SWE 637 Software Testing
Chapter 8.2

Logic Coverage
In-class exercise

Dr. Brittany Johnson-Matthews
(Dr. B for short)

https://go.gmu.edu/SWE637

Adapted from slides by Jeff Offutt and Bob Kurtz

Exercise 8.2 #1, Predicate i

Given predicate $\boldsymbol{f = ab\bar{c} + \bar{a}b\bar{c}}$

Draw the K-map for $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$

Find the non-redundant prime implicant representation for $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$

Give a test set to satisfy the following criteria for the simplified $\boldsymbol{f}$ calculated above

- *Implicant Coverage (IC)*
- *MUTP Coverage*
- *CUTPNFP Coverage*
- *MNFP Coverage*
- *MUMCUT Coverage*

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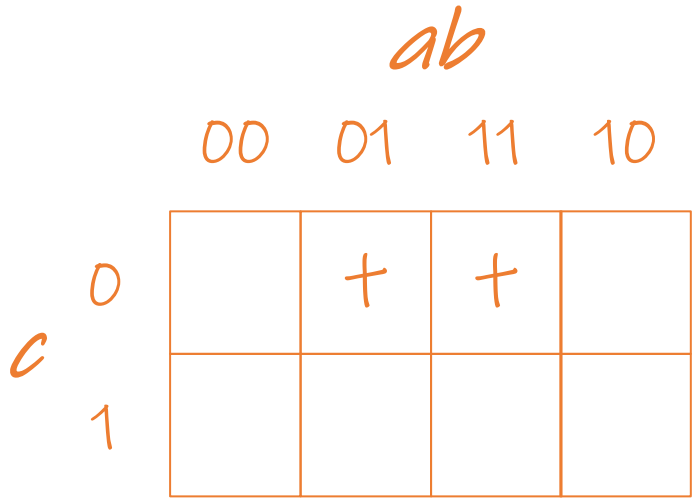

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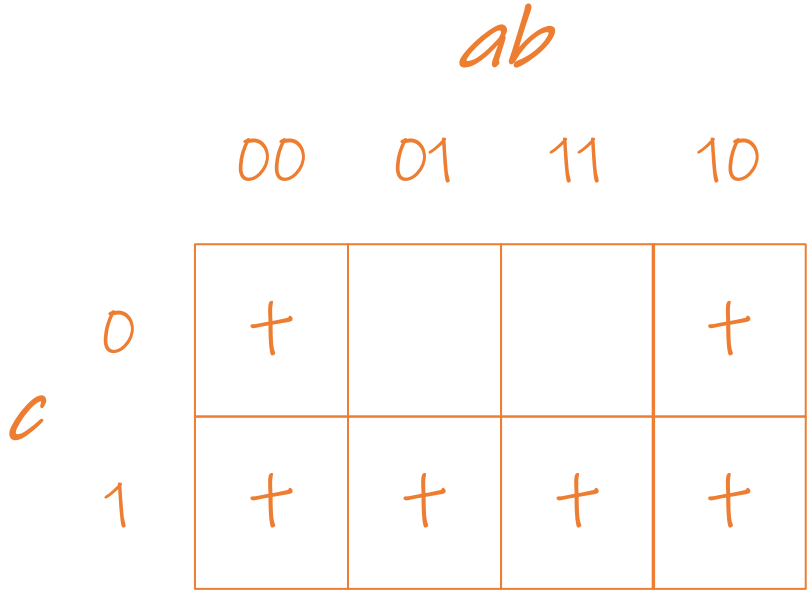

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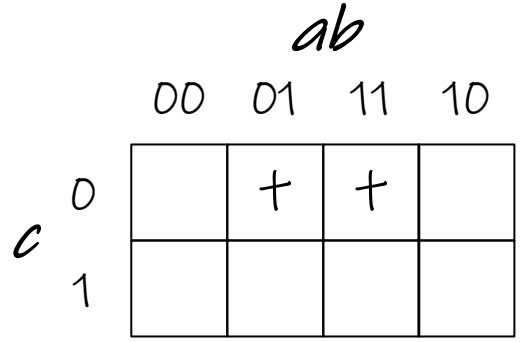

