

CS 311H: Discrete Math (Fall 2026)

Problem Set #2

Due: Sep 11, 2026

Problem 1: Translating English to Nested Quantifiers

Let $L(x, y)$ be the predicate “ x loves y ,” where the domain for both x and y consists of all people in the world D_w . Use quantifiers to express each of these statements.

- (a) Everybody loves Jerry.
- (b) Everybody loves somebody.
- (c) There is somebody whom everybody loves.
- (d) Nobody loves everybody.
- (e) There is somebody whom Lydia does not love.
- (f) There is somebody whom no one loves.
- (g) There is exactly one person whom everybody loves.
- (h) There is exactly two people that Lynn loves.
- (i) Everyone loves himself or herself.
- (j) There is someone who loves no one besides himself or herself.

Problem 2: Not Mother of Self

Let x and y be in the domain of all living things L . Let $M(x, y)$ be the predicate x is the mother of y . Prove the following:

$$\frac{\left(\forall x | x \in L : \left(\forall y | y \in L : M(x, y) \rightarrow \neg M(y, x) \right) \right)}{\therefore \left(\forall x | x \in L : \neg M(x, x) \right)}$$

Problem 3: Prove using Rules of Inference

$$\begin{array}{l} (\exists y|y \in D : P(y)) \rightarrow (\forall x|x \in D : Q(x)) \\ P(a) \\ R(c) \rightarrow \neg (P(a) \wedge Q(b)) \\ \hline \therefore \neg (\forall z|z \in D : R(z)) \end{array}$$

Problem 4: Prove using the Rules of Inferences

$$\frac{\left(\forall y \mid y \in D : \left((\exists x \mid x \in D : F(x, b)) \rightarrow R(b, y) \right) \right)}{\therefore (\forall x \mid x \in D : F(a, x)) \rightarrow (\forall x \mid x \in D : (\exists y \mid y \in D : R(y, x)))}$$