CMPS 251

Read Chapter 13

Graphical User Interfaces (GUI)

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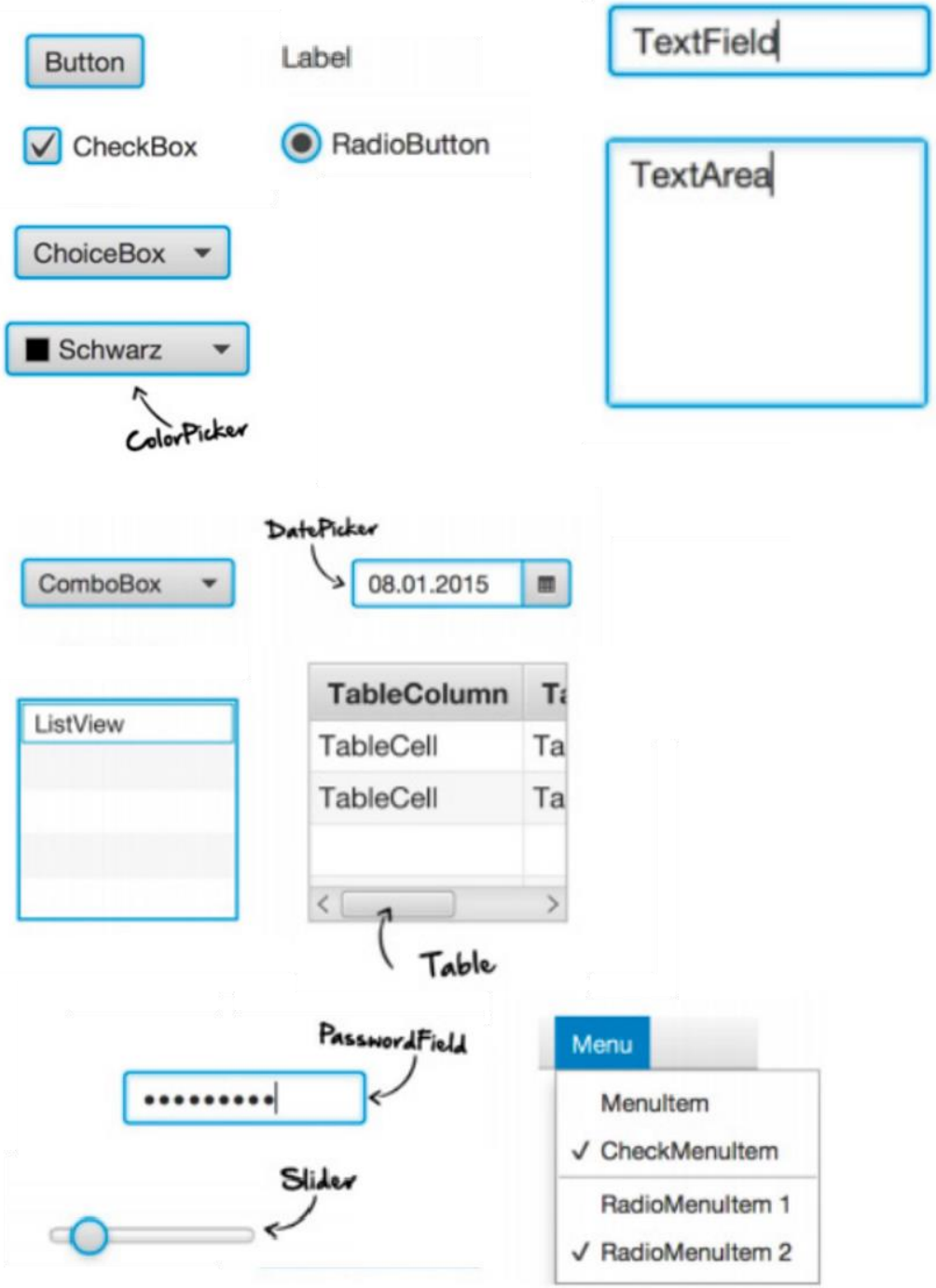
Outline

- Common JavaFX UI Components
- Properties and Bindings
- Dialog Boxes

Common JavaFX UI Components

- _6.controls.combobox
- _6.controls.listview
- _6.controls.piechart
- _6.controls.qbookapp
- _6.controls.registrationform

Back

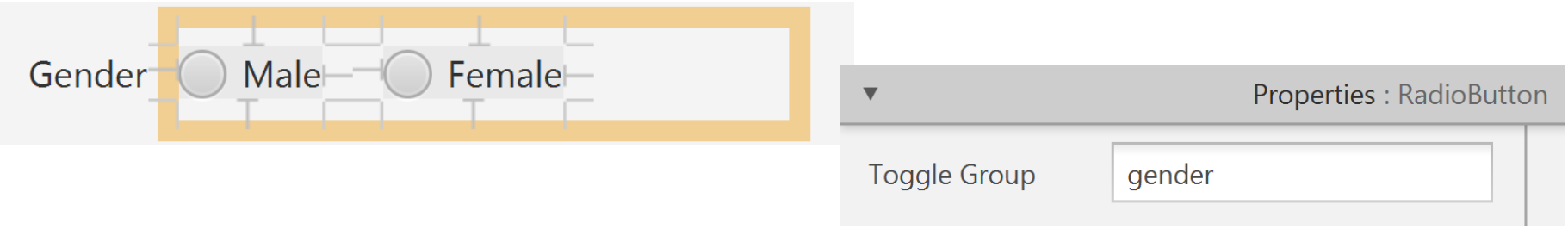


Commonly used JavaFX UI Components

- See posted examples …

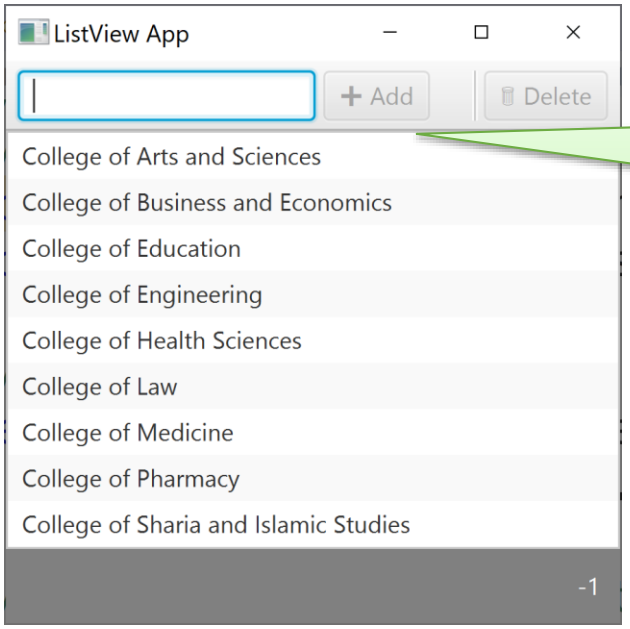
Radio Button

- To group radio button and allow the user the make mutually exclusive choice, select the radio buttons to group and assign them the same '**Toggle Group**' name



