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COMPUTER SCIENCE **9618/22**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2024**

2 hours

You must answer on the question paper.

You will need: Insert (enclosed)

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.
- The insert contains all the resources referred to in the questions.

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This document has **24** pages. Any blank pages are indicated.

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Refer to the **insert** for the list of pseudocode functions and operators.

1 **(a)** The following table contains pseudocode examples.

Each example may contain statements that relate to one or more of the following:

- selection
- iteration (repetition)
- input/output.

Complete the table by placing **one or more** ticks (✓) in each row.

Pseudocode example	Selection	Iteration	Input/Output

`FOR Index ← 1 TO 10`
`  Data[Index] ← 0`
`NEXT Index`
		✓	

`WRITEFILE ThisFile, "****"`			✓
`UNTIL Level > 25`		✓	

`IF Mark > 74 THEN`
`  READFILE OldFile, Data`
`ENDIF`
	✓		✓

[4]

(b) Program variables have data types as follows:

Variable	Data type
MyChar	CHAR
MyString	STRING
MyInt	INTEGER

Complete the table by filling in each gap with a function (from the **insert**) so that each expression is valid.

Expression
MyInt ← ..... INT ..... (3.1415926)
MyChar ← ..... MID ..... ("Elwood", 3, 1)
MyString ← ..... CHR ..... (..... INT ..... (27.509))
MyInt ← ..... TO_LOWER ..... (..... NUM_TO_STR ..... ("ABC123", 3))

[4]

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(c) The variables given in part **(b)** are chosen during the design stage of the program development life cycle.

The choices are to be documented to simplify program maintenance.

State a suitable way of documenting the variables **and** give **one** piece of information that should be recorded, in addition to the data type.

By identifier table : In this it tells what each variable is used for.

..... [2]

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2 A program is being developed.

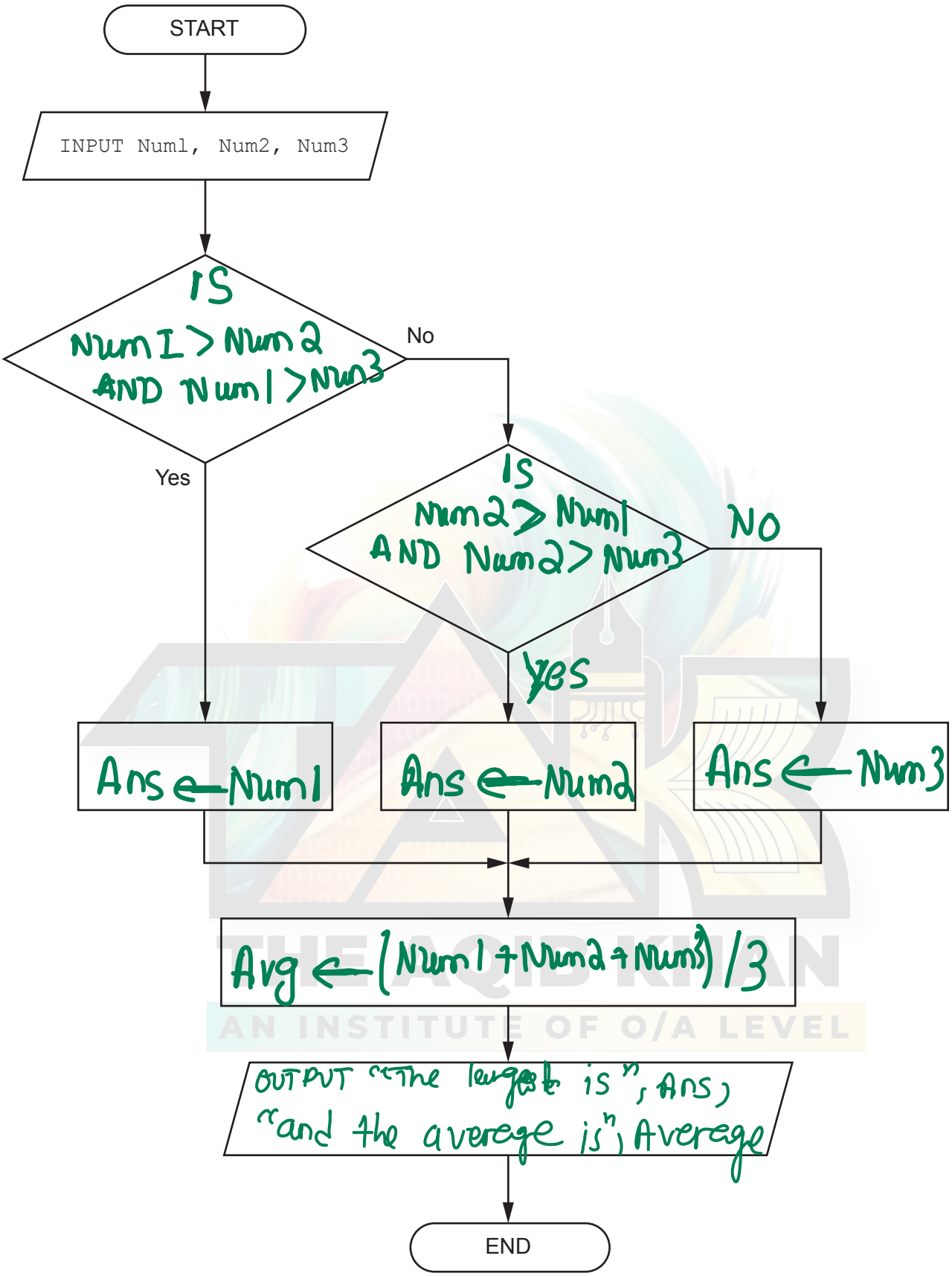
(a) An algorithm for part of the program will:

- input three numeric values and assign them to identifiers `Num1`, `Num2` and `Num3`
- assign the largest value to variable `Ans`
- output a message giving the largest value and the average of the three numeric values.

Assume the values are all different and are input in no particular order.

Complete the program flowchart on page 5 to represent the algorithm.

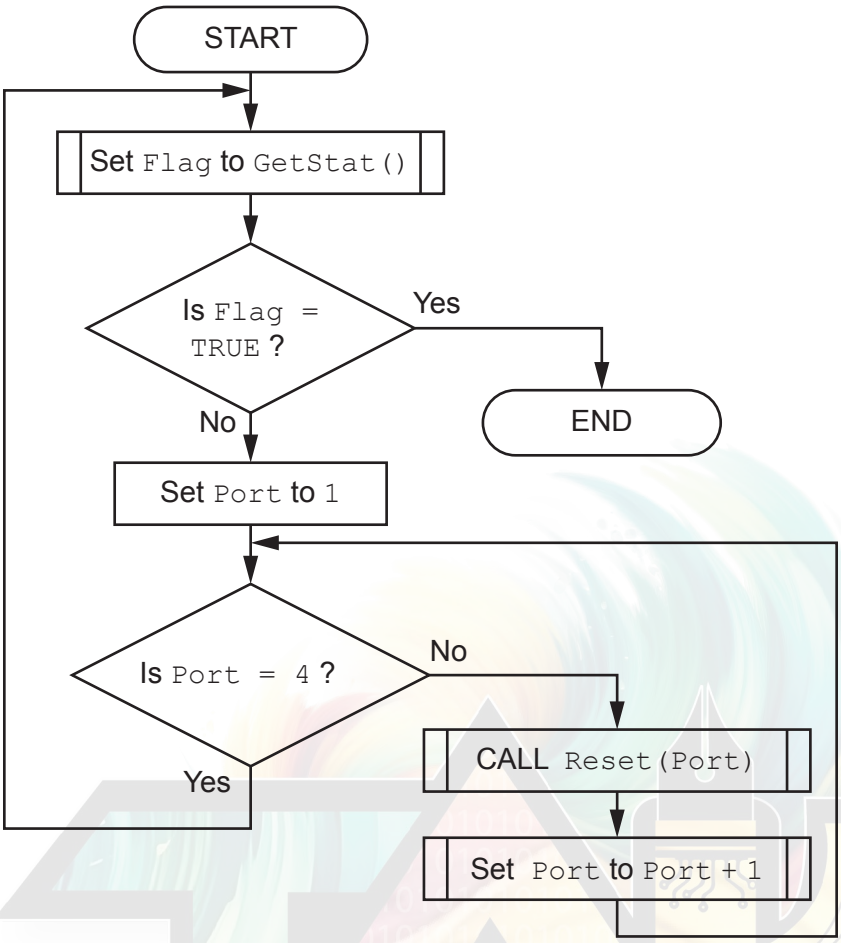
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[5]

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(b) A different part of the program contains an algorithm represented by the following program flowchart:



Write pseudocode for the algorithm.

```
Flag ← GetStat
WHILE Flag = FALSE
    Port ← 1
    WHILE Port <> 4
        CALL Reset(Port)
        Port ← Port + 1
    ENDWHILE
ENDWHILE
```

[5]

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3 A factory needs a program to help manage its production of items.

Data will be stored about each item.

The data for each item will be held in a record structure of type `Component`.

