Lecture 10

Graphics Part III – Building up to Cartoon

1

Outline

- Shapes
  - example: `MovingShape`
  - `App`, `PaneOrganizer`, and `MoveHandler` classes
- Constants
  - Clicker Question: Slide 44
- Composite Shapes
  - example: `Alien`
  - Clicker Question: Slide 56, Slide 64
- Cartoon

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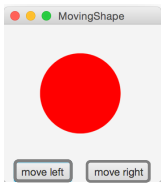
Example: `MovingShape`

- Specification: App that displays a shape and buttons that shift position of the shape left and right by a fixed increment
- Purpose: Practice working with absolute positioning of `Pane`s, various `Shape`s, and more event handling!



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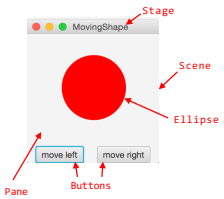
Process: MovingShapeApp

1. **Write a top-level `App` class that extends `javafx.application.Application` and implements `start` (standard pattern)**
2. Write a `PaneOrganizer` class that instantiates root node and makes a public `getRoot()` method. In `PaneOrganizer`, create an `Ellipse` and add it as child of root `Pane`
3. Write `setupShape()` and `setupButtons()` helper methods to be called within `PaneOrganizer`'s constructor. These will factor out the code for creating our custom `Pane`
4. Register `Button`s with `EventHandlers` that handle `Button`s' `ActionEvent`s (clicks) by moving `Shape` correspondingly



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MovingShapeApp: App Class (1/3)

NOTE: Exactly the same process as previous examples

1a. Instantiate a `PaneOrganizer` and store it in the local variable `organizer`

```
public class App extends Application {

    @Override
    public void start(Stage stage) {
        PaneOrganizer organizer = new PaneOrganizer();



    }
}
```


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MovingShapeApp: App Class (2/3)

NOTE: Exactly the same process as previous examples

1a. Instantiate a `PaneOrganizer` and store it in the local variable `organizer`

1b. Instantiate a `Scene`, passing in `organizer.getRoot()` and desired width and height of `Scene` (in this case 200x200)

```
public class App extends Application {

    @Override
    public void start(Stage stage) {
        PaneOrganizer organizer = new PaneOrganizer();
        Scene scene = new Scene(organizer.getRoot(), 200, 200);



    }
}
```


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MovingShapeApp: App Class (3/3)

NOTE: Exactly the same process as previous examples

1a. Instantiate a `PaneOrganizer` and store it in the local variable `organizer`

1b. Instantiate a `Scene`, passing in `organizer.getRoot()` and desired width and height of `Scene` (in this case 200x200)

1c. Set `scene`, set `Stage`'s title and show it!

```
public class App extends Application {

    @Override
    public void start(Stage stage) {
        PaneOrganizer organizer = new PaneOrganizer();
        Scene scene = new Scene(organizer.getRoot(), 200, 200);

        stage.setScene(scene);
        stage.setTitle("Moving Shape!");
        stage.show();
    }

}
```

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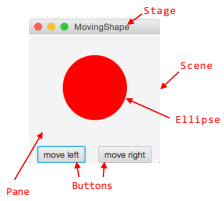
Process: MovingShapeApp

1. Write a top-level `App` class that extends `javafx.application.Application` and implements `start` (standard pattern)
2. **Write a `PaneOrganizer` class that instantiates root node and makes a public `getRoot()` method. In `PaneOrganizer`, create an `Ellipse` and add it as child of root `Pane`**
3. Write `setupShape()` and `setupButtons()` helper methods to be called within `PaneOrganizer`'s constructor. These will factor out the code for creating our custom `Pane`
4. Register `Button`s with `EventHandler`s that handle `Button`s' `ActionEvent`s (clicks) by moving `Shape` correspondingly



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MovingShapeApp: PaneOrganizer Class (1/4)

2a. Instantiate the root `Pane` and store it in the instance variable `_root`

```
public class PaneOrganizer {
    private Pane _root;

    public PaneOrganizer() {
        _root = new Pane();



    }


}
```

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MovingShapeApp: PaneOrganizer Class (2/4)

2a. Instantiate the root `Pane` and store it in the instance variable `_root`

2b. Create a public `getRoot()` method that returns `_root`

```
public class PaneOrganizer {
    private Pane _root;

    public PaneOrganizer() {
        _root = new Pane();



    }

    public Pane getRoot() {
        return _root;
    }
}
```


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MovingShapeApp: PaneOrganizer Class (3/4)

2a. Instantiate the root `Pane` and store it in the instance variable `_root`

2b. Create a public `getRoot()` method that returns `_root`

2c. Instantiate the `Ellipse` and add it as child of the root `Pane`

```
public class PaneOrganizer {
    private Pane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new Pane();
        _ellipse = new Ellipse(50, 50);
        _root.getChildren().add(_ellipse);



    }

    public Pane getRoot() {
        return _root;
    }
}
```


