CO - 2

COURSE NAME : SYSTEM DESIGN AND INTRODUCTION TO CLOUD

COURSE CODE : 23AD2103A

TOPICS : ERROR CONTROL, ERROR DETECTION AND CORRECTION CODES

SESSION DESCRIPTION

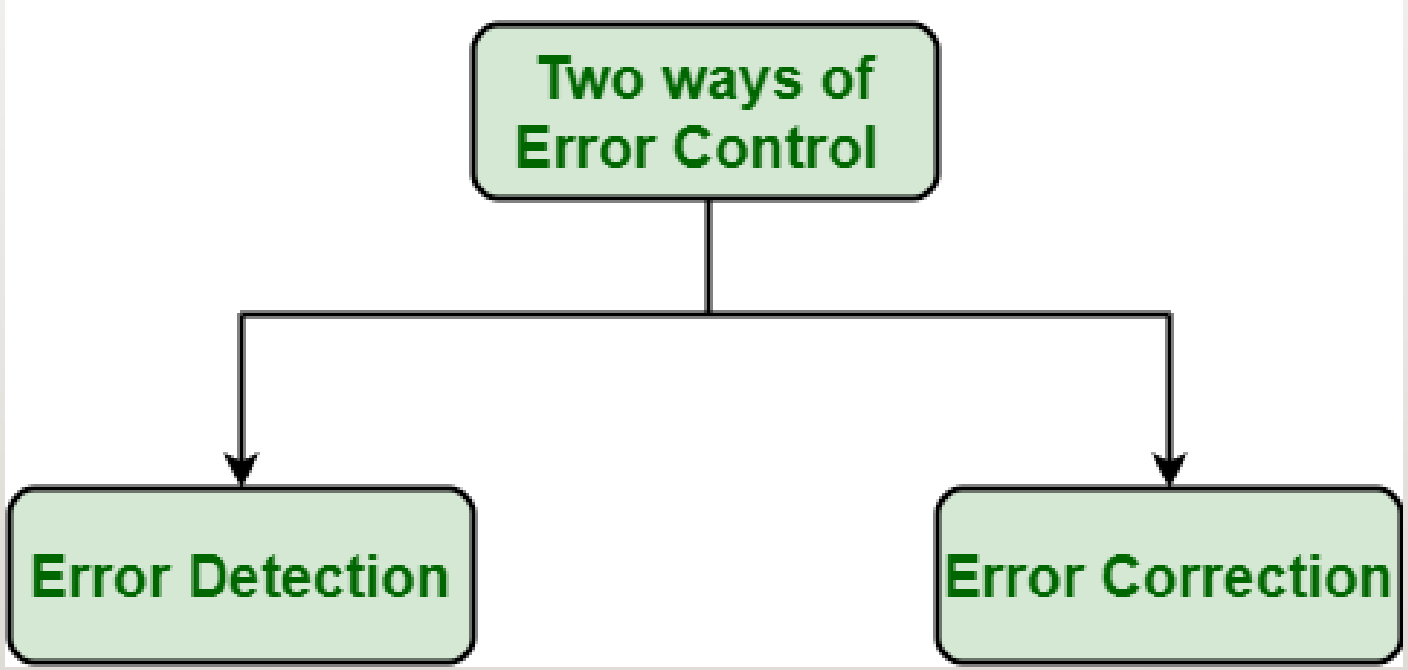
- Error control, error detection and correction codes

ERROR CONTROL

- Data-link layer uses the techniques of error control simply to ensure and confirm that all the data frames or packets, i.e. bit streams of data, are transmitted or transferred from sender to receiver with certain accuracy.
- Using or providing error control at this data link layer is an optimization, it was never a requirement. Error control is basically process in data link layer of detecting or identifying and re-transmitting data frames that might be lost or corrupted during transmission.

WAYS OF DOING ERROR CONTROL :

