Introduction to Sequential Digital Systems

By

Kolawole Yusuf Obiwusi

Sequential Logic Circuits

- • Output depends on current inputs
- • Output also depends on past inputs (memory)
- • Can remember previous states
- • Uses feedback paths

Memory Elements

- Sequential circuits contain memory elements such as:
- • Flip-flops
- • Latches
- • Registers

- These elements store binary data (0 or 1).

Structure of a Sequential Circuit

- Inputs → Combinational Logic → Memory → Output
- • Logic processes inputs
- • Memory stores state
- • Feedback influences future output

Flip-Flop

- • Basic memory device
- • Stores one bit of information
- • Triggered by a clock signal
- • Building block of registers and counters

D Flip-Flop

- • D input represents data
- • On clock edge, Q = D
- • Stores one bit
- • $\bar{Q}$ is inverted output

Combinational vs Sequential Circuits

- Combinational:
- • No memory
- • Output depends only on inputs

- Sequential:
- • Has memory
- • Output depends on present and past inputs

4-Bit Register

- • Consists of four flip-flops
- • Stores four bits of data
- • All flip-flops share same clock
- • Used in CPU data storage

Clock Signal

- • Periodic timing pulse
- • Synchronizes circuit operation
- • Rising or falling edge triggered
- • Controls system speed

Timing Diagram (D Flip-Flop)

- • Shows relationship between CLK, D, and Q
- • Q changes only at clock edge
- • Used for timing analysis

4-Bit Binary Counter

- • Counts from 0 to 15
- • Changes state on each clock pulse
- • Used in timers and digital clocks

Finite State Machine (FSM)

- • System with finite number of states
- • Transitions depend on inputs
- • Controlled by clock
- • Used in control systems

Importance in Computer Systems

- • CPU operation
- • Data storage
- • Timing and control
- • Instruction sequencing

Summary

- Sequential Logic = Logic + Memory + Clock
- • Logic processes data
- • Memory stores state
- • Clock synchronizes operations

Thank You