



**EXAMINATIONS — 2011**

**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.

Non-programmable calculators without a full alphabetic key pad 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.

**Questions**

	<b>Marks</b>
1. Understanding Java	[71]
2. Arrays of Objects	[32]
3. Interface Classes	[23]
4. 2D Arrays	[27]
5. File and Array of Numbers	[27]

**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**

[71 marks]

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

```
int j = 5;
int k = 2;
while (k < j){
    Ul. printf ("%d, %d, %d \n", j, k, j+k);
    k++;
}
Ul. println ("Done");
```

```
5, 2, 7
5, 3, 8
5, 4, 9
Done
```

(Question 1 continued on next page)

**(Question 1 continued)**

**(b)** [8 marks] The choice method below has one parameter and prints out a message depending on the value of the parameter (note the **if**'s and **else**'s carefully):

```
public void choice(int x) {  
    if (x >= 15) {  
        Ul.print ("1st ");  
    }  
    else if (x > 5){  
        Ul.print ("2nd ");  
    }  
    else {  
        Ul.print ("3rd ");  
    }  
    if (x < 10){  
        Ul.print ("4th ");  
    }  
    Ul.println ();  
}
```

What would the following calls to choice print out?

choice(8);  $\implies$

2nd 4th

choice(2);  $\implies$

3rd 4th

choice(20);  $\implies$

1st

(Question 1 continued on next page)

**(Question 1 continued)**

(c) [8 marks] Complete the `computeArea` method below which should compute the area of a rectangle. It should have two parameters (doubles) which are the height and the width of a rectangle. Hint: The value of the area of a rectangle equals the height times the width.

```
public double computeArea (double height, double width){  
  
    return height * width;  
  
}
```

(d) [8 marks] What series of numbers will the following fragment of Java print out?

```
int curr = 3;  
while (curr <= 30){  
    UI.print (curr + " ");  
    int next = curr * 2;  
    curr = next;  
}  
UI.println ("Done");
```

```
3 6 12 24 Done
```

**(Question 1 continued)**

(e) [8 marks] Consider the following printStuff method.

```
public void printStuff (){
    String [ ] words = new String[ ] { "dog", "bee", "fox", "cat", "ant", "eel" };

    Ul.println (words[1]);
    Ul.println (words.length);
    Ul.println (words[0].length ());

    int n= 2;
    Ul.println (words[n] + words[n+1]);

    for( int j=3; j<words.length; j++){
        Ul.print (words[j]+ " ");
    }
    Ul.println ();
}
```

What will be printed in the text pane if printStuff is called?

```
bee
6
3
foxcat
cat ant eel
-
-
-
```

(Question 1 continued on next page)

**(Question 1 continued)**

(f) [8 marks] Complete the following sum method. sum has one parameter – an array of int – and should return the sum of the values in the array.

```
public double sum(int [ ] data){
    int total = 0;
    for (int i=0; i<data.length; i++){ //OR for (double n : data){
        total = total + data[i]; // total += n;
    }
    return total ;
}
}
```

**SPARE PAGE FOR EXTRA ANSWERS**

Cross out rough working that you do not want marked.  
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(g) [8 marks] Suppose the file `offices.txt` contains the following text:

```
Anderson Baylor Carson 323 Cotton
Dirchel Euston 518 Cotton
French Grafton Hill 841 Kirk
Inuei Joyce 401 Kirk
```

What will the following `printOffices` method print out?

```
public void printOffices (){
    try{
        Scanner scan = new Scanner (new File("offices.txt"));
        int s = 0;
        while ( scan.hasNext() ){
            if (scan.hasNextInt()){
                int n = scan.nextInt ();
                UI.println (n + " ");
                s++;
            }
            else {
                scan.next();
            }
        }
        UI.println (s);
        scan.close();
    }
    catch(IOException e){UI.println("File reading failed");}
}
```

```
323
518
841
401
4
```

**(Question 1 continued)**

**(h)** [15 marks] Complete the `Team` class on the facing page that stores information about teams in a game.

A `Team` object should contain three fields:

- `name`, which contains the name of the team.
- `country`, which contains the country of the team.
- `score`, which contains the score of a particular game. The initial value should be zero.

`Team` should have a constructor that takes two `String` parameters and stores them in the `name` and `country` fields.

`Team` should have three methods:

- `showScore()`, which displays the country and the score of the team.
- `updateScore(int p)`, which updates the score by the specified number of points.
- `toString()`, which returns a `String` containing the values of all fields.

(Question 1 continued on next page)

**(Question 1 continued)**

```
public class Team{
    // fields
    private String name;
    private String country;
    private int score;

    // constructor
    public Team(String n, String c){
        this.name = n;
        this.country = c;
        this.score = 0;
    }

    // methods

    public String toString(){
        return this.name + " " + this.country + " (" + this.score + ") ";
    }
    public void updateScore(int p) {
        this.score = this.score + p;
    }
    public void showScore() {
        UI.println (this.country + " : " + this.score);
    }
}
```

## Question 2. Arrays of Objects

[32 marks]

This question concerns a `Game` program to store information of players. The `Game` class (on the facing page) stores the information about the players in a field containing an array of `Player` objects. It also has a `count` field that contains the number of `Player` objects, and the `Player` objects are stored in cells 0 through `count-1` of the array.

