

Monday 22 May 2023 - Afternoon

AS Level Computer Science

H046/02 Algorithms and problem solving

Time allowed: 1 hour 15 minutes

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Please write clearly in black ink. Do not write in the barcodes.								
Centre number						Candidate number		
First name(s)								
Last name								

INSTRUCTIONS

- Use black ink.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- · Answer all the questions.

INFORMATION

- The total mark for this paper is **70**.
- The marks for each question are shown in brackets [].
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has 16 pages.

ADVICE

· Read each question carefully before you start your answer.



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1	A pr	ogram	uses	a bub	ble so	rt to s	ort da	ta into ascending numerical order.
The data is stored in a 0-indexed 1-dimensional array.							ensional array.	
	(a)	Show	each	stage	of a b	ubble	sort t	o sort this data into ascending numerical order:
		1	5	3	9	2	7	
					_	_		
		You s	hould	clearl	y shov	v and	label	each pass in your answer.

.....[4]

.....

.....

.....

(b) A programmer has partially developed a bubble sort algorithm in pseudocode.

This will partially sort an array of numbers called numbers that is passed as a parameter.

01	<pre>procedure bubbleSort(numbers : byRef)</pre>
02	flag = true
03	for $x = 0$ to numbers.length - 1
04	<pre>if numbers[x] > numbers[x + 1] then</pre>
05	holdValue = numbers[x]
06	numbers[x] = numbers[x + 1]
07	numbers[x + 1] = holdValue
08	flag = false
09	endif
10	next x
11	endprocedure
(i)	Explain why the procedure bubbleSort accepts the array numbers by reference and not by value.
	[3]
(ii)	The programmer has used a for loop on line 3 in the procedure bubbleSort. A for loop is a count controlled loop.
	State what is meant by the term 'count controlled loop'.
	[1]

(iii)	State the purpose of the variable holdValue in the procedure bubbleSort.
	[3]
(iv)	The procedure bubbleSort will only partially sort the array numbers into order.
	Describe what the programmer would need to add to the algorithm to enable it to fully sort the numbers into order.
	[2]
(c) (i)	The array numbers contains 356 numbers to be sorted by the bubble sort algorithm.
	State the maximum number of passes a bubble sort would need to complete to sort 356 numbers into order.
	[1]
(ii)	State the name of one other sorting algorithm.
	[1]

- 2 Taylor is designing a program for a client who would like to simulate earthquakes on major cities around the world in 3D. The client would like to be able to view any stage of an earthquake such as:
 - 1. the build-up of the earthquake
 - 2. the earthquake taking place
 - 3. the aftershocks of the earthquake.

The client would also like to be able to play the simulation at different speeds. For example, a slow, normal or fast speed.

Give	e three examples of where abstraction can be used in the design of this program.
1	
2	
3	
	[3]
The	program will need to accept inputs from the user before playing the simulation.
(i)	Identify two different inputs for this program.
	1
	2
	FOI
	[2]
(ii)	One decision point in the program will be to decide if the user inputs are suitable or not.
	Identify two other example decision points in this program.
	1
	2
	[2]
	1 2 3 The

(c)	The	lor is deciding which software development methodology to use to write the program. client has stated that they would like the program as soon as possible and want to be vily involved during the program creation.	
	(i)	Describe the difference between the spiral model and the waterfall model.	
			[4]
	(ii)	Give two reasons why the waterfall model is not suitable for Taylor.	
		1	
		2	
			[2]
	(iii)	Name and describe one other model of software development.	
		Name	
		Description	
			[2]

Nina is writing a computer game using an Integrated Development Environment (IDE). Her friend, James, is writing a computer game using a text-editor which will allow James to create and edit text. James will use a separate compiler.

Discuss the differences between writing and debugging a program using an IDE and a text-editor.

You	should include the following in your answer:
•	features that are used when writing code

 features that are used when debugging code the benefits of using an IDE instead of a text-editor.

[9]

4	A function, toBinary(), is needed to calculate the binary value of a denary integer between 0
	and 255.

toBinary() needs to:

- take an integer value as a parameter
- divide the number by 2 repeatedly, storing a 1 if it has a remainder and a 0 if it doesn't
- combine the remainder values (first to last running right to left) to create the binary number
- return the binary number.

For example, to convert 25 to a binary number the steps are as follows:

	2 = 6 = 3 = 1	remainder 1 remainder 0 remainder 0 remainder 1 remainder 1
retui	n value =	= 11001
(a)	Write the	e function toBinary().
	You shou	uld write your function using pseudocode or program code.

- **(b)** The main program:
 - asks the user to enter a denary number between 1 and 255
 - checks that the input is valid between 1 and 255
 - If valid call the function toBinary() and pass the input as a parameter
 - · outputs the return value

Write the algorithm for the main program.

• If not valid, repeatedly asks the user to input a number until the number is valid.

You should write your algorithm using pseudocode or program code.

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- **5** Layla writes a pseudocode algorithm to:
 - input 20 positive numbers into a 0-indexed 1-dimensional array
 - output the average (mean) number as a decimal
 - · output the smallest number
 - output the largest number.

The pseudocode algorithm is shown. It contains various errors.

```
01 \text{ total} = 1
02 \text{ smallest} = 9999
03 \text{ largest} = -1
04 \text{ for } x = 0 \text{ to } 21
05
    dataArray[x] = input("Enter a number")
06
    total = total + dataArray[x]
07
    if dataArray[x] < largest then</pre>
08
      largest = dataArray[x]
09
    endif
10
    if dataArray[x] < smallest then</pre>
11
      smallest = dataArray[x]
12
    endif
13 next x
14 print("Average = " + total * 20)
15 print("Smallest = " + smallest)
16 print("Largest = " + largest)
(a) (i) Identify the construct used on lines 01 to 03 in the algorithm.
      .....
      [11]
      Identify the construct used on lines 10 to 12 in the algorithm.
      .....[1]
```

(b)	Iden	tify two variables used in this algorithm.			
	1				
	2				
			2]		
(c)	The	algorithm that Layla has written has many errors.			
	Iden	Identify the line number of four different errors and write the corrected line of code.			
	Erro	r 1 line number			
	Erro	r 1 correction			
	Erro	r 2 line number			
	Erro	Error 2 correction			
	Erro	Error 3 line number			
	Error 3 correction				
	Error 4 line number				
	Erro	r 4 correction			
<i>(</i> 1)	_	[4	+J		
(d)	dat	aArray is defined as a local variable within the main program.			
	(i)	State what is meant by a 'local variable'.			
		[1]		
	(ii)	Give one benefit and one drawback of declaring ${\tt dataArray}$ as a local variable in the main program.			
		Benefit			
		Drawback			
		[2	 21		

(a) The program needs to search the array for a number that is input by the user.

b	A program stores data in a 1-dimensional array.

(i)	Describe how a linear search will search the data in the array for a number that has been input.		
	[5]		
(ii)	State why you would use a linear search rather than a binary search.		
	[1]		

	[4]
0)	Describe how an array can be used to store and access data in a stack data structure.

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).				
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