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

EXAMINATIONS – 2016

TRIMESTER 1

COMP 102
INTRODUCTION TO COMPUTER PROGRAM DESIGN

Time Allowed: TWO HOURS ******** WITH SOLUTIONS **********

CLOSED BOOK

Permitted materials: Silent non-programmable calculators or silent programmable calculators with their memories cleared are permitted in this examination.

Printed foreign language–English dictionaries are permitted.

No other material is permitted.

Instructions: Attempt ALL Questions.

The exam will be marked out of 120 marks.

Brief Java Documentation will be provided with the exam script

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

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	[32]
2. Files and ArrayLists	[22]
3. Defining Interfaces and Classes	[20]
4. ArrayLists of Objects	[26]
5. Arrays	[20]

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 **(32 marks)**

(a) (6 marks) Loops and calling methods.

What will the following printNumbers method print out?

```
public void printNumbers(){
    int m = 10;
    this.doPrint(m);
    UI.println(m);
}
public void doPrint(int x){
    while (x < 100){
        x = x * 2;
        UI.println("x: " + x);
    }
    UI.println("finally "+ x);
}
```

```
Write your answers here
x:  20
x:  40
x:  80
x:  160
finally 160
10
```

(b) (6 marks) Calling methods on objects.

Consider the following Score class:

```
class Score {
    private int num;

    public Score(int x ){
        this.num = x;
    }

    public void testA(){
        if ((this.num <3) || (this.num >10)){
            UI. println ("Yes");
        }
        else {
            UI. println ("No");
        }
    }

    public boolean testB(int y){
        return (this.num < y);
    }
}
```

What will the following useObjects method print out?

```
public void useObjects(){
    Score sc1 = new Score(15);
    Score sc2 = new Score(10);
    sc1.testA ();
    UI. println (sc1.testB (12));

    if (sc2.testB(13))
        UI. println ("good");
    else
        UI. println ("better");
}
```

Write your answers here

Yes
false
good

(c) (6 marks) Arrays.

What will the following arrayTest method print out?

```
public void arrayTest(){
    String [ ] cities = new String [ ]{"Syd", "Auck", "Mel", "Wlg", "Cairns"};

    int n = 3;
    cities [n] = cities [n+1];

    for( int i=0; i < cities .length; i++){
        if ( cities [ i ]. length()>3){
            UI. println ( cities [ i ]);
        }
    }
}
```

```
Auck
Cairns
Cairns
```

(d) (6 marks) Using 2D Arrays.

What will the following array2DTest method print out?

```
public void array2DTest(){
    int [ ][ ] nums = new int[ ][ ]{{ 1,  3,  5,  7},
                                    {11, 14, 17, 20},
                                    {21, 25, 29, 33}};

    UI.println ( nums[0][3] );
    UI.println ( nums[2][0] );

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

    for ( int k = 0; k < 3; k++){
        UI.println ( nums[k][k] );
    }
}
```

```
Write your answers here
7
21



-------------------------
1
29
29
```

(e) (8 marks) Using ArrayLists.

What will the following arrayListTest method print out?

```
public void arrayListTest(){
    ArrayList <Double> nums = new ArrayList<Double>();
    nums.add(2.4);
    nums.add(5.2);
    nums.add(7.5);
    nums.add(10.0);
    UI.println(nums.size());
    UI.println(nums.get(0));
    UI.println(nums.indexOf(10.0));
    UI.println("----------------");
    nums.add(1, 20.3);
    for(double n : nums){
        UI.println(n);
    }
    UI.println("----------------");
    nums.set(2, 11.1);
    nums.remove(3);
    for(double n : nums){
        UI.println(n);
    }
}
```

```
Write your answers here
4
2.4
3



-------------------------
2.4
20.3
5.2
7.5
10.0



---------------------
2.4
20.3
11.1
10.0
```

Question 2. Files and ArrayLists **(22 marks)**

This question concerns a class with methods for processing files that contain a mixture of numbers and text. The text can be anywhere in the file and can be of any length. The following is an example of a file that this class can process:

```
5 9 some notes 1.5 2.6 here 10 20 8 8
and 30 20 60 there 20.3 50 every where 70.1
12 40 in any length 40 50 15 70 15.4 19
```