Fill a ListView using an ObservableList

```
@FXML private ListView<String> collegesListView;
@FXML private Button deleteButton;
public void initialize() {
  ObservableList<String> collegesOL =
        FXCollections.observableArrayList(CollegeRespository.getColleges());
  collegesListView.setItems(collegesOL);
}
void handleAdd(ActionEvent event) {
   collegesOL.add(college);
}
```



The **ObservableList notifies** the ListView of any changes (e.g., a new value is added) so that the ListView can auto-update its content

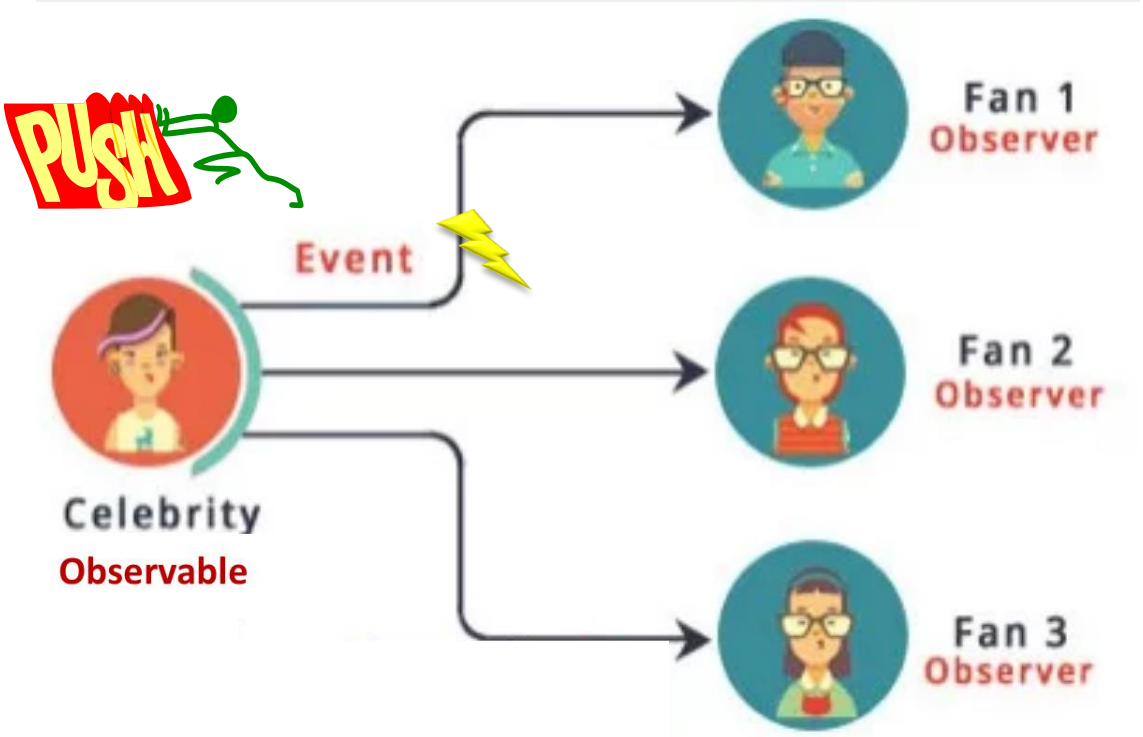
JavaFX automatically updates the UI whenever the observable list is updated

ObservableList

- The previous example uses a ListView control to display a list of college names
- To fill a ListView we pass an ObservableList object to the ListView using **`setItems`** method
  - If we make changes to the `ObservableList`, its **observer** (the ListView in this app) will automatically be notified of those changes
- `FXCollections.`***`observableArrayList`*** static method can be used to create an `ObservableList` from a List

Observable - Real-Life Example

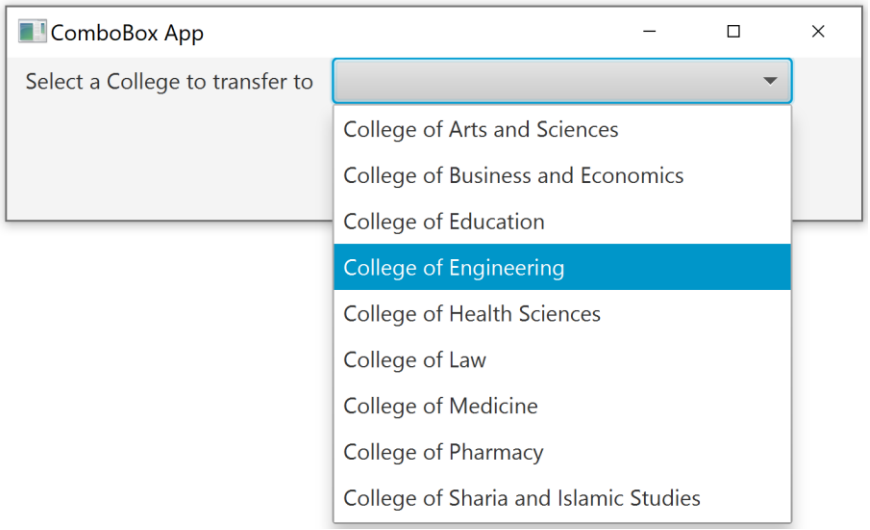
- A celebrity who has many fans on Instagram. Fans want to get all the latest updates (photos, videos, posts etc.). Here fans are **Observers** and celebrity is an **Observable**



Fill a ComboBox using an ObservableList

```
@FXML private ComboBox<String> collegesCombo;

public void initialize() {
 ObservableList<String> collegesOL =
  FXCollections.observableArrayList(CollegeRespository.getColleges());
 collegesCombo.setItems(collegesOL);
}
```



Getting the Selected Item

- To get a selected item from a ComboBox, ListView of a TableView you can use:

```
getSelectionModel().getSelectedItem();
```

e.g.,

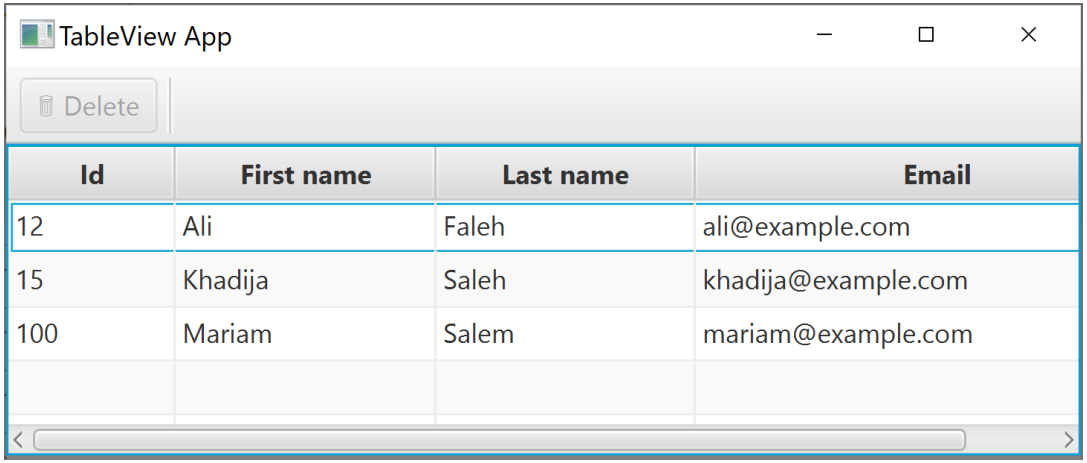
```
continentCombo.getSelectionModel().getSelectedItem();
```

