CSEE 6861 CAD of Digital Systems
Handout: Lecture #2 (part 1)
1/28/16

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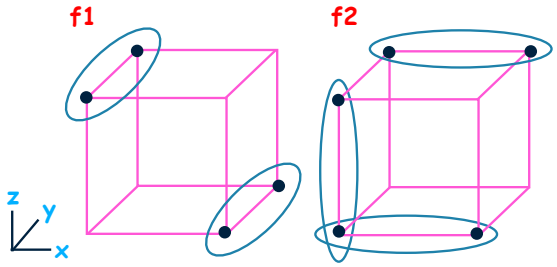
More ESPRESSO Examples

Introduction to ESPRESSO: Examples

Example #4: Multi-Output Minimization

Illustrates EXPAND/IRRED (multi-output)



Initial cover ("seed")

input part *output part*

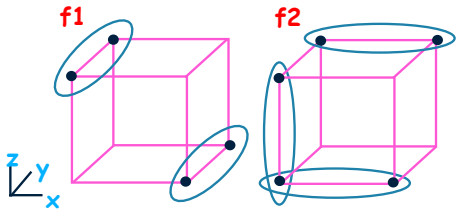
x	y	z	f1	f2
0	-	1	1	0
1	-	0	1	0
0	0	-	0	1
-	0	0	0	1
-	1	1	0	1

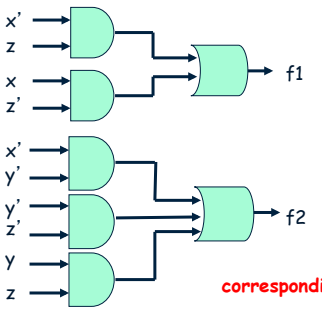
PLA Representation
= "cubical complex"

#3

Introduction to ESPRESSO: Examples

Example #4: Multi-Output Minimization





corresponding 2-level implementation

input part *output part*

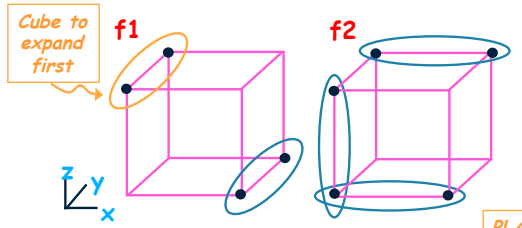
x	y	z	f1	f2
0	-	1	1	0
1	-	0	1	0
0	0	-	0	1
-	0	0	0	1
-	1	1	0	1

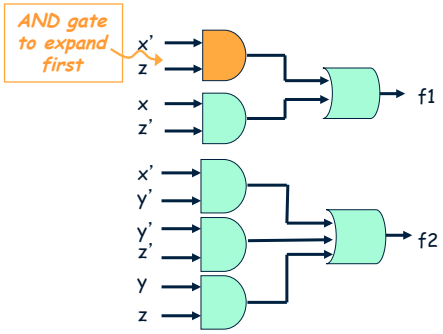
PLA Representation
= "cubical complex"

#4

Introduction to ESPRESSO: Examples

Example #4: Multi-Output Minimization





PLA file row to expand first

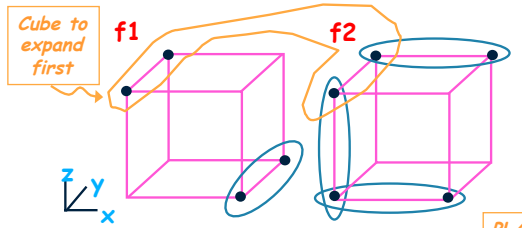
input part			output part	
x	y	z	f1	f2
0	-	1	1	0
1	-	0	1	0
0	0	-	0	1
-	0	0	0	1
-	1	1	0	1

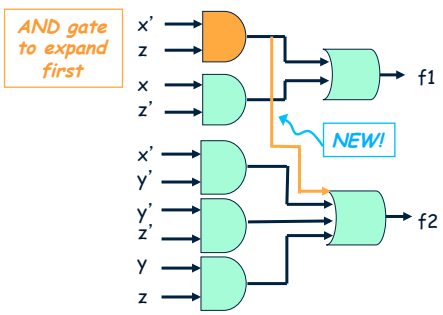
PLA Representation = "cubical complex"

Expand step (multi-output)