Suppose the class has a nums field defined as follows

```
private ArrayList<Double> nums = new ArrayList<Double>();
```

(a) (10 marks) Complete the following readToArrayList method that adds every number in a file into the ArrayList in the nums field. The parameter of the readToArrayList method is the name of the file to read.

```
public void readToArrayList(String filename){

    try{

        Scanner sc = new Scanner(new File(filename));

        while(sc.hasNext()){
            if (sc.hasNextDouble()){
                this.nums.add(sc.nextDouble());
            }
            else {
                sc.next();
            }
        }
        sc.close();









    } catch(IOException e){UI.println("error: " + e);}
}
```

(b) (12 marks) Complete the following writeToFile method that writes the numbers in the nums field into a new file. The name of the new file is specified in the parameter.

The first line in the new file should contain just one integer, which specifies how many numbers are in the file.

The rest of the file should contain all the numbers in the ArrayList. For full marks there should only be 5 numbers on each line.

For example, using the example file on the facing page, the new file should contain

```
22
5.0 9.0 1.5 2.6 10.0
20.0 8.0 8.0 30.0 20.0
60.0 20.3 50.0 70.1 12.0
40.0 40.0 50.0 15.0 70.0
15.4 19.0
```

Hint: write the numbers with print, and after every fifth number, do a println();

```
public void writeToFile(String filename){
    try{


        PrintStream out = new PrintStream(new File(filename));
        out.println(this.nums.size());

        int i = 0;
        while(i < this.nums.size()){
            out.print(this.nums.get(i) + "  ");
            i++;
            if (i % 5 ==0){
                out.println();
            }
        }
        out.println();
        out.close();

( Alternatively , you can use a for loop; also it is Ok to reset i to zero
when it reaches 5)



    } catch(Exception e){UI.println("file error");}
}
```

Question 3. Defining Interfaces and Classes **(20 marks)**

Suppose you are writing a program for a club manager. The club has many different kinds of members(e.g. adults, children, seniors, etc.), who are charged differently and may pay their fees in different ways (e.g. fortnightly or weekly).

Suppose you want to store all club members in an ArrayList, and the following code is written for you. Member is an interface class.

```
public class Club {
    ArrayList <Member> members = new ArrayList<Member>();

public void printInvoices (){
    for (Member m : members) {
        UI. println (m.getName());
        m.printInvoice ();
    }
}

public void makePayment(int memberNo, double amount){
    for (Member m : members) {
        if (m.getNumber()==memberNo){
            m.topUpAccount(amount);
            UI. println (m.toString ());
        }
    }
}
```

The printInvoices method goes through all members and prints the name and an invoice (e.g. "$20 fortnightly") for each member.

The makePayment method updates the account balance of a particular member.

(a) (8 marks) Define the Member interface, so that the code above would compile correctly.

```
public interface Member{



    public int getNumber();
    public String getName();
    public void printInvoice ();
    public void topUpAccount(double a);



}
```

(b) (12 marks) Complete the following AdultMember class.

This class should implement the Member interface and work well with the code given on the facing page.

You will need to define the appropriate fields, a constructor and all the necessary methods.

- The constructor should have parameters for the member's name and number.
- The printInvoice method can be very simple, e.g. prints a one line message "pay $20 fortnightly" for all adult members.
- The topUpAccount method should add an amount to the member's account balance which should be stored in a field.
- The toString method should include the name, number, and account balance.
- The other methods are very straight forward.

```
class AdultMember                    implements Member {

    private String name;
    private int no;
    private double balance;

    public AdultMember(String n, int d){
        this.name =n;
        this.no = d;
    }

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

    public int getNumber(){
        return this.no;
    }

    public void printInvoice (){
        UI. println (this.name + " pay fortnightly: \$20");
    }

    public void topUpAccount(double x){
        this.balance = this.balance + x;
    }

    public String toString (){
        return this.name + "  " + this.no + "  \$" + this.balance;

    }

}
```

Question 4. ArrayLists of Objects **(26 marks)**

This question concerns a program for managing the loyalty programme for customers of a company. The program has two classes: a Customer class and a LoyaltyProgramme class.

