OCR
Oxford Cambridge and RSA

Wednesday 6 October 2021 – Morning

A Level Computer Science

H446/01 Computer Systems

Time allowed: 2 hours 30 minutes

Do not use:
- a calculator

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) Eric Turner

Last name

INSTRUCTIONS
- Use black ink.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.

INFORMATION
- The total mark for this paper is **140**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 OCR Insurance uses a computer system to calculate the price that customers pay for car insurance.

(a) The computer system contains a CPU, GPU, RAM and ROM.

(i) State **two** factors that affect the performance of a CPU.

1 The size of the cache

2 The Clock Speed

[2]

(ii) Explain the difference between RAM and ROM, including how these are used by the computer system.

RAM or random accsess memory is a high speed volitile memory that stores programs / instructions that the computer is working on. As it is volitile all data stored on it is deleted when power is removed. Rom or Read only memory is non volitile memory that is primerily used to store the bios/boot progams of a computer.

[4]

(iii) Describe **one** non-graphical use OCR Insurance may have for a GPU.

GPUS can be used for complicated mathimatical equations as they have a large number of cores that can all symultainiosly work on individual parts of the equation

[2]

(b) The CPU uses pipelining to improve efficiency.

Explain what is meant by the term 'pipelining'.

Pipelining is the process of cocurrently running instructions within a CPU.

Instructions can be decodes as others are executed/fetched.

Pipelining increases the efficiency of a CPU allowing more instructions to be completed in the same period of time.

[3]

(c)* OCR Insurance's computer system uses secondary storage across the company in servers, client machines and for backup purposes.

For each of these, discuss whether magnetic storage or solid state storage would be most suitable, taking into account the advantages and disadvantages of both.

Both Magnetic and Solid state storage are ways of storing large amounts of data in a non-volitile way.

Magnetic Storage, such as Hard Disk Drives, store data on a spinning magnetic pl by changing the level of magnitism of different areas of the drive. As they were developed a long time ago they have become relitivly cheap as well as becoming high capacity. As magnetic storage is well developed and often cheaper than altur it is often used in backups, however with the onset of new technologies magnetic storage is being replaced by solid state storage.

Solid state storage is a metod of storing data without moving parts.

Data is stored on semiconductors called NAND chips. As no moving parts are used Solid state storage devices are able to rech mush faster speed than Magnetic stora However for OCR's use case of creating a backup this isnt a major concsideration as the speed of the backup isnt a priority.

As Solid state storage is a relitivley new technology it is often more expensive per GigaByte.

Overall both solid state and magnetic storage would be apporopriate for use in a backup solution however due to the cost diference i would recomend using magnetic storage if speed isnt a main concern.

[9]

(d) Customers' details are stored in the flat file database table `Customer`. An extract of the table is shown below.

CustomerID	**Surname**	**Title**	**Phone**	**CarReg**
JJ178	James	Mr	(0121) 343223	DY51 KKY
HG876	Habbick	Miss	(01782) 659234	PG62 CRG
EV343	Elise	Mrs	(07834) 123998	HN59 GFR
PG127	Pleston	Mr	(07432) 234543	JB67 DSF

(i) State what is meant by the term 'primary key', identifying the primary key in the table above.

The primary key is a unique identifier used to identify an entry throughout a data base

..... **[2]**

(ii) Write the SQL statement that would show only the `CustomerID` and `Surname` fields for customers with the `Title` "Miss" or "Mrs".

..... **[4]**

(iii) Describe **one** problem that would arise with the flat file database structure if a customer wanted to insure more than one car at the same time.

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..... **[2]**

(iv) Describe how the flat file database structure could be altered to efficiently allow each customer to insure multiple cars at the same time. (You may assume each car is insured to only one customer.)

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..... **[5]**

2 **(a)** **(i)** Convert the denary number 231 to an unsigned 8-bit binary number.

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..... **[1]**

(ii) Convert the hexadecimal number 6F to an unsigned 8-bit binary number.

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..... **[1]**

(b) The floating point number 0011010100 is stored using 6 bits for the mantissa and 4 bits for the exponent, both in two's complement. This number is not normalised.

(i) Give the normalised version of this number, showing your working.

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..... **[4]**

(ii) Convert your answer to part **(i)** to denary, showing your working.

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..... **[3]**

(c) Add together the two numbers below. Both numbers are stored in normalised floating point format, using 6 bits for their mantissa and 4 bits for their exponent which are both in two's complement. Show the result in the same format and show your working.

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0110000110    +

0101000100
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..... **[5]**

3 A website sells tickets for sporting events. The website uses HTML, CSS and JavaScript.

(a) Describe the purpose of HTML and CSS within the code of the website.

HTML .....

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CSS .....

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[4]

(b) One page in the website contains a hyperlink on an image. When the image stored as "ticket.png" is clicked, the user is hyperlinked to the page stored as "booking.htm".

Write the HTML code to implement this hyperlink.

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..... **[3]**

The website charges a booking fee of £2.99 on each ticket sold. In addition, if the tickets are purchased from outside of the UK, £4.99 is added to the booking fee. The booking fee is calculated using a JavaScript function named `bookingfee()`.

(c) Complete the definition of the `bookingfee()` function below.

```
function bookingfee(numtickets, country) {

    var nonUKprice = 4.99;

    var perTicketPrice = ……;

    var total = 0;

    if (country!="UK") {

        total = total + ……;

    }

    total = total + (…… * perTicketPrice);

    …… total;

}
```

[4]

(d) The JavaScript function above is used to show users the booking fee. When users click to buy the tickets, the booking fee is calculated again on the server.

