Oxford Cambridge and RSA

Monday 12 June 2023 – Afternoon

A Level Computer Science

H446/01 Computer Systems

Time allowed: 2 hours 30 minutes

You can use:
- an HB pencil

Do not use:
- a calculator

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

Centre number						Candidate number				

First name(s) ____________________

Last name ____________________

INSTRUCTIONS

- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- 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 **28** pages.

ADVICE

- Read each question carefully before you start your answer.

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1 A small manufacturing business uses networked computers with closed source application software installed.

(a) A spreadsheet application package is used to calculate employee's wages.

(i) Give **one** benefit of using a spreadsheet application for this task compared to calculating wages manually.

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.... **[1]**

(ii) Give **two** other types of application packages that the small business could use, giving an example of a task that the business could use each application for.

Application 1 ....

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Example of task 1 ....

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Application 2 ....

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Example of task 2 ....

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[4]

(iii) Describe a drawback of using closed source software (rather than open source software) for the small business.

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.... **[3]**

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(b) Each computer the business uses has a BIOS.

Tick (✓) **one** box in each row to identify whether each statement in the table is true or false.

Statement	True	False
BIOS stands for Boot Input Output Standard		
The BIOS can be used to alter hardware settings, such as which storage device the computer boots from		
BIOS settings are stored in RAM		

[3]

The business uses virtual storage to hold regular backups of all of its data.

(c) Explain why virtual storage is well-suited for storing backups.

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.... **[2]**

(d) All computers owned by the business are connected together into a Local Area Network (LAN). Various network protocols are used in this network.

(i) Give **three** advantages to the business of connecting computers together in a LAN.

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[3]

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(ii) Explain what is meant by a network protocol.

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.... **[2]**

(iii) Give the names of **two** protocols that may be used in a LAN.

1 ....

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[2]

(iv) Explain why protocol layering is used.

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.... **[3]**

(e) One computer owned by the business monitors critical-safety features of manufacturing. All input data must be processed within a predictable timescale of a fraction of a second.

(i) State the type of operating system that should be used by this computer.

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.... **[1]**

(ii) Give the name of **three** other types of operating system, and for each state its purpose.

Type 1 ....

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Purpose 1 ....

....

Type 2 ....

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Purpose 2 ....

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Type 3 ....

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Purpose 3 ....

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[6]

When a device such as a keyboard or printer requires attention from the CPU, an interrupt is raised.

(f) Explain how an operating system deals with an interrupt.

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.... **[3]**

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(g)* Memory management is a key function of an operating system. Explain how an operating system can manage the memory available to applications and why doing so is important.

You should include the following in your answer:

- the different actions carried out by an operating system to manage memory
- how memory that is being managed can be split up
- why memory management is important. **[9]**

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2 Sundip writes an algorithm to carry out addition and subtraction. The algorithm will use an initially empty stack with the identifier `numbers` and will take input from the user.

The action the algorithm takes depends on the value input by the user. These actions are listed in **Fig. 2**.

Value input	Action to take
A	• Pop two values from the `numbers` stack • Add the two values • Push the result back onto the `numbers` stack
S	• Pop two values from the `numbers` stack • Subtract the first popped value from the second • Push the result back onto the `numbers` stack
E	• Pop one value from the `numbers` stack • Output this value • End program
Any other value	• Push the input value to the `numbers` stack

Fig. 2

(a) Complete the pseudocode here to implement Sundip's algorithm.

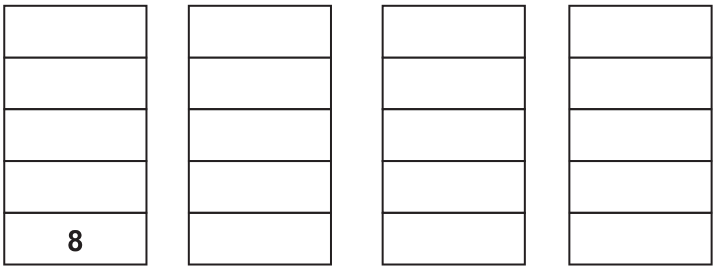
```
do
    value = input("Enter a value")
    if .............................................................. then
        num = numbers.pop()
        print(num)
    elseif value == "A" or .......................................... then
        numone = numbers.pop()
        numtwo = numbers.pop()
        if value == "A" then
            numbers.push............................................................
        elseif value == "S" then
            numbers.push(numtwo - numone)
        endif
    else
        numbers.push(....................................)
    endif
until value == ..................................
```

[5]

(b) **(i)** Complete the diagram to show the state of the stack after each value is entered into the algorithm. The letters will complete an action stated in **Fig. 2**.

The state of the stack after the first value, 8, has been completed for you.

Input **8** **7** **A** **6**



[3]

(ii) Complete the following table to give the output from this algorithm when the following set of inputs are entered by the user. The letters will complete an action stated in **Fig. 2**.

