# An S2A Case Study: Phone Book MVC

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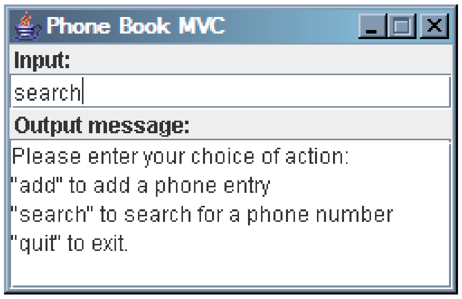
## 1 Introduction

We present a case study application constructed using the S2A compiler. The case study shows how S2A realizes MUSD behavioral contract enforcement and reuse across class hierarchies and interface implementations. For more information on the S2A compiler see the Scenarios in Action website at:
http://www.wisdom.weizmann.ac.il/~maozs/s2a/.

## 2 The Phone Book MVC

We describe a simple desktop phone book application[1]. It includes a text-based interface that allows the user to add name/phone pairs and search for phone by name. The data persist in a text file. Fig. 1 shows the Phone Book GUI.



```
Please enter your choice of action:
"add" to add a phone entry
"search" to search for a phone number
"quit" to exit.
```

**Fig. 1.** A snapshot of the Phone Book GUI.

The application's architecture is based on the popular *Model-View-Controller* (MVC) architectural design pattern; the *Model* is responsible for data processing and persistence, the *View* is responsible for the user interface (presentation and collection of user input), and the *Controller* is responsible for executing actions according to user input and current state of the application. Most significant

[1] The case study was inspired by an example given in an IBM tutorial document for Rational Software Architect written by Tinny Ng, available from http://www.ibm.com/developerworks/.

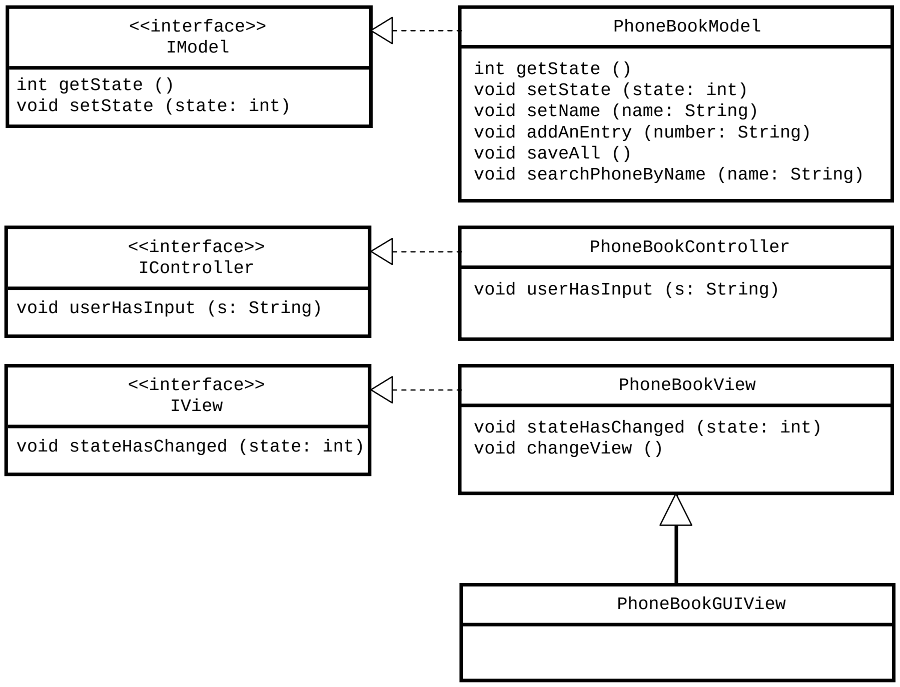

<<interface>>
IModel
int getState ()
void setState (state: int)
PhoneBookModel
int getState ()
void setState (state: int)
void setName (name: String)
void addAnEntry (number: String)
void saveAll ()
void searchPhoneByName (name: String)
<<interface>>
IController
void userHasInput (s: String)
PhoneBookController
void userHasInput (s: String)
<<interface>>
IView
void stateHasChanged (state: int)
PhoneBookView
void stateHasChanged (state: int)
void changeView ()
PhoneBookGUIView

**Fig. 2.** The Phone Book application's Class Diagram.

to our work is that we use MUSDs to specify (and thus actually to program!) all communications *between* the three components. These include both generic behavior at the abstract interfaces level and application specific behavior at the concrete classes level, as we demonstrate next.

Fig. 2 shows the Phone Book application UML class diagram; it includes three interfaces and three concrete classes that implement them, plus another class, `PhoneBookGUIView`, which extends `PhoneBookView`.

The *SetState* MUSD shown in Fig. 3 includes three methods: `setState()` (cold/monitoring), `stateHasChanged()` (hot/execution), and `changeView()` (cold/monitoring). It specifies that whenever the `IModel` method `setState()` is called from an `IController` (more precisely, whenever an object that implements the `IController` interface calls the `setState()` method of an object that implements the `IModel` interface), with whichever `int` argument, the IModel should eventually call the IView method `stateHasChanged()` with the same integer as argument. The IView may then call its `changeView()` method. The behavior is specified at the interface level since it is generic and independent of a specific MVC-based application.

The application specific inter-object behavior of the Phone Book is specified in the *UserInput* MUSD shown in Fig.4. It specifies that whenever the controller's `userHasInput()` method is called by the viewer, and the input is not empty, one of several alternative scenarios should happen, depending on the current state of the application and the input[2]. For example, if the current state is `STATE_IDLE` and the input is `COMMAND_QUIT_STRING` (defined as "quit"), the controller should call the model's `saveAll()` method and then call its `setState()` method with the new state `STATE_EXIT` as argument.

