TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

Student ID: .....

EXAMINATIONS — 2012

END-OF-YEAR

COMP 102
INTRODUCTION TO COMPUTER PROGRAM DESIGN

Time Allowed: 3 Hours ******** WITH SOLUTIONS **********

Instructions: Attempt ALL Questions.

Answer in the appropriate boxes if possible — if you write your answer elsewhere, make it clear where your answer can be found.

The exam will be marked out of 180 marks.

Only silent non-programmable calculators or silent programmable calculators with their memories cleared are permitted.

Non-electronic foreign language dictionaries are permitted.

Java Documentation will be provided with the exam script.

There are spare pages for your working and your answers in this exam, but you may ask for additional paper if you need it.

Questions

	Marks
1. Understanding Java	[75]
2. Objects, Arrays of Objects	[25]
3. Interface Classes	[20]
4. 2D Arrays	[30]
5. Files, Array of Numbers	[30]

SPARE PAGE FOR EXTRA ANSWERS

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 [75 marks]

(a) [8 marks] What will the following fragment of Java code print out?

```
int x = 0;
int y = 0;
while (x < 10){
    UI.println (x + "  :  " + y);
    y = y + 1;
    x = x + 2;
}
UI.println ("done");
```

```
0  :  0
2  :  1
4  :  2
6  :  3
8  :  4
done
```

(b) [8 marks] The conditionalTest method below has two parameters and prints out a message.

```
public void conditionalTest( int first , int second){
    String ans = "";

    if ( first > 2) {
        ans = ans + "start";
    }

    if ( first > 3 && second < 10) {
        ans = ans + " first";
    }
    else if ( first < 2 || second > 12) {
        ans = ans + " second";
    }
    else {
        ans = ans + " all";
    }
    UI. println (ans + " done");

}
```

What would the following calls to conditionalTest print out?

conditionalTest(2, 8); $\Longrightarrow$ all done

conditionalTest(1, 12); $\Longrightarrow$ second done

conditionalTest(5, 5); $\Longrightarrow$ start first done

(c) [10 marks] Complete the following smallNumber method which returns the minimum of the two numbers specified by the two parameters (doubles). For example, smallNumber(4.5, 9.1) should return 4.5.

```
public double smallNumber (double x, double y){

    if (x > y) return y;
    else return x;




}
```

(d) [12 marks] Consider the following printNames method.

```
public void printNames(String [ ] names){
    UI. println (names[3]);
    UI. println (names.length);
    UI. println (names[0].length());
    UI. println (names[1] + names[2+1]);

    for( int i=0; i<names.length−1; i++){
        names[i] = names[i+1];
    }
}
```

Suppose that the variable names is defined as follows:

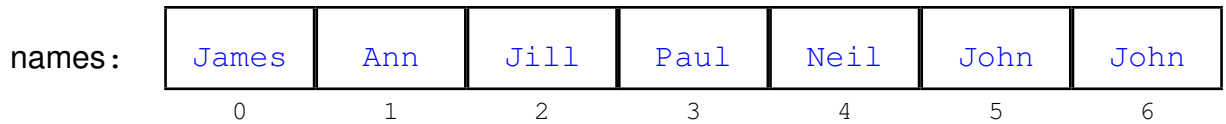
```
String [ ] names = new String[ ]{"Peter","James","Ann","Jill","Paul","Neil","John"};
```

What will be printed in the text pane if printNames(names) is called?

```
Jill
7
5
JamesJill
```

Show the contents of names after the method call

```
printNames(names);
```



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(Question 1 continued)

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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.

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(Question 1 continued)

(e) [12 marks] Suppose the file `data.txt` contains the text:

```
chocolate  3.40   tim tam             17
plain      1.90   ginger nuts         20
chocolate  2.80   mallowpuffs         10
```

What will the following printBiscuits method print out?

```
public void printBiscuits (){
    try{
        Scanner scan = new Scanner (new File("data.txt"));
        UI. println (scan.next ());
        UI. println (scan.nextDouble());
        UI. println (scan.nextLine ());

        while ( scan.hasNext() ){
            if (scan.hasNextDouble()){
                scan.nextDouble();
            }
            else {
                UI. println (scan.next ());
            }
        }
        scan.close();
    }
    catch(IOException e){UI.println("File reading failed");}
}
```

```
chocolate
3.40
tim tam 17
plain
ginger
nuts
chocolate
mallowpuffs
```

(Question 1 continued on next page)

(Question 1 continued)

(f) [13 marks] Complete the House class on the facing page which stores information about houses for sale.

