

COE 405, Term 041

COE 561 Digital System Design and Synthesis

HW# 4

Due date: Thursday, Dec. 16

Q.1. Consider the incompletely-specified FSM represented by the following state table:

Input	Present State	Next State	Output
0	S1	S4	0
1	S1	S5	1
0	S2	S2	0
1	S2	S1	1
0	S3	S3	0
1	S3	S4	*
0	S4	S6	0
1	S4	S5	1
0	S5	S6	1
1	S5	S3	0
0	S6	S1	*
1	S6	S5	1

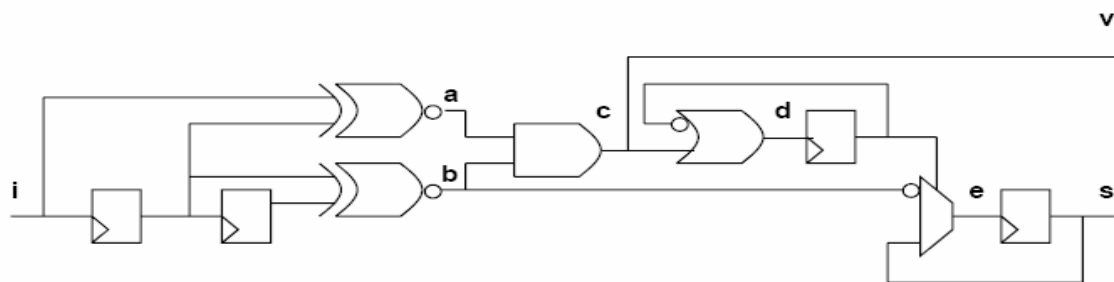
- (i) Replace the don't-care conditions by 0's and minimize the obtained state table.
- (ii) Replace the don't-care conditions by 1's and minimize the obtained state table.
- (iii) Minimize the state table of the incompletely specified FSM.

Q.2. Consider the incompletely-specified FSM represented by the following state table:

Input	Present State	Next State	Output
0	S1	S3	1
1	S1	S5	*
0	S2	S3	*
1	S2	S5	1
0	S3	S2	0
1	S3	S1	1
0	S4	S4	0
1	S4	S5	1
0	S5	S1	0
1	S5	S4	1

- (i) Perform symbolic minimization of the state table using implicant merging, covering and disjunctive relations. Represent the encoding constraints resulting from symbolic minimization in matrices.
- (ii) Show all the seed dichotomies and prime dichotomies satisfying the constraints.
- (iii) Find a minimum cover of seeds by primes. Derives the states codes based on the solution obtained.
- (iv) Using K-MAP, obtain the equations for the output and flip-flops. Compare your solution to the solution obtained by running the SIS command *stg_to_network* using the state codes obtained in (iii).
- (v) Perform state assignment using the program nova by running the SIS command *state_assign nova*. Compare the obtained solution to your solution in (iv) in terms of number of literals.
- (vi) Perform state assignment using the one-hot encoding by running the SIS command *state_assign jedi -e h*. Compare the obtained solution to your solutions in (iv)-(v) in terms of number of literals.
- (vii) Derive the weighted complete state graph based on the **fanout oriented** algorithm. Then, assign the state codes to minimize the cost function $\sum_{i=1}^{N_s} \sum_{j=i+1}^{N_s} Weight(v_i, v_j) * Dist(v_i, v_j)$. Perform state assignment using the SIS command *state_assign jedi -e o*. Compare the obtained solution to the solution you obtained.
- (viii) Derive the weighted complete state graph based on the **fanin oriented** algorithm. Then, assign the state codes to minimize the cost function $\sum_{i=1}^{N_s} \sum_{j=i+1}^{N_s} Weight(v_i, v_j) * Dist(v_i, v_j)$. Perform state assignment using the SIS command *state_assign jedi -e i*. Compare the obtained solution to the solution you obtained.

Q.3. Consider the synchronous sequential circuit given below-specified FSM represented by the following state table:



- (i) Draw the synchronous network graph corresponding to the given circuit. In the graph, vertices represent inputs, outputs, gates, and fanout stems.
- (ii) Assume that delay of each gate is 1. Retime the graph to reduce the cycle time. Draw the resulting circuit.
- (iii) Read the library **synch.genlib** using the command **read_library synch.genlib**. Then, map your design to the library using the command **map -s**. Then, retime the circuit using the command **retime**. Compare the maximum arrival time before and after retiming. Compare the obtained solution to the solution you obtained in (ii).