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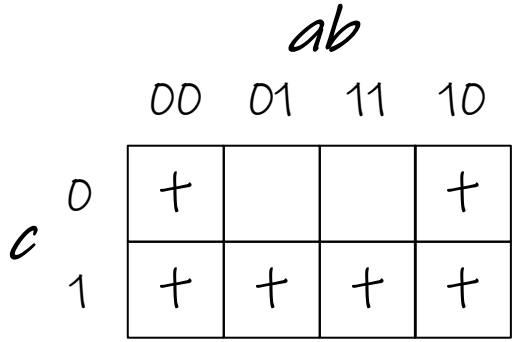

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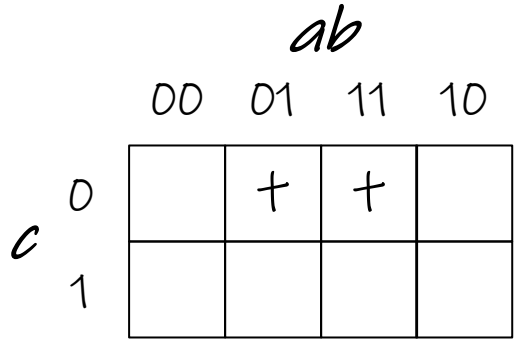

…and for $\boldsymbol{\bar{f}}$

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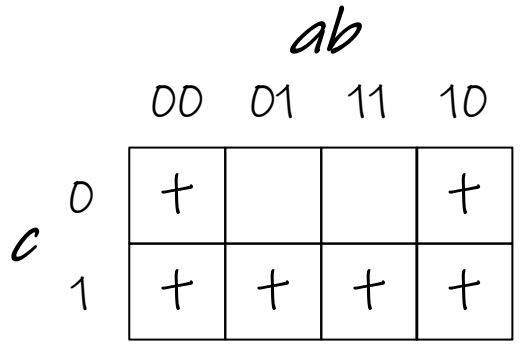
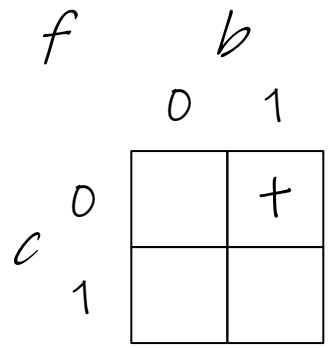
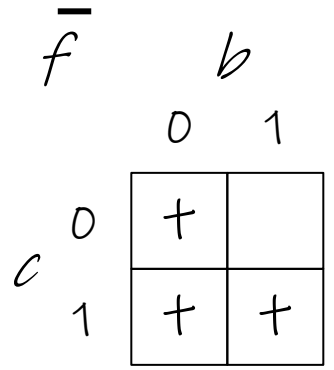


Exercise 8.2 #1, Predicate i

Given predicates $\boldsymbol{f = b\bar{c}}$ and $\boldsymbol{\bar{f} = \bar{b} + c}$, give a test set to satisfy Implicant Coverage (IC)

- For each implicant in $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$, ***TR*** contains the requirement that the implicant evaluate to *true*





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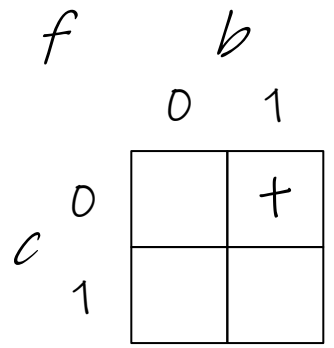
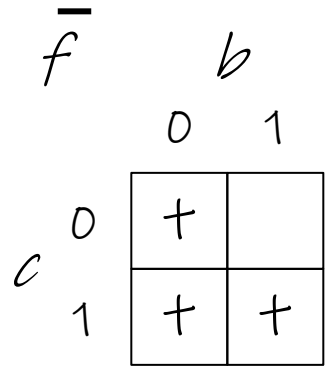


For b!c: TF

For !b: F*

For c: *T

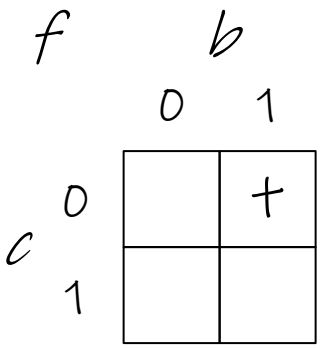
TR = { TF, FT }



Exercise 8.2 #1, Predicate i

Given the predicate $\boldsymbol{f = b\bar{c}}$, give a test set to satisfy MUTP Coverage