Introduction to ESPRESSO: Examples

Example #4: Multi-Output Minimization





PLA file row to expand first

input part			output part	
x	y	z	f1	f2
0	-	1	1	1
1	-	0	1	0
0	0	-	0	1
-	0	0	0	1
-	1	1	0	1

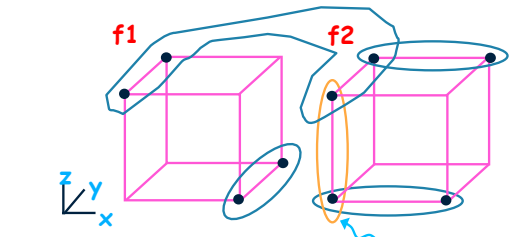
NEW!

PLA Representation = "cubical complex"

Expand step (multi-output)

Introduction to ESPRESSO: Examples

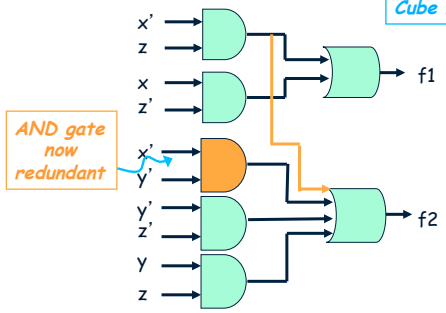
Example #4: Multi-Output Minimization



Cube now redundant

input part			output part	
x	y	z	f1	f2
0	-	1	1	1
1	-	0	1	0
0	0	-	0	1
-	0	0	0	1
-	1	1	0	1

PLA Representation = "cubical complex"



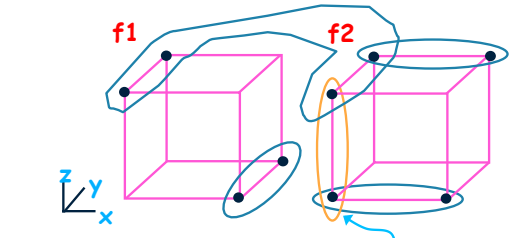
AND gate now redundant

IRREDUNDANT step (multi-output)

#7

Introduction to ESPRESSO: Examples

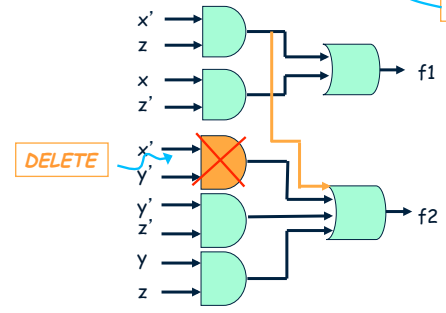
Example #4: Multi-Output Minimization



DELETE

input part			output part	
x	y	z	f1	f2
0	-	1	1	1
1	-	0	1	0
0	0	-	0	1
-	0	0	0	1
-	1	1	0	1

PLA Representation = "cubical complex"



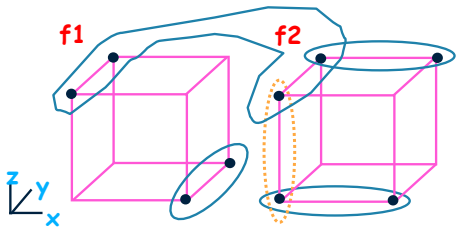
DELETE

IRREDUNDANT step (multi-output)

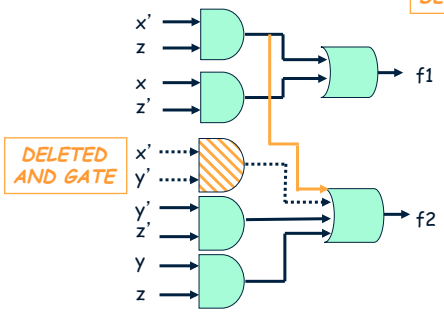
#8

Introduction to ESPRESSO: Examples

Example #4: Multi-Output Minimization



DELETED ROW



input part			output part	
x	y	z	f1	f2
0	-	1	1	1
1	-	0	1	0
-	0	0	0	1
-	1	1	0	1

PLA Representation
= "cubical complex"

IRREDUNDANT step
(multi-output)

