General Certificate of Education
Advanced Subsidiary Examination
June 2011

Computing COMP1

Unit 1 Problem Solving, Programming, Data Representation and Practical Exercise

Friday 27 May 2011 9.00 am to 11.00 am

You will need to refer to the Preliminary Material and the Skeleton Program.
You must **not** use a calculator.

Time allowed
- 2 hours

Instructions
- Enter the information required on the front of your Electronic Answer Document.
- Type your answers into the Electronic Answer Document.
- Answer **all** questions.
- You will need access to:
  - a computer
  - a printer
  - appropriate software
  - an electronic version of the Skeleton Program and Data File
  - a hard copy of the Preliminary Material.
- Before the start of the examination make sure your **Centre Number, Candidate Name** and **Number** are shown clearly in the footer of every page of your Electronic Answer Document.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 100.
- No extra time is allowed for printing and collating.
- The question paper is divided into four sections.
  You are advised to spend time on each section as follows:
  Section A – 30 minutes
  Section B – 20 minutes
  Section C – 20 minutes
  Section D – 50 minutes.

At the end of the examination
- Tie together all your printed Electronic Answer Document pages and hand them to the invigilator.

Warning
- It may not be possible to issue a result for this unit if your details are not on every page.

Section A

You are advised to spend no more than **30 minutes** on this section.

Type your answers to **Section A** in your Electronic Answer Document. You **must save** this document at regular intervals.

Question 1

0 1 Represent the denary number 123 in binary using 8 bits.

Use the space below for rough working, then copy the answer to your Electronic Answer Document.

(1 mark)

0 2 How many different denary numbers can be represented using 8-bit binary?

Use the space below for rough working, then copy the answer to your Electronic Answer Document.

(1 mark)

0 3 What is the hexadecimal equivalent of the denary number 123?

Use the space below for rough working, then copy the answer to your Electronic Answer Document.

(2 marks)

0 4 Why are bit patterns often displayed using hexadecimal instead of binary? *(1 mark)*

Question 2

Table 1 shows the values output by a 3-bit Gray Code (GC) counter.

Some of the GC values are missing.

Table 1

GC	Decimal equivalent
000	0
001	1
(a)	2
(b)	3
(c)	4
111	5
101	6
100	7

0 5 What value should be in position **(a)** in the table? *(1 mark)*

0 6 What value should be in position **(b)** in the table? *(1 mark)*

0 7 What value should be in position **(c)** in the table? *(1 mark)*

0 8 State **one** advantage of GC counters compared with pure binary counters. *(1 mark)*

Turn over for the next question

Question 3

Images are often represented in a computer's main memory using bitmapped graphics. Bitmapped images consist of **pixels**. A pixel is the smallest addressable part of an image.

0 9 What is meant by the **resolution** of a bitmapped graphic image? *(2 marks)*

1 0 What is meant by the **colour depth** of a bitmapped graphic image? *(2 marks)*

1 1 An image has 10 x 10 pixels. It is stored in an image format that is limited to 16 colours.

Calculate the image size in bytes. *(2 marks)*

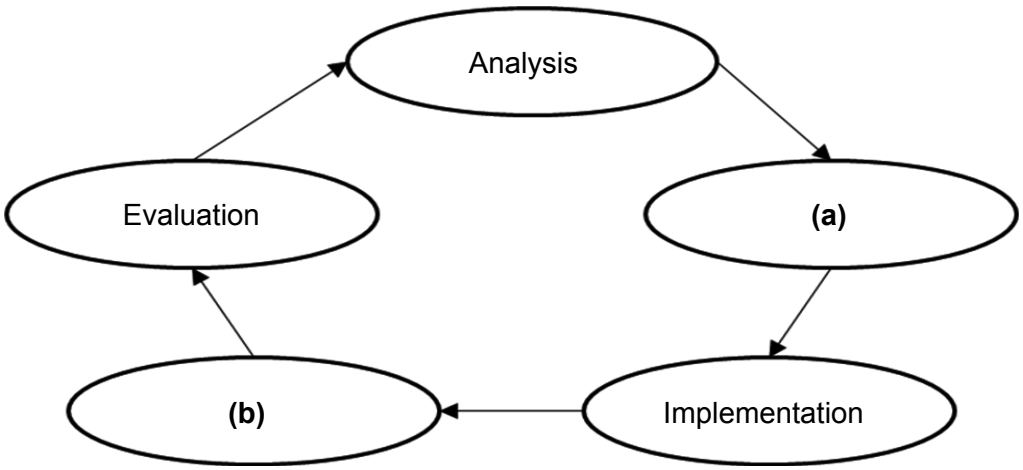
1 2 Instead of using bitmapped graphics, images may be represented in a computer's main memory using vector graphics.

