not assign the student to a tutorial group.

The following activity diagram illustrates the process of execution of an AddStudentCommand .

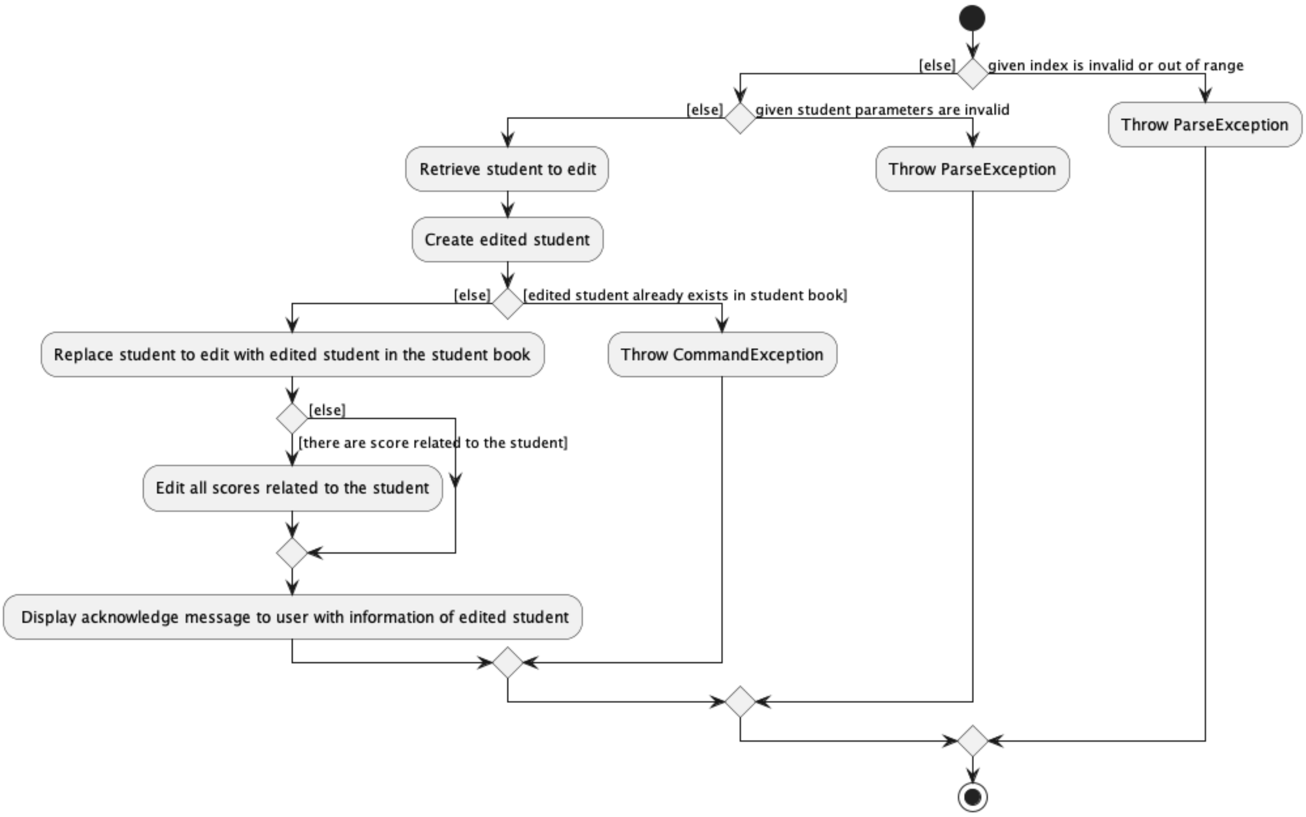

[else]
given student parameters are invalid
Create a new student
Throw ParseException
[else]
[student already exists in student book]
Add student to the student book
Throw CommandException
[else]
[graded component book is not empty]
Add score to all GradedComponent
Display acknowledge message to user with information of added student

Edit Student

The editStu function allows the user to edit the information of the student indicated by index. The previous Student object will be removed from the StudentBook . A new student object with the edited information will be added to the database. All student scores related to this Student will be updated as well.

The student can only be edited if the user entered valid inputs for its name, student id, email, tutorial group(optional) and tag(optional). Otherwise, a ParseException will be thrown and error message will be displayed.

The following activity diagram illustrates the process of execution of an `EditStudentCommand` .


[else]
given index is invalid or out of range
[else]
given student parameters are invalid
Throw ParseException
Retrieve student to edit
Throw ParseException
Create edited student
[else]
[edited student already exists in student book]
Replace student to edit with edited student in the student book
Throw CommandException
[else]
[there are score related to the student]
Edit all scores related to the student
Display acknowledge message to user with information of edited student

Find Commands

The find commands allows users to find the student, student scores and graded components that they are interested in. We have three find commands in total: `findStu` , `findScore` and `findComp` . The implementation of these three commands are similar. Here we use the `findStu` command to illustrate how they are executed.

