CSEE 3827: Fundamentals of Computer Systems

Lecture 11

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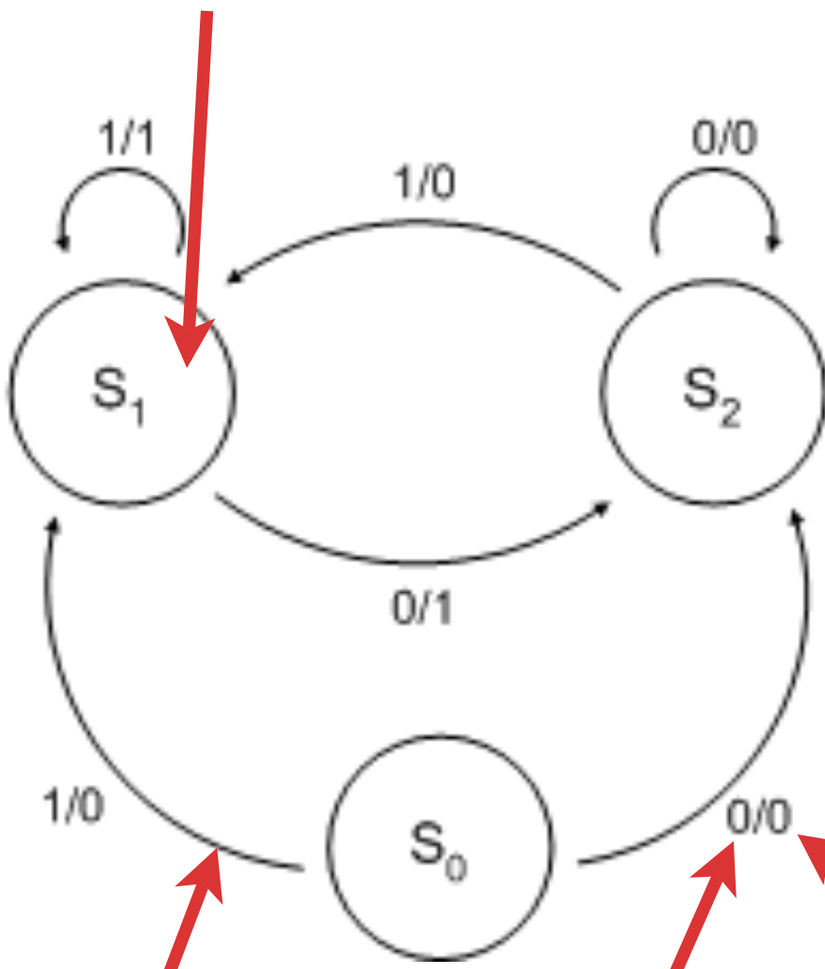
State machine

*A state machine model of a system's behavior in terms of **states** and **transitions** between those states that are triggered by **actions**.*

State diagrams represent state machines

one or more states, indicated by nodes



edges between states

machine output at transition

input value that triggers transition on edge

Finite state machine (FSM)

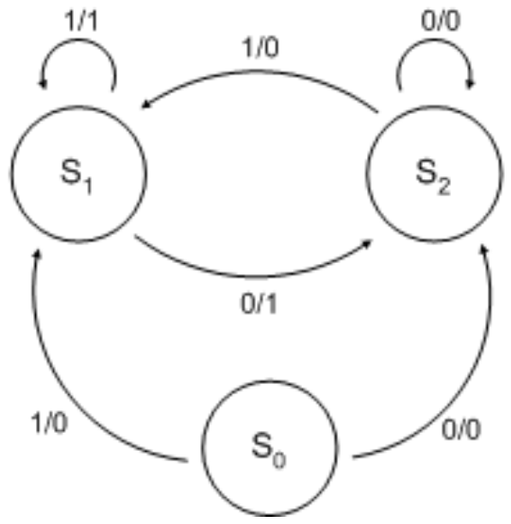
A state machine that has a finite number of states

** Any finite state machine can be implemented with sequential logic*

** All sequential circuits implement finite state machines*

Implementing a finite state machine

1. describe operation



2. convert to truth table

S	in	S+	out
0 0	0	1 0	0
0 0	1	0 1	0
0 1	0	1 0	1
0 1	1	0 1	1
1 0	0	1 0	0
1 0	1	0 1	0

