



INTERNATIONAL SCHOOL OF SOUTH AFRICA

UNIVERSITY OF CAMBRIDGE FELLOWSHIP CENTRE

COMPUTER SCIENCE

28 July 2022

Paper 4 (Further Programming and Problem Solving)

2 Hours 30 Minutes

Form U6

Examiner: Mr D.Y. Feni

Session 2

Moderator: Mr P. Baka

NAME:.....

CLASS:....

INSTRUCTIONS

Candidates answer on the Question Paper.

No calculators allowed

READ THESE INSTRUCTIONS FIRST

- This question paper consists of **9** pages including the cover page.
- Use a black or dark blue pen.
- Write your answer to each question in the space provided.
- Do not use an erasable pen or correction fluid.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must not be used in this paper.

Answer all questions.

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

Total 75 Marks

For office use only

75



- a holistic and balanced education for every student within a broad and inclusive curriculum;
- a stimulating and challenging learning environment founded on tolerance, mutual respect, caring relationships, moral accountability, personal integrity and professional commitment;
- the need to work closely and effectively with all stakeholders.

A `class` declaration can be used to declare a record.

If the programming language used does not support arrays, a list can be used instead.

1 Study the following pseudocode for a recursive function.

```

FUNCTION Unknown(BYVAL X, BYVAL Y : INTEGER) RETURNS INTEGER
    IF X < Y THEN
        OUTPUT X + Y
        RETURN (Unknown(X + 1, Y) * 2)
    ELSE
        IF X = Y THEN
            RETURN 1
        ELSE
            OUTPUT X + Y
            RETURN (Unknown(X - 1, Y) DIV 2)
        ENDIF
    ENDIF
ENDFUNCTION

```

The operator `DIV` returns the integer value after division e.g. `13 DIV 2` would give 6

(a) Write program code to declare the function `Unknown()`.

Save your program as **question 1**.
Copy and paste the program code into **part 1(a)** in the evidence document.

[3]

(b) The main program needs to run all **three** of the following function calls and output the result of each call:

`Unknown(10, 15)`

`Unknown(10, 10)`

`Unknown(15, 10)`

(i) For each of the **three** function calls, the main program needs to:

- output the value of the two parameters
- call the function with those parameters
- output the return value.

Write the program code for the main program.

Save your program.
Copy and paste the program code into **part 1(b)(i)** in the evidence document.

[3]

(ii) Take a screenshot to show the output from **part (b)(i)**.

Copy and paste the screenshot into **part 1(b)(ii)** in the evidence document.

[2]

(c) Rewrite the function `Unknown()` as an iterative function, `IterativeUnknown()`.

Save your program.
Copy and paste the program code into **part 1(c)** in the evidence document.

[7]

d) The iterative function needs to be called **three** times with the same parameters as in **part (b)**.

(i) For each of the **three** function calls, the main program needs to:

- output the value of the two parameters
- call the iterative function with those parameters
- output the return value.

Amend the main program to perform these tasks.

Save your program.
Copy and paste the program code into **part 1(d)(i)** in the evidence document.

[1]

(ii) Take one or more screenshots to show the output of both functions for each set of parameters.

Copy and paste the screenshot(s) into **part 1(d)(ii)** in the evidence document

[1]

2 A program, written using object-oriented programming, stores pictures as objects.

The program stores the dimensions of the picture (width and height), the colour of the frame (e.g.

black), and a description of the picture (e.g. flowers).

The class has the following attributes and methods.

Picture	
Description : STRING Width : INTEGER Height : INTEGER FrameColour : STRING	// stores a description of the picture // stores the width e.g. 30 // stores the height e.g. 40 // stores the colour e.g. black
Constructor() GetDescription() GetHeight() GetWidth() GetColour() SetDescription()	// takes all four values as parameters and sets them to the private attributes // returns the description of the picture // returns the height // returns the width // returns the frame colour // takes the new description as a parameter and writes the value to description

(a) The constructor takes the picture description, frame colour, height, and width as parameters and sets these to the private attributes.

Write the program code to declare the class Picture and its constructor.

Do not write any other methods.

Use your language appropriate constructor. All attributes should be private.

