

EXAMINATIONS – 2017

TRIMESTER 2

COMP 102
Introduction to Computer Program
Design

Time Allowed: TWO HOURS

CLOSED BOOK

Permitted materials: No Calculators permitted.
Brief Java documentation is provided with the exam script.
You may use paper translation dictionaries.

Instructions: Attempt **all** questions. There are 120 marks in total.
If you think some question is unclear, ask for clarification.
You may write notes and working on this paper, but make sure your answers are clear.
Answer in the appropriate boxes or as close to the questions as possible. If you write your answer elsewhere, make it clear where your answer can be found. Please use the blank reverse sides of pages and/or the blank end-page for any extra space you need, for working or for answers.

Questions	Marks	
1. Understanding Java	[35]	<input type="text"/>
2. GUI programs	[10]	<input type="text"/>
3. Writing programs using 2D arrays	[37]	<input type="text"/>
4. Writing programs with objects, ArrayLists and Files	[38]	<input type="text"/>
	TOTAL:	<input type="text"/>

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Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

Question 1. Understanding Java**[35 marks]**(a) **[3 marks]** What will be printed if the following testLoop() method is called?

```

public void testLoop(){
    for (int i = 0; i < 3; i++){
        for(int j=0; j<=i; j++){
            UI.print("*");
        }
        UI.println ();
    }
}

```

```

*
**
***

```

(b) **[3 marks]** What will be printed if testIf(7) is called?

```

public void testIf (int x){
    if(x>5 || x<= 0){
        UI.println ("Correct");
    }
    else{
        UI.println ("Incorrect");
    }
}

```

```

Correct

```

(c) **[3 marks]** What will be printed if testBool(false, true) is called?

```

public void testBool(boolean flag , boolean signal){
    if (!(flag && signal)){
        UI.println ("Yes");
    }
    else {
        UI.println ("No");
    }
}

```

```

Yes

```

(Question 1 continued on next page)

(Question 1 continued)

(d) [5 marks] The following testArray method creates an array of names of colours, then modifies it, then prints out each value in the array. What will it print?

--	--	--	--	--

```

public void testArray(){
    String[ ] colours = new String[ ]{"red", "yellow", "green", "blue", "violet"};

    int n = 2;
    colours[n] = colours[n-1];

    for(int i=0; i < colours.length; i++){
        if(colours[i].length() < 5){
            colours[i] = colours[i+1];
        }
    }

    // print out the array
    for(String p : colours){
        Ul.println(p);
    }
}

```

```

yellow
yellow
yellow
violet
violet

```

(Question 1 continued on next page)

(Question 1 continued)

(e) [8 marks] What will be printed if the following test2D method is called?

```

public void test2D(){
    int [ ][ ] nums = new int [ ][ ]{ {12, 2, 1, 5},
                                       {31, 3, 6, 18},
                                       {14, 0, 17, 20}
                                       };
    for( int col=0; col<nums[0].length; col++){
        for( int row=0; row<nums.length; row++){
            UI. print (nums[row][col]+" ");
        }
        UI. println ();
    }

    UI. println ("= = = = =");
    nums[2][1] = nums[1][2];

    for( int n=0; n<nums[0].length; n++){
        UI. print (nums[2][n]+" ");
    }
}

```

```

12 31 14
2 3 0
1 6 17
5 18 20
= = = = =
14 11 17 20

```

(Question 1 continued on next page)

(Question 1 continued)

(f) [5 marks] What will the following testArrayList method print out?

```

public void testArrayList () {
    ArrayList <String> fruit = new ArrayList<String>();
    fruit .add("banana");
    fruit .add("apple");
    fruit .add("orange");
    fruit .add("pear");
    fruit .add("grape");
    Ul. println ( "-----A-----");
    Ul. println ( fruit .contains("kiwi"));
    Ul. println ( fruit .indexOf("apple"));
    Ul. println ( fruit .get( fruit .size()-1));
    Ul. println ( "-----B-----");
    fruit .set(1, "peach");
    for( String s : fruit ){
        Ul. println (s);
    }
    Ul. println ( "-----C-----");
    fruit .add(3, "mango");
    fruit .remove(2);
    for( String s : fruit ){
        Ul. println (s);
    }
}

```

```

-----A-----
false
1
grape

-----B-----
banana
peach
orange
pear
grape

-----C-----
banana
peach
mango
pear
grape

```

(Question 1 continued on next page)

