

CS 4269/5469 – Fundamentals of Logic In Computer Science

SEMESTER II 2025-2026

Pre-Requisite Quiz
14 January 2026

Propositional and Predicate Logic - Basics

Question 1. Consider the following two statements:

S1 '*Rahul is friends with Sam.*'

S2 '*All friends of Sam love music.*'

If both statements **S1** and **S2** are assumed to be true, then which of the following are also necessarily true (multiple answers allowed).

- (a) '*Rahul loves music.*'
- (b) '*Sam loves music.*'
- (c) '*Rahul does not love music.*'
- (d) '*Sam does not love music.*'

Question 2. Consider the following two statements:

S1 '*The humidity rises whenever it rains.*'

S2 '*It was humid yesterday.*'

If both statements **S1** and **S2** are assumed to be true, then which of the following are also necessarily true (multiple answers allowed).

- (a) '*It rained yesterday.*'
- (b) '*It did not rain yesterday.*'

Question 3. Consider the following two statements:

S1 '*There is a friend of Atif who is taking CS4269.*'

S2 '*Tianyin is a friend of Atif.*'

If both statements **S1** and **S2** are assumed to be true, then which of the following are necessarily **false** (multiple answers allowed).

- (a) '*Tianyin is taking CS4269.*'
- (b) '*All friends of Atif are taking CS4269.*'

Question 4. Consider the following statement:

S1 '*For every natural number n , there is a real number r that is the square root of n .*'

Based on **S1**, can you conclude that 5.5 has a real square root? Can you conclude that 5 has a real square root? Why or why not?

Discrete Mathematics

Question 5. What is a set? What is the cardinality of a set? Illustrate these concepts using a simple example.

Question 6. What is a finite set? What is a countable set? What is an uncountable set? Illustrate using examples.

Question 7. What is a function? What is the domain, range and co-domain of a function? When is a function injective, surjective or bijective?

Question 8. What is the power set of a set S ? Describe a set S and a function f such that f is a bijection from S to its power set.

Question 9. Use induction to prove that the sum of the squares of the first n natural numbers is
$$\sum_{k=0}^n k^2 = \frac{n(n+1)(2n+1)}{6}.$$

Question 10. What is an undirected graph? What is the degree of a vertex in a graph? What is the relationship between the number of edges in a graph and the sum of the degrees of vertices in the graph?

Question 11. Use induction to prove that the number of nodes in a complete binary tree of height h is $2^h - 1$.

Theory of Computation

Question 12. What is a string/word over an alphabet Σ ? What is a language over Σ ? What is Σ^* ?

Question 13. Given an example of a regular language, a context-free language, and a context-free grammar.

Question 14. What is a Turing machine? What is the language accepted by a Turing machine?

Question 15. What is a recursive/decidable language? Give an example.

Question 16. Give an example of an undecidable problem (or alternatively a non-recursive language).

Question 17. When is a Turing machine said to run in deterministic polynomial time?

Question 18. Define the complexity class NP.

END OF PAPER