Group 4

Leon Kim

Robert Berg

CS-207-1: Programming II Spring 2018 Northeastern Illinois University Research Lab: Image Processing Due: Wednesday, 02/07/18 at 11:59 p.m.

Question #A.1 What is the first file your group looks at and why? What are the first (and most important) things that your group takes notice of in the code in this file?

We looked at the TestImage.java file first because this is the file that tests the code.
The first bits of code we saw are the imports that were on top of the program (import java.awt.*) and import (javax.imageio.*).

However, it wasn't very productive to understanding what was occurring, so we quickly switched to investigating the Image class. We noticed that there was a 2D array field named pixels, which we determined is what we were going to have to process. We noticed that it had a constructor, and methods to read, write and draw an image.

Question #A.2 What happens in the constructor?

The constructor has a parameter of (String filename) which looks for a filename. There is a "throw exception" which we think will "throw" if the file name is incorrect or not found. Then the constructor calls another method called "read".

Question #A.3 Find the read method (note that the read method is not complete). How many parameters does the read method take and what are their types? What is its return type? How many objects have been created in this method?

The read method takes 1 parameter which is a string. The method does not return anything. There will be 2 objects that will be created(File and BufferedImage).

Question #A.4 Notice that thereadmethod has an additional part appended to the end of the method signature: throws Exception Use Google to find out the role of this additional part -

what does it do? Where did you find your answer?

The throws Exception is one of three types of exceptions, this one is a "called exception" that reads the file name, if the file name is incorrect the program with throw an exception.

We found our answer at the java documentation website. Link is below.
https://docs.oracle.com/javase/tutorial/essential/exceptions/catchOrDeclare.html

Question #A.5 The first line of the read method creates a File object. What is a File object? In what Java package does the File class live? Where did you find your answers?

The File object is an object created from the File class. The file class allows you to access different files in certain directories. The object is the actual file.

 The class lies in the java.io.File Java package.

We found the answers at the University of Penn CS website and youtube.
https://www.cis.upenn.edu/~bcpierce/courses/629/jdkdocs/api/java.io.File.html
https://www.youtube.com/watch?v=BnOFUptgTUs

Question #A.6 The second line of the read method creates a BufferedImage object by reading in the File object using the ImageIO class. What is a BufferedImage object? More specifically - what is a BufferedImage object composed of? In what Java package does the BufferedImage class live? Where did you find your answers?

A BufferedImage object is information that relates to an image. The two main parts of a BufferedImage is the ColorModel and a Raster, both describing the image data. The ColorModel describes the color of the image using RGB(red, green, and blue) colors represented by pixels. The Raster part gives the size of the pixel values, so this in turn will tell you the size of the BufferedImage.

The package lives in the java.awt.image package. The answers were found on the java docs page as well as a youtube video.

A6-https://docs.oracle.com/javase/7/docs/api/java/awt/image/BufferedImage.html
https://www.youtube.com/watch?v=17y2hZWJN0U

Question #A.7 In Java, how are images represented? What are they composed of? This is a very important question! In order to be able to manipulate the images (flip them around,

etc), you have to be able manipulate the pieces of the image in Java.

Images are represented by pixels. Each image has a quantity of pixels that represents the width and height and an RGB color for each specific pixel. We will be using the pixels 2D array to represent each pixel. We then can exchange the positions of the pixels in order to manipulate the image.

Question #A.8 After the BufferedImage object is created, the width and height instance variables are set using the getWidth and getHeight methods from the BufferedImage class. What do these methods do? Hint: If you wrote down that they give you the width and height of the image, you are wrong! How do they relate to the "pieces" of an image?

The getWidth and getHeight methods will return the number of pixels in the width and the number of pixels in the height of the image.

Part B: Completing the read method Your boss did not give you a lot of instructions from his programmer friend, but you do know that the read method is not complete. You now know that the image has been read in and stored using the BufferedImage class/object, but it is still not in a format (think grids!!) that 2 you can work with. In order to manipulate the image, you need it to be in a grid-like format.

Question #B.1 Is there anything in the Image.java code that makes you think of a grid? What is it?

Yes, the 2D Array makes us think of a grid.

Question #B.2 + coding The pixels instance variable has been declared, but not created. How big is this array instance variable? Create it and compile your code.

The array uses the number of pixels in the width and height of the object to determine the size.

 this.pixels = new int[this.height][this.width];

Question #B.3 + coding Now that you have a 2D integer array of all 0s that is the same size as your image, you need to assign each pixel from your BufferedImage to its corresponding value in the array. Find the Java documentation for the BufferedImage class. Is there a method that returns an integer value for each piece of the image? Hint: Remember that each position in an image can be thought of as a grid where the point (0, 0) is in the upper

left-hand corner. Use the method and assign it to the correct element in your 2D array. Compile your code.

Yes there is a method, the bufImage.getRGB method returns the RGB value at the col, and row position of the specific pixel position. We will use a nested for loop to loop through our pixels array in order to set each value of the array to the RGB value in the corresponding position of the image.

Part C: Understanding the write, draw and createBufferedImage methods It turns out that your boss' programmer friend created several additional methods that you are able to use - but you need to understand how they work in order to use them!

Question #C.1 Find the createBufferedImage method. What is the return type of this method? Using the information about the BufferedImageclass from your previous research, what does this method do? Why would this method be useful for manipulating an image?

The return type is a BufferedImage. This method takes no parameters. This method creates a BufferedImage object using the following parameters width, height, and the TYPE_INT_RGB then it returns a BufferedImage.

Similarly to how we retrieved all the RGB values of an image, this method will set all the values of an image to the specified values in the pixels array using a nested loop.

