Introduction to Programming I
COS1511
School of Computing

Revision Notes

Define tomorrow.

UNISA

college of science, engineering and technology

Overview

Students were asked in the module discussion forum, to suggest the topics or concepts that should be re-visited and clarified.

The following topics were highlighted:

Suggested Topics

1. Variable diagrams;
2. Functions;
3. Data structures (Arrays & Structs); and
4. Two-dimensional arrays;
5. Reference parameters.

Thank you to all the students who participated.

Introduction

Some key **basic principles** to remember:

- Apply the **BODMAS** rules of Mathematics for all calculations;
- The use of **OR (||)** as well as **AND (&&)** are mathematical concepts from Discreet mathematics (∨**;** ∧ respectively), NOT the general English language use.
- Keep together what belongs together.

Basic Principles

Apply the **BODMAS** rules of Mathematics for all calculations;

– e.g. When asked to calculate the average of three assignment marks.

To do this in a single calculation

- Add the item values (marks) together **in Brackets;**
- **Then divide** by the **number of items** (assignments).

```
float Average = (mark1+mark2 + mark3)/numAssignments
```

Basic Principles - continued

– The use of OR as well as AND are mathematical concepts from Discreet mathematics, NOT the general English language use.

– Know the difference between the two questions below:

1. A loop **should execute** if `age` >21 and `averageMark` < 60;
2. A loop **should exit** if `age` < 21 and `averageMark` > 60;

1. A loop **should execute** if `age` >21 and `averageMark` < 60;

The conditions to be met are :

- Condition A (`age` >21) and condition B (`averageMark` < 60)

2. A loop **should exit** if `age` < 21 and `averageMark` > 60;

The conditions to be met are :

- Condition A (`age` < 21) and condition B (`averageMark` > 60)

These questions are essentially different ways of asking the same thing.

– See their implementation in the next slide.

Basic Principles - continued

- A loop **should exit** if `age` >21 and `averageMark` < 60;

- This is probably a **`while loop`** or a **`do while`** loop that should run and stop or **EXIT** when the condition is met;
- In this case, if the `age` is less than 21, the loop should carry on;
- **Also** if the `averageMark` is greater thank 60 then the loop should carry on.
- If the `age` is more than 21, the loop should stop;
- Also if the `averageMark` is less than 60, the loop **should `stop`.**
- It All implies while (A || B):

```
while ( (age < 21)  || (averageMark > 60))
{
cout << "Loop executes… then stops when
condition is met" <<endl;
}
```

- A statement **should execute** if `age` >21 and `averageMark` < 60;

- This statement should only execute if both conditions are met, therefore:

```
if ((age > 21) && (averageMark < 60))
  {
     cout << "Loop executes when the condition
     is met." <<endl;
     }
```

– Then that implies IF (A && B); both of the conditions should be true, for the statement to execute.

Basic Principles

– Keep together what belongs together.

```
int a = 10;
a /= 1+1;
cout << a;
```

You might guess the answer as 11 because most of us translate the compound assignment operator as follows:

`a = a / 1 + 1;` //this is wrong

The statement `a /= 1 + 1;` is equivalent to

```
a = a / (1 + 1);
```

What was on the right hand side stays together. So the output is 5, not 11.

Sample loop question

- Suppose two char variables c1 and c2 are initialised and then input repeatedly in the body of a while loop. The loop **has to be executed** as long as the value of c1 is not equal to 'A' or the value of c2 is equal to 'A'. Which of the options below is a correct condition for the while loop?

  1. ((c1 == 'A') || (c2 != 'A'))
  2. ((c1 != 'A') || (c2 == 'A'))
  3. ((c1 == 'A') && (c2 != 'A'))
  4. ((c1 != 'A') && (c2 == 'A'))
  5. None of the above options is correct.

Correct option: 2

- The loop has to be executed as long as the value of c1 is not equal to 'A' or the value of c2 is equal to 'A'.
- Therefore, as soon as one of the two conditions is not valid anymore, the loop must stop.