Input data (from left to right)	Output
9 3 A E	
10 5 A 8 S E	
25 5 S 2 3 A S E	

[3]

If the user enters **4 2 S A E**, the algorithm will not work correctly.

(iii) Explain what problem this input data will cause and why the problem occurs.

[3]

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(c) A stack is one data structure that is available for Sundip to use. She could also use a queue, list, linked list, array or tuple.

(i) Describe **one** difference between a stack and a queue.

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.... **[2]**

(ii) Describe **one** difference between an array and a list.

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.... **[2]**

(iii) State **how a** tuple is different to a list.

....

.... **[1]**

(iv) Describe how the **second** item in a linked list would be accessed using pointer values.

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.... **[3]**

3 **(a)** **(i)** Convert the denary number **189** to hexadecimal.

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.... **[1]**

(ii) Convert the unsigned binary number **1010101111** to hexadecimal.

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.... **[1]**

(b) Negative binary values can be represented using either sign and magnitude or two's complement.

(i) Convert the denary number **-107** to an 8-bit binary number using sign and magnitude.

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.... **[1]**

(ii) Convert the denary number **-107** to an 8-bit binary number using two's complement.

....

....

....

.... **[1]**

(iii) Give **one** advantage of storing values using two's complement instead of sign and magnitude.

....

.... **[1]**

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(c) Show how the denary value **-15.75** can be represented as a normalised floating point binary number using 8 bits for the mantissa and 4 bits for the exponent.

You must show your working.

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.... **[4]**

(d) The normalised floating point binary number 0100 1110 is stored using 4 bits for the mantissa and 4 bits for the exponent, both in two's complement.

Convert this number to denary.

You must show your working.

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.... **[3]**

(e) Complete each of the following sentences relating to the storage of floating point binary numbers with an appropriate word.

Increasing the number of bits used for the mantissa increases the .... of the number that can be stored.

Increasing the number of bits used for the exponent increases the .... of the number that can be stored.

[2]

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4 A team of programmers create a robot that will be used in a factory. The robot will be able to do the work of multiple humans.

The programmers discuss whether to write the instructions for the robot in assembly language or a high-level language.

(a) Describe **two** differences between assembly language and high-level languages.

Difference 1 ....

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Difference 2 ....

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[4]

(b) The robot uses a multi-core processor. The programmers assume that this means that the robot will execute programs more quickly than using a single core processor.

(i) Give **one** reason why this assumption can sometimes be true.

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.... **[1]**

(ii) Explain why this assumption is not always true.

....

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.... **[2]**

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(c)* The robot stores data internally and also communicates with other robots and users via a wireless network which is password protected. All data for these tasks is secured using either encryption or hashing.

Compare the robot's use of encryption and hashing for storing and communicating data.

You should include the following in your answer:

- the different types of encryption that could be used and how this would secure data
- how hashing could be used to secure data and which data would be suitable
- why encryption and hashing are used by the robot for stored data and communications.

[9]

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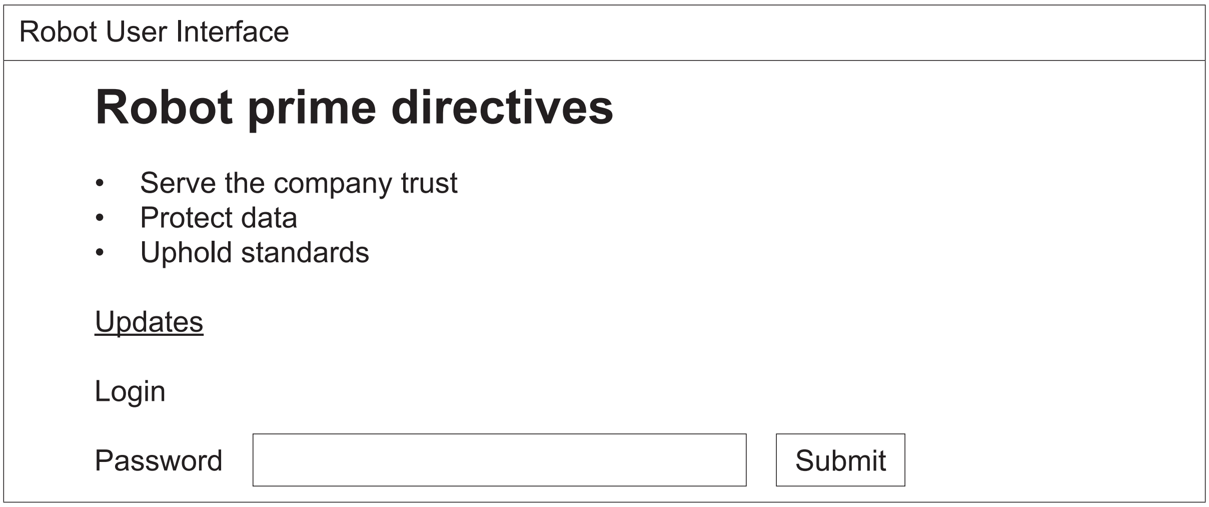
(d) The robot provides a web-based interface for users. The home screen webpage for this interface is shown in **Fig. 4**.