The `Player` class, for representing information about individual player, is shown below.

---

```
public class Player{

    private String name;
    private String country;
    private int gamesPlayed;

    public Player(String nm, String bcountry, int games){
        this.name = nm;
        this.country = bcountry;
        this.gamesPlayed = games;
    }

    public void printDetails (){
        Ul. printf ("%s of %s: %d caps\n",
            this.name, this.country, this.gamesPlayed );
    }

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

    public String getCountry() { return this.country; }

    public int getGamesPlayed() { return this.gamesPlayed; }

}
```

---

**(Question 2 continued)**

(a) [10 marks] What will the following test method in the Game class print out?

```
Public class Game {  
    private Player [ ] players = new Player [8000];  
    private int count = 0;  
  
    public void test(){  
        Player p1 = new Player("Richie McCaw", "NZ", 100);  
        Player p2 = new Player("Dan Carter","NZ", 85);  
        p2.printDetails ();  
        Ul.println (p1.getCountry());  
  
        this.players[count] = p1;  
        this.count++;  
        this.players[count] = p2;  
        this.count++;  
        Ul.println (players [0].getGamesPlayed());  
        Ul.println (players [1].getName());  
    }  
}
```

```
Dan Carter of NZ: 85 caps  
NZ  
100  
Dan Carter
```

**SPARE PAGE FOR EXTRA ANSWERS**

Cross out rough working that you do not want marked.  
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**(Question 2 continued)**

The following is one of the methods of the Game class:

---

```
public void listPlayers (){
    for (int i=0; i<this.count; i++){
        UI.print (i+" : ");
        this.players[i]. printDetails ();
    }
}
```

---

**(b)** [10 marks] Complete the following addPlayer method of the Game class. Its parameter is a Player and it should add the given Player to the players array. If the array is full, the method should print out a message.

```
public void addPlayer (Player p){
    if (this.count < this.players.length) {
        this.players[this.count++] = p;
    }
    else {
        UI.println ("No room to add");
    }
}
```

**SPARE PAGE FOR EXTRA ANSWERS**

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(c) [12 marks] Complete the following `sufficientGames` method in the `Game` class, which has one parameter — the name of a country — and should return true if the total of the numbers of games played by the players from that country is at least 500.

```
public boolean sufficientGames(String country){
    int total = 0;
    for (int i=0; i<this.count; i++){
        if (country.equals(this.players[i].getCountry())){
            total = total +this.players[i].getGamesPlayed();
        }
    }
    return total >= 500;
}
```

### Question 3. Interface classes

[23 marks]

The VehicleSales program involves an array storing a collection of Vehicle objects. The array can store a collection of different kinds of Vehicles — Car, Van, Bicycle and Bus.

The definition of the Vehicle interface class is given below:

```
public interface Vehicle {  
    public void setPrice(int newPrice);  
    public int getPrice();  
    public int getYear();  
    public String toString ();  
}
```

(Question 3 continued on next page)

**(Question 3 continued)**

(a) [15 marks] Modify/Extend the Bus class below so that a Bus is a type of Vehicle, ensuring that it correctly implements the Vehicle interface class.

```

public class Bus {
    private String company;
    private int capacity;

    private int year;
    private int price;

    public Bus(String comp, int cap){
        this.company = comp;
        this.capacity = cap;
    }

    this.year = y;
    this.price = price;

    public String toString(){
        return this.company + " (" + this.capacity + ") ";
    }

    public void setPrice(int x) {this.price =x;}
    public int getPrice() {return this.price;}
    public int getYear() {return this.year;}

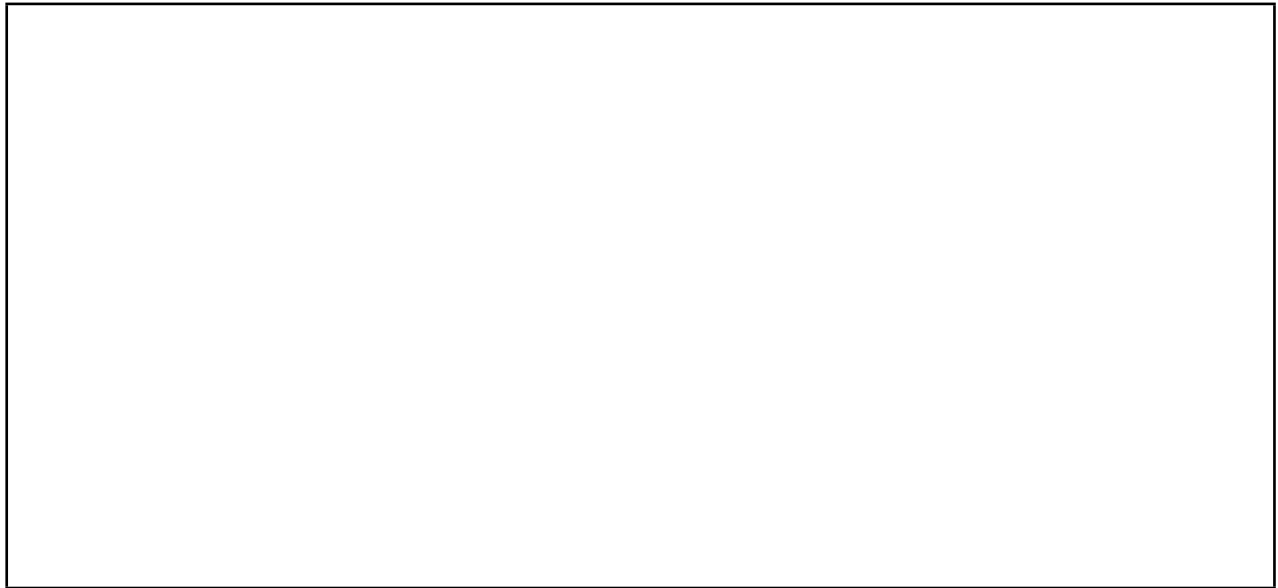
}

