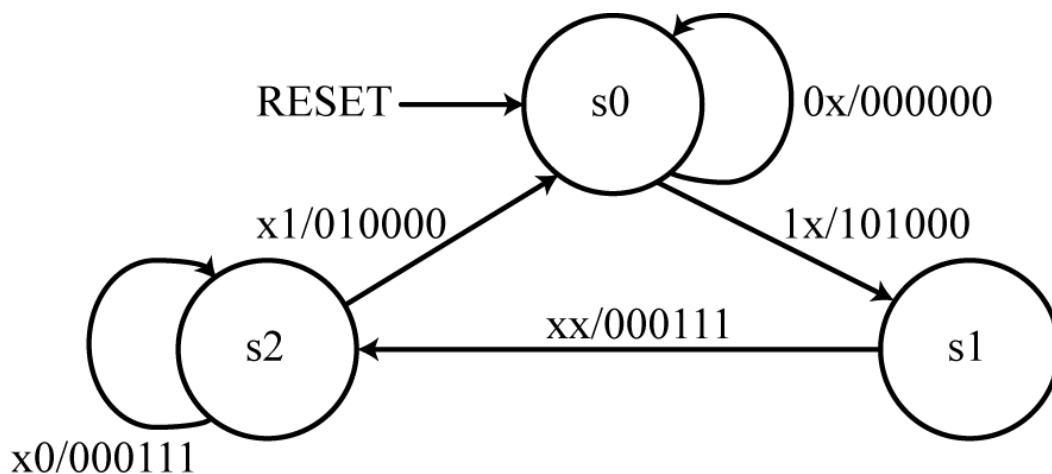


FSM Modeling

- 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

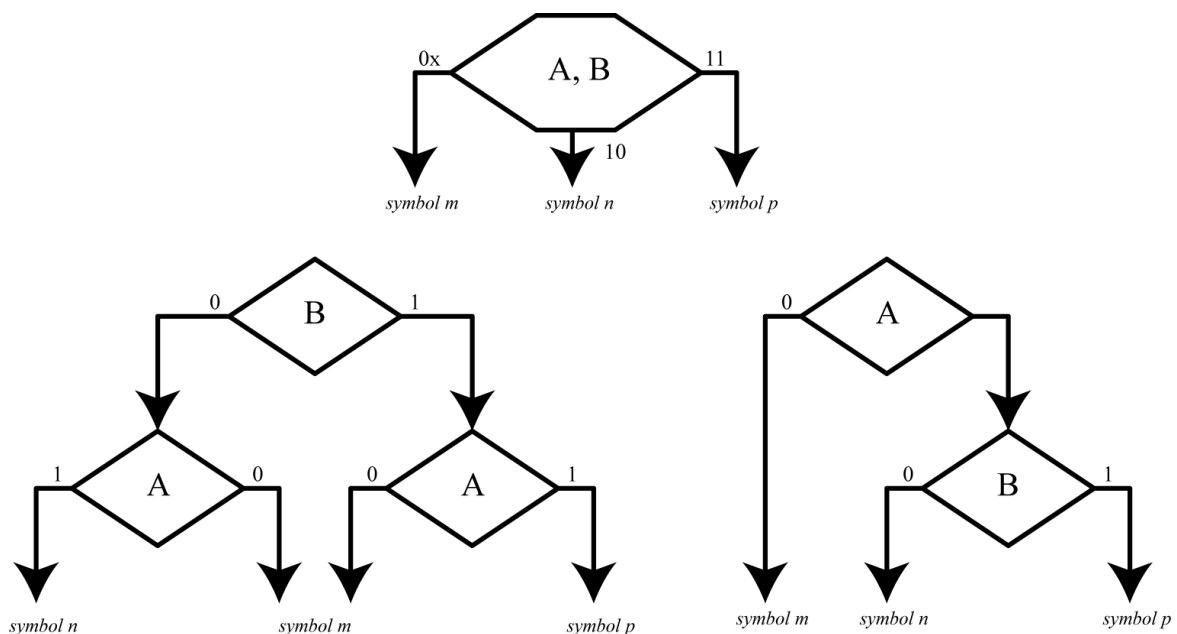


Mealy Controller Model

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