The programmer has started to define the fields that will be needed as shown in the table.

Field	Example value	Comment
`Item_Num`	`123478`	a numeric value used as an array index
`Reject`	`FALSE`	`TRUE` if this item has been rejected
`Stage`	`'B'`	a letter to indicate the stage of production
`Limit_1`	`13.5`	any value in the range 0 to 100 inclusive
`Limit_2`	`26.4`	any value in the range 0 to 100 inclusive

(a) (i) Write pseudocode to declare the record structure for type `Component`.

```
TYPE Component
    DECLARE Item_Num : INTEGER
    DECLARE Reject : BOOLEAN
    DECLARE Stage : CHAR
    DECLARE limit_1 : REAL
    DECLARE limit_2 : REAL
ENDTYPE
```

[4]

(ii) A 1D array `Item` of 2000 elements will store the data for all items.

Write pseudocode to declare the `Item` array.

```
DECLARE Item[1:2000] of Component
```

[2]

(b) State **three** benefits of using an array of records to store the data for all items.

1 Can use a loop to access the records.

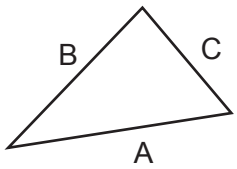
2 It simplifies the code and easier to write program.

3 Use of index directly access to records.

[3]

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4 A triangle has sides of length A, B and C.



In this example, A is the length of the longest side.

This triangle is said to be right-angled if the following equation is true:

$A \times A = (B \times B) + (C \times C)$

A procedure will be written to check whether three lengths represent a right-angled triangle. The lengths will be input in any sequence.

The procedure `IsRA()` will:

- prompt and input three integer values representing the three lengths
- test whether the three lengths correspond to the sides of a right-angled triangle
- output a suitable message.

The length of the longest side may **not** be the first value input.

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Write pseudocode for the procedure `IsRA()`.

```
PROCEDURE IsRA()
    DECLARE a, b, c : INTEGER
    OUTPUT "Input length of first side"
    INPUT a
    OUTPUT "Input length of second side"
    INPUT b
    OUTPUT "Input length of third side"
    INPUT c
        IF (a*a = (b*b) + (c*c)) OR
           (b*b = (a*a) + (c*c)) OR
           (c*c = (b*b) + (a*a)) THEN
           OUTPUT "It's a Right Angled Triangle"
        ELSE
        OUTPUT "Not Right Angled Triangle"
    ENDIF
ENDPROCEDURE
```

[5]

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5 A program is being designed in pseudocode.

The program contains a global 1D array `Data` of type string containing 200 elements.

The first element has the index value 1.

A procedure `Process()` is written to initialise the values in the array:

```
PROCEDURE Process(Label : STRING)
    DECLARE Index : INTEGER
    Index ← 0
    INPUT Data[Index]
    WHILE Index < 200
        Index ← Index + 1
        CASE OF (Index MOD 2)
            0 : Data[Index] ← TO_UPPER(Label)
            1 : Data[Index] ← TO_LOWER(Label)
        OTHERWISE : OUTPUT "Alarm 1201"
        ENDCASE
    NEXT Index
    OUTPUT "Completed " & Index & " times"
ENDPROCEDURE
```

(a) (i) The pseudocode contains **two** syntax errors and **one** other error.

Identify the errors.

Syntax error 1 NEXT Index it should be ENDWHILE

Syntax error 2 OUTPUT and Index , we cannot concatenate an integer with string

Other error Index was initalized with 0, it should be 1.

[3]

(ii) The procedure contains a statement that is **not** needed.

Identify the pseudocode statement **and** explain why it is **not** needed.

Statement OTHERWISE

Explanation Since the value in case of statment will produce only 0 or 1.

[2]

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(b) After correcting all syntax errors, the pseudocode is translated into program code which compiles without generating any errors.

When the program is executed it unexpectedly stops responding.

Identify the type of error that has occurred.

Run-time ..... [1]

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6 A music player stores music in a digital form and has a display which shows the track being played.

(a) Up to 16 characters can be displayed. Track titles longer than 16 characters will need to be trimmed as follows:

- Words must be removed from the end of the track title until the resulting title is less than 14 characters.
- When a word is removed, the space in front of that word is also removed.
- Three dots are added to the end of the last word displayed when one or more words have been removed.

The table below shows some examples:

Original title	Display string															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bat out of Hull	B	a	t		o	u	t		o	f		H	u	l	l	
Bohemian Symphony	B	o	h	e	m	i	a	n	.	.	.					
Paperbook Writer	P	a	p	e	r	b	o	o	k		W	r	i	t	e	r
Chris Sings the Blues	C	h	r	i	s		S	i	n	g	s	.	.	.		
Green Home Alabama	G	r	e	e	n		H	o	m	e	.	.	.			

