Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Digital Technologies 2024

91898 Demonstrate understanding of a computer science concept

EXEMPLAR

Merit

TOTAL 05

INSTRUCTIONS

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

- computer security (page 3)
- error control (page 9)
- artificial intelligence (page 15).

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

Read all parts of your chosen question before you begin. Do not repeat your response in different parts of the question.

Candidates must complete their assessments individually under teacher supervision, in accordance with the NCEA Assessment and Examination Rules and Procedures. The material submitted for assessment must be the candidate's own work.

Candidates are not permitted to access any resources (either in hard copy or online) other than those supplied in the assessment itself.

Schools, teachers, and candidates are not permitted to share or discuss the assessment or their assessment responses with any other schools, teachers, or candidates until after the final date for submission (30 October 2024).

The use of chatbots, generative AI, paraphrasing tools, or other tools that can automatically generate content is not permitted and material generated by these tools should not be submitted as part of the candidate's work.

(Assessment Specifications, NZQA 2024)

OR: **QUESTION TWO: Error control**

(a) (i) Where would you find error control used when shopping (online **or** in person)?

When you scan your products in the check out, the barcodes that you scan have error control. The credit card that you use has error control to check if you have a valid credit card number. There is error control online when using websites because they send information in packets.

(ii) Explain at least two advantages for retailers of using error control.

If the barcode machine isn't beeping the employee can tell if the barcode isn't working. Store employees can use the numbers on the barcodes to manually type into the check out if the barcode isn't working. Having this kind of error notification is very useful to diferentiate between a working and not working barcode.

It can make sure that when they scan the product they know it is the correct product because of the error control. If it didn't have the error control they could be scanning an product from a different store which the employee would have to notice by them selfs. The retailers can then be sure that they aren't charging too much or less to the customers.

Refer to the image below of a QR code generator and its output.

Source: https://www.the-qrcode-generator.com/

(b) (i) What is contained in this QR code and how does a QR code work?

The URL for nzqa is contained in the QR code. It works by having camera typicaly a smart phone read the QR code. QR codes can be read by finding the black sqares with a black square inside of them around the QR codes. Different sized QR codes have different amounts of the squares. These squares are used to locate a QR code and then if the image is distorted on the camera (maybe from viewing from a not straight on view) the squares can be used to shape the QR code into a readable fromate. Data is stored on a QR code with the black and white squares, these represent 0 and 1 bits. The 1 and 0's are stored in 8 bit bytes. Some is the data that the QR code is representing like a website link and the other data is redundant for error detection and correction.

(ii) How does a QR code use error control to ensure accuracy? How effective is it?

Reed soloman is used to ensure accuracy. It's very effective to restore data that might be corrupted possibly from something blocking the QR code. When you try to read to the QR code it can still be read and corrected. There are different amounts of error control that a QR code can have. Reed soloman uses a polynomial math function for error control. There can be different amounts of chunks of bytes allocated on the QR code for error control. The more allocated to error control the less data can fit in a QR for the measage that it is trying to give out. That just means there is a trade off for how much error control you want for the measage. The error control is effective enough that people who make the QR codes sometimes has a logo in the centre that blocks out the black squares/ data on the QR code but it will still be able to be read. Companys who do this might even get more impression to the website they might be trying to promote because it looks more unique giving character. The QR code could still have enough error control that even if a error occurs on the QR code it can still be read with the logo/picture blocking out some parts of the QR code.

(c) Choose ONE of the following to answer:

- Explain what 'check digits' are. Where might you find them? Give an example of how they work.

  OR

- How do automatic repeat requests (ARQ) **or** forward error correction (FEC) work in networks?

Choice (copy and paste below):

Explain what 'check digits' are. Where might you find them? Give an example of how they work.