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MovingShapeApp: PaneOrganizer Class (4/4)

2a. Instantiate the root `Pane` and store it in the instance variable `_root`

2b. Create a public `getRoot()` method that returns `_root`

2c. Instantiate the `Ellipse` and add it as a child of the root `Pane`

2d. Call `setupShape()` and `setupButtons()`, defined next

```
public class PaneOrganizer {
    private Pane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new Pane();
        _ellipse = new Ellipse(50, 50);
        _root.getChildren().add(_ellipse);

        this.setupShape();
        this.setupButtons();
    }

    public Pane getRoot() {
        return _root;
    }
}
```


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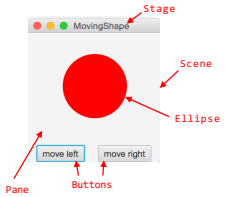
Process: MovingShapeApp

1. Write a top-level `App` class that extends `javafx.application.Application` and implements `start` (standard pattern)
2. Write a `PaneOrganizer` class that instantiates root node and makes a public `getRoot()` method. In `PaneOrganizer`, create an `Ellipse` and add it as child of root `Pane`
3. **Write `setupShape()` and `setupButtons()` helper methods to be called within `PaneOrganizer`'s constructor. These will factor out code for creating our custom `Pane`**
4. Register `Button`s with `EventHandler`s that handle `Button`s' `ActionEvent`s (clicks) by moving `Shape` correspondingly



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Aside: helper methods

- As our applications start getting more complex, we will need to write a lot more code to get the UI looking the way we would like
- Such code would convolute the `PaneOrganizer` constructor—it is good practice to **factor** out code into **helper methods** that are called within the constructor—another use of the delegation pattern
  - `setupShape()` fills and positions `Ellipse`
  - `setupButtons()` adds and positions `Button`s, and registers them with their appropriate `EventHandler`s
- Helper methods of the form `setupX()` are fancy initializing assignments. Should be used to initialize variables, but **not** for arbitrary/non-initializing code.
- Generally, helper methods should be `private` – more on this in a moment

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MovingShapeApp: setupShape() helper method

- For this application, "helper method" `setupShape()` will only set fill color and position `Ellipse` in `Pane` using absolute positioning
- Helper method is `private`—why is this good practice?
  - only `PaneOrganizer()` should be allowed to initialize the color and location of the `Ellipse`
  - `private` methods are not directly inherited and are not accessible to subclasses—though inherited superclass methods may make use of them w/o the subclass knowing about them!

```
public class PaneOrganizer {
    private Pane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new Pane();
        _ellipse = new Ellipse(50, 50);
        _root.getChildren().add(_ellipse);

        this.setupShape();
        this.setupButtons();
    }

    public Pane getRoot() {
        return _root;
    }

    private void setupShape() {
        _ellipse.setFill(Color.RED);
        _ellipse.setCenterX(50);
        _ellipse.setCenterY(50);
    }
}
```


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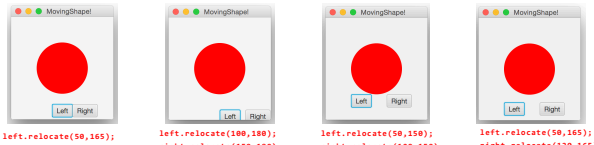
Aside: PaneOrganizer Class (1/3)

- We were able to absolutely position (position is fixed, cannot be changed) `_ellipse` in the root `Pane` because our root is simply a `Pane` and not one of the more specialized subclasses
- We could also use absolute positioning to position the `Button`s in the `Pane` in our `setUpButtons()` method… But look how annoying trial-and-error is!



Is there a better way? ...hint: leverage Scene Graph hierarchy and delegation!

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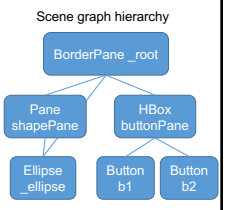
Aside: PaneOrganizer Class (2/3)

- Rather than absolutely positioning `Button`s directly in root `Pane`, use a specialized layout `Pane`: add a new `HBox` as a child of the root `Pane`
  - add `Button`s to `HBox`, to align horizontally
- Continuing to improve our design, use a `BorderPane` as root to use its layout manager
- Now need to add `Ellipse` to the root
  - could simply add `Ellipse` to CENTER of root `BorderPane`
  - but this won't work—if `BorderPane` dictates placement of `Ellipse` we won't be able to update its position with `Button`s
  - instead: create a `Pane` to contain `Ellipse` and add the `Pane` as child of root! Can adjust `Ellipse` within its `shapePane` independently!



