CS 349
07 Model-View-Controller

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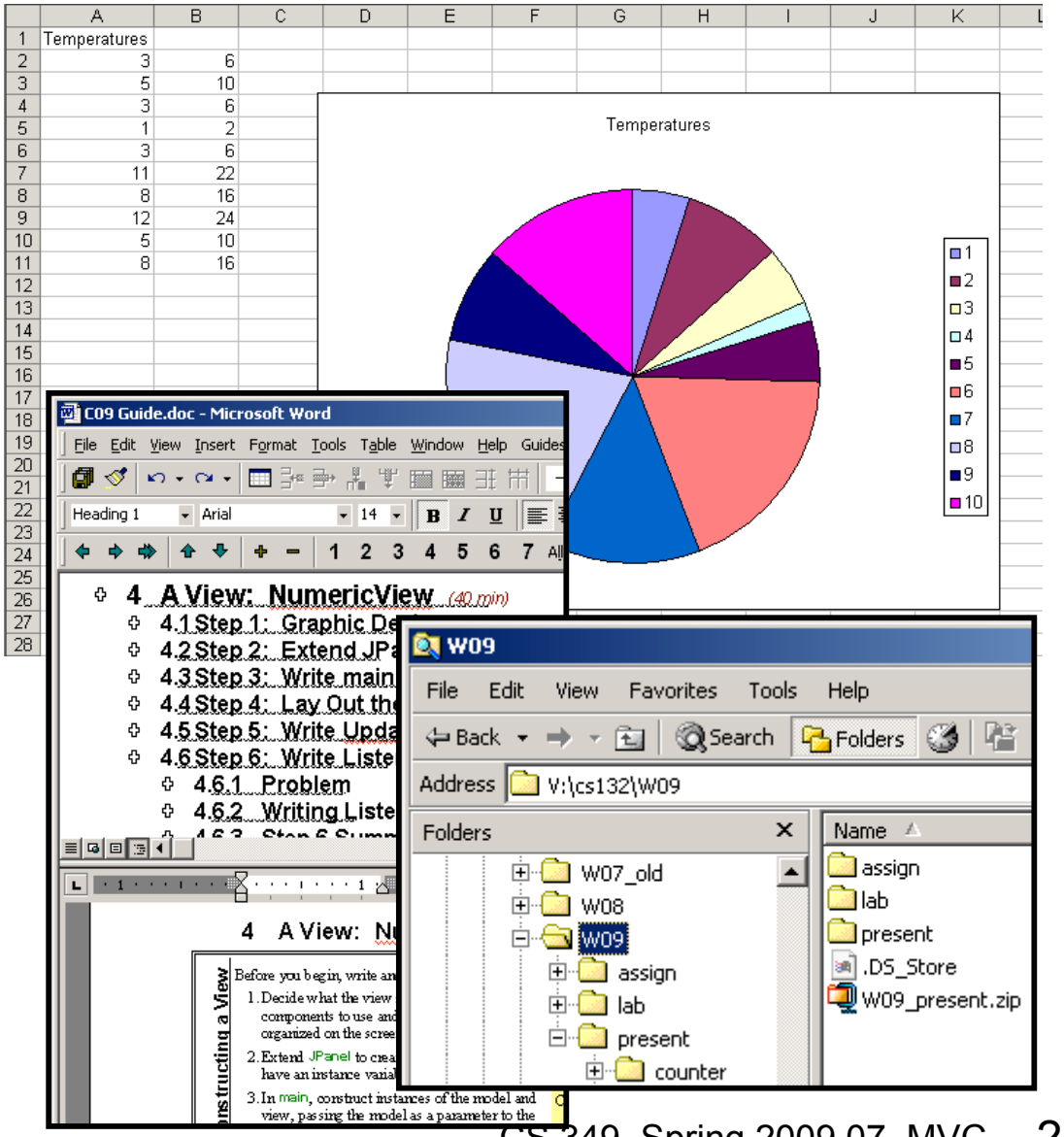
Applications with Multiple Views

- Two (or more!) views is normal. Examples:
- MS Word
  - outline view, normal view, map
  - often at the same time
- Excel
  - table, chart
- Windows Explorer
  - folder view, file view, address



Design Considerations

- When one view changes, the other(s) should change as well.
- The user interface probably changes more and faster than the underlying application
  - Many of the changes to the most recent version of Office were to the UI
  - Excel's underlying functions and data structures are probably very similar to Visicalc, the original spreadsheet
- How do we design software to support these observations?