The Customer class below defines Customer objects, which store the customer names and the points they have earned.

```
class Customer {
    private String name;
    private int points = 0;

    public Customer(String s) {
        this.name = s;
        this.points = 0;
    }

    public void updatePoints(int n) {
        this.points = this.points + n;
    }

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

    public String toString(){
        return (this.name + " : " + this.points + " points ");
    }
}
```

(Question 4 continued on next page)

(Question 4 continued)

The LoyaltyProgramme class defines a field to store the list of Customer objects:

```
private ArrayList<Customer> customers = new ArrayList<Customer>();
```

You may assume that customers will never contain any null values.

The LoyaltyProgramme class also defines several methods.

(a) (12 marks) Complete the following printVouchers method that prints a voucher for each customer in the loyalty programme who has earned more than 200 points.

The amount of the voucher depends on the points: $10 is awarded for every 200 points. For example, if a customer has earned 600 points, the voucher should be $30.

Print the name and the amount for each voucher. For full marks, the vouchers should always be for a multiple of $10 — with 430 points, the voucher should be just $20.

```
public void printVouchers(){


    for(Customer c : this.customers){
        if (c.getPoints() > 200){
            int n = c.getPoints()/200 * 10;
            UI. println (c.getName() + ": \$" + n);
        }
    }









}
```

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 4 continued)

(b) (14 marks) Complete the following earnPoints method that calculates and updates the points for a purchase by a customer. The first parameter is the customer name. The second parameter is the amount that the customer has spent. The customers earn 1 point for each $20 they spend.

If the customer is not found in the database, earnPoints should print a "new customer" message and automatically add this customer to the database and update the customer's points.

After the points are updated, it should print the details of the customer.

```
public void earnPoints(String name, double amount){

    int p = (int) amount/20;
    for (Customer c : this.customers) {
        if (name.equals(c.getName())){
            c.updatePoints(p);
            UI.println(c);
            return;
        }
    }

    UI.println("new customer!");
    Customer nc = new Customer(name);
    nc.updatePoints(p);
    this.customers.add(nc);
    UI.println(nc);
    }









}
```

Question 5. Arrays **(20 marks)**

Consider the following program with a field called hand which contains an array of up to 10 cards.

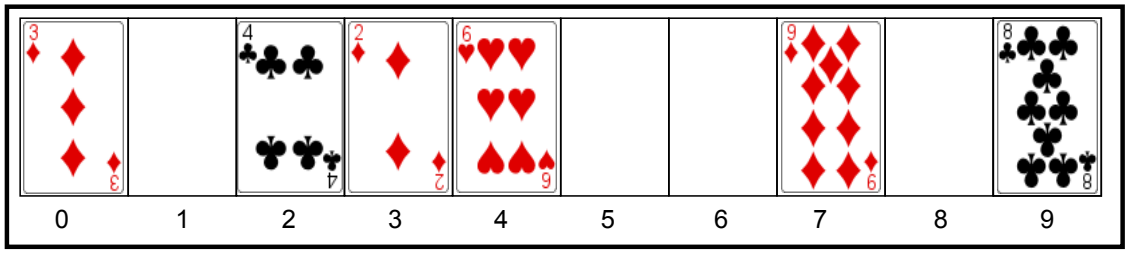
The startHand method adds some cards to the array.