Find Student

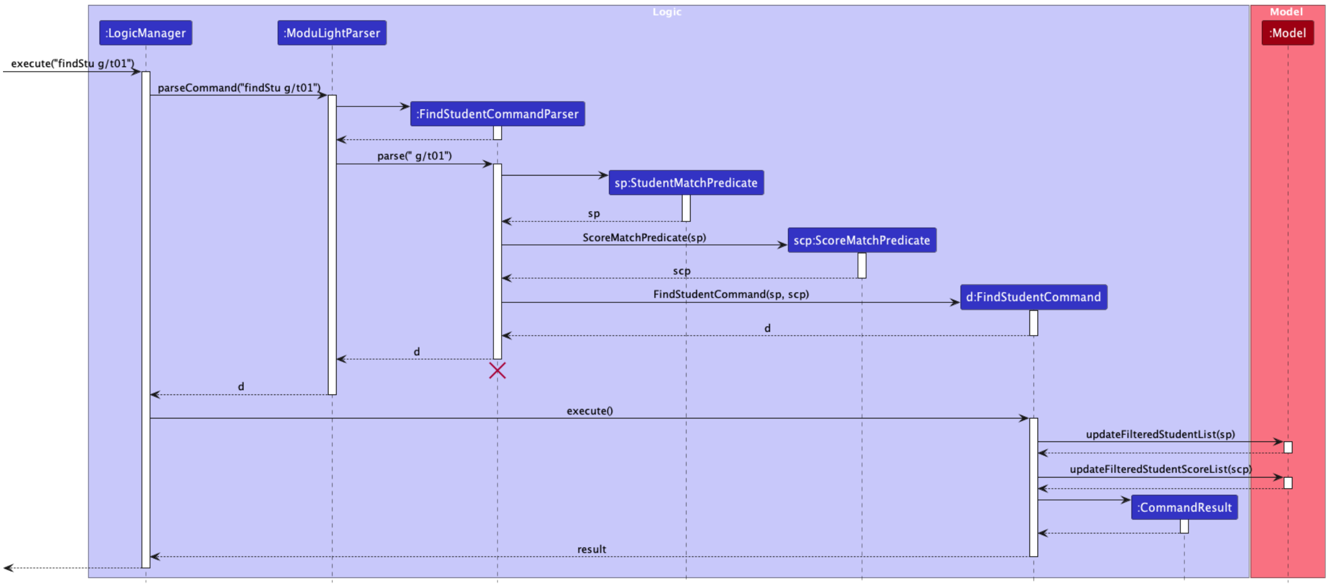
The `findStu` function allows the user to find the student that matches the given search criteria.

It displays both the matching students and relevant student scores that belongs to the student. All graded components are displayed since they are considered relevant to the student.

To find the wanted student, a `StudentMatchPredicate` is created to test whether a student matches the search keywords. A `ScoreMatchPredicate` is created from the `StudentMatchPredicate` to test whether the score belongs to the matched student.

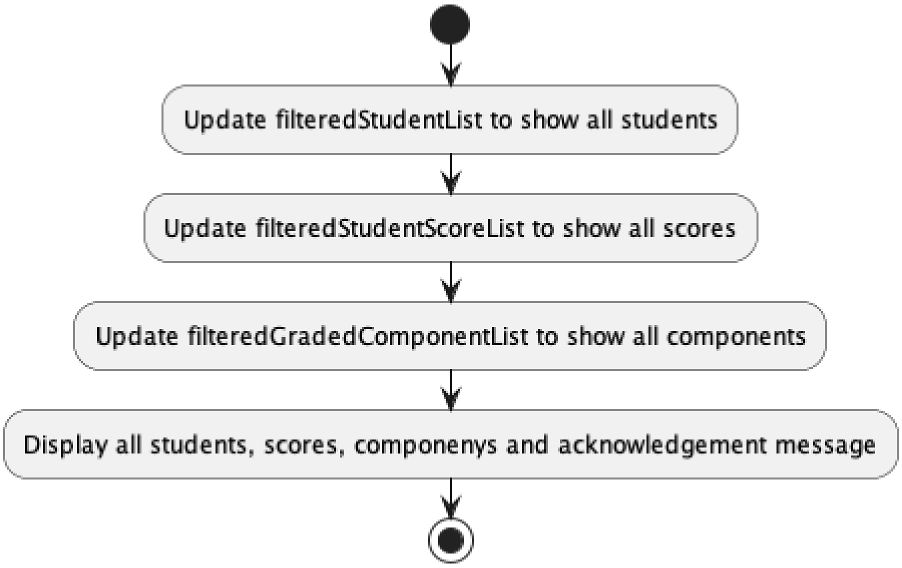
This only changes the displayed list of students and student scores, stored as `filteredStudentList` and `filteredStudentScoreList` in `Model` , without affecting the data stored in ModuLight.

The following sequence diagram illustrates the process of execution of an `FindStudentCommand` .