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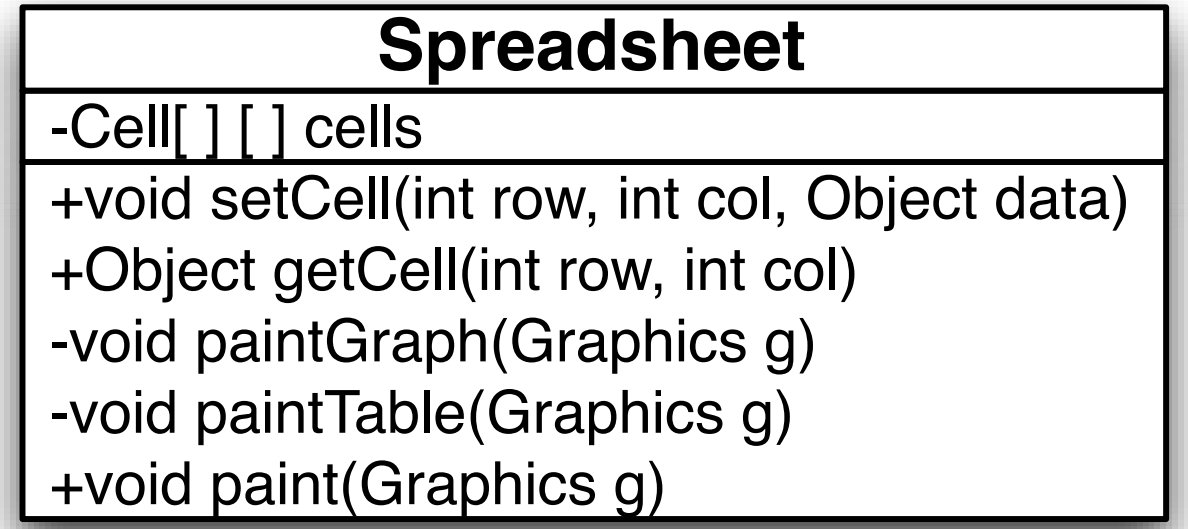
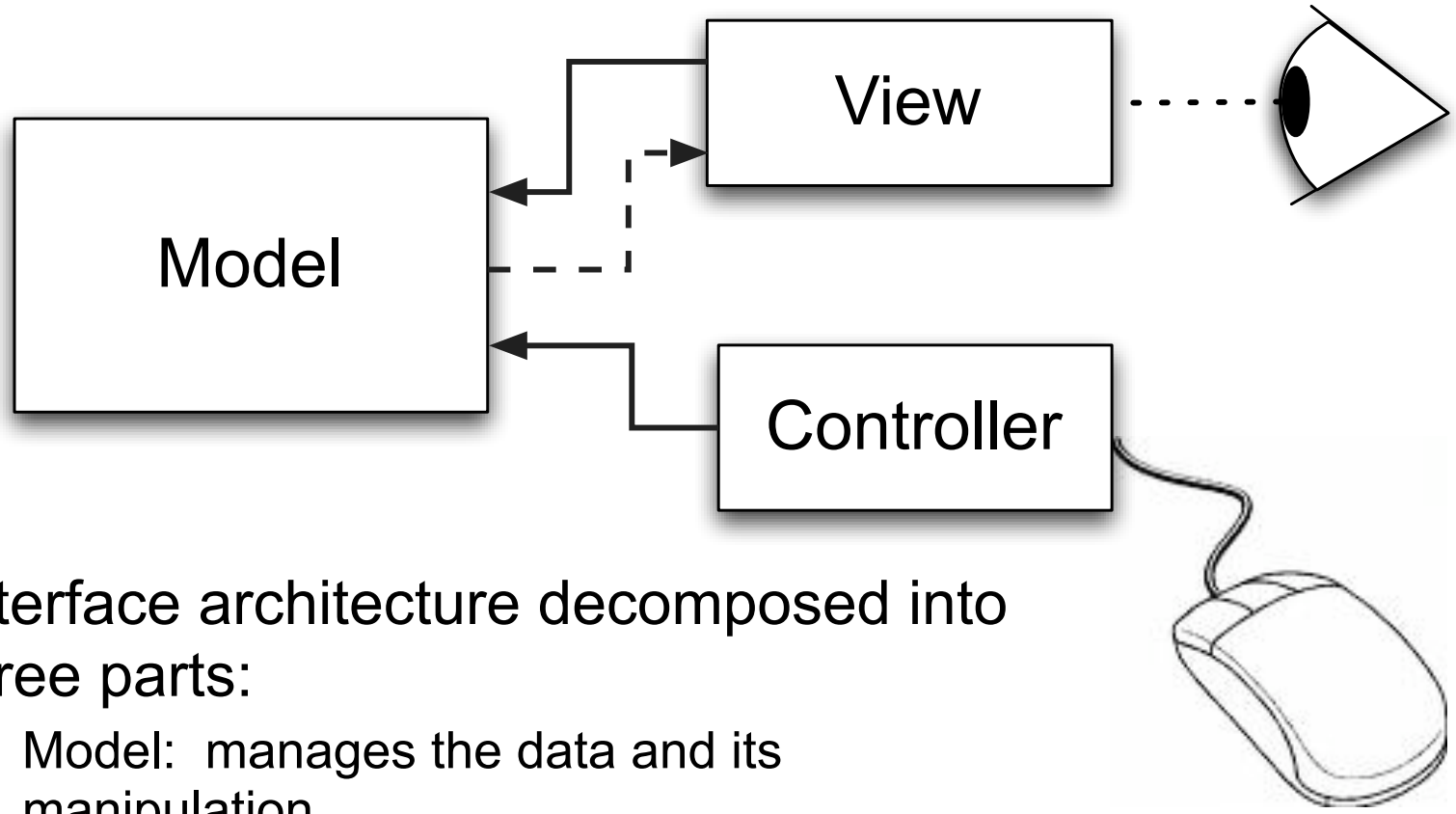
Possible Design