State **one** advantage of vector graphics compared with bitmapped graphics. *(1 mark)*

Question 4

Figure 1 shows an incomplete diagram of the systems development life cycle.

Figure 1



1 3 What phase of the systems development life cycle is **(a)** in **Figure 1**? *(1 mark)*

1 4 What phase of the systems development life cycle is **(b)** in **Figure 1**? *(1 mark)*

Question 5

Bob has a problem that he needs to solve. The problem is described below.

"*There are two jugs – A and B. Jug A has a capacity of three litres. Jug B has a capacity of five litres. There are no markings on the jugs, so it is not possible to tell exactly how much is in a jug just by looking (unless it is full or empty). There is a sink with a water tap and a drain. How can exactly one litre of water be obtained from the tap using the two jugs*?"

A well-defined problem consists of a given, a goal, a set of resources, a set of constraints and ownership.

1 5 Describe the *goal* of this problem. *(1 mark)*

1 6 Describe the set of *resources* available to Bob when solving this problem. *(3 marks)*

1 7 What is meant by *ownership* of a problem? *(1 mark)*

Turn over for the next question

Question 6

The contents of an array `Scores` are shown in **Figure 2**.

A pseudo code representation of an algorithm is given in **Figure 3**.

Figure 2

Scores							
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
18	23	36	21	58	40	45	59

Figure 3

```
Max ← 8
FOR Count1 ← 1 TO (Max – 1) DO
  FOR Count2 ← 1 TO (Max – 1) DO
    IF Scores[Count2] > Scores[Count2 + 1]
      THEN
        Temp ← Scores[Count2]
        Scores[Count2] ← Scores[Count2 + 1]
        Scores[Count2 + 1] ← Temp
    ENDIF
  ENDFOR
ENDFOR
```

1 8 **One pass** is made through the outer loop of the algorithm in **Figure 3**.

Complete **Table 2** to show the changed contents of the array `Scores` after this single pass. You may use **Table 3** to help you work out your answer, though you are neither required to use **Table 3** nor to copy it into your Electronic Answer Document.

*Copy the bottom row of your completed **Table 2** into the Electronic Answer Document.*

Table 2

Scores							
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]

Table 3

Max	Count1	Count2	Temp	Scores							
				[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
				18	23	36	21	58	40	45	59

(4 marks)

1 9 What is the name of the standard algorithm shown in **Figure 3**? *(1 mark)*

Turn over for the next section

Section B

You are advised to spend no more than **20 minutes** on this section.

Type your answers to **Section B** in your Electronic Answer Document. You **must save** this document at regular intervals.

The question in this section asks you to write program code **starting from a new program/project/file.**

- Save your program/project/file in its own folder/directory.
- You are advised to save your program at regular intervals.

Question 7

Create a folder/directory **Question7** for your new program.

The variable table, **Table 4**, and the Structured English algorithm, **Figure 4**, describe a linear search algorithm that could be used with a simplified version of the Dice Cricket game to find out if a particular player's name appears in the high score table.

In this simplified version only the names of the players getting a top score are stored. Their scores are **not** stored.

