CSE 260M / ESE 260
Intro. To Digital Logic & Computer Design

Bill Siever
&
Jim Feher

This week

- Hw #3 Due Thursday - Don’t wait until the last minute!!!
  - Clarifications / Examples

Review (Again)

- Negation Notation
  - $\overline{AB}$ vs. $\overline{A} \cdot \overline{B}$
    - $\overline{A} \cdot \overline{B} = \overline{A}\overline{B}$
- K-Maps: What, why, and how?

K-Maps (Again)

Review

- D Flip-Flops
  - Sequence of two D-Latches
    - Transparent at opposite clock cycles
  - Provide precise timing of data acquisition / storage
  - General focus: positive/rising edge triggers

Sequential & Synchronous Logic

- Sequential circuits
  - Can’t be represented with a *simple* table of just inputs and outputs (Possibly a complex table of history of inputs and outputs)
  - Output depends on sequence of inputs and timing
  - *Synchronous* Sequential Circuits
    - Sequential circuits with additional restrictions on form to improve predictability

Synchronous Sequential Circuits

- Are *synchronized* by a common clock
- Uses registers (D Flip-Flops)
- Mix of registers and combinational logic
- All cycles include *at least one register*
- Goal: Impose predictable behavior!

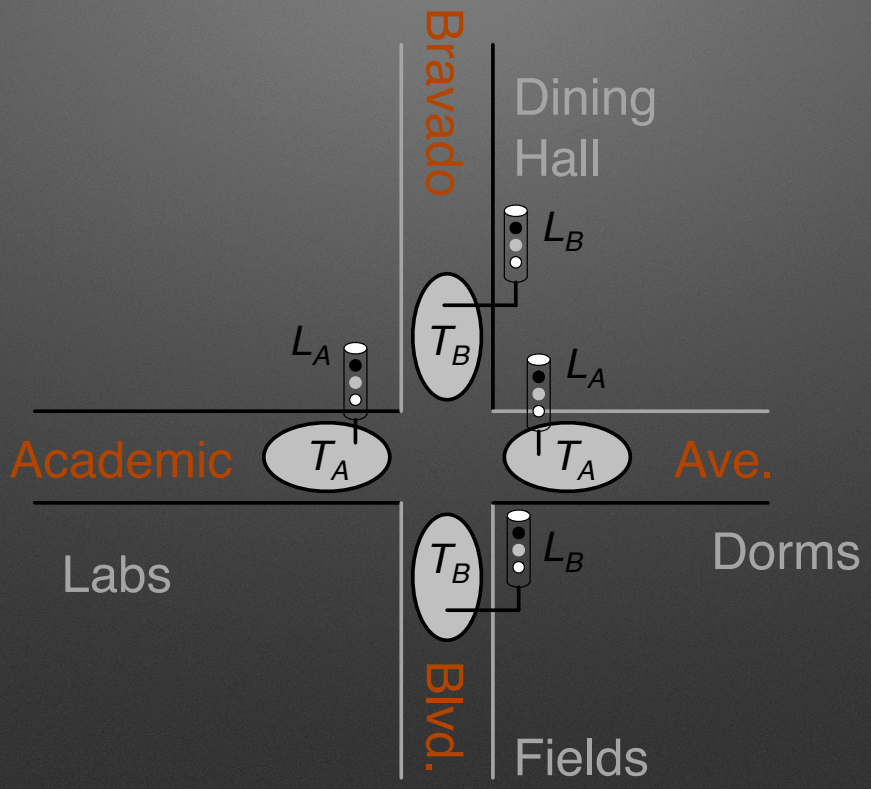
Finite State Machines (FSMs)

- State: A condition of being
- Finite: Er. Finite
  - Real machine has real-world limitations: $k \times$ D-latches
  - k D-Latches means $\leq 2^k$ states (finite)
- (Typically) implemented via *synchronous* sequential logic