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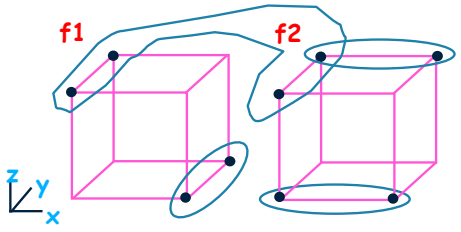
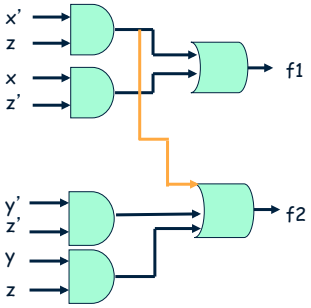
Introduction to ESPRESSO: Examples

Example #4: Multi-Output Minimization





input part			output part	
x	y	z	f1	f2
0	-	1	1	1
1	-	0	1	0
-	0	0	0	1
-	1	1	0	1

PLA Representation
= "cubical complex"

FINAL MINIMIZED COVER
(multi-output)

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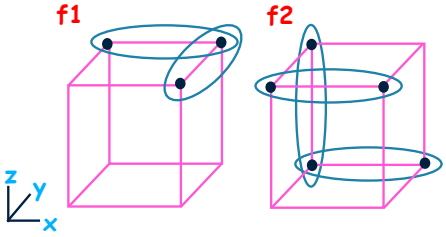
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization

Illustrates complete iteration loop (multi-output)



Initial cover ("seed")

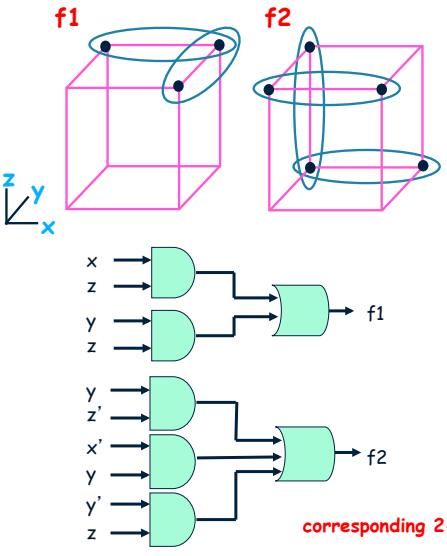
input part *output part*

x	y	z	f1	f2
1	-	1	1	0
-	1	1	1	0
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization



corresponding 2-level implementation

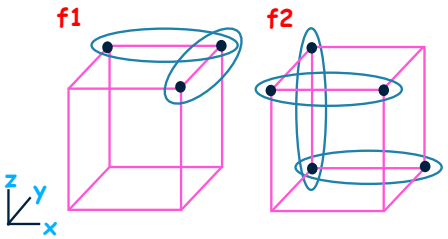
input part *output part*

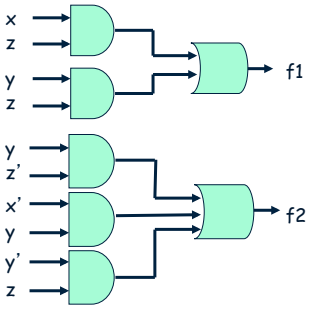
x	y	z	f1	f2
1	-	1	1	0
-	1	1	1	0
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





input part *output part*

x	y	z	f1	f2
1	-	1	1	0
-	1	1	1	0
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

Expand step… (multi-output)

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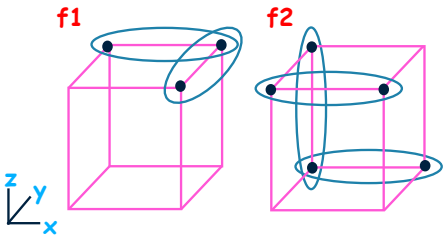
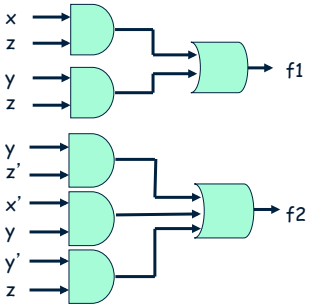
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





input part *output part*

x	y	z	f1	f2
1	-	1	1	0
-	1	1	1	0
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