- For each implicant in $\boldsymbol{f}$, ***TR*** contains UTPs such that clauses not in ***i*** take on *true* and *false*



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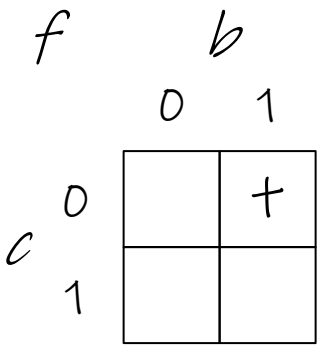
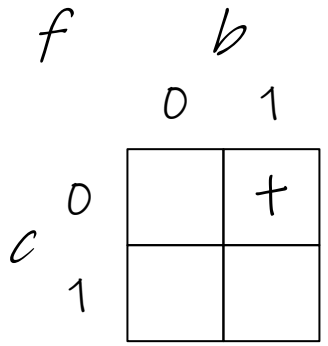


TR = { TF }

Exercise 8.2 #1, Predicate i

Using the simplified prime representation of ***f***, give a test set to satisfy CUTPNFP Coverage

For each literal ***c*** in each implicant ***i***, ***TR*** contains a UTP for ***i*** and a NFP for ***c*** in ***i*** such that the two points differ only by the value of ***c***



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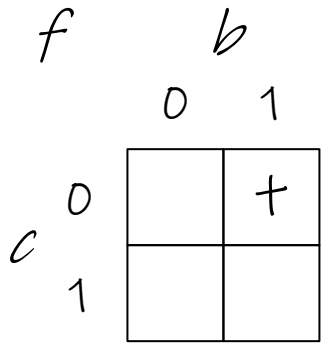
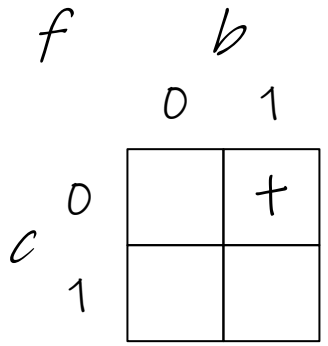


TR = { TF, FF, TT }

Exercise 8.2 #1, Predicate i

Given the predicate $\boldsymbol{f = b\bar{c}}$, give a test set to satisfy MNFP Coverage

- For each literal ***c*** in each implicant ***i***, ***TR*** contains NFPs such that clauses not in ***i*** take on true and false



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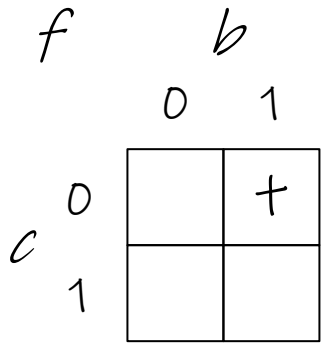

TR = { FF, TT }

Exercise 8.2 #1, Predicate i

Given the predicate $\boldsymbol{f = b\bar{c}}$, give a test set to satisfy *MUMCUT Coverage*

Given a minimal DNF representation of a predicate $\boldsymbol{f}$, apply MUTP, CUTPNFP, and MNFP

TR = { TF, FF, TT }

END OF EXERCISE

Exercise 8.2 #1, Predicate ii

Given predicate $\boldsymbol{f} = \overline{\boldsymbol{abcd}} + \boldsymbol{abcd}$

Draw the K-map for $\boldsymbol{f}$ and $\overline{\boldsymbol{f}}$

Find the non-redundant prime implicant representation for $\boldsymbol{f}$ and $\overline{\boldsymbol{f}}$

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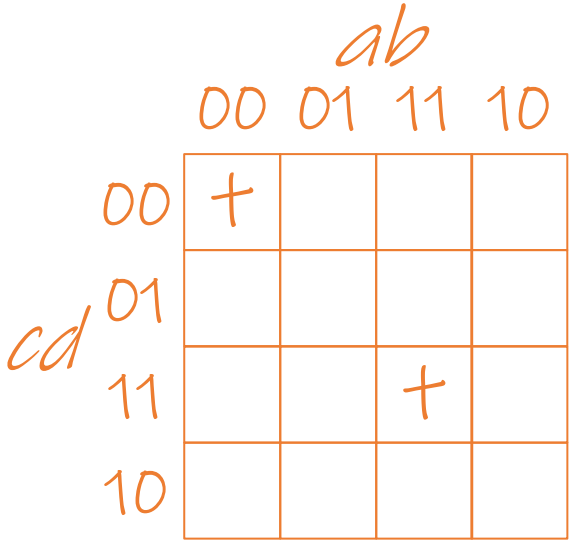