3. choose type of flip-flop

4. annotate table with flip-flop inputs for next state

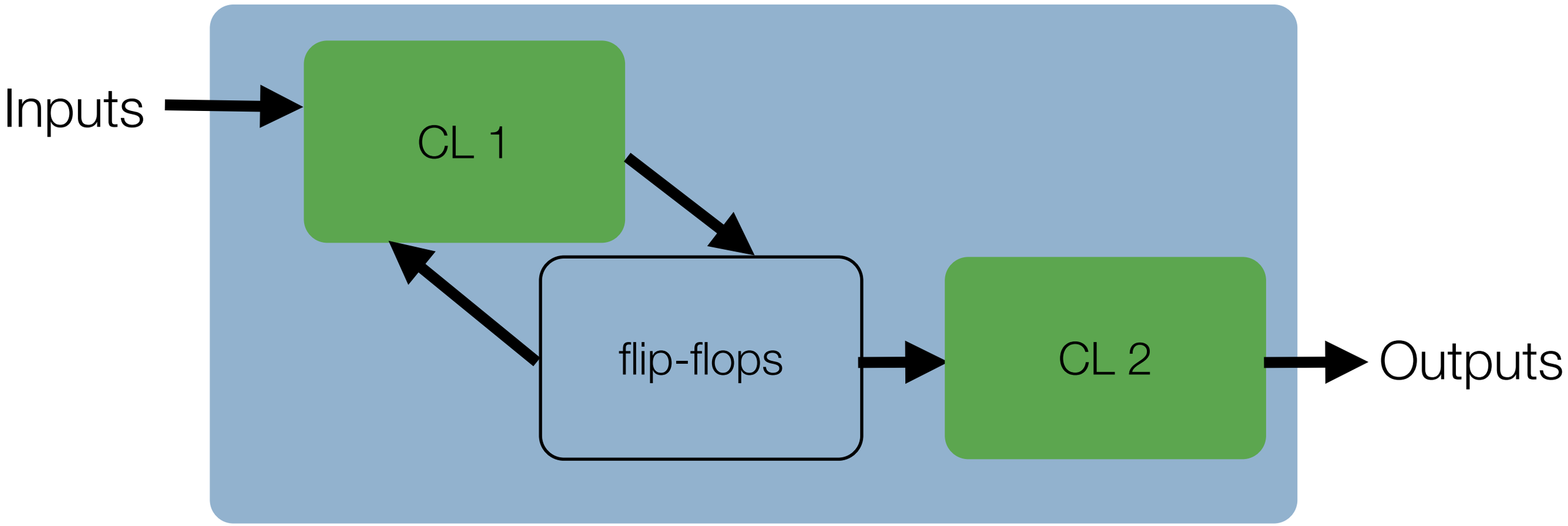
S	in	S+	out	T1	T2
0 0	0	1 0	0	1	0
0 0	1	0 1	0	0	1
0 1	0	1 0	1	1	1
0 1	1	0 1	1	0	0
1 0	0	1 0	0	0	0
1 0	1	0 1	0	1	1