Question #C.2 Find the write method. What is the return type of this method? How many parameters does this method take and what are their types? What does this method do (be specific!)? Why would you want to use this method?

The return type of the write method is void. The write method takes 1 parameter which is a String. The method first creates a new file object using using the File class. Then it looks for an a file extension. The method then calls the createBufferedImage. The ImageIO would then use bufImage, ext, and filename as parameters to create a new file of the image and places it in the folder where the project exists.

Question #C.3 Find the draw method. What is the return type of this method? How many parameters does this method take and what are their types? What are the second and third parameters used for? What is a Graphics object and what does its drawImage method do? How will this method (the draw method of the Image class) be useful?

The return type of this method is void. This method take 3 parameters, their types are Graphics

and ints. The second and third parameter is the top left coordinate of where the image will be placed on the frame. A graphics object acts like a pen and is used to put shapes, images, text, etc.. on the frame. The draw method draws an image within a frame using x, y coordinates.

This draw method of the Image class is useful because you can draw a new image from using an image source and set the image in a specific location (x,y).

Part D: The TestImage class Your boss' friend made a test class that you can use to test yourImageclass. Again, it's important to understand the code that has already been written for you.

Question #D.1 What do the first 4 lines in the main method do?

The 1st line creates a new frame object using the frame class. A frame object creates a displayable frame on the screen.

The 2nd line set the size of the frame 1024 pixels x 768 pixels.

3rd line sets the frame to be visible.

The 4th line allows you to use the graphic class which allows the program to draw graphics.

Question #D.2 Notice that there is some code that looks like a block of code - with the words try and catch, but with nothing inside the braces that follow the word try. This is called a try-catch block.You will learn about this in detail later in the class. Using Google, find out what a try-catch block should do and explain it.

https://docs.oracle.com/javase/tutorial/essential/exceptions/catch.html

The try catch block allows a code to happen if the Exception has occurred. You put the exception after the "catch" part of the code, then after this you put the result code if this code executes.

This sort of works like conditional statements where if the catch is true then the code under the catch will execute.

Question #D.3 + coding You want to make a new Image object using the Image class that you finished. What type of parameter does yourImageclass constructor require? Inside of the try-block, create a newImage object using the animals image provided. Make sure that the animals.jpg file, the Image.java class, and the TestImage.java class are all in the same folder! Then, call the draw method on the Image object that you just created and pass in the Graphics object, 10 for the parameter x, and 40 for the parameter y. Compile and run the TestImage class.

The parameter yourImageclass requires a name of an image such as ("animals.jpg").

Part E: Manipulating the image After all that work trying to understand the other programmer's code, you are ready to write your own code to manipulate the image.

Question #E.1 + coding The first method that your boss wants you to create in the Image class is named flipY. This method should take the image and flip it around the y-axis. Think of this as what you would see if you looked at the image in a mirror. Everything would be reversed horizontally, but not vertically (i.e. not upside-down). Should your method take any parameters? Why or why not? Should your method return anything? Why or why not? Create the code for this method and then compile. Then, call your method on the Image object in the TestImage class and make sure to draw it (place it next to the original image!). Compile and run your TestImage class.

The method should not take any parameters because we are using the image object to flip the pixels. We are not using a new image or changing the size, the purpose of this method is to exchange the pixels of the col with the width minus the col minus 1. We set the method up to create a new bufferedImage, but we also could have used a temp integer to exchange positions and only loop through half the columns.

The method does not need to return anything because the method is only supposed to flip the pixel instance variable. We have another method that will draw the image, and one that will write a file.

Question #E.2 + coding The second method that your boss wants you to create in the Image class is named flipX. This method should take the image and flip it around the x-axis, meaning that the modified image should be upside-down. Should your method take any parameters? Why or why not? Should your method return anything? Why or why not? Create the code for this method and then compile. Then, call your method on the Image object in the TestImage class and make sure to draw it (place it next to the original image!). Don't forget to comment out the code for flipping the image horizontally, otherwise your image will end up reversed and upside down! Compile and run your TestImage class

The method should not take any parameters because we are using the image object to flip the pixels. We are not using a new image or changing the size, the purpose of this method is to exchange the pixels of the row with the height minus the row minus 1. We set the method up to create a new bufferedImage, but we also could have used a temp integer to exchange positions and only loop through half the rows.

The method does not need to return anything because the method is only supposed to flip the pixel instance variable. We have another method that will draw the image, and one that will write a file.

Question #E.3 - only coding Your boss is so happy with you! But there's just one more thing. Your boss wants saved copies of the modified images. You're ready for this - no hints on this one! Write the code to save copies of the modified image (one saved copy of the image reversed and one saved copy of the image upside-down) in .jpg formats. Do not overwrite your original image!

Part F: Final Summary

Whenever you complete a project, it is important to assess what you think went well and what you need to improve on.

Question #F.1 What was the most challenging part of this research lab for your group?

Understanding each of the new classes was the most difficult part of this assignment. There were multiple classes we have never seen so it took some time to research to understand how each class works, and which methods we would need to use. It was tough to look at code and see things we have never seen such as the try and catch block in the main method. We also had to review 2D arrays.

Question #F.2 What did your group learn/find the most useful by doing this research lab?

Being able to understand every part of a program is the most useful part of this lab. The questions asked in this lab really made you research and understand why each class and methods exist to make the program run. We were able to discover new java packages, methods, and classes through the java documentation. There is no way that anyone could memorize every class and method in a programming language and this lab showed us how to read the documentation and implement it in our programs.

Question #F.3 What was the most fun aspect of doing this research lab?

Working with another person would be the most fun. The two of us work together are we would share ideas with each other about the lab throughout the week and try to work on it individually to have the time to be able to process the conversations. Being able to ask another person questions and getting feedback helped a lot.