You can assume the Card class has a constructor with two parameters specifying the card suit (diamonds, hearts, spades, clubs) and rank (1-13).

```
private Card[] hand = new Card[10];

public void startHand() {
    this.hand[0] = new Card("diamonds", 3);
    this.hand[2] = new Card("clubs", 4);
    this.hand[3] = new Card("diamonds", 2);
    this.hand[4] = new Card("hearts", 6);
    this.hand[7] = new Card("diamonds", 9);
    this.hand[9]= new Card("clubs", 8);
}
```

After calling startHand, the array would look like this:



(a) (5 marks) What does the following testPrint method print out? Very briefly describe what it does in one sentence.

```
public void testPrint () {
    int count = 0;

    for (int i = 0; i < this.hand.length; i++){

        if (this.hand[i] == null){
            count ++;
        }
    }
    UI.println (count);
}
```

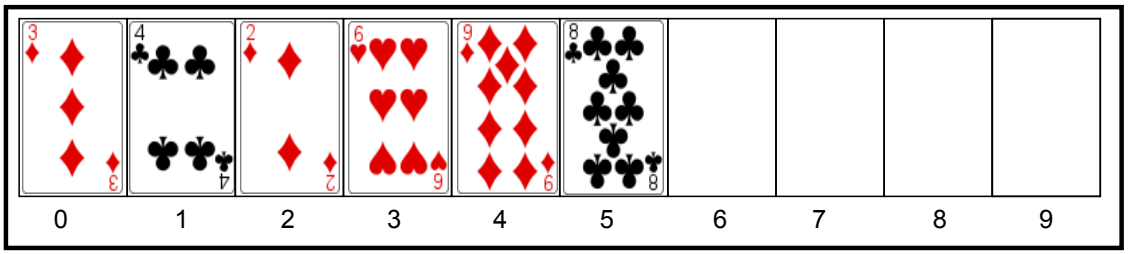
Output:

4

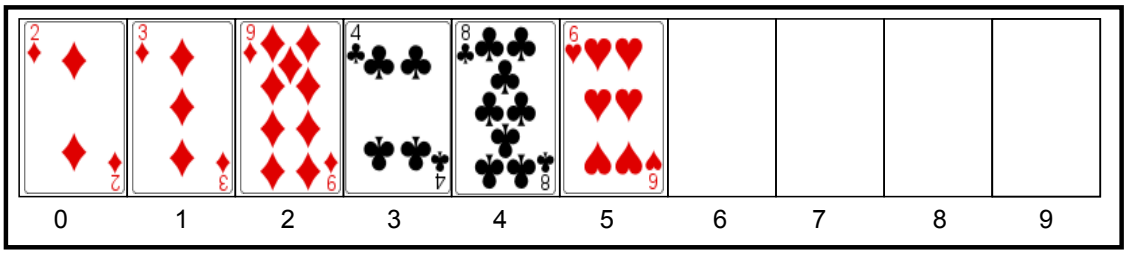
Description: It counts the number of empty places in the array.

(b) (15 marks) Complete the following compact method that moves all the Cards as far to the left as possible, so that the Cards fill the first part of the array and any nulls are in the rest of the array.

For example, after running this method on the example array shown before, the array should now look like this:



For full marks, you should put all cards with the same suit together, and sort the card in each suit in increasing order of the ranks. For example, it would be better if your array looks like this:



You may assume the Card class has getSuit and getRank methods that return the suit and the rank of a Card.

```
    public void compact(){
        int i = 0;
        int j = 0;
        while (i < hand.length){
            if (hand[i] != null){
                hand[j] = hand[i];
                if (i>j) {hand[i]=null;}
                i++;
                j++;
            }
            else{
                i++;
            }
        }
//OR
        ArrayList<Card> newHand = new ArrayList<Card>();

        for (Card c : this.hand){
            if (c!=null){
                newHand.add(c);
            }
        }
        this.hand = new Card[this.hand.length];
        for (int i=0; i<newHand.size(); i++){
            this.hand[i] = newHand.get(i);
        }
    }
//OR WITH SORTING
        Card[] newHand = new Card[10];
        int pos = 0;
        for (String suit : new String[]{"diamonds", "hearts", "clubs", "spades"}){
            for (int rank = 1; rank<=13; rank++){
                for (Card c : this.hand){
                    if (c!=null && suit.equals(c.getSuit()) && rank==c.getRank()){
                        newHand[pos] = c;
                        pos++;
                    }
                }
            }
        }
    }   this.hand = newHand;
```

* * * * * * * * * * * * * * *