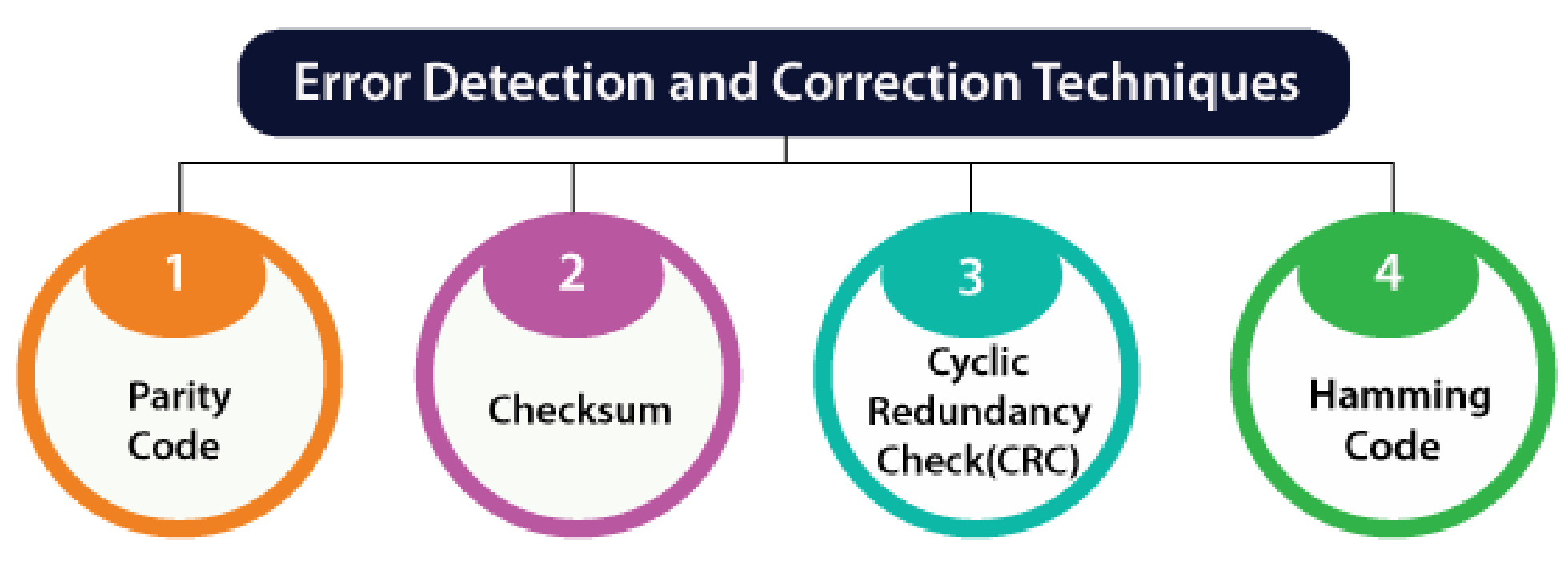
- There are basically two ways of doing Error control as given below :



ERROR DETECTION AND CORRECTION CODES

- **Error Detection :** Error detection, as the name suggests, simply means detection or identification of errors. These errors may occur due to noise or any other impairments during transmission from transmitter to the receiver, in communication system. It is a class of techniques for detecting garbled i.e. unclear and distorted data or messages.
- **Error Correction :** Error correction, as the name suggests, simply means correction or solving or fixing of errors. It simply means reconstruction and rehabilitation of original data that is error-free. But error correction method is very costly and very hard.

ERROR DETECTION AND CORRECTION CODE



ERROR DETECTION CODE

- **Purpose:** Identifies errors in transmitted data.
- The error detection codes are the code used for detecting the error in the received data bitstream. In these codes, some bits are included appended to the original bitstream.
- Error detecting codes encode the message before sending it over the noisy channels. The encoding scheme is performed in such a way that the decoder at the receiving can find the errors easily in the receiving data with a higher chance of success.

Parity Code

- In parity code, we add one parity bit either to the right of the LSB or left to the MSB to the original bitstream. On the basis of the type of parity being chosen, two types of parity codes are possible, i.e., even parity code and odd parity code.
- **Checksums:**
- Summing up the binary values in a block of data and sending the sum along with the data. The receiver recomputes the sum and compares it with the transmitted checksum.
- **Cyclic Redundancy Check (CRC):**
- Treats data as a polynomial and divides it by a predefined generator polynomial. The remainder is sent as the CRC value. The receiver performs the same division and checks the remainder.
- **Hamming Distance:**
- Measures the number of differing bits between two strings of equal length. Codes are designed so that even after an error, the original data can be detected.

ERROR CORRECTION:

- **Purpose:** Not only detects errors but also corrects them, enabling the receiver to recover the original data without the need for retransmission.
- Error correction codes are generated by using the specific algorithm used for removing and detecting errors from the message transmitted over the noisy channels. The error-correcting codes find the correct number of corrupted bits and their positions in the message.

- **Hamming Code:** Adds redundant bits at specific positions in the data block. It can detect and correct single-bit errors by using the positions of the redundant bits.
- **Reed-Solomon Code:** Widely used in CDs, DVDs, and QR codes. It works well for burst errors and adds multiple check symbols to the data.
- **Convolutional Code:** Used in digital communication systems, including satellite and deep-space communications. It spreads the information over multiple bits to help in correcting errors.
- **Turbo Codes and LDPC (Low-Density Parity-Check) Codes:** Modern codes used in deep-space communications and cellular networks (e.g., 5G) for their near-optimal error correction performance.

APPLICATIONS:

- **Data Storage:** Ensures integrity in storage devices like hard drives, CDs, and flash drives.
- **Digital Communications:** Provides reliable data transmission over noisy channels (e.g., satellite communications, wireless networks).
- **Networking Protocols:** Used in protocols like TCP/IP to maintain data integrity in network communications.
- These codes are crucial for maintaining data integrity, especially in environments prone to errors due to noise or other interference.

THANK YOU

Team – System Design & Introduction to Cloud