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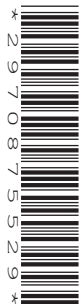
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COMPUTER SCIENCE

9608/21

Paper 2 Fundamental Problem-solving and Programming Skills

October/November 2021

2 hours

You must answer on the question paper.

No additional materials are needed.

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.

This document has **20** pages. Any blank pages are indicated.

1 Part of the procedure `InitVars()` is shown:

```
PROCEDURE InitVars()
    DECLARE Var1 : INTEGER // daily rainfall
    DECLARE Var2 : REAL    // the average wind speed
    DECLARE Var3 : STRING  // the ID number of the weather station
    {
ENDPROCEDURE
```

- (a) Give a **more meaningful** identifier name for each of the following variables used by the procedure.

Variable	New identifier name
Var1	
Var2	
Var3	

[3]

- (b) A function called `ProcessVars()` assigns values to variables as shown.

Variable	Value
HouseCount	12
Turnout2018	20.23
TidalRiskCategory	'C'
IsConservationArea	FALSE
StationLocationName	"Ocean Boulevard"

Some pseudocode expressions in the function are shown in the following table.

Complete the table by evaluating each expression and writing the answer in the **Evaluates to** column.

If the expression is invalid, write "ERROR" in the **Evaluates to** column.

Refer to the **Appendix** on pages 18–19 for a list of built-in pseudocode functions and operators.

Pseudocode expression	Evaluates to
<code>LENGTH(HouseCount) > 6</code>	
<code>MOD(INT(Turnout2018) * 3, 4)</code>	
<code>ASC(TidalRiskCategory) + Turnout2018</code>	
<code>IsConservationArea AND (HouseCount <= 50)</code>	
<code>MID(StationLocationName, 1, 5) & " Eleven"</code>	

[5]

(c) The function header for `ProcessVars()` is:

```
FUNCTION ProcessVars(DataItem : REAL) RETURNS REAL
```

The following is an example of a parameter value passed to the function.

```
"L-MH-245,ManorHouse,N,F,230,12.34,0.98,12,N"
```

There is an error in the function header.

State the error **and** write the correct function header.

Error

Correct function header

[2]

(d) A programmer writes program code using an Integrated Development Environment (IDE).

Define the following **three** features of an IDE.

Breakpoints

Report (watch) window

Single stepping

[3]

- 2 (a) The following pseudocode function counts the occurrences of a character in a string.

Line numbers are shown for reference only.

```

01  DECLARE Message : STRING
02
03  FUNCTION CharacterCount(Letter : CHAR) RETURNS INTEGER
04
05      DECLARE LetterCount, Index : INTEGER
06      DECLARE ThisChar : INTEGER
07
08      LetterCount ← 1
09
10      FOR Index ← 1 TO LENGTH(Message) - 1
11          ThisChar ← LEFT(Message, Index, 1)
12          IF ThisChar = Letter
13              THEN
14                  LetterCount ← LetterCount + 1
15          ENDIF
16      ENDFOR
17      RETURN LetterCount
18  ENDFUNCTION

```

- (i) State the technical name of the iterative control structure used in this function.

..... [1]

- (ii) Examine the pseudocode and write the answer in the table for each item.

Item	Answer
The scope of the variable <i>Message</i> is	
The start and end line numbers of a selection structure	
The identifier name of a user-defined function is	
An arithmetic operator used in the function is	

[4]

(b) Four lines of the pseudocode given in **part (a)** contain an error.

Identify the errors **and** write the correct pseudocode.

Line number for error 1

Correct pseudocode

.....

Line number for error 2

Correct pseudocode

.....

Line number for error 3

Correct pseudocode

.....

Line number for error 4

Correct pseudocode

.....

[4]

.....
.....
..... [8]

(b) A decision is made to use constants in the procedure `CheckWeight()` to represent the maximum weight and the maximum number of cases.

State **two** advantages of using constants instead of variables.

Advantage 1
.....
Advantage 2
..... [2]

(c) `CheckWeight()` is a user-defined function.

(i) State **two** benefits of user-defined functions.

Benefit 1
.....
Benefit 2
..... [2]

(ii) State **two** benefits of built-in functions.

Do **not** give the same answers as in **part (c)(i)**.

Benefit 1
.....
Benefit 2
..... [2]

(d) One method of passing a parameter is by reference.

Name **and** describe another method.

Name
Description
.....
..... [3]

- 4 A willow tree is a type of tree that grows at an angle. A 1D array, `TreeAngle`, has 20 elements of integer type. Each element stores the angle of a willow tree measured in degrees.

A procedure called `SafetyCheck()` is required to:

- check each tree angle in the array and count the number of trees that exceed the safe limit of 36 degrees
- determine whether the count exceeds a maintenance limit stored in the global variable `MainTrigger`, in which case a maintenance visit is required
- output a suitable message if the count is less than or equal to `MainTrigger`, otherwise output a message showing the number of times the safe limit was exceeded as follows: "Maintain 10 trees".

