Cambridge Assessment International Education

CS BY AQIB KHAN

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COMPUTER SCIENCE **9618/21**

Paper 2 Fundamental Problem-solving and Programming Skills **May/June 2023**

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 **20** pages. Any blank pages are indicated.

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

1 A programmer has written a program which includes the function `Calculate()`.
When the program is run, the function returns an unexpected value.

(a) Describe how a typical Integrated Development Environment (IDE) could be used to help debug the program to find the errors in the function `Calculate()`.

Use breakpoints so the program pauses at that line when running. Use debugging tools and error messages because IDE highlights syntax errors and may show runtime error message so to identify logical mistake. Use report or watch window to check the value of variable. Single stepping can be used to execute one statment. [4]

(b) The algorithm for function `Calculate()` contains the three pseudocode statements shown.

Describe the error in each statement or write 'no error' if the statement contains no error.

Assume any variables used are of the correct type for the given function.

Statement 1: `Index ← STR_TO_NUM(("27") + 2)`

Error 27 is a string and 2 is a number so string and number cannot be add directly.

Correct → Index ← STR_TO_NUM("27") + 2

Statement 2: `Index ← STR_TO_NUM(MID("CPE1704TKS", 4, 2))`

Error No Error

Statement 3: `IF MONTH(ThisDate) > '6' THEN`

Error MONTH(ThisDate) returns a number but 6 is a string so cannot compare a number with string [3]

CORRECT → IF MONTH(ThisDate) > 6 THEN

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(c) The program contains variables with values as follows:

Variable	Value
Active	TRUE
Points	75
Exempt	FALSE

(i) Complete the table by evaluating each expression.

	Expression	Evaluation
1	(Points > 99) OR Active	TRUE
2	(Points MOD 2 = 0) OR Exempt	FALSE
3	(Points <= 75) AND (Active OR Exempt)	TRUE
4	(Active OR NOT Active) AND NOT Exempt	TRUE

75 → 1 → FALSE OR FALSE

[2]

(ii) Write expression **4** from the table in part **(c)(i)** in its simplest form.

NOT Exempt ..... [1]

Explaination

(Active OR NOT Active) AND NOT Exempt

Active OR NOT Active = TRUE

TRUE AND NOT Exempt

Simplifies to

NOT Exempt

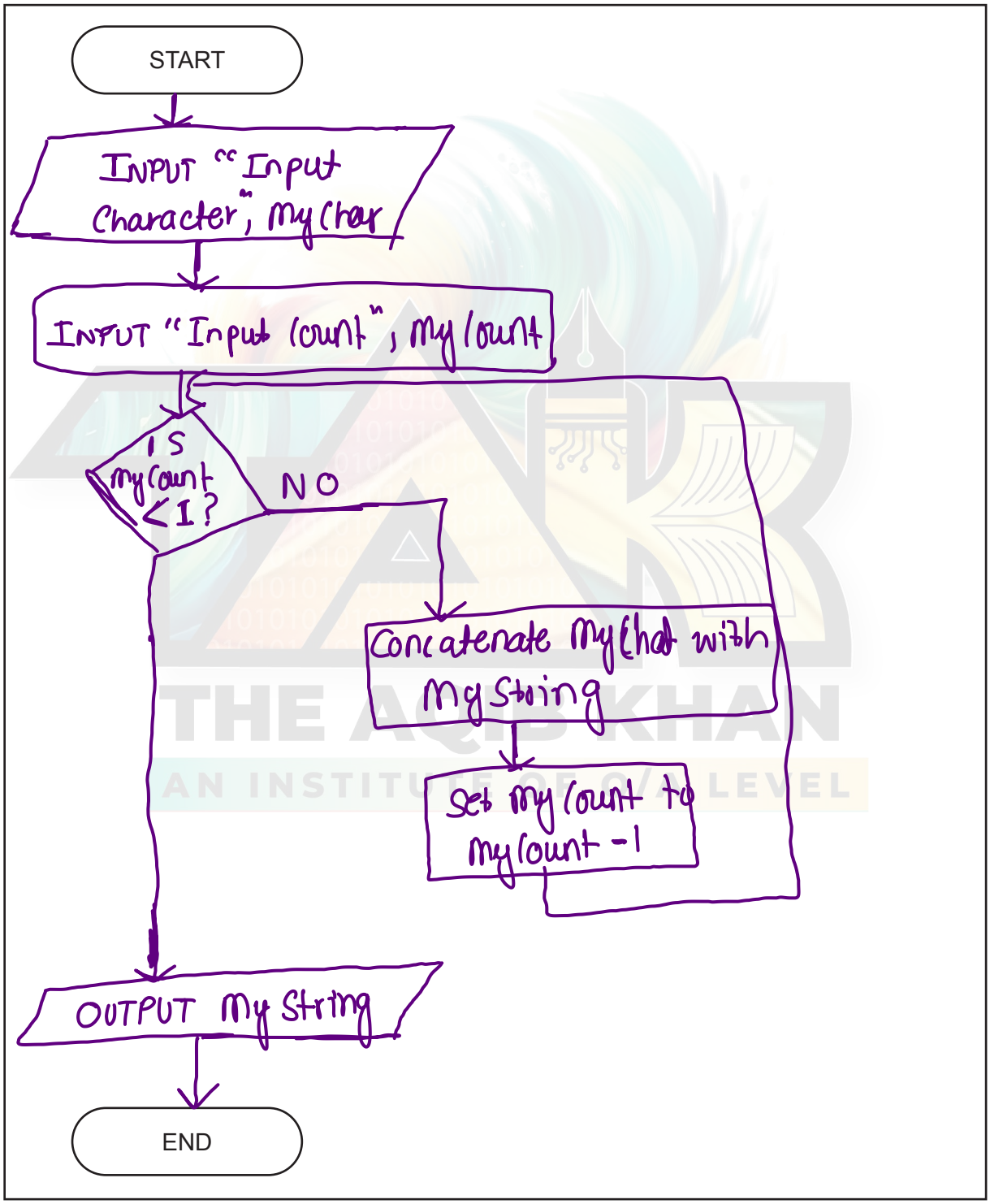
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2 A program contains an algorithm to output a string of a specified length containing identical characters.