A House object should contain three fields:

- address, which contains the address of the house.
- size, which contains the number of bedrooms (*e.g.* 3)
- price, which contains the price.

House should have a constructor that takes one String parameter, one integer parameter and one double parameter and stores them in the fields.

House should have three methods:

- getPrice, which returns the price of the house.
- setPrice, which updates the price field with a specified new price.
- toString, which returns a String containing the values of all the fields, e.g.

```
"21 karori, 3 brms, $650000.0"
```

(Question 1 continued on next page)

(Question 1 continued)

```
public class House{
    // fields

    private String address;
    private int size;
    private double price;



    // constructor

    public House(String a, int s, double p){
        this.address = a;
        this.size = s;
        this.price = p;
    }




    // methods
    public double getPrice(){
        return this.price;
    }

    public String toString(){
        return ( this.address + " ," + this.size + " brms \$" + this.price);
    }

    public void setPrice(double p){
        this.price = p;
    }









}
```

(Question 1 continued on next page)

(Question 1 continued)

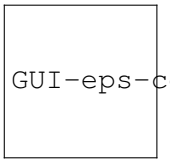
(g) [12 marks]

Consider the PatternDrawer class on the facing page, which constructs a simple GUI. It has two fields that store a position (lastX, lastY) and a field to store the current shape to draw.

Sketch below what the program would draw on the canvas if the user took the following actions in sequence:

1. press mouse at point 1
2. release mouse at point 2
3. press the "Button1" button
4. press mouse at point 3
5. release mouse at point 4
6. press the "Button2" button
7. press mouse at point 5
8. release mouse at point 6

Draw your answers in the figure below.



(Question 1 continued on next page)

(Question 1 continued)

```
public class PatternDrawer implements UIButtonListener, UIMouseListener{

    private double lastX = -1;
    private double lastY = -1;
    private String shape = "";

    public PatternDrawer(){
        UI.setMouseListener(this);
        UI.addButton("Button1", this);
        UI.addButton("Button2", this);
        UI.addButton("Clear", this);
    }

    public void buttonPerformed(String button){
        if (button.equals("Button1"))
            this.shape = "shape1";
        if (button.equals("Button2"))
            this.shape = "shape2";
        if (button.equals("Clear"))
            UI.clearGraphics();
    }

    public void mousePerformed(String action, double x, double y) {
        if (action.equals("pressed")){
            this.lastX = x;
            this.lastY = y;
        }
        else if (action.equals("released")){
            if (this.shape.equals("shape1")){
                UI.drawOval(x-10, y-10, 20, 20);
            }
            else{
                UI.drawLine(this.lastX, this.lastY, x, y);
            }
        }
    }
}
```

Question 2. Objects, Arrays of Objects [25 marks]

This question concerns a FlatFinder program to let users examine a list of available flats. The FlatFinder class (on the facing page) stores the information about the flats in a field containing an array of Flat objects. It also has a count field that contains the number of Flat objects, and the Flat objects are stored in cells 0 through count-1 of the array.

The Flat class, for representing information about individual flats, is shown below. You should use the appropriate Flat methods in your answers.

```
public class Flat{
    // fields
    private String address;
    private String landlord;
    private int bedrooms;  // number of bedrooms
    private double rent;      // weekly rent
    // constructor
    public Flat(String addr, String landl, int beds, double rnt){
        this.address = addr;
        this.landlord = landl;
        this.bedrooms = beds;
        this.rent = rnt;
    }
    //methods
    public void printDetails (){
        UI.printf ("%d beds, $%.0f /week, %s (%s)\n",
                this.bedrooms, this.rent, this.address, this.landlord );
    }
    public String getAddress() {
        return this.address;
    }
    public boolean hasLandlord(String name){
        return (this.landlord.equals(name));
    }
    public int getBeds() {
        return this.bedrooms;
    }
    public double getRent() {
        return this.rent;
    }
}
```

(Question 2 continued on next page)

(Question 2 continued)

The following are some of the fields of the FlatFinder class:

```
public class FlatFinder{

    private Flat [ ] flats = new Flat[1000];
    private int count = 0;
```

(a) [10 marks] What will the following testFlats method print out?

```
public void testFlats (){
    Flat f = new Flat("1/12 Victoria", "Alex", 4, 400);
    Flat g = new Flat("90 Glenmore", "Bob", 8, 600);

    UI.println (f.getRent());
    g.printDetails ();

    count= 0;
    flats [count] = f;
    count++;
    flats [count]= g;
    count++;

    flats [0]. printDetails ();
    UI.println ( flats [1]. getBeds());
}
```

```
400.0
8 beds, $600 /week, 90 Glenmore(Bob)
4 beds, $400 /week, 1/12 Victoria (Alex)
8
```