- Issues with bundling everything together:
  - What if we want to display data from a different type of source (eg: a database)?
  - What if we want to add new ways to view the data?
- Primary Issue: Data and its presentation are tightly coupled

Solution: Model-View-Controller



- Interface architecture decomposed into three parts:
  - Model: manages the data and its manipulation
  - View: manages the presentation of the data
  - Controller: handles user interaction

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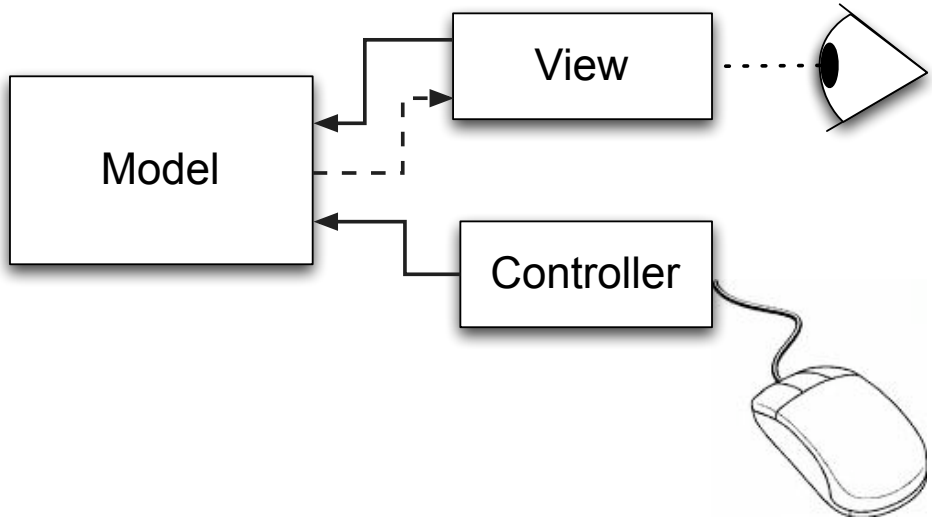
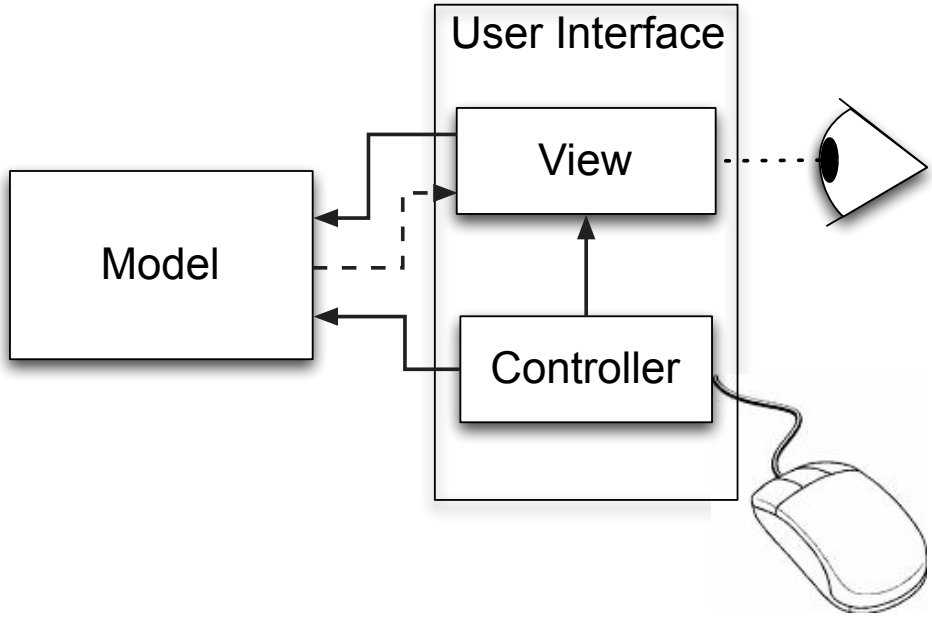
MVC background

- History
  - Developed in Smalltalk-80 in 1979 by Trygve Reenskaug
  - Now the standard design pattern for GUI toolkits
- Used at many levels
  - Overall application design
  - Individual components
    - eg: JTable
- Will feel very familiar because the Listener model we've already examined is very similar.

- MVC in Theory
  - View and Controller both refer to Model directly.
  - Model uses a listener-style design to inform view of changes.



- MVC in Practice
  - The View and Controller are tightly coupled.
  - Why?
  - Model is very loosely coupled with UI using the observer pattern (listeners in Java)



