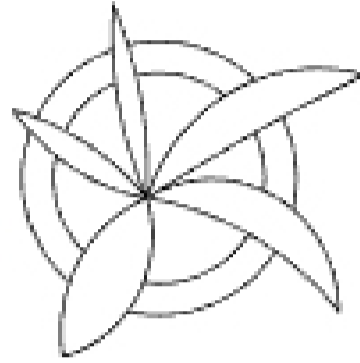


GROUP TECHNOLOGY PART II BRANCHING ALGORITHMS

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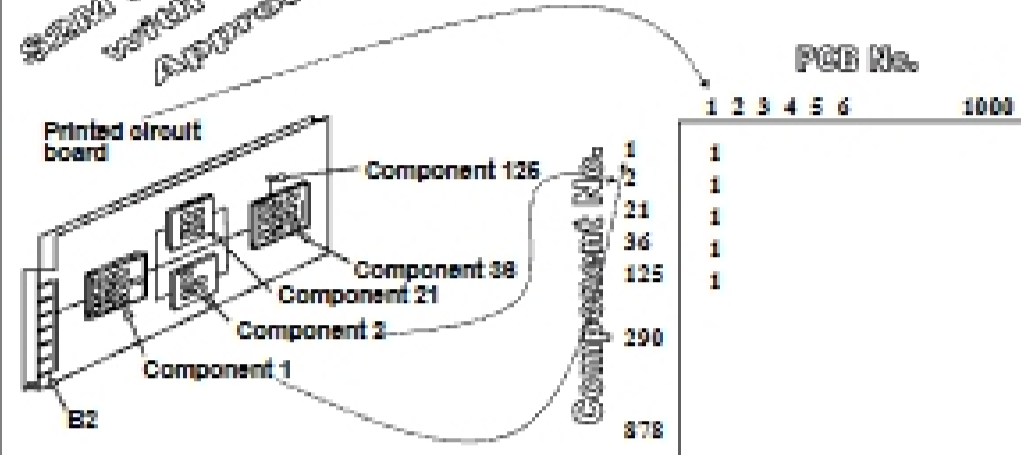


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Motivating Example (1/2)

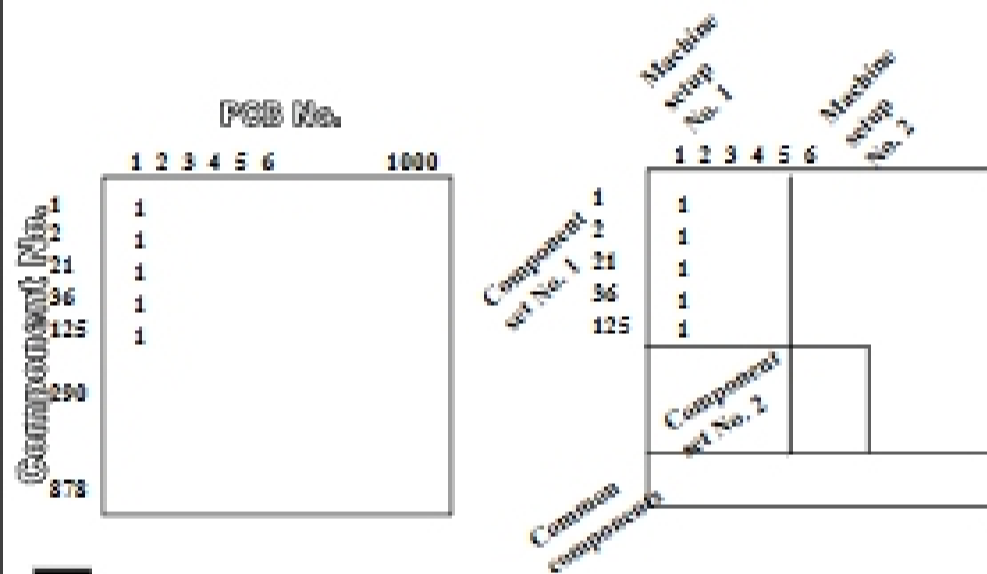
*32% savings/year
with the GT
Approach*



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Motivating Example (2/2)



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Classroom Exercise 1

Decompose the manufacturing system

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1		1		



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Exercise 1 Solution

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1		1		

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1		1		



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Exercise 1 Solution

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1		1		

Reorganized matrix

	P1	P5	P3	P2	P4	P6
M1	1	1	1			
M3			1			
M4	1	1				
M2				1	1	1
M5				1	1	



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Classroom Exercise 2

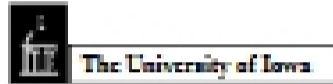
Exercise 1

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1		1		

Consider this data

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1	1	1		

One operation added



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Exercise 2 Solution

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2		1		1		1
M3			1			
M4	1				1	
M5		1	1	1		

