

CS-472: Design Technologies for Integrated Systems

Exercise Problem Set 7 Solution

Date: 14/11/2024

Topic: Symbolic and Encoding Optimization (cf. slide set 9)

Problem 1

Given the constraint mapping A , find the minimum encoding matrix E that satisfies the constraints of A .

$$A = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix}$$

- (a) Write the dichotomies considering that the columns in A correspond to the operations AND , OR , JMP and ADD .

Ans:

$$A = \begin{array}{c} \begin{array}{cccc} & AND & OR & JMP & ADD \end{array} \\ \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

$(\{AND, OR\}, \{JMP, ADD\})$

$(\{JMP, ADD\}, \{AND, OR\})$

$(\{OR, JMP\}, \{AND, ADD\})$

- (b) Write the seed dichotomies.

Ans:

$(\{AND, OR\}, \{JMP\}) \rightarrow s_1$

$(\{AND, OR\}, \{ADD\}) \rightarrow s_2$

$(\{JMP, ADD\}, \{AND\}) \rightarrow s_3$

$(\{JMP, ADD\}, \{OR\}) \rightarrow s_4$

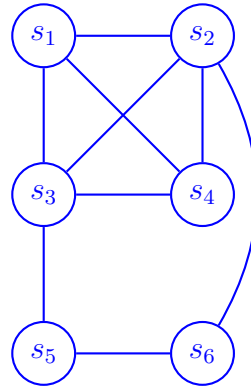
$(\{OR, JMP\}, \{AND\}) \rightarrow s_5$

$(\{OR, JMP\}, \{ADD\}) \rightarrow s_6$

(c) Find the compatible seed dichotomies and draw the compatibility graph.

Ans:

$(s_1, s_2), (s_1, s_3), (s_1, s_4),$
 $(s_2, s_3), (s_2, s_4), (s_2, s_6),$
 $(s_3, s_4), (s_3, s_5),$
 (s_5, s_6)



(d) Find the prime dichotomies.

Ans:

$s_1, s_2, s_3, s_4 : (\{AND, OR\}, \{JMP, ADD\}) \rightarrow p_1$
 $s_5, s_6 : (\{OR, JMP\}, \{AND, ADD\}) \rightarrow p_2$
 $s_3, s_5 : (\{OR, JMP, ADD\}, \{AND\}) \rightarrow p_3$
 $s_2, s_6 : (\{AND, OR, JMP, \}, \{ADD\}) \rightarrow p_4$

(e) Write the covering matrix and find a minimum cover.

Ans:

	s_1	s_2	s_3	s_4	s_5	s_6
p_1	1	1	1	1	0	0
p_2	0	0	0	0	1	1
p_3	0	0	1	0	1	0
p_4	0	1	0	0	0	1

Minimum cover by selecting p_1 and p_2 .

(f) Write the encoding matrix.

Ans:

$$E = \begin{matrix} & p_1 & p_2 \\ AND & \begin{bmatrix} 1 & 0 \end{bmatrix} \\ OR & \begin{bmatrix} 1 & 1 \end{bmatrix} \\ JMP & \begin{bmatrix} 0 & 1 \end{bmatrix} \\ ADD & \begin{bmatrix} 0 & 0 \end{bmatrix} \end{matrix}$$