- Look at the wording in the question. The question dictates the conditions for which the loop has to be executed which means the wording can be directly translated to condition.
- However, if the wording is like – the loop has to exit when the value of c1 is equal to 'A' or c2 not equal to A, then it needs a bit more effort to arrive at the condition. See the next question.
-

Sample loop question contd…

- Suppose two char variables c1 and c2 are initialised and then input repeatedly in the body of a while loop. The loop **has to exit** when the value of c1 is equal to ‘B’ and the value of c2 is not equal to ‘B’. Which of the options below is a correct condition for the while loop?

  1. ((c1 == 'B') && (c2 != 'B'))
  2. ((c1 == 'B') || (c2 != 'B'))
  3. ((c1 != 'B') && (c2 == 'B'))
  4. ((c1 != 'B') || (c2 == 'B'))
  5. None of the above options is correct.

  Correct option: 4
- Contrary to the previous question, where the conditions under which the loop must be executed, is described, the condition under which the loop must be exited, are described in this question. The loop must exit when c1 is equal to ‘B’ and c2 is not equal to ‘B’. **Therefore, the condition in the loop should be ‘opposite’ of this.**

  Opposite of c1 is equal to ‘B’ → c1 != ‘B’

  Opposite of c2 not equal to B → c2 == ‘B’

  Opposite of ‘AND’ which connects the above two conditions → OR
- Combine all, and you have the answer!