Expand step… (multi-output) → *No change: all primes*

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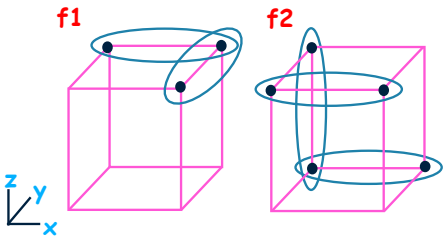
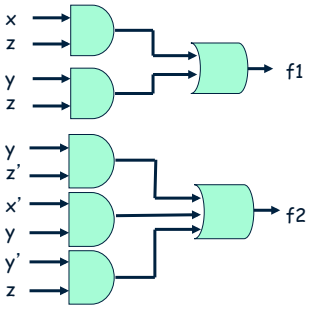
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





input part *output part*

x	y	z	f1	f2
1	-	1	1	0
-	1	1	1	0
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

IRRED step…
(multi-output) → *No change*

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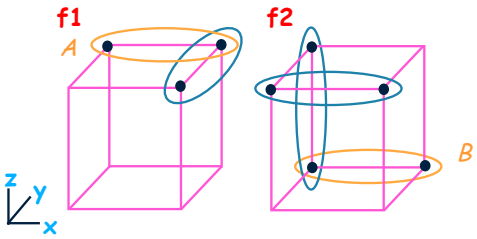
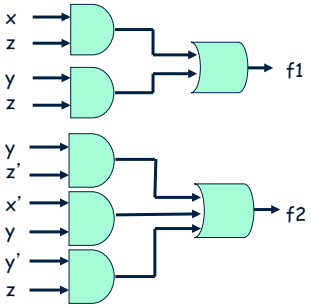
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





input part *output part*

x	y	z	f1	f2
1	-	1	1	0
-	1	1	1	0
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

REDUCE step…
(multi-output)

cube order: A, B

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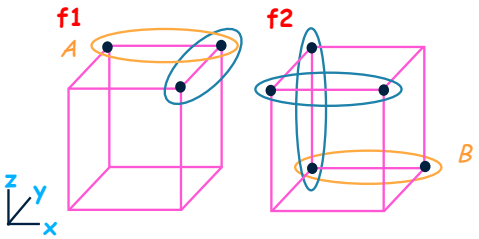
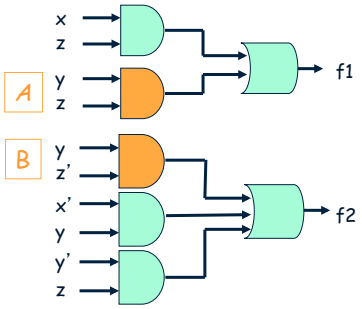
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	input part			output part	
	x	y	z	f1	f2
	1	-	1	1	0
A	-	1	1	1	0
B	-	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

PLA Representation
= "cubical complex"

REDUCE step…: BEFORE (multi-output)

cube order: A, B

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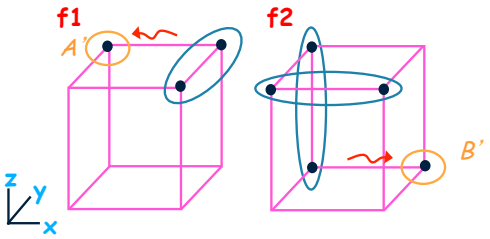
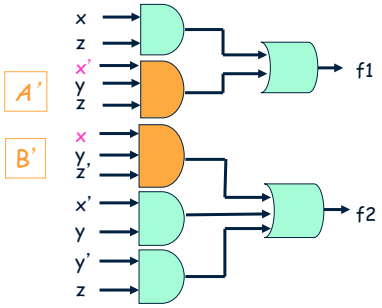
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	input part			output part	
	x	y	z	f1	f2
	1	-	1	1	0
A'	0	1	1	1	0
B'	1	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

PLA Representation
= "cubical complex"

REDUCE step…: AFTER (multi-output)

cube order: A, B

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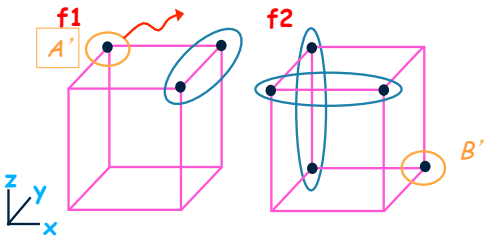
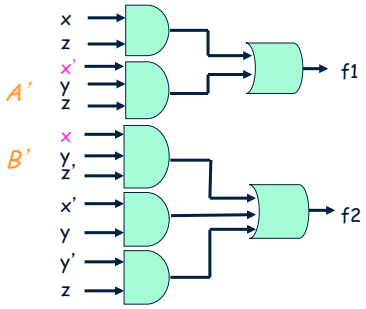
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	input part			output part	
	x	y	z	f1	f2
	1	-	1	1	0
A'	0	1	1	1	0
B'	1	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

