FSM Modeling

• State Diagrams (SDs) and Algorithmic State Machine (ASM) charts Describe Behavior of FSMs
• Translating Directly from SD/ASMs to Verilog is Advantageous
  – No Worry about Mistake in Logic Simplification
  – No Tedious Tables to Create
  – Automatic Tools (synthesis) Create the Schematic Directly
  – Synthesis Tools can Handle Very Large FSMs (100s even 1000s of DFFs)
  – Can EASILY Change State Assignment

Example State Diagram

Mealy Controller Model
ASM Chart Symbols

- State-Representing Symbol
- Basic Decision Symbol
- Conditional Output Symbol
- Flow Direction Symbol

Example ASM Chart
Comments about ASM Example

• How many states?
  – Three states, count the boxes

• How many inputs?
  – Two inputs (zero, cnt_eq). Count signals within decision boxes. Inputs ALWAYS appear within decision boxes.

• How many outputs?
  – 4 unconditional outputs (count signals within state boxes)
  – 2 conditional outputs (count signals within conditional output boxes)
  – Outputs ALWAYS appear in either state boxes or conditional output boxes.

ASM Chart Decision Symbols
ASM Chart Rules

State Representation Symbol

• Should only contain zero or more unconditional output expressions inside
• May or may not have state names or state encodings appear outside but near the symbol
• Must have one or more flow direction symbols (arrows) pointing to them
• Must have one or more flow direction symbols (arrows) exiting them

ASM Chart Rules

Decision Symbol

• Should contain input signals or expressions dependent upon input signals only
• Must have a flow direction symbol pointing to them that originates from a state representation (or other decision) symbol
• Must have two (single bit, basic decision symbol) or more (generalized decision symbol) outgoing flow direction symbols
• Each outgoing flow direction symbol must be labeled with a unique and complete set of all possible values of the input signals or set of expressions contained within them
• All outgoing signal flow arrows must point to another decision symbol, a conditional output symbol, or another state representation symbol
ASM Chart Rules

Conditional Output Symbol

• Must have exactly one incoming flow symbol in ASMs where generalized decision symbols are used
• May have more than one incoming flow symbol if they all originate from decision symbols in ASM charts containing cascades of decision symbols
• Must have exactly one outgoing flow symbol that points to another decision symbol or a state representation symbol
• The oncoming flow signal must always originate from a decision symbol and never from a state representation symbol

Reasons for ASM Chart Preference

• ASM Charts Adhere to a Few Strict Rules - Allows for Easy Translation into Correct HDL Description
• ASM Charts Easier to Understand by Human than HDL Code Listing
• Combination of ASM Chart and HDL Description is Comprehensive Form of Controller Documentation
• ASM Charts Allow Mealy- and Moore-type Outputs to be Easily Recognized