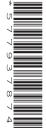


Cambridge International Examinations

Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME			
CENTRE NUMBER		CANDIDATE NUMBER	
COMPUTER SO	CIENCE		9608/43



Paper 4 Further Problem-solving and Programming Skills

October/November 2018

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

No calculators allowed.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces at the top of this page.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams, graphs or rough working.

Do not use staples, paper clips, glue or correction fluid.

DO **NOT** WRITE IN ANY BARCODES.

Answer all questions.

No marks will be awarded for using brand names of software packages or hardware.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

The maximum number of marks is 75.



1 A declarative language is used to represent the following facts and rules about animals.

```
01 feature(dog, drinks_milk).
02 feature(dog, has_lungs).
03 feature(horse, has_lungs).
04 feature(tuna, lives_in_water).
05 feature(tuna, has_gills).
06 feature(crab, lives_in_water).
07 mammal(drinks_milk).
08 mammal(has_lungs).
09 fish(lives_in_water).
10 fish(has_gills).
11 is_a_mammal(X) IF (feature(X, Y) AND mammal(Y)) AND (feature(X, Z) AND mammal(Z)).
```

These clauses are explained in the following table.

Clause	Explanation
01	A dog has the feature, drinks milk
07	A mammal drinks milk
11	 X is a mammal, if: X has the feature Y and a mammal has a feature Y, and X has the feature Z and a mammal has the feature Z

- (a) More facts are to be included.
 - (i) A bird has wings, and a bird lays eggs.

Write the additional clauses to record these facts.

12)	• • •
13		
		21

(ii) An eagle has all the features of a bird.

Write the additional clauses to record this fact.

14

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[2]

(b)	(i)	Using the variable B, the goal
		<pre>feature(B, drinks_milk)</pre>
		returns
		B = dog
		Write the result returned by the goal
		<pre>feature(B, lives_in_water)</pre>
		B =[2]
	(ii)	Write a goal, using the variable ${\tt C}$, to find the feature(s) of tuna.
		[2]
(c)	An	animal is a bird if it lays eggs and it has wings.
	Cor	mplete the following rule.
	is_	_a_bird(X) IF
		[3]
(d)		clarative programming and object-oriented programming are two examples of programming adigms.
	(i)	Define the term programming paradigm .
		[1]
	(ii)	Give two examples of programming paradigms, other than declarative and object-oriented programming.
		1
		2
		[2]

2 Kendra collects books. She is writing a program to store and analyse information about her books.

Her program stores information about each book as a record. The following table shows the information that will be stored about each book.

Field name	Description
Title	The title of the book
Author	The first listed author of the book
ISBN	A 13-digit code that uniquely identifies the book, for example: "0081107546738"
Fiction	If the book is fiction (TRUE) or non-fiction (FALSE)
LastRead	The date when Kendra last read the book

(a)	Write pseudocode information in the ta	n Abstract	Data 7	Гуре (ADT	named	Book,	to stor	e the
								[4]

(b)	The records are stored in a random access file.
	The function, ${\tt Hash}$ (), takes as a parameter the ISBN and returns the hash value.
	The disk address of the record in the hash table is calculated as: ISBN modulus 2000 plus 1
	Write program code for the function Hash ().
	Programming language
	Program code
	[4

(c	The random access file	. M	vBooks.dat	stores the	data	about the	he boo	oks in	the	format

<Title>
<Author>
<ISBN>
<Fiction>
<LastRead>

A procedure, FindBook():

- prompts the user to input the ISBN of a book until the ISBN contains 13 numeric digits
- uses the function <code>Hash()</code> to calculate the disk address of the record
- reads the record for that book from MyBooks.dat into a variable of type Book
- outputs all the data about the book.

Use pseudocode to write the procedure FindBook().
You can assume that the record exists at the disk address generated.

8]8

LIGOCOTING A CTACK CTRUCTURG	list using a stack	
Describe a stack structure.		
The stack is represented as an array in the	program, the first	element in the array is [0
The current contents of the stack, Parts, a	nd its pointer . Sta	ackPointer are shown .
	•	
StackPointer 5	0	StackContents "Screw 1"
	1	"Screw 2"
	2	"Back case"
	3	"Screw 3"
	4	Engine outer"
	5	
	I	
	6	
	6 7	

(ii) The procedure POP() removes an item from the stack. The procedure PUSH(<identifier>) adds an item to the stack.

