IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N03/750/S(2)

COMPUTER SCIENCE
STANDARD LEVEL
PAPER 2

Friday 14 November 2003 (morning)

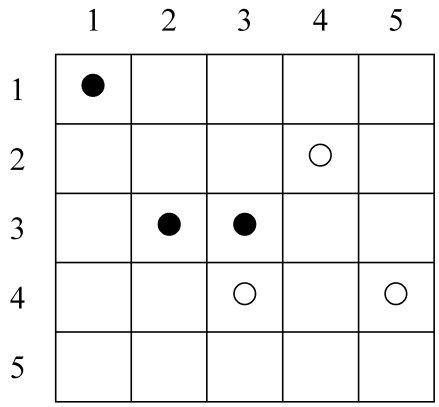
1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Answer all the questions.

1. A game for two players is played on board made up of squares. Each player starts with the same number of tokens, placed in a set pattern on the board. They then take turns to move the tokens across the board according to specific rules. One player has white tokens and the other has black.

In a computer simulation of the game, the current state of the board is held in an integer array `BOARD` with 0 representing no token on the corresponding board, 1 representing black and 2 for white.



[3,2] is black and [2,4] is white.

BOARD

	[1]	[2]	[3]	[4]	[5]
[1]	1	0	0	0	0
[2]	0	0	0	2	0
[3]	–	1	–	–	–
[4]	–	–	–	–	–
[5]	–	–	–	–	–

Note: *not all the values in the array are shown.*

(a) State the contents of `BOARD` [4,5] in the above example. *[1 mark]*

(b) State the contents of `BOARD` [4,4] in the above example. *[1 mark]*

The rules for moving are that a player can move from one square to another if there is an opponent's token adjacent and a space on the other side. In this case the player jumps over the opponent's token and that token changes colour so that it now belongs to the player. **Note**: that diagonal moves are allowed.

(c) State the position that [2,4] could move to and identify the changes that would be made to the array `BOARD`. *[4 marks]*

The following algorithm has been written to find a position to which a token can move and to update the BOARD after the move. The current row and column positions of the token are passed into the procedure and updated if a new position is found.

```
procedure MOVE (ref BOARD[1..10,1..10] integer array,
                ref ROW integer,ref COL integer,ref FOUND boolean)
  declare AR,AC integer /*adjacent ROW and COL */
  declare TR,TC integer /*target ROW and COL */
          FOUND <-- false
          AR <-- ROW-1
  while (AR < ROW+2) and not FOUND
       AC <-- COL-1
    while (AC<COL+2) and not FOUND
      if BOARD[AR,AC] < > 0 and BOARD[ AR,AC]< >BOARD[ROW COL]then
         /* checks that adjacent square holds opposite token */
         TR <-- 2*AR-ROW
         TC <-- 2*AC-COL
         if BOARD [TR, TC] = 0 then
            FOUND <-- true
            BOARD[TR, TC] <-- BOARD[ROW, COL]
            BOARD[AR, AC] <-- BOARD[ROW, COL]
            BOARD[ROW, COL] <-- 0
            ROW <-- TR
            COL <-- TC
         endif
        endif
      AC <-- AC+1
    endwhile
    AR <-- AR+1
  endwhile
endprocedure
```

(d) Copy and complete the following trace table for the grid as shown in the example, to find a move for the token [3,3]. *[9 marks]*
Note: the name of the array BOARD has been abbreviated to B to save space in the table.

ROW	COL	AR	AC	TR	TC	FOUND	B[AR,AC]	B[TR,TC]	B[ROW,COL]
3	3	2	2			**false**	0		1
3	3	2	3			**false**	0		1
...									

(e) When a token has found a position to move to then the player can continue to move that same token until there are no further moves possible. Explain how the procedure MOVE can be used to make all the moves possible in one turn. *[3 marks]*

(This question continues on the following page)

(Question 1 continued)

The game is normally played on a 10 by 10 board. If a square outside the limits of the array is checked then a subscript overflow error will occur.

(f) Identify six statements where this could happen and state the subscript overflow that could occur. *[6 marks]*

The score at any time is the number of tokens each player has on the board.

(g) Write a procedure `SCORES` that will output the scores for both players and state the winner. *[6 marks]*

This question requires the use of the Case Study.

2. (a) Explain how cookies and web bugs differ from viruses and worms. *[2 marks]*

(b) Explain why web bugs are considered more intrusive than cookies. *[2 marks]*

(c) Jon downloads a long file from an internet server. Outline the importance of protocols in this transfer. *[3 marks]*

(d) Describe how a school could use a cookie (or web bug) to monitor a student's use of the school network. Discuss the benefits and drawbacks of this use of technology. *[6 marks]*

(e) The HTML source code for Waldo High School included the following.

```
<img src="http://dubious.com/check" width=1 height=1 border=0>
<img src="schoolpicture.gif" width=200 height=250 border=5>
```

(i) Identify the part of the source code that suggests the use of web bugs. *[2 marks]*

(ii) Identify the sites that the user is visiting directly or indirectly. *[2 marks]*

(f) The techniques described in the case study could be used by government departments to collect data about their citizens. Outline **two** possible consequences for citizens. *[4 marks]*

(g) Much of the material in the case study and the majority of e-commerce activity originates in the USA. Discuss the possible consequences for other cultures. *[4 marks]*

3. CompuData is a large company whose business is to sell computers. Each computer bought has a one year guarantee and a licence certificate for the operating system that has been installed. The company keeps a database which contains information about the customer.

When a customer buys a computer from CompuData, a card is filled in and sent to the company with all the details needed for the database. The licence number is held as a barcode on the card. Alternatively, the customer can use the company's website and fill in the details including the number on the card.

(a) Compare the data entry errors that could occur when a customer enters details of a purchase over the Internet with those that could occur when the card is sent by post. *[4 marks]*

(b) Describe how the following techniques could be used to minimize these errors.

(i) Verification

(ii) Validation *[4 marks]*

Once a month a letter is generated to all those customers whose licence will expire within two months, offering an extension to the agreement or the possibility of upgrading the computer. When customers have a problem they contact the company by telephone or via the website and their details are checked to see the state of the guarantee.

(c) Identify **one** batch process and **one** on-line process, apart from data entry over the Internet, and explain why it is suitable for this type of processing. *[4 marks]*

(d) Discuss the advantages of holding the database file as a direct access file as opposed to a sequential access file. *[3 marks]*