(a) The algorithm is described as follows:

1. prompt and input a character and store in `MyChar`
2. prompt and input an integer and store in `MyCount`
3. generate a string consisting of `MyChar` repeated `MyCount` times
4. output the string.

Draw a program flowchart to represent the algorithm.



[4]

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(b) A different part of the program uses the variable `StartDate`.

Write pseudocode statements to declare `StartDate` **and** assign to it the date corresponding to 15/11/2005.

Declaration DECLARE StartDate : DATE

Assignment StartDate ← SETDATE(15,11,2005)

[3]

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3 Customers collect points every time they make a purchase at a store.

A program is used to manage the points system and the table lists some of the information stored for one customer.

Information	Data type required
Name	String
Number of points collected	Integer
Date of birth	Date

(a) (i) Identify a suitable structure for storing the information for one customer. Explain the advantage of using this structure.

Structure ... Record ...

Advantage ... All data is related to one customer, of different types. It is held under a single entity. ...

[4]

(ii) Describe a data structure that could be used to store the information for **all** customers.

1D array of records ...

... [2]

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(b) Customers receive points depending on the amount they spend. The number of points depends on the band that the amount falls into:

Band	Amount	Points
1	Less than $10	5 per whole dollar ($)
2	Between $10 and $100 inclusive	7 per whole dollar ($)
3	Over $100	10 per whole dollar ($)

For example, if the amount is $99.77, this amount is in band 2 and therefore the number of points is 7 × 99, which is 693 points.

The algorithm to calculate the points from a given amount is expressed as follows:

- work out the appropriate band
- calculate and output the number of points.

Apply the process of stepwise refinement to increase the detail of the algorithm. Structure your algorithm into a sequence of five steps that could be used to produce pseudocode.

Write the **five** steps.

1 Refer to use of constants or variables for two threshold values 10 and 100.

2 work out one band that amount maps to.

3 Calculate the rounded value of amount maps to.

4 Calculate the points by multiplying the rounded amount by appropriate band

5 Output the number of points.

[5]

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4 Function `Replace()` will:

1. take three parameters:
   - a string (the original string)
   - a char (the original character) → Char1
   - a char (the new character) → Char2
2. form a new string from the original string where all instances of the original character are replaced by the new character
3. return the new string.

