**Assignment #2**

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1. Use the laws of propositional calculus to find a formula in disjunctive normal for tautologically equivalent to the formula:   
     
   State all laws of propositional calculus that you use. Simplify your result as must as possible.  
     
    Elimination of implication Elimination of implication Elimination of implication Double-negation law  
    Distributive law  
    is equivalent to the disjunctive formula
2. Use the laws of propositional calculus to find a formula in conjunctive normal for tautologically equivalent to the formula:  
     
    Elimination of implication Distributive law  
    Elimination of implication   
    Elimination of implication Associative law   
    Commutative law  
    Idempotent law   
    Absorption law   
    Idempotent law   
     
   Therefore, is equivalent to the conjunctive formula
3. Use the truth table method to find the disjunctive normal for of the formula in **question 1**, and the conjunctive normal form of the formula in **question 2**. How do the resulting formula compare to the ones you obtained in **questions 1 and 2**? Justify your answer.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |  |  |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |

Therefore, since is true when the following values are true,

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 |

Therefore, since is false when the following values are true,  
  
 is,   
  
and that the conjunctive formula for is,

The resulting formulas compare the formulas in questions 1 and 2 by the fact that they are equal. Furthermore, the formulas in question 3 include every case produced by the truth table, but the results in questions 1 and 2 include a more compressed version of these results, thanks to the propositional laws of calculus.

,,e ore, since he disjunctive obtained in 1) and 2) =al for of the formula in 1)a

1. Connectives.
   1. Show that the set of connectives is adequate, where ⊕ is define the truth table:

|  |  |  |
| --- | --- | --- |
|  |  |  |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

During the class discussion we conclude that any set of connectives is adequate if it can generate a negation and has one of the following connectives   
  
Therefore, we use a truth table to find an expression that is equivalent to a negation.

|  |  |  |
| --- | --- | --- |
|  |  |  |
| 0 | 1 | 1 |
| 1 | 0 | 0 |

Therefore, since is logically equivalent to. We can conclude that this set, is an adequate set, because the set is an adequate set that can be extracted from.

* 1. Show that the set of connectives is not adequate.  
       
     To prove that this set is an inadequate set, the set must be able to generate a formula that only uses one variable and is able to equal the negation of that variable. If we look at the truth tables of we find that there does not exist a function that uses one variable and is able to generate a negation of that variable. This is because the will always return a true whenever its variables are the same, and if the will return 1 if its values are 1 and 0 otherwise. Any combination of these two connectives will either result in a constant value of 1, or 0, or the same value, p.  
       
     However, the formula is a valid formula. This formula is logically equivalent to the negation of p. In this case the set of connectives is not adequate.

1. Give formal proofs that the following arguments are valid using only the 11 rules of formal deduction and the theorems proved in class. State each rule you use.  
   1. Argument:   
        
        
      1.   
      2.   
      3.   
      4.   
      5.   
      6.   
      7.   
      8.   
      9.   
      10.   
      11.   
        
      Therefore, proven.

* 1. Argument:   
       
       
     1.   
     2.   
     3.   
     4.   
     5.   
     6.   
     7.   
     8.   
     9.   
       
     Therefore.