



EXAMINATIONS — 2011

MID-YEAR

**COMP 102
INTRODUCTION TO
COMPUTER PROGRAM
DESIGN**

Time Allowed: 3 Hours

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

	Marks
1. Understanding Java	[57]
2. Files	[26]
3. Arrays of Objects	[26]
4. Interface classes	[13]
5. Event driven input	[15]
6. 2D Arrays	[23]
7. Debugging loops	[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

[57 marks]

(a) [4 marks] What will the following fragment of Java print out?

```
int i = 1;
int j = 5;
while (j>0){
    Ul. printf ("%d %d %d\n", i, j, i*j );
    i++;
    j--;
}
```

(b) [5 marks] Almost every line of the following broken method has a syntax error that the compiler would complain about. Circle, and briefly explain each error

```
public int broken(number){

    if (number = 10){

        Ul. println ("size 10);

        return;
    }

    for (int i = 0, i < number, i++){

        ans = ans + i;

    }

}
```

(Question 1 continued on next page)

(Question 1 continued)

(c) [6 marks] The `printTimes` method below has one parameter and prints out the times a store is open depending on the value of the parameter (note the **if**'s and **else**'s carefully):

```
public void printTimes(String today){
    if ( today.equals("saturday") || today.equals("sunday") ) {
        Ul.print("Yes, we are open on ");
    }
    else if ( today.equals("thursday") ) {
        Ul.print("Normal hours on ");
    }
    else if ( today.equals("monday") ) {
        Ul.print("Open till late on ");
    }
    }

    Ul.println (today);

    if ( today.startsWith("t") ) {
        Ul.println (today + " special sale");
    }
    else {
        Ul.println (today + " half day");
    }
}
```

What would the following calls to `printTimes` print out?

`printTimes("saturday");` \implies

`printTimes("thursday");` \implies

`printTimes("MONDAY");` \implies

(Question 1 continued on next page)

(Question 1 continued)

(d) [5 marks] Complete the `thirdAngle` method below which should compute the size of the third angle of a triangle. It should have two parameters (doubles) which are the sizes of the first two angles of a triangle.

Hint: the value of the third angle is 180 minus the sum of the first two angles.

```
public      thirdAngle  
  
  
  
  
  
  
  
  
  
}
```

(e) [5 marks] Consider the following `printSeries` method.

```
public void printSeries( int max){  
    int prev = 1;  
    UI. print (prev + " ");  
    int curr = 2;  
    while(curr <= max){  
        UI. print (curr + " ");  
        int next = 2*curr + prev;  
        prev = curr;  
        curr = next;  
    }  
    UI. println ("Done");  
}
```

What will be printed in the text pane if `printSeries` is called with the argument 30?

(Question 1 continued)

(f) [7 marks] Consider the following `printStuff` method which copies some values of an array of `String` into another array, then prints out the other array.

```
public void printStuff (){
    String [] animals = new String[]{"cat","tiger","dog","turtle","sheep","eel","snake"};
    String [] pets = new String [animals.length];

    int count=0;
    for( int i=0; i<animals.length; i++){
        if (animals[i].length()>3){
            pets[count] = animals[i];
            count++;
        }
    }

    for( int i=0;i<pets.length;i++){
        if (pets[i]!=null){
            UI.println (pets[i ]);
        }
        else {
            UI.println ("--");
        }
    }
}
```

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

Hint: show your working, especially the contents of the `pets` array.

(Question 1 continued on next page)

(Question 1 continued)

(g) [7 marks] Suppose the file `offices.txt` contains the following text:

```
Anderson 323 Cotton
Bayson   518 Cotton
Carson   841 Kirk
```

What will the following `printOffices` method print out?

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

(Question 1 continued on next page)

(Question 1 continued)

(h) [8 marks] The Sushi2Go class on the facing page defines Sushi2Go objects, which have three fields to store their fillType, traySize, and sushiCount. The class defines a constructor and three methods.

