

In-class Exercise – Branch and Bound

- Use branch-and-bound to find the minimum cover for the following constraint matrix

	P1	P2	P3	P4	P5	P6
m4	X	X				
m5	X		X			
m7			X	X		
m12		X				X
m14					X	X
m15				X	X	

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In-class Exercise – Branch and Bound

Call to BCP(F, U, {})

- Initialize best solution (F) and current cost (U) variables
- Reduce matrix
- Solution found? No.
- Calculate lower bound on subtree

F = Φ
U = 6+1 = 7

	P1	P2	P3	P4	P5	P6
m4	X	X				
m5	X		X			
m7			X	X		
m12		X				X
m14					X	X
m15				X	X	

*No reduction can be made,
matrix cyclic*

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In-class Exercise – Branch and Bound

CALL MIS QUICK

	P1	P2	P3	P4	P5	P6	
m4	X	X					w=4
m5	X		X				w=4
m7			X	X			w=4
m12		X				X	w=4
m14					X	X	w=4
m15				X	X		w=4

MIS = {m4}
Remove m4, m5, m12

	P3	P4	P5	P6	
m7	X	X			w=3
m14			X	X	w=3
m15		X	X		w=4

MIS = {m4, m7}
Remove m7, m15

	P5	P6	
m14	X	X	w=2

MIS = {m4, m7, m14}
Remove m14

Matrix empty -- done!

Return |MIS| = 3

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In-class Exercise – Branch and Bound

Call to BCP(F, U, {})

1. Initialize best solution (F) and current cost (U) variables
2. Reduce matrix
3. Solution found? No.
4. Calculate lower bound on subtree
MIS_QUICK returns {m4, m7, m14}
Lower bound (L) = # prime implicants + MIS
= 0 + 3 = 3
5. $L \geq U$? No.
6. $x_i = P1$
7. $S^i = \text{BCP}(F_{S^i}, U, \text{currentSoln} \cup x_i)$

F = Φ
U = 6+1 = 7

L = 3

P1

	P1	P2	P3	P4	P5	P6
m4	X	X				
m5	X		X			
m7			X	X		
m12		X				X
m14					X	X
m15				X	X	

No reduction can be made,
matrix cyclic

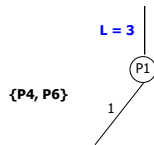
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In-class Exercise – Branch and Bound

Call to BCP(F, U, {P1})

$F = \Phi$
 $U = 6+1 = 7$

2. Reduce matrix



	P1	P2	P3	P4	P5	P6
m4	x	x				
m5	x		x			
m7		x	x			
m12		x				x
m14					x	x
m15				x	x	

P1 included in cover

	P2	P3	P4	P5	P6
m7	x	x			
m12	x				x
m14				x	x
m15			x	x	

*No row dominance.
P6 dominates P2, P4 dominates P3*

	P4	P5	P6
m7	x		
m12			x
m14		x	x
m15	x	x	

P4 and P6 become essential

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Call to BCP(F, U, {P1})

$F = \{P1, P4, P6\}$
 $U = 3$

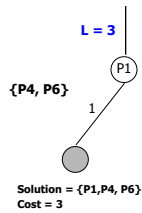
~~$F = \Phi$~~
 ~~$U = 6+1 = 7$~~

2. Reduce matrix

3. Solution found? Yes

cost(currentSoln) < U ?
cost(3) < 7 ? Yes.

Update placeholders



	P4	P5	P6
m7	x		
m12			x
m14		x	x
m15	x	x	

remove P4 and P6 (and minterms covered)

matrix empty – no further simplification

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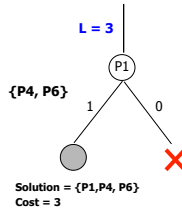
Call to BCP(F, U, {})

1. Initialize best solution (F) and current cost (U) variables
2. Reduce matrix
3. Solution found? No.
4. Calculate lower bound on subtree
 MIS_QUICK returns {m4, m7, m14}
 Lower bound (L) = # prime implicants + MIS
 = 0 + 3 = 3
5. $L \geq U$? No.
6. $x_i = P1$
7. $S^1 = \text{BCP}(F_{x_i}, U, \text{currentSoln} \cup x_i)$ ← Returns from here with updated F and U
8. Cost($S^1 = L$)? Yes.
 Kill S^0 subtree.

F = {P1, P4, P6}
 U = 3

	P1	P2	P3	P4	P5	P6
m4	X	X				
m5	X		X			
m7			X	X		
m12		X				X
m14					X	X
m15			X	X		

No reduction can be made,
 matrix cyclic



Done!