List Commands

The `listAll` command lists all student, student scores and graded components in ModuLight. Below is an activity diagram that demonstrates how this command works.


Update filteredStudentList to show all students
Update filteredStudentScoreList to show all scores
Update filteredGradedComponentList to show all components
Display all students, scores, componenys and acknowledgement message

Add Graded Component

The `addComp` command allows users to add a graded component and automaticaly create student scores associated with that component for every student in the database. A typical program flow is as follows:

1. User enters a command to add a graded component, for instance `addComp 1 c/Midterms w/30 mm/60` .
2. `AddGradedComponentCommandParser` attempts to parse the flags `c/` , `mm/` and `w/` which represent the component name, maximum mark and weightage values respectively. It performs several checks, failing which a `ParseCommandException` is thrown:
   i. All 3 flags have non-empty values.
   ii. The component name, maximum marks and weightage values provided are valid. (eg. `Weightage` is a number between 0 and 100)

    iii. There are no duplicate flags provided.
3. Assuming all flag values have been successfully parsed, these are used to initialize a `GradedComponent` which is passed into `AddGradedComponentCommand`.
4. Within `AddGradedComponentCommand`, a second round of checks is initiated, failing which a `CommandException` is thrown:
    i. There does not exist another `GradedComponent` in the database with the same name as the added one.
    ii. After adding the `GradedComponent`, the total weightage does not exceed 100.
5. If all checks are successful, the new `GradedComponent` is added into the database.
6. For every student in the database, the command additionally creates a student score corresponding to that student and the newly created `GradedComponent`, with marks initialized to 0.
7. The linkages between `Student` and `GradedComponent` are updated accordingly (ie. their corresponding `StudentScores` are added to their score lists)

Alternative Implementations:

- For step 6, we initially considered letting users add student scores on their own corresponding to an existing student ID and component name. However, we rejected this idea as users would likely find it very troublesome to individually create student scores, and it would also make the calculation of scores more convoluted. (eg. how to calculate mean for components/students with missing scores) se the index provided, checking that it is a valid integer from 1 to the size

Edit Graded Component

The `editComp` command allows users to edit a graded component's details based on its 1-based index, which are propagated to the component's associated student scores. A typical program flow is as follows:

1. User enters a command to edit a graded component, for instance `editComp 1 c/Midterm Exam w/25 mm/50`.
2. `EditGradedComponentCommandParser` checks for the flags c/, mm/ and w/ which represent the component name, maximum mark and weightage values respectively. It performs several checks, failing which a `ParseCommandException` is thrown:
    i. The index provided is an integer between 1 and the size of the displayed `GradedComponent` list
    ii. The component name, maximum marks and weightage values provided are valid. (eg. Weightage is a number between 0 and 100)
    iii. There are no duplicate flags provided.
    iv. At least one field to be edited must be provided.
3. An `EditGradedComponentCommandDescriptor` is created using the provided arguments. This is because the graded component list in `GradedComponentBook` is read-only, so to edit a `GradedComponent`, we will need to create a new `GradedComponent` using the descriptor, and call the `setGradedComponent` function to replace the old component with the new one.
4. An `EditGradedComponentCommand` is created and executed with the `Model`.
5. In `EditGradedComponentCommand`, more checks are performed, failing which a `CommandException` is thrown:
    i. There does not exist another `GradedComponent` in the database with the same name as the edited one.
    ii. After editing the `GradedComponent`, the total weightage does not exceed 100.

    iii. After editing the `GradedComponent`, none of the associated student scores exceeds its maximum mark.
6. This new graded component replaces the old one using `setGradedComponent` in `GradedComponentBook`.
7. All associated student scores of the old `GradedComponent` have their linkages updated.

Alternative Implementations:

- We considered making the lists of `GradedComponentBook` not read-only, but decided against it at the time as it would require refactoring a large part of the codebase. However, this may create some inefficiency as the `Model` has to search through the entire `GradedComponent` list for the appropriate item to replace. Therefore, this is a possible extension that future developers may consider.

Delete Graded Component

The `deleteComp` command allows users to delete a graded component alongside its associated student scores based on its 1-based index. A typical program flow is as follows:

1. User enters a command to delete a graded component, for instance `deleteComp 2`.
2. `DeleteGradedComponentCommandParser` checks that the only argument provided is a valid index, which is an integer between 1 and the size of the displayed `GradedComponent` list.
3. Index is passed into `DeleteGradedComponentCommand`'s constructor which is then executed.
4. The graded component corresponding to the index in the currently displayed `GradedComponentBook` list is removed.
5. All associated student scores of that `GradedComponent` are also removed.

Alternative Implementations:

- We originally considered having users remove graded components based on their unique component name. Ultimately, we decided it would be faster for users to type in an index rather than a name (especially if it is quite lengthy), although future developers may want to extend this functionality so that users can choose to remove by either index or component name.