- To get the selected index then use:

```
continentCombo.getSelectionModel().getSelectedIndex();
```

TableView

```
@FXML private TableView<Student> studentsTable;
@FXML private TableColumn<Student, Integer> idCol;
@FXML private TableColumn<Student, String> firstNameCol;
private ObservableList<Student> studentsOL = null;
public void initialize() {
    ...
    studentsTable.setItems(studentsOL);
    //Link table columns to student attributes
    idCol.setCellValueFactory(new PropertyValueFactory("id"));
    firstNameCol.setCellValueFactory(new
            PropertyValueFactory("firstName"));
}
```



TableColumn Cell Value Factory

- A TableColumn must have a ***cell value factory*** to extract the values of the object attribute to be displayed in each cell column.
- The **`PropertyValueFactory`** can extract a property value from a Java object
  - The name of the object attribute is passed as a parameter to the `PropertyValueFactory` constructor

```
PropertyValueFactory factory = new
    PropertyValueFactory<>("firstName");
```

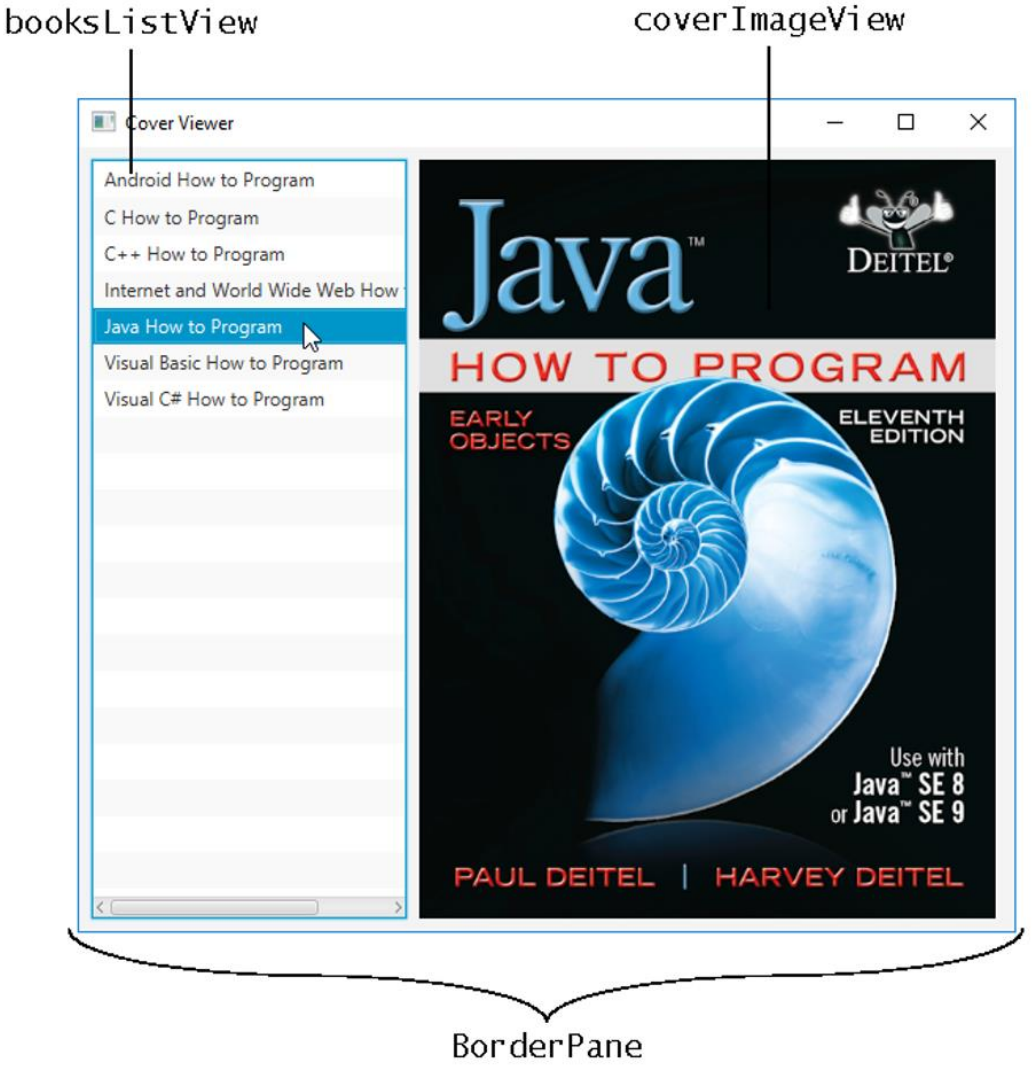
- The property name firstName will match the getter method getFirstName() of the Person objects to get the values to display on each row

Book Cover Viewer App

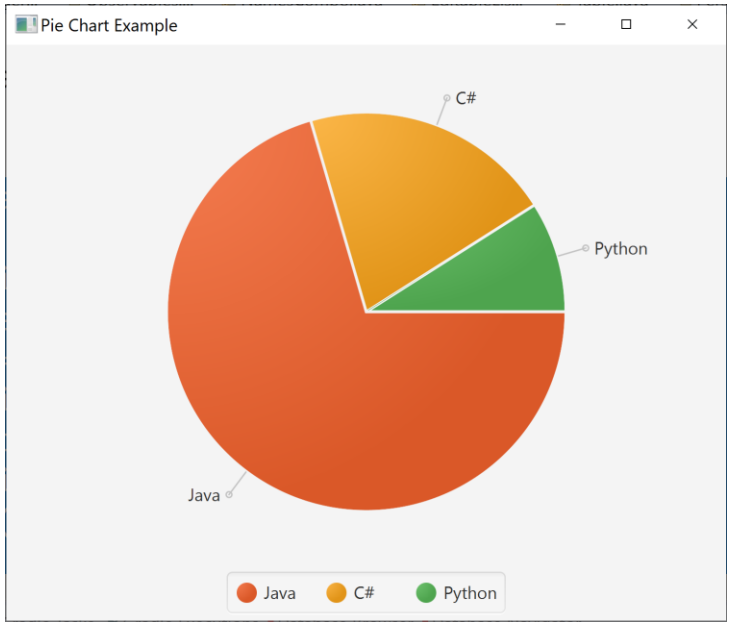
EXAMPLE

> _6.controls.qbookapp

- Binds a list of Book objects to a ListView
- When the user selects an item in the ListView, the corresponding Book's cover image is displayed in an ImageView.
  - **Property listener** is used to display the correct image when the user selects an item from the ListView