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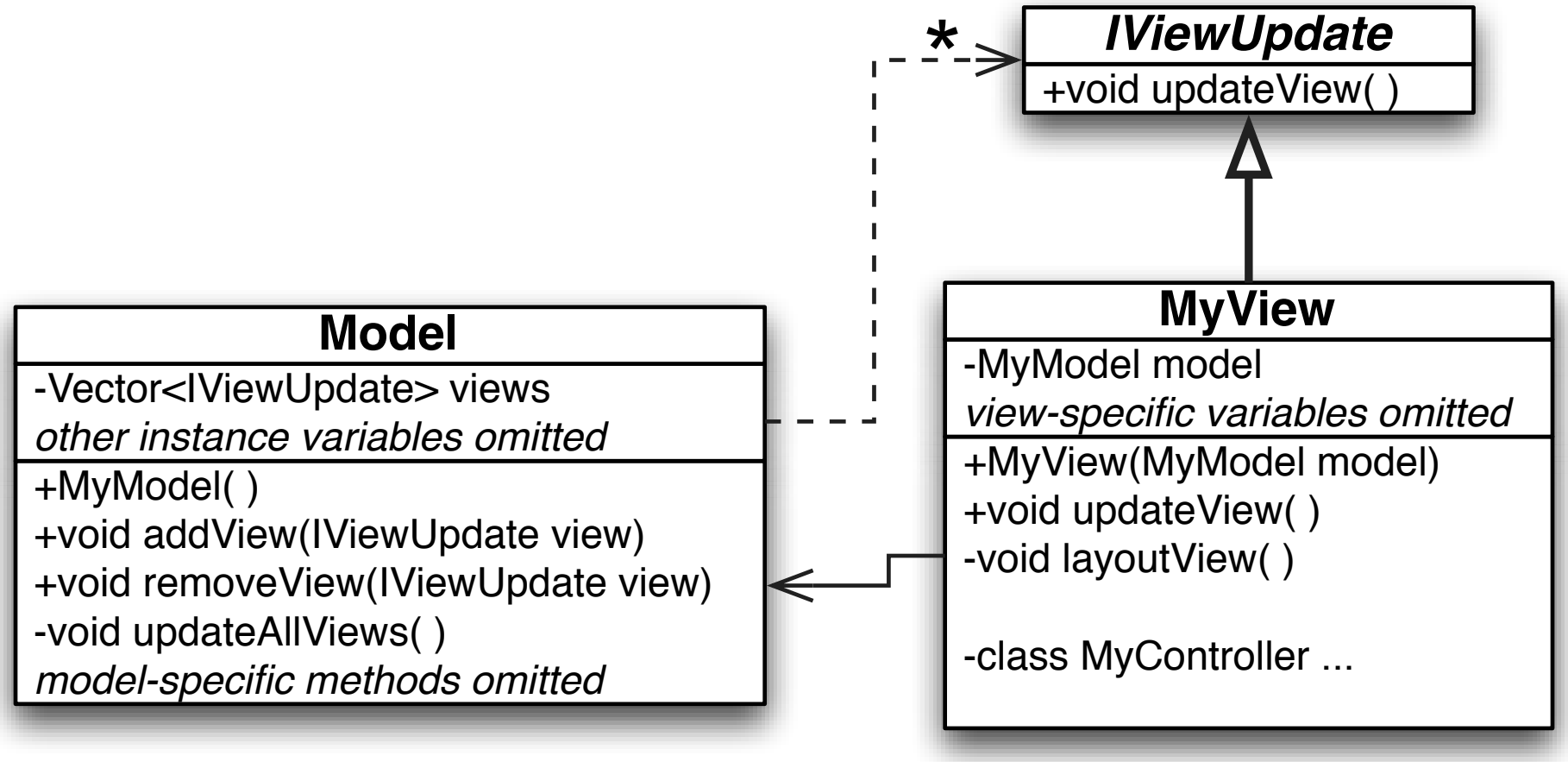
MVC as UML



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MVC Rationale 1: Multiple Views

Separation of concerns enables multiple, simultaneous views of the data.

- Given the same set of data, we may want to render it in multiple ways:
  - a table of numbers
  - a pie chart
  - a line graph
  - an audio stream
  - ...
- A separate model makes it easier for different components to use the same data
  - Each view is unencumbered by the details of the other views
  - Reduces dependencies on the GUI that could change

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MVC Rationale 2: Alt. Interactions

Separation of concerns enables alternative forms of interactions with the same underlying data.

- Data and how it is manipulated (the model) will remain fairly constant over time.
  - Consider a stable application like…
- How we present and manipulate that data (view and controller) via the user interface will likely change more often.

MVC Rationale 3: Code Reuse

Separation of concerns enables programmers to more easily use a stock set of controls to manipulate their unique application data.

- Example: JTable
  - Because the model is separated out, it can be used to manipulate many kinds of data stored in many different ways.
  - More time and attention can be given to JTable itself to make it more robust and versatile.