Write pseudocode for function `Replace()`.

```
Function Replace (OldString : STRING, Char1, Char2 : CHR)
                                                RETURNS STRING
DECLARE NewString : STRING
DECLARE ThisChar : CHAR
DECLARE Index : INTEGER
NewString ← ""
    FOR Index ← 1 TO LENGTH(OldString)
    ThisChar ← MID(OldString, Index, 1)
      IF ThisChar = Char1 THEN
      ThisChar ← Char2
    ENDIF
    NewString ← NewString and ThisChar
NEXT INDEX
      RETURN NewString
ENDFUNCTION
```

[6]

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Chap - 12

5 Several companies are developing websites to market a new type of games console. The company that is first to create a website that can demonstrate the interactive features of the games console will have an advantage over the others. The requirements for the website are likely to change as more information about the features of the console are made available.

One company has decided to develop their website using a program development life cycle based on the waterfall model.

(a) (i) Give **two** reasons why this may **not** be the most appropriate model to use in this case.

Reason 1 ..... It does not allow the creation of early versions .....

Reason 2 ..... Needs high involvment of the client .....

[2]

(ii) Identify a **more appropriate** program development life cycle model for this scenario.

..... Iterative ..... [1]

(b) The website has been running in test mode for several weeks.

Identify **and** describe a final stage of testing that should take place before the website is made available to all customers.

Stage ..... Beta testing .....

Description ..... Testing is carried out by a small group of users. Users will check that the website works in real world. Users will give suggestions for the improvement. .....

[3]

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6 A video-conferencing program supports up to six users. Speech from each user is sampled and digitised (converted from analogue to digital). Digitised values are stored in array `Sample`.

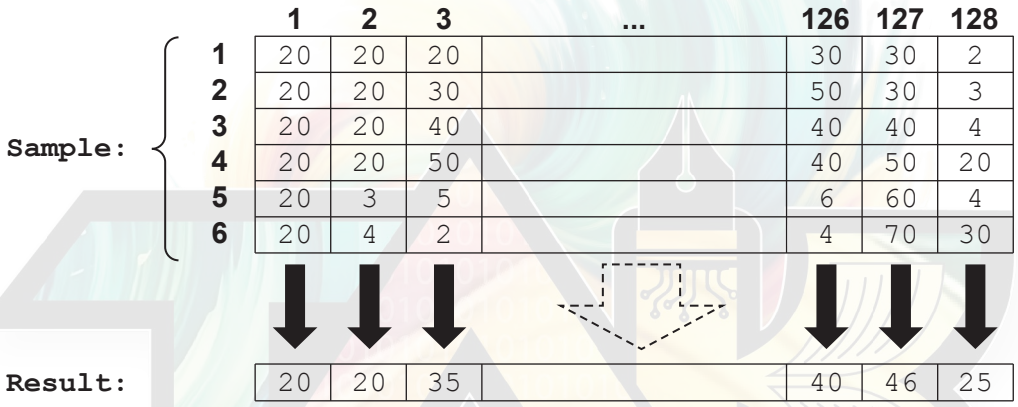
The array `Sample` consists of 6 rows by 128 columns and is of type integer. Each row contains 128 digitised sound samples from one user.

The digitised sound samples from each user are to be processed to produce a single value which will be stored in a 1D array `Result` of type integer. This process will be implemented by procedure `Mix()`.

A procedure `Mix()` will:

- calculate the average of each of the 6 sound samples in a column
- ignore sound sample values of 10 or less
- store the average value in the corresponding position in `Result`
- repeat for each column in array `Sample`

The diagram uses example values to illustrate the process:



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Write pseudocode for procedure `Mix()`.

Assume `Sample` and `Result` are global.

```
PROCEDURE Mix()
  DECLARE Count, Total, ThisNum: INTEGER
  DECLARE ThisUser, ThisSample: INTEGER
  .
  FOR ThisSample ← 1 TO 128
      Count ← 0
      Total ← 0
      FOR ThisUser ← 1 TO 6
          IF Sample[ThisUser, ThisSample] > 10 THEN
          COUNT ← COUNT + 1
          Total ← Total + Sample[ThisUser, ThisSample]
      ENDIF
      NEXT USER
      Result[ThisSample] ← INT(Total / Count)
  NEXT ThisSample
ENDPROCEDURE
```

[6]

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7 A school has a computerised library system that allows students to borrow books for a fixed length of time. The system uses text files to store details of students, books and loans.