Table 4

Identifier	Data Type	Purpose
`Names`	`Array[1..4] of String`	Stores the names of the players who have one of the top scores
`PlayerName`	`String`	Stores the name of the player being looked for
`Max`	`Integer`	Stores the size of the array
`Current`	`Integer`	Indicates which element of the array `Names` is currently being examined
`Found`	`Boolean`	Stores `True` if the player's name has been found in the array, `False` otherwise

Figure 4

```
Names[1] ← 'Ben'
Names[2] ← 'Thor'
Names[3] ← 'Zoe'
Names[4] ← 'Kate'
Max ← 4
Current ← 1
Found ← False
OUTPUT 'What player are you looking for?'
INPUT PlayerName
WHILE (Found = False) AND (Current <= Max)
  IF Names[Current] = PlayerName
    THEN Found ← True
    ELSE Current ← Current + 1
  ENDIF
ENDWHILE
IF Found = True
  THEN OUTPUT 'Yes, they have a top score'
  ELSE OUTPUT 'No, they do not have a top score'
ENDIF
```

What you need to do

Write a program for the above algorithm.

Test the program by searching for a player named 'Thor'.

Test the program by searching for a player named 'Imran'.

Save the program in your new **Question7** folder/directory.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

2 0	Your PROGRAM SOURCE CODE.	*(11 marks)*
2 1	SCREEN CAPTURE(S) for the test searching for 'Thor'.	*(2 marks)*
2 2	SCREEN CAPTURE(S) for the test searching for 'Imran'.	*(2 marks)*

Section C

You are advised to spend no more than **20 minutes** on this section.

Type your answers to **Section C** in your Electronic Answer Document. You **must save** this document at regular intervals.

These questions refer to the **Preliminary Material** and require you to load the **Skeleton Program**, but do **not** require any additional programming.

Refer either to the **Preliminary Material** issued with this question paper or your electronic copy.

Question 8

A constant is a value that does not change throughout a program. Instead of referring to the value itself throughout a program, a named constant can be used.

2 3 Give an example of a constant declaration from the **Skeleton Program**. *(1 mark)*

2 4 State **one** advantage of using named constants for constant values. *(1 mark)*

2 5 State the name of an identifier for a variable that has a fixed value role. *(1 mark)*

2 6 State the name of an identifier for a variable that has a most wanted holder role. *(1 mark)*

The decision table shown in **Table 5** represents the logic of the selection structure in the `GetMenuChoice` subroutine. '✓' has been used to indicate the action that results from particular values for the conditions. The decision table is only partially complete; some incomplete parts have been labelled **(a)**, **(b)**, **(c)** and **(d)**.

Table 5

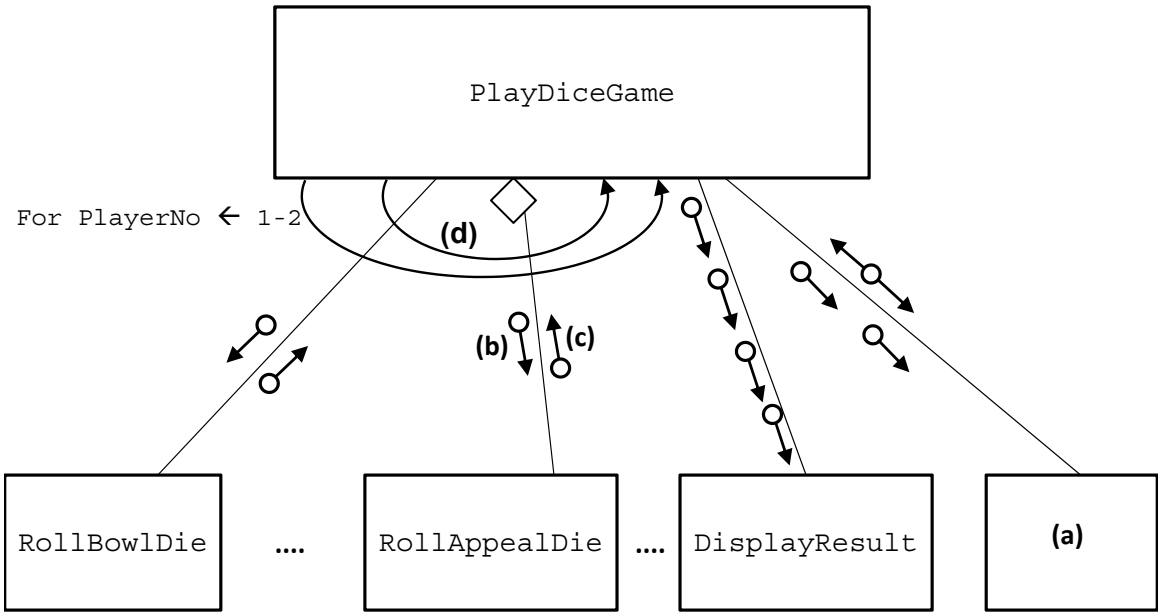
Conditions	`OptionChosen < 1`	`True`	`False`	`False`	`False`
	`OptionChosen > 4`	`False`	`True`	`True`	**(d)**
	`OptionChosen <> 9`	**(c)**	`False`	`True`	`True`
Action	Output error message	✓	**(a)**	**(b)**	