Pie Chart




```
@FXML private PieChart pieChart;

public void initialize() {
    pieChart.setData( Model.getChartData() );
}
```

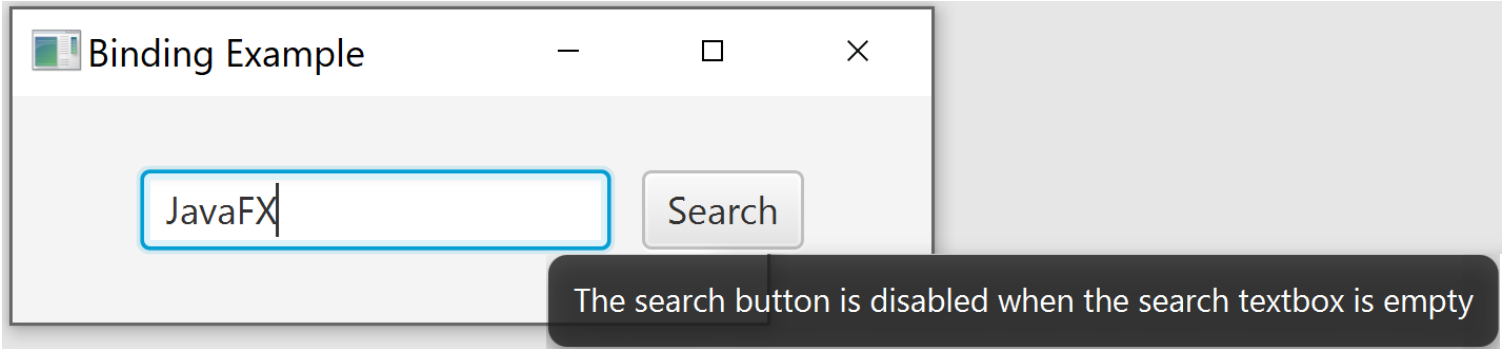
```
public class Model {
 public static ObservableList<Data> getChartData() {
    ObservableList<Data> data =
        FXCollections.observableArrayList();
    data.add(new Data("Java", 70.5));
    data.add(new Data("C#", 20.5));
    data.add(new Data("Python", 9));
    return data;
  }
}
```

Tool Tips

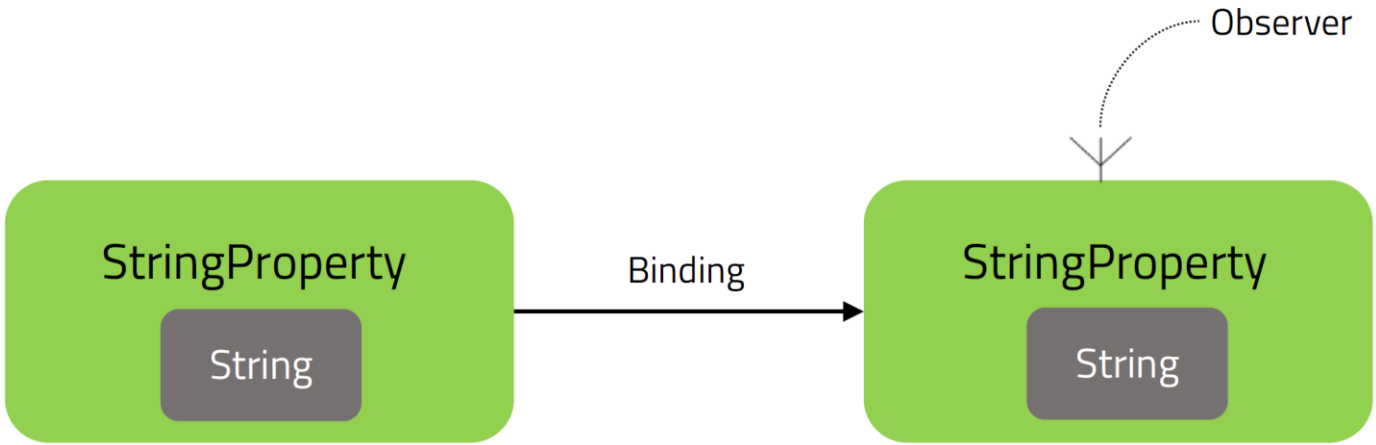
- A *tool tip* provides a short pop-up description when the mouse cursor rests momentarily on a component

- A tool tip is assigned using the `setTooltip` method of a JavaFX control

```
Tooltip tip = new Tooltip("The search button is
        disabled when the search textbox is empty");
searchButton.setTooltip(tip);
```



Properties and Bindings



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Excel is an excellent example …

Properties

- A JavaFX *property* is an object that holds a value
  - So, instead of holding an `int` value in integer primitive type, we store it in a **property** object of type `IntegerProperty`
- Most attributes of JavaFX classes are defined as properties, such as the `textProperty` of a `TextField`
  - `E.g., nameTextField.textProperty()`
  - a `ChangeListener` can be registered with an object's property to monitor its old and new values
- A property is ***observable:*** when a property's value changes, listing objects get notified and can respond accordingly
  - Properties fire **property change** events to registered listeners
- A key benefit of properties is ***property binding***

Converting Class Attributes to Properties

- Change the data type of attributes to property data type:
  - `String -> StringProperty`
  - `int -> IntegerProperty …`
- Change the constructor method to instantiate and initialize the class properties. E.g.,

```
this.code = new SimpleStringProperty(code);
```

- Change the getters and setters to get/set the property value. E.g.,

```
public String getCode() {
   return code.getValue();
}
```

```
public void setCode(String code) {
    this.code.setValue(code);
}
```

- Add public property getter methods consisting of the property name followed by the word "**Property**"

```
public StringProperty codeProperty() { return code; }
```

Property data type

- Wraps attribute value to make it **observable**
- Abstract Classes:

```
IntegerProperty      FloatProperty      DoubleProperty
BooleanProperty      LongProperty       StringProperty
ObjectProperty<T>    ...
```

- Wrapper Classes

```
SimpleIntegerProperty          SimpleFloatProperty
SimpleDoubleProperty           SimpleBooleanProperty
SimpleLongProperty             SimpleStringProperty
SimpleObjectProperty<T>        ...
```

Change Listeners

- Change listeners allow monitoring the old and new value of a property. Then update the UI accordingly.

