Logic Coverage
In-class exercise

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(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 $f = ab\bar{c} + \bar{a}b\bar{c}$

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

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

Give a test set to satisfy the following criteria for the simplified $f$ calculated above

Implicant Coverage (IC)
MUTP Coverage
CUTPNFP Coverage
MNFP Coverage
MUMCUT Coverage
Exercise 8.2 #1, Predicate i

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

Draw the K-map for $f$
Exercise 8.2 #1, Predicate i

Given predicate \( f = ab\overline{c} + \overline{a}b\overline{c} \)

Draw the K-map for \( f \)

\[
\begin{array}{cccc}
ab & 00 & 01 & 11 & 10 \\
0 & + & + & & \\
1 & & & & \\
\end{array}
\]
Exercise 8.2 #1, Predicate i

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

Draw the K-map for $\overline{f}$
Exercise 8.2 #1, Predicate i

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

Draw the K-map for $\overline{f}$
Exercise 8.2 #1, Predicate i

Given predicate \( f = ab\overline{c} + \overline{a}b\overline{c} \)

Find the non-redundant prime implicant representation for \( f \)
Exercise 8.2 #1, Predicate i

Given predicate $f = abc + \overline{a}bc$

Find the non-redundant prime implicant representation for $f$

$f = b\overline{c}$

...and for $\overline{f}$
Exercise 8.2 #1, Predicate i

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

Find the non-redundant prime implicant representation for $f$

$f = b\overline{c}$

…and for $\overline{f}$

$\overline{f} = \overline{b} + c$
Exercise 8.2 #1, Predicate \( i \)

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

For each implicant in \( f \) and \( \overline{f} \), TR contains the requirement that the implicant evaluate to \textit{true}
Exercise 8.2 #1, Predicate i

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

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

For $b \land c$: TF
For $\overline{b}$: $F^*$
For $c$: $^*T$

$TR = \{ TF, FT \}$
Exercise 8.2 #1, Predicate $i$

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

For each implicant in $f$, TR contains UTPs such that clauses not in $i$ take on true and false.
Exercise 8.2 #1, Predicate $i$

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

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

$TR = \{ TF \}$
Exercise 8.2 #1, Predicate \( i \)

Using the simplified prime representation of \( f \), give a test set to satisfy CUTFNPF 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 \( c \)
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 $c$.

$TR = \{ TF, FF, TT \}$
Exercise 8.2 #1, Predicate $i$

Given the predicate $f = b\bar{c}$, 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
Exercise 8.2 #1, Predicate $i$

Given the predicate $f = b\overline{c}$, 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.

$$TR = \{ FF, TT \}$$
Exercise 8.2 #1, Predicate $i$

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

Given a minimal DNF representation of a predicate $f$, apply MUTP, CUTPNFP, and MNFP.

$TR = \{ TF, FF, TT \}$
END OF EXERCISE
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \)

Draw the K-map for \( f \) and \( \overline{f} \)

Find the non-redundant prime implicant representation for \( f \) and \( \overline{f} \)

Give a test set to satisfy the following criteria for the simplified \( f \) calculated above

- Implicant Coverage (IC)
- MUTP Coverage
- CUTPNFP Coverage
- MNFP Coverage
- MUMCUT Coverage
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \)

Draw the K-map for \( f \)
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \)

Draw the K-map for \( f \)
Exercise 8.2 #1, Predicate ii

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

Draw the K-map for $\overline{f}$
Exercise 8.2 #1, Predicate ii

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

Draw the K-map for $\overline{f}$
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \)

Find the non-redundant prime implicant representation for \( f \)
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \)

Find the non-redundant prime implicant representation for \( f \)
\( f = \overline{abcd} + abcd \)

…and for \( \overline{f} \)
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \)

Find the non-redundant prime implicant representation for \( f \)

\( f = \overline{abcd} + abcd \)

…and for \( \bar{f} \)

\( \bar{f} = ab + cd + \overline{ad} + b\overline{c} \)
Exercise 8.2 #1, Predicate ii

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

For each implicant in \( f \) and \( \bar{f} \), TR contains the requirement that the implicant evaluate to true.
Exercise 8.2 #1, Predicate ii

Given predicates \( f = \overline{abcd} + abcd \) and \( \bar{f} = ab + \overline{cd} + \overline{ad} + b\overline{c} \), give a test set to satisfy Implicant Coverage (IC).

