Comp 401 - Assignment 5: Object and Shape Composition

Early Submission Date: Wed Sep 27, 2017 (+5%)

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In this assignment, you will incrementally create an initial bridge scene. You will define some image shapes and then compose them with a line shape (which you can use from the extra credit part of the last assignment or praxis/lecture/recitation exercises) to create avatars, which will be composed into the initial bridge scene. Most of your time will go into the creation of the avatar (and avoiding magic numbers!).

If you have not done so, you may want to also look at my demos for what an avatar could look like and where we are going:

Bridge Scene - 1st day (long)

Bridge Scene - 2nd day (short)

Images of Avatars	images.zip

User Interfaces	PowerPoint PDF YouTube	Docx PDF Drive		Commands and Graphics Checks File	lectures.ui Package Git (UI) lectures.graphics Package Git (Graphics)
Composite Objects	PowerPoint PDF YouTube	Docx PDF Drive		Composites Checks File	lectures.composite.object_shapes.Package Git (Composite)

	Mix				
Composite: Tree, DAGS & Graphs of Objects and Windows	PowerPoint PDF YouTube Mix	Docx PDF Drive			lectures.composite.tree_dag_graph_objects_windowsPackage Git (Trees, DAGS, Graphs, Windows)

Packages

Divide the classes you have into at least three packages making sure that only main classes (recall that a main class is one that has a main method) are in the main package. How exactly you do the division is up to you, but the classes in the same package should share one or more properties not shared with classes in other packages. This constraint should be met in this and future assignments. Any import that does not start with mp (For Monty Python) or grail (for Holy Grail) will be classified as a foreign import and will be considered illegal unless explicitly allowed. So make sure your non-main packages are children of mp or grail. You do not and should not choose both prefixes, grail and mp. If you choose one of them, say grail, you are free to choose the names of sub-packages such as grail., grail.B, ..., where A, B, ... are your names. In addition to main, you should have at least two more packages.

Line, Image and String Class(es)

Create one or more classes that can be instantiated to create objects that ObjectEditor displays in the graphics window as:

1. (an image shape representing) the head of Arthur
2. the head of Lancelot
3. the head of Robin
4. the head of Galahad
5. the head of the guard.
6. a string shape with both a getter and setter method
7. a (possibly rotating) line

The recitation and lecture code gives examples of creating objects understood by ObjectEditor – best to start by copying the code.

I have found that the easiest (for me) way to create an image file on a Windows machine is to display the image on your screen, use the Snipping Tool to copy a portion of it, paste the copied part to a PPT slide, use PPT to adjust the size of the image, and finally, use the Save As Picture right menu PPT command to save the image to a file. We are also providing you with files I used for the images (images.zip).

If you will use short file names (without "/") the image files should be in the project folder, the one containing bin and src.

Each of these shape classes should allow its properties to be edited. Thus, it should have setters for each of properties. Remember that because we require public methods to be in some implemented interface, you will need to create appropriate interfaces.

Make sure these classes are annotated with the appropriate structure pattern annotations (LINE_PATTERN, STRING_PATTERN, IMAGE_PATTERN) and put these annotations also in the interfaces. All classes other than atomic shapes should use the BEAN_PATTERN annotation along with the associated PropertyNames and EditablePropertyNames annotations.

Before you proceed further, make sure that each of these shapes display correctly using ObjectEditor. Write main methods to do so, which you can delete later.

Even though the various shapes can take locations to be Point objects, you are required to define X and Y properties for locations.

Angle/V Shape Class and Interface (Tag: "Angle")

Implement a composite shape class that can be instantiated to create an object that ObjectEditor displays as an "angle shape" or a "V shape". Tag this class and its interface as "Angle".

This shape consists of two (possibly rotating/moving) readonly line properties, named *LeftLine* and *RightLine*, whose upper left corner is always at the same location, which is also considered the conceptual location of the angle. (You do not have to make this location an explicit variable or a property – this value can be derived from the properties of the two lines). In addition to the getter methods for the two lines in the angle, define a method to move the location of the shape by an int x and y offset, which should be given in that order as arguments to the method. These offsets indicate by what amount (positive/negative) the object moves in the X and Y direction, respectively. Tag this method as *"move"*. (Remember that you can tag methods the same way you do classes).