2 7 Which of the two cells labelled **(a)** and **(b)** in **Table 5** should have an '✓' in it? *(1 mark)*

2 8 What should be the contents of the cell labelled **(c)** in **Table 5**? *(1 mark)*

2 9 What should be the contents of the cell labelled **(d)** in **Table 5**? *(1 mark)*

Figure 5 shows an incomplete structure chart for part of the **Skeleton Program**.



With reference to the **Skeleton Program** and **Figure 5**, answer questions 30 to 33.

3 0 What should be written in box **(a)** in **Figure 5**? *(1 mark)*

3 1 How should the arrow **(b)** in **Figure 5** be labelled? *(1 mark)*

3 2 How should the arrow **(c)** in **Figure 5** be labelled? *(1 mark)*

3 3 How should the curved arrow **(d)** in **Figure 5** be labelled? *(1 mark)*

3 4 There is a variable called `Count` in the `LoadTopScores` subroutine.
There is also a variable called `Count` in the `UpdateTopScores` subroutine.

Explain why these two different variables can have the same identifier. *(2 marks)*

Turn over for the next question

Look at the repetition structure in the `UpdateTopScores` subroutine, used to find the lowest of the current top scores.

3 5 When `UpdateTopScores` is called, how many times will this section of code repeat? *(1 mark)*

3 6 Describe what the selection structure inside the repetition structure does. *(4 marks)*

Section D

You are advised to spend no more than **50 minutes** on this section.

Type your answers to **Section D** in your Electronic Answer Document. You **must save** this document at regular intervals.

These questions require you to load the **Skeleton Program** and make programming changes to it. You will also need the data file **HiScores.txt**

Question 9

This question refers to the subroutines `RollAppealDie` and `DisplayAppealDieResult`.

There are four options on the Appeal Die – `"NOT OUT"`, `"CAUGHT"`, `"LBW"` and `"BOWLED"`.

Adapt the program source code for the subroutines `RollAppealDie` and `DisplayAppealDieResult` so that there is a fifth option - `"RUN OUT"` – on the Appeal Die.

If a player is run out then their turn finishes, they are out. A suitable message must be shown.

This option should be available for **both** the real dice and virtual dice versions of the game.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

3 7 Your amended PROGRAM SOURCE CODE for the subroutine `RollAppealDie`. *(2 marks)*

3 8 Your amended PROGRAM SOURCE CODE for the subroutine `DisplayAppealDieResult`. *(2 marks)*

3 9 SCREEN CAPTURE(S) for a test run showing the correct working of the `"RUN OUT"` option when real dice are being used. *(2 marks)*

Question 10

This question refers to the subroutine `DisplayResult`.

This subroutine compares the two players' scores and displays a message saying who has won.