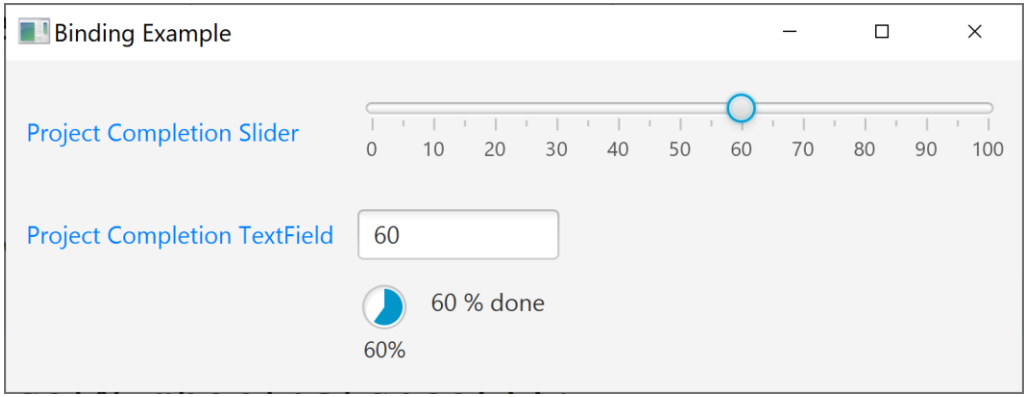
```
slider.valueProperty().addListener((observable, oldVal, newVal) -> {
   double progressValue = newVal.doubleValue();
   progressField.setText( String.valueOf(newVal.intValue()) );
   progressLabel.setText( String.format("%3.0f %% done", progressValue) );
   progressIndicator.setProgress(progressValue / 100);
});
```

Property Binding

- Property binding enables propagating changes
  - The target listens for changes in the source and updates itself when the source changes
  - 1-Way binding syntax: `target.bind(source);` e.g.,

```
label.textProperty().bind(slider.valueProperty().asString("%.0f"));
```

EXAMPLE > > _8.binding.aslider

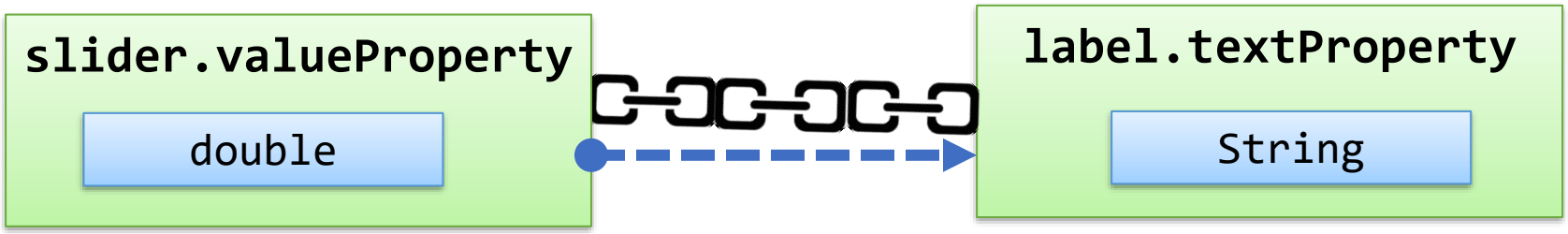


Property Binding

- Binding lets you **succinctly** express dependencies among object properties without registering change listeners
  - Observes changes of source (i.e., dependencies) and auto-update the target
  - When `slider.valueProperty` is **bound** to `label.textProperty` then changes to the slider value will be reflected in the label text
  - Property Binding is used to **synchronize** the UI components with each other
- Property binding is a better alternative to property change listeners
  - More concise
  - Keeps UI controls in sync with their model data

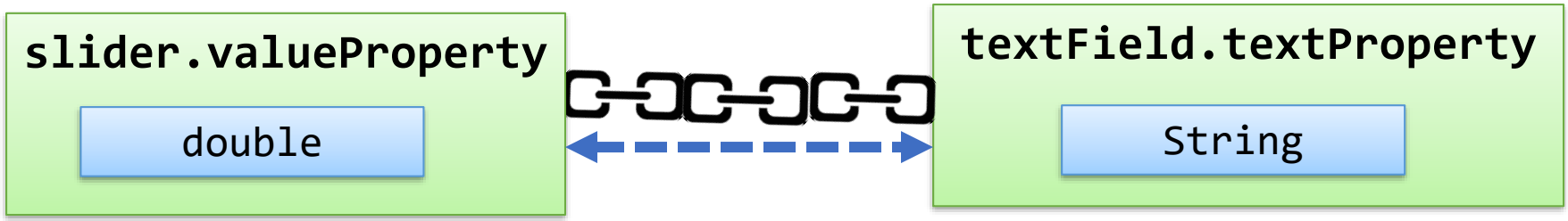
Unidirectional vs. Bidirectional Binding

- Unidirectional (1-Way) Binding



  - `label.textProperty().bind(slider.valueProperty().asString("%.0f"));`
  - Changes in the Slider value will be reflected in the Label text.

- Bidirectional (2-Way) Binding



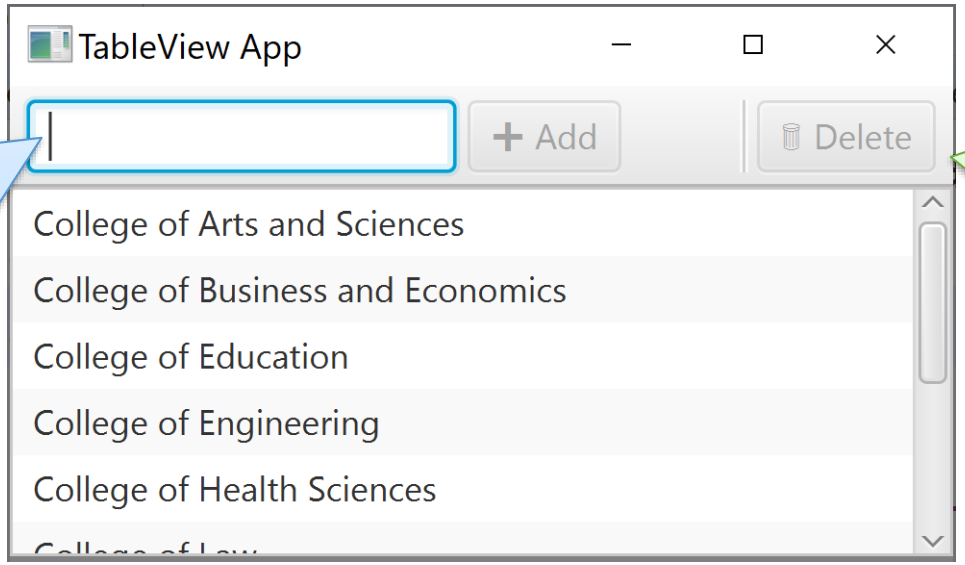
  - `textField.textProperty().bindBidirectional(slider.valueProperty().asString("%.0f"));`
  - Any changes of the `TextField` text or the Slider value will be synchronized

Property Binding Examples

```
//If no college selected then disable the delete button
deleteButton.disableProperty().bind( Bindings.isNull(
      collegesList.getSelectionModel().selectedItemProperty()) );
}
```