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Given predicate $\boldsymbol{f = \overline{abcd} + abcd}$

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cd \ ab	00	01	11	10
00		+	+	+
01	+	+	+	+
11	+	+		+
10	+	+	+	+

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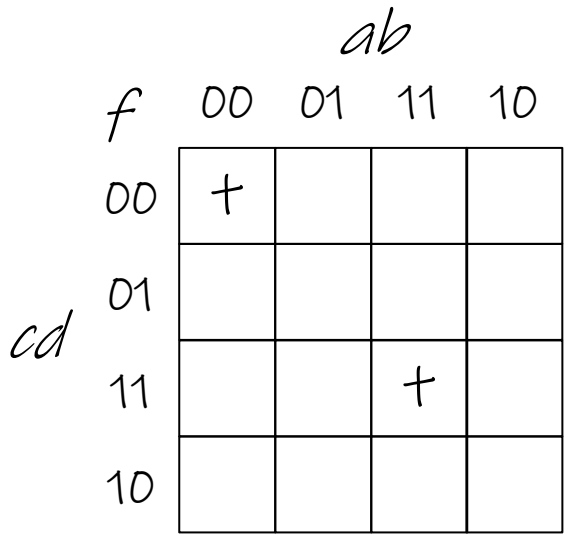

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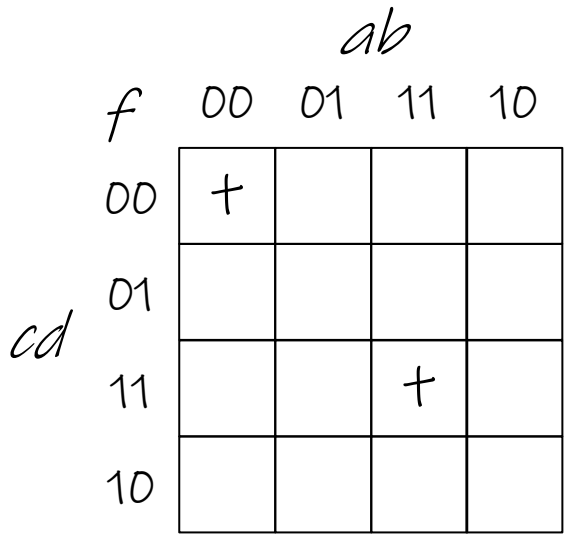

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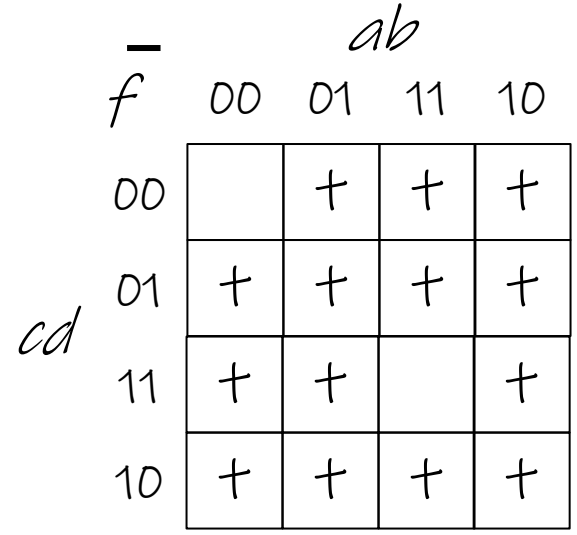

