S228/211

DUBLIN INSTITUTE OF TECHNOLOGY

BSc. (Honours) Degree in Computer Science

Year 2

SUMMER EXAMINATIONS 2014/2015

OBJECT ORIENTED PROGRAMMING [CMPU2016]

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THURSDAY 14TH MAY 9.30 A.M. – 12.30 P.M.

THREE HOURS

ATTEMPT ANY 4 QUESTIONS. ALL QUESTIONS CARRY EQUAL MARKS.

Question 1

(a) Give an example of the usage of each of the following Processing methods.

i. stroke
ii. rect
iii. ellipse
iv. size
v. translate
vi. popMatrix

(6 marks)

(b) Figure 1 gives an extract from a Processing sketch that converts numbers from binary to decimal. Figure 2 shows an example of the sketch running. A user can click on any of the squares to toggle a bit *on* or *off*.

```
boolean[] bits = new boolean[16]; // Stores the array of bits

void draw()
{
  background(127);
  // Code missing here to draw the square representing the bits
  // The square should be filled if the bit is toggled on
  // Or empty if the bit is toggled off
  int number = binaryToDecimal(bytes);
  fill(255);
  text(number, centX, 100);
}

// Go through the elements in the bits array and get the power
of 2 for that element
// Return the sum or all the powers of 2
int binaryToDecimal(boolean[] bits)
{
  int ret = 0;
  return ret;

}

// Get the mouseX and mouseY position and figure out which bits
to toggle
// on or off in the boolean array of bits
void mousePressed()
{

}
```

Figure 1

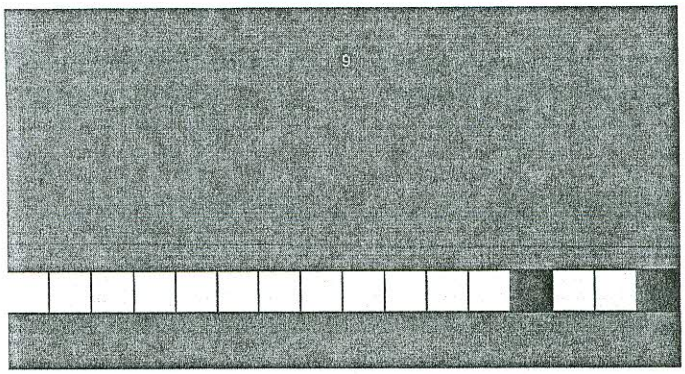

Figure 2

Write an implementation for the method `binaryToDecimal` in the sketch. This method should return the binary number that is represented by the toggled bits in the boolean array parameter.

(7 marks)

(c) Write an implementation for the method `mousePressed` in Figure 1. This method should toggle the appropriate bit on or off in the boolean array `bits` depending on where the user clicks on the screen.

(6 marks)

(d) Write the missing code for the `draw` method in Figure 1. This method should draw a row of squares in the centre of the screen to represent the bits in the boolean array bits. If the bit is toggled true, then the square should be filled in black, otherwise the square should be drawn empty.

(6 marks)

Question 2

Figure 3 shows a spaceship from a computer game called YASC. YASC is a SpaceWar clone implemented in Processing. In this game, the player can move the spaceship forwards by pressing the W key and rotate left and right using the A and D keys. You are required to write a class to encapsulate the behaviour of this spaceship in the game.

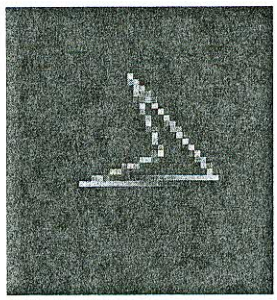

Figure 3

(a) What fields will this class need in order to implement the functionality described above? Write the Processing code to declare these. Consider the scenario where we might need to implement ships of different sizes. Use `PVectors` in your solution.

(4 marks)

(b) Write the Processing code for the constructor that initialises the fields such that the initial position is in the centre of the screen and the spaceship points upwards.

(6 marks)

(c) Write code for a method called `display` that draws the ship.

(8 marks)

(d) Write code for a method called `move` that responds to key presses to rotate and move the spaceship.

(7 marks)

Question 3

(a) Distinguish between how *primitive types* and *classes* are managed in memory by the Java Virtual Machine. Provide examples of each in your solution.

(7 marks)

(b) Java supports a concept called *constructor chaining*. Briefly describe what is meant by this concept. Include examples in your solution.

(6 marks)

(c) Define *polymorphism* and present a simple example in Java or Processing. What types of problems can polymorphism solve?

(10 marks)

(d) What is meant by the keyword `static` when applied to a field in a class in Java?

(2 marks)

Question 4

(a) Multiply the two matrices given in Figure 4.

1	-2
0	1
7	-3
4	2

1	0	1
-7	9	0

Figure 4

(4 marks)

(b) You are required to create a class called Matrix2D to encapsulate the functionality and operations of a 2D matrix. It should have the following:

i. A private fields for `elements` (of type 2D float array), `rows` (of type int) and `cols` (of type int). (2 marks)

ii. Public getters for the `rows` and `columns` fields. (2 marks)

iii. A public constructor that takes the number of rows and the number of columns as parameters. This should allocate memory to the `elements` field. (4 marks)

iv. An appropriate `toString` method that returns the elements of the matrix formatted as a String. (4 marks)

v. A static method to multiply two matrices together. The method should take two matrices as parameters and return the multiplication of these two matrices. (9 marks)

Question 5

(a) Give examples for the following features of the Java programming language:

i. *Interfaces* (8 marks)

ii. *Exceptions* (10 marks)

(b) Compare the Java `ArrayList` and `Hashmap` collection classes. Be sure to discuss the efficiency of each collection and include a short example of each in your solution. (7 marks)

Question 6

(a) Figure 5 shows an extract from a Java program. Explain each numbered line of code in this extract in detail.

```
1. try
   {
2.    int start_ = file.getName().indexOf("_");
3.    int end_ = file.getName().indexOf("_", start_ + 1);
4.    studentNumber = file.getName().substring(start_ + 1,
   end_);
      String current;
5.    BufferedReader reader = new BufferedReader(new
   FileReader(file));
6.    while ((current = reader.readLine()) != null)
      {
7.        if (current.contains("http"))
          {
8.            current = current.replaceAll("\\<[^>]*>","");
9.        int i = current.indexOf("http");
10.           url = current.substring(i, current.length());
11.           System.out.println(studentNumber + "\t" +
   current);
12.           cloneRepo(studentNumber, url);
13.           break;
          }
      }
14.       reader.close();
   }
15.   catch (Exception e)
  {
16.       System.out.println("Error cloning:  " + url + "
   Student: " + studentNumber + " Name: " + studentName);
17.       e.printStackTrace();
  }
```

Figure 5

(17 marks)

(b) Imagine you are planning to work on a Java project with a team of your classmates. How would you go about using git and github for version tracking on this project?

(8 marks)