UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2003

COMPUTING AND INFORMATION SYSTEMS

CS52007A(CS217) Object Oriented Programming

Duration: 2 hours and 15 minutes

Date and time:

Answer FOUR questions including Question 1.

Full marks will be awarded for complete answers to FOUR questions including Question 1, i.e. you must answer Question 1.

There are 100 marks available on this paper.

Electronic calculators may be used. The make and model should be specified on the script and the calculator must not be programmed prior to the examination.

THIS EXAMINATION PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

Section A

Question 1 Attempt the following multiple choice questions. Answer the questions by writing down, on your answer book (i.e. the script), the number for a selected answer.

(a) A major difference between AWT and Swing applets is that __________. [3]

(i) the AWT applet uses a content pane

(ii) they are executed using different Java commands

(iii) they are executed within different HTML documents

(iv) the Swing applet imports from the .javax.swing package

(b) The name of any Swing applet called after the tag 'CODE' within a HTML document must use the __________ extension. [3]

(i) `.exe`

(ii) `.code`

(iii) `.java`

(iv) `.class`

(c) A JTextField is a Swing component __________. [3]

(i) into which a user can type a single line of text data

(ii) into which a user can type multiple lines of text data

(iii) that automatically has focus when the applet runs

(iv) whose text cannot be changed

(d) The constructor public JButton("4") creates __________. [3]

(i) an unlabeled JButton

(ii) a JButton four pixels wide

(iii) a JButton four characters wide

(iv) a JButton with a "4" on it

(e) An event occurs when a __________. [3]

(i) component requests focus

(ii) component is enabled

(iii) component sets text

(iv) button is clicked

(f) When a Swing applet is registered as a listener with a JButton, if a user clicks the JButton, the method that executes is __________. [3]

(i) buttonPressed()

(ii) addActionListener()

(iii) start()

(iv) actionPerformed()

(g) When you write a method that has the same method header as an automatically provided method, you __________ the original version. [3]

(i) destroy

(ii) override

(iii) call

(iv) copy

(h) In a window that is 200 x 200 pixels, position 10, 190 is nearest to the __________ corner. [2]

(i) upper-left

(ii) upper-right

(iii) lower-left

(iv) lower-right

(i) If you use an argument with a JFrame constructor, the argument represents the JFrame's __________. [2]

(i) title

(ii) size

(iii) color

(iv) position

Question 2 (a) What is *recursion*? What are the main characters of recursive approach in terms of solving problems? [4]

(b) Consider the algorithm below. What does it do? Discuss why it is a recursive algorithm. You may use the line number to help referring certain algorithm steps in your discussion. [6]

```
// theDictionary is an array of string
// aWord is a string.

1  bsearch(theDictionary, aWord) {
2    if (dictionary has 1 page) {
3       scan the page for aWord
4    }
5    else {
6       divide dictionary into 2 halves:A and B
7       if (aWord in A) {
8          bsearch(A, aWord)
9       }
10      else bsearch(B, aWord)
11      } // end if
12   } // end if
13 } // end search
```

(c) Write a recursive method '`writeBackward`' in Java that prints out a given string backwards. The method would take two arguments: a string and the size of the string. [10]

(d) Write a main method that first takes a string from the keyboard, and then calls the method in the subquestion above, i.e. `writeBackward`, to print the string backwards on the screen. [5]

Question 3 (a) With the aid of an example, explain what is meant by *overloading*. [4]

(b) Using overloading approach, write two methods to print out a date. The first method takes *two* arguments namely `month` and `year`, and displays on the screen a simplified date such as "September, 2003". The second method takes *three* arguments namely `day`, `month` and `year`, and prints out a full date such as "20, September, 2003". [6]

(c) Following subquestion (b) above, write a main method that takes the input data from the keyboard to produce a full date, and displays on the screen *both* the simplified date and the full date, such as the message below: [4]

```
September, 2003
20, September, 2003.
```

Hint: Use `JOptionPlane.showInputDialog()` *as a user interface for input.*

(d) Consider the Java program below. Write down what will be displayed on the screen on completion of the execution of the main class C. [5]

```
class A {
  void red () {
    System.out.println("Red");
  }

  void green () {
    System.out.print("Green");
  }
}

class B extends A {
  void red () {
    System.out.print("Red + ");
    super.red();
  }

  void green () {
    System.out.print("Green + ");
    super.red();
  }
}
```

```
class C {
  public static void main (String [] args) {
    A a = new A ();
    B b = new B ();
    // a.red();
    b.green();
  }
}
```