## 3 Conclusions

The Phone Book case study shows how S2A realizes MUSD behavioral contract enforcement and reuse across class hierarchies and interface implementations. Since the lifelines in the *SetState* MUSD represent interfaces, this diagram can be explicitly reused, as is, together with the three interfaces, in other applications that employ the MVC design pattern. Reusing the *SetState* MUSD enforces the correct use of the pattern; S2A generates the code that actually performs the required behavior and thus ensures that the behavioral aspect of the pattern is indeed preserved in the implementation. As future work we thus envision assembling a repository of reusable MUSD specifications of popular behavioral patterns, such as MVC, from which one could choose and then reuse when constructing new applications.

The Phone Book application uses the `PhoneBookGUIView` class to implement a Java Swing interface. The `main()` method of the application initiates this class. Since it extends the `PhoneBookView` class (and thus implicitly also implement the `IView` interface), the corresponding lifelines in the two MUSDs bind to it at runtime. Thus, the diagrams can be reused both with new interface implementations and with subclassing.

Finally, the case study shows the applicability of MUSD to popular frameworks that implement the MVC pattern, most importantly, to server-side programming frameworks of web-based applications (e.g., Struts, Spring). Specifying such a server-side application using MUSD and constructing it using S2A is a project we plan to pursue.

The Phone Book MVC UML model, source, generated aspect code, and executable, can be downloaded from the Scenarios in Action web site at: `http://www.wisdom.weizmann.ac.il/~maozs/s2a/`.

[2] To specify different alternatives and to choose between them using guards we use the UML 2 standard *ALT* combined interaction fragment.

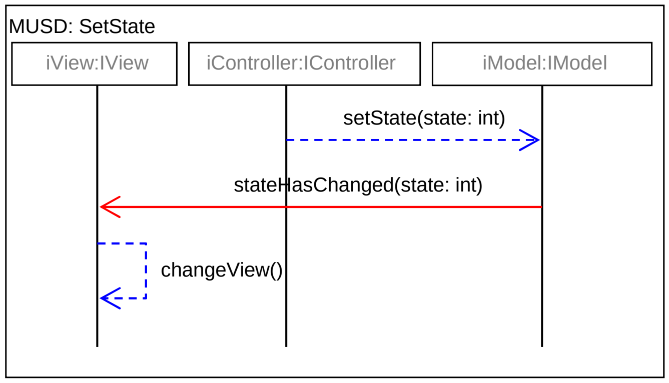


**Fig. 3.** `SetState` MUSD.

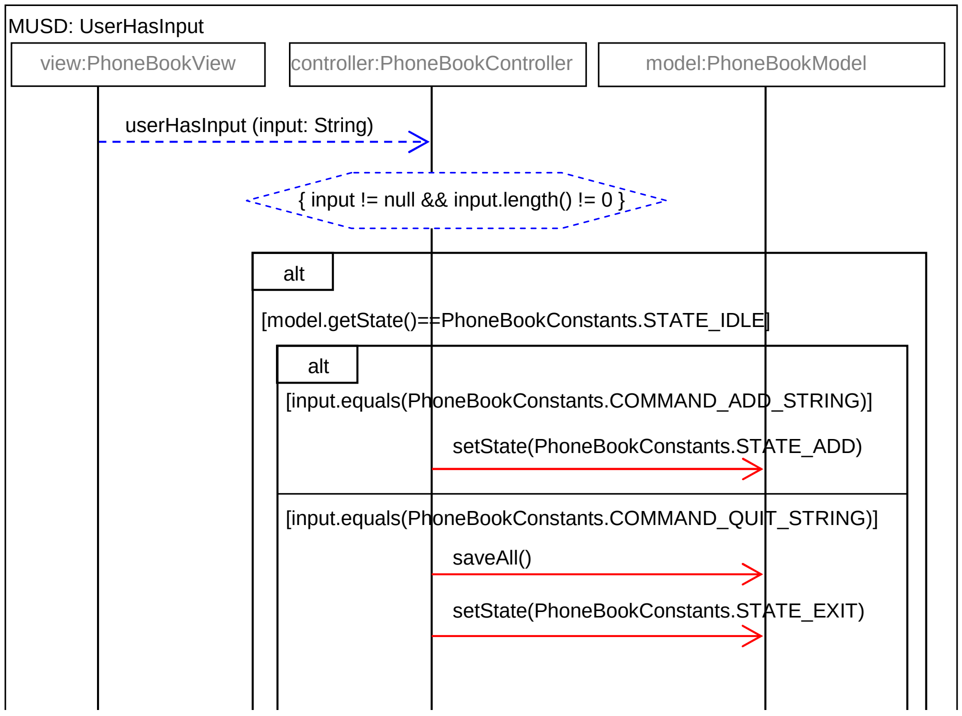

MUSD: UserHasInput
view:PhoneBookView
controller:PhoneBookController
model:PhoneBookModel
userHasInput (input: String)
{ input != null && input.length() != 0 }
alt
[model.getState()==PhoneBookConstants.STATE_IDLE]
alt
[input.equals(PhoneBookConstants.COMMAND_ADD_STRING)]
setState(PhoneBookConstants.STATE_ADD)
[input.equals(PhoneBookConstants.COMMAND_QUIT_STRING)]
saveAll()
setState(PhoneBookConstants.STATE_EXIT)

**Fig. 4.** `UserHasInput` MUSD.