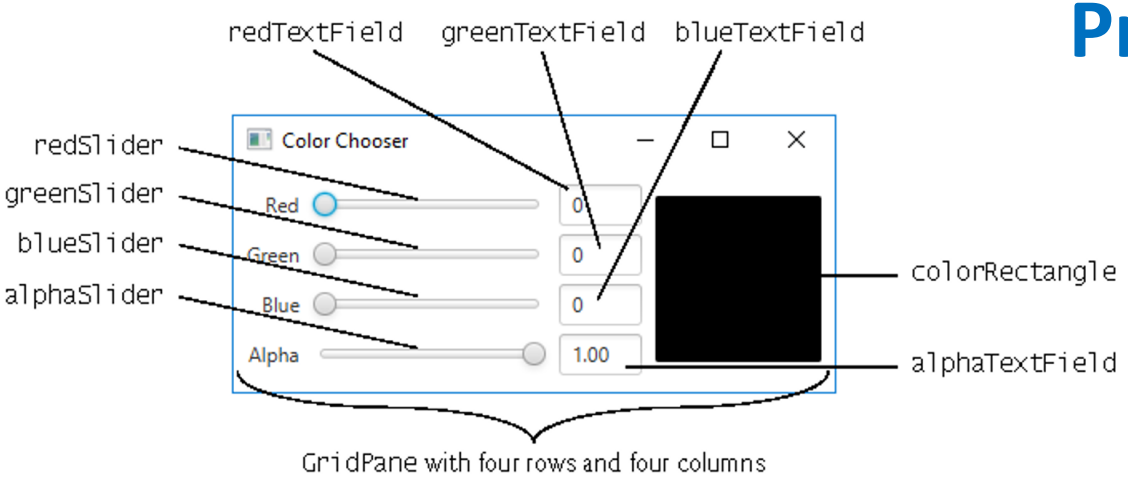
```
//If the collegeTextField is empty then disable the add button
addButton.disableProperty().bind( Bindings.isEmpty(
      collegeTextField.textProperty()) );
```

If the collegeTextField is empty then disable the add button



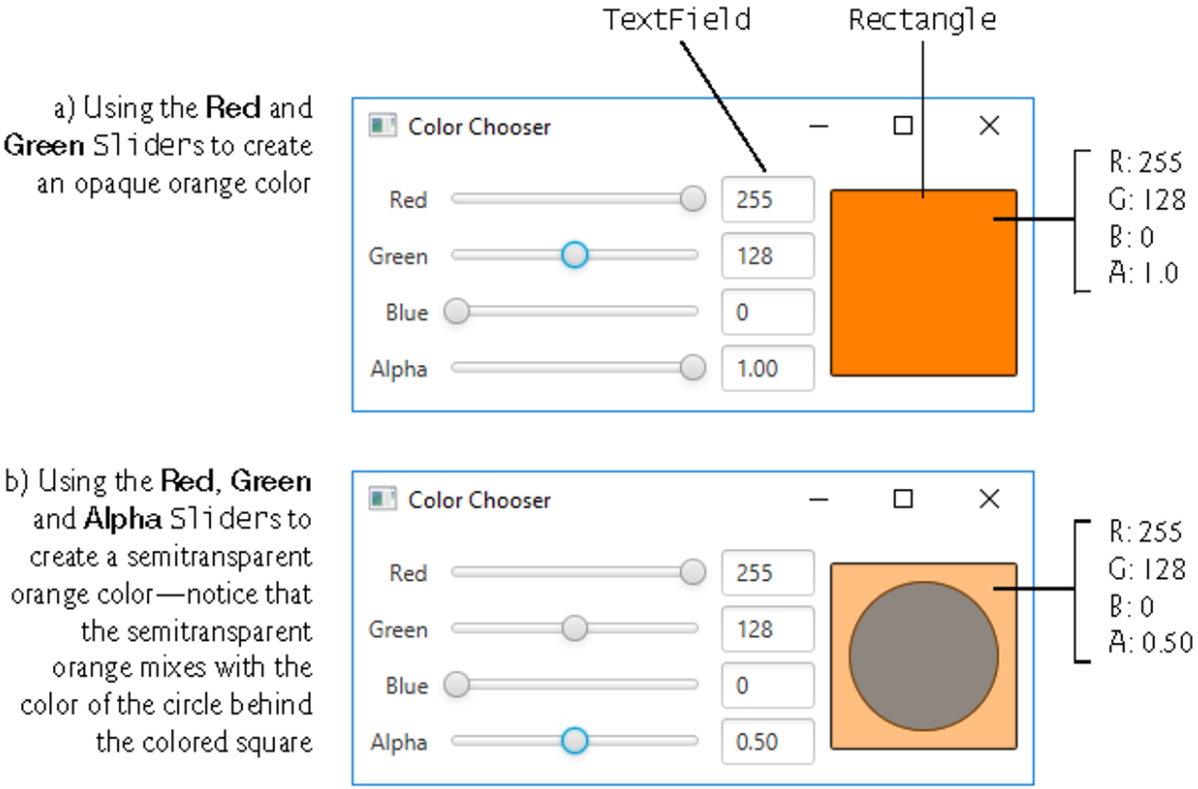
When no college is selected then the delete button should be disabled

