



# Algorithmic State Machines

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# ASM Design

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- Data processing:
  - what sorts of manipulations of the input and output data are requested? How many/what sorts of things need to be stored?
  - How to design
    - Ad hoc/creative/by insight
    - List requested operations/manipulations
    - Include initialization controls
    - Include status lines



# ASM Design

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- Control logic
  - All of the commands to the data proc. logic need to be controlled, and the status lines need to be monitored and acted upon.
  - ASM charts are like state diagrams, but without specific drawbacks.
    - Don't list all inputs for each transition – don't care inputs
    - Don't list all outputs for each state – not changed outputs



# ASM Design

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- How to design - ASM chart/state diagram (for small problems)
  - State assignment
  - State table
  - Kmap-gates/FF/Reg Mux Dec/EPRROM, or, creatively, a combination of them



# ASM Design

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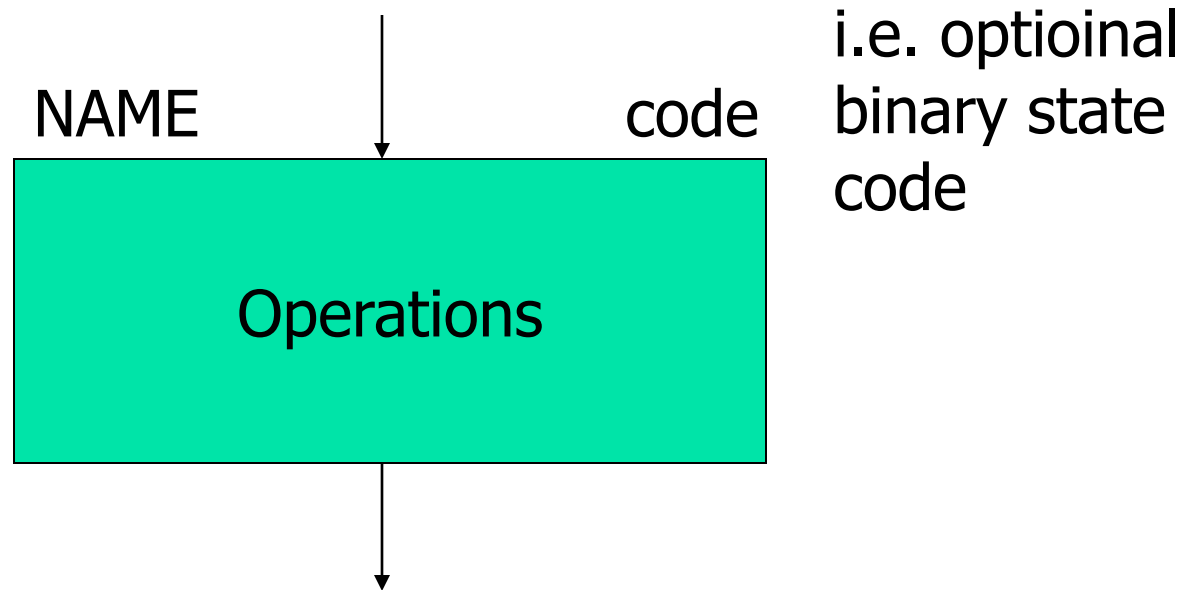
- ASM charts are like flowcharts, with a few crucial differences. Be careful, especially with timing.
  - State Box
  - Decision Box
  - Combinational Box



# ASM Design

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- State Box – one box per system state





