

UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2009

COMPUTING AND INFORMATION SYSTEMS

IS50003A (FY03)

FY03 Foundations of Problem Solving with Programming

Duration: 3 hours

Date and time: 20 May 2009, 10am

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*There are six questions in this paper. You should answer no more than FOUR questions. Full marks will be awarded for complete answers to a total of FOUR questions. Each question carries 25 marks. The marks for each part of a question are indicated at the end of the part in [.] brackets.*

*There are 100 marks available on this paper.*

*No calculators should be used.*

**THIS PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM**

**Question 1 (Total marks 25)**

- a. What is an algorithm? [1]
- b. Write an algorithm for calculating the average of three numbers and printing the result on the screen. [6]
- c. The following algorithm calculates the total salary for all the employees in an organisation. Draw a flowchart for it. [8]

```
Repeat
    Process Read employee salary
    Process Calc total salary for employee
    Process Print
Until
NoMoreEmployees
End
```

- d. A local cinema charges different prices for tickets depending on the person's age. If a person is under 16 years, then the cinema charges 7 pounds. If a person is over 65 years of age, the charge is 3 pounds. For all other ages the cinema charges 10 pounds.
  - i) Based on the information given above, write an algorithm to find how much to charge people of different ages for a cinema ticket. [5]
  - ii) Draw a flowchart for the above problem. [5]

**Question 2 (total marks 25 marks)**

- a. Describe the four components of the *Problem Analysis Chart*. Explain how you can use the *Problem Analysis Chart* to work out an employee's gross pay based on the following formula :-  
GrossPay = Hours \* PayRate [6]

The following questions are concerned with structure charts.

- b. Define the term *structure chart*. [2]
- c. What are the four basic components of a structure chart? Draw a diagram to represent each component and provide a description of each component. [8]
- d. Identify the five steps usually involved in Problem Solving. Explain in detail how you can use the Problem solving methodology to solve an everyday problem you have come across in your daily life. [9]

**Question 3 (total marks 25 marks)**

a. What is a dry run? [3]

An incomplete algorithm to divide two numbers is given below.

i). Complete the algorithm (Note: you must write the answers in your answer book, not on the exam paper). [3]

- L1 Declare variables first num second num .....
- L2 Initialise .....
- L3 Ask user to enter first number
- L4 .....
- L5 Ask user to enter second number
- L6 Assign user input to second num variable
- L7 .....
- L8 Print result.

ii). Do a dry run for this algorithm assuming the user enters 8 for the first number and 2 for the second. A table for the dry run is provided for you. (Note: you must write the answers in your answer book, not on the exam paper) [4]

After Execution	First num	Second num	Result

d. Briefly describe the *merge sort algorithm*. [3]

e. Trace the steps the *merge sort algorithm* takes in merging the following two arrays = [35 28 18 45] [62 48 30 38], to produce a new sorted array [18 28 30 35 38 45 48 62]. [12]

**Question 4 (total marks 25 marks)**

a. Explain the *exchange sort (bubble sort) algorithm*. [4]

b. Identify one disadvantage of the *exchange sort* when compared to a more complex sort such as the merge sort. [1]

c. Using the list below, trace the first phase of the *exchange sort* algorithm. [10]

391  
251  
183  
46  
236

d. Describe the *smallest element selection sort algorithm*. [4]

f. Trace the steps that the *smallest element selection sort* algorithm takes in sorting the following array in ascending order. [6]

8 5 1 3 7

**Question 5 (total marks 25 marks)**

- a. Below is a outline for a *for loop*. Draw a similar outline for a *while loop* and *repeat loop*. Explain in detail how each loop works. You should explain all the programming specific terms you use, such as *condition*, *instruction loop*. Also explain how many times a loop is repeated and under what circumstances a loop is entered.

```
For j 1 to 10
```

```
    instruction  
    instruction  
    instruction
```

```
End loop
```

[10]

- b. Describe the *Binary Search* method. Illustrate your answer by showing the successive steps of binary search applied to the following list, when searching for element 75. [7]

5 9 20 26 35 40 46 49 67 76 90 96

- c. Below is a partially completed *Binary Search* algorithm. Complete the Binary search algorithm. [8]

```
low = 0; high = n -1;  
mid = .....  
if target = array[mid]  
    .....  
else  
    if target < array[mid]  
        .....  
    else  
        target is not in the 0 ..mid range;  
        .....
```

repeat with new range until possible array is of length 1.

**Question 6 (total marks 25 marks)**

- a. Define the notion of a *Stack*. [3 ]
- b. Explain the following stack operations. [10]
- (i) push(object)
  - (ii) pop()
  - (iii) object top()
  - (iv) integer size()
  - (v) Boolean isEmpty()
- c. Attempting the execution of an operation may sometimes cause an error condition called an *exception*. Explain what an *exception* is and give an example. [4]
- d. Define a the notion of a *Queue*. [5]
- e. Give an example of a *Queue* [3]