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1. S(X) = X can swim

F(X) = X can catch fish

X = all bears

∀x (S(x) ∧ F(x))

Negation = ∃x ¬(S(x) ∧ F(x))

English: There exist bears that can’t swim and catch fish.

1. ∀x(P(x) 🡪 Q(x)) is not equivalent to ∀x P(x) 🡪 ∀x Q(x)

X = all people

P(x) = x is comedian

Q(x) = x is funny

∀x(P(x) 🡪 Q(x)) = all comedians are funny. But not everyone is comedian.

∀x P(x) 🡪 ∀x Q(x) = If everyone is comedian, then everyone is funny.

1. S(x) = x is a student

F(x) = x is a faculty member

A(x, y) x has asked y a question

1. ∃x∀y F(x) ∧ (S(y) 🡪 ¬A(x, y))
2. ∀x∃y (F(y) ∧ S(y)) 🡪 A(x, y)
3. PREFIX (x, y) = x is a prefix of y

SUBSTRING (x, y) = x is a substring of y

NO – 1S(x) = x is empty or a string of 0’s

1. ∃y (x = yyy)
2. NO – 1S(x) ∧ ∃y (x = yy)
3. ¬ (SUBSTRING (0, x) ∧ SUBSTRING (1, x))
4. Equal (m, n) = Zero(k) AND A(m, n, k)
5. One (n) = ∀x M(x, x, n) x = x . n
6. Prime (p) = ∀x NOT(One(x)) AND NOT(Equal(x, p) AND Greater(p, x) AND NOT(M(Zero(k), p, 1/x))
7. Two(n) = ∀x One(x) AND A(n, x, x)
8. I = ice

S = snow

C = school is open

E = exam postponed

1. I ∨ S 🡪 ¬C hyp 1
2. ¬C 🡪 E hyp 2
3. I ∨ S 🡪 E hypothetical syllogism 1,2
4. ¬E

¬ ( I ∨ S) Modus tollens 3, 4]

1. X = people

M = Mary

M(x) = x is Minnesotan

I(x) = x knows how to ice fish

C(x) = x in the class

1. C(m) ∧ M(m) hyp 1
2. ∀x M(x) 🡪 I(x) hyp 2
3. M(m) 🡪 I(m) universal instantiation 2
4. M(m) simplification 1
5. I(m) modes ponens
6. C(m) simplification 1
7. C(m) ∧ I(m) conjunction 5, 6
8. ∃x C(x) ∧ I(x) existential generalization 7
9. X = all bear

S(x) = x is good swimmer

C(x) = x can catch fish

H(x) = x goes hungry

1. ∀x S(x) hyp 1

(2)S(c) universal instantiation 1

(3) C(x) 🡪 ¬ H(x) hyp 2

(4) ¬ C(x) 🡪 ¬ S(x) hyp 3

(5) S(x) 🡪 C(x) Modus tollens 4

(6) S(c) 🡪 C(c) universal instantiation 5

(7) C(c) 🡪 ¬ H(c) universal instantiation 3

(8) S(c) 🡪¬ H(c) hypothetical syllogism 7, 8