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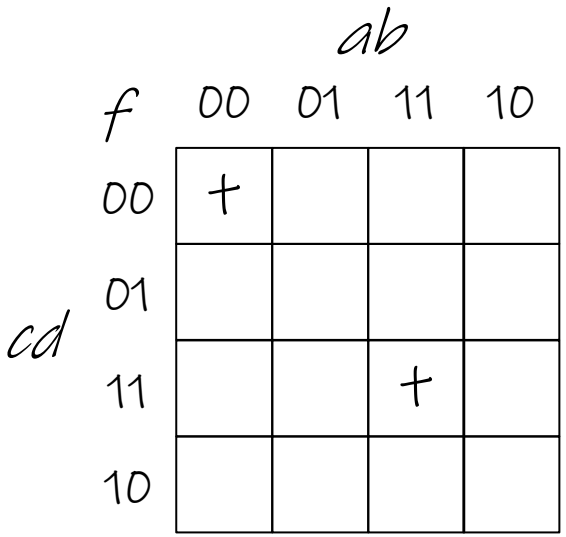

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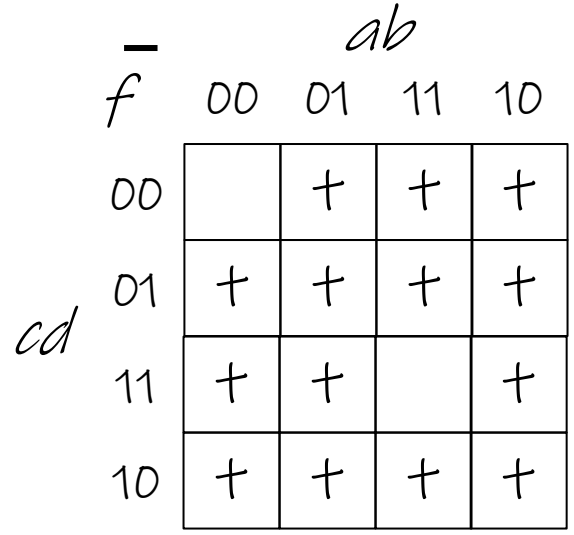
$\boldsymbol{\bar{f} = a\bar{b} + c\bar{d} + \bar{a}d + b\bar{c}}$



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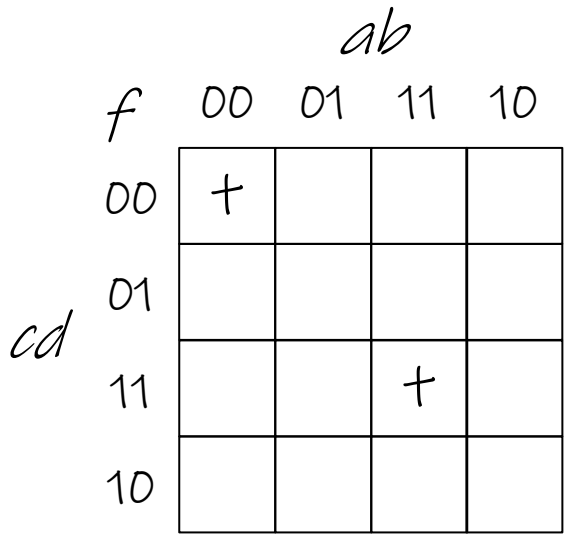
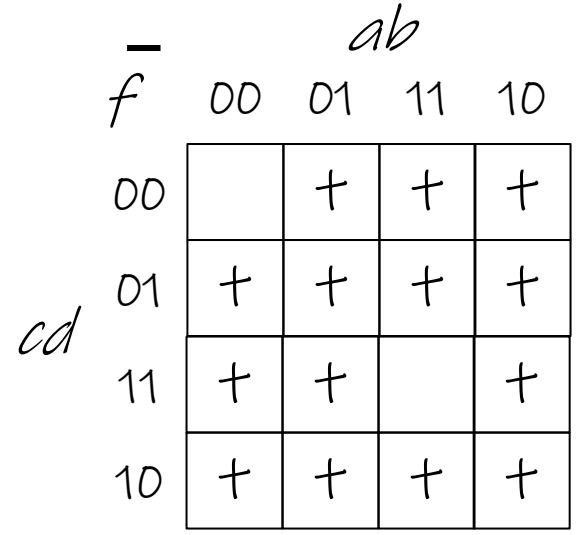
Given predicates $\boldsymbol{f = \overline{abcd} + abcd}$ and $\boldsymbol{\bar{f} = a\bar{b} + c\bar{d} + \bar{a}d + b\bar{c}}$, give a test set to satisfy Implicant Coverage (IC)

For each implicant in $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$, ***TR*** contains the requirement that the implicant evaluate to *true*





