Chapter 08: The Memory System

Lesson 14:

Memory Storage Error Correction

Objective

- Understand the detection and correction process for the memory errors
- Learn about different type of the codes

Type of codes for detection and correction

EDC

- Certain codes are called error detection and correction codes (EDC) codes

SEC

- An SEC (single error correction) code correct one-bit error in the stored data bits

DED

- A DED (double error detection) code detects two bit errors

SEC-DED (single error correction double error detection)

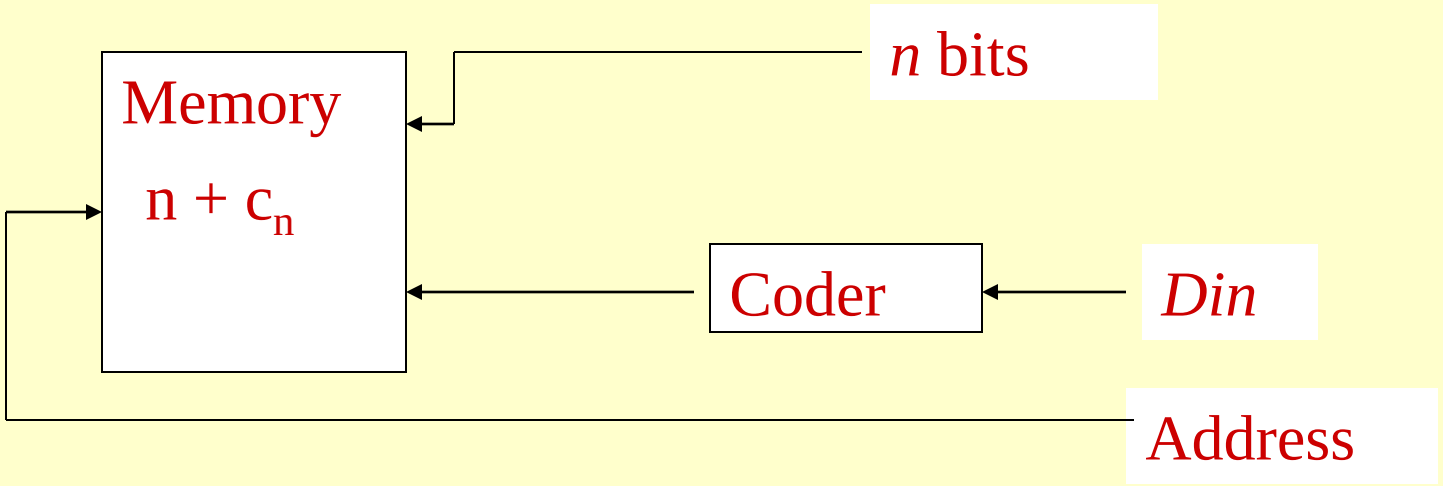
- An SEC-DED corrects if there is one bit error and detects two bits error

