Compound Patterns

Isaac Griffith

CS 2263
Department of Informatics and Computer Science
Idaho State University

Outcomes

After today's lecture you will be able to:

- Understand that several patterns exist which are combinations of simpler patterns
- Understand the basic concepts surrounding the model-view-controller pattern

Inspiration

“If you think good architecture is expensive, try bad architecture.” – Brian Foote and Joseph Yoder

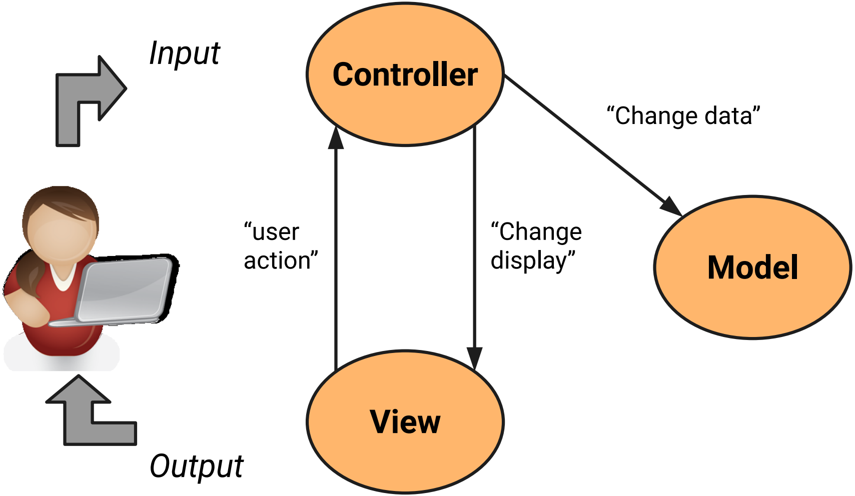
Motivation

- Basic parts of any application:
  - Data being manipulated
  - A UI through which this manipulation occurs
- The data is logically independent from how it is displayed to the user
  - Display should be separately designable/evolvable
- Example: grade distribution in class
  - Displayed as both pie chart and/or bar chart
- Anti-example: see BigBlob
  - Presentation, logic, and state all mixed together

Model-View-Controller Pattern

- Model
  - The data (i.e., state)
  - Methods for accessing and modifying state
- View
  - Renders contents of model for user
  - When model changes, view must be updated
- Controller
  - Translates user actions (i.e., interactions with view) into operations on the model
  - Example user actions: button clicks, menu selections

Basic Interactions in MVC



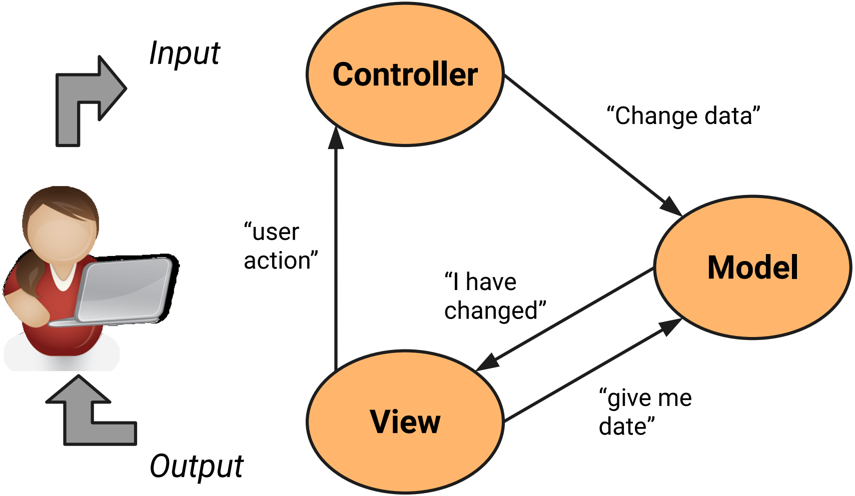
Implementing Basic MVC in Swing

- Mapping of classes to MVC parts
  - View is a Swing widget (like a JFrame & JButtons)
  - Controller is an ActionListener
  - Model is an ordinary Java class (or database)
- Alternative mapping
  - View is a Swing widget and includes (inner) ActionListener(s) as event handlers
  - Controller is an ordinary Java class with “business logic”, invoked by event handlers in view
  - Model is an ordinary Java class (or database)
- Difference: Where is the ActionListener?
  - Regardless, model and view are completely decoupled (linked only by controller)

Mechanics of Basic MVC

- Setup
  - Instantiate model
  - Instantiate view
    - Has reference to a controller, initially null
  - Instantiate controller with references to both
    - Controller registers with view, so view now has a (non-null) reference to controller
- Execution
  - View recognizes event
  - View calls appropriate method on controller
  - Controller accesses model, possibly updating it
  - If model has been changed, view is updated (via the controller)
- Example: CalcMVC
  - CalcModel, CalcView, CalcController
  - Note: View includes (gratuitous) reference to model
  - Note 2: The example code has a bug! Can you find it?