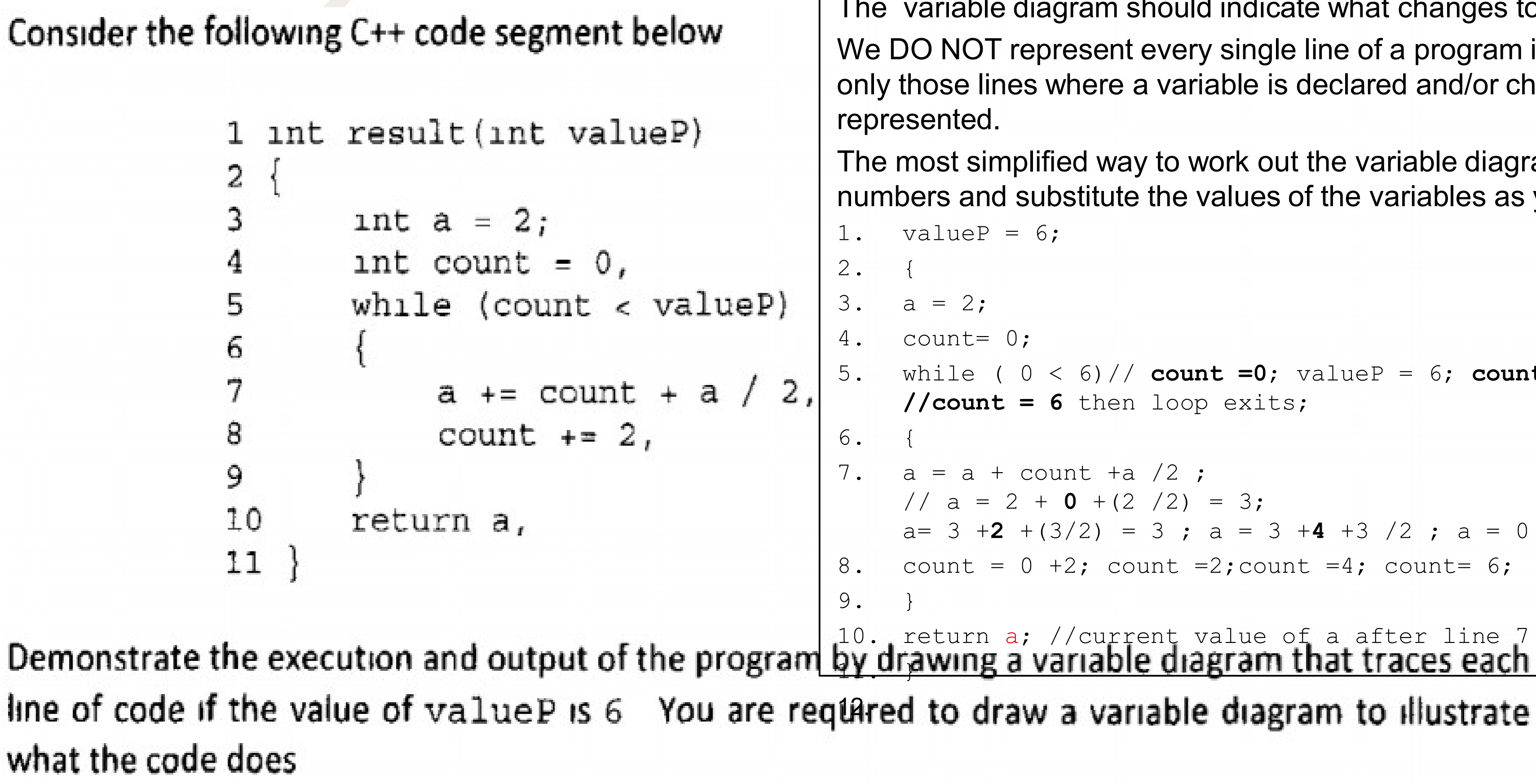
1. Variable Diagrams

Variable diagrams help in tracing the value stored in each variable as the program executes.

In a variable diagram we only show those lines which changes the value of variable(s).

For instance, we do not draw diagrams for `cout` statements.

1. Variable Diagrams- Example



Consider the following C++ code segment below

```
1 int result(int valueP)
2 {
3       int a = 2;
4       int count = 0,
5       while (count < valueP)
6       {
7             a += count + a / 2,
8             count += 2,
9       }
10      return a,
11 }
```

Demonstrate the execution and output of the program by drawing a variable diagram that traces each line of code if the value of valueP is 6 You are required to draw a variable diagram to illustrate what the code does

The variable diagram should indicate what changes took place in variables.

We DO NOT represent every single line of a program in a variable diagram;it is only those lines where a variable is declared and/or changes made to them represented.

The most simplified way to work out the variable diagrams is to label the line numbers and substitute the values of the variables as you go along;e.g.:

```
1.   valueP = 6;
2.   {
3.   a = 2;
4.   count= 0;
5.   while ( 0 < 6)// count =0; valueP = 6; count = 2; count = 4;
     //count = 6 then loop exits;
6.   {
7.   a = a + count +a /2 ;
     // a = 2 + 0 +(2 /2) = 3;
     a= 3 +2 +(3/2) = 3 ; a = 3 +4 +3 /2 ; a = 0 +2 /2 ;
8.   count = 0 +2; count =2;count =4; count= 6;
9.   }
10.  return a; //current value of a after line 7 updated
11.  }
12.
```

Note: The quality of the past exam papers uploaded on myunisa is very poor. Some of the semicolons are displayed as commas. Consider them as semicolons, especially those at the end of C++ statements.

Solution to previous example

Line 1

valueP
6

Line 3:

a	valueP
2	6

Line 4:

a	count	valueP
2	0	6

We do not have to represent line 5 and line 6. Line 5 just checks a condition and line 6 is a curly bracket.

Line 7

a	count	valueP
3	0	6

Line 8

a	count	valueP
3	2	6

After line 9, control goes back to line 5, to check the condition again.

Lines 7 and 8 repeat in the variable diagram until the while loop exits.

