



Cambridge International AS & A Level

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COMPUTER SCIENCE

9618/32

Paper 3 Advanced Theory

October/November 2021

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Any blank pages are indicated.

1 (a) Numbers are stored in a computer using floating-point representation with:

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both the mantissa and exponent.

(i) Write the normalised floating-point representation of the following unsigned binary number using this system.

1011100.011001

Working

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Mantissa

Exponent

| | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|
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[2]

(ii) State the consequence of storing the binary number in part (a)(i) as a floating-point number in this system. Justify your answer.

Consequence

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Justification

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[2]

(b) Explain the reason why binary numbers are stored in normalised form.

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[3]

3

2 Draw **one** line from each programming paradigm to its **most appropriate** description.

| Programming paradigm | Description |
|----------------------|---|
| Declarative | Programs using the instruction set of a processor |
| Imperative | Programs based on events such as user actions or sensor outputs |
| Low-level | Programs using the concepts of class, inheritance, encapsulation and polymorphism |
| Object-oriented | Programs with an explicit sequence of commands that update the program state, with or without procedure calls |
| | Programs that specify the desired result rather than how to get to it |

[4]

3 Enumerated and pointer are two non-composite data types.

(a) Write **pseudocode** to create an enumerated type called `Parts` to include these parts sold in a computer shop:

Monitor, CPU, SSD, HDD, LaserPrinter, Keyboard, Mouse

.....

 [2]

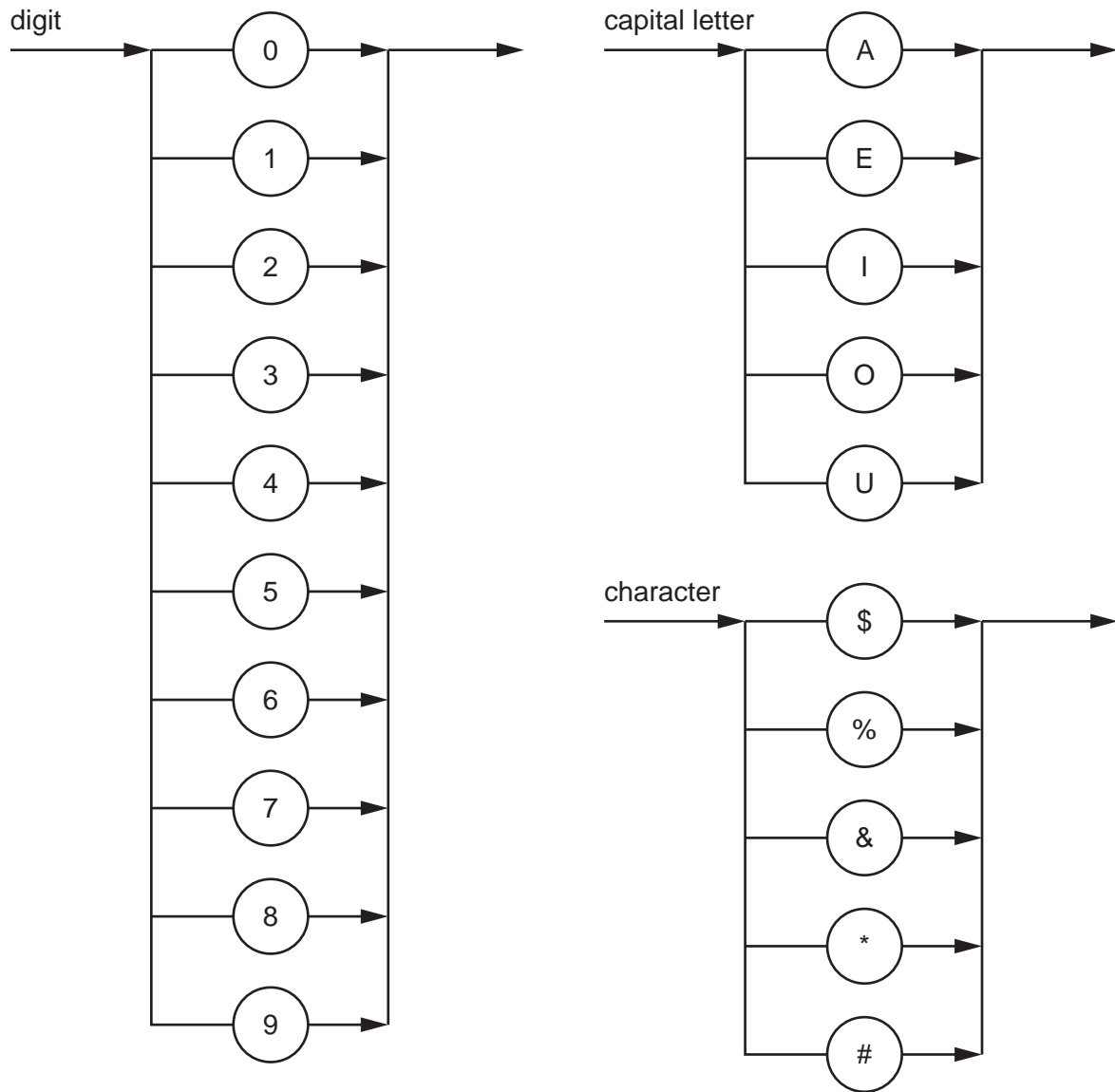
(b) Write **pseudocode** to create a pointer type called `SelectParts` that will reference the memory location in which the current part name is stored.

.....

 [2]

4 The following syntax diagrams for a particular programming language show the syntax of:

- a digit
- a capital letter
- a character.