MVC Rationale 4: Testing

Separation of concerns enables one to more easily develop and test data-specific manipulations that are independent of the user interface

Process

- Set up the infrastructure
  - Write three classes:
    - the model
    - one or more view/controller classes (extends JComponent)
    - a class containing the main method
  - In the main method:
    - create an instance of the model
    - create instances of the views/controllers, passing them the model
    - display the view in a frame
- Build and test the model
  - Design, implement, and test the model
    - add commands used by controllers to change the model
    - add queries used by the view
  - Call updateAllViews just before exiting any public method that changes the model

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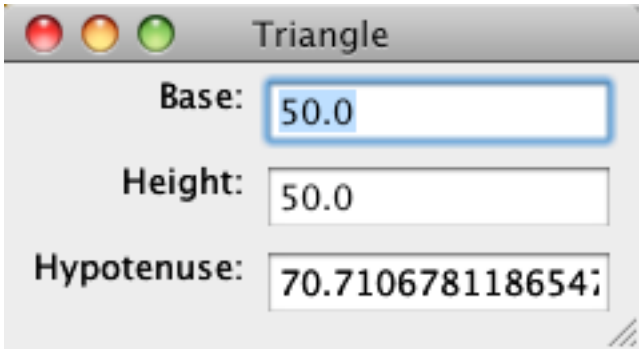
Process (cont.)

- Build the Views and Controllers
  - Design the user interface as one or more views. For each view:
    - Construct components
    - Lay the components out in the view
    - Write and register appropriate controllers for each component
    - Write updateView to get and display info from the model; register it with the model.

Demo: Triangles



- Demo the program
- Examine the model
- Examine SimpleTextView; discuss its deficiencies
- Examine TextView

