UNIVERSITY OF WATERLOO

CS 349
Midterm Exam
Fall 2013

Course Title: User Interfaces
Sections: All
Instructor: Byron Weber Becker

Exam Date: 23-October-2013
Time: 4:30 - 5:50p.m.
Duration: 80 minutes
Pages: 10

Exam Type: Closed Book
Permitted Aids: None

Cheating is an academic offense. Your signature on this exam indicates that you understand and agree to the University's policies regarding cheating on exams.

Signature: _____

Last Name: _____

Given Name: _____

Student ID: ___ ___ ___ ___ ___ ___ ___ ___

Instructions:

1. Place answers in this booklet. Use the last page if additional space is required.
2. Before you begin, make certain that you have 10 pages.
3. There are 6 questions on the exam. Answer all questions and each part of each question. The marks assigned to each question are shown at the beginning of the question. Use this information to organize your time effectively.
4. Questions will not be interpreted. Proctors will confirm or deny errors only. If you consider the wording of a question to be ambiguous, state your assumptions clearly and proceed to answer the question to the best of your ability.
5. Documentation is always appreciated, but is not required unless explicitly requested.

Q #	Marks Available	Marks Earned	Grader Initials
1	11		
2	14		
3	16		
4	17		
5	08		
6	07		
Total	73		

This exam has been made public in two forms. This one is as printed for the exam (except for this note). It's a good one to look at first to test your understanding. The second one has sample solutions as well as the instructor's post-exam comments.

Name: _____

1. [11] Events

a. [08] In response to a student question, the following event loop pseudocode was posted to Piazza:

```
while (true)
  if (events) handle one
  if (time to paint) paint
  if (no events) sleep a while
```

Analyze the following variants. In each briefly describe conditions where the program does not behave as desired and what that undesired behaviour is.

`while (true)`
`  if (events)`
`  handle one`
`  if (time to paint)`
`  paint`
`  sleep a while`	

`while (true)`
`  while (events)`
`  handle one`
`  if (time to paint)`
`  paint`
`  if (no events)`
`  sleep a while`	

`while (true)`
`  if (events)`
`  handle one`
`  else if (time to paint)`
`  paint`
`  else if (no events)`
`  sleep a while`	

`while (true)`
`  if (events)`
`  handle one`
`  else if (time to paint)`
`  paint`	

b. [03] In XWindows, the pseudocode `if (events) handle one` is implemented with XPending and XNextEvent. What is the purpose of each of these functions? In what kinds of programs would we use one (which one?) without the other?

Name: _____

2. [14] XWindows and Drawing

a. [05] XWindows: Mark each statement with "T" (true) or "F" (false).

[Marking: -1 for each incorrect T/F answer and -1/2 for each blank answer to a floor of 0.]

__ The Base Window System is multi-threaded to handle multiple windows.
__ The Base Window System resides on the XWindows client.
__ Network speed has increased enough since the mid-1980's that programmers can pretty much ignore it.
__ The window manager is a separate application that "owns" the title bar of each window; the application using the window "owns" everything else.__ X is great for UI researchers because it's really easy to change the window manager to obtain a different look and feel.
__ X requires programmers to select which events their programs receive with a set of predefined flags that are ORed together.
__ A graphics context includes settings related to background colours, line widths, line joining policies, and how newly drawn bits are combined with bits already on the screen.
__ Because there is only one graphics context, programmers need a disciplined policy in how to use it to avoid sending extraneous commands across the network.
__ The Xwindows client sends events to the server; the server sends drawing commands to the client.

4th one (window mgr owns..) was judged to be really tricky; only deducted ½ if wrong

b. [04] Two performance-enhancing techniques we discussed were clipping and double buffering. Succinctly explain the problem each is designed to solve and a high-level description of how it solves it.

c. [03] Compare and contrast the RGB and HSB colour models. Be sure to indicate what each letter in the name represents.

d. [02] What is the Critical Flicker Frequency? What are appropriate values for humans?

3. [16] Misc.

a. [03] History: Mark each statement with "T" (true) or "F" (false).

[Marking: -1 for each incorrect T/F answer and -1/2 for each blank answer to a floor of 0.]

__ Ivan Sutherland created "Sketchpad" which included a constraint solver so one could say, for example, "make these lines parallel."
__ Ivan Sutherland invented the mouse to work with his Sketchpad system.
__ Doug Engelbart demonstrated a system that allowed people to collaborate across a network.
__ Doug Engelbart demonstrated a system that used copy & paste, hypertext, and maps.
__ All of the true statements, above, occurred during the 1960's.

b. [02] What's the difference between "interaction" and "interface"?

c. [02] Compare and contrast "cognitive conscious" and "cognitive unconscious".

d. [03] With respect to user interfaces, what is a desirable consequence of "automatic actions"? What is an undesirable consequence? Give examples.

e. [06] Provide a sketch showing a better design for the interface shown on the right. Annotate your sketch to show where you used two different Gestalt principles to improve the design. Separately, give a brief definition of the two principles you used.