Line 7

a	count	valeuP
6	2	6

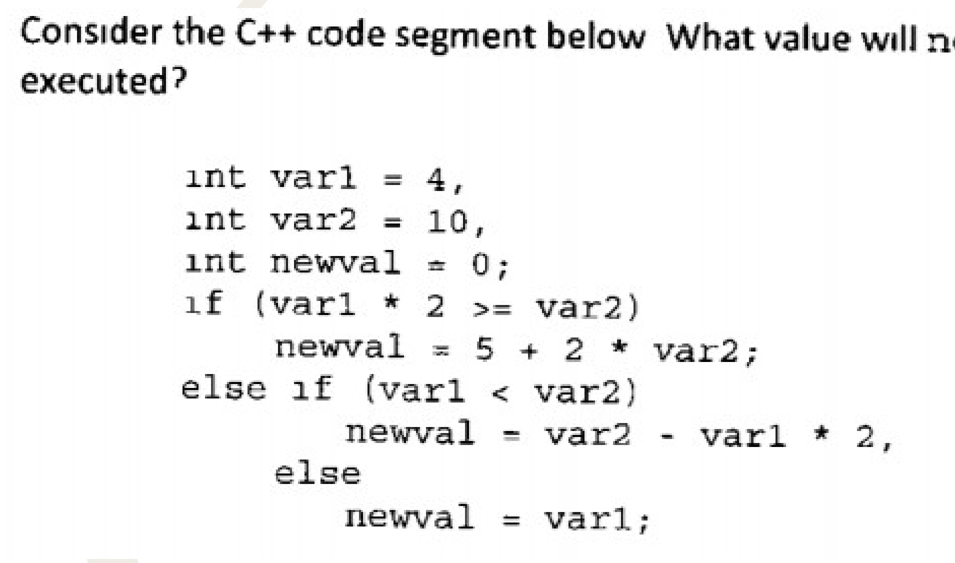
Solution contd…

Line 8	a	count	valeuP
	6	4	6
Line 7	a	count	valueP
	13	4	6
Line 8	a	count	valueP
	13	6	6

On checking the condition, it is false now, so the function exits.

The value of a that is returned is 13.

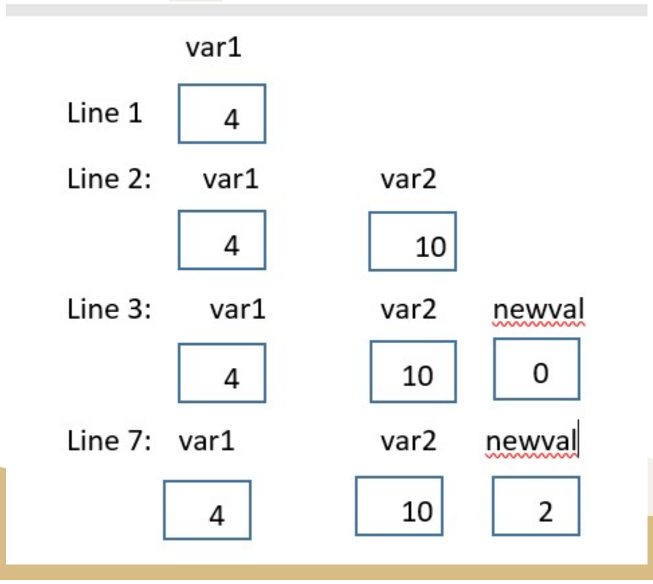
1. Variable Diagrams- Example



Consider the C++ code segment below What value will `newval` have after this code has been executed? (2)

```
int var1 = 4,
int var2 = 10,
int newval = 0;
if (var1 * 2 >= var2)
     newval = 5 + 2 * var2;
else if (var1 < var2)
         newval = var2 - var1 * 2,
     else
         newval = var1;
```

Solution:



- You can use variable diagrams to trace the value as it changes.
- The variable diagram should indicate those lines where changes took place to variable(s).
- In this question keep in mind that only statements following the condition that is true will execute, not all of them.
- `if(var1 * 2 >= var2)` evaluates to `if(4 * 2 >= 10)`. It is false, therefore the control goes to the next `else if`. There it checks the condition `if(var1 < var2)` which evaluates to `if(4 < 10)`. The condition is true, therefore the line of statement following this `else if` will execute and the control will exit the `if` structure.
- Therefore after line 3 in the VD, we need to represent only line 7.