What will the following testSushi method print out?

```
public void testSushi(){
    Sushi2Go order1 = new Sushi2Go("fish", 6);
    UI.println (order1.toString ());

    order1.addPieces(5);
    UI.println (order1.toString ());
    order1.addPieces(4);
    UI.println (order1.toString ());

    Sushi2Go order2 = new Sushi2Go("eel", 4);
    order2.addPieces(3);
    UI.println (order2.toString ());

    order1.swapTray(order2);
    UI.println (order1.toString ());

    Sushi2Go order3 = new Sushi2Go("carrot", 10);
    order3.addPieces(3);
    order3.swapTray(order1);
    UI.println (order3.toString ());
}
```

(Question 1 continued on next page)

(Question 1 continued)

```
public class Sushi2Go{
    private String fillType ;
    private int traySize;    // maximum number of pieces
    private int pieces;    // current number of pieces in the tray

    public Sushi2Go(String filling , int size){
        this.fillType = filling ;
        this.traySize = size;
        this.pieces = 0;
    }

    public String toString(){
        return (this.pieces + " of " + this.fillType + " on tray " + this.traySize);
    }

    public void addPieces (int n){
        this.pieces = Math.min(this.pieces + n, this.traySize);
    }

    public void swapTray(Sushi2Go other){
        if ( this.pieces < other.traySize  && other.pieces < this.traySize){
            int temp = this.traySize;
            this.traySize = other.traySize;
            other.traySize = temp;
        }
        else {
            UI.println ("Swap failed");
        }
    }
}
```

(Question 1 continued on next page)

(Question 1 continued)

(i) [10 marks] Complete the `SpaceShip` class on the facing page that stores information about space ships.

A `SpaceShip` object should contain two fields:

- `shipName`, which contains the name of the ship.
- `planetsVisited`, which contains the number of planets the ship has been on. The initial value of the field should be 1.

`SpaceShip` should have a constructor that takes one `String` parameter and stores it in the `shipName` field.

`SpaceShip` should have three methods:

- `getPlanets()`, which returns the number of planets the `SpaceShip` has visited.
- `explorePlanet()`, which is called when the `SpaceShip` visits a new planet, and should update the `planetsVisited` field to record that the ship has visited one more planet.
- `toString()`, which returns a `String` containing the name of the space ship and the number of planets visited in the form `"VogonExplorer has visited 35 planets"`

(Question 1 continued on next page)

(Question 1 continued)

```
public class SpaceShip{
```

```
  // fields
```

```
  // constructor
```

```
  // methods
```

```
}
```

Question 2. Files

[26 marks]

Suppose the file `MemorySticks.txt` contains data about memory sticks. Each line of the file contains information about memory stick - the manufacturer, capacity (GB), speed (MB/s), the model, and the price. For example, the following might be the first eight lines of the file.

SanDisk	8	3	Pro Duo	38.82
SanDisk	8	10	Ultra	79.95
SanDisk	16	4	Pro Duo Gaming	78.89
Lexar	32	9	Jump Drive Retrax	59.46
Sony	16	20	Pro-HG Duo	103.85
Sony	4	4	Pro Duo Mark2	33.89
Transcend	8	5	Pro Duo	70.53

The manufacturer name is always a single word; the model name consists of one or more words.

(a) [7 marks] Complete the following `listManufacturer` method, whose parameter is the name of a manufacturer (e.g. `Lexar`). `listManufacturer` should print out the details of each memory stick in the file of the given manufacturer.

For example, on the data above, `listManufacturer("Sony");` should print

```
Memory Sticks from Sony
 16 20 Pro-HG Duo 103.85
  4  4 Pro Duo Mark2 33.89
```

```
public void listManufacturer(String mfr){
    String filename = "MemorySticks.txt";
    UI.println("Memory Sticks from "+ mfr);
    try{

        }catch(IOException e){UI.println("fail");}
}
```

(Question 2 continued on next page)

(Question 2 continued)

(b) [9 marks] Complete the following `maxSpeed` method which should print out the manufacturer that makes the fastest memory stick in the file.

For example, if the file had only the eight lines in the example above, `maxSpeed()` should print out "Fastest is Sony" because Sony makes the fastest memory stick (the 20Mb/s one).

```
public void maxSpeed(){
    String filename = "MemorySticks.txt";
    String
    try{
        Scanner sc = new Scanner(new File(filename));

        sc.close ();
    }
    catch(IOException e){UI.println("Fail: " + e);}
}
```

(Question 2 continued on next page)

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 2 continued)

(c) [10 marks] Complete the following `cheapModels` method which is passed a price, and then prints out the manufacturer, model name, and capacity for all the memory sticks less than that price.

