OLLSCOIL NA GAILLIMHE
UNIVERSITY OF GALWAY

Semester 1 Examinations 2022-2023

Course Instance Code(s)	3BCT1, 3BP1, 3BP4
Exam(s)	Third Year Computer Science & Information Technology Third Year Electronic and Computer Engineering
Module Code(s)	CT326
Module(s)	Programming III
Paper No.	1
External Examiner(s)	Dr Ramona Trestian
Internal Examiner(s)	Professor M. Madden *Dr. Adrian Clear

Instructions: Answer any 4 questions. All questions will be marked equally.

Duration	2 hours
No. of Pages	6
Discipline(s)	Computer Science
Course Co-ordinator(s)	Dr Colm O'Riordan

Requirements:

Release in Exam Venue	Yes [X]	No [ ]
MCQ Answersheet	Yes [ ]	No [X]
Handout	None	
Statistical/ Log Tables	None	
Cambridge Tables	None	
Graph Paper	None	
Log Graph Paper	None	
Other Materials	None	
Graphic material in colour	Yes [ ] No [X]	

PTO

Q1.

(a) Explain the difference between **processing** streams and **data sink** streams. Use a **byte stream** example involving reading and writing to support your answer.

10 MARKS

(b) Explain in your own words the following Java program. Include in your answer how you would run the program and what you would expect the output to be.

```
import java.io.PrintWriter;

public class Q1b {
      public static void main (String [] args) {
            String format = "%s:\n %.2f %d";
            PrintWriter writer = new PrintWriter(System.out);
            writer.format(format, args[0],
                              Double.valueOf(args[1]),
                              Integer.valueOf(args[2]));
            writer.close();
      }
}
```

7 MARKS

(c) You are writing a class to represent a `Book` object. A `Book` has a title (`String`), an author (`String`), and a price (`org.joda.money.Money`). Describe using Java code examples how you would make `Book` objects serializable.

Given that book objects are serializable, provide a Java code snippet of how you would serialize a `Book` instance to a file.

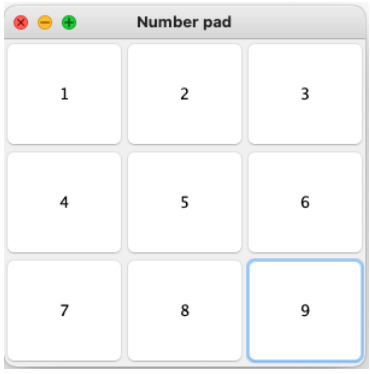
8 MARKS

Q2.

(a) List and describe with the use of diagrams **three** layout managers that can be used to organise components in Swing applications. For each one, provide a code example of how to add a component to a container that has been defined to use that layout manager.

10 MARKS

(b) Write a Java program to produce the GUI below using Swing, which illustrates a number pad. When a button is clicked by the user (like button 9 in the figure), it should print the button's number to the console with a message like "Button 9 pressed". The GUI should have a size of 300x300 pixels, a title, and should terminate the application when the close button ('x') is pressed.



15 MARKS

Q3.

(a) Show using a code example how a thread may be created (and started) using an application class that implements the `Runnable` interface.

Include a mechanism in the `Runnable` class to allow it to be shutdown gracefully (i.e., without needing to call the `stop()` method).

Assume you have a bank account class that may be accessed by more than one thread of execution simultaneously. Show how the various business methods of the class may be made thread safe.

10 MARKS

(b) Outline the design and code implementation of a thread-safe Java class for an object that will be used as a buffer to hold an `int` value. After an initial value has been set, the value may be updated randomly by one or more `Producer` threads, provided that it has already been consumed by one of a number of `Consumer` threads. Each value produced must be consumed exactly once and there may be multiple producer and consumer threads executing (and attempting to access the buffer) concurrently.

15 MARKS

Q4.
Demonstrate using code examples how you would make use of an `Iterator` to remove all elements from a `Collection` of strings that begin with the letter "n" or "N".

10 MARKS

Demonstrate using code examples how you would use a `Map` to maintain a mapping between students and the modules that they are taking (e.g. "CT326"). The `Map` should maintain the order of students based on the lexicographic order of their surname followed by their first name.

Illustrate the code for adding a student called Steve Higgins to the Map who takes two modules, CT326 and CT355, followed by a student called Mary Higgins who takes CT326 only.

What would the program output be if you print the `Map` to the console?

Note: you can represent a student by their surname and first name only. Your code should include a `toString()` method that represents a `Student` as "[surname], [first name]"

15 MARKS

Q5.

(a) List and describe the activities involved in the main stages of a test driven development approach.

5 MARKS

(b) You have been asked to write a class to represent a bank account called `Account`. Write the **unit tests** you would use to test the following functionality.

(i) It should be possible to make a deposit of funds to the account as long as the value is positive.

(ii) It should be possible to make a withdrawal from the account as long as there are sufficient funds. If there are insufficient funds in the account, an appropriate exception should be thrown.

(iii) An `Account` is represented with an account number and a balance. It should be possible to serialize an `Account` (including all its member variables) to a file.

15 MARKS

(c) Assume you have a `List` containing `Account` objects, and that the `Account` class has an appropriate `toString()` method implementation. Use a call to the `Iterable forEach` method to print the `Account` objects to the standard output stream.

5 MARKS

END