Sort Commands

The Sort related features allows NUS professors to sort the currently displayed students or student scores. When successfully executed, the sorted students or student scores will be shown on the Graphical User Interface.

We will discuss the implementation of `sortScore` (Sort Student Scores) command here and omit the discussion of the implementation of `sortStu` command since it is very similar to `sortScore` command and simpler.

Implementation

The `sortScore` mechanism is facilitated by GradedComponentBook, StudentBook and StudentScoreBook. It implements the following operations:

- `GradedComponentBook#hasGc(GcName gcName)` - Returns true if a graded component is already created and in the graded component list.

- `studentScoreBook.sortStudentScore(Boolean isReverse)` - Filters the student scores with the given graded component and sort them according to the given reverse order.
- `studentBook.sortStudentScore(GcName gcName, Boolean isReverse)` - Sorts students by their scores in a given graded component.

Given below is an example usage scenario and how the `sortScore` mechanism behaves at each step.

Step 1. The GUI displayed the list of students and their student scores that the user wants to sort after some `find` or `list` commands.

Step 2. The user executes `sortStuScore c/Midterm` command to sort the current displayed lists of students and student scores. The `sortStuScore` command calls SortStudentScoreCommandParser#parse() which parses the string keyed into the command line of the GUI.

Step 3. `SortStudentScoreCommandParser#parse()` invokes the creation of a `SortStudentScoreCommand` object.

> **Note**: If a command fails its execution due to incorrect command format, it will not create a `SortStudentScoreCommand` object, an error message will be displayed and user will retype their command.

Step 4. Upon creation and execution of `SortStudentScoreCommand` object, `GradedComponentBook#hasGc(GcName gcName)` , `studentScoreBook.sortStudentScore(Boolean isReverse)` and `studentBook.sortStudentScore(GcName gcName, Boolean isReverse)` methods are called.

> **Note**: If upon invoking `GradedComponentBook#hasGc(GcName gcName)` method and return value is false, it will throw an error and will not call the remaining two methods, so the students and student scores will not be sorted.

Step 5. After successfully sorting student scores and their associated students, a `CommandResult` object will be created to tell the user that the student scores has been successfully sorted.

The following sequence diagram shows how the sort student scores operation works:

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

Stats Commands

The Stats related features allows NUS professors to calculate the statistics of student scores effectively. When successfully executed, the relevant statistics will be shown in the result display box of Graphical User Interface.

We will discuss the implementation of `compStats` (calculate the statistics for a specific graded component) command here and omit the discussion of the implementation of `stats` command since it is very similar to `compStats` command and simpler.

Implementation

The `compStats` mechanism is facilitated by GradedComponentBook, StudentBook and StudentScoreBook. It implements the following operations:

- `GradedComponentBook#hasGc(GcName gcName)` - Returns true if a graded component is already created and in the graded component list.
- `studentBook.getStudentList()` - Returns the stored list of students.
- `compStatsCommand.generateOverallStatsSummary(List<Student> students)` - Returns a string represented all the relevant statistics.
- `statsCalculator` - A class that helps calculate different types of statistical measures.

Given below is an example usage scenario and how the `compStats` mechanism behaves at each step.

Step 1. The user executes `compStats c/Midterm` command to calculate the statistics of student scores of Midterm. The `compStats` command calls CompStatsCommandParser#parse() which parses the string keyed into the command line of the GUI.

Step 2. `CompStatsCommandParser#parse()` invokes the creation of a `CompStatsCommand` object.

> **Note**: If a command fails its execution due to incorrect command format, it will not create a `CompStatsCommand` object, an error message will be displayed and user will retype their command.

Step 3. Upon creation and execution of `CompStatsCommand` object, `GradedComponentBook#hasGc(GcName gcName)`, `studentBook.getStudentList()` and `compStatsCommand.generateOverallStatsSummary(List<Student> students)` methods are called.

> **Note**: If upon invoking `GradedComponentBook#hasGc(GcName gcName)` method and return value is false, it will throw an error and will not call the remaining two methods, so statistics will not be calculated and displayed.

Step 4. After successfully calculating the statistics, a `CommandResult` object will be created to show the calculated statistics.

The following sequence diagram shows how the `compStats` operation works:

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

Auto-grading

Implementation

The auto-grading command uses the help of `EditStudentScommand` and `SortStuCommand` to properly assign each grade to the students. The `SortStuCommand` is used to find the grade threshold value for each grade, if the method used is by `percentile` (this will be explained later). Additionally, it creates clearer result as it sorts the students by their total score inversely. In a short manner, the mechanism works by finding the grade threshold for each grade and assigning the grade to each student by comparing their total score to the previously found grade threshold.

There are 2 possible method of grading:

- Percentile Method: `percentile`
  - Calculate students' grade based on the statistical percentile. This will assign the grade for students above k-th percentile. `SortStuCommand` will be used to sort the students and find the students at the exact position of the grade threshold. Note that it will **round up** the index to take a more lenient approach. The total score of that student will be used as the grade threshold.
- Absolute Score Method: `absolute`
  - Calculate students' grade based on the given passing grade values.
  - The absolute value is compared directly with the students' total score (in percentage of the maximum score possible).