(Question 2 continued)

(Question 2 continued on next page)

(Question 2 continued)

(b) [15 marks] Complete the following costOfBiggest method to return the rent of the biggest flat with the most number of bedrooms. If there is a tie for biggest, it should return the rent of the earliest one in the list. This method should also print the details of the biggest flat.

```
public double costOfBiggest(){
    int room = 0;
    int biggest = -1;
    for (int i=0; i<this.count; i++){
        if (this.flats[i].getBeds() > room){
            room = this.flats[i].getBeds();
            biggest = i;
        }
    }
    this.flats[biggest].printDetails();
    return this.flats[biggest].getRent();




}
```

Question 3. Interface Classes [20 marks]

This question addresses the design of a program to help a manager record all the products in a shop. There are a number of different kinds of products: fruits, vegetables, food, toys, etc. The different kinds of products behave differently, so there is a separate class for each. However, every product will have the following in common:

- fields to store values such as the name of the product, the barcode, the price and whether it is on sale.
- a getInfo method that returns a short String containing a description of the product, including the name, price and whether it is on sale.
- a getPrice method that returns the price of the product.
- a putOnSale method with a parameter to specify the discount, e.g. 30 for 30% off. This method should set a true value to the onSale field and update the price accordingly.

The program must have a single array containing all the products. To do this, we need an interface class called Product that specifies a type that includes the different kinds of products.

(a) [10 marks] Complete the following definition of the Product interface class.

```
public interface Product {
    public String  getInfo ();
    public double getPrice();
    public void putOnSale(int n);









}
```

(Question 3 continued on next page)

(Question 3 continued)

(b) [10 marks] Modify/Extend the following Food class so that a Food is a type of Product, ensuring that it corretly implements the Product interface class.

```
public class Food implements Product{
    private String name;
    private String barcode;
    private double price;
    private boolean onSale = false;
    private String expiryDate;
    private String pictureName;

    public Food(String Nm, String code, double val, String d, String fileName){
        this.name = Nm;
        this.barcode = code;
        this.price = val;
        this.expiryDate = d;
        this.pictureName = fileName;
    }

   public void display(double x, double y){
        UI.drawImage(this.pictureName, x, y);
    }

    public double getPrice(){return this.price;}
  // Write your answers here

    public String getInfo(){
        String s = this.name +'' ''+ this.price + '' ''+ this.expiryDate;
        if (onSale) s = s + " on sale";
        return s;
    }

    public void putOnSale(int x){
        this.price = this.price * (1-x/100);
        this.onSale = true;
    }









}
```

Question 4. 2D Arrays [30 marks]

The Noughts and Crosses is a game consisting of a 3×3 grid of squares. The class stores the current state of the game in a field containing a 2D array of char values ('O' for noughts, 'X' for crosses, '\0' for empty):

```
public class NoughtsCrosses{
    private char [ ][ ] board;
    private sqSize = 50;
      :
```

You are to write two methods for the NoughtsCrosses class.

(a) [15 marks] Complete the following drawBoard method which should draw the board in the Graphics pane.

For example, if the 2D array contains

```
{{'\0','X','X'},
 {'O','O','O'},
 {'X','X','O'}}
```

it should draw the following diagram.

You should draw nine squares for the board. The top left square should be at position (100,100), and the width of the squares should be 50 units. Each square may contain a circle (for 'O' value), or two lines (for 'X' value) or nothing for a default value of '\0'(not a char).

```
private void drawBoard(){
    UI.clearGraphics();

    for (int row=0; row<3; row++){
        for (int col=0; col<3; col++){
            double x = 100 + col *sqSize;
            double y = 100 + row *sqSize;
            UI.drawRect(x, y, sqSize, sqSize);
            if (board[row][col]=='O')
                UI.drawOval(x+1, y+1, sqSize-2, sqSize-2);
            else if ( board[row][col]=='X'){
                UI.drawLine(x, y, x+sqSize, y+sqSize);
                UI.drawLine(x+sqSize, y, x, y+sqSize);
            }
        }
    }









}
```

(Question 4 continued on next page)

(Question 4 continued)

(b) [15 marks] Complete the following checkRow method whose parameter is the index of a row on the board, and should return true if all the cells in the given row are filled with the same char (either 'O' or 'X'), and false otherwise.