The Angle class should define a constructor that takes no arguments. It can define other constructors, which can take the lines as arguments. The constructor with no arguments should create two lines joined at a point. Test this class by writing a main method that

creates an instance of this class and displays the instance using ObjectEditor. This is only for debugging purposes – you can delete this method later.

This is a composite shape and is not to be confused with the angle property from the previous extra credit. This shape will ultimately represent the arms and legs of an avatar. If you created a rotating line in the previous assignment, then you can rotate each arm and leg. The shape does not require a rotate method - instead you can rotate a line by getting it from the angle shape and rotating it, as in:

angle.getLeftLine().rotate(5)

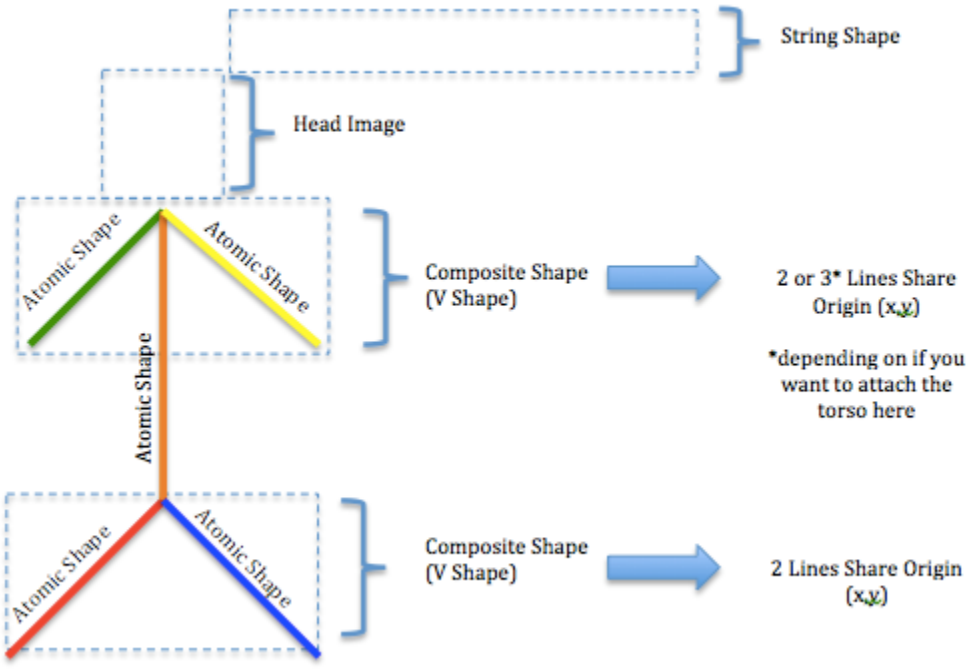
Of course, the discussion about rotating the lines is only for the ones who did the extra credit in the last assignment.

Avatar Class and Interface (Tag: "Avatar")

Create an avatar (by defining appropriate classes and interfaces) composed of *the following* shape properties recognized by ObjectEditor whose names are given before each colon.

1. StringShape (Readonly) One of them is a String shape representing the utterance "spoken" by the avatar.
2. Head (Readonly): Another is an image shape representing its head.
3. Arms and Legs (Readonly): The two of them are angle objects, which represent the arms and legs of the avatar.
4. Other body parts (Readonly): Finally, you should have *one or more* additional shapes representing the other body parts of the shape. You are free to choose the names of these properties and the type – the only constraint is that the logical structure of each of these properties contain at least one object recognized by ObjectEditor as a shape.

These components should connect at the avatar joints. Here is a great graphic from Sean Jarecki (from a previous class) that gives one way to do the avatar.



In my implementation (which is in the video) I also had a neck, which of course is optional

The class of the complete avatar should define a constructors that takes as an argument the head shape. You are free to define other constructors. You are free to customize the avatar in other ways such as allowing its color to be specified by the user of the class.

