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COMMON ASSESSMENT TASK

Level 3 Digital Technologies and Hangarau Matihiko 2021

91908 Analyse an area of computer science

Credits: Three

Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Analyse an area of computer science.	Analyse, in depth, an area of computer science.	Critically analyse an area of computer science.

Type your School Code and 9-digit National Student Number (NSN) into the space below. (If your NSN has 10 digits, omit the leading zero.) It should look like "123-123456789-91908".

SchoolCode-YourNSN-91908

There are three questions in this document. **Choose ONE question to answer.**

Make sure you have the PDF of the Resource Booklet 91908R. This contains resources for Questions Two and Three.

You should aim to write **800–1500 words** in total.

Your answers should be presented in 12pt Times New Roman font, within the expanding text boxes, and may include only information you produce during this assessment session. Internet access is not permitted.

Save your finished work as a PDF file as instructed by your teacher.

By saving your work at the end of the examination, you are declaring that this work is your own. NZQA may sample your work to ensure this is the case.

INSTRUCTIONS

There are three questions in this assessment, on the topics of:

- Formal languages (page 3)
- Network communication protocols (page 9)
- Big data (page 14).

Choose only ONE question to answer.

Questions Two and Three require you to refer to the separate resource booklet.

Read all parts of your chosen question before you begin.

EITHER: **QUESTION ONE: Formal languages**

(a) Figure 1 shows a finite-state machine.

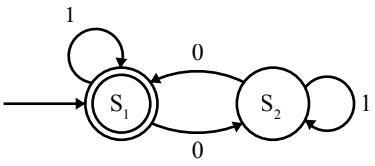

Figure 1.

(i) What is the alphabet used in this machine?

(ii) What is the label of the accepting state?

(iii) Give the shortest string accepted by this machine. Explain your answer.

(iv) Can “11011” be considered an accepted string? Explain your answer.

(v) Does this machine accept a string that is the digit “0” repeated 931 times? Explain your reasoning.

(b) The following table shows examples of some common regular expressions:

Expression	Description
`a?`	Zero or one of `a`
`a*`	Zero or more of `a`
`a{3}`	Exactly 3 of `a`
`\d`	Any digit
`\D`	Any non-digit
`\w`	Any word character (letter, number, or underscore)
`\W`	Any non-word character
`[A-Z]`	Any single character in the range A to Z

Consider the regular expression `[A-Z]{3}\d{3}`

(i) Give TWO examples of a string this regular expression would accept.

(1)

(2)

(ii) Explain how you came to this conclusion.

(c) The following are the production rules of a context-free grammar:

$E \rightarrow N$
$E \rightarrow E + E$
$E \rightarrow E * E$
$E \rightarrow -E$
$E \rightarrow (E)$
$N \rightarrow 0–9$

Select from these rules and fill in (2) to (4) below to show the sequence you would use to build the expression **(–3)**.

(1)	E
(2)	
(3)	
(4)	
(5)	$N \rightarrow 3$

(d) Give a practical example of how formal languages are regularly used by people, and explain how problems can arise when using formal languages in this way.

(e) Give a brief summary of the similarities and differences between regular languages and context-free languages. In your answer, explain the capabilities of each, and the limits of what they can do.

(f) Choose ONE of the following options to answer.

Option (1)

The variation on a finite-state automaton (FSA) shown in Figure 2 has an output on every transition.

For example, the transition labelled "0/1" means that the transition is on a "0" (as in a simple FSA), but it outputs the symbol "1" when it takes the transition.

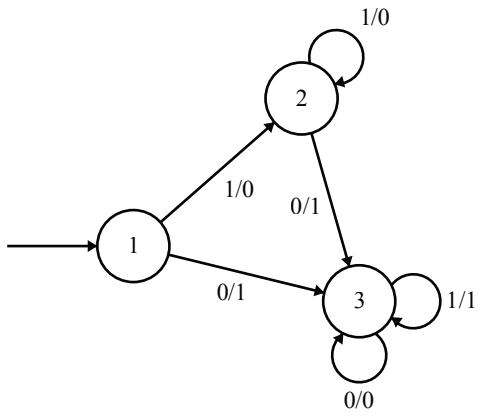

Figure 2. A finite-state automaton

Option (2)

A non-deterministic finite-state automaton (NFA) allows two transitions from a state to have the same label, and accepts a string if taking either choice can lead to an accepting state.