Extended Interactions in MVC



Extended Pattern

- Background: Observer Pattern
  - One object is notified of changes in another
  - In extended MVC, view is an observer of model
- Application within MVC
  - Asynchronous model updates
    - Model changes independent of user actions
    - Associated view must be notified of change in order to know that it must update
  - A model may have multiple views
    - But a view has one model
    - All views have to be updated when model changes

Mechanics of Extended MVC

- Setup
  - Instantiate model
    - Has reference to view, initially null
  - Instantiate view with reference to model
    - View registers with model
  - Instantiate controller with references to both
    - Controller registers with view
- Execution
  - View recognizes event
  - View calls appropriate method on controller
  - Controller accesses model, possibly updating it
  - If model has been changed, it notifies all registered views
  - Views then query model for the nature of the change, rendering new information as appropriate

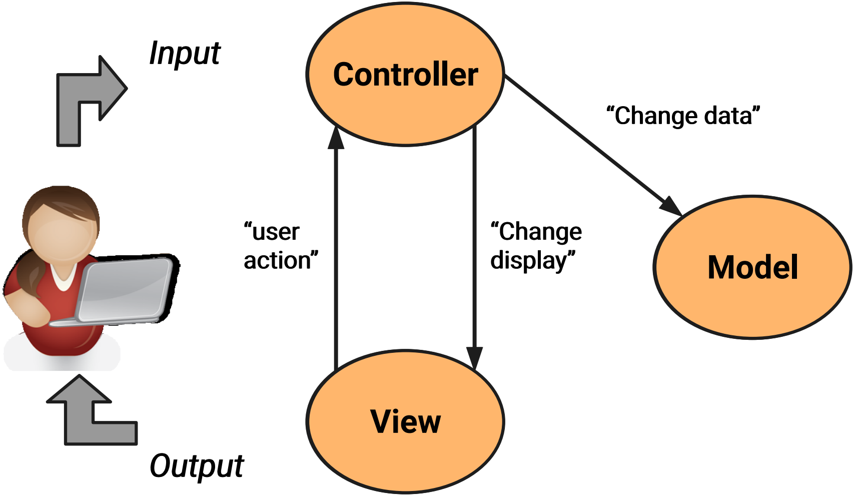
Problems with Classic MVC

- Controller might need to produce its own output
  - e.g. Popup menu
- Some state is shared between controller and view, but does not belong in model
  - e.g., Selection (highlighted text)
- Direct manipulation means that user can interact (control) visual elements (views)
  - e.g., ScrollBar
- Overall Issue: Input and Output are often intermingled in a GUI
  - Result: View and Controller are tightly coupled

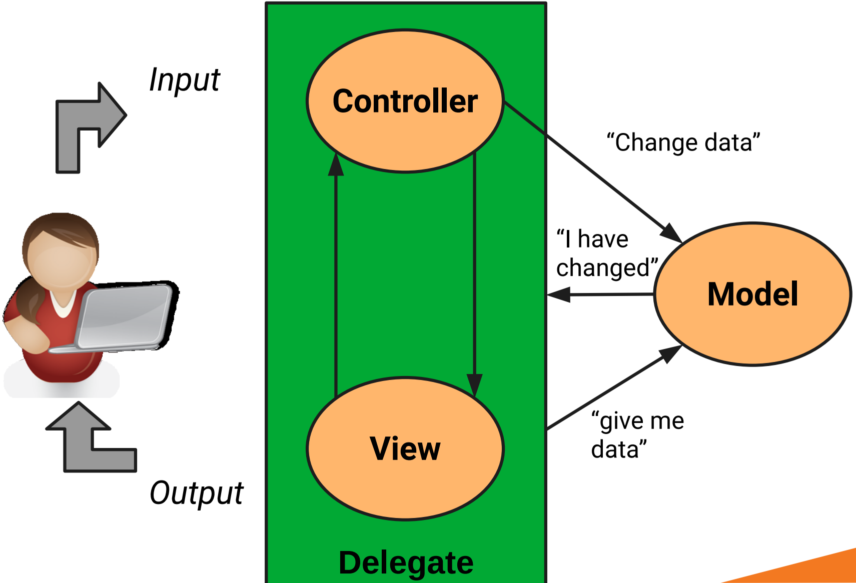
Delegate-Model Pattern

- Model
  - Data, same as before
- Delegate
  - Responsible for both input and output
  - A Combination of both view and controller
- Many other names
  - UI-Model
  - Document-View

Basic Interactions in Delegate Model



Basic Interactions in Delegate Model



Mechanics of Delgate Model

- Setup
  - Instantiate model
    - As with MVC, model does not know/care about UI
  - Instantiate delegate with reference to model
- Execution
  - Delegate recognizes event and executes appropriate handler for the event
  - Delegate accesses model, possibly updating it
  - If model has been changed, UI is updated
- Example: CalcV3
  - CalcModel, CalcViewController
  - Note: CalcModel is exactly the same as with CalcMVC

Notes

- Litmus test: Swapping out user interface
  - Can the model be used, without modification, by a completely different UI?
  - e.g., Swing vs. console text interface
- Model can be easily tested with JUnit
- Model actions should be quick
  - GUI is frozen while model executes
  - Alternative: multithreading, which gets much more complicated

Summary

- Motivation: Information hiding
  - Data (state) vs. UI
  - State should be agnostic of UI
- Model-View-Controller
  - Model contains state (data)
  - View displays model to user (presentation)
  - Controller modifies model (business logic)
- UI-Model
  - Allows for tight coupling between view and controller
  - Preserves most significant separation

Are there any questions?