5. derive “next state” and “output” logic

6. wire circuit and flip-flops together together

In class exercise: design a 3-bit counter

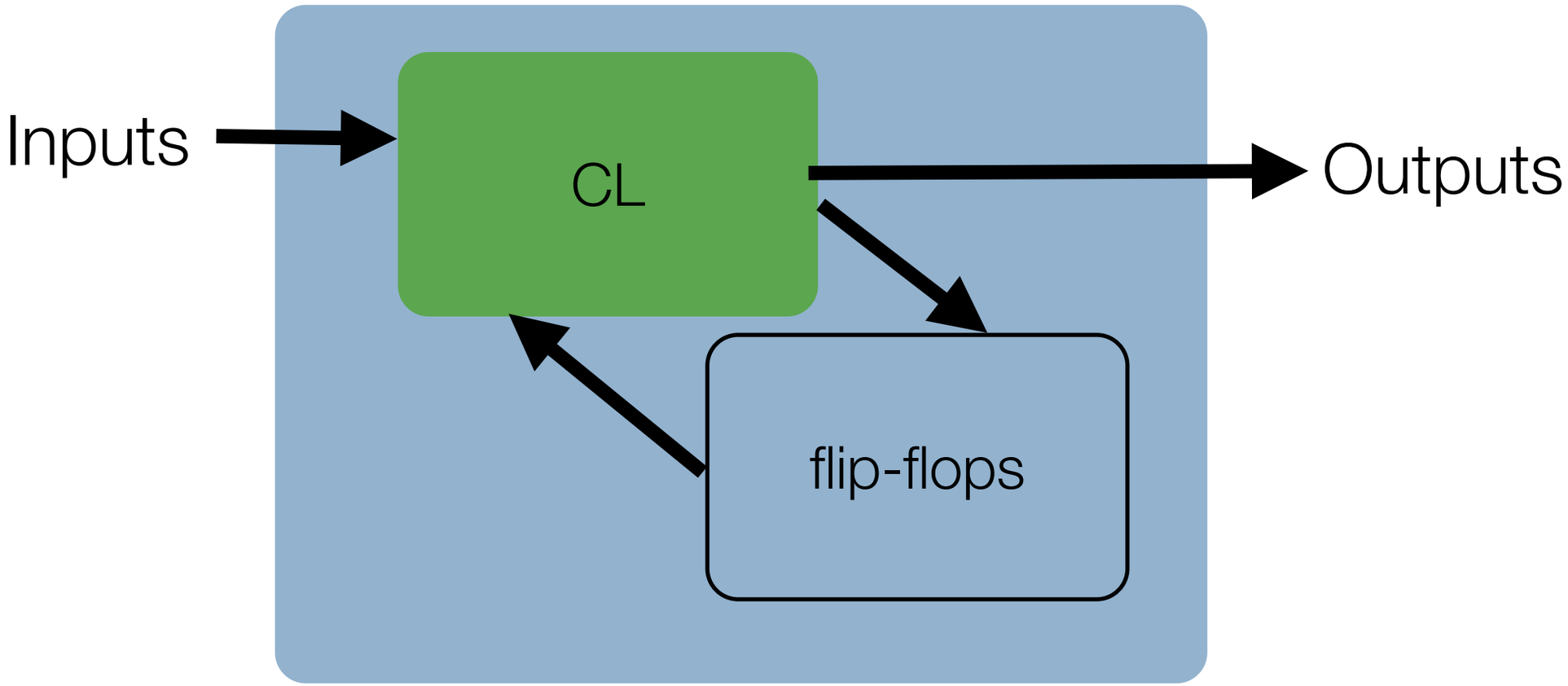
Moore machine



a circuit in which the output depends only on the current state

(+ outputs are synchronous)

