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Computer Organization and Architecture (10th Edition)

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Problem

Simplify the following expressions according to the commutative law:

a. $A \cdot \bar{B} + \bar{B} \cdot A + C \cdot D \cdot E + \bar{C} \cdot D \cdot E + E \cdot \bar{C} \cdot D$

b. $A \cdot B + A \cdot C + B \cdot A$

c. $(L \cdot M \cdot N)(A \cdot B)(C \cdot D \cdot E)(M \cdot N \cdot L)$

d. $F \cdot (K + R) + S \cdot V + W \cdot \bar{X} + V \cdot S + \bar{X} \cdot W + (R + K) \cdot F$

Step-by-step solution

Step 1 of 5

Simplifying Expression according to Commutative law:

Commutative law is given by

- $AB = BA$
- $A+B = B+A$

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Step 2 of 5

a. Consider the given expression $A \cdot \bar{B} + \bar{B} \cdot A + C \cdot D \cdot E + \bar{C} \cdot D \cdot E + E \cdot \bar{C} \cdot D$

Explanation:

The given expression is evaluated as shown below:

$$\begin{aligned}
 F &= A \cdot \bar{B} + \bar{B} \cdot A + C \cdot D \cdot E + \bar{C} \cdot D \cdot E + E \cdot \bar{C} \cdot D \\
 &= A \cdot \bar{B} + C \cdot D \cdot E + \bar{C} \cdot D \cdot E + E \cdot \bar{C} \cdot D \text{ (From Commutative law 1 } A \cdot \bar{B} + \bar{B} \cdot A) \\
 &= A \cdot \bar{B} + C \cdot D \cdot E + \bar{C} \cdot D \cdot E \\
 &= A \cdot \bar{B} + C \cdot D \cdot E + \bar{C} \cdot D \cdot E \text{ (} \bar{C} \cdot D \cdot E + \bar{C} \cdot D \cdot E = \bar{C} \cdot D \cdot E) \\
 &= A \cdot \bar{B} + C \cdot D \cdot E + \bar{C} \cdot D \cdot E
 \end{aligned}$$

Thus, according to Commutative Law simplified expression $F = A \cdot \bar{B} + C \cdot D \cdot E + \bar{C} \cdot D \cdot E$

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Step 3 of 5

b. Consider the given expression $A.B + A.C + B.A$.

Explanation:

The given expression is evaluated as shown below:

$$\begin{aligned} F &= A.B + A.C + B.A \\ &= A.B + B.A + A.C \\ &= A.B + A.C \text{ (From Commutative law 1 } AB = BA) \end{aligned}$$

Thus, according to Commutative Law simplified expression $F = A.B + A.C$

[Comment](#)

Step 4 of 5

c. Consider the given expression $(L.M.N)(A.B)(C.D.E)(M.N.L)$.

Explanation:

The given expression is evaluated as shown below:

$$\begin{aligned} F &= (L.M.N)(A.B)(C.D.E)(M.N.L) \\ &= (A.B)(C.D.E)(M.N.L)(L.M.N) \\ &= (A.B)(C.D.E)(M.N.L) \end{aligned}$$

Because $A.A = A$ that is $(M.N.L)(M.N.L) = (M.N.L)$

Thus simplified expression is $F = (A.B)(C.D.E)(M.N.L)$.

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Step 5 of 5

d. Consider the expression $F.(K + R) + S.V + W.\bar{X} + V.S + \bar{X}.W + (R + K).F$.

Explanation:

The given expression is evaluated as shown below:

$$\begin{aligned} F &= F.(K + R) + S.V + W.\bar{X} + V.S + \bar{X}.W + (R + K).F \\ &= F.(K + R) + (R + K).F + S.V + V.S + W.\bar{X} + \bar{X}.W \\ &= F.(K + R) + S.V + V.S + W.\bar{X} + \bar{X}.W \text{ (From Commutative Law 1)} \\ &= F.(K + R) + S.V + W.\bar{X} + \bar{X}.W \text{ (From Commutative Law 1)} \\ &= F.(K + R) + S.V + W.\bar{X} \text{ (From Commutative Law 1)} \\ &= F.(K + R) + S.V + W.\bar{X} \end{aligned}$$

Thus, according to Commutative Law simplified expression is $F = F.(K + R) + S.V + W.\bar{X}$.

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