LESSON MAKER PRO

Catch the Glitch

Use check bits to detect errors and repeated bits to correct them.

HIGH SCHOOL · FM.IP.A.31

FM.IP.A.31 "Apply error-detecting codes and error-correcting codes to determine accuracy of information processing."

NAME _____ DATE _____

TWO WAYS TO CHECK

For even parity, add one check bit so the complete string has an even number of 1s. An odd number of 1s in a received string detects an error, but even parity does not prove that no error occurred. In a three-copy code, each bit is sent three times. Decode each group as the bit that appears at least twice.

WORKED EXAMPLE

Add an even-parity bit to 1011. Then decode the three-copy group 001.

1. 1011 has three 1s, so append 1 to make the total even: 10111.
2. In 001, the bit 0 appears twice.
3. Decode 001 as 0.

Answer: Even-parity string: 10111. Decoded bit: 0.

PRACTICE 6 problems

1 Append an even-parity bit to 1001. Write the complete string.

ANSWER _____

2 Append an even-parity bit to 1110. Write the complete string.

ANSWER _____

3 The received string 01011 includes an even-parity bit. Does the parity check detect an error?

ANSWER _____

4 The received string 10100 includes an even-parity bit. Does it pass the parity check? Does that prove no bit changed?

ANSWER _____

_____

5 Decode this three-copy message, reading one group at a time: 111 000 011.

ANSWER _____

6 Decode this three-copy message, reading one group at a time: 010 110 100.

ANSWER _____

APPLY IT Show your work

1 A game server adds an even-parity bit to each four-bit score update. Your phone receives 01110. Does the parity check detect an error? Can it tell which bit changed?

WORK SPACE

ANSWER _____

2 A concert ticket app sends its entry code by repeating each bit three times. Your phone receives 110 010 111 000. What four-bit code should the app read?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A system sends two data bits followed by an even-parity bit. It repeats each of the three bits three times. The receiver gets 110 110 011. Decode the groups and check the resulting parity. What does the check show about the limit of majority decoding? Explain.

WORK SPACE AND ANSWER

ANSWER KEY

Catch the Glitch

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Append an even-parity bit to 1001. Write the complete string.	**10010**
2	Append an even-parity bit to 1110. Write the complete string.	**11101**
3	The received string 01011 includes an even-parity bit. Does the parity check detect an error?	**Yes. The string has three 1s, an odd total.**
4	The received string 10100 includes an even-parity bit. Does it pass the parity check? Does that prove no bit changed?	**It passes because it has two 1s. No, two changed bits could leave the total even.**
5	Decode this three-copy message, reading one group at a time: 111 000 011.	**101**
6	Decode this three-copy message, reading one group at a time: 010 110 100.	**010**

PART 2 · APPLY IT

1. **Yes, it detects an error. No, it cannot tell which bit changed.** The received string has three 1s, so it fails even parity. A parity check does not identify the changed bit.
2. **1010** The most common bit in each group is 1, 0, 1, and 0, in that order.

CHALLENGE

Majority decoding gives 111, which fails even parity because it has three 1s. If the sender used even parity, at least one group had two or more bits change, so majority decoding did not correct every error.

Accept answers that give the correct result without counting the 1s explicitly. Three-copy decoding is guaranteed to correct a group only when at most one bit in that group changed.