2. Functions

- A function is a piece of code(a group of statements) that executes a particular task.
- All C++ programs have at least one function in it which is the main().
- Two types of functions:
  - built-in functions. eg: abs(), rand(), sqrt()
  - user-defined functions

Functions contd...

- Built-in functions:

  C++ has built-in functions for which we do not have to write the code. eg: rand(), abs(), sqrt() etc. These functions are already defined in the C++ library. We just have to invoke them through a function call.

- User-defined functions

  Users can define their own function. It takes the form:

```
return-type function-name(parameter list)
{
body of the function;
}
```

3. Data Structures- Arrays & Structs

- A **data structure** is a collection of related data values stored under a single name and organised so that the individual values can be accessed separately.

- **Structs** are data structures for storing related data values of different types.

- **Arrays** are **data structures** for storing related data values of the same type.

4. Data Structures-2D Arrays

- Two-dimensional Arrays
- eg: `int arr[2][3];` declares a 2D array `arr` with two rows and 3 columns.
- When a 2D array is initialized as follows the first dimension is optional.
- eg:- `int arr[][3] = { {1,2,3}, {4,5,6}};`

Solution to Q 6.2.1 of Oct/Nov 2016 exam paper

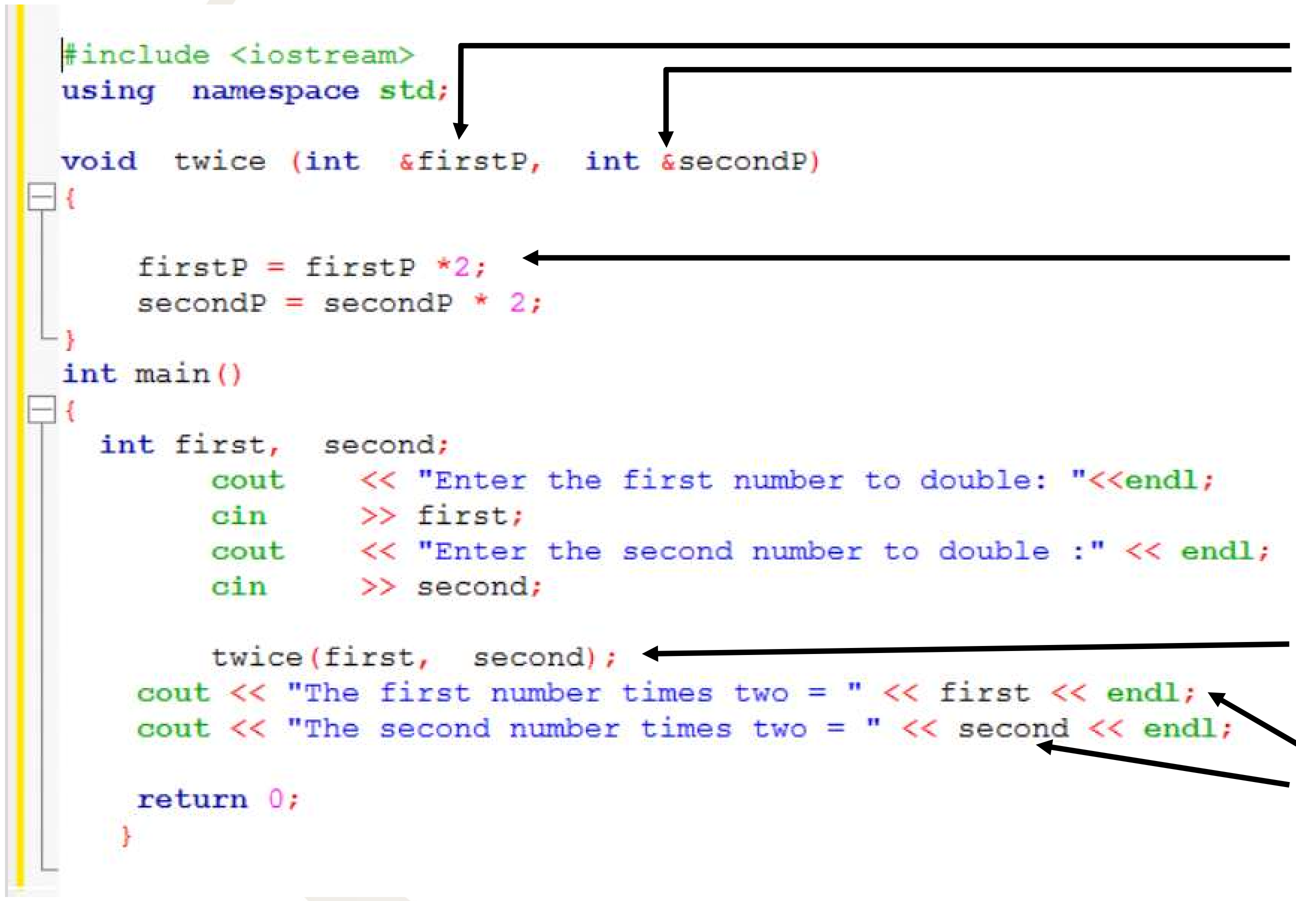
```
bool checkNumber(const int arr1[size_of_array], int num1, int & pos1)
{
    bool flag = false;
    //checking the number in the array
    for(int i=0;i< size_of_array;i++)
    {
        if(arr1[i]==num1)
        {
            pos1=i;
            flag=true;
        }
    }
    return flag;
}
```