- (a) The `SafetyCheck()` procedure is written in pseudocode.

Complete the following pseudocode.

Refer to the **Appendix** on pages 18–19 for a list of built-in pseudocode functions and operators.

```

PROCEDURE SafetyCheck()
    DECLARE Count : INTEGER
    DECLARE Index : INTEGER
    CONSTANT TreeCount = 20
    ..... ← 0
    FOR Index ← 1 TO .....
        IF TreeAngle[Index] > .....
            THEN
                Count ← Count + 1
            ENDIF
        ENDFOR
    IF ..... <= MainTrigger
        THEN
            OUTPUT "Maintenance not needed"
        ELSE
            OUTPUT "Maintain " & NUM_TO_STRING(Count) & " trees"
        ENDIF
    ENDPROCEDURE

```

[4]

(b) The `TreeAngle` array is changed to a 2D array that contains 20 rows and 2 columns of integer numbers as follows:

- The first column stores the integer reference number of the tree.
- The second column stores the integer angle of the tree.

Study this example:

```
TreeAngle[15, 1] ← 767 // tree reference  
TreeAngle[15, 2] ← 12 // the angle of the tree
```

A procedure, `CheckTree()`, is called with an integer parameter representing the tree's reference number.

The procedure will:

- search the `TreeAngle` array for the reference number
- when a match is found, prompt and input the angle of the tree, store the data in the second dimension of the `TreeAngle` array, and then output a message if its safety status has changed
- when a match is not found, output the reference number and "No match".

Write **program code** for the procedure `CheckTree()`.

Visual Basic and Pascal: You should include the declaration statements for variables.

Python: You should show a comment statement for each variable used with its data type.

Programming language

Program code

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5 (a) Module iteration and module selection are features of a structure chart.

State **two other** features that may be represented in a structure chart.

Feature 1

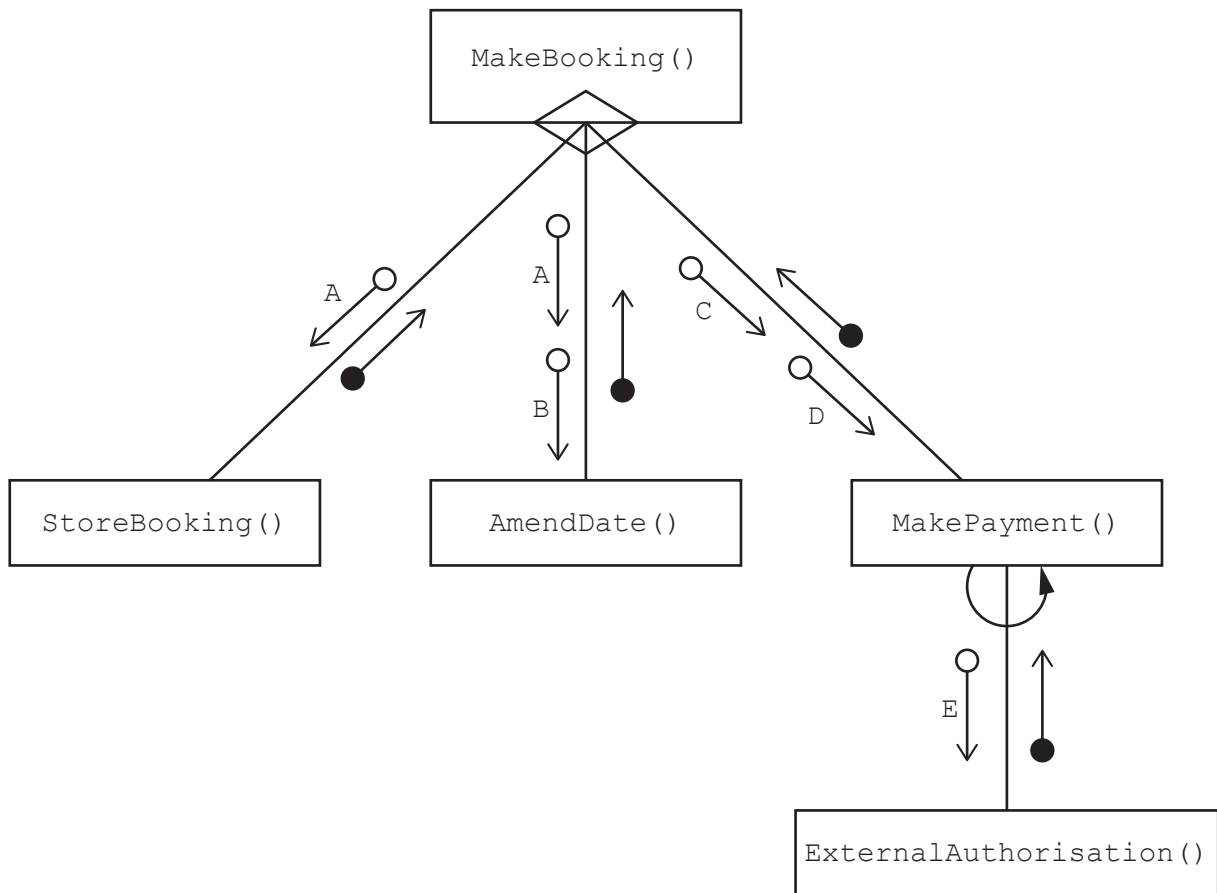
.....