A function `Trim()` will:

- take a string representing the original title
- return the string to be displayed.

Assume:

- Words in the original title are separated by a single space character.
- There are no spaces before the first word or after the last word of the original title.
- The first word of the original title is less than 14 characters.

Chris Sings the Blues
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

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Write pseudocode for the function `Trim()`.

```
FUNCTION Trim (Name : STRING) RETURNS STRING
    CONSTANT Dots = "..."
    CONSTANT Space = " "
    IF LENGTH (Name) <= 16 THEN
        RETURN Name
    ENDIF
    // Otherwise it has to be trimmed
    WHILE LENGTH (Name) > 13
        REPEAT
            Name ← LEFT (Name, LENGTH(Name)-1
        UNTIL RIGHT (Name,1) = SPACE
    ENDWHILE
    Name ← LEFT(Name, LENGTH (Name)-1 //remove Space
    Name ← Name & Dots
    RETURN Name
ENDFUNCTION
```

[7]

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(b) Music is stored as a sequence of digital samples.

Each digital sample is a denary value in the range 0 to 99999999 (8 digits).

The samples are to be stored in a text file. Each sample is converted to a numeric string and 32 samples are concatenated (joined) to form a single line of the text file.

Each numeric string is 8 characters in length; leading '0' characters are added as required.

Example:

Sample	Denary value	String
1	456	"00000456"
2	48	"00000048"
3	37652	"00037652"
⋮	⋮	⋮
32	673	"00000673"

The example samples will be stored in the text file as a single line:

"00000456000000480003765 2...00000673"

(i) Identify one drawback of adding leading '0' characters to each numeric string.

very large file is created

..... [1]

(ii) Suggest an alternative method of storing the samples which does **not** involve adding leading '0' characters but which would still allow each individual sample to be extracted.

Add a special character after each number

..... [1]

(iii) State **one** drawback of the alternative method given in part **(b)(ii)**.

Algorithm to store and extract the individual values will be more complex. [1]

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7 A fitness club has a computerised membership system.

The system stores information for each club member: name, home address, email address, mobile phone number, date of birth and exercise preferences.

Many classes are full, and the club creates a waiting list for each class. The club adds details of members who want to join a class that is full to the waiting list for that class.

When the system identifies that a space is available in one of the classes, a new module will send a text message to each member who is on the waiting list.

(a) Decomposition will be used to break the new module into sub-modules (sub-problems).

Identify **three** sub-modules that could be used in the design **and** describe their use.

Sub-module 1 Identify Member

Use identifies a club member who has interest in a given class.