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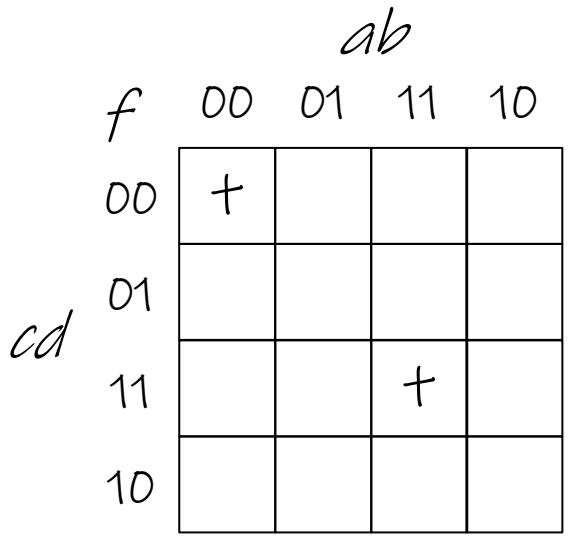
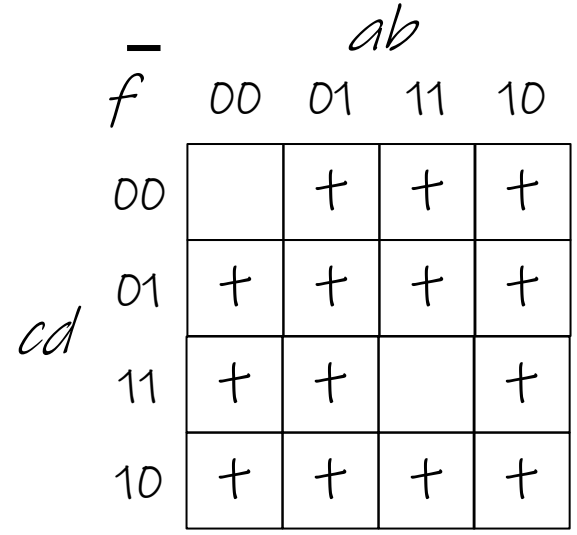
For each implicant in $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$, **TR** contains the requirement that the implicant evaluate to *true*

TR = { FFFF, TTTT, TFTF, FTFT }





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Given predicate $\boldsymbol{f = \overline{abcd} + abcd}$, give a test set to satisfy MUTP Coverage

- For each implicant in $\boldsymbol{f}$, ***TR*** contains UTPs such that clauses not in ***i*** take on *true* and *false*

f / cd \ ab	00	01	11	10
00	+			
01				
11			+	
10				

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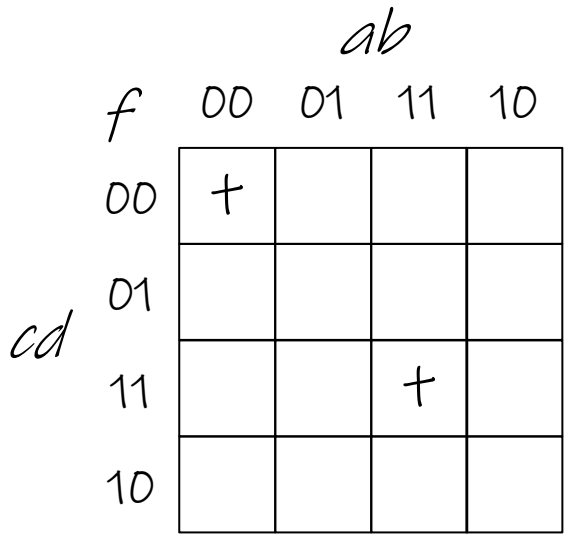

TR = { FFFF, TTTT }

Exercise 8.2 #1, Predicate ii

Given predicate $\boldsymbol{f = \overline{abcd} + abcd}$,, give a test set to satisfy CUTPNFP Coverage

- For each literal ***c*** in each implicant ***i***, ***TR*** contains a UTP for ***i*** and a NFP for ***c*** in ***i*** such that the two points differ only by the value of ***c***

f / cd \ ab	00	01	11	10
00	+			
01				
11			+	
10				

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f	ab 00	01	11	10
cd 00	+			
01				
11			+	
10				

TR = { FFFF, TFFF, FTFF, FFTF, FFFT,
TTTT, FTTT, TFTT, TTFT, TTTF }

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01				
11			+	
10				

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f	ab 00	01	11	10
cd 00	+			
01				
11			+	
10				