Important Note:

- The `autoGrade` command works on the filtered student list. This would allow for example, to grade students only compared to their own tutorial group. To automatically grade every student in the module, `findStu` command can be used to display every student.

Given below is an example usage scenario and how the auto-grading mechanism for percentile calculation behaves at each step.

Step 1. The user launch the application for the first time.

Step 2. The user creates the desired graded components, adds all the students in the cohort, and assign them with scores.

Step 3. The user then executes `autoGrade ag/percentile pg/95 70 65 50 40 30 20` to execute the auto-grading system, the `percentile` keyword indicates that ModuLight grades based on the students' percentile compared to another. The value after `pg/` indicates the top percentile for each corresponding grade threshold, i.e. `pg/[A+] [A] [A-] [B+] ...` .

Note: The value for `ag/` can be type `absolute` which determines the grade based on the passing score of the student's total score.

This step will first trigger the parse function and several things will be executed

1. The string argument will be parsed into the grading method and the passing value.
2. `AutoGradeCommandParser#checkAutoGradeType()` then will parse the grading method string into AutoGradeType `PERCENTILE` .
3. `AutoGradeCommandParser#mapToFloat()` will parse the passing value string into an array of float. In this step, string that is not parsable will be checked and an exception will be thrown. Furthermore, values less than zero or more than 100 will cause an exception to be thrown as the total mark of a student is in percentage. Further check on values must be decreasing is also available as lower grades cannot have higher grade threshold.
4. The parser then will return a new `AutoGradeCommand` object.

Step 4. The `AutoGradeCommand` returned will then be executed and several other things will be executed

1. This step will first trigger the `sortStuCommand` and causes the filtered student list to be updated into the sorted form.

2. A check will be done to ensure that the inputted array of float does not pass the maximum number of values. An exception will be thrown otherwise.
3. As the grading method used in this example is `PERCENTILE` , it will then trigger `AutoGradeCommand#setGradeThresholdPercentile()` to be executed in order to calculate the grade threshold.
4. It will then create an `EditStudentDescriptor` for each student in the filtered list and the assigned grade. The grade is determined by comparing the student's total score and the grade threshold.
5. `EditStudentCommand` will be created and executed for each student and the grade will be added.

The following sequence diagram shows how the auto-grading mechanism works:

- The parser implementation (Command execution is hidden):
- The command implementation :

Design considerations:

Aspect: How the assignments of grade works:

- Create new Grade object for each student.
  - Pros: Cleaner and extendable code implementation.
  - Cons: require change of implementation on multiple classes.

[Proposed] Undo/redo feature

Proposed Implementation

Since `Student` , `StudentGrade` and `GradedComponent` have similar dependencies and behavior, we will use `Ssc` to refer these three classes and their related classes in the following discussion. In other words, `VersionedSscBook` means `VersionedStudentBook` , `VersionedStudentScoreBook` and `VersionedGradedComponentBook` . The proposed undo/redo mechanism is facilitated by `VersionedSscBook` . It extends `SscBook` with an undo/redo history, stored internally as an `sscStateList` and `currentStatePointer` . Additionally, it implements the following operations:

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

These operations are exposed in the `Model` interface as `Model#commitSscBook()` , `Model#undoSscBook()` and `Model#redoSscBook()` 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 `VersionedSscBook` will be initialized with the initial Ssc book state, and the `currentStatePointer` pointing to that single Ssc book state.

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

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

Note: If a command fails its execution, it will not call `Model#commitSscBook()` , so the ssc book state will not be saved into the `sscBookStateList` .

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

Note: If the `currentStatePointer` is at index 0, pointing to the initial SscBook state, then there are no previous SscBook states to restore. The `undo` command uses `Model#canUndoSscBook()` 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#redoSscBook()` , which shifts the `currentStatePointer` once to the right, pointing to the previously undone state, and restores the ssc book to that state.

Note: If the `currentStatePointer` is at index `sscBookStateList.size() - 1` , pointing to the latest address book state, then there are no undone SscBook states to restore. The `redo` command uses `Model#canRedoSscBook()` 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 `listAll` . Commands that do not modify the address book, such as `list` , will usually not call `Model#commitSscBook()` , `Model#undoSscBook()` or `Model#redoSscBook()` . Thus, the `sscBookStateList` remains unchanged.

Step 6. The user executes `clearAll` , which calls `Model#commitSscBook()` . Since the `currentStatePointer` is not pointing at the end of the `sscBookStateList` , all address book states after the `currentStatePointer` will be purged. Reason: 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:

Design considerations:

Aspect: How undo & redo executes:

- **Alternative 1 (current choice):** Saves the entire ssc 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 `deleteStu` , just save the student being deleted).
    - Cons: We must ensure that the implementation of each individual command are correct.