For example, checkRows(0) on the game shown on the previous page should return false and checkRows(1) should return true.

```
public boolean checkRow(int row){
    for ( int col=1; col<3; col++){
        if ( board[row][col]=='\0' ||!(board[row][col]==(board[row][0])) ){
            return false;
        }
    }
    return true;









}
```

SPARE PAGE FOR EXTRA ANSWERS

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

Question 5. Files, Array of Numbers [30 marks]

This question stores and processes a collection of integer numbers in an array. The array is declared and created as follows:

```
private int[ ] data = new int [200];
private int count = 0;
```

(a) [12 marks] Suppose the numbers.txt file contains about 100 integer numbers, and some text which may appear anywhere in the file. Complete the following loadNumbers method to read all the numbers into the data array and ignore all the text.

The file numbers.txt may look like this:

```
10 3 text may appear
anywhere 1 20 in 5
2 4 in the 10 file
```

```
public void loadNumbers() {
    try{
        Scanner scan = new Scanner (new File("numbers.txt"));

        while (scan.hasNext() && this.count < this.data.length){
            if (scan.hasNextInt()){
                this.data[count] = scan.nextInt ();
                this.count++;
            }
            else scan.next();
        }

        scan.close();
    }
    catch(IOException e){UI.println("File reading failed");}
}
```

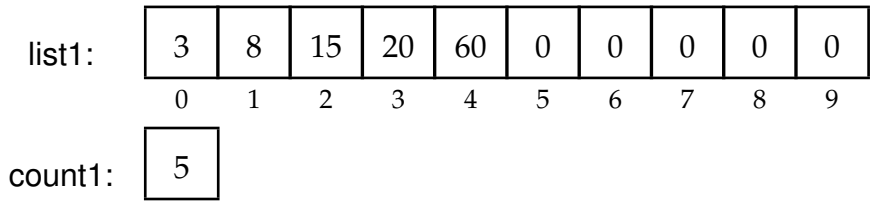
(Question 5 continued on next page)

(Question 5 continued)

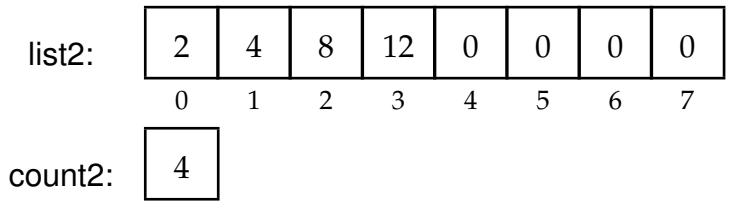
(b) [18 marks] Write a method to merge two sorted/ordered list of numbers into one sorted list of numbers.

The result list should be saved in the array data field data (with the help of the integer field count). You may assume that the data array has enough extra space for all the numbers.

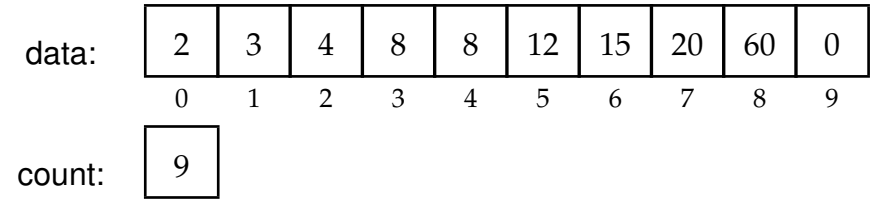
For example, given a sorted list of 5 numbers:



and an array of 4 sorted numbers:



merge(list1, 5, list2, 4) should produce the following array:



Note that the numbers in list1 and list2 are ordered and the numbers in the data array must be ordered too. Duplicate numbers are allowed.

```
public void merge(int [ ] list1 , int count1, int [ ] list2 , int count2){
    count = 0;
    int i = 0;
    int j = 0;

    while((i < count1)&& (j <count2)) {
        if ( list1 [i] < list2 [j]){
            data[count] = list1 [i];
            i++;
            count++;
        }
        else{
            data[count] = list2 [j];
            j++;
            count++;
        }
    }
    if (i==count1) {
        for( int t = j; t < count2; t++){
            data[count] = list2 [t];
            count++;
        }
    }
    if (j==count2) {
        for( int t =i; t <count1; t++){
            data[count] = list1 [t];
            count++;
        }
    }









}
```

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SPARE PAGE FOR EXTRA ANSWERS

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