Problem 1

- Problem 2.7 from Text

Simplify the following Boolean expressions to a minimum number of literals.

a) \( ABC + A'B + ABC' \)
   \[ = AB(\bar{A} + C') + A'B \]
   \[ = AB \cdot 1 + A'B \]
   \[ = AB + A'B \]
   \[ = B(A + A') \]
   \[ = B \cdot 1 \]
   \[ = B \]

b) \( X'YZ + XZ \)
   \[ = Z(X'Y + X) \]
   \[ = Z(X' + X)(Y + X) \]
   \[ = Z \cdot 1 \cdot (Y + X) \]
   \[ = Z \cdot (X + Y) \]
   
   \text{Step: Not Neg. if you use \( E \equiv 2 \cdot 1 \equiv 2 \)}

C)

\[ (x+y)'(x'+y') \]
\[ x'y'(x'+y) \] \text{De Morgan's}
\[ x'x'y' + x'y'y' \]
\[ x'y' + x'y' \]
\[ x'(y' + y) \]
\[ x'y' \]

C)

\[ xy + x(\overline{wz} + wz') \]
\[ = xy + x \overline{w(z + z')} \]
\[ = xy + x \overline{w} \cdot 1 \]
\[ = xy + x \overline{w} \]
\[ = x(y + w) \]
\[ = x(y + w) \]

\[ \]
Problem 1 cont.

e) \((BC' + A'D)(AB' + CD')\)

\[= BC'AB' + BC'CD' + A'DAB' + A'DCD'\]

\[= C'AD(AB') + B(C'CD') + (A'DAB') + A'DCD'\]

\[= C'AD + B + AD + A'DCD'\]

\[= 0 + 0 + 0 + 0\]

\[= 0\]

f) \((x + y + z')(x' + z') = \frac{xx' + xz' + y'y'z' + z'x' + z'z'}{z'}\)

\[= \frac{xz' + y'x' + y'z' + z'x' + z'}{z'}\]

\[= \frac{z' + y'x' + y'z' + z'}{z'}\]

\[= \frac{z' + y'x'}{z'}\]

\[= \frac{z' + y'x'}{z'}\]

Note: There are many ways to get the same result.
Problem 2 —

Problem 2.6 from the text

Draw logic diagrams of the circuits that implement the original & simplified expressions in Problem 2.5

(Note: Truth tables are not necessary. I used to verify my work.)

These are not optimized - may have too many unneeded inverters.

\[ \text{A MATCH! YEAH!} \]
Problem 2 cont.

b) \[ \begin{array}{ccc}
    x & y & z \\
    \hline
    0 & 0 & 0 \\
    0 & 0 & 1 \\
    0 & 1 & 0 \\
    0 & 1 & 1 \\
    1 & 0 & 0 \\
    1 & 0 & 1 \\
    1 & 1 & 0 \\
    1 & 1 & 1 \\
\end{array} \]

For the given Boolean functions, determine the truth table for the following expressions:

- \( E \)
- \( X + Y \)

The truth table is as follows:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( y )</th>
<th>( z )</th>
<th>( x' )</th>
<th>( y' )</th>
<th>( z' )</th>
<th>( x \cdot y \cdot z )</th>
<th>( E )</th>
<th>( X + Y )</th>
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</tr>
</tbody>
</table>

The final output is the same for both expressions, hence:

\( E = X + Y \)
Problem 2 cont.

\[ X \]
\[ Y \]

\[ x \]
\[ y \]

BUFFED NOT NECESSARY

<table>
<thead>
<tr>
<th>X</th>
<th>Y</th>
<th>X+Y</th>
<th>X+Y'</th>
<th>(X+Y)(X+Y')</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

SAME
Problem 2 cont.

\[ \begin{array}{cccc|c|c|c|c|c} 
X & Y & W & Z & \overline{W} & W + \overline{W} & X \cdot Y \cdot Z & X + Y + Z & W \cdot (Y \cdot \overline{W}) \\
\hline 
0 & 0 & 0 & 0 & 1 & 1 & 0 & 1 & 0 \\
0 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 1 \\
0 & 0 & 1 & 0 & 1 & 1 & 0 & 1 & 1 \\
0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\
0 & 1 & 1 & 0 & 1 & 1 & 0 & 1 & 0 \\
0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
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1 & 0 & 0 & 1 & 0 & 1 & 0 & 0 & 0 \\
1 & 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\
1 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
1 & 1 & 0 & 1 & 1 & 0 & 0 & 0 & 0 \\
1 & 1 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\
1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\
\end{array} \]
Problem 2 cont.

\[ F(\overline{A}, \overline{B}, \overline{C}, \overline{D}, \overline{A'}B'C', D', BC, \overline{A}D, \overline{B}C, AB', CD', AB'CD') = F \]

<table>
<thead>
<tr>
<th>A B C D</th>
<th>A' B' C' D'</th>
<th>\overline{BC}</th>
<th>\overline{A}D</th>
<th>\overline{B}C</th>
<th>A' B'C'</th>
<th>D'</th>
<th>F</th>
<th>AB'CD'</th>
</tr>
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<tbody>
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Problem 2:

![Logic Circuit Diagram]

<table>
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<tr>
<th>x</th>
<th>y</th>
<th>z</th>
<th>x'</th>
<th>y'</th>
<th>z'</th>
<th>x'z</th>
<th>x'y'z'</th>
<th>F</th>
<th>x'y'</th>
<th>z' + y'x</th>
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</tbody>
</table>

Same
Problem 3

Find the complement of the following expressions

a) \( xy' + x'y \)
\[
= (xy' + x'y)' \quad \text{← Take complement}
\]
\[
= (xy')'(x'y)'
\]
\[
= (x + y)(x + y')
\]
\[
= xx' + x'y' + xy + yy'
\]
\[
= xy' + x'y \quad \text{←}
\]

b) \((A + B)(C' + D)\)
\[
= (A + B)(C' + D) \quad \text{← Take complement}
\]
\[
= (A + B)' + (C + D)'
\]
\[
= A'B' + CD' \quad \text{←}
\]

c) \(A + CD'\)
\[
= (A + CD')' \quad \text{← Take complement}
\]
\[
= (A' + CD')'
\]
\[
= A'(C' + D) \quad \text{←}
\]
Problem 3d

Find The Complement of the following expressions

\( (x'y'+x'y + x'y')' \rightarrow \text{To find complement use DeMorgan's Twice} \)

\( (x'y')' \cdot (x'y')' = (x'y')' \cdot (x'y')' = (x+y+z')(x+y) \)

\( (x+y+z')(x+y)'(x+y) \)

\( x(x+y+z')(x+y) \)

\( x+1+y'+z' \cdot 1 \cdot (x+y) \)

\( x+1+y'+z' \cdot 1 \cdot (x+y) \)

\( x+1+y'+z' \cdot 1 \cdot (x+y) \)

\( x+1+y'+z' \cdot 1 \cdot (x+y) \)

\( F = x+z'y \)

Note: There may be other solution paths.
Problem 4

List the truth table for the function

\[ F = x'y'z + x'y + x'z' \]

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
<th>z</th>
<th>x'</th>
<th>y'</th>
<th>z'</th>
<th>xy</th>
<th>x'y</th>
<th>x'z'</th>
<th>F</th>
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PROBLEMS

PROBLEM 2.17C

OBTAIN A TRUTH TABLE & EXPRESS IN SUM-OF-MIN TERMS & PRODUCT-OF-MAX TERMS FORMS.

\[ F = zx'y' + wx'y + wyz' + wy'z' \]

<table>
<thead>
<tr>
<th>( w )</th>
<th>( x )</th>
<th>( y )</th>
<th>( z )</th>
<th>( wx'y )</th>
<th>( wyz' )</th>
<th>( w'yz' )</th>
<th>( w'x'y'z' )</th>
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<td>15</td>
</tr>
</tbody>
</table>

SUM-OF-MIN TERMS

\[ F = \Sigma (0, 1, 3, 4, 5, 9, 10, 11, 14) \]

OR

\[ F = wx'y'z' + w'x'y' + wxy' + w'x'z' + w'x'y + wx'y' + wxy' + wxy'z' + wxy'z \]

PRODUCT-OF-MAX TERMS

\[ F = \Pi (2, 4, 7, 8, 12, 13, 15) \]

OR

\[ F = (w+x+y+z)(w+x+y+\bar{z})(w+x+\bar{y}+\bar{z})(w+x+y+\bar{z})(w+x+y+z)(w+x+y+z)(w+x+y+z) \]
Problem 16 - Problem 20

Express the complement of the following functions in sum-of-minterms form.

a) \( F(A, B, C, D) = \Sigma (3, 5, 7, 9, 11, 15) \)

These indicate min terms (where function = 1).
So for complement these would be zero.
A missing term would be 1.

\( F(A, B, C, D) = \Sigma (0, 1, 2, 4, 6, 8, 10, 12, 13, 14) \)

b) \( F(x, y, z) = \Pi (2, 4, 5, 7) \)

These indicate the max terms (where function = 0).
So these terms will = 1 when complemented.

\( F(x, y, z) = \Sigma (0, 3, 6, 7) \)
Problem 7

Draw the logic diagram corresponding to the following Boolean expressions without simplifying them and find the truth tables.

(a) \((BD + A)(A' + C') = F\)

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>A'</th>
<th>C'</th>
<th>BD</th>
<th>BD + A</th>
<th>A' + C'</th>
<th>F</th>
</tr>
</thead>
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Problem 7 cont.

b) \( BD' + B'C'D + A'B = F \)

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\[ A \quad B \quad C \quad D \]

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0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 1 \\
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\end{array} \]
Problem 7 cont.

\( (A'B + C)(B'D') = F \)

\[
\begin{array}{cccc|ccc|c}
A & B & C & D & B' & D' & A'B + C & B'D' & F \\
0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 \\
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