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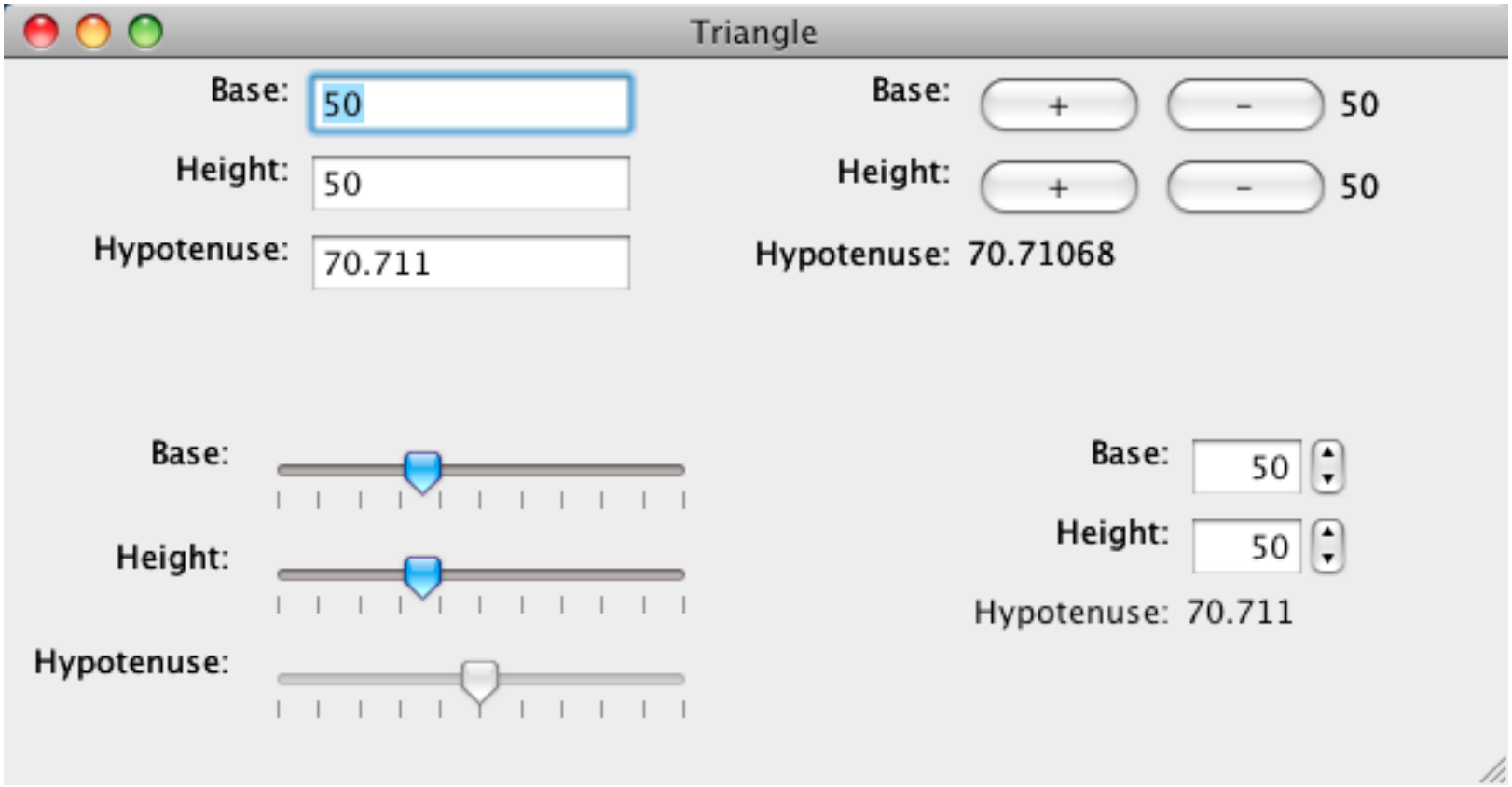
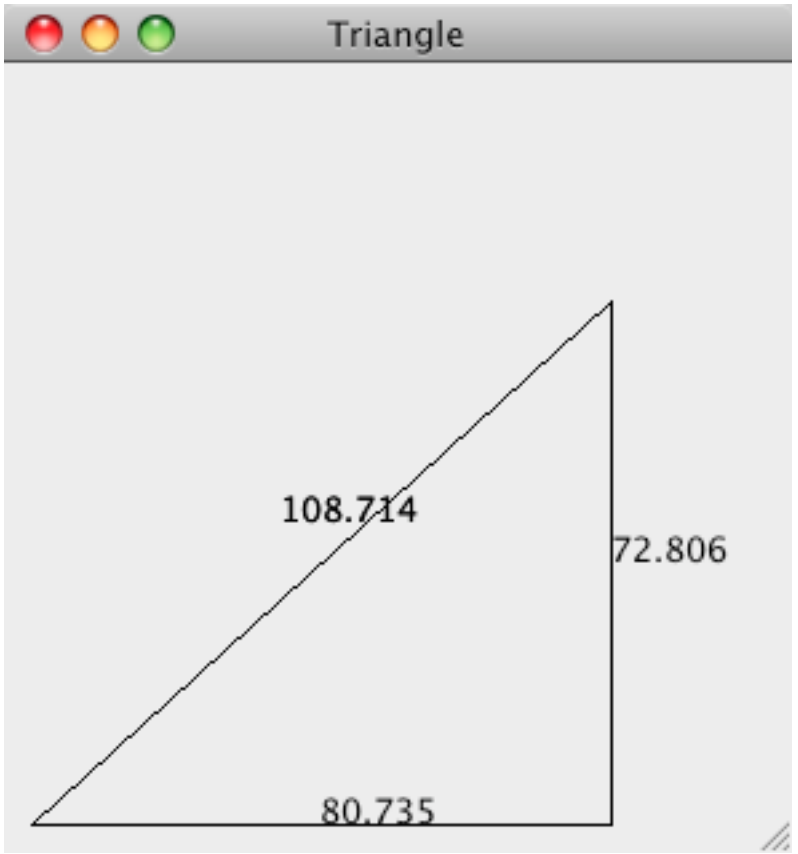
Multiple Views



A Graphical View

- Click the right side to select
- Once selected:
  - show “handles” for dragging
  - drag the right side to change the base
  - drag the apex to change both the base and the height
  - adjust cursor when over the right side or the apex



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