Feature 2

.....

[2]

(b) Examine this structure chart of a booking system.



Complete the following table by writing the correct parameter letter (A, B, C, D or E) for each parameter identifier.

Parameter identifier	Parameter letter
Quantity	
BookingID	
ItemCost	
TotalCost	
BookingDate	

[5]

6 A geocode is a string that specifies a geographical location.

The string consists of two alphanumeric characters which are followed by:

- the character '+'
- two more alphanumeric characters
- a comma
- a description of the location.

Here is an example of an email message that contains two geocodes. The first is for Coventry in the UK and the second is for Cambridge in the UK.

"This is my previous address 65+ER,CoventryUK.

I have now moved to my new location at 64+AA,CambridgeUK."

(a) A programmer decides to store the geocodes in a 1D array called `Location`. The array contains 10 000 elements and unused array elements are initialised with the string "22+VV".

Write **pseudocode** to declare and initialise the array `Location`.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [3]

(b) The following example pseudocode uses the function `FindGeoCodeIndex()` to search the array `Location` for the index position of a given geocode.

```

DECLARE CodePosition : INTEGER

CodePosition ← FindGeoCodeIndex(GeoCode)

IF CodePosition <> -1
    THEN
        OUTPUT Geocode & " found at " & NUM_TO_STRING(CodePosition)
    ENENDIF

```

Complete the program flowchart to represent the algorithm **only** for the function `FindGeoCodeIndex()`. Variable declarations are **not** required in program flowcharts.



[4]

Appendix

Built-in functions (pseudocode)

Each function returns an error if the function call is not properly formed.

`MID(ThisString : STRING, x : INTEGER, y : INTEGER)` RETURNS STRING
returns a string of length `y` starting at position `x` from `ThisString`

Example: `MID("ABCDEFGH", 2, 3)` returns "BCD"

`LENGTH(ThisString : STRING)` RETURNS INTEGER
returns the integer value representing the length of string `ThisString`

Example: `LENGTH("Happy Days")` returns 10

`LEFT(ThisString : STRING, x : INTEGER)` RETURNS STRING
returns leftmost `x` characters from `ThisString`

Example: `LEFT("ABCDEFGH", 3)` returns "ABC"

`RIGHT(ThisString: STRING, x : INTEGER)` RETURNS STRING
returns rightmost `x` characters from `ThisString`

Example: `RIGHT("ABCDEFGH", 3)` returns "FGH"

`ASC(ThisChar : CHAR)` RETURNS INTEGER
returns the ASCII value of `ThisChar`

Example: `ASC('A')` returns 65

`NUM_TO_STRING(x : REAL)` RETURNS STRING
returns a string representation of a numeric value
Note: This function will also work if `x` is of type INTEGER

Example: `NUM_TO_STRING(87.5)` returns "87.5"

`STRING_TO_NUM(x : STRING)` RETURNS REAL
returns a numeric representation of a string
Note: This function will also work if `x` is of type CHAR

Example: `STRING_TO_NUM("23.45")` returns 23.45

`UCASE(ThisChar : CHAR)` RETURNS CHAR
returns the character value representing the upper case equivalent of `ThisChar`
`ThisChar` is returned unchanged if it is not a lower-case alphabetic character

Example: `UCASE('a')` returns 'A'

`INT(x : REAL)` RETURNS INTEGER
returns the integer part of `x`

Example: `INT(27.5415)` returns 27

`MOD(ThisNum : INTEGER, ThisDiv : INTEGER)` RETURNS INTEGER
returns the integer value representing the remainder when `ThisNum` is divided by `ThisDiv`

Example: `MOD(10, 3)` returns 1

Operators (pseudocode)

Operator	Description
&	Concatenates (joins) two strings Example: "Summer" & " " & "Pudding" produces "Summer Pudding"
AND	Performs a logical AND on two Boolean values Example: TRUE AND FALSE produces FALSE
OR	Performs a logical OR on two Boolean values Example: TRUE OR FALSE produces TRUE

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