Department of Computer Science and Engineering
M.Tech. I Computer Science and Engineering
Mathematical Foundations of Computer Science CSE 601
Tutorial 1

1. Which of these sentences are propositions? What are the truth values of those that are propostions?
    a. $2 + 3 = 5$
    b. Boston is the capital of Massachusetts.
    c. $X + 2 = 11$

2. Let p and q be the propositions
    p: I bought a lottery ticket this week.
    q: I won the million-dollar jackpot on Friday.
    Express each of these propositions as an English sentence
    a. $p \wedge q$
    b. $p \vee q$
    c. $\neg p$
    d. $\neg p \vee (p \wedge q)$

3. Let p and q be the propositions
    p : It is below freezing.
    q : It is snowing.
    Write these propositions using p and q and logical connectives.
    a. It is below freezing and snowing.
    b. It is below freezing but not snowing.
    c. It is not below freezing and it is not snowing.

4. Fuzzy logic is used in artificial intelligence. In fuzzy logic, a proposition has a truth value that is a number between 0 and I, inclusive. A proposition with a truth value of 0 is false and one with a truth value of 1 is true. Truth values that are between 0 and 1 indicate varying degrees of truth. For instance, the truth value 0.8 can be assigned to the statement "Fred is happy," because Fred is happy most of the time, and the truth value 0.4 can be assigned to the statement "John is happy," because John is happy slightly less than half the time.
    a. The truth value of the negation of a proposition in fuzzy logic is 1 minus the truth value of the proposition. What are the truth values of the statements "Fred is not happy" and "John is not happy"?
    b. The truth value of the conjunction of two propositions in fuzzy logic is the minimum of the truth values of the two propositions. What are the truth values of the statements "Fred and John are happy" and "Neither Fred nor John is happy"?
    c. The truth value of the disjunction of two propositions in fuzzy logic is the maximum of the truth values of the two propositions. What are the truth values of the statements "Fred is happy, or John is happy" and "Fred is not happy, or John is not happy"?

5. Express these system specifications using the propositions p "The message is scanned for viruses" and q "The message was sent from an unknown system" together with logical connectives.
    a. "The message is scanned for viruses whenever the message was sent from an unknown system."
    b. "The message was sent from an unknown system but it was not scanned for viruses."
    c. "It is necessary to scan the message for viruses whenever it was sent from an unknown system."
    d. "When a message is not sent from an unknown system it is not scanned for viruses."

6. Express these system specifications using the propositions p "The user enters a valid password," q "Access is granted," and r "The user has paid the subscription fee" and logical connectives.
    a. "The user has paid the subscription fee, but does not enter a valid password."
    b. "Access is granted whenever the user has paid the subscription fee and enters a valid password."
    c. "Access is denied if the user has not paid the subscription fee."
    d. "If the user has not entered a valid password but has paid the subscription fee, then access is granted."

7. Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives.
    a. Something is not in the correct place.
    b. All tools are in the correct place and are in excellent condition.
    c. Everything is in the correct place and in excellent condition.
    d. Nothing is in the correct place and is in excellent condition.
    e. One of your tools is not in the correct place, but it is in excellent condition.

8. What rule of inference is used in each of these arguments?
    a. Alice is a mathematics major. Therefore, Alice is either a mathematics major or a computer science major.
    b. Jerry is a mathematics major and a computer science major. Therefore, Jerry is a mathematics major.
    c. If it is rainy, then the pool will be closed. It is rainy. Therefore, the pool is closed.
    d. If it snows today, the university will close. The university is not closed today. Therefore, it did not snow today.
    e. If I go swimming, then I will stay in the sun too long. If I stay in the sun too long, then I will sunburn. Therefore, if I go swimming, then I will sunburn.
9. Determine whether each of these arguments is valid. If an argument is correct, what rule of inference is being used? If it is not, what logical error occurs?
    a. If n is a real number such that n > 1, then n 2 > 1. Suppose that n 2 > 1. Then n > 1.
    b. If n is a real number with n > 3, then $n^2 > 9$. Suppose that $n^2 \leq 9$. Then n ≤ 3.
    c. If n is a real number with n > 2, then $n^2 > 4$. Suppose that n ≤ 2. Then $n^2 \leq 4$.