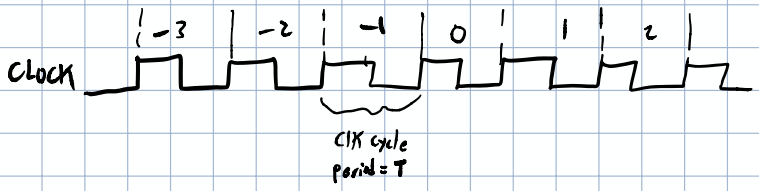
SEQUENTIAL SYSTEMS

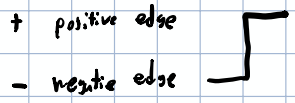
So far, we've looked @ pure functions
→ takes in input, outputs #

Sometimes, we need to remember what happens
→ state

- all sequential systems will have clk signal
- all subsystems run off same clock

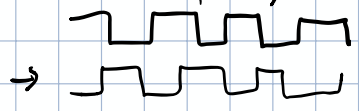


+ positive edge
- negative edge



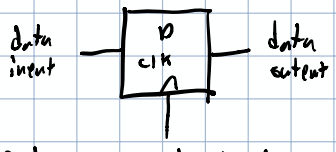
- has index, which is relative
- on schematic, clock looks like

- to invert function, invert clock

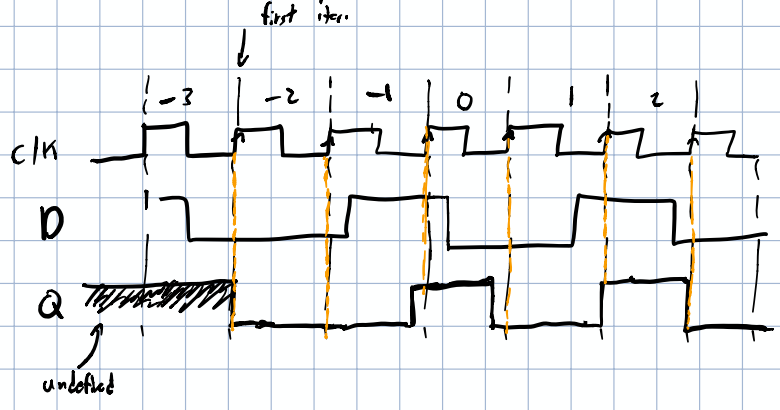


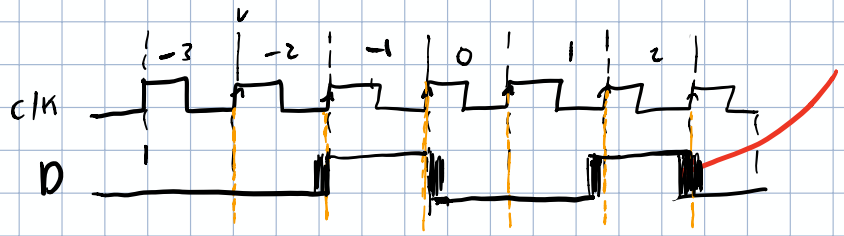
discrete time
→ no units

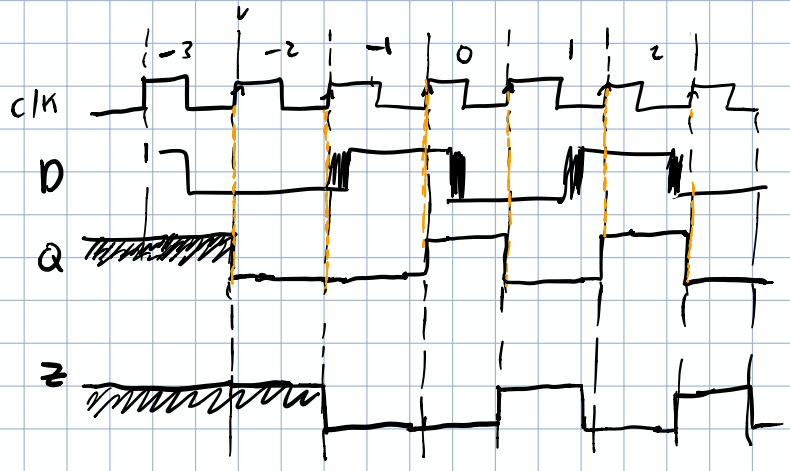
DELAY

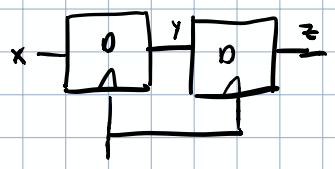


Delay propagates input → output on positive edge of clock



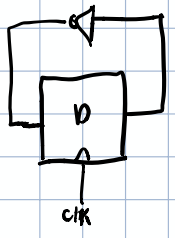






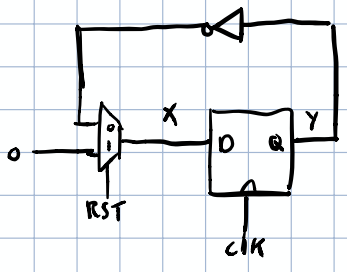
☆ Chaining delay delays signal by 1 clk cycle