Robot User Interface

Robot prime directives

- Serve the company trust
- Protect data
- Uphold standards

Updates

Login

Password

Fig. 4

(i) Complete this HTML code that will display the webpage shown in **Fig. 4**.

```
<html>
     <head>
          <title>Robot User Interface</title>
     </head>
     <body>
          <h1>Robot prime directives</h1>
          ..............................................
               <li>Serve the company trust</li>
               <li>Protect data</li>
               <li>Uphold standards</li>
          ..............................................
     <a .............................. = "updates.html">Updates</a>
     <p>..........................................</p>
     <form action="dologin.php">
          Password
          <input type = "................................." name="pw">
          <input type = ".................................">
     </form>
     </body>
</html>
```

[5]

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(ii) Write CSS code that could be used in an external stylesheet to format all text using the <h1> tag as white with a red background.

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.... **[3]**

The robot's web interface uses images that show the robot in action. These photographs have been taken using a digital camera.

(e) The programmers do not want other people to download and use these images.

(i) State the name of **one** relevant piece of legislation and describe how this would protect these images.

Legislation ....

....

Description ....

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[3]

For other areas of the web interface, the programmers need to use images that they have not created themselves.

(ii) Give **two** ways that they could make sure these images are used legally.

1 ....

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2 ....

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[2]

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(f) Details of all users that have accessed the robot are stored in a database table called `TblAccessLog`. This table stores the username and user type of each user. When a user accesses the robot, the current date is added to the `DateAccessed` field for that user.

A selection of the data from this table is shown here. Username is the key field.

Username	UserType	DateAccessed
Mrphy003	User	08/05/21, 07/06/21, 08/06/21
Lwis076	Admin	17/04/21, 19/07/21
Bbby412	NotNeeded	01/06/21, 02/07/21, 14/07/21

`TblAccessLog`

(i) Write an SQL statement to delete all records from the table `TblAccessLog` for users who have a UserType of "`NotNeeded`".

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.... **[2]**

(ii) State **two** requirements for a database to be in First Normal Form (1NF).

1 ....

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2 ....

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[2]

(iii) Explain why the structure of `TblAccessLog` means that this database is **not** in First Normal Form (1NF).

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.... **[2]**

5 A `doCheck()` function takes an integer value as a parameter, carries out a series of calculations and returns an integer value.

The function is shown here.

```
function doCheck(number)
    temp = str(number)
    max = temp.length - 1
    total = 0
    for x = 0 to max
        total = total + int(temp.subString(x,1))
    next x
    return total MOD 10
endfunction
```

(a) State the value returned from the function when `doCheck(3178)` is called.

....

.... **[1]**

(b) Write an algorithm that will:

- allow the user to enter an integer value
- pass the value entered into the `doCheck()` function as a parameter
- store both the value input and the value returned from the function in a text file with name "storedvalues.txt"

You should write your algorithm using either pseudocode or program code.

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.... **[5]**

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6 **(a)** A computer scientist has created the following logic circuit shown in **Fig. 6**.

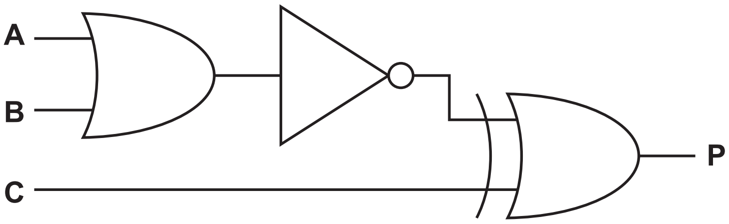

Fig. 6

(i) Give the Boolean expression that represents the logic circuit shown in **Fig. 6**. Do not attempt to simplify the expression.

....

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.... **[2]**

(ii) Complete the truth table for the logic circuit shown in **Fig. 6**.

A	B	C	P
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[3]

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The following Karnaugh map represents another logic circuit.

		AB 00	01	11	10
CD	00	1	1	1	1
	01	1	1	0	0
	11	0	0	0	0
	10	0	0	1	1

(b) Use this Karnaugh map to find the simplified expression for this circuit.

You should highlight the map as appropriate and write the expression here.

....

....

....

.... **[4]**

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7* The Regulation of Investigatory Powers Act (2000) has been described as both a vital legal tool to ensure the public's safety and an attack on an individual's freedoms.

Evaluate the purpose and use of the Act.

You should include:

- the additional powers given under the Act
- to whom these powers are given
- the perceived benefits and/or drawbacks of the Act.

[12]

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END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

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

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