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Aside: PaneOrganizer Class (3/3)

- This makes use of the built-in layout capabilities available to us in JavaFX!
- Also makes symmetry between the panel holding a shape (in Cartoon, this panel will hold composite shapes that you'll make) and the panel holding our buttons
- Note: this is only one of *many* design choices for this application!
  - keep in mind all of the different layout options when designing your programs!
  - using absolute positioning for entire program is most likely *not* best solution—where possible, leverage power of layout managers (`BorderPane`, `HBox`, `VBox`,…)

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MovingShapeApp: update to BorderPane

3a. Change root to a BorderPane, create a Pane to contain Ellipse

```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup shape pane
        Pane shapePane = new Pane();
        _ellipse = new Ellipse(50, 50);
        shapePane.getChildren().add(_ellipse);

        this.setupShape();
        this.setupButtons();
    }

    private void setupButtons() {
        // more code to come!
    }

}
```


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MovingShapeApp: update to BorderPane

3a. Change root to a BorderPane, create a Pane to contain Ellipse

3b. To add shapePane to center of BorderPane, call setCenter(shapePane) on root

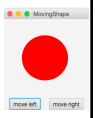
- note: none of the code in our setupShape() method needs to be updated since it accesses _ellipse directly… with this redesign, _ellipse now is just **graphically** contained within a different Pane (the shapePane) and now in the center of the root because we called setCenter(shapePane)
- **and** PaneOrganizer can still access the ellipse because it remains its instance variable!
  - this could be useful if we want to change any properties of the Ellipse later on, e.g., updating it's x and y position, or changing its color
  - illustration of graphical vs. logical containment

```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup shape pane
        Pane shapePane = new Pane();
        _ellipse = new Ellipse(50, 50);
        shapePane.getChildren().add(_ellipse);
        _root.setCenter(shapePane);
        this.setupShape();
        this.setupButtons();
    }

    private void setupButtons() {
        // more code to come!
    }
}
```



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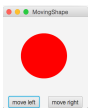
MovingShapeApp: setupButtons() method (1/5)

3c. Instantiate a new HBox, then add it as child of BorderPane, in bottom position

```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup of shape pane and shape elided!

        this.setupButtons();
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);



    }
}
```



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MovingShapeApp: setupButtons() method (2/5)

3c. Instantiate a new HBox, then add it as a child of BorderPane, in bottom position

3d. Instantiate two Buttons


```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup of shape pane and shape elided!

        this.setupButtons();
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("move left");
        Button b2 = new Button("move right");



    }
}
```


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MovingShapeApp: setupButtons() method (3/5)

3c. Instantiate a new HBox, then add it as a child of BorderPane, in bottom position

3d. Instantiate two Buttons

3e. Add the Buttons as children of the new HBox

- note: different from before—now adding Buttons as children of HBox
- some changes in the order are okay here, e.g., adding the buttons to the Hbox before adding it to the BorderPane
- order **does** matter when adding children to Panes. For this HBox, b1 will be to the left of b2 because it is added first in the list of arguments in addAll(…)


```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup of shape pane and shape elided!

        this.setupButtons();
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("move left");
        Button b2 = new Button("move right");
        buttonPane.getChildren().addAll(b1, b2);



    }
}
```


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MovingShapeApp: setupButtons() method (4/5)

3f. Set horizontal spacing between Buttons as you like


```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup of shape pane and shape elided!

        this.setupButtons();
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);

        buttonPane.setSpacing(30);



    }
}
```


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MovingShapeApp: setupButtons() method (5/5)

3f. Set horizontal spacing between Buttons as you like

3g. We will come back to the PaneOrganizer class in the next step in order to register Buttons with their EventHandlers, but first we should define the EventHandler

```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup of shape pane and shape elided!

        this.setupButtons();
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);

        buttonPane.setSpacing(30);

    }

}
```

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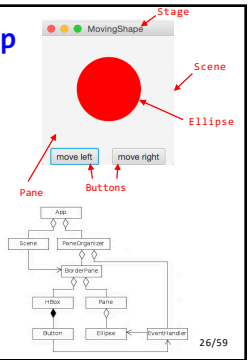
Process: MovingShapeApp

1. Write a top-level App class that extends javafx.application.Application and implements start (standard pattern)
2. Write a PaneOrganizer class that instantiates root node and makes a public getRoot() method. In PaneOrganizer, create an Ellipse and add it as child of root Pane
3. Write setupShape() and setupButtons() helper methods to be called within PaneOrganizer's constructor. These will factor out the code for creating our custom Pane
4. **Register Buttons with inner class EventHandlers that handle Buttons' ActionEvents (clicks) by moving Shape correspondingly**



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Aside: Creating EventHandlers

- Our goal is to register each button with an EventHandler
  - the "Move Left" Button moves the Ellipse left by a set amount
  - the "Move Right" Button moves the Ellipse right the same amount
- We could define two separate EventHandlers, one for the "Move Left" Button and one for the "Move Right" Button…
  - why might this not be the optimal design?
  - remember, we want to be efficient with our code usage!
- Instead, we can define one EventHandler
  - factor out common behavior into one class that will have two instances
  - specifics determined by parameters passed into the constructor!
  - admittedly, this is not an obvious design—these kinds of simplifications typically have to be learned…