For example, if the file had the eight lines in the example above, `cheapModels(60.0)` should print:

```
SanDisk Pro Duo 8GB
Lexar Jump Drive Retrax 32GB
Sony Pro Duo Mark2 4GB
```

since these are all the memory sticks under \$60.00.

```
public void cheapModels(double maxPrice){
    String filename = "MemorySticks.txt";
    try{
        Scanner sc = new Scanner(new File(filename));

        sc.close ();
    }
    catch(IOException e){UI.println("Fail: " + e);}
}
```

Question 3. Arrays of Objects

[26 marks]

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

The `Batsman` class, for representing information about individual batsmen, is shown below.

```
public class Batsman{

    private String name;
    private String country;
    private int gamesPlayed;
    private double battingAvg;

    public Batsman(String nm, String ctry, int games, double avg){
        this.name = nm;
        this.country = ctry;
        this.gamesPlayed = games;
        this.battingAvg = avg;
    }
    public void printDetails (){
        Ul. printf ("%s of %s av: %.2f over %d\n",
            this.name, this.country, this.battingAvg, this.gamesPlayed );
    }
    public boolean hasName(String nm){
        return (this.name.equals(nm));
    }
    public String getCountry(){
        return this.country;
    }
    public int getGamesPlayed(){
        return this.gamesPlayed;
    }
    public double getBattingAvg(){
        return this.battingAvg;
    }
}
```

(Question 3 continued)

The following are some of the fields and two of the methods of the `CricketAnalyser` class:

```
public class CricketAnalyser{

    private Batsman [] cricketers = new Batsman [8000];
    private int count = 0;

    public void listCricketers (){
        for ( int i=0; i<this.count; i++){
            this.cricketers [ i ]. printDetails ();
        }
    }
    public Batsman findCricketer(String name){
        for ( int i=0; i<this.count; i++){
            if ( this. cricketers [ i ]. hasName(name) ){
                return this. cricketers [ i ];
            }
        }
        return null;
    }
}
```

(a) [6 marks] Complete the following `addCricketer` method of the `CricketAnalyser` class. Its parameter is a `Batsman` and it should add the given `Batsman` to the `cricketers` array. If the array is full, the method should print out a message.

```
public void addCricketer (Batsman batsman){

}
}
```

(Question 3 continued on next page)

(Question 3 continued)

(b) [6 marks] Complete the following `findHighest` method which should find the batsman with the highest batting average and print out their details (using the `printDetails` method). If there is a tie for highest, it may print any of the highest batsmen.

```
public void findHighest(){
```

```
}
```

(c) [6 marks] Complete the following `longServers` method which has one parameter — the name of a country — and should print the details of all the cricketers from the specified country who have played more than 100 games.

```
public void longServers(String country){
```

```
}
```

(Question 3 continued on next page)

(Question 3 continued)

(d) [8 marks] Complete the following `boycott` method in the `CricketAnalyser` class. Its parameter is *String* specifying a country, and it should remove *all* cricketers from this country from the list of cricketers. It is important that there should be no nulls in the cricketers array in the range from 0 to `count-1`. The order the cricketers are stored in the array is not important and may be changed.

```
public void boycott(String country){
```

```
}
```

Question 4. Interface classes

[13 marks]

The `CricketAnalyser` program in question 3 involved an array storing a collection of `Batsman` objects. Each `Batsman` had several fields, including the name, country, and number of games they had played.

Note, this question is independent of your answers for question 3.

The `CricketAnalyser` program is limited because it only stored and analysed information about batsmen; a cricket program should also work with information about bowlers, wicket keepers and fielders. For this question, you need to modify the `CricketAnalyser` program so that it can store a collection of different kinds of `Cricketers` — `Batsman`, `Bowler`, `WicketKeeper`, and `Fielder`.