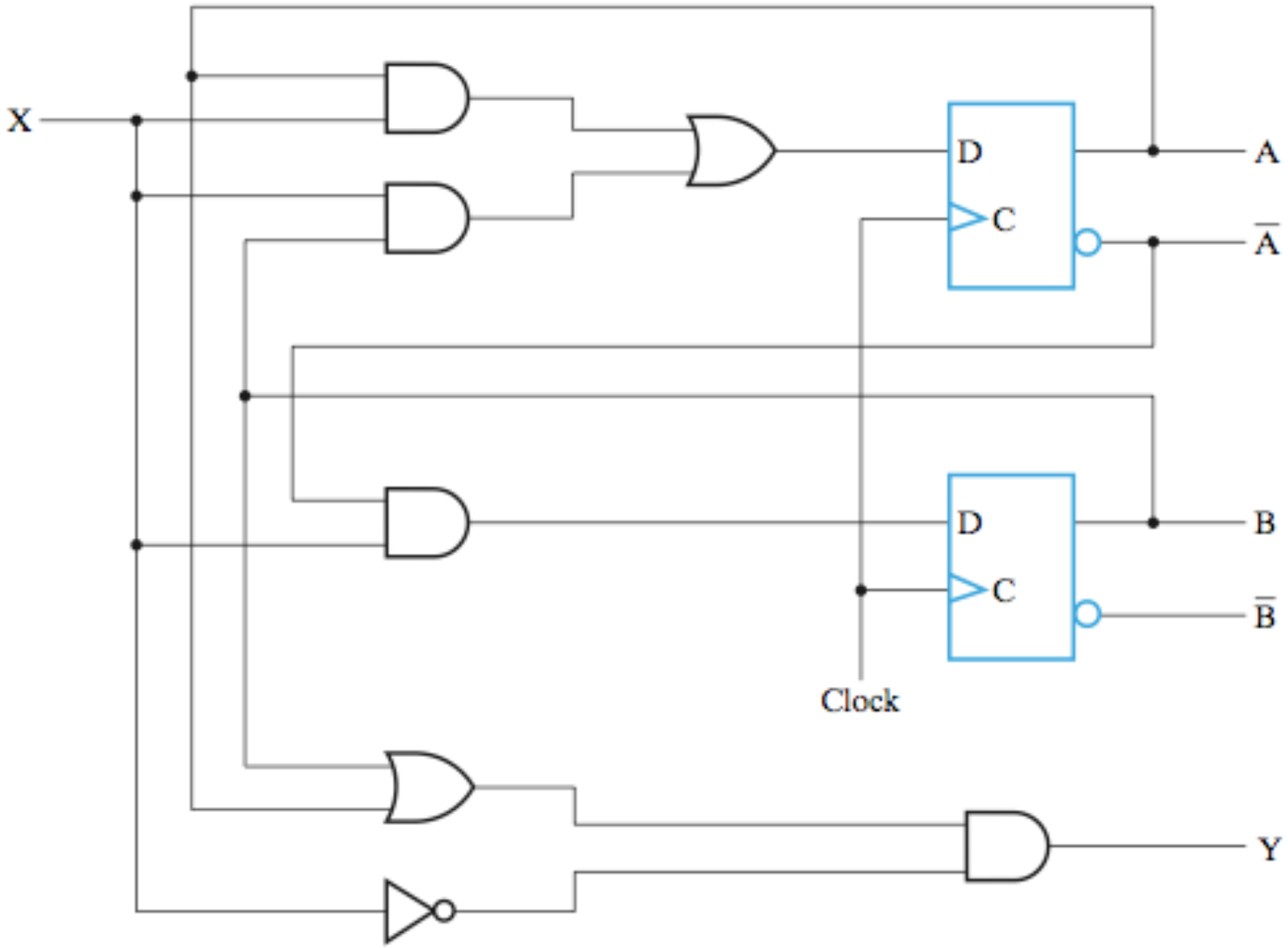
Mealy machine



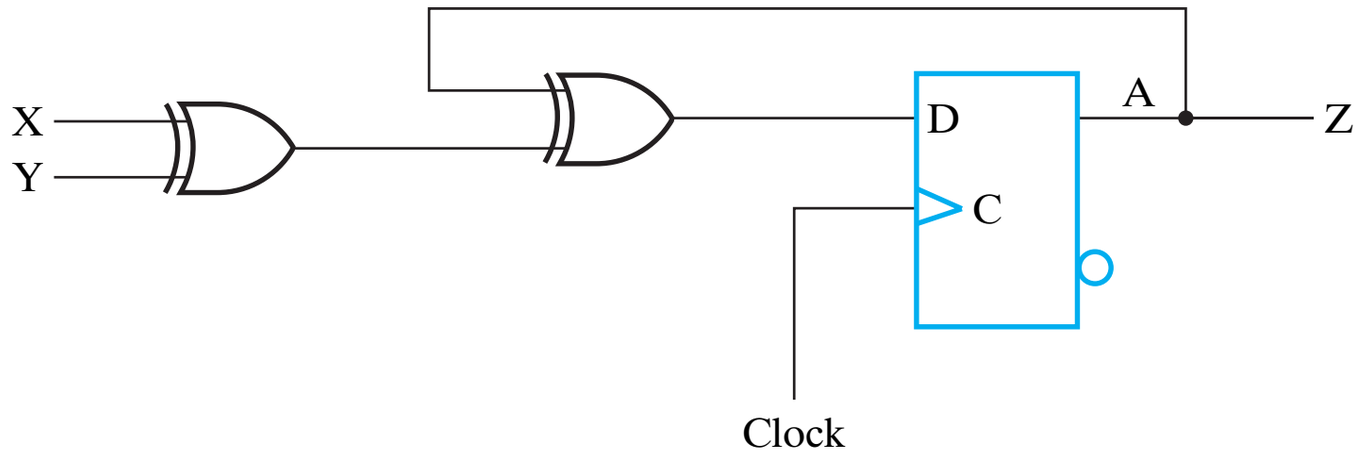
a circuit in which the outputs depend on the inputs as well as the current state

(+ typically fewer states than a Moore machine)

A Mealy or Moore circuit?



An example Moore circuit



(a)

Present state	Inputs		Next state	Output
A	X	Y	A	Z
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	0
1	0	0	1	1
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

(b) State table

In class exercise

- Design a Mealy machine to identify when the sequence “3827” has occurred in a serial numerical input.

- Now design a Moore machine to do the same thing.

In class exercise: design a vending machine

- This vending machine will dispense a soda after the user has entered $.15
- Inputs: N, D (nickel, dime, quarter inserted)
- Output: R (release soda)