Sub-module 2 Send Message

Use Sends a text message to member in the waiting list

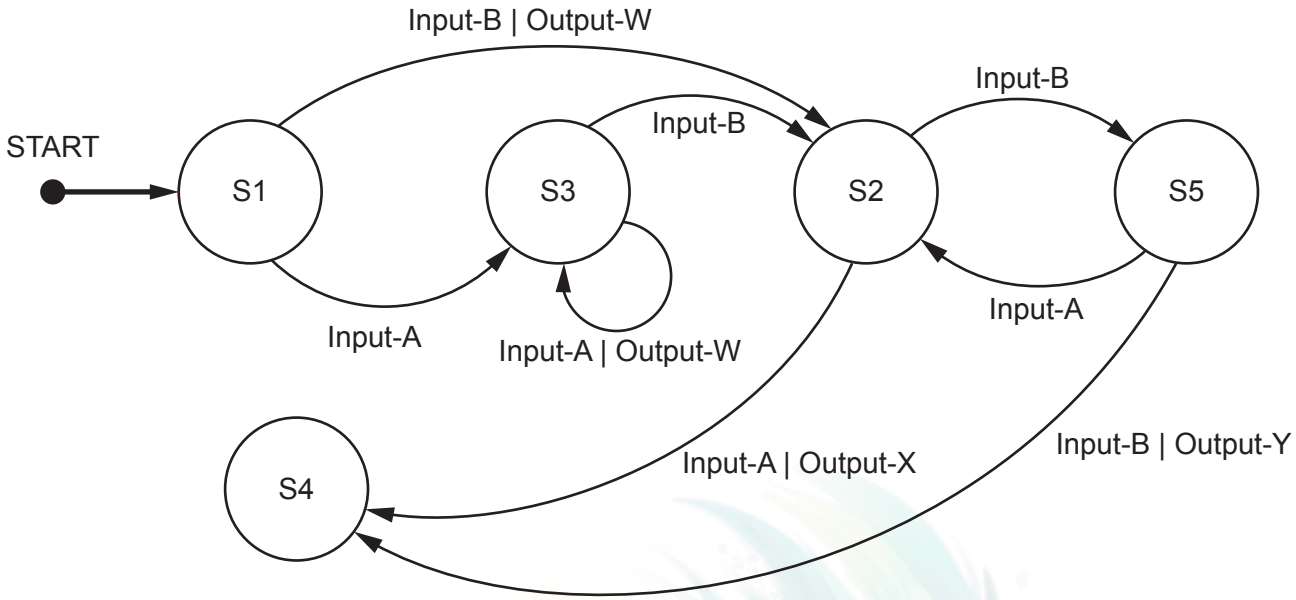
Sub-module 3 Get Member Phone Number

Use Gets the mobile phone number of a member.

[3]

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(b) A different part of the program is represented by the following state-transition diagram.



(i) Complete the table to show the inputs, outputs and next states.

Assume that the current state for each row is given by the 'Next state' on the previous row. For example, the first Input-A is made when in state S1.

If there is no output for a given transition, then the output cell should contain 'none'.

The first two rows have been completed.

Input	Output	Next state
		S1
Input-A	none	S3
Input A	Output-W	S3
Input B	none	S2
Input-B	none	S5
Input-A	none	S2
Input A	Output X	S4

[5]

(ii) Identify the input sequence that will cause the minimum number of state changes in the transition from S1 to S4.

Input-B, Input-A ..... [1]

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8 A teacher is designing a program to process pseudocode projects written by her students.

Each student project is stored in a text file.

The process is split into a number of stages. Each stage performs a different task and creates a new file.

For example:

File name	Comment
`MichaelAday_src.txt`	Student project file produced by student Michael Aday
`MichaelAday_S1.txt`	File produced by stage 1
`MichaelAday_S2.txt`	File produced by stage 2

(a) Suggest a reason why the teacher's program has been split into a number of stages **and** give the benefit of producing a different file from each stage.

Reason ..... Implementation and easier to design .....

Benefit ..... Easier to debug and update .....

..... [2]

(b) The teacher has defined the first program module as follows:

Module	Description
`DeleteSpaces()` Function	• called with a parameter of type string representing a line of pseudocode from a student's project file • returns the line after removing any leading space characters The following example shows a string before and after the leading spaces have been removed: Before: `"    IF X2 > 13 THEN"` After: `"IF X2 > 13 THEN"`

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Complete the pseudocode for module `DeleteSpaces()`.

```
FUNCTION DeleteSpaces(Line : STRING) RETURNS STRING
```

```
DECLARE Count, NumSpace : INTEGER
DECLARE Newline : STRING
DECLARE End of leading : BOOLEAN
DECLARE Next Char : CHAR
CONSTANT Space = " "

NumSpace ← 0
END Of leading ← False
    FOR Count ← 1 TO LENGTH(line)
        Next Char ← MID(Line, Count, 1)
        IF Next Char <> Space and End of leading
            = FALSE
THEN
            NumSpace ← Count - 1
            END of leading = TRUE
        ENDIF
Next Count
        Newline ← RIGHT(line, LENGTH(line) - Num
                                              Space
 Return Newline
END FUNCTION
```

```
ENDFUNCTION
```

[6]

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(c) Two modules are defined:

Module	Description
`DeleteComment()` (already written)	• called with a parameter of type string representing a line of pseudocode from a student's project file • returns the line after removing any comment

`Stage_2()`	• called with two parameters:
	  ○ a string representing an input file name
	  ○ a string representing an output file name
	• copies each line from the input file to the existing output file having first removed all leading spaces and comments from that line
	• does not write blank lines to the output file
	• outputs a final message giving the number of blank lines removed

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Write pseudocode for module `Stage_2()`.

Modules `DeleteComment()` and `DeleteSpaces()` must be used in your solution.

```
PROCEDURE Stage_2(F1, F2 : STRING)
    DECLARE line : STRING
    DECLARE Count : INTEGER
Count ← 0
    OPEN F1 FOR READ
    OPEN F2 FOR APPEND
WHILE NOT EOF(F1)
    READFILE F1, Line
    Line ← DeleteSpaces(Line)
    Line ← DeleteComment(line)
  IF line <> "" THEN
    WRITEFILE F2, line //Skip blank lines
  ELSE
    Count ← Count + 1
  ENDIF
ENDWHILE
    CLOSEFILE F1
    CLOSEFILE F2
OUTPUT Count, "blank lines were removed"
ENDPROCEDURE
```

[8]

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