FUKIEN SECONDARY SCHOOL S5 Final Examination (2020-2021) Information and Communication Technology Paper 2D (1 hour 30 minutes)

Date: 21st June 2021 Time: 11:00 a.m. - 12:30 p.m. Name:_____ Class: _____ No.: _____

INSTRUCTIONS:

- 1. When told, write your name, class and class number on this question-answer book.
- 2. **ANSWER ALL QUESTIONS.** Write your answers in the spaces provided in this Question-Answer book. Do not write in the margins. Answers written in the margins will not be marked. Supplementary answer sheets will be supplied on request.
- 3. The total mark of this paper is 60.

1. Amy, Ben and Clara work on a project on upgrading a document management system (DMS) in an international company. They have some discussions during the system development.

<u>Discu</u> Amy Ben: Clara	ussion : 1:	n <u>1</u> Which kind of programming language should we use for this project? I suggest using a procedural language such as Pascal. I prefer using an object-oriented language such as Python.
(a)	(i)	Briefly describe how object-oriented languages are different from procedural languages in terms of programming paradigms.
		(2 marks)
	(ii) 	Give three criteria that Amy can use to select a programming language for the project, other than programming paradigms.
		(3 marks)
<u>Discu</u> Amv	ussio	<u>n 2</u> What is the progress of your programming work?
Ben:	•	I have completed the security module of the DMS. I need to know whether it is compatible with the current system.
Clara	1:	I have completed a new user interface. I need to know whether it meets users' expectations.
(b)	Wh imp	at type of testing should Ben and Clara each carry out? What is the ortance of each type of testing?
	Ben	:

	Clara:
	(4 marks)
Disc Amy Ben: Clara	 ussion 3 What do you think about the system conversion? We should schedule a day for implementing the upgraded DMS and removing the old system in all the offices in different countries. a: I disagree. I think we should first implement the upgraded DMS in the Hong Kong office. After that, we can do it for the other offices.
(c)	Which strategy of system conversion (pilot conversion, phased conversion, parallel conversion or direct cutover conversion) did Ben and Clara each suggest? Give one advantage of each suggestion.
	Ben:
	Clara:
	(1 marks)
(d)	Give two reasons why regular undates of the DMS are necessary for the
(u)	company.

2. Peter uses stacks to manage boxes. Each box stores some apples. In the following example, a stack contains 3 boxes with 10, 20 and 30 apples.



Below are the operations on the stacks:

Operation	Description
Push(S, k)	Push a box with k apples into stack S
Pop(S)	Remove a box from stack $\ensuremath{\mathbb{S}}$ and return the number of apples in the box
Empty(S)	Return TRUE if stack S has no boxes in it; otherwise, return FALSE.

(a) (i) Initially there is an empty stack A. Write down the final content of A after executing the following pseudocode.



(2 marks)

(ii) Initially there is an empty stack B. Write down the final content of B after executing the following pseudocode.

Push(B,	10)
Push(B,	20)
Push(B,	30)
Push(B,	Pop(B) + Pop(B))
	← Bottom of B

(b) Initially there is a non-empty stack A and an empty stack B, as shown below:



Write down the final content of ${\tt A}$ and ${\tt B}$ after executing the following pseudocode.



(3 marks)

(c) Initially there is a non-empty stack X and an empty stack Y. REV(X, Y) is a subprogram for moving all the boxes in stack X to stack Y, where the boxes in Y are in reverse order. An example is shown below:



Complete the pseudocode for REV (X, Y) below.



(d) Initially there is a non-empty stack A and an empty stack B.



It is found that the apples in the bottom N boxes in A are rotten. Write the pseudocode for removing the bottom N boxes and keeping the remaining boxes in the original order in A with the use of REV(X, Y).

(4 marks)

(e) When implementing REV, Peter uses break points for debugging. Describe how break points can help Peter write a program.

3. Tom writes a subprogram F1 to process a global integer array, A, of size n. The pseudocode for F1 is:

```
Subprogram F1

isStop ← False

pos ← n - 1

while isStop <> TRUE do

if A[pos] = 1 then

A[pos] ← 0

pos ← pos - 1

else

A[pos] ← 1

isStop ← TRUE
```

Suppose that n = 8.

(a) (i) Suppose that the initial content of A is the binary representation of the decimal value 1:

	0	1	2	3	4	5	6	7
A:	0	0	0	0	0	0	0	1

What is the content of A after executing F1?

	0	1	2	3	4	5	6	7
A:								
							(1	mark)

(ii) Suppose that the initial content of A is the binary representation of the decimal value 7:

	0	1	2	3	4	5	6	7
A:	0	0	0	0	0	1	1	1

What is the content of A after executing F1?

	0	1	2	3	4	5	6	7
A:								

(1 mark)

(iii) What is the purpose of F1?

- (b) Tom creates some test data to test boundary cases for F1.
 - (i) Why does Tom need to test the boundary cases?