Documentation, logging, testing, configuration, dev-ops

- Documentation guide
- Testing guide
- Logging guide
- Configuration guide
- DevOps guide

Appendix: Requirements

Product scope

Target user profile

NUS professors who:

- have a need to manage a significant number of students and assessments in a single module
- are beginners to intermediate in spreadsheet technology
- prefer typing over interacting with the GUI with the mouse
- is reasonably comfortable using CLI apps

Value proposition:

- NUS professors need a convenient system to manage students and assessments. We propose a program to track students and their performance on graded components, utility functions to get statistics on the cohort and certain subgroups, ability to tag students (e.g. dropped module, potential TA etc.), alongside general GUI improvements.

User stories

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

Priority	As a …	I want to …	So that I can…
`* * *`	NUS professor	add a new student	track all students taking my course.
`* * *`	NUS professor	add a new graded component	track all graded components in my course thus far.
`* * *`	NUS professor	add a new student score	track individual student performance on this module's graded components.

Priority	As a …	I want to …	So that I can…
* * *	NUS professor	delete a student	remove students dropping the course/wrongly assigned.
* * *	NUS professor	delete a graded component	remove a graded component if I feel it is no longer necessary.
* * *	NUS professor	delete a student score	
* * *	NUS professor	save changes made	so I can update student grade information throughout the semester.
* * *	NUS professor	load information	so I can update student grade information throughout the semester.
* *	NUS professor	edit a student	update outdated student information or correct mistakes.
* *	NUS professor	edit a graded component	make changes to a component (eg. modify weightage) or correct mistakes.
* *	NUS professor	edit a student score	regrade student scripts or correct mistakes.
* *	NUS professor	find student and associated scores by ID	quickly find information about a student and their scores without having to search through the list
* *	NUS professor	find graded component and associated scores by ID	quickly find information about a graded component and student scores without having to search through the list
* *	NUS professor	quickly calculate the overall statistics of student grades	have a quick insight of how my students are performing
* *	NUS professor	sort students with specific order	find the top students easily
* *	NUS professor	sort student scores with specific order	find the top students with their associated scores easily
* *	NUS professor	automatically grade students based on their total score, the grading method I want to use, and the passing value for each grade	significantly reduce the time needed to grade the students and avoid manually grading each student.

Priority	As a …	I want to …	So that I can…
*	NUS professor	toggle between dark and light mode	have a pleasant user experience.

Use cases

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

Use case: Add a student

MSS

1. User enters the details to add a student.
2. ModuLight adds the student with entered details to the student list.
   Use case ends.

Extensions

- 1a. There is some error in the entered data.
  - 1a1. ModuLight shows an error message.
    Use case ends.
- 2a. There are already some existing graded components.
  - 2a1. ModuLight creates student scores correspond to the new student for every graded component.
    Use case ends.

Use case: Edit a student's information

MSS

1. User requests to list students.
2. ModuLight shows a list of students.
3. User requests to edit the details of a specific student.
4. ModuLight updates the detail of that student with entered data.
   Use case ends.

Extensions

- 2a. The list is empty.
  Use case ends.
- 3a. The given index is invalid.
  - 3a1. ModuLight shows an error message.
    Use case resumes at step 2.
- 3b. The given parameter is of invalid format
  - 3b1. ModuLight shows an error message.
    Use case resumes at step 2.
- 3c. The edited student number already exists.
  - 3c1. ModuLight shows an error message.

Use case resumes at step 2.

Use case: Delete a student and the associated scores

MSS

1. User requests to list students.
2. ModuLight shows a list of students.
3. User requests to delete a specific student in the list.
4. ModuLight deletes the student.
5. ModuLight shows a list of updated students.
   Use case ends.

Extensions

- 2a. The list is empty.
  Use case ends.
- 3a. The given index is invalid.
  - 3a1. ModuLight shows an error message.
    Use case resumes at step 2.
- 3b. The selected student has some associated student scores.
  - 3b1. ModuLight deletes all associated students scores.
  - 3b2. ModuLight shows a list of updated student scores.
    Use case resumes at step 4.

Use case: Add a new graded component

MSS

1. User creates new Graded Component.
2. ModuLight adds the graded component with entered details to the graded component list.
3. ModuLight shows lists of updated graded components and student scores.
   Use case ends.

Extensions

- 1a. There is some error in the entered data.
  - 1a1. ModuLight shows an error message.
    Use case ends.
- 2a. There are already some existing students.
  - 2a1. ModuLight creates student scores correspond to the new graded component for every student.
    Use case ends.

Use case: Edit a student score

MSS

1. User requests to list student scores.
2. ModuLight shows a list of student scores.
3. User requests to edit the details of a specific student score.

4. ModuLight updates the detail of that student score with entered data.
5. ModuLight shows a list of updated student scores.
   Use case ends.