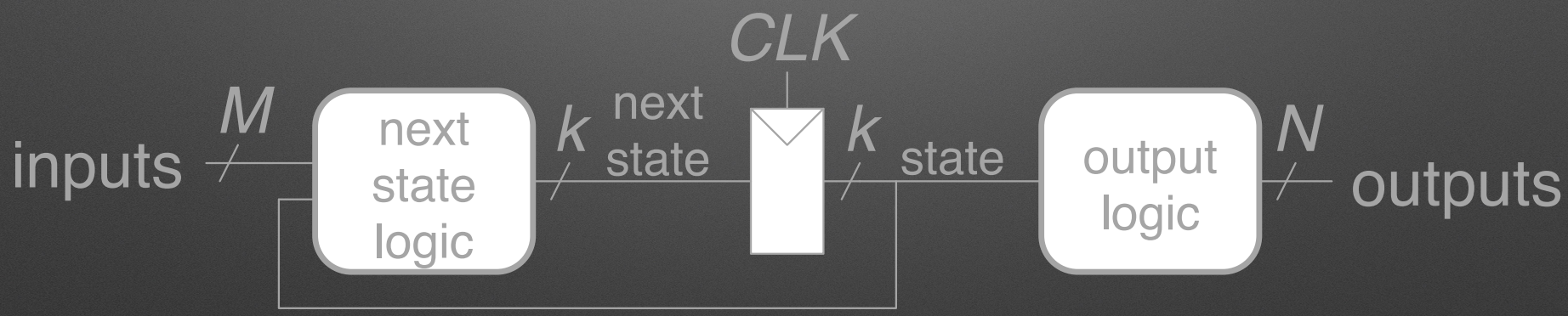
FSM Applications

- Things with modes or sequences of steps. Examples:
  - Washing Machine (fill, agitate, rinse, spin)
  - Stop lights & Traffic control: Green, Yellow, Red
  - Locks: Locked & unlocked
  - Computer programs: Playing game vs. on menu
  - Elevator controls (state = floor)
  - …