Detection and correction

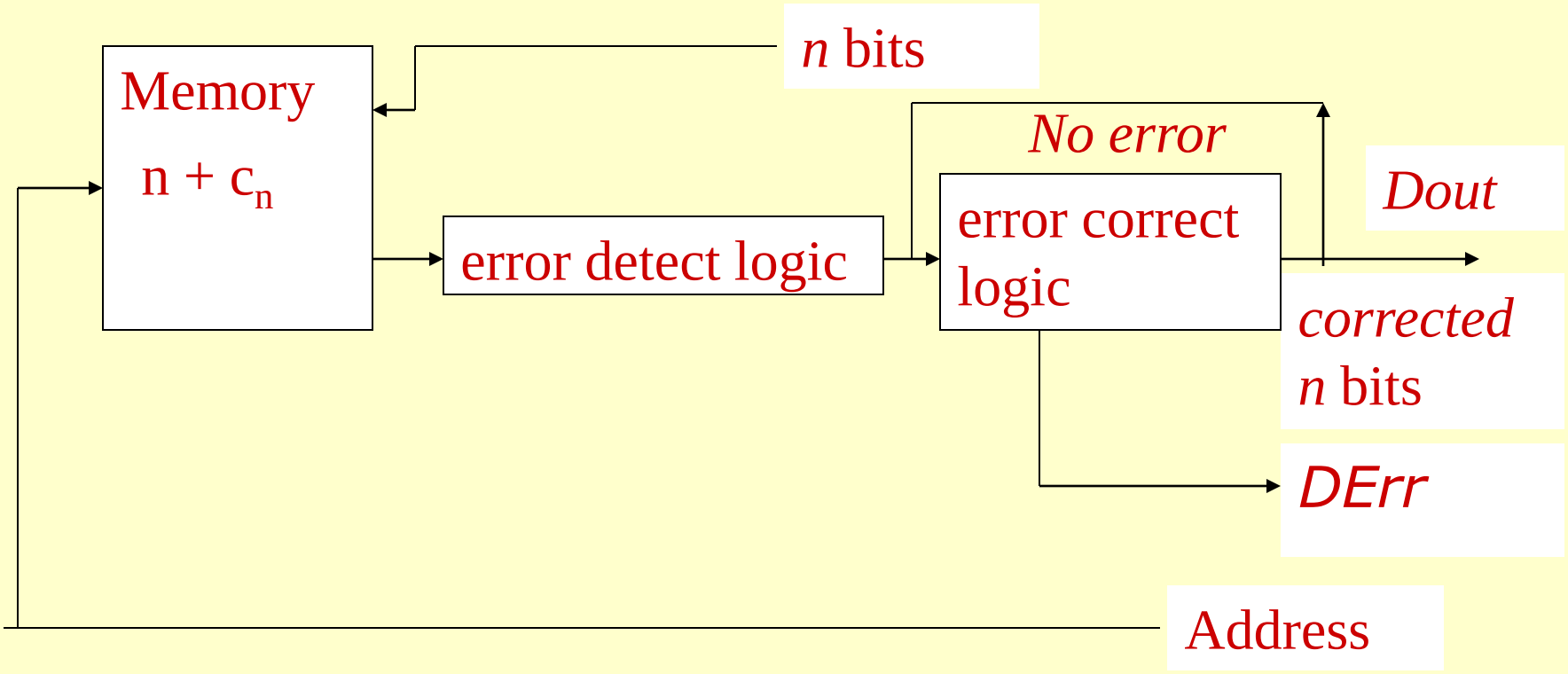
Method

- A logic circuit is used for detecting the error using n and c_n, bits that occurs during write in a memory address
- The c_n -bits along with n bits generate data-error signal and also detect and correct the errors in the n bits

Memory saving n as well as c_n bits



Error detection and correction logic



Method

- *Dout* are the *n* bits after correction in case an error found by ERR error detect logic and corrected by Err correction logic
- *Derr* is signal when the error detected but could not be corrected
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Method

- Note that only errors due to in-between noise signal pickup or power line noise, which is random and infrequent ones can be corrected
- Internal hardware failure in ROM can’t b corrected

Detection and Correction by Hamming code

Detection and Correction by Hamming code

- A SEC-DED code
- If $n = 8$, then $cn = 5$
- If $n = 16, 32, 64, 128$ and 256 then $cn = 6, 7, 8, 9$ and 10, respectively

The required value of *cn*

- First compute ($\log_2$ n), the number of circles that are required to be made and arranged such that there are intersecting with each other
- The number of intersections = ($\log_2$ n) + 1
- In each intersecting area, the *n*-bits are divided and arranged in correct order
- In each nonintersecting area, a parity bit is placed

The required value of *cn*

- The parity bit is chosen such that the total number of ones is even
- Number of bits in SEC = $(\log_2 n) + 1$
- Number of bits in SEC-DED = $(\log_2 n) + 2$

Example

- If 256 bits are to be stored at an address using Coder for SEC-DED code using Hamming scheme, then $c_n = (\log_2 256) + 2 = 10$
- The fractional increase required in number of bit-cells of DRAM at that address = (10÷ 256) = 0.039

Summary

We learnt

- Memory error due to noise
- Detection and correction be SEC-DED code

End of Lesson 14 on

Memory Storage Error Correction