The current contents of the stack, Parts, and its pointer, StackPointer are shown.

StackPointer 5 StackContents 0 "Screw 1" 1 "Screw 2" 2 "Back case" 3 "Screw 3" 4 "Engine outer" 5 6 7

Use the table below to show the contents of the stack, Parts, and its pointer after the following code is run.

POP()
POP()
PUSH("Light 1")
PUSH("Light 2")
PUSH("Wheel 1")
POP()
POP()

StackPointer	StackContents
0	
1	
2	
3	
4	
5	
6	

7

(c) A 1D array, Parts, is used to implement the stack. Parts is declared as:

```
DECLARE Parts: ARRAY[0:19] OF STRING
```

(i) The procedure POP outputs the last element that has been pushed onto the stack and replaces it with a '*'.

Complete the **pseudocode** for the procedure POP.

```
PROCEDURE POP

IF ...... = .....

THEN

OUTPUT "The stack is empty"

ELSE

StackPointer ← .....

OUTPUT .....

Parts[StackPointer] ← .....

ENDIF

ENDPROCEDURE
```

(ii) The procedure PUSH() puts the parameter onto the stack.

Complete the **pseudocode** for the procedure PUSH().

ENDPROCEDURE

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[4]

[5]

4

The	recu	ursive algorithm for the Calculate() function is defined as follows:	
01	FUN	ICTION Calculate(BYVALUE Number : INTEGER) RETURNS INTEGER	
02		IF Number = 0	
03		THEN	
04		Calculate ← -10	
05		ELSE	
06		Calculate ← Number * Calculate(Number - 1)	
07		ENDIF	
08	END	FUNCTION	
(a)	(i)	State what is meant by a recursive algorithm.	
			[1]
	(ii)	State the line number in Calculate() where the recursive call takes place.	
			[1]

Question 4(b) begins on the next page.

(b)	The function	is	called	with	Calculate	(3))

Dry run the function **and** complete the trace table below. State the final value returned. Show your working.

01	FUNCTION Calculate(BYVALUE Number : INTEGER) RETURNS INTEGE	R
02	IF Number = 0	
03	THEN	
04	Calculate ← -10	
05	ELSE	
06	Calculate ← Number * Calculate(Number - 1)	
07	ENDIF	
08	ENDFUNCTION	
Woı	ing	
Tro	a table:	

Trace table:

Call number	Function call	Number = 0 ?	Return value

ı	Final	return	value	

[6]

(c)	A re	ecursive algorithm within a subroutine can be replaced with an iterative algorithm.
	(i)	Describe one problem that can occur when running a subroutine that has a recursive algorithm.
		ro
	(ii)	Rewrite the Calculate () function in pseudocode , using an iterative algorithm .
		[5]

5	A game uses a set of cards. Each card has a number (between 0 and 9 inclusive) and a shape
	("square", "triangle" Or "circle").

The game is written using object-oriented programming.

The class, Cards, has the private properties:

- Number
- Shape

and the methods:

- Constructor()
- GetNumber()
- GetShape()

The purpose of each method in the class Cards is given in the following table.

Method	Purpose
Constructor()	Takes a number and a shape as parameters Checks that the number and the shape are valid and: • either assigns the parameters to Number and Shape • or reports an error.
GetNumber()	A public method that returns the number for that card.
GetShape()	A public method that returns the shape for that card.

(a)	Explain why the properties are private.
	[2

(b)	Write program code for the Constructor() method.
	Programming language
	Program code
	[5]
(c)	Write program code for the GetNumber () method.
	Programming language
	Program code
	[2]
(d)	A card, OneS, has the value 1 for Number and the value "square" for Shape.
	Write program code to instantiate an instance of Cards for OneS.
	Programming language
	Program code

(e) The game has a function, Compare () that takes two cards as parameters and compares

If the cards are identical, the function outputs "SNAP" and returns -1 . If they are not identical, and the card numbers are different, it returns the Number of the card with the higher value or the Number for the cards if they are the same.
Write program code for the Compare () function.
Programming language
Program code
[6]

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