Book Example Variation: Stop Light

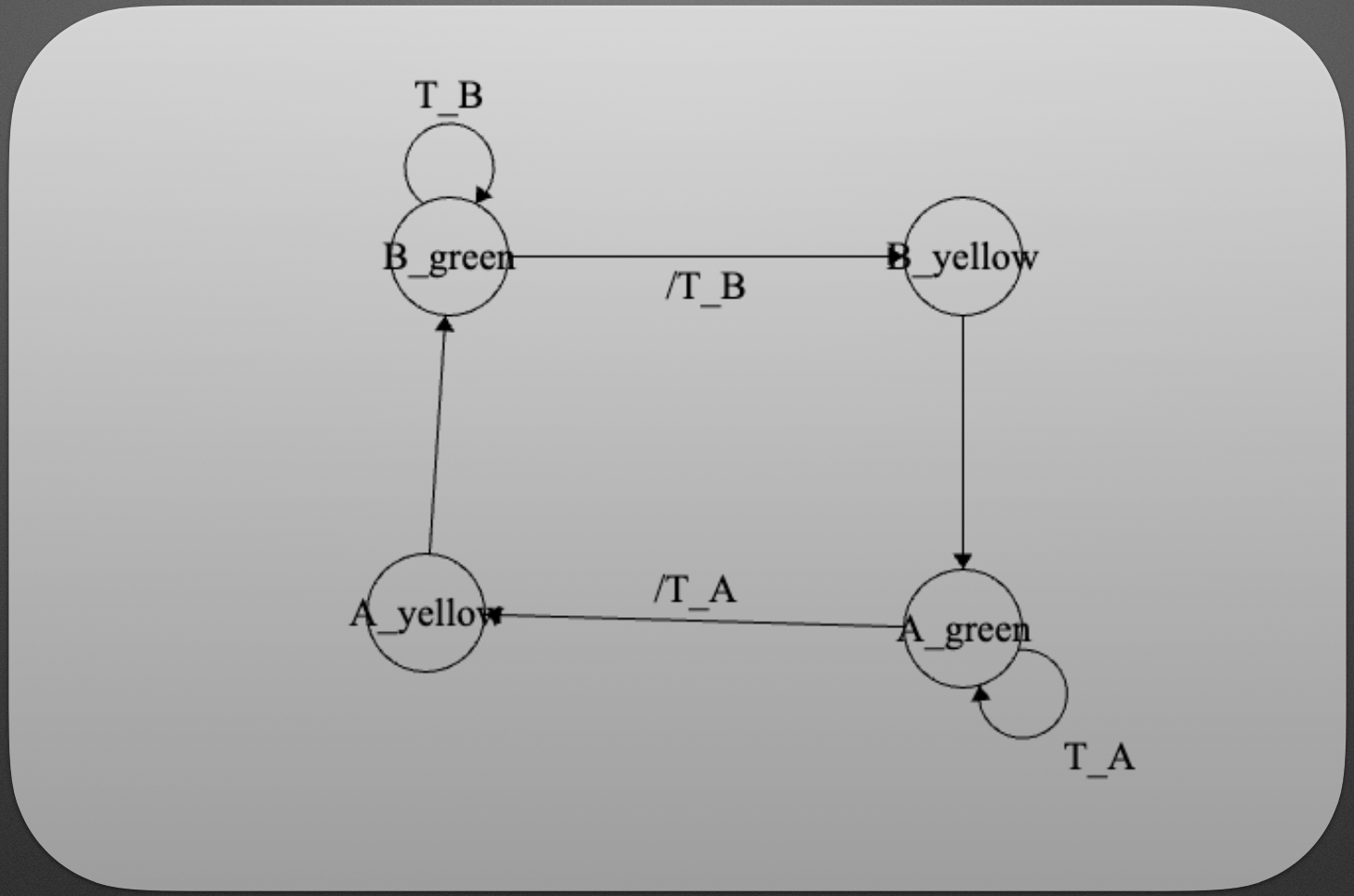


FSM: Moore Machine Structure

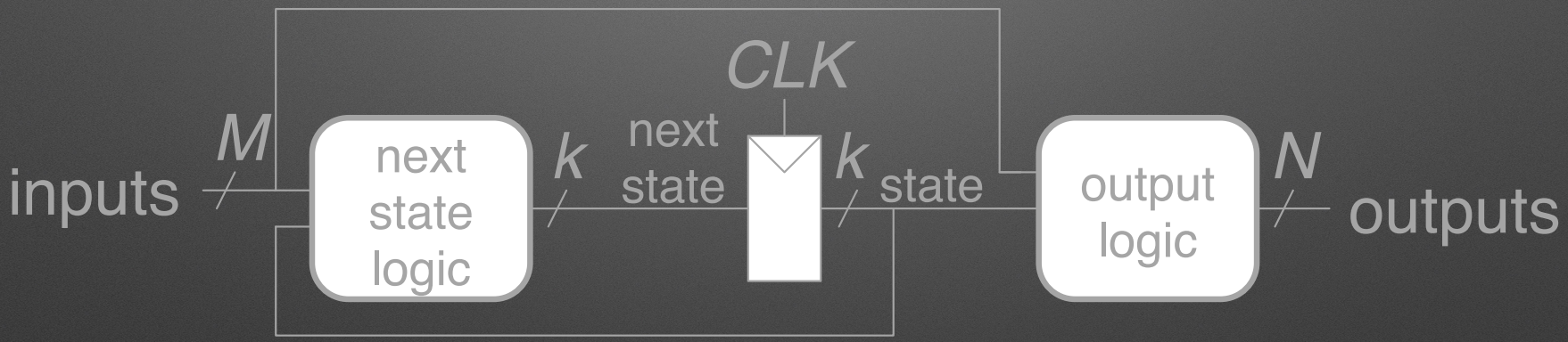


Background

- Clock is 5s: minimum time in a state
- Need to describe behavior over time
- State diagram forms
  - FSM Designer: https://wilsonem.github.io/fsm/
- Example


T_B
B_green
/T_B
B_yellow
A_yellow
/T_A
A_green
T_A

FSM: Mealy Machine



Next Time

- Studio
- Homework 3 due Thursday night!