(Question 1 continued)

(g) [7 marks] Consider the following Car class.

```
public class Car {
    private int modelNum;
    private String modelName;
    public Car(){
        Ul.println ("Constructor 1");
    }

    public Car(int num, String name){
        Ul.println ("Constructor 2");
        this.modelName = name;
        this.modelNum = num;
    }

    public void printCarData(){
        Ul.println ("Car Num: " + this.modelNum + " Car Name: " + this.modelName);
    }
}
```

What will be printed out if the following testCars method is called?

```
public void test(){
    Car c1 = new Car(1123, "Mazda");
    c1.printCarData();
    Car c2 = new Car();
    c2.printCarData();
}
}
```

```
Constructor 2
Car No: 1123 Car Name: Mazda
Constructor 1
Car No: 0 Car Name: null
```

(Question 1 continued)

WHY NOT A USING FILES QUESTION

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Cross out rough working that you do not want marked.
Specify the question number for work that you do want marked.

Question 2. GUI programs**[10 marks]**

Complete the following ImagePlacer program that allows the user to place images on the graphics pane. The program has a button, which when clicked, will open a file chooser dialogue box. From the dialogue box, the user can choose a file name that will be stored in a field. When the user releases the mouse on the graphics pane, the program will draw the image in the file at that place.

You need to

- declare a field,
- complete the constructor to add a button,
- complete the setFileName method,
- complete the doMouse method.

```
public class ImagePlacer{

    private String fileName;

    public ImagePlacer(){
        UI.addMouseListener( this :: doMouse);
        UI.addButton("Set fileName", this::setFileName);
    }

    public void setFileName(){
        this.fileName = UIFileChooser.open();
    }

    public void doMouse(String action, double x, double y){
        if(action.equals("released") && this.fileName!=null){
            UI.drawImage(fileName, x, y);
        }
    }
}
```

Question 3. Writing programs using 2D arrays**[37 marks]**

This question deals with images that are represented by a 2D array of integers between 0 and 255. Each integer represents the value of one pixel.

(a) **[10 marks]** Complete the following `setTwoTones` method which converts a greyscale image to either dark grey or light grey, as in the following images.



The parameter of `setTwoTones` is a 2D array of integers (0...255).

A pixel is set to dark grey (pixel value of 100) if it is less than 150, otherwise it is set to light grey (pixel value of 200). You may assume that the array is not null.

```

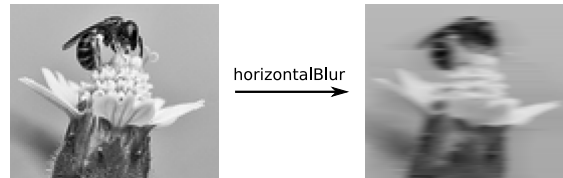
public void setTwoTones(int [ ][ ] img){
    for(int row = 0; row < img.length; row++){
        for(int col = 0; col < img[row].length; col++){
            if(img[row][col]<150){
                img[row][col] = 100;
            }
            else{
                img[row][col] = 200;
            }
        }
    }
}

```

(Question 3 continued on next page)

(Question 3 continued)

(b) [12 marks] Complete the following `horizontalBlur` method which performs a horizontal blur operation on an image. Such an operation can achieve the following effect:



`horizontalBlur` is passed a 2D array of integers, and blurs the pixels by replacing each pixel value (except the ones on the left and right borders) by the average of the pixel value, the pixel value to the left, and the pixel value to the right. You may assume that the array is not null.

Hint: you may choose to use a temporary array.

```

public void horizontalBlur (int [ ][ ] img){
    int rows = img.length;
    int cols = img[0].length;

    int [ ][ ] temp = new int [rows][cols];
    for (int row = 0; row < rows; row++){
        for (int col = 1; col < cols-1; col++){
            temp[row][col] = (img[row][col-1]+img[row][col]+img[row][col+1])/3;
        }
    }
    // Copy temp back into img
    for (int row = 0; row < rows; row++){
        for (int col = 1; col < cols-1; col++){
            img[row][col] = temp[row][col];
        }
    }
}

```

```

}

```

(Question 3 continued on next page)

(Question 3 continued)

TOO MUCH 2D ARRAYS. WHY NOT AN EASY FILE QUESTION. EG Read a file of numbers and plot them/add them/average them/count number over threshold EG Read a file of lines of three numbers, and draw colored strips. EG

(c) **[15 marks]** Complete the code for `flipValues` that takes a 2D array of integer values, flips it into a new 2D array, then returns the flipped 2D array. The input 2D array may be of any size but the number of rows must be odd. If not, print out a message to the user that it is not possible to complete this method because the number of rows is not odd. In this case, the method returns null. You may assume that the array is not null.