The avatar should define a method to move it. Like the angle, the method takes two int parameters, giving the (positive or negative) distance (in pixels) to be moved in the X and Y directions respectively, declared in this order. Again, tag this method as *"move";*

When an avatar moves, the relative distances between its components remain fixed. Thus, each component should move by the same amount. To implement this method, you may want to define a particular point in the avatar (such as the upper left corner of its head or the point at which the neck meets the head) as its location. The code that properly connects the body parts should not be duplicated. Many of you will have code in your avatar class that explicitly connects the body parts, though there are ways to avoid writing such code. If you do, you should write a single method that, given an avatar position, connects the body parts. This method should be called by all methods (including constructors) that initialize or move the position. The shared method should not instantiate body parts – otherwise each move will create new body parts, which is inefficient and illegal and will cause the move tests to fail.

To properly position the head, you will need to know its height or its width. See the class AnImageWithHeight in the composition PPT to see how the size of an image in a file can be determined. AShapeDemo in the lecture.graphics also gives this information.

As mentioned above, given that the arms and legs are angles, without doing extra work, you should be able to rotate each arm and leg while keeping the avatar connected (if you did the previous extra credit). You do not have to define extra methods in an avatar to rotate the limbs. You can simply get one of these lines and rotate it, as in:

avatar.getArms().getLeftLine().rotate(3)

However, you are free to define such methods and additional methods in the avatar.

Tag this class and its interface as "Avatar".

Again, test this class by writing a main method that creates an instance of this class and displays the instance using ObjectEditor; you can delete this method later.

Bridge Scene Class and Interface (Tag: "BridgeScene")

Create another composite shape class consisting of five instances of the avatar class defined above, which represent the five characters of interest: Arthur, Lancelot, Robin, Galahad, and Guard. These avatars must have different heads, though you are free to add other idiosyncrasies. For example you can color them differently. Each avatar will be a separate property in the scene object. We will add additional objects to the scene later such as the bridge, but for now this much is enough.

Tag this class and its interface as "BridgeScene". This class should have a readonly property for each of the five characters, whose name is the name of the character. For instance it should have a getter called "getArthur()".

This class should define a constructor that takes no arguments, as we will be instantiating it. This constructor should create a correctly functioning scene. It can have other constructors.

Animating Demoing Main Class

To demonstrate your work, write a main class that instantiates the bridge scene, displays it in an ObjectEditor window, and animates the movement and (for extra credit) arm rotation of at least one avatar in the scene. (It is sufficient to rotate just one arm). As before, an animation is done by using the refresh and sleep calls. For fun and preparation for future assignments (but not extra credit) make the avatars march and speak in your animations.

Extra Credit

1. Scalable avatar: allow each avatar to be scaled, that is, define a method taking a single double argument (tagged *"scale"*) to change by the same proportion the size of each scalable component (line, rectangle, oval) of the avatar while keeping the avatar connected. You do not have to worry about changing the size of the head or the text spoken by the avatar, though you would have to move the text to account for avatar growth and shrinkage. For example, if you give the value 2.5 to your scale method, the avatar should become two and a half times bigger. If you do scale the head, you will get more extra credit points.

For Fun

1. Colorable avatar: allow coloring of the avatar, that is, define one or more methods to change the color of the each colorable component (line, rectangle, oval, text) of the avatar. See the previous assignment on how color is specified to ObjectEditor. No extra credit points will be given for this.

Constraints

1. Do not use any libraries I have not covered in class or authorized that make your task easier, such as ArrayList or Vector.
2. You can use any Math function in this and other assignments.
3. **No magic numbers – use named constants instead.**
4. Java allows two different packages to have classes with the same name. However, this makes code difficult to understand and grade. So make sure that each class has a unique name. Recall that the short name of a class is the name used to declare it and the full name consists of the package and short name. Java requires only the full name to be unique. **We require the short name to be unique.**
5. If you know inheritance, feel free to make use of it in this assignment.
6. In this and all other assignments, your getters and setters should not create component objects. You should not move, resize, color or change other aspects of a component shape by replacing it with a new component.
7. Recall that in every assignment, every public method of an instantiated class must be in some interface implemented by that class. Do not use classes as types of variable or array elements – use interfaces instead. Follow these two constraints in all future assignments also, even if they are not explicitly stated.
8. Remember also to use the PropertyNames and EditablePropertyNames annotations (discussed in the User Interface lectures) for all non-graphics Bean classes in this and future assignments. Please note that ObjectEditor puts spaces in the middle of property names to "beutify" the names. Please do not put these spaces in the property names, which are of course derived from the getters in the code. If you get property names wrong, they will not be displayed by ObjectEditor.