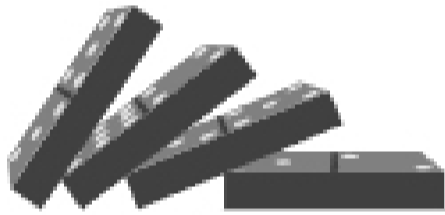
Delete

	P1	P2	P3	P4	P5	P6
M1	1		1		1	
M2						
M3			1			
M4	1				1	
M5		1	1	1		



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BRANCHING ALGORITHM



- Explicit Enumeration
- Implicit Enumeration



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Algorithm 1

Step 0. (Initialization): Begin with the incidence matrix $[a_{ij}]$ at level 0.

Solve the GT problem represented with $[a_{ij}]$ with the CI algorithm.

Step 1. (Branching): Using the breadth-first search strategy, select an active node (not fathomed) and solve the corresponding GT problem with the CI algorithm.

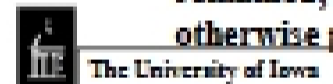
Step 2. (Fathoming): Exclude a new node from further consideration if:

Test 1: cluster size is not satisfactory

Test 2: cluster structure is not satisfactory

Step 3. (Backtracking): Return to an active node.

Step 4. (Stopping rule): Stop when there are no active nodes remained; the current incumbent solution is optimal; otherwise go to Step 1.



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Branching

Branching is performed in one of the following two ways:

- (1) the CI algorithm in case when the incidence matrix partitions into mutually separable submatrices.
- (2) removing one column at a time from the corresponding incidence matrix in case when the matrix does not partition into mutually separable submatrices.

Fathoming

The fathoming is based on the following tests:

Test 1: cluster size is not satisfactory

Test 2: cluster structure is not satisfactory



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Example:

Bottleneck

Parts

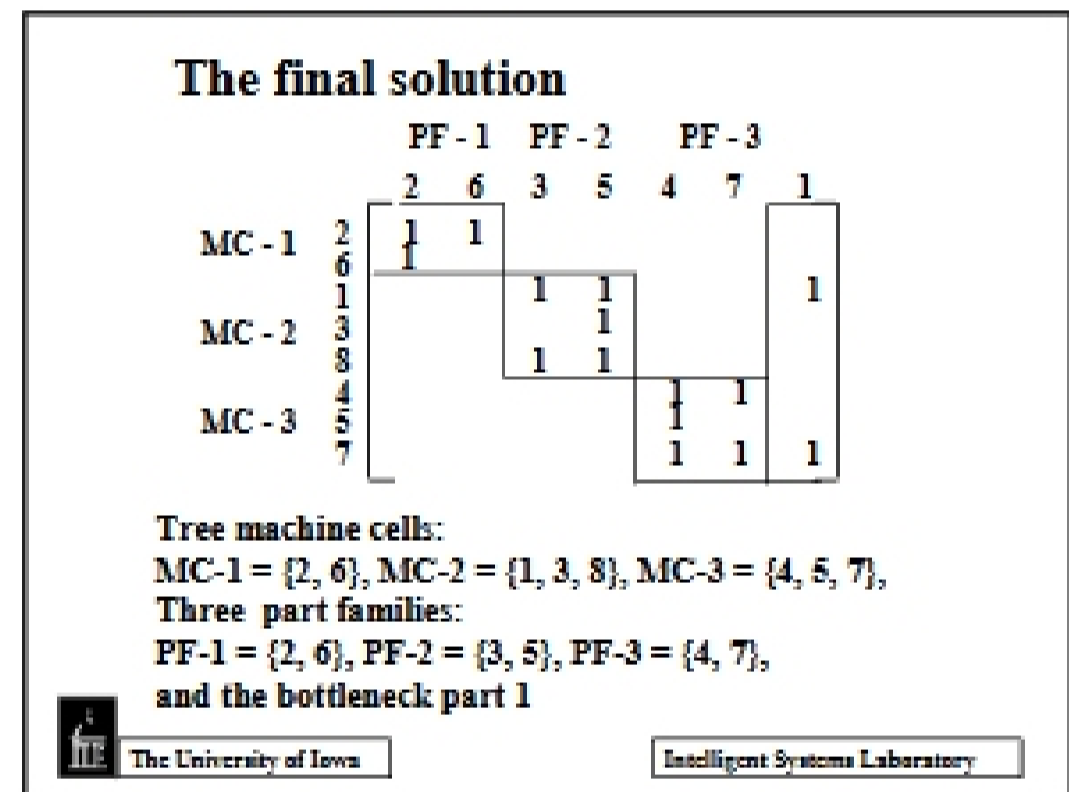
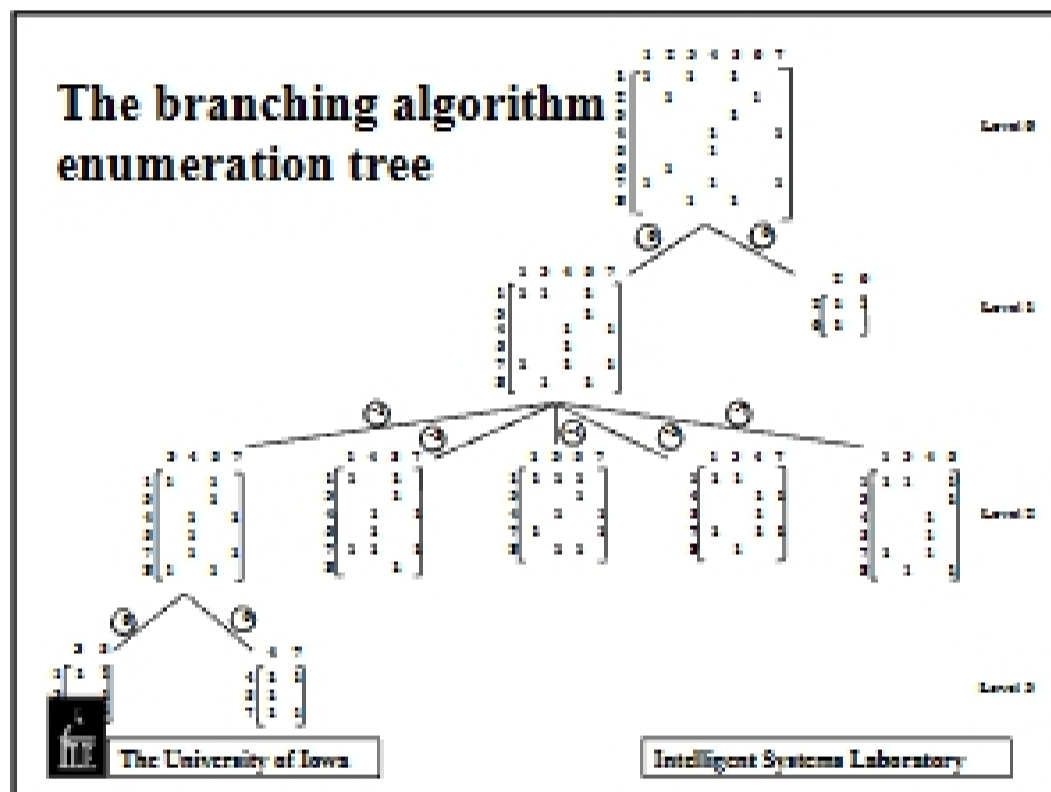
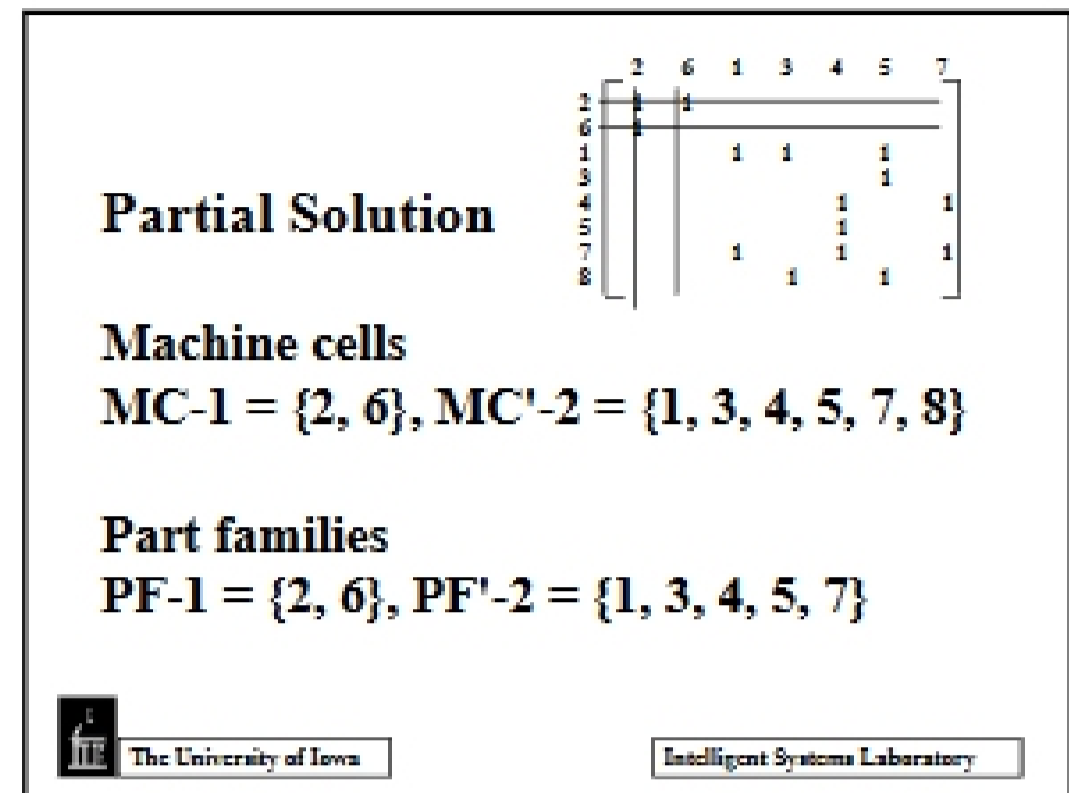
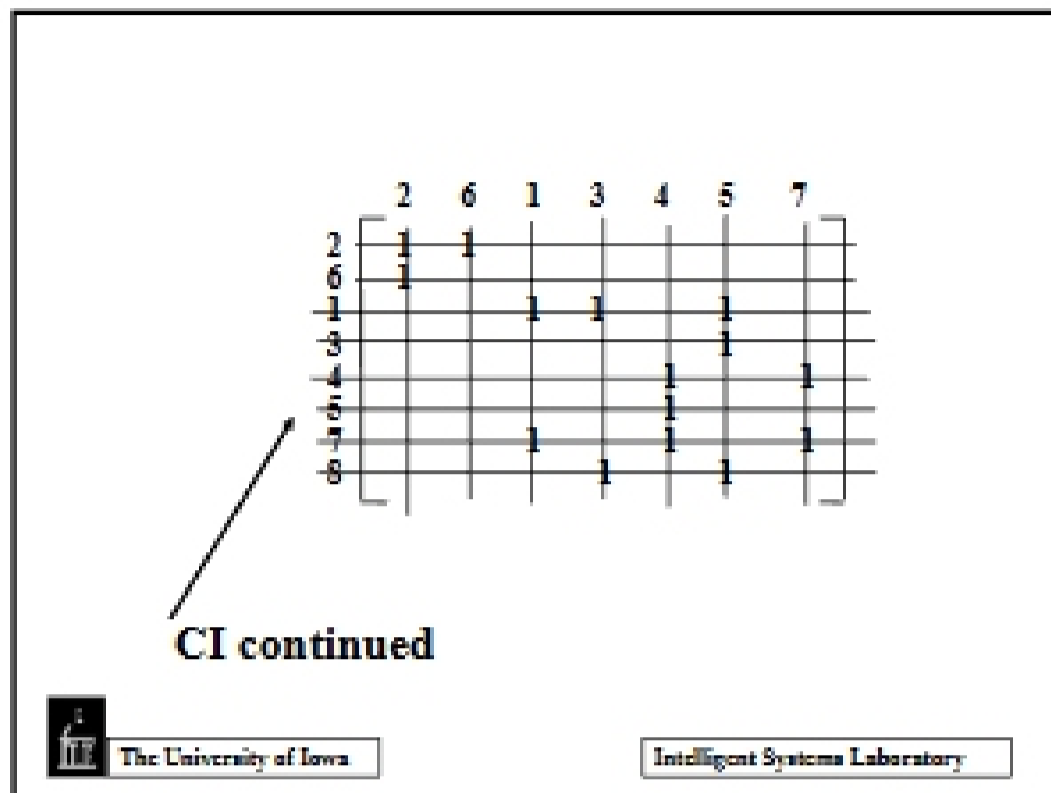
	Part number						
	1	2	3	4	5	6	7
1	1		1		1		
2		1				1	
3					1		
4				1			1
5				1			
6		1			1		
7	1			1			1
8			1	1	1		

Step 0: CI algorithm

	2	6	1	3	4	5	7
2	1	1					
6	1						
1			1	1		1	
3						1	
4					1		1
5					1		
7			1	1	1		1
8				1		1	



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Algorithm 2: Bottleneck Machines

Branching Scheme

		Part number				
		1	2	3	4	5
Machine number	1	1	1	1	1	1
	2	1	1	1	1	1
	3	1	1	1	1	1
	4	1	1	1	1	1

- Assuming that machine 1 is a bottleneck
- Assign one copy of machine 1 to each part performed on machine 1

		Part number				
		1	2	3	4	5
Machine number	1(1)		1			
	1(2)			1		
	1(3)					1
	2	1			1	
	3		1	1		1
	4	1		1	1	

- Applying the CI algorithm, this proves that machine 1 is not a bottleneck machine. The same is true for machines 2 and 3.