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MovingShapeApp: MoveHandler (1/3)

4a. Declare an instance variable `_distance` that will be initialized differently depending on whether the `isLeft` argument is `true` or `false`

```
public class PaneOrganizer {
    // other code elided

    public PaneOrganizer() {
        // other code elided
    }

    private class MoveHandler implements EventHandler<ActionEvent> {
        private int _distance;

        public MoveHandler(boolean isLeft) {



        }

        public void handle(ActionEvent e) {

        }

    }

}
```

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MovingShapeApp: MoveHandler (2/3)

4a. Declare an instance variable `_distance` that will be initialized differently depending on whether the `isLeft` argument is `true` or `false`

4b. Set `_distance` to 10 initially—if the registered `Button isLeft`, change `_distance` to -10 so the `Ellipse` moves in the opposite direction

```
public class PaneOrganizer {
    // other code elided

    public PaneOrganizer() {
        // other code elided
    }

    private class MoveHandler implements EventHandler<ActionEvent> {
        private int _distance;

        public MoveHandler(boolean isLeft) {
            _distance = 10;
            if (isLeft) {
                _distance *= -1;//change sign
            }
        }

        public void handle(ActionEvent e) {

        }

    }

}
```

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MovingShapeApp: MoveHandler (3/3)

4a. Declare an instance variable `_distance` that will be initialized differently depending on whether the `isLeft` argument is `true` or `false`

4b. Set `_distance` to 10 initially – if the registered `Button isLeft`, change `_distance` to -10 so the `Ellipse` moves in the opposite direction

4c. Implement the handle method to move the `Ellipse` by `_distance` in the horizontal direction

```
public class PaneOrganizer {
    // other code elided

    public PaneOrganizer() {
        // other code elided
    }

    private class MoveHandler implements EventHandler<ActionEvent> {
        private int _distance;

        public MoveHandler(boolean isLeft) {//constructor
            _distance = 10;
            if (isLeft) {
                _distance *= -1;//change sign
            }
        }

        public void handle(ActionEvent e) {//called by JFX
            _ellipse.setCenterX(_ellipse.getCenterX()+_distance);
        }

    }

}
```

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MovingShapeApp: back to setupButtons()

Register Buttons with their EventHandlers by calling setOnAction() and passing in our instances of MoveHandler, which we just created!

```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();

        // setup of shape pane and shape elided!

        this.setupButtons();
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);

        buttonPane.setSpacing(30);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }
}
```

This is where we set isLeft

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The Whole App

```
package MovingShape;

// imports for the App class
import javafx.application.Application;
import javafx.scene.Scene;
import javafx.stage.Stage;

// imports for the PaneOrganizer class
import javafx.event.*;
import javafx.geometry.Pos;
import javafx.scene.control.Button;
import javafx.scene.layout.*;
import javafx.scene.paint.Color;
import javafx.scene.shape.Ellipse;

public class App extends Application {
    @Override
    public void start(Stage stage) {
        PaneOrganizer organizer = new PaneOrganizer();
        Scene scene = new Scene(organizer.getRoot(), 200, 130);
        stage.setScene(scene);
        stage.setTitle("MovingShape!");
        stage.show();
    }

    public static void main(String[] args) {
        launch(args);
    }
}
```


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Reminder: Constants Class

- In our MovingShapeApp, we've been using absolute numbers in various places
  - not very extensible! what if we wanted to quickly change the size of our Scene or Shape to improve compile time?
- Our Constants class will keep track of a few important numbers
- For our MovingShapeApp, make constants for width and height of the Ellipse and of the Pane it sits in, as well as the start location and distance moved

```
public class Constants {
    // units all in pixels
    public static final double X_RAD = 50;
    public static final double Y_RAD = 50;
    public static final double APP_WIDTH = 200;
    public static final double APP_HEIGHT = 130;
    public static final double BUTTON_SPACING = 30;
    /* X_OFFSET is the graphical offset from the edge
    of the screen to where we want the X value of the
    Ellipse */
    public static final double X_OFFSET = 100;
    public static final double Y_OFFSET = 50;
    public static final double DISTANCE_X = 10;
}
```


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Clicker Question

When should you define a value in a `Constants` class?

A. When you use the value in more than one place.

B. Whenever the value will not change throughout the course of the program.

C. When the value is nontrivial (i.e., not 0 or 1)

D. All of the above.

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The Whole App

no more literal numbers = much better design!

