General Certificate of Education
Advanced Subsidiary Examination
June 2010

# Computing COMP1

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

**Monday 24 May 2010 9.00 am to 11.00 am**

**For this paper you must have:**
- access to the Electronic Answer Document
- a copy of the *Preliminary Material*.

You must **not** use a calculator.

**Time allowed**
- 2 hours

**Instructions**
- Type your answers into the Electronic Answer Document.
- Enter the information required on the front of your Electronic Answer Document.
- Answer **all** questions.
- You will need access to:
  - a computer
  - a printer
  - appropriate software
  - the electronic version of the Skeleton Program.
- Before the start of the examination make sure your **Centre Number, Candidate Name** and **Number** are shown clearly in the footer of the Electronic Answer Document (not the front cover).

**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 - 35 minutes
  Section B - 20 minutes
  Section C - 15 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 **35 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

**Figure 1** shows the contents of a memory location.

**Figure 1**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |

**0 1** What is the denary equivalent of the contents of this memory location if it represents an **unsigned binary integer**?

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

*(1 mark)*

**0 2** What is the denary equivalent of the contents of this memory location if it represents an **unsigned binary fixed point number**, with 4 bits before and 4 bits after the binary point?

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

*(2 marks)*

**0 3** What is the denary equivalent of the contents of this memory location if it represents a **two's complement binary integer**?

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

*(2 marks)*

**0 4** What is the **hexadecimal** equivalent of the binary pattern shown in **Figure 1**?

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

*(1 mark)*

**Question 2**

The ASCII system uses 7 bits to represent a character. The ASCII code for the character 'A' is 65; other alphabetic characters follow on from this in sequence.

**0 5** How many different characters can be represented using ASCII? *(1 mark)*

**0 6** How would the character 'B' be represented in ASCII using 7 bits?

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

*(1 mark)*

Characters are transmitted using an 8-bit code that includes a parity bit in the most significant bit.

**0 7** Using even parity, what bit pattern is sent for the character 'A'?

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

*(2 marks)*

**0 8** Explain how the even parity system works. Include a description of the roles of the sender and receiver during transmission. *(4 marks)*

## Question 3

To record sound a computer needs to convert the analogue sound into a digital form. During this process samples of the sound have to be taken. **Figure 2** shows 6 samples that have been stored in a computer's memory. These samples have been taken from the analogue signal over a period of one hundredth of a second.

**Figure 2**

| | |
|---|---|
| Sample 6 | `01101100` |
| Sample 5 | `01101100` |
| Sample 4 | `01100000` |
| Sample 3 | `00001101` |
| Sample 2 | `00001000` |
| Sample 1 | `00011011` |

Look at the digital representation, shown in **Figure 2**, of the analogue sound.

One Hertz (Hz) is one sample per second.

**0 9** What sampling rate, in Hertz, has been used? *(2 marks)*

**1 0** What sampling resolution has been used? *(1 mark)*

**1 1** State Nyquist's theorem. *(2 marks)*

## Question 4

**1 2** State **three** features of well-written program code that help to make it understandable without the need to include lots of comments. *(3 marks)*

## Question 5

**13** Explain what is meant by an *algorithm*. *(2 marks)*

One way of checking that an algorithm is correct is to complete a dry run.

**14** Dry run the algorithm in **Figure 3** by completing **Table 1.**

*Copy **all seven** rows of your completed **Table 1** into the table provided in the Electronic Answer Document.*

Assume that x has a value of 7.
The MOD operator calculates the remainder resulting from an integer division.

**Figure 3**

```
Answer ← True
FOR Count ← 2 TO (x – 1) DO
  Remainder ← x MOD Count
  IF Remainder = 0 THEN
    Answer ← False
  ENDIF
ENDFOR
```

**Table 1**

| Answer | Count | Remainder |
|---|---|---|
| True | - | - |
|  | 2 | 1 |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

*(6 marks)*

**15** What is the purpose of this algorithm? *(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 6

Create a folder/directory **Question6** for your new program.