Invalid

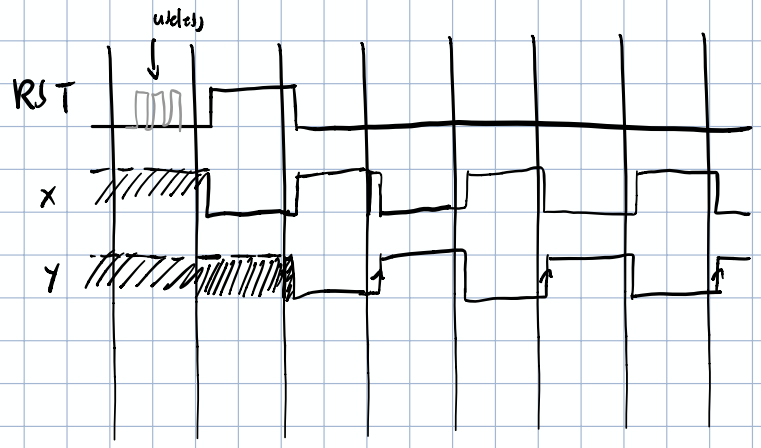


RESET

- all clocks need reset.



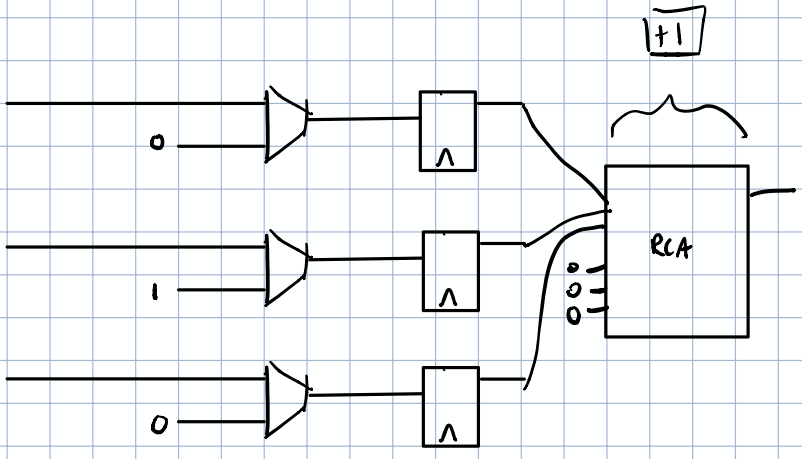
- this is small reset btn on small electronics
  - ↳ got into bad state/unknown



☆ Y happens @ ½ speed of CLK!!

- X is 0 so long as RST=1
- reset must be held long enough until positive clk cycle
  - ↳ hold reset for X seconds....

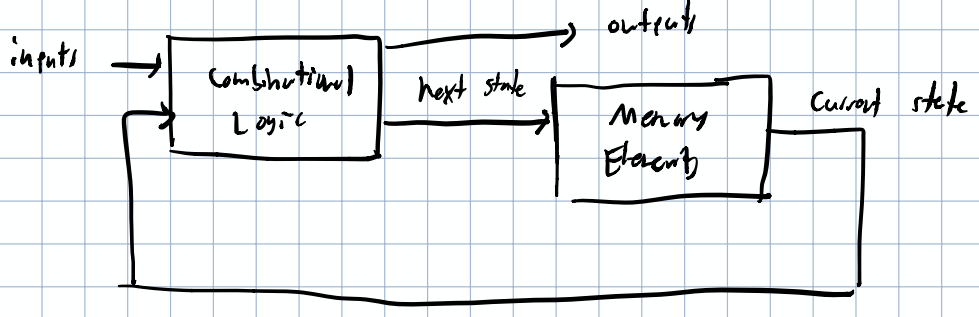
- all sequential circuit NEED resets!



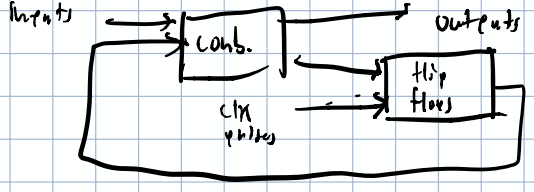
A sequential circuit...

1) receives binary information from external inputs
2) uses those inputs along w/ present state to determine binary values of outputs
3) external inputs determine conditions for changing state in storage elements.

Always in this format!



synchronous sequential circuit: behavior can be determined by knowledge of signals at instant in time.
↳ uses flip-flops, which store 1 bit of information
↳ to store X bits, use X flip flops



- outputs found by combinational logic, prev. state of flip flops, or both
- clk pulses need to be less than propagation delay!!

asynchronous sequential circuit: depends on input signals at any instant in time AND order in which inputs change
↳ storage elements are time-delay devices
↳ logic gates have significant propagation delay to provide storage
↳ combinational circuit w/ feedback