TR = { TFFF, FTFF, FFTF, FFFT, FTTT, TFTT, TTFT, TTTF }

Exercise 8.2 #1, Predicate ii

Given predicate $\boldsymbol{f = \overline{abcd} + abcd}$, give a test set that is guaranteed to detect all faults

- MUMCUT - given a minimal DNF representation of a predicate $\boldsymbol{f}$, apply MUTP, CUTPNFP, and MNFP

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Given predicate $\boldsymbol{f = \overline{abcd} + abcd}$, give a test set that is guaranteed to detect all faults

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END OF EXERCISE

Exercise 8.2 #1, Predicate iii

Given predicate $\boldsymbol{f = ab + a\bar{b}c + \overline{abc}}$

Draw the K-map for $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$

Find the non-redundant prime implicant representation for $\boldsymbol{f}$ and $\boldsymbol{\bar{f}}$

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Given predicate $\boldsymbol{f = ab + a\bar{b}c + \overline{abc}}$

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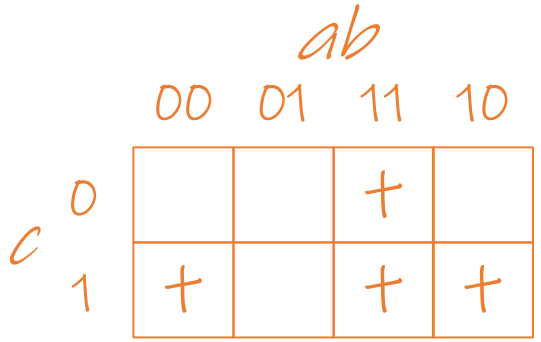
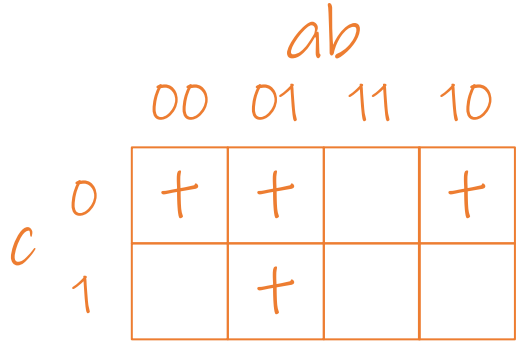


…and for $\boldsymbol{\bar{f}}$



Exercise 8.2 #1, Predicate iii

Given predicate $\boldsymbol{f = ab + a\bar{b}c + \overline{abc}}$

Find the non-redundant prime implicant representation for $\boldsymbol{f}$

f	ab = 00	01	11	10
c = 0			+	
1	+		+	+

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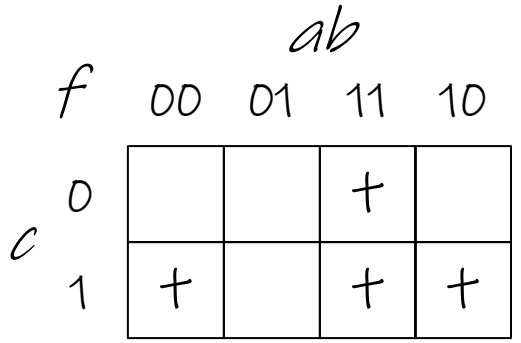
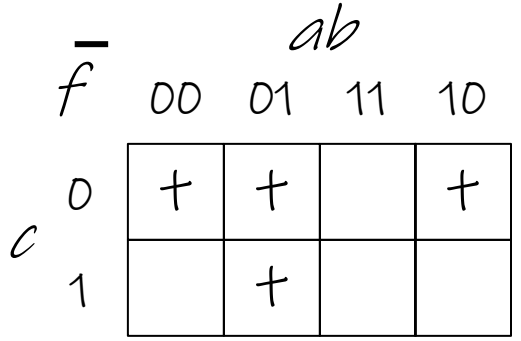


...and for $\bar{\boldsymbol{f}}$

$\bar{\boldsymbol{f}} = \bar{a}b + \overline{bc}$



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For each implicant in $\boldsymbol{f}$ and $\boldsymbol{\overline{f}}$, **TR** contains the requirement that the implicant evaluate to *true*

f	ab = 00	01	11	10
c = 0			+	
c = 1	+		+	+

$\overline{f}$	ab = 00	01	11	10
c = 0	+	+		+
c = 1		+		

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f	ab 00	01	11	10
c 0			+	
1	+		+	+