For each implicant in \( f \) and \( \bar{f} \), TR contains the requirement that the implicant evaluate to true.

\[
\text{TR} = \{ \text{FFFF, TTTT, TFTF, FTFT} \} 
\]
Exercise 8.2 #1, Predicate ii

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

For each implicant in $f$, TR contains UTPs such that clauses not in $i$ take on true and false.
Exercise 8.2 #1, Predicate ii

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

For each implicant in $f$, $TR$ contains UTPs such that clauses not in $i$ take on true and false.

$$TR = \{ FFFF, TTTT \}$$
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \), 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 \( c \).
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \), 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 \( c \)

\[
\begin{align*}
TR &= \{ \overline{FFFF}, TFFF, FFFF, FFTE, FFFT, \\
 &= TTTT, FTTT, TFFT, TTFT, TTTF \}
\end{align*}
\]
Exercise 8.2 #1, Predicate ii

Given predicate $f = \overline{abcd} + abcd$, 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.
Exercise 8.2 #1, Predicate ii

Given predicate \( f = \overline{abcd} + abcd \), 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

\[
TR = \{ \text{TFFF, FTFF, FFFT, FFFT, FTTT, TTTT, TFFT, TTFT, TTTF} \} \]
Exercise 8.2 #1, Predicate ii

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

MUMCUT - given a minimal DNF representation of a predicate $f$, apply MUTP, CUTPNFP, and MNFP.
Exercise 8.2 #1, Predicate ii

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

MUMCUT - given a minimal DNF representation of a predicate \( f \), apply MUTP, CUTPNFP, and MNFP

\[ \text{TR} = \{ FFFF, TTTT, TFFF, FTFF, FFTF, FFFT, FTTT, TFFT, TTFT, TTTF \} \]
END OF EXERCISE
Exercise 8.2 #1, Predicate iii

Given predicate $f = ab + abc + \overline{abc}$

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

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

Give a test set to satisfy the following criteria for the simplified $f$ calculated above

- Implicant Coverage (IC)
- MUTP Coverage
- CUTPNFP Coverage
- MNFP Coverage
- MUMCUT Coverage
Exercise 8.2 #1, Predicate iii

Given predicate $f = ab + \overline{abc} + \overline{abc}$

Draw the K-map for $f$
Exercise 8.2 #1, Predicate iii

Given predicate \( f = ab + \overline{abc} + \overline{abc} \)

Draw the K-map for \( f \)

...and for \( \overline{f} \)
Exercise 8.2 #1, Predicate iii

Given predicate $f = ab + abc + \overline{abc}$

Find the non-redundant prime implicant representation for $f$.
Exercise 8.2 #1, Predicate iii

Given predicate $f = ab + abc + \overline{abc}$

Find the non-redundant prime implicant representation for $f$

$f = ab + \overline{bc}$

...and for $\overline{f}$

$\overline{f} = \overline{ab} + \overline{bc}$
Exercise 8.2 #1, Predicate iii

Given predicates \( f = ab + \overline{bc} \) and \( \overline{f} = \overline{ab} + \overline{bc} \), give a test set to satisfy Implicant Coverage (IC).

For each implicant in \( f \) and \( \overline{f} \), TR contains the requirement that the implicant evaluate to true.

\[
\begin{array}{c|c|c|c|c}
00 & 01 & 11 & 10 \\
\hline
f & - & + & + & + \\
\hline
c & 0 & + & + & + \\
\hline
1 & + & + & + & + \\
\end{array}
\]

\[
\begin{array}{c|c|c|c|c}
00 & 01 & 11 & 10 \\
\hline
\overline{f} & + & + & + & + \\
\hline
c & 0 & + & + & + \\
\hline
1 & + & + & + & + \\
\end{array}
\]
Given predicates $f = ab + \overline{bc}$ and $\overline{f} = \overline{ab} + \overline{bc}$, give a test set to satisfy Implicant Coverage (IC).

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

$$TR = \{ TT^*, *FT, FT^*, *FF \}$$
Exercise 8.2 #1, Predicate iii

Given $f = ab + \overline{bc}$, give a test set to satisfy MUTP Coverage

For each implicant in $f$, $TR$ contains UTPs such that clauses not in $i$ take on true and false.
Exercise 8.2 #1, Predicate iii

Given \( f = ab + \overline{bc} \), give a test set to satisfy MUTP Coverage

For each implicant in \( f \), \( TR \) contains UTPs such that clauses not in \( i \) take on true and false

\[ TR = \{ TTT, TTF, TFT, FFT \} \]
Exercise 8.2 #1, Predicate iii

Given the predicate $f = ab + \overline{bc}$, 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 $c$.
Exercise 8.2 #1, Predicate iii

Given the predicate $f = ab + \overline{bc}$, 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 $c$

$$TR = \{ TTF, FTF, TFF, FFT, FTT, FFF \}$$
Exercise 8.2 #1, Predicate \( iii \)

Given the predicate \( f = ab + \overline{bc} \), 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.
Exercise 8.2 #1, Predicate iii

Given the predicate $f = ab + \overline{bc}$, 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.

$$TR = \{ FTF, FTT, TFF, FFF \}$$

But is infeasible for $c$.
Exercise 8.2 #1, Predicate iii

Given the predicate \( f = ab + \overline{bc} \), give a test set that is guaranteed to detect all faults

MUMCUT - given a minimal DNF representation of a predicate \( f \), apply MUTP, CUTPNFP, and MNFP
Exercise 8.2 #1, Predicate iii

Given the predicate $f = ab + \overline{bc}$, give a test set that is guaranteed to detect all faults.

MUMCUT - given a minimal DNF representation of a predicate $f$, 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