2

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COMMON ASSESSMENT TASK

Level 2 Digital Technologies and Hangarau Matihiko 2021

91898 Demonstrate understanding of a computer science concept

Credits: Three

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of a computer science concept.	Demonstrate in-depth understanding of a computer science concept.	Demonstrate comprehensive understanding of a computer science concept.

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 "123-123456789-91898".

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

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.

Achievement

TOTAL **03**

ASSESSOR'S USE ONLY

INSTRUCTIONS

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

- Computer security (page 3)
- Encryption (page 8)
- Error control (page 13).

Choose only ONE question to answer. Note that parts (b), (c), and (d) of the question include options for you to choose from.

Read all parts of your chosen question before you begin.

OR: QUESTION THREE: Error control

(a) (i) Name a **specific** New Zealand-based company or organisation that uses error control.
Note: If you want to discuss your school, state "My school".

> Pak n Save Rangiora

(ii) Give at least TWO examples of ways error control is used by this organisation.

> One way Pak n Save uses error control is through the checking of barcodes. When a barcode is scanned it will beep if it was successfully scanned and you can see the item on the screen at the checkout, you can then see if the item on screen matches with the item you purchased.
>
> Pak n Save also uses error control in various in store departments such as Click & Collect. When an item is placed into a crate, the QR code is scanned and checked for errors. This is to avoid staff placing the item in the wrong crate thus resulting in it not going to the person who ordered it.

(iii) What do these uses of error control enable this organisation to do that would otherwise be difficult or impossible?

> If barcodes weren't checked for errors, then it would be difficult to purchase the correct product from Pak n Save. Barcodes are error checked to ensure the barcode matches with the product, if they weren't checked then a pack of Tim Tams could be interpreted as a bottle of wine by the computer since the code wasn't checked. This results in customers paying for items they didn't even receive which would reduce sales since people won't come back to the store to buy more products.
>
> In the case of Click & Collect, error control allows products to be put with the correct orders. If this system wasn't in place it would be impossible for Click & Collect to function properly since there would be no way to tell which product was purchased by which customer without asking them. But even if you ask a customer whether or not this item is for them they could lie and get free products or just not remember what they ordered.

(b) Choose TWO of the following to answer:

- Name a type of barcode, and the algorithm(s) involved in its error control. What is the purpose of using these algorithm(s)?
- How does "automatic repeat request" (ARQ) error control work in network traffic?
- How is redundant data used in error control?

Choice (1) – (copy and paste below)

> - Name a type of barcode, and the algorithm(s) involved in its error control. What is the purpose of using these algorithm(s)?

Response

GTIN-13 barcodes are the most standard type of barcodes and the GTIN-13 algorithm is used to calculate the check digit

The purpose of using the GTIN-13 algorithm is to calculate or check the check digit of the GTIN-13 barcode. If the barcodes number is run through the algorithm and the check digit is calculated to be correct, then the barcode is correct. If the check digit is calculated to be wrong however, then the user will be notified that there is something wrong with this barcode.

The algorithm can only check to see if something is wrong, it cannot fix the incorrect digit(s). This is why the user is notified and they must fix it themselves.

Choice (2) – (copy and paste below)

> - How is redundant data used in error control?

Response

Redundant data is used in error control typically by adding extra digits onto codes that act as check digits or adding parity bits into packets.

Redundant data means data that doesn't change the value of a barcode or internet packet, it only acts as a check to see whether the original data is correct.

Parity checking is an excellent example of redundant data because not only does it detect errors but it can also fix most of them.

0	1	0	1
0	0	1	1
1	1	0	0
0	0	1	0

Each square represents a 1 or a 0

The nine squares in the top right are the original packet that is being sent over the internet to your computer.

The line down the left and along the bottom is the redundant data, or the parity bits.

These parity bits indicate how many 1's or 0's are on a line, with 0 meaning there is an even number of 1's on that line (excluding the parity bit)

0	1	1	1
0	0	1	1
1	1	0	0
0	0	1	0

If a bit is changed in the original packet, then the parity bit will no longer be correct.

Since the 0 on the top row was changed to a 1, this means that there is now an odd number of 1's on that line, the 3rd line from the left is also incorrect since there is now an even number of 1's.

The incorrect digit can easily be found by finding where the two parity bit lines intersect and then flipping the bit at the intersection.

0	1	0	1
0	0	1	1
1	1	0	0
0	0	1	0

This packet is now correct and the receiving computer's website/video will now load.

Without the parity bits, packets would just be constantly sent until the correct one is received.

(c) Choose ONE of the following to answer:

- What are some ways that error control can be future-proofed?
- What are some ways that human factors influence decisions about error control?

You should consider this question in the context of the organisation you wrote about in part (a).

Choice (copy and paste below)

What are some ways that error control can be future-proofed?

Response

GTIN-13 barcodes do work for most stores, however if more unique products are to be sold then there could be double ups of barcodes which would cause problems.

For example, Pak n Save is a supermarket so they sell various food products. But if Pak n Save wanted to expand their inventory and potentially sell books, there is currently no way for them to do this because food products use GTIN-13 barcodes and books use ISBN codes.

There is a way to combat this problem and that would be to switch all products to using QR codes. QR codes can store exponentially more data than standard GTIN-13 or ISBN barcodes. This would mean that a unique barcode can be given to every item in Pak n Save, including the books, that would run on the same error checking system. If all stores and manufacturers switched to using QR codes instead of barcodes, then that would mean that any store could sell any product and not have to worry about duplicate codes or different error checking systems.

3D barcodes would be the next logical step after QR codes because you would be able to give every single item on this planet a unique code and still have more unique codes left over.

(d)   Choose ONE of the following to answer:

- QR codes use Reed-Solomon codes for error control. How does this differ from the method of error control used in barcodes? What are the advantages and limitations of each method? *Note: You are not required to explain how Reed-Solomon code works.*

- Network traffic on the internet involves the transfer of large amounts of data. Explain the key problems and issues with the transfer of data, and how error control helps to solve these.

If relevant, you should consider this question in the context of the organisation you wrote about in part (a).

Choice (copy and paste below)

- Network traffic on the internet involves the transfer of large amounts of data. Explain the key problems and issues with the transfer of data, and how error control helps to solve these.

Response

Every time a packet is sent across the internet it takes time to reach your computer. The more data the packet has the slower it takes to reach you.

When you click on a YouTube video the data for that video gets sent from YouTube HQ, through the internet, and reaches your computer. If the data that was sent had some bits changed while it was travelling through the internet to you, then the video won't load and the data would be sent again. This is why it sometimes takes a long time to load websites/videos, it's because the packets are being altered and need to be sent again.

This could potentially take minutes or even hours, but thanks to parity bits, the amount of resending is reduced. Parity bits are redundant data added to a packet to check for changes in the data and to correct it as explained in question b.

This means that small changes in data is corrected and when that data reaches its destination it is correct. This reduces the amount of data needing to be resent and in turn makes the video you want to watch load faster. Sometimes packets still need to be resent however because parity don't always work.

Achievement Exemplar 2021

Subject	Level 2 Digital Technologies		Standard	91898	Total score	03
Q	**Grade score**	**Annotation**				
3	A3	The candidate has explained the use of error control in barcodes and QR codes and given a good example of their use in a store. In part (b), the candidate has not explained how the check digit is calculated, which would have been good information to include. In part (c), the candidate uses the parity 'trick' to help explain the purpose of redundant data. The responses to parts (c) and (d) are good attempts and help to provide overall evidence in determining the overall grade of Achievement.				