All four kinds of `Cricketer` have these things in common:

- fields to store a name, country, number of games
- a `printDetails` method to print out information about the `Cricketer`
- a `role` method that returns a `String` that is the `Cricketer`'s primary role ("`Batsman`", "`Bowler`", or "`WicketKeeper`").
- a `hasName` method with one parameter that returns a boolean value saying whether the `Cricketer` has the specified name.
- `getCountry` and `getGamesPlayed` methods which return the `Cricketer`'s country and number of games played, respectively.

The four different kinds of `Cricketer` each have additional fields and methods, specific to their role.

(a) [5 marks] Complete the following definition of the `Cricketer` interface class to represent the `Cricketer` type:

```
public interface Cricketer {
```

```
}
```

(Question 4 continued on next page)

(Question 4 continued)

(b) [4 marks] Modify the `Batsman` class below so that a `Batsman` is a type of `Cricketer`, ensuring that it correctly implements the `Cricketer` interface class.

Note: The code below is identical to the code on page 16 for Question 3.

```
public class Batsman {

    private String name;
    private String country;
    private int gamesPlayed;
    private double battingAvg;

    public Batsman(String nm, String ctry, int games, double avg){
        this.name = nm;
        this.country = ctry;
        this.gamesPlayed = games;
        this.battingAvg = avg;
    }

    public void printDetails (){
        Ul. printf ("%s of %s av: %.2f over %d\n",
            this.name, this.country, this.battingAvg, this.gamesPlayed );
    }

    public boolean hasName(String nm){
        return (this.name.equals(nm));
    }

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

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

    public double getBattingAvg(){
        return this.battingAvg;
    }

}
```

(Question 4 continued on next page)

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)

(c) [4 marks] Modify the part of the CricketAnalyser program shown below so that it can store a collection of any type of Cricketer. You may or may not need to modify the two method definitions. Note: The code below is identical to the code on page 17 for Question 3.

```
public class CricketAnalyser{

    private Batsman [] cricketers = new Batsman [8000];
    private int count = 0;

    public void listCricketers (){
        for (int i=0; i<this.count; i++){
            Ul.print(i+": ");
            this.cricketers[i].printDetails ();
        }
    }

    public Batsman findCricketer(String name){
        for (int i=0; i<this.count; i++){
            if (this.cricketers[i].hasName(name) ){
                return this.cricketers[i];
            }
        }
        return null;
    }

    :

}
```

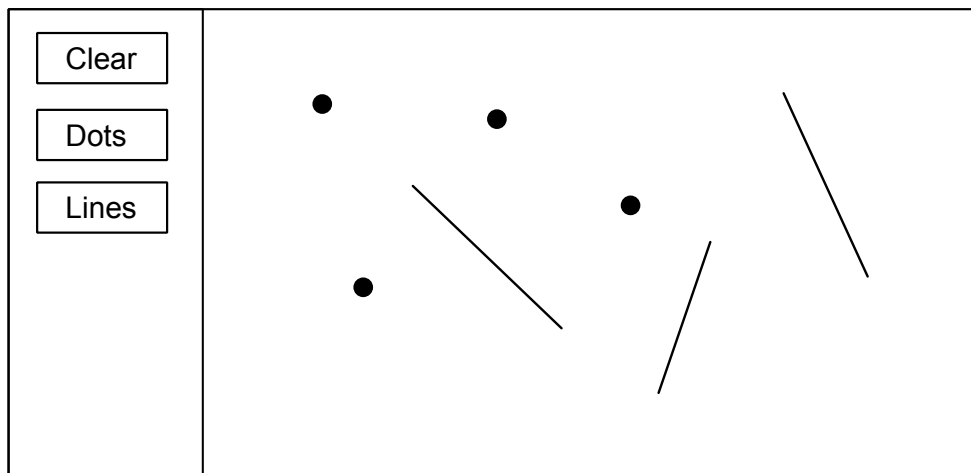
Question 5. Event Driven Input

[15 marks]

Complete the DotAndLine program on the facing page so that it allows the user to draw a pattern of round dots and straight lines on the graphics pane. The program should have three buttons labeled "Clear", "Dots", and "Lines". The "Clear" button should clear the graphics pane. The other two buttons control the effect of the mouse. After the user has clicked the "Dots" button, the program should draw a small circle (5 units wide) at each point that the user releases the mouse. After the user has clicked the "Lines" button, the program should draw a straight line between the point that the user pressed the mouse and the point the user releases the mouse.

