DUE DATE: By the end of your lab session

CSE-271: Object-Oriented Programming

Exercise #8

Max Points: 20

Name: Zach Clouse

For your own convenient reference – You should first save/rename this document using the naming convention **`MUid_Exercise8.docx`** (example: `amjadm_Exercise8.docx`) prior to proceeding with this exercise.

Objectives: The objectives of this exercise are to:

1. Review the concepts of Graphical User Interfaces (GUI)
2. Review basics of Swing class hierarchy (`JFrame`, `JPanel`, `JButton`)
   a. Develop a custom `JComponent` via inheritance & polymorphism
3. Gain some familiarity layout managers (`GridLayout`)
4. Gain familiarity with GUI builder – Eclipse's `Window Builder` tool

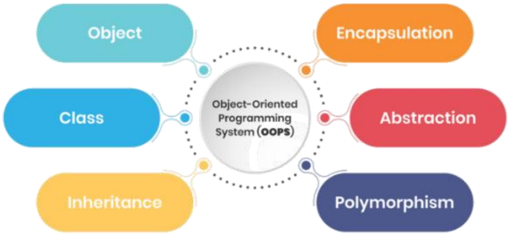
Fill in answers to all of the questions. For some of the questions you can simply copy-paste appropriate text from Eclipse output into this document. You may discuss the questions or seek help from your neighbor, TA, and/or your instructor.

Part #0: One time setup of Eclipse (IDE) – Only if needed

We already configured `Eclipse`'s source formatter and Checkstyle plug-in as part of Lab #1. If your `Eclipse` is not configured (because you are using a different computer) then use the instructions from Lab #1 to configure `Eclipse`.

Part #1: GUI basics and Object-oriented programming

Estimate time: < 30 minutes



Background: Object-oriented Programming (OOP) is a programming paradigm that is heavily used for developing GUI libraries such as Swing and gaming libraries such as Unity. OOP enables developing an flexible and unambiguous (*i.e.*, intention is clearly communicated between programmers who develop libraries versus those who use the libraries).
It is also important to remember that building a GUI essentially involves same basic concepts:

- Creating objects and calling methods with suitable arguments
- Using existing methods for basic problem-solving.

Exercise: Briefly (2-to-3 sentences each) respond to the following questions regarding generic concepts of Graphical User Interface (GUI)

1. What is a Graphical User Interface (GUI)?

   A GUI is an alternative for text based I/O, using graphics of the modern computer. It can use different input devices such as a mouse, keyboard, etc.

2. Briefly (2-to-3 sentences) describe 1 advantage offered by a GUI

   GUI's are user friendly. It is much easier for a user to interact with a GUI.

3. Briefly (2-to-3 sentences) describe 1 disadvantage of GUIs

   GUI's are less efficient. It requires more steps to carry out the same exact task.

4. Referring to the following Wikipedia page https://en.wikipedia.org/wiki/Xerox_Alto, briefly (2-to-3 sentences) describe the importance of the `Xerox Alto`.

   The Xerox Alto was the very first computer with a graphical operating system. This led way to the future of computing.

5. GUIs use pixels in many different colors to create a picture. The colors of pixels are determined based on a combination of 8-bits (or 256 distinct values) of red, green, and blue (RGB) colors (sadly, RAObot's eyes are only 3-bit color). The colors can be represented as RGB triplets or correspondingly as hex codes. Complete the following table using information from https://htmlcolorcodes.com/color-names (the first one is already completed to illustrate an example):

Name	RGB	HTML
Miami Pantone Red	rgb(152, 0, 46)	#98002e

Light Salmon	**rgb(255, 160, 122)**	**#FFA07A**
Deep Pink	**rgb(255, 20, 147)**	**#FF1493**
Lemon Chiffon	**rgb(255, 250, 205)**	**#FFFACD**
Medium Aquamarine	**rgb(102, 205, 170)**	**#66CDAA**
Ghost White	**rgb(248, 248, 255)**	**#F8F8FF**

6. What is the event-driven programming (or approach) that is used in GUIs?

   Event-driven programming is when all actions are represented as events occurring in the system. So, events are stored in a queue and processed one after another.