PLA Representation
= "cubical complex"

EXPAND step (2nd time!) … (multi-output)

cube order: A', B'

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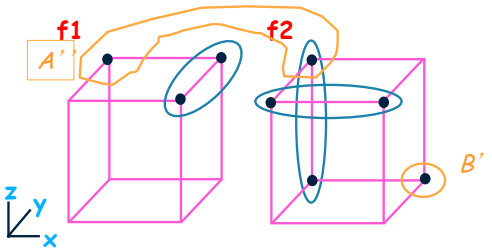
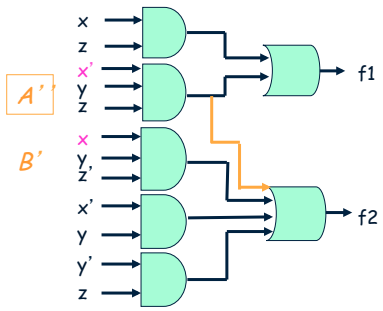
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	input part			output part	
	x	y	z	f1	f2
	1	-	1	1	0
A'	0	1	1	1	1
B'	1	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

PLA Representation
= "cubical complex"

EXPAND step (2nd time!) … (multi-output)

cube order: A', B'

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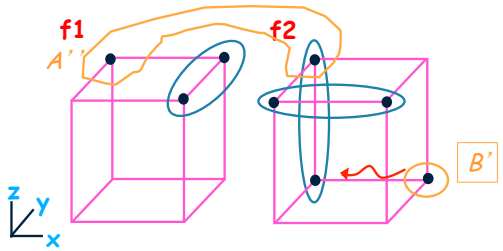
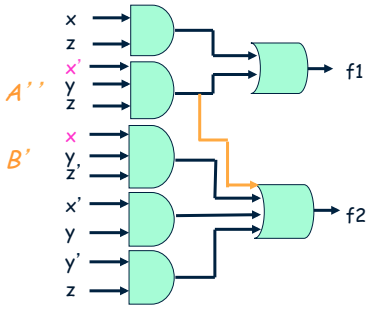
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	input part			output part	
	x	y	z	f1	f2
	1	-	1	1	0
A''	0	1	1	1	1
B'	1	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

PLA Representation
= "cubical complex"

EXPAND step (2nd time!) … (multi-output)

cube order: A', B'

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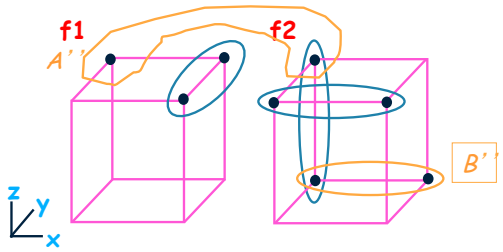
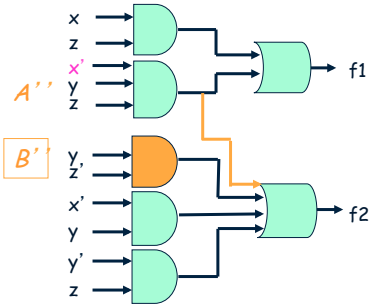
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	input part			output part	
	x	y	z	f1	f2
	1	-	1	1	0
A''	0	1	1	1	1
B'	-	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

PLA Representation
= "cubical complex"

EXPAND step (2nd time!) … (multi-output)

cube order: A', B'