The following diagram shows the effect of

- clicking the Clear button,
- clicking the Dots button,
- releasing the mouse at four points to make four dots
- clicking the Lines button,
- dragging the mouse three times to make three lines.



(Question 5 continued)

```
public class DotAndLine implements UIButtonListener, UIMouseListener{

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

    public DotAndLine(){

    }

    public void buttonPerformed(String button){

    }

    public void mousePerformed(String action, double x, double y) {

    }

}
```

Question 6. 2D Arrays

[23 marks]

A Word Find puzzle is a 2D array of letters that contains words hidden in the rows and columns. For example, the following Word Find contains the word "CUBA" hidden in row 2 and the word "MALL" in column 4.

D	W	K	I	O
Q	S	A	D	M
X	C	U	B	A
J	H	R	D	L
M	E	O	P	L

The WordFinder class implements a Word Find puzzle. It uses a field containing a 2D array of Strings (all of which will be a single letter) to store a Word Find puzzle. You are to complete several methods for the WordFinder class.

```
public class WordFinder{  
  
    private String[ ][ ] puzzle;  
  
    :
```

(a) [6 marks] Complete the following printPuzzle method which should print out a puzzle in the textPane with a space between each letter. For example, if the puzzle field contained the word find puzzle above, printPuzzle would print out

```
D W K I O  
Q S A D M  
X C U B A  
J H R D L  
M E O P L
```

```
private void printPuzzle(){
```

```
}
```

(Question 6 continued on next page)

(Question 6 continued)

(b) [7 marks] Complete the following `loadPuzzle` method which should read a puzzle from a file into the `puzzle` field. The parameter of the method is the name of the file to load from. The first line of the file will contain two integers: the number of rows and columns of the puzzle. The remaining lines will contain all the letters in the puzzle, separated by spaces, with the letters in the first row first, followed by the second row, *etc.*

For example, a file with the following contents would represent the 5x5 puzzle above:

```
5 5
D W K I O Q S A D M X C U B A
J H R D L M E O P L
```

```
public void loadPuzzle(String fname) {
    try{
        Scanner file = new Scanner(new File(fname));

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

(Question 6 continued on next page)

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 6 continued)

(c) [10 marks] Complete the following `findWordHorizontal` method which should search for a word hidden in a row of a puzzle. The parameter of the method is an array containing the word, one `String` for each letter. The method must search each row for the word. If it finds the word, it will print out the row and column where the word starts.

For example, with the puzzle above, the following code

```
String[ ] wordToFind = new String[ ] { "C", "U", "B", "A" };  
findWordHorizontal(wordToFind);
```

should print out "Found at (2, 1)" since the word CUBA starts at row 2, column 1.

```
public void findWordHorizontal(String [ ] word){
```

```
);
```

```
}
```

Question 7. Debugging Loops

[20 marks]

The following `moveSmallestToFront` method is intended to find the minimum value in an array of numbers, and swap all copies of that value to the front of the array.

For example, given the array

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

`moveSmallestToFront` should find that -2 is the minimum value, and then swap all the -2's to the front:

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

This version of `moveSmallestToFront` has multiple errors.

```
1  public void moveSmallestToFront(double[] data){
2      double min = 0;
3      for (int i=0; i<data.length; i++){
4          if (min < data[i]){
5              min = data[i];
6          }
7      }
8      int indexInsert = 0;
9      for (int i=0; i<data.length-1; i++){
10         if (data[i] == min){
11             data[i] = data[indexInsert++];
12             data[indexInsert] = min;
13         }
14     }
15 }
```

(a) [8 marks] If this version of `moveSmallestToFront` (with the errors) was passed the first array above, what would the contents of the array be when the method was finished?

(Question 7 continued on next page)

(Question 7 continued)

(b) [6 marks] Circle and briefly describe three errors in the version of `moveSmallestToFront` above.

You may answer on the code above or list line numbers and describe the error in the box below

(c) [6 marks] Write a correct version of `moveSmallestToFront`.

```
public void moveSmallestToFront(double[] data){
```

```
}
```
