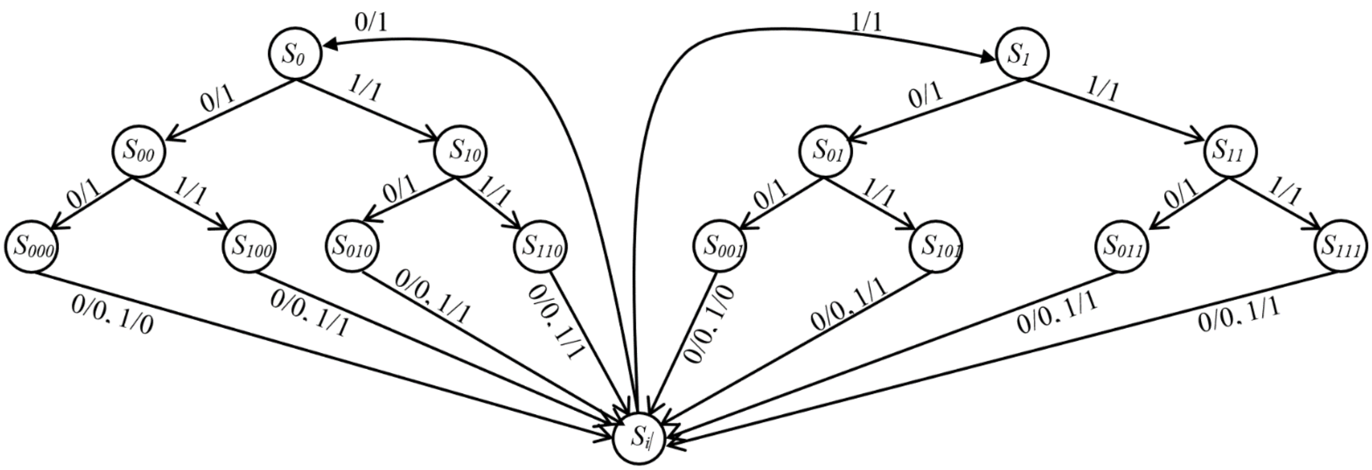
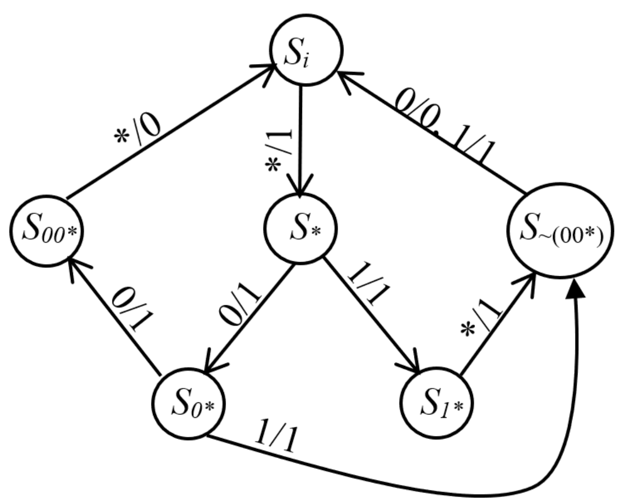
1. Mealy model example
   a. Design a circuit for checking binary coded decimal (BCD)
      i. BCD uses a 4-bit number to represent a single decimal digit
      ii. Circuit will take in 4 bits, indicate whether BCD is valid, then take in another 4 bits
      iii. First bit taken in is least significant, last bit is most significant
         1. This means newest numbers get placed on left side in our diagram below
      iv. Circuit outputs 0 if the BCD is valid (binary number formed is between 0 and 9) and 1 otherwise
   b. State transition diagram
      i. Left branch means 0 input
      ii. Right branch means 1 input



2. Minimizing a Mealy model
   a. Apply the Partitioning Minimization Procedure to reduce the number of states in the Mealy model
   b. Except for state i, we will refer to the states simply by their bit patterns
   c. Since this is a Mealy model, states do not have output values
      i. The k-successors for a state are the output value created by the combination of the state and the possible inputs
   d. P_1 = (i, 0, 1, 00, 01, 10, 11, 000, 001, 010, 011, 100, 101, 110, 111)
   e. P_2 = (i, 0, 1, 00, 01, 10, 11) (000, 001) (100, 010, 110, 101, 011, 111)
      i. The first block all have k-successors of 0/1, 1/1
      ii. The second block all have 0/0, 1/0
      iii. The last block all have 0/0, 1/1
      iv. Don't have a fourth block based on the other possible k-successor combination, 0/1, 1/0
         1. No states that have that combination
   f. P_3 = (i, 0, 1) (00, 01) (10, 11) (000, 001) (100, 010, 110, 101, 011, 111)
      i. The first block all have k-successors in the first block of P_2
      ii. (00, 01) have 0-successors in (001, 001), and 1-sucessors in (100, 010, 110, 101, 011, 111)
      iii. (10, 11) have both of their k-successors in (100, 010, 110, 101, 011, 111)
      iv. (000, 001) have the single state, i, as their k-successor
         1. We can presume that that block will never split
         2. Ignore it until the end of the procedure
      v. Similarly, (100, 010, 110, 101, 011, 111) all have a single state, i, as their k-successor
         1. That block will never split either

g. P_4 = (i) (0, 1) (00, 01) (10, 11) (000, 001) (100, 010, 110, 101, 011, 111)
    i. (i, 0, 1) of P_3 must split
        1. i leads to (i, 0, 1) for both of its k-successors
        2. 0 and 1 both lead to (00, 01) for its 0-successor and (10, 11) for its 1-successor
h. No need for another partition because all elements in each block of P_4 lead to identical blocks of P_4
i. Therefore, P_4 is our final partition, and we will use it to make the state diagram below

3. Implementing the FSM
    a. We let * stand for either a 0 or 1 at a given position
    b. ~(00*) = (100, 010, 110, 101, 011, 111) in our notation
        i. Call it so because these states are not (~) 00*
    c. State transition diagram and state table below



State transition diagram

Present State	Next State		Output	
	x = 0	x = 1	x = 0	x =1
i	*	*	1	1
*****	0*	1*	1	1
0*	00*	~(00*)	1	1
1*	~(00*)	~(00*)	1	1
00*	*i*	*i*	0	0
~(00*)	*i*	*i*	0	1

State table

4. Assigning binary codes
    a. Will need 3 flip flops to represent 6 states
    b. Can assign binary codes randomly, but careful assignment reduces the combinational logic
    c. Rule of thumb for state binary code assignments
        i. Try to assign adjacent (Hamming distance of 1) code words to a state and the state that follows it
        ii. If two present states have the same next state, assign those present states adjacent code words
        iii. Creating a K-map will help
        iv. Initial state *i* will always be all 0s

d. Assign using the rules above
    i. Place i at 000, will always do this
        1. Place * next to i at 010 since * is the successor to i
        2. Place 0* and 1* adjacent to * at 110 and 011 respectively
        3. 00* needs to be adjacent to i and 0*, which leaves 100 as the only place
        4. Would like ~(00*) to be adjacent to 0*, 1*, and i, but that isn't possible
            a. These are rules of thumb, not fixed laws
        5. Can place ~(00*) at 001 to be adjacent to i and 1*, though

e. Note that there may potentially be more than one valid code assignment that minimizes distance

AB

C	**00**	**01**	**11**	**10**
0	*i*	*	0*	00*
1	~(00*)	1*		