The variable table, **Table 2**, and the Structured English algorithm, **Figure 4**, describe a simplified version of a noughts and crosses match. A match consists of a user-specified number of games. In this simplified version, the two players complete each game on paper and then enter information about the result of each game into a program that totals the number of games won by each player. Assume that all games have a winner – there are no drawn games.

**Table 2**

| Identifier | Data Type | Purpose |
|---|---|---|
| `NoOfGamesInMatch` | `Integer` | Stores the number of games in the match (specified by user) |
| `NoOfGamesPlayed` | `Integer` | Stores the number of games played so far |
| `PlayerOneScore` | `Integer` | Stores the number of games won by Player One |
| `PlayerTwoScore` | `Integer` | Stores the number of games won by Player Two |
| `PlayerOneWinsGame` | `Char` | Stores a 'Y' if Player One won the game and 'N' otherwise |

**Figure 4**

```
PlayerOneScore ← 0
PlayerTwoScore ← 0
OUTPUT "How many games?"
INPUT NoOfGamesInMatch
FOR NoOfGamesPlayed ← 1 TO NoOfGamesInMatch Do
  OUTPUT "Did Player One win the game (enter Y or N)?"
  INPUT PlayerOneWinsGame
  IF PlayerOneWinsGame = 'Y'
    THEN PlayerOneScore ← PlayerOneScore + 1
    ELSE PlayerTwoScore ← PlayerTwoScore + 1
  ENDIF
ENDFOR
OUTPUT PlayerOneScore
OUTPUT PlayerTwoScore
```

**What you need to do**

Write a program for the above algorithm.

Test the program by showing the results of a match consisting of three games where Player One wins the first game and Player Two wins the second and third games.

Save the program in your new **Question6** folder/directory.

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

**1 6** Your PROGRAM SOURCE CODE. *(9 marks)*

**1 7** SCREEN CAPTURE(S) for the test described above. *(4 marks)*

**Turn over for the next section**

## Section C

You are advised to spend no more than **15 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 7**

**1 8** State the name of an identifier used for a global variable that has been declared in the Skeleton Program. *(1 mark)*

**1 9** State the name of an identifier used for a local variable that has been declared in the Skeleton Program. *(1 mark)*

**2 0** Explain a difference between a global variable and a local variable. *(2 marks)*

Look at the instructions in the main program block used to choose Player One's symbol.

**2 1** Describe the circumstances under which these instructions will stop being repeated. *(2 marks)*

When the Skeleton Program is run it is possible that a game might stop after 9 moves while there are still empty cells on the board – even though neither player has won.

**2 2** Explain why this could happen. *(2 marks)*

**2 3** State the name of an identifier for a variable that has a stepper role. *(1 mark)*

**2 4** State the name of an identifier for a variable that has a fixed-value role. *(1 mark)*

**2 5** State the name of an identifier for a user-defined subroutine that has exactly **three** parameters. *(1 mark)*

Study the code for the subroutine `GetWhoStarts`.

**2 6** Give an example of an assignment statement in this subroutine. *(1 mark)*

**2 7** Describe what the selection structure in this subroutine does. *(3 marks)*

## Question 8

This question refers to the subroutine `CheckValidMove`.

As part of the testing of a subroutine, boundary data should be used.

**2 8** Explain what is meant by a *boundary value*. *(1 mark)*

**2 9** List the **three** essential boundary values that should be used to test the upper boundary of the x coordinate entered by a user. *(3 marks)*

**3 0** Include SCREEN CAPTURE(S) showing the input and output when you run the **Skeleton Program** using **one** of the values given in your answer to **29** in your Electronic Answer Document. *(1 mark)*

**Turn over for the next section**

## 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.

### Question 9

This question refers to the subroutine `CheckValidMove`.

This subroutine is used to check that the coordinates entered by a player are for a valid move. A valid move is defined as being an x coordinate and a y coordinate for a cell that exists and that is currently empty. At the moment the subroutine only checks that the x coordinate entered by the user is in the allowed range.