If you are writing in Python programming language, include attribute declarations using comments.

Save your program as **question 2**.

Copy and paste the program code into **part 2(a)** in the evidence document.

[5]

(b) The four get methods return the associated attribute, for example, GetDescription() returns the description of the picture.

Write the **four** get methods

Save your program.
Copy and paste the program code into **part 2(b)** in the evidence document.

[3]

(c) The method `SetDescription()` takes a new description as a parameter, and writes this value to the appropriate attribute.

Write the method `SetDescription()`.

Save your program.
Copy and paste the program code into **part 2(c)** in the evidence document.

[2]

(d) Write program code to declare an array of type `Picture` with 100 elements.

Save your program.
Copy and paste the program code into **part 2(d)** in the evidence document.

[1]

3 A program stores the following ten integers in a 1D array with the identifier `arrayData`.

10 5 6 7 1 12 13 15 21 8

(a) Write program code for a **new program** to:

- declare the global 1D array, `arrayData`, with ten elements
- initialise `arrayData` in the main program using the data values shown.

- Save your program as **question3**.
- Copy and paste the program code into **part 3(a)** in the evidence document.

[2]

(b) (i) A function, `linearSearch()`, takes an integer as a parameter and performs a linear search on `arrayData` to find the parameter value. It returns `True` if it was found and `False` if it was not found.

Write program code for the function `linearSearch()`.

Save your program.
Copy and paste the program code into **part 3(b)(i)** in the evidence document.

[2]

(ii) Edit the main program to:

- allow the user to input an integer value
- pass the value to `linearSearch()` as the parameter
- output an appropriate message to tell the user whether the search value was found or not.

Save your program.
Copy and paste the program code into **part 3(b)(ii)** in the evidence document.

[4]

(iii) Test your program with one value that is in the array and one value that is not in the array.

Take a screenshot to show the result of each test.

Save your program.
Copy and paste the screenshots into **part 3(b)(iii)** in the evidence document.

[2]

(c) The following bubble sort pseudocode algorithm sorts the data in `theArray` into descending numerical order. There are **five** incomplete statements.

```

PROCEDURE bubbleSort()

    DECLARE temp : INTEGER

    FOR x ← 0 to .....

        FOR y ← 0 to .....

            IF theArray[y] ..... theArray[y + 1] THEN

                temp ← theArray[y]

                theArray[y] ← .....

                theArray[y + 1] ← .....

            ENDIF

        NEXT y

    NEXT x

ENDPROCEDURE

```

Save your program.

Copy and paste the program code into **part 3(c)** in the evidence document.

4. A linked list called `myLinkedList` is to be created that has a size of **12**. All the items are of `INTEGER` datatype. The pointers of `myLinkedList` are stored in `myLinkedListPointers` 1D array.

(a) Write a program to setup `myLinkedList` such that these values are in the Linked List

27, 19, 36, 42, 16, None, None, None, None, None, None, None

And `myLinkedListPointers` contains

-1, 0, 1, 2, 3, 6, 7, 8, 9, 10, 11, -1

In your program set `startPointer` to 4 and `nullPointer` to -1. Save your program as **question 4**.

Save your program

Copy and paste the program code into part **4 (a)** of the evidence document.

[4]

(b) Write a program to find items in `myLinkedList`, your program should use a function called `find` which takes one parameter `item` and returns the `itemPointer`.

Save your program

Copy and paste the program code into part **4(b)** of the evidence document.

[4]

(c) Write a program to find the following item: 42

Save your program

Copy and paste the program code into part **4 (c)** of the evidence document.

[4]

(d) Copy and paste screenshots of your output into part **34(d)** of the evidence document

[2]

(e) Write a program to push new items in the LinkedList, myLinkedList, your program should use `insert()` function which takes `item` as a parameter and returns the `startPointer`.

Save your program.

Copy and paste the program code into **part 4 (e)** in the evidence document.

[9]

(e) Write a program to push the following items : 35,98,50,45,56,78

Save your program.

Copy and paste the program code into **part 4 (e)** in the evidence document.

[6]

(f) Copy and paste screenshots of your output into part **4(f)** of the evidence document

[1]