Property-to-Property Bindings Example

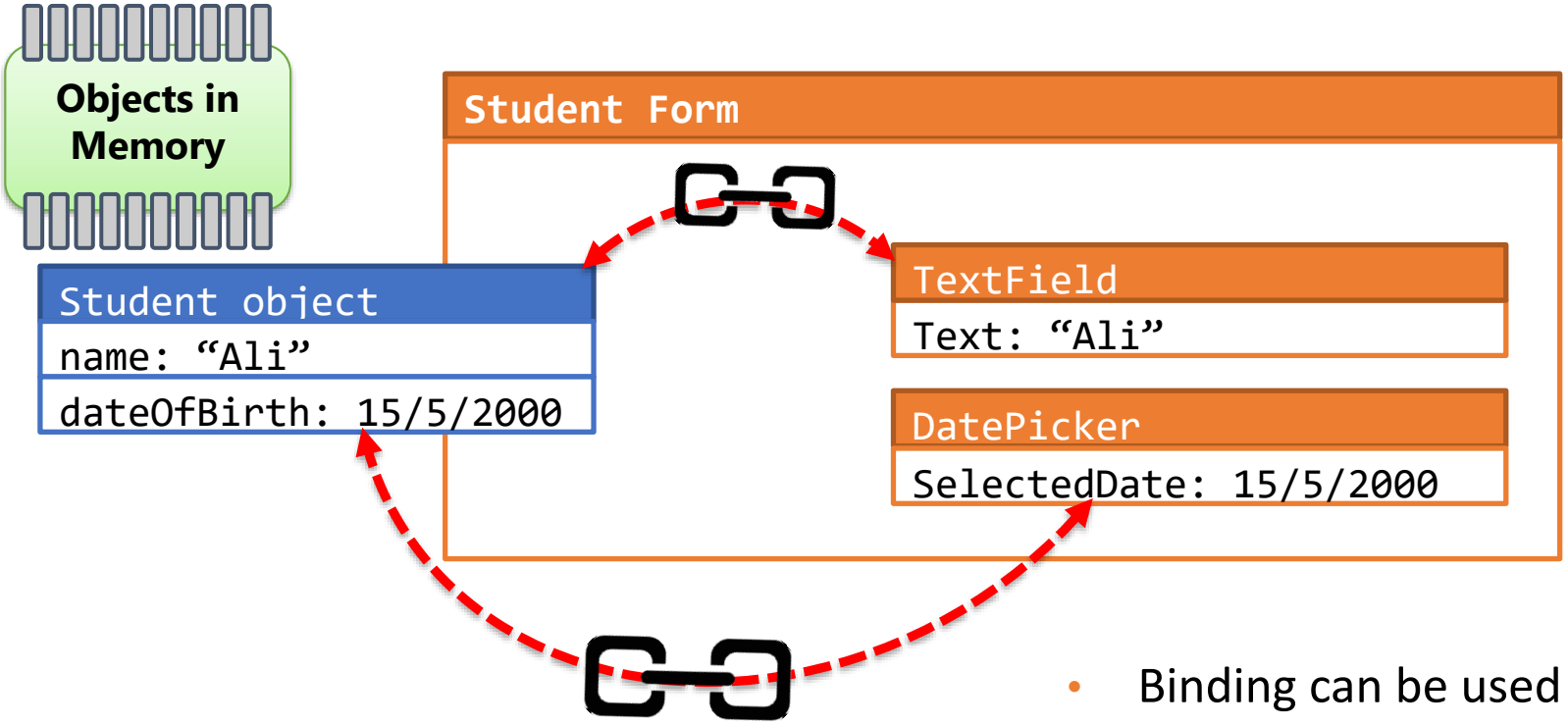


EXAMPLE

> > _8.binding.colorapp



Two-way binding to UI components

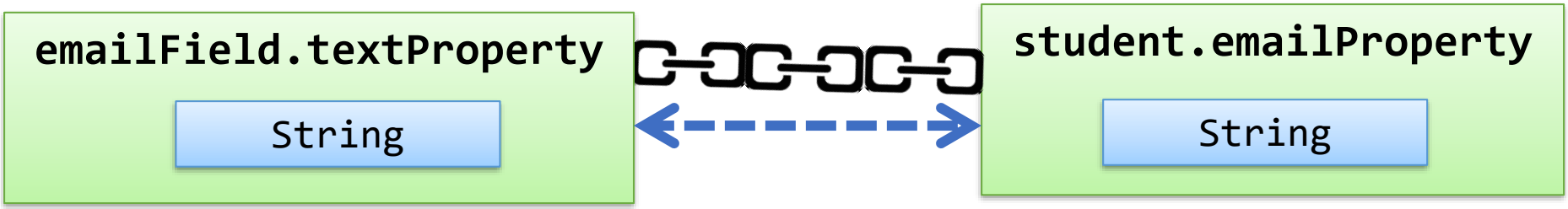


- Binding can be used to **synchronize** the UI components with the model
- Automatic propagation of data changes between the model and the view

bindBidirectional

- Bind TextBox **text** property and Model email property

```
emailField.textProperty().bindBidirectional(
student.emailProperty() )
```



- Behavior:
  - If TextBox **text** property updates, **email** property changes
  - If **email** property updates, TextBox **text** property changes

Binding UI components to Object Properties

> _8.binding.studentapp

```
public class Student {
    private final SimpleStringProperty firstName;
    private final SimpleStringProperty lastName;
    ...
    public SimpleStringProperty lastNameProperty()
       { return lastName; }
    public SimpleStringProperty emailProperty()
       { return email; }
    ...
}
//Bind the student properties to the UI controls
firstNameField.textProperty().bindBidirectional(
       student.firstNameProperty() );
lastNameField.textProperty().bindBidirectional(
       student.lastNameProperty());
....
```

Dialog Boxes

> _4.dialogs

> _8.binding.studentapp

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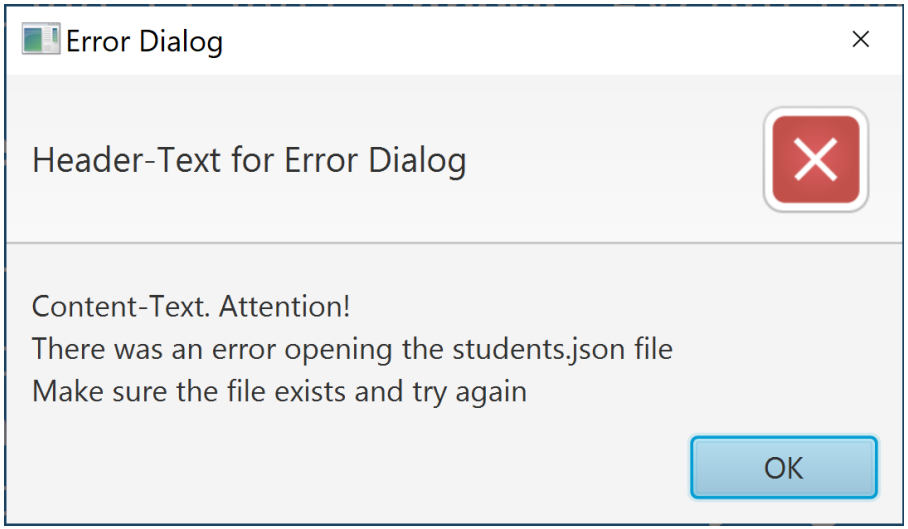
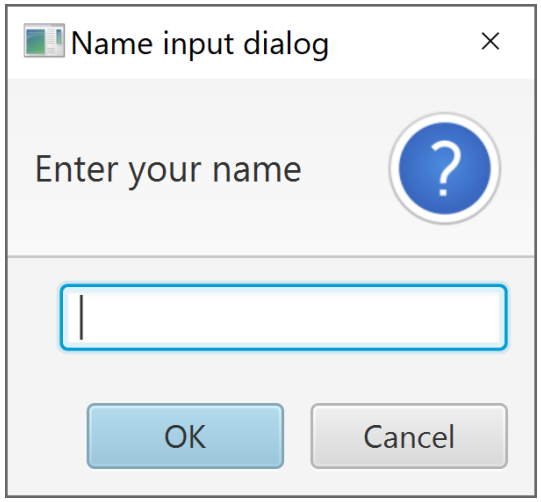
Info/Warn/Error Dialog

```
public void start(Stage stage) throws Exception
{
 Alert alert = new Alert(AlertType.ERROR);
 alert.setTitle("Error Dialog");
 alert.setHeaderText("Header-Text for Error Dialog");
 alert.setContentText("Content-Text. Attention!\n" +
  "There was an error opening the students.json   file\n" +
   "Make sure the file exists and try again");
 alert.showAndWait();
}
```