TR =

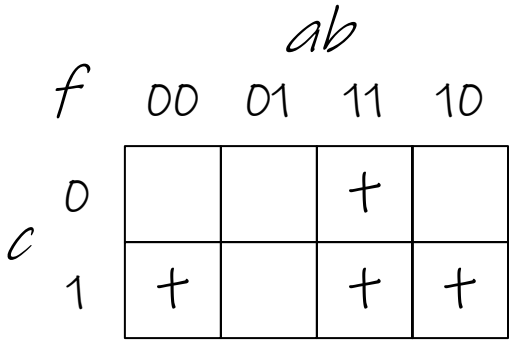
{ TT*, *FT, FT*, *FF }

$\overline{f}$	ab 00	01	11	10
c 0	+	+		+
1		+		

Exercise 8.2 #1, Predicate iii

Given $\boldsymbol{f = ab + \bar{b}c}$, give a test set to satisfy MUTP Coverage

- For each implicant in $\boldsymbol{f}$, ***TR*** contains UTPs such that clauses not in ***i*** take on *true* and *false*



Exercise 8.2 #1, Predicate iii

Given $\boldsymbol{f = ab + \bar{b}c}$, give a test set to satisfy MUTP Coverage

For each implicant in $\boldsymbol{f}$, **TR** contains UTPs such that clauses not in **i** take on *true* and *false*

f	ab 00	01	11	10
c 0			+	
1	+		+	+

TR =

{ TTT, TTF, TFT, FFT }

Exercise 8.2 #1, Predicate iii

Given the predicate $\boldsymbol{f = ab + \bar{b}c}$, give a test set to satisfy CUTPNFP Coverage

For each literal ***c*** in each implicant ***i***, ***TR*** contains a UTP for ***i*** and a NFP for ***c*** in ***i*** such that the two points differ only by the value of ***c***

	f \ ab	00	01	11	10
c	0			+	
	1	+		+	+

Exercise 8.2 #1, Predicate iii

Given the predicate $\boldsymbol{f = ab + \bar{b}c}$, give a test set to satisfy CUTPNFP Coverage

For each literal ***c*** in each implicant ***i***, ***TR*** contains a UTP for ***i*** and a NFP for ***c*** in ***i*** such that the two points differ only by the value of ***c***

f / c	ab = 00	01	11	10
0			+	
1	+		+	+

TR = { TTF, FTF, TFF, FFT, FTT, FFF }

Exercise 8.2 #1, Predicate iii

Given the predicate $\boldsymbol{f = ab + \overline{b}c}$, give a test set to satisfy MNFP Coverage

- For each literal ***c*** in each implicant ***i***, ***TR*** contains NFPs such that clauses not in ***i*** take on true and false

f	ab = 00	ab = 01	ab = 11	ab = 10
c = 0			+	
c = 1	+		+	+

Exercise 8.2 #1, Predicate iii

Given the predicate $\boldsymbol{f = ab + \bar{b}c}$, give a test set to satisfy MNFP Coverage

For each literal ***c*** in each implicant ***i***, ***TR*** contains NFPs such that clauses not in ***i*** take on true and false

f / c	ab = 00	ab = 01	ab = 11	ab = 10
0			+	
1	+		+	+

TR = { FTF, FTT, TFF, FFF }

But is infeasible for c

Exercise 8.2 #1, Predicate iii

Given the predicate $\boldsymbol{f = ab + \bar{b}c}$, give a test set that is guaranteed to detect all faults

- MUMCUT -given a minimal DNF representation of a predicate $\boldsymbol{f}$, apply MUTP, CUTPNFP, and MNFP

Exercise 8.2 #1, Predicate iii

Given the predicate $\boldsymbol{f = ab + \bar{b}c}$, give a test set that is guaranteed to detect all faults

MUMCUT -given a minimal DNF representation of a predicate $\boldsymbol{f}$, apply MUTP, CUTPNFP, and MNFP

TR = { TTT, TTF, TFT, FFT, FTF, TFF, FTT, FFF }

or {TTT, TTF, TFT, FFT, TFF, FTT } using minimal-MUMCUT

END OF EXERCISE