`Constants` class elided

200,80,10

```
public class App extends Application {
    @Override
    public void start(Stage stage) {
        PaneOrganizer organizer = new PaneOrganizer();
        Scene scene = new Scene(organizer.getRoot(),
            Constants.APP_WIDTH, Constants.APP_HEIGHT);
        stage.setScene(scene);
        stage.setTitle("MovingShape!");
        stage.show();
    }

    public static void main(String[] args) {
        launch(args);
    }
}
```

*Note: We use the syntax `Constants.x` to access "x" in the `Constants` class

```
public class PaneOrganizer {
    private BorderPane _root;
    private Ellipse _ellipse;

    public PaneOrganizer() {
        _root = new BorderPane();
        Pane shapePane = new Pane();
        _ellipse = new Ellipse(Constants.X_RAD, Constants.Y_RAD);
        shapePane.getChildren().add(_ellipse);
        _root.setCenter(shapePane);
        this.setupShape();
        this.setupButtons();
    }
    public Pane getRoot() {
        return _root;
    }
    private void setupShape() {
        _ellipse.setFill(Color.RED);
        _ellipse.setCenterX(Constants.X_OFFSET);
        _ellipse.setCenterY(Constants.Y_OFFSET);
    }
    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left!");
        Button b2 = new Button("Move Right!");
        buttonPane.getChildren().addAll(b1, b2);
        buttonPane.setSpacing(Constants.BUTTON_SPACING);
        buttonPane.setAlignment(Pos.CENTER);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }
    private class MoveHandler implements EventHandler<ActionEvent> {
        private int _distance;
        public MoveHandler(boolean isLeft) {
            _distance = Constants.DISTANCE_X;
            if (isLeft) {
                _distance *= -1;
            }
        }
        public void handle(ActionEvent event) {
            _ellipse.setCenterX(_ellipse.getCenterX() + _distance);
        }
    } // end of private MoveHandler class
```


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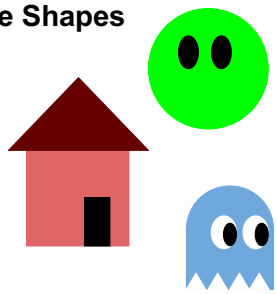
Creating Composite Shapes

- What if we want to display something more elaborate than a single, simple geometric primitive?
- We can make a **composite shape** by combining two or more shapes!



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Specifications: `MovingAlien`

- Transform `MovingShape` into `MovingAlien`
- An alien should be displayed on the central `Pane`, and should be moved back and forth by `Button`s

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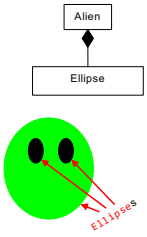
`MovingAlien`: Design

- Create a class, `Alien`, to model a composite shape
- Define composite shape's capabilities in `Alien` class
- Give `Alien` a `setLocation()` method that positions each component (face, left eye, right eye, all `Ellipse`s)
  - another example of **delegation pattern**



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Process: Turning `MovingShape` into `MovingAlien`

1. **Create `Alien` class to model composite shape, and add each component of `Alien` to `alienPane`'s list of children**
2. Be sure to explicitly define any methods that we need to call on `Alien` from within `PaneOrganizer`, such as *location setter/getter methods*!
3. Modify `PaneOrganizer` to contain an `Alien` instead of an `Ellipse`

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Alien Class

- The Alien class is our composite shape
- It contains three Ellipses—one for the face and one for each eye
- Constructor instantiates these Ellipses, sets their initial sizes/colors, and adds them as children of the alienPane—which was passed in as a parameter
- Although Alien class deals with each component of the composite shape individually, every component should reside on the same pane as all other components
  - thus, must pass pane as a parameter to allow Alien class to define methods for manipulating composite shape in pane

```
public class Alien {
    private Ellipse _face;
    private Ellipse _leftEye;
    private Ellipse _rightEye;

    public Alien(Pane _alienPane) {//Alien lives in passed Pane
        _face = new Ellipse(Constants.X_RAD, Constants.Y_RAD);
        _face.setFill(Color.CHARTREUSE);

       /*EYE_X and EYE_Y are constants referring to the width and
        height of the eyes, the eyes' location/center is changed later
        in the program.*/

        _leftEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _leftEye.setFill(Color.BLACK);
        _rightEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _rightEye.setFill(Color.BLACK);

        alienPane.getChildren().addAll(_face, _leftEye, _rightEye);
    }
}
```

Note: Order matters when you add children to a Pane! The arguments are added in that order graphically and if there is overlap, the shape later in the parameter list will lie wholly or partially on top of the earlier one. For this example, _face is added first, then _leftEye and _rightEye on top. The inverse order would be wrong!

