

Assignment-1

Foundation of Logical Thoughts (CS-13104)

Date: 30/8/2020

Note:

1. Please show your work. Partial credit cannot be given for a wrong answer if your work isn't shown.
2. Write assumptions correctly if used anywhere in the answer.
3. Questions are related to Chapter 1 (Rosen, Kenneth H. Discrete mathematics and its applications / Kenneth H. Rosen. — 7th ed.)
4. Submit the assignment at MSTEAM by 03/09/2020 at 17:00 hrs.
5. For any query, you can write a mail to tassign2017@gmail.com
6. For reference: <https://ocw.mit.edu/ans15436/ZipForEndUsers/6/6-042j-fall-2010/6-042j-fall-2010.zip>

1. Consider the following two statements.
 - (a) A1: If the thief is known to be smart, then he will not be caught.
 - (b) A2: If the thief is lazy, he will be caught.

verify if the statement is true "If a person is lazy, he is not known to be smart"

2. Why are the duals of two equivalent compound propositions also equivalent, where these compound propositions contain only the operators \wedge , \vee , and \neg ?
3. Determine whether $\forall x(P(x) \leftrightarrow Q(x))$ and $\forall x P(x) \leftrightarrow \forall x Q(x)$ are logically equivalent. Justify your answer. Show that $\exists x(P(x) \vee Q(x))$ and $\exists x P(x) \vee \exists x Q(x)$ are logically equivalent.
4. Use quantifiers to express the distributive laws of multiplication over addition for real numbers.
5. Show that $\forall x P(x) \wedge \exists x Q(x)$ is logically equivalent to $\forall x \exists y (P(x) \wedge Q(y))$, where all quantifiers have the same nonempty domain.
6. What is wrong with this argument? Let $S(x, y)$ be "x is shorter than y." Given the premise $\exists s S(s, \text{Max})$, it follows that $S(\text{Max}, \text{Max})$. Then by existential generalization it follows that $\exists x S(x, x)$, so that someone is shorter than himself.
7. For each of these arguments determine whether the argument is correct or incorrect and explain why.
 - a) All students in this class understand logic. Xavier is a student in this class. Therefore, Xavier understands logic.
 - b) Every computer science major takes discrete mathematics. Natasha is taking discrete mathematics. Therefore, Natasha is a computer science major.
 - c) All parrots like fruit. My pet bird is not a parrot. Therefore, my pet bird does not like fruit.

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8. Translate the following sentences from English to predicate logic. The domain that you are working over is X , the set of students. You may use the functions $S(x)$, meaning that "x has been a student of FoLT," $A(x)$, meaning that "x has gotten an 'A' in FoLT," $T(x)$, meaning that "x is a TA of FoLT," and $E(x, y)$, meaning that "x and y are the same students."
- a. There are Students who have taken FoLT and have gotten A's in FoLT.
 - b. All Students who are FoLT TA's and have taken FoLT got A's in FoLT.
 - c. There are no Students who are FoLT TA's who did not get A's in FoLT.
 - d. There are at least three Students who are TA's in FoLT and have not taken FoLT.