Response:

Check digits can be found on barcodes and credit cards etc. Barcodes have these to verify if the baracode is valid. For a UPC-A barcode, this can be done by adding up the numbers in the odd position then multiplying them by 3 adding them to the sum of the numbers on the even position of the barcode. Then dividing and finding the remainder of that number by 10. The last step would be to then minus that number from 10 to find the check digit. If the number is different from the check digit that would be an error. An example of a barcode could be 012345678912. Barcodes are split into sections like 1-5-5-1 which means the first digit to check what kind security number it is. The next 5 is the maufactor code for what manufator it is and the next 5 after that is the product code. The last number is the check digit. Here is an example of how you would check if the barcode is valid. For the UPC-A barcode of 012345678905 we ignore the first digit "0" then add up the numbers in the odd position 1+3+5+7+9 = 25 multiply that by 3, 25X3=75. Now add up the numbers in the even position 2+4+6+8+0=20 and add that to the 75 which is 75+20=95 divide that by 10 and find the remainder 95/10=9.5 remaindeer of 5. Now we minus the 5 from 10, 10-5=5 and now check if 5 matchs with the check digit which is also 5. This barcode is valid.

(d) Choose ONE of the following to answer:

- Barcodes found in supermarkets have been used on products since the 1970s. Explain whether this is an example of future-proofing or reluctance to change to QR codes.

  OR

- Explain how error correction has future-proofed the internet from transmission errors.

Choice (copy and paste below):

Barcodes found in supermarkets have been used on products since the 1970s. Explain whether this is an example of future-proofing or reluctance to change to QR codes.

Response:

This is not an example of future proofing because when you comparing barcodes to QR codes, QR codes have much more data stored in them when compared to barcodes. A barcode released in 1973 UPC-A has worse error control than QR codes. The UPC-A barcode has limited error control because if a number in the even position is swapped with another number in the even position the barcode will still think its valid because it still adds up the same numbers but it is now a different manufactor or product. This can also happen if you swap the numbers in the odd position since the same problem applies. If these false positives happen it has to be the store employee to notice and if they don't they would of charged the wrong price for the customer. QR codes can have much better error control because it can detect much more errors and correct them then be read. While the barcode I mentioned can only do error detection but not error correction. Supermarkets have a reluctance to change to QR codes because of the possible massive costs to change to a different technoledgy. Supermarkets will just go with what works best at the time. The time it takes to switch and costs doesn't justify having QR codes for the products.

(e) Choose ONE of the following to answer:

- Explain the principles of 'Reed-Solomon' error control.

  OR

- How does error control work in the different levels of RAID storage?

Ensure that you discuss problems or issues involving data integrity. Consider time, storage needed, or bandwidth required.

Choice (copy and paste below):

How does error control work in the different levels of RAID storage?

Response:

layer 0

There is no error control so if one disk fails all the data is lost.

In layer 1

If there is an error in the disks of the raid storage the disk might of just failed. There is error detection but not any error correction. This means it can detect the errors but it could be too late to recover the data since it might have errors that corrupt the data too much. These disks can be change even when the server is running.

Layer 2

Same as layer 1. These aren't as used like the others

Layer 3

Same as layer 1. These aren't as used like the others

Layer 4

Parity disks are used. A basic understanding of how these work is for a byte of 1 and 0's there can 7 bits of data and one for error control. This error control works by counting the number of 1's in that byte and seeing if it is even or odd amount then having the error control bit change to 1 or 0 based off if there are even or odd number of 1's. If there is a bit that has been stwitched from 1 to 0 or vise versa the error control bit will show that the amount of 1's in the byte is wrong compared to the parity.

Layer 5

2 parity disks are used

Layer 6

Parity is spread out on all disks. This means that if any disk fails and gets replaced all the data can be recovered from the other disks.

Merit

Subject: Digital Technologies

Standard: 91898

Total score: 05

Q	Grade score	Marker commentary
Error control	M5	The candidate gave a suitable response explaining the use of error control in checkouts. They identified all components and their use (a QR contains the data, error control, and alignment data). They then gave a maths-based explanation of how error control is implemented. Answers explaining the use of forward error correction (FEC) were also accepted. A good explanation of how check digits work was given, including where they are found. The candidate gave a good explanation of the origin of barcodes, and compared their effectiveness with QR codes. They also gave a suitable explanation as to why they feel supermarkets are not changing from barcodes to QR codes. In explaining RAID, a basic answer was given but lacked depth, especially around error control. This response did not meet the requirement to gain a higher score. Overall, this candidate gave sound answers to the questions, gaining a Merit. To reach Excellence, their answers would need to have greater depth.