A new module is to be written which will generate emails to each student who has an overdue book.

(a) Decomposition will be used to break down the problem of designing the new module into sub-problems.

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

Module 1 GetOverdueLoan

Use To identify an overdue book.

Module 2 IdentifyStudent

Use To identify a student with overdue book.

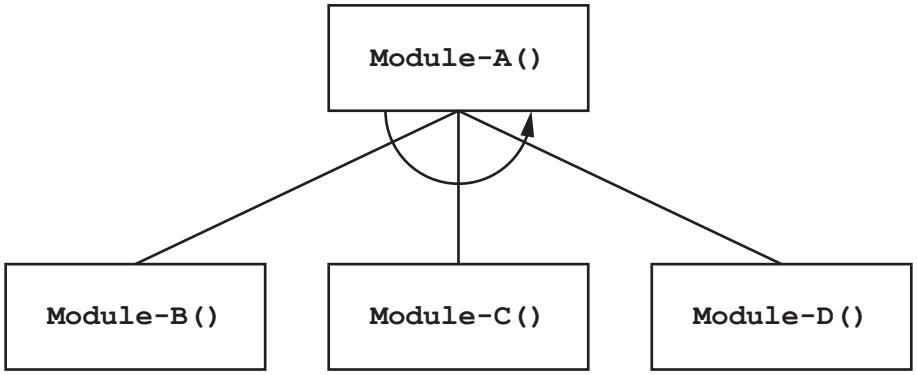
Module 3 SendEmail

Use sends email to students with an overdue book.

[3]

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(b) The program designer produces a structure chart for the new module. Part of the structure chart is shown:



(i) Explain the relationship between the four modules shown.

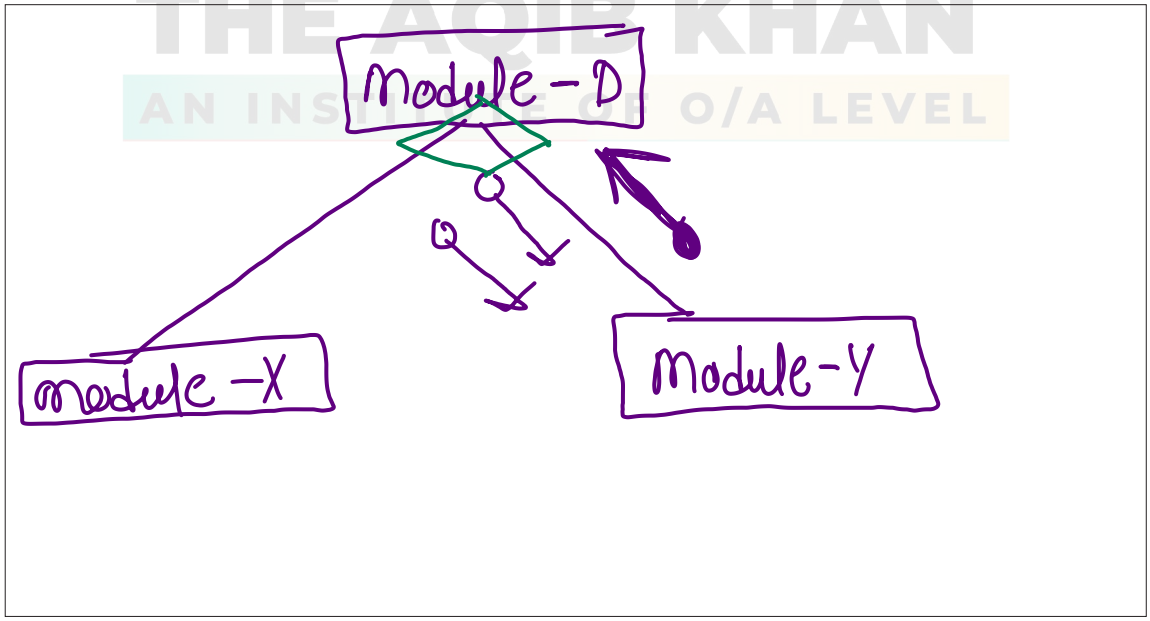
Module A calls other three modules and the process is repeated.

[2]

(ii) Two new modules are added: `Module-X()` and `Module-Y()`.