```

**SPARE PAGE FOR EXTRA ANSWERS**

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**(b)** [8 marks] Draw a class diagram for the `VehicleSales` program, showing the relationship between the `VehicleSales` class, the `Vehicle` interface class, and the four classes `Bus`, `Car`, `Van`, and `Bicycle`.



#### Question 4. 2D Arrays

[27 marks]

This question is based on your Assignment 9 Part 1 Image Processor. Your task is to implement two main methods. The `ImageProcessor` program deals with greyscale images. Each pixel value is an integer between 0 and 255 where 0 represents black and 255 represents white. The `ImageProcessor` class contains a field called `image` which contains the 2D array of pixel values. You may assume that this class has methods for loading an image and converting it to an 2D array of integers, and methods for displaying the image and saving the image.

---

```
public class ImageProcessor{  
  
    private int[ ][ ] image;  
  
    :
```

---

(a) [13 marks] Complete the following `lightenImage()` method which should make the whole image lighter by 20 greylevels. That is, it should increase the value of each pixel by 20, except that the pixel value must never go above 255.

```
private void lightenImage(){  
  
    for ( int row = 0; row < this.image.length; row++){  
        for ( int col = 0; col < this.image[0].length; col++){  
            this.image[row][col] = Math.min(this.image[row][col] + 20, 255);  
        }  
    }  
  
}
```

(Question 4 continued on next page)

**(Question 4 continued)**

(b) [14 marks] Complete the following `flipImage` method which should flip the image horizontally so that the values on the left side of the image are exchanged with the values on the right side of the image. Be careful not to flip the image twice (eg by copying a pixel to the opposite side and then copying it back.)

```
public void flipImage(){
    int cols = this.image[0].length;
    for (int row = 0; row < this.image.length; row++){
        for (int col = 0; col < cols/2; col++){
            int temp = this.image[row][col];
            this.image[row][col] = this.image[row][cols-1-col];
            this.image[row][cols-1-col] = temp;
        }
    }
}
```

### Question 5. Array of Numbers

[27 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, most of them are positive and some are negative. Complete the following loadPositive method to read all the positive numbers into the data array.

```
public void loadPositive() {  
    try{  
        Scanner scan = new Scanner (new File("numbers.txt"));  
        while (scan.hasNextInt() && count < data.length){  
            int n = scan.nextInt ();  
            if (n > 0) {  
                data[count] = n;  
                count++;  
            }  
        }  
    }  
  
    scan.close();  
}  
catch(IOException e){UI.println("File reading failed");}  
}
```

(Question 5 continued on next page)



**(Question 5 continued)**

**(b)** [15 marks] Complete the following `deleteMax` method to find the maximum value in an array of numbers, and delete all copies of that value in the array.

For example, given the array

6	4	3	7	2	7	1	2	7	2	.....
0	1	2	3	4	5	6	7	8	9	

`deleteMax` should find that 7 is the maximum value, and then delete all the 7s:

6	4	3	2	1	2	2	.....
0	1	2	3	4	5	6	

```

public void deleteMax(){

    int max= data[0];
    for( int i=0; i < this.count;i++){
        if (max < data[i]) max = data[i];
    }

    int k =0;
    int j = 0;
    while(k < data.length){
        if (data[k]==max){
            k++;
            this.count--;
        }
        else{
            data[j] = data[k];
            k++;
            j++;
        }
    }
}

```

```

}

```

\*\*\*\*\*

**SPARE PAGE FOR EXTRA ANSWERS**

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