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Process: Turning MovingShape into MovingAlien

1. Create Alien class to model composite shape, and add each component of Alien to alienPane's list of children
2. **Be sure to explicitly define any methods that we need to call on Alien from within PaneOrganizer, such as *location setter/getter methods*!**
3. Modify PaneOrganizer to contain an Alien instead of an Ellipse

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Alien Class

- In MovingShapeApp, the following call is made from within our MoveHandler's handle method in order to move the Ellipse:

```
_ellipse.setCenterX(_ellipse.getCenterX() + _distance);
```

- Because we called JavaFX's getCenterX() and setCenterX(…) on our shape from within the PaneOrganizer class, we must now define our own equivalent methods such as setLocX(…) and getLocX() to set the Alien's location in the Alien class!
- This allows our Alien class to function like an Ellipse in our program!
- Note: most of the time when you are creating complex shapes, you will want to define a more extensive setLocation(double x, double y) method rather than having a separate method for the X or Y location

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MovingAlien: Alien Class (1/3)

2a. Define `Alien`'s `setXLoc(…)` by setting center X of face, left and right eyes (same for `setYLoc`);
note use of additional constants
- **note: relative positions between the `Ellipse`s remains the same**

```
public class Alien {
    private Ellipse _face;
    private Ellipse _leftEye;
    private Ellipse _rightEye;

    public Alien(Pane alienPane) {
        _face = new Ellipse(Constants.X_RAD, Constants.Y_RAD);
        _face.setFill(Color.CHARTREUSE);
        _leftEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _leftEye.setFill(Color.BLACK);
        _rightEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _rightEye.setFill(Color.BLACK);

        alienPane.getChildren().addAll(_face, _leftEye, _rightEye);

    }

    public void setXLoc(double x) {
        _face.setCenterX(x);
        _leftEye.setCenterX(x - Constants.EYE_OFFSET);
        _rightEye.setCenterX(x + Constants.EYE_OFFSET);
    }


}
```


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MovingAlien: Alien Class (2/3)

2a. Define `Alien`'s `setXLoc(…)` by setting center X of face, left and right eyes (same for `setYLoc`);
- note: relative positions between the `Ellipse`s remains the same

2b. Define `getXLoc()` method: the horizontal center of the `Alien` will always be center of `_face Ellipse`

```
public class Alien {
    private Ellipse _face;
    private Ellipse _leftEye;
    private Ellipse _rightEye;

    public Alien(Pane alienPane) {
        _face = new Ellipse(Constants.X_RAD, Constants.Y_RAD);
        _face.setFill(Color.CHARTREUSE);
        _leftEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _leftEye.setFill(Color.BLACK);
        _rightEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _rightEye.setFill(Color.BLACK);

        alienPane.getChildren().addAll(_face, _leftEye, _rightEye);

    }

    public void setXLoc(double x) {
        _face.setCenterX(x);
        _leftEye.setCenterX(x - Constants.EYE_OFFSET);
        _rightEye.setCenterX(x + Constants.EYE_OFFSET);
    }

    public double getXLoc() {
        return _face.getCenterX();
    }
}
```


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MovingAlien: Alien Class (3/3)

2a. Define `Alien`'s `setXLoc(…)` by setting center X of face, left and right eyes (same for `setYLoc`);
- note: relative positions between the `Ellipse`s remains the same

2b. Define `getXLoc()` method: the horizontal center of the `Alien` will always be center of `_face Ellipse`

2c. Set starting X location of `Alien` in constructor!

```
public class Alien {
    private Ellipse _face;
    private Ellipse _leftEye;
    private Ellipse _rightEye;

    public Alien(Pane alienPane) {
        _face = new Ellipse(Constants.X_RAD, Constants.Y_RAD);
        _face.setFill(Color.CHARTREUSE);
        _leftEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _leftEye.setFill(Color.BLACK);
        _rightEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _rightEye.setFill(Color.BLACK);

        alienPane.getChildren().addAll(_face, _leftEye, _rightEye);
        this.setXLoc(Constants.START_X_OFFSET);
    }

    public void setXLoc(double x) {
        _face.setCenterX(x);
        _leftEye.setCenterX(x - Constants.EYE_OFFSET);
        _rightEye.setCenterX(x + Constants.EYE_OFFSET);
    }

    public double getXLoc() {
        return _face.getCenterX();
    }
}
```


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Clicker Question

Which `House` constructor makes the correct composite shape, given the rest of the program is set up correctly?

A.

```
public House (Pane housePane) {
    _foundation = new Rectangle(Constants.X, Constants.Y);
    _window = new Rectangle(Constants.WIND_X, Constants.WIND_Y);
    _door = new Rectangle(Constants.DOOR_X, Constants.DOOR_Y);
    //code to fill _foundation, _window, _door elided
    housePane.getChildren().addAll(_foundation, _window, _door);
    this.setXLoc(Constants.INITIAL_X_OFFSET);
}
```

B.

```
public House () {
    _foundation = new Rectangle(Constants.X, Constants.Y);
    _window = new Rectangle(Constants.WIND_X, Constants.WIND_Y);
    _door = new Rectangle(Constants.DOOR_X, Constants.DOOR_Y);
    //code to fill _foundation, _window, _door elided
    new Pane().getChildren().addAll(_foundation, _window, _door);
    new Pane().setX(Constants.INITIAL_X_OFFSET);
}
```