Extensions

- 2a. The list is empty.
  Use case ends.
- 3a. The given index is invalid.
  - 3a1. ModuLight shows an error message.
    Use case resumes at step 2.
- 3b. There is some error in the entered data.
  - 3b1. ModuLight shows an error message.
    Use case resumes at step 2.

Use case: List all

MSS

1. User requests to list all students, student scores and graded components.
2. ModuLight shows lists of all students, student scores and graded components.
   Use case ends.

Use case: Delete a graded component and its associated scores

MSS

1. User requests to list graded components.
2. ModuLight shows a list of graded components.
3. User requests to delete a specific graded component in the list.
4. ModuLight deletes the graded component.
5. ModuLight shows a list of updated graded components.
   Use case ends.

Extensions

- 2a. The list is empty.
  Use case ends.
- 3a. The given index is invalid.
  - 3a1. ModuLight shows an error message.
    Use case resumes at step 2.
- 3b. The selected graded component has some associated student scores.
  - 3b1. ModuLight deletes all associated students scores.
  - 3b2. ModuLight shows a list of updated student scores.
    Use case resumes at step 4.

Use case: Find student(s)

MSS

1. User requests to find a student or students with the specific keywords.

2. ModuLight shows a list of students that fulfilling the searching criteria and a list of student scores belonging to the listed students.
   Use case ends.

Extensions

- 1a. There are some unsupported or incorrect keywords.
  - 1a1. ModuLight shows an error message.
    Use case ends.
- 1b. There are no keywords given
  - 1b1. ModuLight shows all students, scores and graded components.
    Use case ends.

Use case: Sort student(s)

MSS

1. User requests to sort the displayed student list with the specific order.
2. ModuLight shows a list of sorted students.
   Use case ends.

Extensions

- 1a. The given sorting order is unsupported.
  - 1a1. ModuLight shows an error message.
    Use case ends.

Use case: Calculate the overall stats of student performance

MSS

1. User requests to calculate the overall statistics of student performance
2. ModuLight shows a summary of statistics
   Use case ends.

Extensions

- 1a. There is currently no student scores.
  - 1a1. ModuLight shows an error message.
    Use case ends.
- 1b. User requests to calculate a non-supported statistical measure.
  - 1b1. ModuLight shows an error message and a list of supported statistical measures.
    Use case ends.

Use case: Automatically grade students based on their total score

MSS

1. User requests to automatically grade student using AutoGradeCommand.
2. Modulight automatically grade every student command based on their total score, grading method, and passing value.

3. Modulight automatically sort students based on their total score for convenience.
   Use case ends.

Extensions

- 1a. User request to use unsupported grading method.
  - 1a1. Modulight shows an error message and a list of supported grading method available.
    Use case ends.
- 1b. User inputted non-decreasing values for passing value.
  - 1b1. Modulight shows an error message specifying that the values inputted is non-decreasing.
    Use case ends.
- 1c. User inputted passing values outside the bound of 0 and 100 inclusively.
  - 1c1. Modulight shows an error message specifying that the values must be between 0 and 100 inclusively.
    Use case ends.
- 1d. User inputted too many passing values.
  - 1d1. Modulight shows an error message specifying that there are too many passing values inputted.
    Use case ends.

{More to be added}

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 students, 10000 student scores and 10 graded components 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. Should respond to user requests within 2 seconds.
5. The user interface shall be intuitive and user-friendly.
6. Should allow edit only by authorized users.
7. Should not take more than 128MB memory while in operation.

{More to be added}

Glossary

- **Mainstream OS**: Windows, Linux, Unix, OS-X
- **Confidential Grade**: A grade detail that is not meant to be shared with students

Appendix: 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.

Launch and shutdown

1. Initial launch
   1. Download the jar file and copy into an empty folder
   2. 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
   1. Resize the window to an optimum size. Move the window to a different location. Close the window.
   2. Re-launch the app by double-clicking the jar file.
      Expected: The most recent window size and location is retained.
3. *{ more test cases … }*

Adding a student

1. Adding a student to Modulight
   1. Test case: `addStu n/John Doe s/A1234567Y e/john@gmail.com g/T07` Expected: If there is already a person with the same student ID in ModuLight an error message will appear in the feedback box. Otherwise, a new student with name `John Doe`, student id `A1234567Y`, email `john@gmail.com` and tutorial group `T07` will be created and displayed in the student list. If there exists graded component in the graded component list, new student scores that belongs to this student will be added.
   2. Test case: `addStu n/Jane Plain s/A1111111Y e/jane@gmail.com` Expected: If there is already a person with the same student ID in ModuLight an error message will appear in the feedback box. Otherwise, a new student with name `Jane Plain`, student id `A1111111Y`, email `jane@gmail.com` and default tutorial group `T00` will be created and displayed in the student list. If there exists graded component in the graded component list, new student scores that belongs to this student will be added.
   3. Test case: `addStu n/Amy e/amy@gamil.com` Expected: An error message of Invalid command format will be displayed in the feedback box, as the student id parameter is missing.