(e) Using the classes given in subquestion (d) above as an example, discuss the hierarchical relationship between class A and class B and illustrate how one method may *override* another. [6]

Question 4 (a) Consider a binary tree below containing some characters:

```
      A
    /   \
   B     C
 /  \   /  \
D    E  F   G
    /        \
   H          M
```

List the characters encountered in each of the following traversals: [9]

(i) *pre*order traversal

(ii) *post*order traversal

(iii) *in*order traversal

(b) Define a class `TreeNode` which provides a reference-based implementation for the ADT binary tree. Each treeNode should contain at least *three* data fields, namely `leftChild`, `treeItem` and `rightChild`, and the necessary operations for initialising and accessing a tree node. [11]

(c) Write a recursive method in Java for the postorder traversal in a binary tree. [5]

Question 5 (a) Construct a new binary search tree when you insert the following values in the order given: 12 34 2 9 7 5 8. Draw the binary search tree constructed in a diagram. [3]

(b) What is a (binary) heap? Describe the *two* properties of a heap. [4]

(c) Consider the list of integers in the array below, where *i* is the index of the array. Let the target be 9.

i	1	2	3	4	5	6	7
A[i]	7	4	8	3	9	1	2

Using the above list as an example, discuss briefly the difference between the approach of *sequential search* algorithm and of *binary search* algorithm. [6]

(d) Consider the adjacent matrix below. Draw in a diagram the graph which is represented by the matrix and derive the adjacent list for the graph. [6]

$$\begin{array}{cccccc}
 & A & B & C & D & E \\
A & 0 & 0 & 0 & 0 & 1 \\
B & 1 & 0 & 0 & 0 & 0 \\
C & 0 & 0 & 0 & 0 & 0 \\
D & 0 & 0 & 0 & 0 & 0 \\
E & 0 & 1 & 1 & 1 & 0
\end{array}$$

(e) The class below displays a text window with a piece of message.

```
import javax.swing.*;

class text1 {
  public static void main(String [] xxx) {
    JTextArea myText = new JTextArea(10,20);
    myText.append("This is a test message !\n\n");
    JOptionPane.showMessageDialog(null,myText);
    System.exit(0);
  } // end main
} // end text1
```

(i) Convert the application above into an applet.

(ii) Describe briefly how to make the applet work step by step. Provide necessary examples for commands, HTML file and testing the applet.

[6]

Question 6 (a) A (binary) heap can be easily implemented by an array. Given a heap stored in the array below, illustrate the heap structure in a diagram. [6]

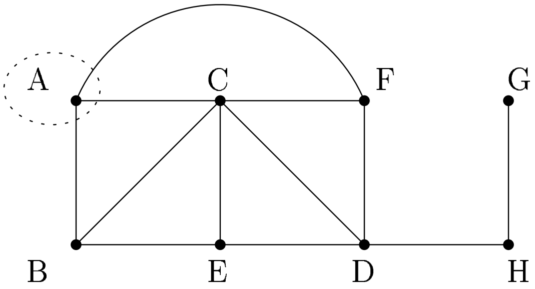
1 6 5 14 12 10 8 15

(b) Using the same list above as an example, demonstrate the difference between *insertion sort* algorithm and *selection sort* algorithm by tracing the state of the array used on completion of each run of the algorithms. [8]

(c) Consider a connected graph below. Write the vertex sequence in the order of that each vertex is visited by the [6]

(i) *depth first* traversal algorithm

(ii) *breadth first* traversal algorithm, starting from vertex **A**.



(d) Analyse and compare the *time* efficiency of the two program segments below. Which one is more efficient? Give your reasons. [5]

```
Segment 1:
if (choice == ‘m’) System.out.println("Motherland");
if (choice == ‘e’) System.out.println("Examination");
if (choice == ‘p’) System.out.println("People");
if (choice == ‘c’) System.out.println("Contribution");

Segment 2:
switch (choice) {
  case ‘m’: System.out.println("Motherland"); break;
  case ‘e’: System.out.println("Examination"); break;
  case ‘p’: System.out.println("People"); break;
  case ‘c’: System.out.println("Contribution"); break;
}
```