Computer Science (H046, H446)

Data Types & Data Structures
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32/44

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename	Daishen	Candidate surname	Cui

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **44**.
- The total number of marks may take into account some 'either/or' question choices.

1 Convert the denary number 43 into an 8 bit binary number.

128 64 32 16 8 4 2 1 00101011

0 0 1 0 1 0 1 1 [1]

2 Using the denary number 89 as an example, explain the relationship between binary and hexadecimal representations.

128 64 32 16 8 4 2 1

0 1 0 1 1 0 0 1

~~8 4 2 1~~ 0101 1001

8421 8421

0101 1001 Binary representation of 89 is the format that the number 89 is stored in the device, as computers store things with 0 and 1 and can't read anything else.

5 9

89 [3]

Explanation needed of how we convert to 2 nibbles

Hexadecimal is simply base16 which allows us to display the number in a shorter format. Making it easier to display.

3 Convert the binary number 01101111 to a hexadecimal number.

8421 8421

0110 1111 6F

6 15

6 F [1]

4 A supermarket uses a stock control system.

Details of products are stored on a stock database.

The quantity of a particular product in stock is stored as a binary number usingtwo bytes. 16 bits
There are 312 tins of beans left in stock.

How would this quantity be represented as a binary number in the computer?

312-255 = 57 128 64 32 16 8 4 2 1

0 0 1 1 1 0 0 1

~~128~~ 5

255 = 1111 1111

57 = 0011 1001 0011 1001 + 1111 1111 [2]

should be represented as one 16 bit binary number. X

5(a) Convert the unsigned binary number 11110000 to:

(i) Denary:

128 64 32 16 8 4 2 1

128+64+32+16 = 192+32+16 = 192+48 = 240

240

[1]

(ii) Hexadecimal:

8421	8421
1111	0000
15	0
F	0

F0

[1]

(b) 00001100 is shifted two places to the left.

(i) Show the result.

00001100

00110000

= 00110000

[1]

(ii) Identify what arithmetic operation this shift is equivalent to.

The number is multiplied by 4.

[1]

6 A supermarket uses a stock control system.

Details of products are stored on a stock database.

The name of a product is stored using characters from the computer's character set.

(i) Explain what is meant by the character set of a computer.

A character set is a group of characters that can be used by the computer and displayed. For example ASCII is a character set which contains characters like the alphabet in both lower and upper case as well numbers and symbols, etc. [2]

(ii) Explain how codes are used to represent a character set.

Each character in a character set has it's unique code to distinguish it from the others. Each character set will have a list of character codes stored in binary, then when they are needed to be displayed, they are converted to their character form to represent themselves [3]

2

7 Below are extracts from the ASCII and EBCDIC character sets.

ASCII

Denary Value	65	66	67	68	69	70	71	72	73	74	75	76	77
Character	A	B	C	D	E	F	G	H	I	J	K	L	M
Denary Value	78	79	80	81	82	83	84	85	86	87	88	89	90
Character	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

EBCDIC

Denary Value	193	194	195	196	197	198	199	200	201	...	209	210	211	212
Character	A	B	C	D	E	F	G	H	I	...	J	K	L	M
Denary Value	213	214	215	216	217	...	226	227	228	229	230	231	232	233
Character	N	O	P	Q	R	...	S	T	U	V	W	X	Y	Z

Explain, referring to ASCII and EBCDIC, what would happen if computers were to use different character sets when communicating.

When the ~~ASCII code~~ a character that is typed in that has ~~both~~ a code in ASCII and EBCDIC, the ASCII ~~one~~ one will be represented because it takes upless memory, then when the user needs a character not present in ASCII, like a character from a different language, EBCDIC will be used instead

[2]

8 A company releases an Internet connected fridge. Users can email messages to the fridge and it puts them on its display.

The fridge uses the ASCII character set. Give **one** disadvantage of the fridge using ASCII rather than Unicode.

ASCII only contains characters used in English, so if the person using the fridge doesn't understand English, they won't be able to read it or use it.

[1]

9 A programmer creates another function to count and return how many capital letters are in a string that is passed into the function as a parameter.

The `asc()` function takes in a character and returns its ASCII value. For example `asc("A")` returns 65. Capital letters have ASCII values between 65 and 90 inclusive.

(i) Complete the function below.

```
function countCapitals(text)
    // initialise counter to 0
    capCount = 0
    // loop through each character in the string passed in
    for x = 0 to text.length-1
        c = text.subString(x, 1)
        // check if character is a capital
        if asc(c) >= 65 and asc(c) <= 90 then
            // if so, increment counter
            capCount += 1
        endif
    next x
    return capCount
endfunction
```

[3]

(ii) Give **one** similarity between ASCII and Unicode.

They both support character from the English alphabet

B.O.P [1]

(iii) Give **two** differences between ASCII and Unicode.

Difference 1 Unicode contains characters from other languages other than English's alphabet

Difference 2 Unicode generally requires more memory due to having

i

Characters from other languages needs more explanation

[2]

10 Data structures may be described as static or dynamic.

(i) State the meaning of the term static.

size

The data structure cannot be changed while the code is running

(ii) State **one** type of data structure that is always considered to be static.