9. Use the appropriate StructurePattern annotations for the graphics and other Bean classes in this and future assignments. You know you have used them correctly in classes when you do not get any warnings from ObjectEditor telling you of missing structure pattern annotations.
10. You may get some errors on the console from Swing if you show the tree panel, which I believe is a bug in Swing or an indication that I am not using it correctly in ObjectEditor. These should go away if you hide the tree panel.
11. For graphics classes, put StructurePattern annotations also in the interfaces. For example, the interface for the class implementing a string pattern should have the annotation: @StructurePattern(StructurePatternNames.STRING_PATTERN). This interface allows CheckStyle to do more thorough checking and us to give you partial credit for having the right getters and setters. You do not have to worry about putting such annotation for interfaces defining bean patterns.
12. Even though the ObjectEditor structure pattern names allow locations of graphics objects, use X and Y coordinates for these objects to prevent accidental creation of DAGs and allow for easier grading. You can create internal Point objects not exposed as properties.
13. Annotations are not inherited, for those using inheritance.
14. Encapsulate all of your classes, as we discussed in lectures, in this and future assignments. This means should not make any non-final variable public.
15. You should have no errors other than refresh warnings from ObjectEditor.
16. Expected new class and interface tags: Angle, Avatar, BridgeScene.
17. **Do not use System.exit().**

Submission Instructions

- These are the same is in the previous assignment. The TAs will run the main method to see the test cases animate
- Be sure to follow the conventions for the name and package of the main class so that its full name is: **main.Assignment5**.
- Good luck!

Possible Mistakes You Might Make

1. Avatar constructor takes head- image string - it should take head- image object as an argument.

2. Avatar has only text properties - it should have a graphics properties for different parts.

3. Avatar constructor does not initialize head shape variable - id you do not do so, you will get a null pointer exception.

4. Avatar parts jumbled up - execute Common-->Tree to see the logical structure and the coordinates and write a method to align them correctly.

5. Associating location coordinates with an angle, and updating them and not the ones of the component lines. There is no need to have separate coordinates for each composite object, and if you do, keep them consistent with the coordinates of the children coordinates.

Optional ObjectEditor Features

Here are some ObjectEditor features you could use to spruce up your drawing windows. If there is anything else you would like, post a message to Piazza, and we may be able to help you.

Graphics objects such as lines, ovals, and rectangles can have the following properties given special meaning by ObjectEditor:

Filled: This is a boolean property. If its value is true, then an oval or a rectangle graphics object is filled.

Color: This property is of type java.awt.Color. It can be set to any instance of this class. Some standard values are provided as constants, such as Color.BLUE and Color.RED It specifies both the color of the outline of the shape and its filling, if the shape is filled. Thus, if a rectangle has a Color property that is Color. BLUE and a Filled property that is true, then both its outline and its interior will be blue.

Stroke: This is a property of type java.awt.Stroke. It can be assigned any value of this type. In particular you can assign it values of type java.awt.BasicStroke. For example, if this property has the value new BasicStroke(8.0f) you will get a very thick line.

Font: This property is of type java.awt.Font. It determines the font used in a String shape.

Rounded: This property is of type boolean and determines if the edges of a rectangle are rounded.

The above properties apply only to atomic shapes such as Rectangle and Line. If you store these values in a non-atomic shape, do not make them visible to ObjectEditor, as some of these value are large or non-Tree structures that it cannot handle. This means do not make these values visible properties. (You can use the @Visible(false) annotation to make a property invisible, as discussed in class).

You may want control over how properties of an object are ordered in both the main window and graphics window. In the latter the ordering is important when the positions of two objects overlap and you want one displayed over another.

Given an object you can order its properties by putting before the getter of a property the annotation:

@Position(n)

where n is the order of the property.

You need the import:

import util.annotations.Position

A property (and its children) that has a smaller position number is shown above the one with a larger one.

If you use this annotation for one property of an object, be sure to use it for all of the other properties of the object also, and use consecutive numbers, starting from 0, for the positions.

As mentioned in StateProperties.PPTX, you can also order properties using the PropertyNames annotation as in:

@PropertyNames ({“Height”, “Weight”, “BMI”})

Positions are given in left to right order, with the left most being the smallest. Do not use @Position if you use @PropertyNames.