Name: _____

4. [17] 2D Graphics

Consider a graphics editor with a set of templates for drawing common shapes. There are three predefined templates, a hexagon, a star, and a speech bubble. Each of the templates is defined with respect to the origin, as shown in Figure 2A. The user first positions a copy of each template as shown in Figure 2B. The user then groups the hexagon and speech bubble, rotating them 45° about the centre of the hexagon, (3,4), to arrive at the final drawing, shown in Figure 2C.

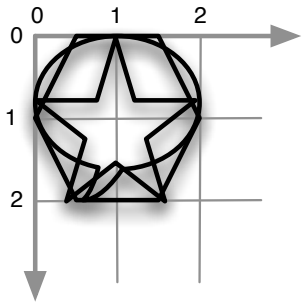


Figure 2A

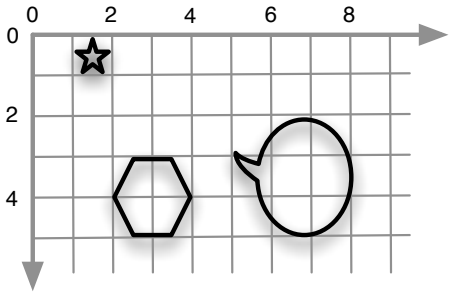


Figure 2B

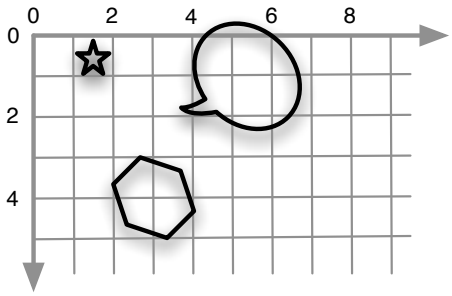


Figure 2C

In the following questions, use $T_{(dx, dy)}$, $R_{(\Theta)}$, and $S_{(sx,sy)}$ to indicate the appropriate translation, rotation, and scaling matrices. Use I for the identity matrix. Use degrees for rotations. Fill in appropriate values for dx, dy, Θ, sx, and sy, of course.

a. [02] What is the affine transformation matrix that $T_{(dx, dy)}$ represents?

b. [04] What are the affine transformation matrices, expressed in terms of T, R, and S, for the shapes in Figure 2B?

Star:

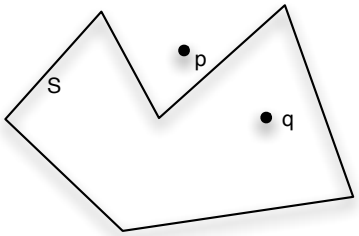
Hexagon:

Bubble:

c. [02] Assume that the hexagon and speech bubble in Figure 2C are still grouped so they can be operated on together. Draw an appropriate scene graph.

d. [04] Given the description of the user's actions, what would be the transformation matrix for each node of your scene graph to yield the image in Figure 2C?

e. [05] Inside Tests: Describe the algorithm for determining whether points such as p and q are inside or outside of the shape S.



Name: _____

5. [08] Model-View-Controller

The model classes in the MVC architecture have common code that can be factored out into a superclass. Here is the model for a counter application that extends such a superclass.

```
public class CounterModel extends DefaultModel {
  private int count = 0;
  public void increment()  {  this.count = this.count + 1;  }
  public void reset()      {  this.count = 0;               }
  public int getCount()    {  return this.count;            }
}
```

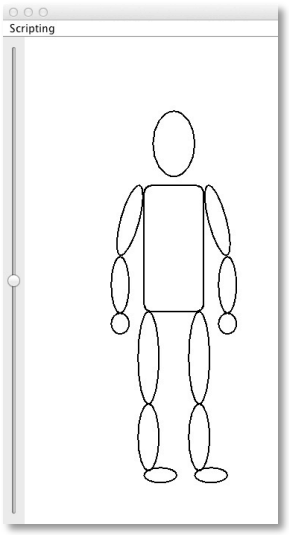
a. [07] Implement **`DefaultModel`**.

b. [01] Describe any change(s) required to **`CounterModel`**.

Name: _____

6. [07] Direct Manipulation and Instrumental Interaction

One model for evaluating interfaces is "instrumental interaction". Answer the following questions about instrumental interaction with reference to the design for A2 shown on the right. The slider on the left side of the frame is used to control the length of the selected leg. Click and drag a body part to rotate or move it.



a. [02] Instrumental interaction distinguishes between objects and instruments. Define each of these.

Define Object:	Define Instrument:

b. [05] Instrumental interaction uses three measures to evaluate an interface: degree of indirection, degree of integration, and degree of compatibility. For each of these three measures, (a) provide a brief definition, and (b) use it to evaluate the above interface. Assume the user has a mouse.

Degree of indirection:
Degree of integration:
Degree of compatibility:

Place continued answers here with appropriate notations both here and where the question is asked.