Arrays

(iii) State the meaning of the term dynamic.

The data structure's data can be changed while code is running, for example it's size

B.O.D

(iv) Give **one disadvantage** of using a dynamic data structure.

If you add too many elements to a dynamic data structure, it will take up alot of memory.

This is true, but not what examiner is looking for

[4]

(2)

11(a) The organisers of an international football competition are planning to use a large electronic score board to display information to spectators in the stadium. The board can display three lines of text of 15 characters each.

The program stores the text to be displayed in an array called Board, so that

- Board(1,1) contains the letter in the top left corner of the display board
- Board(3,15) contains the letter in the bottom right corner of the display board.

A module in the program updates the display every time the contents of this array are changed.

State the identifier, number of dimensions and most appropriate data type of the array Board.

Identifier Board

Number of dimensions 2

Most appropriate data type List

[3]

(b) The program contains a module which clears the display using a routine to insert a space in each element of the array using the following algorithm.

Complete this algorithm by filling in the blanks.

```
01    PROCEDURE ClearDisplay
02
03      FOR Row = 1 TO 3
04
05        FOR Column = 1 to 15
06
07          Board( Row, .Column.....) = " "
08
09        NEXT Column
10
11      NEXT .Row.....
12
13    END PROCEDURE
```

[3]

12 A 2-dimensional (2D) array, `data`, holds numeric data that Karl has entered. The declaration for the array is:

```
array data[16,11]
```

The array `data`, has 16 'rows' and 11 'columns'.

Fig. 1.1 shows an extract from `data`.

	0	1	2	3	...	10
0	1	5	7	12	...	36
1	3	4	15	16	...	48
2	0	0	1	3	...	10
3	12	16	18	23	...	100
...	...	...	...	...	...	...
15	6	10	15	25	...	96

Fig. 1.1

The data in each 'row' is in ascending numerical order.

Karl needs to analyse the data.

Karl needs to find the mean average of each 'column' of the array. The mean is calculated by adding together the numbers in the column, and dividing by the quantity of numbers in the column.

For example, in Fig. 1.3 the first 'column' mean would be: (1+3+0+12)/4 = 4

1	5	7	12
3	4	15	16
0	0	1	3
12	16	18	23

Fig. 1.3

Write an algorithm to output the mean value of each 'column' in the array `data`.

```
for i = 1 to 16
total1nColumn = 0
```

for i = 1 to 16

total = 0

~~A = 0~~

~~column = 0~~

for x = 1 to 10

~~total = 0~~

total += data[x, i]

next x

print(total/16)

next i

wrong way round

or this is the wrong way round

4

[5]

13 A games company has developed a game called Kidz Arrowz. The players throw an arrow at a target board and are awarded different points depending on which circle the arrow lands. Fig. 1 shows the board.

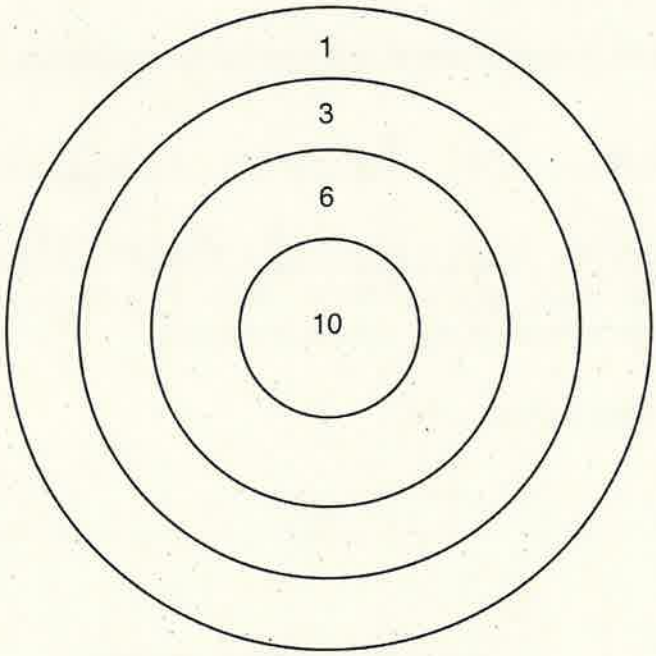

Fig. 1

A computer program is required to keep track of the scores for each competition. The user will enter

the number of players, and the name of each player, in that competition to a maximum of 10.

(i) The program will then ask for the score of each player in turn. Each competition has 8 rounds, with each player throwing one arrow each round. The program will then display the total score of each player.

The players are declared as a record structure:

```
record player(string playerName, integer totalScore)
```

Describe what is meant by a record structure.

The Record structure is a data structure composed of fields that hold data values in them. It is a data structure stored in files

(1) [2]

(ii) The records for the players are stored in a 1D array.

State why a 1D array is a suitable data structure for the records.

Because one dimensional arrays holds an individual element in each position. In the record, the elements (fields) are all individual so you can store the record's data in an organised manner by using 1D arrays. [1]

(iii) Three data structures are arrays, records and stacks.

Identify **one** other data structure.

Tuples [1]

END OF QUESTION PAPER