

Exercise walk-through

2.2

Methods of error detection

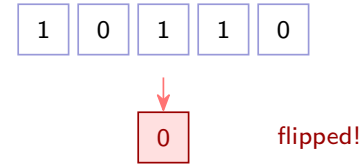
IGCSE Computer Science

Why check for errors?

Interference in transit can cause:

- **data loss** – bits do not arrive
- **data gain** – extra bits appear
- **data change** – bits are flipped

So the receiver checks the data arrived correctly, using one of several methods.



Parity check

data: 1 0 1 1 0 0 1

count the 1s: four (even)

parity bit = 0 (keep it even)

sent: 1 0 1 1 0 0 1 0

A parity bit is added to make the number of 1s even (or odd)

A parity block finds *which* bit is wrong

The problem

A single **parity bit** tells you *that* an error happened, never *where*.

Parity block

Send several bytes together: each byte carries a row parity bit, and one extra **parity byte** at the end carries the column parities.

Finding it

The row that fails and the column that fails cross at the flipped bit – change it back and the data is repaired.

Row parity plus a **parity byte** turns error *detection* into error *correction* for a single flipped bit.

ARQ: decide the next message

Automatic Repeat reQuest
and a **timeout** .

(ARQ) uses **acknowledgements**

A sender sends packet 4 and starts its timer. Consider three separate cases:

Case	What happens at the receiver?
------	-------------------------------

- | | |
|---|---|
| A | Packet 4 arrives; its error check passes. |
| B | Packet 4 arrives; its error check detects an error. |
| C | Packet 4 never arrives. |

For each case, choose the receiver's response and the sender's next action. When does the sender need its timer?

ARQ: trace the three outcomes

Case	Receiver	Sender
A	Sends a positive acknowledgement: the check passed.	Receives it before timeout; stops this timer and can send the next packet.
B	Sends a negative acknowledgement: an error was detected.	Receives it; sends packet 4 again and restarts the timer.
C	Has no packet to check; sends no acknowledgement.	Timer expires without a positive acknowledgement; resends packet 4 and restarts the timer.

A negative reply can trigger a repeat *before* timeout. The timer handles silence, including a lost packet or a lost reply.

Exercises 2.1-2.3

2.1 State what a parity bit is used for.

[1]

2.2 State one error a check digit can detect.

[1]

2.3 Give two differences between a LAN and a WAN.

[2]

Exercises 2.1-2.3

2.1 State what a parity bit is used for. [1]

2.1

- extra bit added to a byte so the receiver can check it
- used **to detect an error after transmission**

2.2 State one error a check digit can detect. [1]

2.2

- a check digit is calculated from the other digits
- any **one** of: an **incorrect digit** / a **transposition** / a **missing or extra digit**

2.3 Give two differences between a LAN and a WAN. [2]

2.3

- any **two** of: LAN is one building / WAN is a large area; LAN cabling belongs to the owner / WAN uses third-party links; a LAN is usually faster

Exercises 2.4-2.5

2.4 Identify the device that uses MAC addresses to send data only to the correct port, and the device that connects two different networks. [2]

2.5 Give two advantages of a wired connection over a wireless one. [2]

Exercises 2.4-2.5

2.4 Identify the device that uses MAC addresses to send data only to the correct port, and the device that connects two different networks. [2]

2.4

- sends data only to the correct port: **switch**
- connects two different networks: **router**

2.5 Give two advantages of a wired connection over a wireless one. [2]

2.5

- any **two** of: faster / more reliable (fewer dropouts) / more secure (signal cannot be picked up outside)

Exercise 3.1

3.1 Using **even** parity, the parity bit for the data 1101001 is:

[1]

☐

A 0

B 1

C either

D none

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[1]

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A 0

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D none

3.1 A

- 1101001 has four 1s, already even, so the even-parity bit is **0**
- B would make the count odd; C and D are not how even parity works

Exercise 3.2 (a)

3.2 Data is checked using a checksum.

(a) Describe how a checksum detects an error.

[2]

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(a)

- checksum is calculated before sending and again at the receiver
- if the two values **differ**, an error has occurred

Exercise 3.2 (b)

3.2 Data is checked using a checksum.

(b) Explain why a parity check might fail to detect an error.

[2]

Exercise 3.2 (b)

3.2 Data is checked using a checksum.

(b) Explain why a parity check might fail to detect an error.

[2]

(b)

- if two bits flip, the number of 1s may still be even (or odd) as required
- the parity check **passes despite the error**

Exercise 3.3

3.3 Describe how Automatic Repeat reQuest (ARQ) ensures data arrives correctly. [2]

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3.3

- the receiver sends a positive or negative acknowledgement
- if the sender gets **no positive ACK before a timeout**, it **resends** the packet

Exercise 3.4 (a)

3.4 A small office has eight computers, a printer and an internet connection.

(a) Identify the type of network the eight computers form, and justify your answer. [2]

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- eight computers in one building, office owns the cabling
- **LAN**

Exercise 3.4 (b)

3.4 A small office has eight computers, a printer and an internet connection.

(b) Complete the table by naming the device that performs each task. [3]

Task	Device
gives each computer a MAC address and connects it to the network	
sends data only to the port of the computer it is addressed to	
connects the office network to the internet	

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connects the office network to the internet	

(b)

- MAC address and join the network: **NIC**
- send data only to the addressed port: **switch**
- connect the office to the internet: **router**

Exercise 3.4 (c)

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(c)

- **MAC:** fixed in the hardware by the manufacturer; identifies the device
- **IP:** identifies where the device is on a network and can change
- a switch uses MAC addresses inside the LAN; a router uses IP addresses between networks

Exercise 3.4 (d)

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- benefit: visitors can **move around** and need no cabling
- drawback: **slower or less secure**, and walls can weaken the signal

Exercise 3.4 (e)

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(e) Explain why the Wi-Fi should use a network key.

[2]

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[2]

(e)

- without a key, anyone in range could join
- the key **encrypts** the traffic and **keeps outsiders out**