C.

```
public House (Pane housePane) {
    _foundation = new Rectangle();
    _window = new Rectangle();
    _door = new Rectangle();
    //code to fill _foundation, _window, _door elided
    housePane.getChildren().addAll(_foundation, _window, _door);
    this.setXLoc(Constants.INITIAL_X_OFFSET);
}
```

D.

```
public House (Pane housePane) {
    _foundation = new Rectangle(Constants.X, Constants.Y);
    _window = new Rectangle(Constants.WIND_X, Constants.WIND_Y);
    _door = new Rectangle(Constants.DOOR_X, Constants.DOOR_Y);
    //code to fill _foundation, _window, _door elided
    this.setXLoc(Constants.INITIAL_X_OFFSET);
}
```

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Process: Turning `MovingShape` into `MovingAlien`

1. Create `Alien` class to model composite shape, and add each component of `Alien` to `alienPane`'s list of children
2. Be sure to explicitly define any methods that we need to call on `Alien` from within `PaneOrganizer`, such as *location setter/getter methods*!
3. **Modify `PaneOrganizer` to contain an `Alien` instead of an `Ellipse`**

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`MovingAlien`: `PaneOrganizer` Class (1/4)

- Only have to make a few changes to `PaneOrganizer`!
- Instead of knowing about an `Ellipse` called `_ellipse`, knows about an `Alien` called `_alien`
- Change the `shapePane` to be an `alienPane` (we could have called it anything!)

```
public class PaneOrganizer {
    private BorderPane _root;
    private Alien _alien;

    public PaneOrganizer() {
        _root = new BorderPane();
        Pane alienPane = new Pane();
        _alien = new Alien(alienPane);
        _root.setCenter(alienPane);
        this.setupShape();
        this.setupButtons();
    }

    public Pane getRoot() {
        return _root;
    }

    private void setupShape() {
        _ellipse.setFill(Color.RED);
        _ellipse.setCenterX(Constants.X_OFFSET);
        _ellipse.setCenterY(Constants.Y_OFFSET);
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);
        buttonPane.setSpacing(30);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }

/* private class MoveHandler elided */
```

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MovingAlien: PaneOrganizer Class (2/4)

- `setupShape()` method is no longer needed, as we now setup the `Alien` within the `Alien` class

```
public class PaneOrganizer {
    private BorderPane _root;
    private Alien _alien;

    public PaneOrganizer() {
        _root = new BorderPane();
        Pane alienPane = new Pane();
        _alien = new Alien(alienPane);
        _root.setCenter(alienPane);
        this.setupShape();
        this.setupButtons();
    }

    public Pane getRoot() {
        return _root;
    }

    private void setupShape() {
        _ellipse.setFill(Color.RED);
        _ellipse.setCenterX(Constants.X_OFFSET);
        _ellipse.setCenterY(Constants.Y_OFFSET);
    }

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);
        buttonPane.setSpacing(30);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }

    /* private class MoveHandler elided */
```


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MovingAlien: PaneOrganizer Class (3/4)

- `setupShape()` method is no longer needed, as we now setup the `Alien` within the `Alien` class
  - remember that we set a default location for the `Alien` in its constructor:

```
this.setXLoc(Constants.START_X_OFFSET);
```

```
public class PaneOrganizer {
    private BorderPane _root;
    private Alien _alien;

    public PaneOrganizer() {
        _root = new BorderPane();
        Pane alienPane = new Pane();
        _alien = new Alien(alienPane);
        _root.setCenter(alienPane);
        //this.setupShape();
        this.setupButtons();
    }

    public Pane getRoot() {
        return _root;
    }

    //private void setupShape() {
    //    _ellipse.setFill(Color.RED);
    //    _ellipse.setCenterX(Constants.X_OFFSET);
    //    _ellipse.setCenterY(Constants.Y_OFFSET);
    //}

    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);
        buttonPane.setSpacing(30);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }
    /* private class MoveHandler elided */
}
```


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MovingAlien: PaneOrganizer Class (4/4)

- Last modification we have to make is from within the `MoveHandler` class, where we will swap in `_alien` for `_ellipse` references
- We implemented `setXLoc(…)` and `getXLoc()` methods in `Alien` so `MoveHandler` can call them

```
public class PaneOrganizer {
    private BorderPane _root;
    private Alien _alien;
    public PaneOrganizer() {
        _root = new BorderPane();
        Pane alienPane = new Pane();
        _alien = new Alien(alienPane);
        _root.setCenter(alienPane);
        this.setupButtons();
    }
    public Pane getRoot() {
        return _root;
    }
    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);
        buttonPane.setSpacing(30);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }
    private class MoveHandler implements EventHandler<ActionEvent> {
        private int _distance;
        public MoveHandler(boolean isLeft) {
            _distance = Constants.DISTANCE_X;
            if (isLeft) {
                _distance *= -1;
            }
        }
        public void handle(ActionEvent event) {
            _alien.setXLoc(_alien.getXLoc() + _distance);
        }
    }
```