For example, the NFA shown in Figure 3 accepts the strings "b" and "bab", but not "bbab".

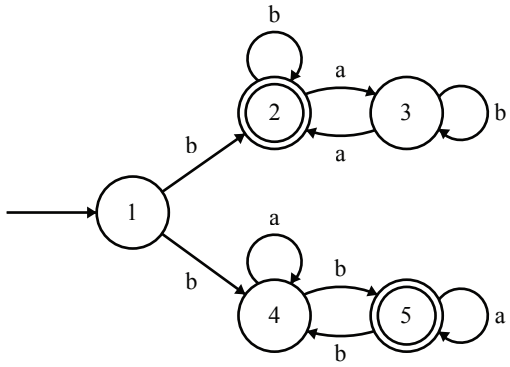

Figure 3. A non-deterministic finite-state automaton

Explain what your chosen machine does, or could do, and give examples of relevant strings to support your answer.

Option (1 or 2)

Response

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OR: **QUESTION TWO: Network communication protocols**

This question includes references to **Resources A to D** on pages 2 and 3 of the resource booklet.

(a) Name TWO application layer protocols and TWO transport layer protocols, and state the function of each. You may refer to **Resources A and B** in your answer.

(1)	Application layer protocol:
(2)	Application layer protocol:
(3)	Transport layer protocol:
(4)	Transport layer protocol:

(b) Give examples of the ways you use network communication protocols.

(c) (i) What are the capabilities and limitations of a network communication protocol you have investigated this year? You may refer to **Resource C** in your answer.

(ii) Explain how the limitations you identified could be addressed.

(d) Two ways of communicating over the internet are **email** and **videoconferencing** (using Zoom, Skype, FaceTime etc.).

For each of these two ways, explain why TCP and / or UDP would be used as network communication protocols. Comment on the advantages and limitations of the protocol for each.

You may refer to **Resources C and D** in your answer.

The number of internet-connected devices is increasing globally. In 2018 there were approximately 8.4 billion networked devices. A forecast at the beginning of 2020 predicted that this number will increase to 29.3 billion by 2023, and that 71 per cent of the global population will be mobile subscribers by then.

Source (adapted): Hill, K. (2020). Connected devices will be 3x the global population by 2023, Cisco says. RCR Wireless News, 18 February 2020. https://www.rcrwireless.com/20200218/internet-of-things/connected-devices-will-be-3x-the-global-population-by-2023-cisco-says

(e) With reference to the statement above, what are some possible future uses or improvements you think will be necessary in the field of network communication protocols?

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OR: **QUESTION THREE: Big data**

This question includes references to **Resources E to G** on pages 4 and 5 of the resource booklet.

(a) Briefly describe the "3 Vs" of big data (**volume**, **variety**, and **velocity**).

(b) What key problems or issues relating to the 3 Vs can you see with the collection of the dataset used to generate **Resources E and F**? How might these problems or issues be addressed?

(c) With reference to **Resources E to G**, how do the technical capabilities and limitations of big data affect people's lives? Give examples to support your answer.

(d) With reference to **Resources E to G**, what are some of the benefits and disadvantages of big data? Discuss whether you think it is possible to find a balance between these benefits and disadvantages.

The number of internet-connected devices is increasing globally. In 2018 there were approximately 8.4 billion networked devices. A forecast at the beginning of 2020 predicted that this number will increase to 29.3 billion by 2023, and that 71 per cent of the global population will be mobile subscribers by then.

Two-and-a-half quintillion (2.5×10^{18}) bytes of data are created daily. This could potentially rise even more thanks to better internet access. Today, we can collect big data from every imaginable field we're able to monitor digitally, including science, commerce, medicine, government, and sport, just to name a few.

Sources (adapted):

Hill, K. (2020). Connected devices will be 3x the global population by 2023, Cisco says. RCR Wireless News, 18 February 2020. https://www.rcrwireless.com/20200218/internet-of-things/connected-devices-will-be-3x-the-global-population-by-2023-cisco-says

Mills, T. (2018). Big data is changing the way people live their lives. Forbes, 16 May 2018. https://www.forbes.com/sites/forbestechcouncil/2018/05/16/big-data-is-changing-the-way-people-live-their-lives

(e) With reference to the statement above, discuss how a particular organisation or technology sector you have studied this year uses the concept of big data. What are some future uses or improvements you think are possible in this area, and what are the implications of these?