5. Reference Parameters

– Reference parameters are used when the values for variables declared in the `main` function should be updated within other functions.

– For example, if a function has to change more than one value and if both the values has to be returned to the calling function – then we have to use reference parameters (`&`).

5. Reference Parameters - example



```
#include <iostream>
using  namespace std;

void  twice (int  &firstP,   int &secondP)
{

    firstP = firstP *2;
    secondP = secondP * 2;
}
int main()
{
  int first,  second;
        cout    << "Enter the first number to double: "<<endl;
        cin     >> first;
        cout    << "Enter the second number to double :" << endl;
        cin     >> second;

        twice(first,  second);
    cout << "The first number times two = " << first << endl;
    cout << "The second number times two = " << second << endl;

    return 0;
   }
```

Reference parameter variables declared with the ampersand (&).

Here, the value of the variable `first` in the main function is updated. The same happens for the variable `second`, in the next line.

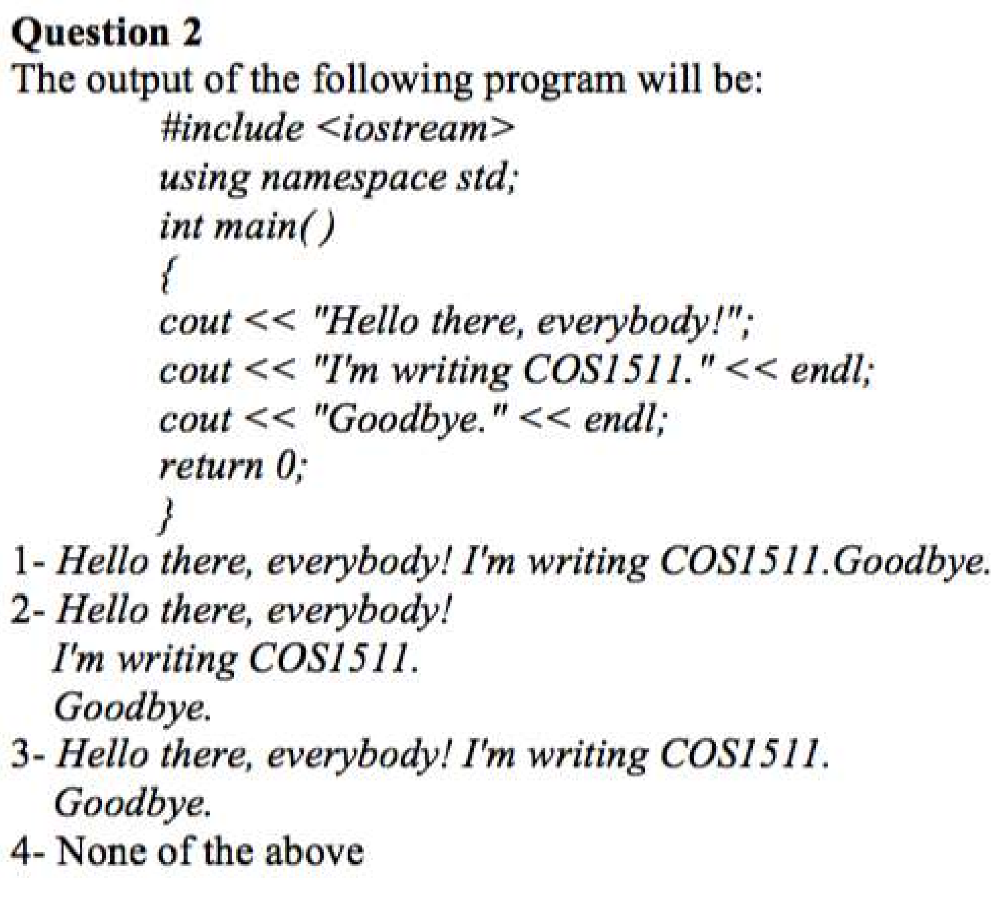
The function `twice` is called with the two variables that it should updated.

The updated variable values after the execution of the function `twice` will be displayed.

5. Reference Parameter example Code

```
#include <iostream>
using  namespace std;

void  twice (int  &firstP,  int &secondP)
{

    firstP = firstP *2;
    secondP = secondP * 2;
}
int main()
{
  int first,  second;