(i) Explain why server side processing is used to recalculate the booking fee.

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..... **[3]**

(ii) Explain **one** advantage of client side processing to either the customer buying the tickets, or to company who own the website.

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..... **[2]**

(e) Users are able to search for and find the ticket website using a search engine. Search engines can use indexing and ranking.

(i) Describe how a website is indexed by a search engine.

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..... **[4]**

A search engine can use the PageRank algorithm to determine a website's ranking. The PageRank algorithm utilises a damping factor.

(ii) State what is meant by the term 'damping factor'.

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..... **[1]**

(iii) Give **two** other factors that affect the output value given by the PageRank algorithm for a website.

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2 .....

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[2]

4* *"The Computer Misuse Act means that computer users are criminalised for simply trying to learn how systems work."*

Discuss whether or not you agree with this statement.

.... **[9]**

5 All users of a computer system have a unique username and password. The computer system has implemented two-factor authentication so that users must respond to either an email or text message containing a secret code to be able to access the system.

Let:

A be a Boolean value for if a user enters a valid username

B be a Boolean value for if a user enters a password that matches their username

C be a Boolean value for if a user is able to respond to an email containing a secret code

D be a Boolean value for if a user is able to respond to a text message containing a secret code

Q be a Boolean value for if entry to the computer system is allowed

(a) Complete the Boolean expression below:

Q ≡ ..... **[3]**

(b) Another Boolean expression for a logic system is shown below:

Q ≡ ¬ (¬ A ∧ ¬ B)

(i) Simplify this Boolean expression so that it does not include any negation. You must explain which Boolean algebra rule(s) you are using at each step.

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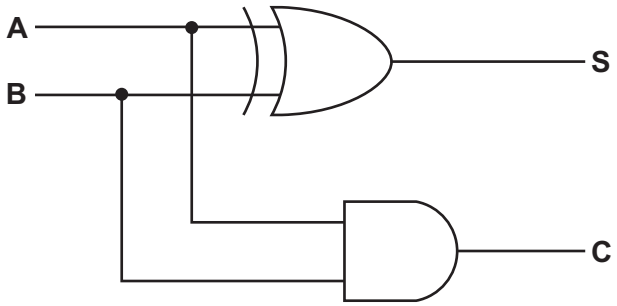
..... **[2]**



(c) The logic circuit above has two inputs (**A**, **B**) and two outputs (**S**, **C**).

(i) Give the Boolean expressions for the outputs **S** and **C**.

S ≡ .....

C ≡ .....

[2]

(ii) Complete the truth table for this logic circuit.

A	B	S	C
0	0		
0	1		
1	0		
1	1		

[2]

(iii) Describe how this logic circuit can be adapted to add together two 4-bit binary numbers.

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..... **[4]**

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6 A program written using the Little Man Computer instruction set is shown in **Fig. 1**.

```
          INP
          STA  numone
          INP
          STA  numtwo
main      LDA  numone
          SUB  numtwo
          BRP  pos
notpos    LDA  count
          OUT
          LDA  numone
          OUT
          HLT
pos       STA  numone
          LDA  count
          ADD  one
          STA  count
          BRA  main
numone    DAT
numtwo    DAT
one       DAT 1
count     DAT 0
```

Fig. 1

(a) Various registers are used when the program above is executed.

(i) State what is meant by the term 'register'.

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..... **[2]**

(ii) Explain how the accumulator is used when the line `BRP pos` is executed.

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..... **[2]**

(b) Complete the table below to show the output(s) from this program given the inputs.

Inputs	Output(s)
12, 5	
18, 2	
16, 4	
3, 7	

[4]

(c) Write an algorithm using pseudocode that has the same functionality as the code in **Fig. 1**.

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..... **[4]**

(d)* In assembly language, different modes of addressing memory can be used.

Discuss the different modes used. You should include:

- How the operand value is determined
- What an operand of `27` would refer to in that mode
- The reasons for requiring multiple modes of addressing **[12]**

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7 A business uses an array with the identifier `wNames` to store workers' names. A variable with the identifier `top` is used to store the index of the last element to be added to the array, which is also the element which will next be removed.

`wNames`

0	1	2	3	4	5	6
Kirstie	Martyn	Louise	Alex	Anna		

`top`

4

(a) (i) State the name of the type of data structure described above.

..... **[1]**

(ii) Using pseudocode, write an algorithm that allows the user to enter a name which is then pushed onto the data structure above, checking first that the data structure is not full.

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..... **[4]**

(b) The same workers' names are stored in a binary search tree which is ordered alphabetically.

Kirstie is set as the root node, with Martyn, Louise, Alex and Anna added one by one.

(i) Complete the tree diagram above to show where Martyn, Louise, Alex and Anna would be added to this binary search tree. **[4]**

(ii) Describe the process of using the binary search tree above to search for the name "Zoe".

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..... **[3]**

(iii) Compare the efficiency of a binary search tree to a linked list when searching for data.

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..... **[2]**

(iv) Compare the efficiency of a binary search tree to a hash table when searching for data.

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..... **[2]**

(c) An object oriented system is implemented to organise further information about each worker's attendance. Classes, objects, methods and attributes are used in this system.

(i) State the meaning of each of the following terms:

Object .....

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Method .....

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Attribute .....

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[3]

Each worker has a name and an attendance figure which can be between 0 and 100.

(ii) Write a definition for a fully encapsulated customer class, providing both get and set methods for all attributes. You do **not** have to write code for the constructor method.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page. The question number must be clearly shown in the margin(s).