7. What does mean to "*fire an event*"? When are events fired?

   Firing an event is when an event is generated. This happens when the user interacts with a GUI.

8. Briefly (2-to-3 sentences) describe 1 advantage offered by a GUI-builder program

   GUI builders let the programmer drag and drop components. This can enable rapid prototyping and have a low learning curve.

9. Briefly (2-to-3 sentences) describe 1 disadvantage of GUI-builder programs

   GUI builders cannot handle complex GUIs and interactions. Also, they can cause for the code to be clunky.

Part #2: Java-Swing and GUI programming

Estimate time: < 30 minutes

Background: Object-oriented Programming (OOP) is a programming paradigm that is heavily used for developing GUI libraries such as Swing and gaming libraries such as Unity. OOP enables developing a flexible and unambiguous (*i.e.*, intention is clearly communicated between programmers who develop libraries versus those who use the libraries).
It is also important to remember that building a GUI essentially involves same basic concepts:

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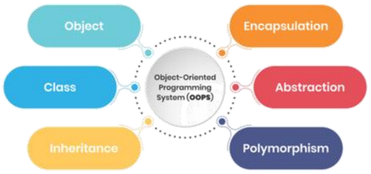
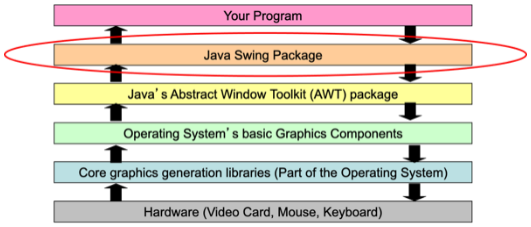



Your Program
Java Swing Package
Java's Abstract Window Toolkit (AWT) package
Operating System's basic Graphics Components
Core graphics generation libraries (Part of the Operating System)
Hardware (Video Card, Mouse, Keyboard)

Exercise: Briefly (2-to-3 sentences each) respond to the following questions involving the Java-Swing GUI library

1. What is a layout manager?

   A layout manager decides the size and placement of each component in a container. The common types are border, flow, and grid layouts.

2. What is a “functional interface”?

   A functional interface is one that has exactly one method. This makes their parameters and returns values easy to see.

3. Rewrite the following methods that involve anonymous classes to use the more concise lambda syntax:

Anonymous class syntax	Corresponding lambda syntax

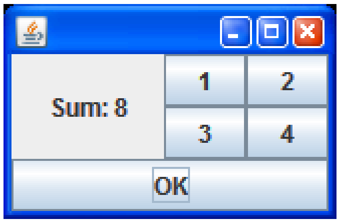
`doIt.addActionListener(new`
`  ActionListener() {`
`    @Override`
`    public void`
`    actionPerformed(ActionEvent e) {`
`      System.out.println(“Click!”);`
`    }`
`  });`
	doIt.addActionListener((e) ->
	{ System.out.println(“Click!”); });

Part #3: Working with Eclipse’s Window Builder

Estimated time: < 30 minutes

Background: GUI-builders are software tools that are used to ease development and/or rapid-prototyping of GUI. Window Builder is a Java-Swing GUI-builder that is available for Eclipse. It provides a visual approach for laying out components and adding actions to components. As the GUI is developed, the corresponding source code for it is automatically generated/updated by Window Builder.

Exercise: In this part of the exercise, you are expected to install and use Window Builder to develop the GUI shown in the adjacent screenshot.



There is a video on Canvas demonstrating the use of Eclipse's `Window Builder`. It may be useful to quickly review these videos as part of this exercise.

Part #4: Submit to Canvas via CODE plug-in

Estimated time: < 5 minutes

Exercise: You will be submitting the following files on Canvas as normal submissions:

1. This MS-Word document saved as a PDF file – **Only submit PDF file**.
2. The Java source file for the GUI that you developed using Window Builder

Ensure you actually complete the submission on Canvas by verifying your submission (after you submit)