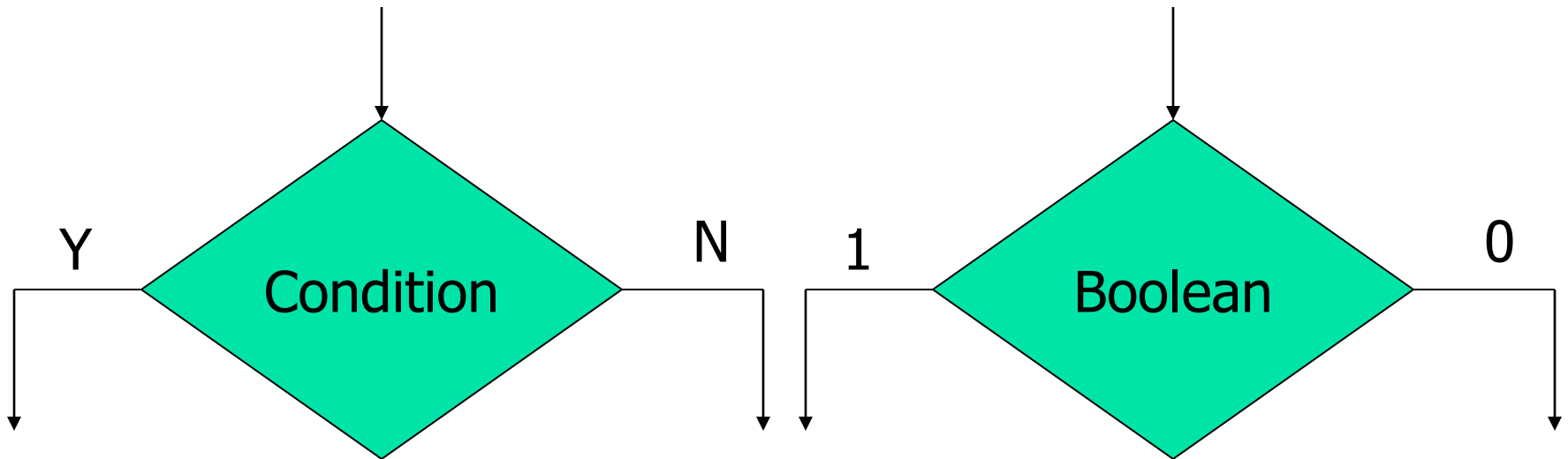
# ASM Design

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- Operation notation:
  - Sum  $\leftarrow$  0 or Carry  $\leftarrow$  0 or LOAD A
  - Combinational variable:  $S=0$ ,  $T=S+V$
- Idea: keep operations abstract & high level. Don't work in detailed language of processing logic (i.e. write Sum  $\leftarrow$  0, not  $CLR_{\text{Sum Reg}}=1$ )
- Operations will take place at the end of the clock period

# ASM Design

- Decision Box - Basic condition, i.e. logic flow control. Only the decision boxes depend on inputs.

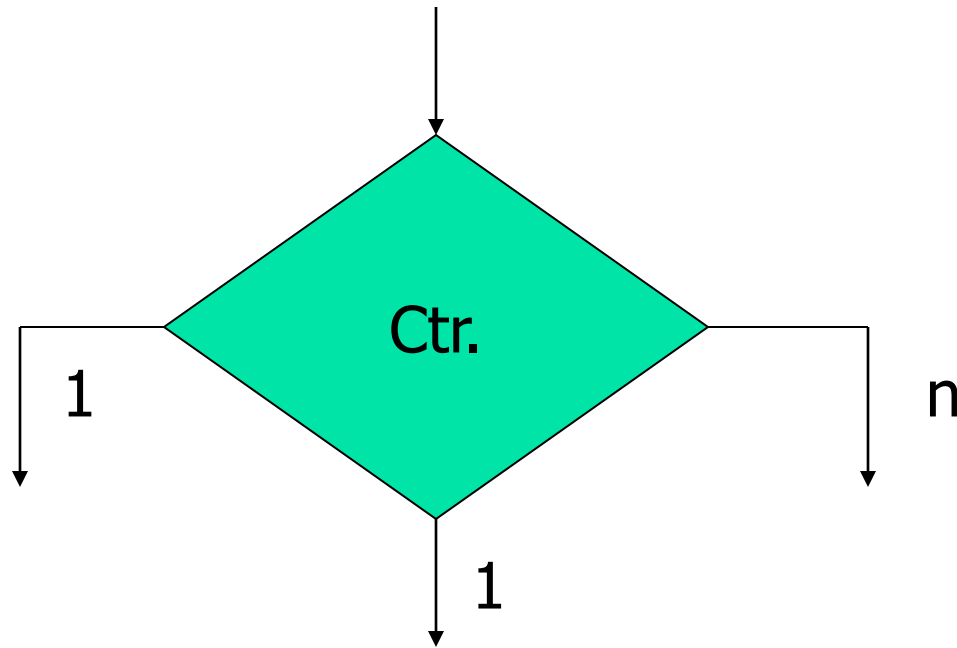






# ASM Design

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# ASM Design

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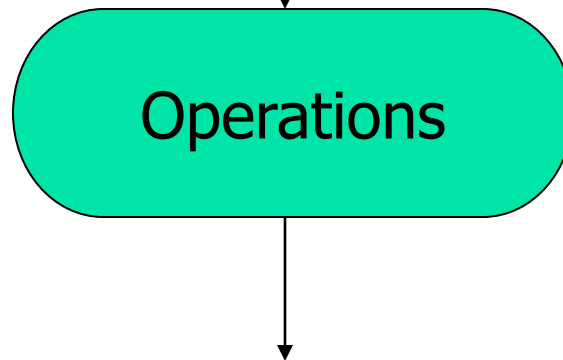
- Keep conditions as general as possible.
- Prefer: Carry high? Over  $Q_{FF\#5}=1$ ?



# ASM Design

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- Conditional Box - An action/operation to be undertaken conditioned on some earlier decision box.





# ASM Design

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- Conditional boxes do not appear in normal flowcharts. The essential difference is timing:
  - Flowcharts are sequential
  - ASM charts are not. All of the operations associated with a given state take place simultaneously.