- `Module-X()` has no parameters.
- `Module-Y()` will take a string and a real number as parameters and return a Boolean value.
- `Module-D()` will call either `Module-X()` or `Module-Y()`.

Draw **only** the part of the structure chart that represents the relationship between `Module-X()`, `Module-Y()` and `Module-D()`.



[3]

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8 A computer shop assembles computers using items bought from several suppliers. A text file `Stock.txt` contains information about each item.

Information for each item is stored as a single line in the `Stock.txt` file in the format:

```
<ItemNum><SupplierCode><Description>
```

Item information is as follows:

	Format	Comment
`ItemNum`	4 numeric characters	unique for each item in the range "0001" to "5999" inclusive
`SupplierCode`	5 alphabetic characters	to identify the supplier of the item
`Description`	a string	a minimum of 12 characters

The file is organised in ascending order of `ItemNum` and does **not** contain all possible values in the range.

A programmer has started to define program modules as follows:

Module	Description
`SuppExists()` (already written) Function	• called with a parameter of type string representing a supplier code • returns `TRUE` if the supplier code is already in use, otherwise returns `FALSE`
`IsNewSupp()` Function	• called with a parameter of type string representing a new supplier code • returns `TRUE` if the string only contains alphabetic characters (either upper or lower case) and the supplier code is **not** already in use, otherwise returns `FALSE`

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(a) Write pseudocode for module `IsNewSupp()`.

Module `SuppExists()` has already been written and should be used as part of your solution. Module `SuppExists()` will generate a run-time error if the given parameter is not 5 characters in length.

```
Function IsNewSupp(ThisString:String) Return Boolean
    DECLARE Index : INTEGER
    DECLARE ThisChar : CHAR
    IF LENGTH(ThisString) <> 5 THEN
        RETURN FALSE
    ENDIF
    FOR Index ← 1 TO 5
    ThisChar ← TO_LOWER(MID(ThisString,Index,1))
        IF ThisChar < 'a' OR ThisChar > 'z' THEN
            RETURN FALSE
        ENDIF
    NEXT Index
        RETURN TRUE
ENDFUNCTION
```

[7]

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(b) A new module has been defined:

Module	Description
`CheckNewItem()`	• called with a parameter of type string representing a line of item information • checks to see whether an item with the same `ItemNum` already exists in the file • returns `TRUE` if the `ItemNum` is not already in the file, otherwise returns `FALSE`

Write **efficient** pseudocode for module `CheckNewItem()`.

```
Function CheckNewItem(NewLine:STRING)
                                    RETURNS BOOLEAN
  DECLARE NotFound : BOOLEAN
  DECLARE NewItemNum, ThisItemNum, ThisLine:STRING
  NotFound ← TRUE
  OPENFILE "Stock.txt" FOR READ
  NewItemNum ← LEFT(NewLine, 4)
  ThisItemNum ← "000"

  WHILE NOT EOF("STOCK.txt") AND NotFound=TRUE
                          AND ThisItem < NewItemNum
    READFILE(Stock.txt, ThisLine)
    ThisItemNum ← LEFT(ThisLine, 4)
    IF ThisItemNum = NewItemNum THEN
      NotFound ← FALSE

    ENDIF
  ENDWHILE
      CLOSEFILE "Stock.txt"
    RETURN NotFound
ENDFUNCTION
```

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.....

.....

.....

..... [7]

(c) The program modules `SuppExists()`, `IsNewSupp()` and `CheckNewItem()` are part of a group of modules that are combined to create a complete stock control program.

Each module in the program is tested individually during development and is debugged as necessary. It is then added to the program and further testing performed.

(i) Identify this method of testing.

Integration testing ..... [1]

(ii) One of the modules does not work properly when it is added to the program.

Describe a testing method that can be used to address this problem so that testing can continue and other modules can be added.

Simple module is written to replace the module that does not work properly. Output a message to show it has been called. ..... [2]

(d) A new module `AddItem()` will be used to add information to the `Stock.txt` file.

State the file mode that should be used for the algorithm within this module.

Append ..... [1]

(e) A new module `FindItem()` searches for a given item in the `Stock.txt` file, which is already organised in ascending order of `ItemNum`.

Describe how this organisation may improve the efficiency of the algorithm.

Iteration can stop if the current value read from the file is greater than the value being searched for.

.....

.....

..... [3]

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