Adapt the program source code for the subroutine `CheckValidMove` so that it checks that the y coordinate entered by the user is in the allowed range and that the cell chosen by the user is empty.

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

**3 1** Your amended PROGRAM SOURCE CODE for the subroutine `CheckValidMove`. *(5 marks)*

**3 2** SCREEN CAPTURE(S) for test runs showing that moves with coordinates (2, -3) and (2, 7) are both rejected. *(2 marks)*

**3 3** SCREEN CAPTURE(S) for a test run showing that when the player selects a non-empty cell the move is rejected. *(1 mark)*

**Question 10**

This question refers to the subroutine `CheckXOrOHasWon`.

This subroutine is used to check, after each move, if the player has won the game. The subroutine checks for three symbols in a line on the rows and on the columns. It should also detect three symbols in a line on the two diagonals.

Adapt the program source code for the subroutine `CheckXOrOHasWon` so that it does check for **three** symbols in a line along the diagonals.

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

**3 4** Your amended PROGRAM SOURCE CODE for the subroutine `CheckXOrOHasWon`. *(6 marks)*

**3 5** SCREEN CAPTURE(S) showing a game won by a player getting three in a line along a diagonal. *(1 mark)*

**3 6** SCREEN CAPTURE(S) showing a game won by a player getting three in a line along the other diagonal. *(1 mark)*

**Question 11**

This question refers to the main program block.

Part of the main program block updates the scores and displays the result using a selection structure.

Half a point should be awarded to each player if the game is drawn.

Adapt this part of the program source code to award points for a draw.

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

**3 7** Your amended PROGRAM SOURCE CODE for the selection structure. *(2 marks)*

**3 8** SCREEN CAPTURE(S) showing the correct points awarded for a drawn game that is the **first and only** game in a match. *(2 marks)*

**Turn over ▸**

**Question 12**

This question expands the functionality of the **Skeleton Program**. The **Skeleton Program** needs to be changed so that the game is played on a **4x4** grid instead of a 3x3 grid. The aim of the game is still to get **three** consecutive symbols in a line.

Follow the steps below to change the **Skeleton Program** to work with a 4x4 grid.

- Change the `Board` array data type.

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

| 3 | 9 | Your amended PROGRAM SOURCE CODE for the necessary change to the `Board` array data type or an explanation of why no change is required. *(1 mark)*

- Change the condition for the selection structure in the main program that checks if the maximum number of allowed moves has been reached.

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

| 4 | 0 | Your amended PROGRAM SOURCE CODE for the necessary change to the condition for the selection structure in the main program. *(1 mark)*

- Change the subroutine `ClearBoard` so that it clears the 4x4 grid.

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

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

- Change the subroutine `DisplayBoard` so that it displays the 4x4 grid.

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

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

| 4 | 3 | SCREEN CAPTURE(S) showing an empty 4x4 grid is displayed at the beginning of the game. *(2 marks)*

- Change the subroutine `CheckValidMove` so that it checks that the move entered by a user is valid on the 4x4 grid.

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

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

- Change the subroutine `CheckXOrOHasWon` so that it checks for three of the same symbol in consecutive positions on a horizontal line on any row on the 4x4 grid. You are **not** expected to check for the extra winning positions along the diagonals or in the columns.

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

**4 5** Your amended PROGRAM SOURCE CODE for the subroutine `CheckXOrOHasWon`. *(4 marks)*

**4 6** SCREEN CAPTURE(S) showing a 4x4 grid game won with three symbols in a horizontal line – where one of the symbols in the winning line is in cell (2,4)*(2 marks)*

The Noughts and Crosses game has been adapted so that it is played using a 4x4 grid on a square. It is decided to alter the program further so that it is played using a 4x4x4 cube instead of a 4x4 square.

**4 7** Describe how the data structure(s) for a cube-shaped board could be represented in the **Skeleton Program**. *(2 marks)*

**END OF QUESTIONS**

**There are no questions printed on this page**

**There are no questions printed on this page**

**There are no questions printed on this pager**