P3360/AEP3630
Lecture 29

**FF applications**

1. Parallel data storage
   - [Diagram of four D flip-flops with CLR inputs]
   - *inputs stored*
   - *CLR input ___ the data ___

2. Shift register
   - [Diagram of four D flip-flops with CLR inputs]
   - *data ______ after each ___

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Apps:

* _____________ data conversion

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**Timing terminology**

transition time = time for FF output to go

setup time = min time inputs must be stable

hold time = min time inputs must be stable

3) Counters, ripple counters

T flip-flops

asynchronous vs. synchronous counters

see LT spice ex. actually can work as

0111 → 1000

0111 → 0110 → 0100 → 0000 → 1000
Timing circuits & clocks

* many cases when one needs to output a pulse at/after some event

set width/delay

* are important to synchronize sequential circuits

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**555 Timer**

* 8 DIP package

* in part _____, in part _______

* can be wired as __________
or as a __________
sympified symbol

supply voltage
4.5V ≤ Vcc ≤ 16V
output current
(Iout)_{max} ~ 200mA

\( x \) as a one-shot: \( Tw \sim 1\mu s \to 100s \)
\( x \) as a clock: \( f \sim 0.01Hz \to 1MHz \)