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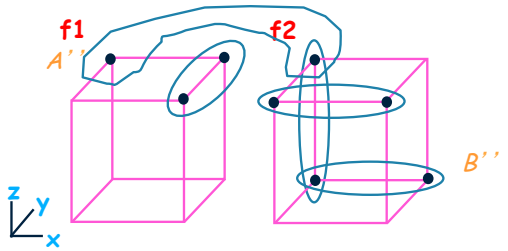
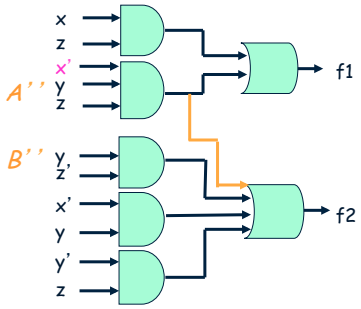
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	x	y	z	f1	f2
	1	-	1	1	0
A''	0	1	1	1	1
B''	-	1	0	0	1
	0	1	-	0	1
	-	0	1	0	1

input part / output part

PLA Representation
= "cubical complex"

IRRED step (2nd time!) ...
(multi-output)

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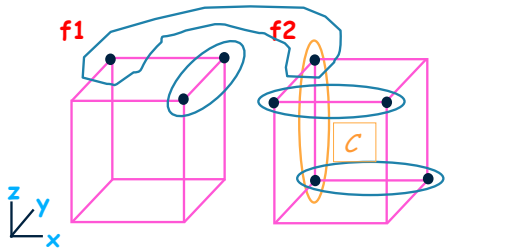
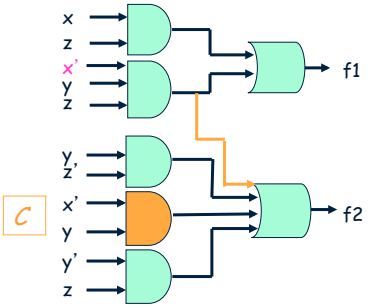
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization





	x	y	z	f1	f2
	1	-	1	1	0
	0	1	1	1	1
	-	1	0	0	1
C	0	1	-	0	1
	-	0	1	0	1

input part / output part

PLA Representation
= "cubical complex"

IRRED step ...
(multi-output)

"C" redundant:
DELETE

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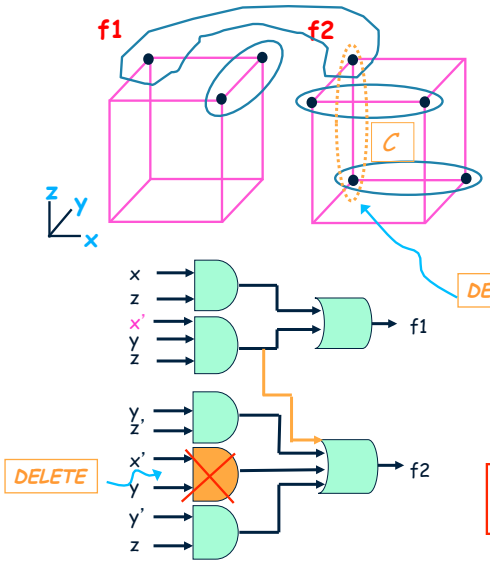
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization



input part | output part

x	y	z	f1	f2
1	-	1	1	0
0	1	1	1	1
-	1	0	0	1
0	1	-	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

IRRED step ... (multi-output) → "C" redundant: DELETE

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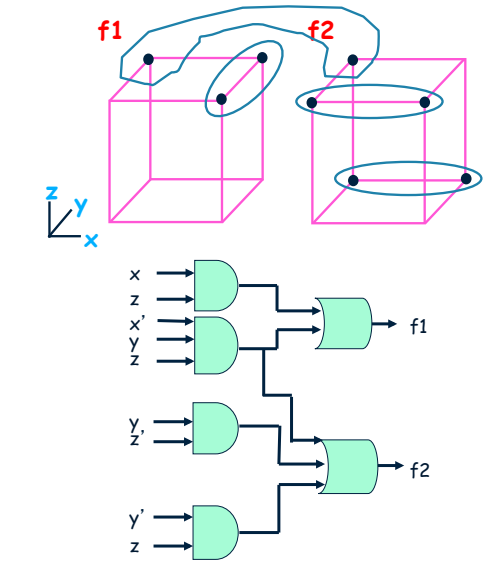
Introduction to ESPRESSO: Examples

Example #5: Multi-Output Minimization



input part | output part

x	y	z	f1	f2
1	-	1	1	0
0	1	1	1	1
-	1	0	0	1
-	0	1	0	1

PLA Representation
= "cubical complex"

FINAL MINIMIZED COVER (multi-output)

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