

-
1. For each of these statements find a domain for which the statement is true and a domain for which the statement is false.
 - a) Everyone is studying discrete mathematics.
 - b) Everyone is older than 21 years.
 - c) Every two people have the same mother.
 - d) No two different people have the same grandmother.
 2. Translate each of these statements into logical expressions using predicates, quantifiers, and logical connectives.
 - a) No one is perfect.
 - b) Not everyone is perfect.
 - c) All your friends are perfect.
 - d) At least one of your friends is perfect.
 - e) Everyone is your friend and is perfect.
 - f) Not everybody is your friend or someone is not perfect.
 3. Express each of these system specifications using predicates, quantifiers, and logical connectives.
 - a) Every user has access to an electronic mailbox.
 - b) The system mailbox can be accessed by everyone in the group if the file system is locked.
 - c) The firewall is in a diagnostic state only if the proxy server is in a diagnostic state.
 - d) At least one router is functioning normally if the throughput is between 100 kbps and 500 kbps and the proxy server is not in diagnostic mode.
 4. Express each of these statements using quantifiers. Then form the negation of the statement so that no negation is to the left of a quantifier. Next, express the negation in simple English. (Do not simply use the phrase “*It is not the case that.*”)
 - a) No one has lost more than one thousand dollars playing the lottery.
 - b) There is a student in this class who has chatted with exactly one other student.
 - c) No student in this class has sent e-mail to exactly two other students in this class.
 - d) Some student has solved every exercise in this book.
 - e) No student has solved at least one exercise in every section of this book.
 5. The uniqueness quantifier denoted by $\exists!$ and used as $\exists!P(x)$ states “*there is a unique x such that $P(x)$ is True.*”
Express the quantification $\exists!P(x)$ using universal quantifications, existential quantifications, and logical operators.
 6. For each of these arguments determine whether the argument is correct or incorrect and explain why.
 - a) Everyone enrolled in the university has lived in a dormitory. Mia has never lived in a dormitory. Therefore, Mia is not enrolled in the university.
 - b) A convertible car is fun to drive. Isaac’s car is not a convertible. Therefore, Isaac’s car is not fun to drive.
 - c) Quincy likes all action movies. Quincy likes the movie Eight Men Out. Therefore, Eight Men Out is an action movie.

- d) All lobstermen set at least a dozen traps. Hamilton is a lobsterman. Therefore, Hamilton sets at least a dozen traps.
7. Use resolution to show that the hypotheses “*It is not raining or Yvette has her umbrella,*” “*Yvette does not have her umbrella or she does not get wet,*” and “*It is raining or Yvette does not get wet*” imply that “*Yvette does not get wet.*”
8. The Logic Problem, taken from WFF’N PROOF, The Game of Logic, has these two assumptions:
1. “*Logic is difficult or not many students like logic.*”
 2. “*If mathematics is easy, then logic is not difficult.*”

By translating these assumptions into statements involving propositional variables and logical connectives, determine whether each of the following are valid conclusions of these assumptions:

- a) That mathematics is not easy, if many students like logic.
 - b) That not many students like logic, if mathematics is not easy.
 - c) That mathematics is not easy or logic is difficult.
 - d) That logic is not difficult or mathematics is not easy.
 - e) That if not many students like logic, then either mathematics is not easy or logic is not difficult.
9. Determine whether this argument is valid.

If Superman were able and willing to prevent evil, he would do so. If Superman were unable to prevent evil, he would be impotent; if he were unwilling to prevent evil, he would be malevolent. Superman does not prevent evil. If Superman exists, he is neither impotent nor malevolent. Therefore, Superman does not exist.