        cout<< "Enter the first number to double: "<<endl;
        cin >> first;
        cout<< "Enter the second number to double :" << endl;
        cin >> second;

        twice(first,  second);
  cout << "The first number times two = " << first << endl;
  cout << "The second number times two = " << second << endl;

       return 0;
   }
```

Sample question



Question 2

The output of the following program will be:

```
#include <iostream>
using namespace std;
int main( )
{
cout << "Hello there, everybody!";
cout << "I'm writing COS1511." << endl;
cout << "Goodbye." << endl;
return 0;
}
```

1- *Hello there, everybody! I'm writing COS1511.Goodbye.*

2- *Hello there, everybody!*
   I'm writing COS1511.
   Goodbye.

3- *Hello there, everybody! I'm writing COS1511.*
   Goodbye.

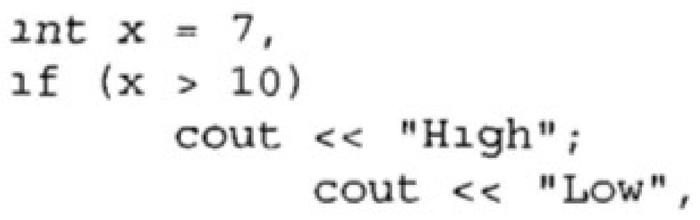
4- None of the above

Answer is option 3.

There is no `endl` in the first `cout` statement. Hence the string in the second `cout` statement will be printed on the same line as the previous string.

There is `endl` in the second `cout` statement. So the third string will be printed on a newline.

Sample Question



```
int x = 7,
if (x > 10)
        cout << "High";
                cout << "Low",
```

- [In your past exam papers because of the poor quality, you are seeing commas where it should be semicolon in some places].

  The indentation is given just to confuse you.

  Here `x` is not greater than 10. so the statement after the `if` structure will be executed.
- Output is `Low`

Thank you