(a) Write the Backus-Naur Form (BNF) notation of the syntax diagram for character.

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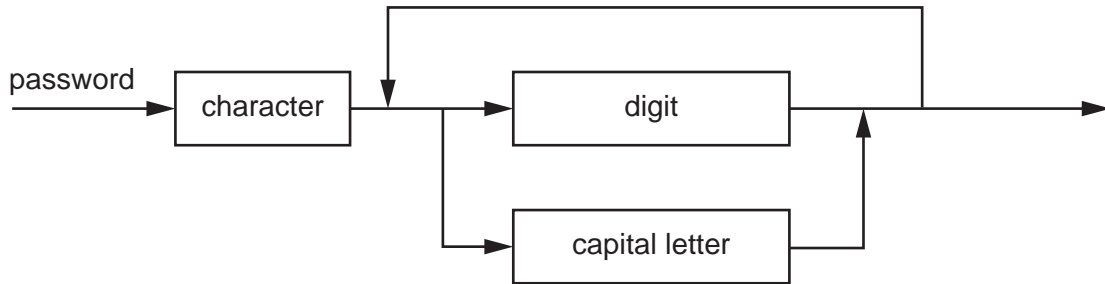
..... [2]

(b) A password must begin with a character and be followed by one or more digits or capital letters.

(i) State an example of a valid password.

..... [1]

(ii) A valid password is represented by the syntax diagram:



Write the BNF notation of the syntax diagram for password.

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..... [4]

5 (a) Compare sequential and serial methods of file organisation.

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..... [4]

(b) State the most suitable method of file access when a record is referenced by a unique address on a disk-type storage medium.

..... [1]

(c) State the most suitable method of file access when a bank stores its data records in ascending order of account number.

..... [1]

6 (a) Explain how packet switching is used to transfer messages across the internet.

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..... [5]

(b) Outline the function of a router in packet switching.

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..... [3]

7 (a) Write the Boolean expression that corresponds to the given truth table as a sum-of-products.

| INPUT | | | | OUTPUT |
|-------|---|---|---|--------|
| A | B | C | D | Z |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

Z =

..... [3]

(b) (i) Complete the Karnaugh map (K-map) for the given truth table.

| | | | | | |
|----|----|----|----|----|----|
| | | AB | | | |
| | | 00 | 01 | 11 | 10 |
| CD | 00 | | | | |
| | 01 | | | | |
| | 11 | | | | |
| | 10 | | | | |

[2]

(ii) Draw loop(s) around appropriate group(s) of 1s in the K-map to produce an optimal sum-of-products. [2]

(iii) Write the Boolean expression from your answer to **part b(ii)** as a simplified sum-of-products.

Z =
 [2]

(iv) Write the simplified Boolean expression for your answer to **part b(iii)**.

Z =
 [1]

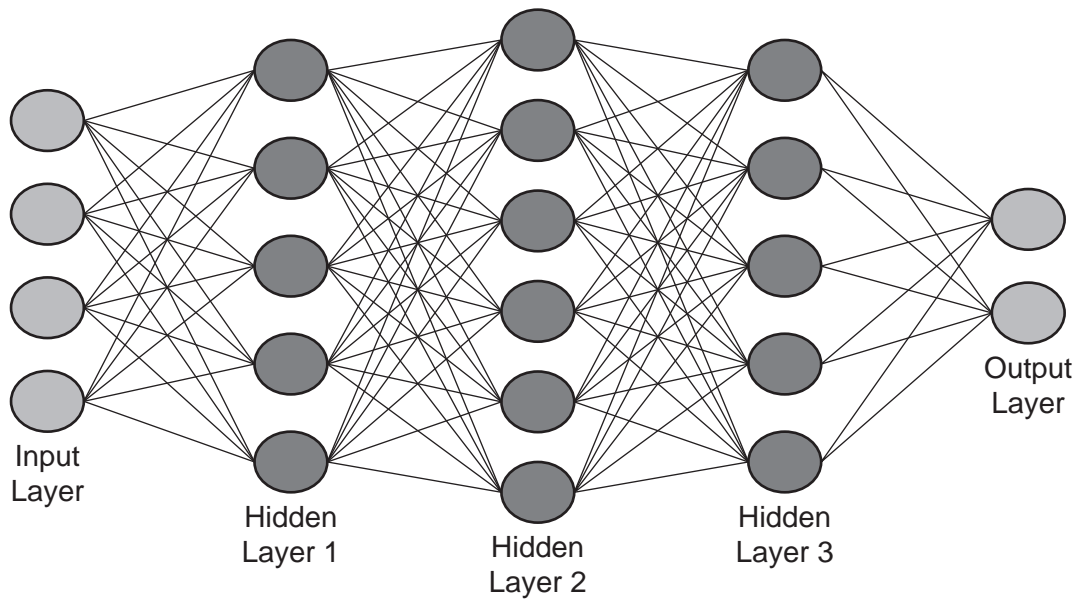
8 (a) Describe the purpose of the Secure Sockets Layer (SSL) and Transport Layer Security (TLS) protocols.

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..... [2]

(b) Explain how SSL/TLS protocols are used when a client-server communication is initiated.

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9 (a) The diagram shown represents an artificial neural network.



(i) State the reason for having multiple hidden layers in an artificial neural network.

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..... [1]

(ii) Explain how artificial neural networks enable machine learning.

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..... [4]

10 (a) State **three** essential features of **recursion**.

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[3]

(b) Explain the reasons why a stack is a suitable Abstract Data Type (ADT) to implement recursion.

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[3]

(c) Identify **two** ADTs other than a stack.

1

2

[2]

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