Deleting a student

1. Deleting a student while all students are being shown
   1. Prerequisites: List all students using the `listAll` command. Multiple students in the list.
      1. Test case: `deleteStu 1`
         Expected: First student is deleted from the student list. All related scores are deleted from the score list. Details of the deleted student shown in the status message. Timestamp in the status bar is updated.
      2. Test case: `deleteStu 0`
         Expected: No student is deleted. Error details shown in the status message. Status bar remains the same.
      3. Other incorrect delete commands to try: `deleteStu`, `deleteStu x`, `...` (where x is larger than the list size)

Expected: Similar to previous.

Finding a student

1. Find a student in ModuLight
    - i. Prerequisite: student list is not empty.
        - a. Test case: `findStu g/T00` Expected: All students from tutorial group `T00` will be displayed. All graded components and all scores related to the displayed students should be displayed.
            - a. Test case: `findStu` Expected: Since there is no search words given, all students, student scores and graded components will be displayed.
            - b. Test case: `findStu n/John n/Amy` Expected: All students whose name contains `John` or `Amy` (case-insensitive) will be displayed. All graded components and all scores related to the displayed students should be displayed.
            - c. Test case: `findStu n/John g/T00` Expected: All students whose name contains `John` (case-insensitive) and is from `T00` will be displayed. All graded components and all scores related to the displayed students should be displayed.

Sorting Students

1. Sort students in ModuLight
    - i. Prerequisite: displayed student list is not empty.
        - a. Test case: `sortStu` Expected: The displayed students are sorted by their total scores.
        - b. Test case: `sortStu o/n r/t` Expected: The displayed students are sorted by their names in the reverse alphabetical order.
        - c. Test case: `sortStu o/wrongInput` Expected: An error message that states "Invalid command format!" and the correct usage is shown.

Sorting Student Scores

1. Sort student scores in ModuLight
    - i. Prerequisite: displayed student list and student score list are not empty and a graded component with name "Midterm" is created.
        - a. Test case: `sortScore c/Midterm` Expected: Only Midterm student scores are shown, and they are sorted in the ascending order.
        - b. Test case: `sortScore c/Final` (Assuming there is no such graded component with name "Final") Expected: An error message that states "This graded component is not created. Please check if the information is correct" is shown.

Calculating Statistics

1. Calculate overall statistics of students' total scores
    - i. Prerequisite: student list and student score list are not empty and there is at least a valid score in Tut `T01` .
        - a. Test case: `stats` Expected: A message that states all relevant statistical measures (The exhaustive list can be found in UG) are shown.
        - b. Test case: `stats st/max st/min` Expected: A message that states the max and min is shown.

    c. Test case: `stats g/T01` Expected: A message that states all relevant statistical measures of Tut `T01` is shown.
    d. Test case: `stats st/wrongInput` Expected: An error message that states "Some statistic measures are not supported yet." and all supported statistical measures are shown.
  ii. Prerequisite: student score list is empty
    a. Test case: `stats` Expected: An error message that state "Please have at least one score fulfilling the condition." is shown.

Saving and Loading data

1. Dealing with missing files
   i. Delete all three json files `studentBook.json` , `gradedComponentBook.json` , `scoreBook.json` .
   ii. Run the program.
   Expected: The program will load with the original sample data just like it was run for the first time.
2. Dealing with corrupted files
   i. Open `studentBook.json` .
   ii. Edit any "studentName" field and input "R@chel".
   iii. Run the program.
   Expected: The program will load with completely empty data instead of edited data.
   iv. Other ways to corrupt the files are to change "tutorialGroup" to "AAA", "gcName" (in `gradedComponentBook. json`) to "@Quiz", ...
   v. Run the program.
   Expected: Similar to previous.
3. Manually editing data files
   i. Open `studentBook.json` .
   ii. Edit any "studentName" field and input "Rachel" or some other name which contains alphanumeric characters.
   iii. Run the program.
   Expected: The program will load with the updated studentName.

Appendix: Effort

Challenges

AB-3 mainly deals with one entity type, which is person. The implementation of MuduLight is more complicated as we have three entities: student, student score and graded components who related to each other. For example, a student score belongs to a student and a graded components, and every student and graded component entity contains a list of student scores.

In the implementation, we have carefully considered the interconnectedness of the entities and made sure that our features addresses the relationships. For example, when a student is deleted from the database, all student scores related to this student will be deleted as well, as it is pointless to keep them when they belong to no student.

Appendix: Planned Enhancements

1. Support special characters in student name parameter as some people's legal name do include some special characters(e.g. "s/o").
2. Allow the Student List Panel, Student Score List Panel and Graded Component List Panel to automatically scroll down when adding new Student, Student Grade or Graded Component.
3. Include visualisation of statistics by plotting graphs.
4. Support more flexible search methods that find the entity of interest despite small inaccuracies(e.g. typo) in the search keyword.
5. Support storage and display of student photos to help the professors recognise and identify their students.