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The Whole App

```
public class App extends Application {
    @Override
    public void start(Stage stage) {
        PaneOrganizer organizer = new PaneOrganizer();
        Scene scene = new Scene(organizer.getRoot(),
            Constants.APP_WIDTH, Constants.APP_HEIGHT);
        stage.setScene(scene);
        stage.setTitle("MovingAlien!");
        stage.show();
    }

    public static void main(String[] args) {
        launch(args);
    }
}
```

```
public class Alien {
    private Ellipse _face;
    private Ellipse _leftEye;
    private Ellipse _rightEye;
    public Alien(Pane root) {
        _face = new Ellipse(Constants.X_RAD, Constants.Y_RAD);
        _face.setFill(Color.CHARTREUSE);
        _leftEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        _rightEye = new Ellipse(Constants.EYE_X, Constants.EYE_Y);
        this.setXLoc(Constants.START_X_OFFSET);
        root.getChildren().addAll(_face, _leftEye, _rightEye);
    }
    public void setXLoc(double x) {
        _face.setCenterX(x);
        _leftEye.setCenterX(x - Constants.EYE_OFFSET);
        _rightEye.setCenterX(x + Constants.EYE_OFFSET);
    }
    public double getXLoc() {
        return _face.getCenterX();
    }
}
```

```
public class PaneOrganizer {
    private BorderPane _root;
    private Alien _alien;
    public PaneOrganizer() {
        _root = new BorderPane();
        Pane alienPane = new Pane();
        _alien = new Alien(alienPane);
        _root.setCenter(alienPane);
        this.setupButtons();
    }
    public Pane getRoot() {
        return _root;
    }
    private void setupButtons() {
        HBox buttonPane = new HBox();
        _root.setBottom(buttonPane);
        Button b1 = new Button("Move Left");
        Button b2 = new Button("Move Right");
        buttonPane.getChildren().addAll(b1, b2);
        buttonPane.setSpacing(30);
        b1.setOnAction(new MoveHandler(true));
        b2.setOnAction(new MoveHandler(false));
    }
    private class MoveHandler implements EventHandler<ActionEvent> {
        private int _distance;
        public MoveHandler(boolean isLeft) {
            _distance = Constants.DISTANCE_X;
            if (isLeft) {
                _distance *= -1;
            }
        }
        public void handle(ActionEvent event) {
            _alien.setXLoc(_alien.getXLoc() + _distance);
        }
    }
}
```

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Additional Classes

- Notice how we created another class for our Alien composite shape instead of simply adding each individual shape to `PaneOrganizer`
- As your programs get more complex (e.g., two shapes interacting with one another, shapes changing color, etc.), you may want to create even more additional classes that perform the desired functions instead of doing everything in `PaneOrganizer`
  - for example, if we are trying to create a Tic Tac Toe app, all of the game logic should go into a separate class; `PaneOrganizer` would only be responsible for placing `Pane`s and other elements on the screen
  - this will make `PaneOrganizer` less cluttered and your program as a whole much easier to read
  - keep this in mind for your upcoming assignments!!!

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Clicker Question

What is the best practice for setting up graphical scenes (according to CS15)?

A. Absolutely position everything using trial and error, and use as few panes as possible.

B. Have any shape be contained in its own pane, and only make classes for composite shapes of more than 5 shapes.

C. Use a top-level class, make classes for more complicated shapes, and store composite shapes, or just generally related objects, within panes.

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Your Next Project: Cartoon! (1/2)

- You'll be building a JavaFX application that displays your own custom "cartoon", much like the examples in this lecture
- But your cartoon will be animated!

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Your Next Project: Cartoon! (2/2)

- How can we animate our cartoon (e.g. make the cartoon move across the screen)?
- As in film and video animation, can create *apparent motion* with many small changes in position
- If we move fast enough and in small enough increments, we get smooth motion!
- Same goes for smoothly changing size, orientation, shape, etc.

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Animation in Cartoon

- Use a `TimeLine` to create incremental change
- It'll be up to you to figure out the details… but for each repetition of the `KeyFrame`, your cartoon should move (or change in other ways) a small amount!
  - reminder: if we move fast enough and in small enough increments, we get smooth motion!

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Announcements

- Cartoon has been released!
  - Early Handin: Tuesday, 10/16 at 11:59pm
  - On-Time Handin: Thursday, 10/18 at 11:59pm
  - Late Handin: Saturday, 10/20 at 11:59pm
- Section has 2 parts this week: Cartoon check-in and lab
  - Meet at normal section time at the Sunlab to get practice with JavaFX
  - Section TAs will send out signups for you to go over your design for Cartoon, and get to connect with your section TAs