For example,

$$\text{FlipValues of } \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} \Rightarrow \begin{pmatrix} 7 & 8 & 9 \\ 4 & 5 & 6 \\ 1 & 2 & 3 \end{pmatrix}$$

```

public int [ ][ ] flipValues (int [ ][ ] nums) {
    if(nums.length %2 == 0){
        Ul.println ("Can't continue!!!");
        return null;
    }
    int [ ][ ] newNums = new int [nums.length][nums[0].length];

    int rows = nums.length;
    int cols = nums[0].length;

    for (int row=0; row<rows; row++){
        for (int col=0; col<cols; col++) {
            newNums [rows - row - 1][col] = nums[row][col];
        }
    }

    return newNums;
}
}

```

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Question 4. Writing programs with objects, ArrayLists and Files**[38 marks]****(a) [20 marks] Defining classes and writing methods with ArrayList**

For this question, you are to complete the Student class on the facing page, which is part of a program for a university to keep track of student grades. You need to define the following fields inside the Student class:

1. ID: an integer that represents the student's ID.
2. name: a string that represents the student's first name.
3. marks: an ArrayList of type Double that holds the marks of the student's courses.

You are to complete the constructor and the following methods:

1. The constructor that creates a Student object with the given ID and name, and an empty list of marks.
2. getName(): returns the name of the student.
3. getID(): returns the ID of the student.
4. addMark(double mark): adds the given mark to the list of student's marks.
5. computeAverage(): computes and returns the average of the marks the student has received. If a student has no marks, then it should return -1;

(Question 4 continued on next page)

(Question 4 continued)

```
public class Student {
    // Fields
    private int ID;           // the student ID
    private String name;     // the student name
    private ArrayList<Double> marks; // The courses marks

    public Student(int id, String name){
        this.ID = id;
        this.name = name;
        this.marks = new ArrayList<Double>();
    }

    public String getName() {
        return this.name;
    }

    public int getID() {
        return this.ID;
    }

    public void addMark(double mark){
        this.marks.add(mark);
    }

    public double computeAverage(){
        if (this.marks.size() == 0){
            return -1;
        }
        else {
            double sum = 0;
            for(Double d : this.marks){
                sum += d;
            }
            return sum/this.marks.size();
        }
    }
}
```

(Question 4 continued on next page)

(Question 4 continued)

(b) [23 marks] The following StudentReporter class reads data about students from a file, and reports their average grades.

A student data file contains one line for each student:

- The first value on each line is a student ID, followed by
- The student first name, followed by
- The number of courses this student had, followed by
- All the grades this student has received.

For example, in the file

```
3001 David 5 25.3 48.5 25.1 93 74
3023 Lindsay 2 20.3 50.5
3022 Monique 1 99
```

David's ID is 3001 and he has taken 5 courses with the marks 25.3, 48.5, 25.1, 93, and 74.

You may assume that for each student, the number of marks matches exactly the number of courses.

Complete the following methods in the StudentReporter class:

1. `public void loadStudentFile(String fileName)`. This method loads all the data about the students from the given file into the list of Students in `stdList`.
2. `public void printAverageMarks()`. This method prints out the name, ID, and average mark for each student in `stdList`. It should use the `computeAverage()` method in the Student class.

(Question 4 continued)

```
public class StudentTest {

    private ArrayList<Student> stdList = new ArrayList<Student>(); // list of Students

    public void loadStudentFile( String fileName){
        try{
            Scanner scan = new Scanner (new File(fileName));
            while(scan.hasNext()){
                int ID = scan.nextInt ();
                String name = scan.next();
                int count = scan.nextInt ();
                Student s = new Student(ID, name);
                for( int i = 0; i<count; i++){
                    s.addMark(scan.nextDouble());
                }
                this . stdList . add(s);
            }
        }

        } catch(Exception e){Ul. println ("Fail: " + e);}
    }

    public void printAverageMarks(){
        for (Student s : this . stdList ){
            Ul. println (s.getID() + " " + s.computeAverage());
        }
    }
}
```

Student ID:

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