(1 mark)

(ii) Which of the following cases is/are boundary case(s) for F1? Justify your answer.

Case 1		0	1	2	3	4	5	6	7
	A:	0	0	0	0	0	0	0	0
Case 2		0	1	2	3	4	5	6	7
	A:	1	1	1	1	1	1	1	0
Case 3		0	1	2	3	4	5	6	7
	A:	1	1	1	1	1	1	1	1
				<u> </u>	<u></u>				

(2 marks)

(c) Tom plans to write a subprogram F2 (m) where m is an integer input parameter. The pseudocode for F2 is:

Subprogram F2 (m) For i from 1 to m

Execute F1

(i) Assume that the initial content of A is:

	0	1	2	3	4	5	6	7
A:	0	0	0	0	0	0	1	0

What is the content of A after executing F2 (4)?

	0	1	2	3	4	5	6	7
A:								
l							(1	mark)

(11)	What is the purpose of F2?
	(2 marks)
(iii)	After executing F2 (1000) , Tom finds that the result is not what he expected. Why not?
	(1 mark)
(iv)	In order to generate the proper result for $F2(1000)$, what change in A should be made? Explain your answer briefly.

4. Two-dimensional arrays P and B1 are used to represent an image with 3×3 pixels and an image with 5×10 pixels respectively. In the arrays, T and F represent black and white pixels respectively, as shown in the following example:

							1	2	3	4	5	6	7	8	9	10
		1	2	3		1	Τ	F	Τ	F	F	F	F	F	F	F
Ρ:	1	Т	F	Т	B1:	2	Т	Т	Т	F	Т	F	Т	F	F	F
	2	Т	Т	Т		3	F	F	Т	Т	Т	F	Т	F	F	F
	3	F	F	Т		4	F	F	F	F	Т	Т	Т	F	F	F
						5	F	F	Т	F	Т	F	Т	F	F	F

Peter plans to write a pattern matching program to count the number of occurrences of P in Bl. In the example above, there are two occurrences of P in Bl.

(a) Observe the following case:

							1	2	3	4	5	6	7	8	9	10
		1	2	3		1	Т	F	Т	F	F	F	F	Т	F	Т
P:	1	Т	F	Т	B1:	2	Т	Т	Т	F	Т	F	F	Т	Т	Т
	2	Т	Т	Т		3	Т	Т	Т	Т	Т	F	Т	F	F	Т
	3	F	F	Т		4	F	F	F	F	Т	Т	Т	F	F	F
						5	F	F	F	F	F	F	Т	F	Т	F

How many occurrences are there of P in B1?

(1 mark)

Peter writes a subprogram Compare(i,j) where i and j are integer input parameters. Compare checks if P matches the image assembled by Bl[i,j] to Bl[i+2,j+2]. It returns 'TRUE' if there is a match; otherwise, it returns 'FALSE'.

(b) Complete the pseudocode for Compare below.



Peter considers another method, calculating a K value for every 9 (3×3) pixels. 9 values, 2^0 , 2^1 , ..., 2^8 , (i.e. 1, 2, 4, 8, 16, 32, 64, 128 and 256) are used to represent 9 black pixels, as shown below. K is the sum of the values that represent the black pixels in image P.



Hence, for image P in the example above, K = 1 + 4 + 8 + 16 + 32 + 256 = 317.

(c) (i) Find the value of K for the following image.

		1	2	3
P:	1	Т	Т	Т
	2	F	Т	F
	3	F	F	F

(ii) Peter writes a subprogram FindK to find the value of K for image P that is represented by temp[1,1] to temp[3,3]. Complete the pseudocode for FindK below.



(5 marks)

For image B1, an integer array B2 is used to store the corresponding K values. The value in B2[i,j] is the K value for the 9 pixels from B1[i,j] to B1[i+2,j+2]. In the following example, the values in B2[1,1] and B2[2,1] are given.

		1		2	3	4	5	6	7	8	9	10
	1	Т	1	F	Т	F	F	F	F	Т	F	Т
B1:	2	Т		Т	Т	F	Т	F	F	Т	Т	Т
	3	F	1	F	Т	Т	Т	F	Т	F	F	Т
	4	F	FF		F	F	Т	Т	Т	F	F	F
	5	F	1	F	F	F	F	F	Т	F	Т	F
	B2:				1	2	3	4	5	6	7	8
			1		317							
			2	2	39							

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(3 marks)

⁽d) (i) What is the value in B2[3,1]?_____

⁽ii) Describe how to use searching and K values to find the number of occurrences of P in Bl.

- (e) (i) Suppose that a sequential search is used and there is no occurrence of P in Bl in (d)(ii). How many comparisons involving the values in B2 will have been done during the searching process?
 - (ii) Someone suggests that binary search could be applied in order to improve the efficiency of the pattern matching. Do you agree? Explain briefly.

(3 marks)

END OF PAPER