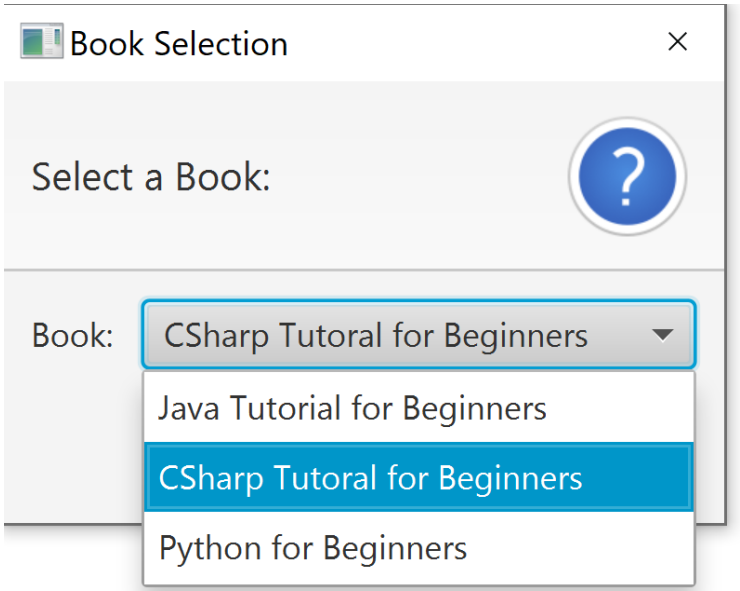
Input Dialog

```
public void start(Stage stage) throws Exception
{
 TextInputDialog dialog = new TextInputDialog();
 dialog.setTitle("Name input dialog");
 dialog.setHeaderText("Enter your name");
 Optional<String> result = dialog.showAndWait();
 result.ifPresent(name ->
      System.out.println("Your name: " + name));
}
```



Choice Dialog

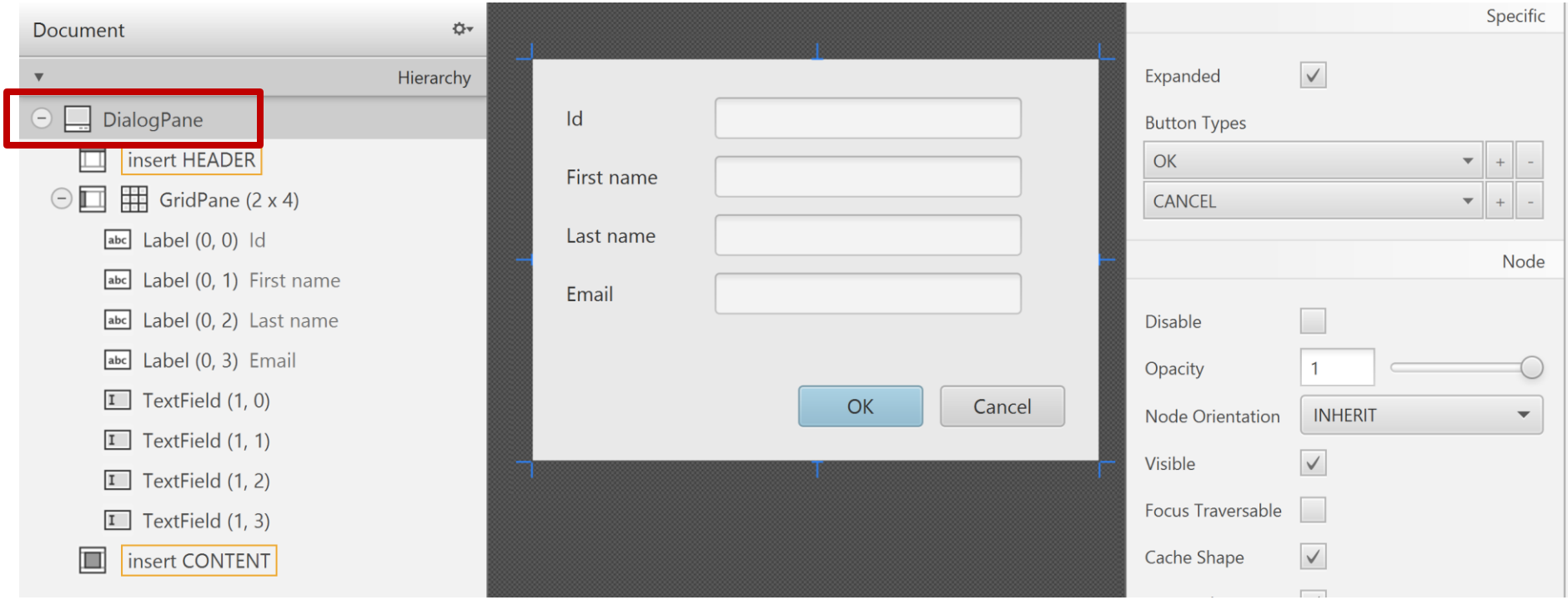
```
List<Book> books = List.of(java, csharp, python);
Book defaultBook = csharp;
ChoiceDialog<Book> dialog = new ChoiceDialog<Book>(defaultBook, books);
dialog.setTitle("Book Selection");
dialog.setHeaderText("Select a Book:");
dialog.setContentText("Book:");
Optional<Book> result = dialog.showAndWait();
result.ifPresent(book -> System.out.println(book.getName()) );
```



Create a Custom Dialog Box

- You can create a Custom Dialog Box by first creating a **DialogPane**

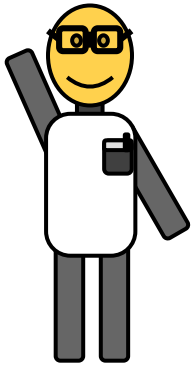
EXAMPLE > _8.binding.studentapp



Show the Custom Dialog Box

```
//Load the fxml file and create a new popup dialog.
FXMLLoader fxmlLoader = new FXMLLoader();

fxmlLoader.setLocation(getClass().getResource("StudentEditor.fxml"));
DialogPane studentDialogPane = fxmlLoader.load();

//Get the student controller associated with the view
StudentController studentController = fxmlLoader.getController();
//Pass the new student / student to the update the controller
associated with the studentDialogPane
studentController.setStudent(student);
Dialog<ButtonType> dialog = new Dialog<>();
dialog.setDialogPane(studentDialogPane);
dialog.setTitle("Add new student");

Optional<ButtonType> clickedButton = dialog.showAndWait();

if (clickedButton.get() == ButtonType.OK) {
    System.out.println("User selected ok");
} else {
    System.out.println("User selected cancel");
}
```

Summary



- JavaFX provides a set of UI components to ease building GUI applications.
- The key expected learning outcome is gaining a good understanding and hands on experience with:
  - UI components
  - Layout panes
  - Event handlers
  - Apply Model-view-controller (MVC) Pattern
  - ObservableList, Properties and Bindings

Resources

- JavaFX Tutorial

https://code.makery.ch/library/javafx-tutorial/

- Video Tutorials

https://www.youtube.com/playlist?list=PLoodc-fmtJNYbs-gYCdd5MYS4CKVbGHv2

- Scene Builder Guide

https://docs.oracle.com/javafx/scenebuilder/1/user_guide/jsbpub-user_guide.htm

https://www.youtube.com/playlist?list=PLpFneQZCNR2ktqseX11XRBc5Kyzdg2fbo

- A curated list of awesome JavaFX libraries, books, frameworks, etc...

https://github.com/mhrimaz/AwesomeJavaFX