Adapt the program source code for the subroutine `DisplayResult` so that it also checks to see if a game is drawn and displays an appropriate message when this happens.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

4 0 Your amended PROGRAM SOURCE CODE for the subroutine `DisplayResult`. *(3 marks)*

4 1 SCREEN CAPTURE(S) for a test run showing a drawn game where both players scored 0. *(2 marks)*

Question 11

This question refers to the subroutine `RollBowlDie`.

If the user chooses to play the game with real dice then they are prompted to enter a number between 1 and 6 to indicate what the result of rolling the Bowl Die was.

Add a validation check to the subroutine `RollBowlDie` so that it repeatedly gets the Bowl Die result from the user until a number between 1 and 6 is entered.

Each time an invalid value is entered the message "`Please enter a value between 1 and 6 only`" should be displayed.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

4 2 Your amended PROGRAM SOURCE CODE for the subroutine `RollBowlDie`. *(4 marks)*

4 3 SCREEN CAPTURE(S) showing the results of testing the subroutine with values of 0, 2 and 7 for the Bowl Die. *(3 marks)*

Question 12

*You may wish to make a copy of the data file **HiScores.txt** before attempting this question in case the contents of the file are changed in an unintended way*.

This question will add extra functionality to the **Skeleton Program**.

The **Skeleton Program** allows two players to have a game of Dice Cricket. It can load previous top scores from the file **HiScores.txt** and every time a game is played the scores of the players are compared to the top scores. The top scores are then updated if necessary.

The **Skeleton Program** is going to be extended so that the top scores can be saved to the file **HiScores.txt**.

Additional marks will be awarded in Question 12 for writing code which demonstrates good practice and which will be easy to maintain in the future.

Task 1

Change the `DisplayMenu` subroutine so that it displays the new menu option "`5.  Save top scores`".

Evidence that you need to provide
Include the following in your Electronic Answer Document.

4	4	Your amended PROGRAM SOURCE CODE for the subroutine `DisplayMenu`.	*(1 mark)*

Task 2

Adapt the `GetMenuChoice` subroutine so that a value of 5 is accepted.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

4	5	Your amended PROGRAM SOURCE CODE for the subroutine `GetMenuChoice`.	*(1 mark)*

Turn over for the next question

Task 3
Create a new subroutine `SaveTopScores`.

The new subroutine must:

- open the file **HiScores.txt**
- store each record in the `TopScores` array as a line in the file; with the `Name` and `Score` fields separated by a comma
- close the file **HiScores.txt**

Evidence that you need to provide
Include the following in your Electronic Answer Document.

4 6 Your PROGRAM SOURCE CODE for the new subroutine `SaveTopScores`. *(10 marks)*

Task 4
Adapt the main program block so that the selection of option 5 from the menu is accepted as a valid choice and so that the subroutine `SaveTopScores` is called when the user selects option 5 from the menu.

Test that the changes you have made work:

- run the **Skeleton Program**
- enter the player names Janet and Lily
- load the contents of the file **HiScores.txt**
- play a real dice game where player one gets a score of 4 and player two gets a score of 0
- select the save option you have added to the menu.

Evidence that you need to provide
Include the following in your Electronic Answer Document.

4 7 Your adapted PROGRAM SOURCE CODE for the main program block. *(4 marks)*

4 8 SCREEN CAPTURE(S) for a test run showing that:
- Option 3 (load scores) was selected
- Option 2 (real dice game) was selected
- Player one (Janet) got a score of 4
- Player two (Lily) got a score of 0
- Option 5 (save scores) was selected. *(2 marks)*

4 9 Copy and paste the contents of the file **HiScores.txt** after the test run. *(1 mark)*

Question 13

This question refers to rolling the Bowl Die.

The game of Dice Cricket, as represented by the **Skeleton Program**, is to be made more similar to the real game of cricket. In real cricket, a batter is likely to get the lower scores (0 and 1) more frequently than the higher scores (4 and 6).

The **Skeleton Program** is to be modified to represent this more realistic batting behaviour.

5 0 Describe changes that could be made to the **Skeleton Program** to achieve this. You are **not** expected to actually make the changes. *(2 marks)*

END OF QUESTIONS

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