Conjunctive Normal Form

$\forall x\ (P(x) \rightarrow (\forall y\ (P(y) \rightarrow P(f(x,y))) \wedge \neg\forall y\ (Q(x,y) \rightarrow P(y))))$

2. Eliminate $\rightarrow$

$\forall x\ (\neg P(x) \vee (\forall y\ (\neg P(y) \vee P(f(x,y))) \wedge \neg\forall y\ (\neg Q(x,y) \vee P(y))))$

3. Reduce scope of negation

$\forall x\ (\neg P(x) \vee (\forall y\ (\neg P(y) \vee P(f(x,y))) \wedge \exists y\ (Q(x,y) \wedge \neg P(y))))$

4. Standardize variables

$\forall x\ (\neg P(x) \vee (\forall y\ (\neg P(y) \vee P(f(x,y))) \wedge \exists z\ (Q(x,z) \wedge \neg P(z))))$

5. Eliminate existential quantification (skolemize)

$\forall x\ (\neg P(x) \vee (\forall y\ (\neg P(y) \vee P(f(x,y))) \wedge (Q(x,g(x)) \wedge \neg P(g(x)))))$

6. Drop universal quantification symbols

$(\neg P(x) \vee ((\neg P(y) \vee P(f(x,y))) \wedge (Q(x,g(x)) \wedge \neg P(g(x)))))$

7. Convert to conjunction of disjunctions (distribute)

$(\neg P(x) \vee (\neg P(y) \vee P(f(x,y)))) \wedge (\neg P(x) \vee (Q(x,g(x))) \wedge \neg P(g(x))))$

$(\neg P(x) \vee \neg P(y) \vee P(f(x,y))) \wedge (\neg P(x) \vee Q(x,g(x))) \wedge (\neg P(x) \vee \neg P(g(x)))$

1

1. all X (read (X) --> literate (X))
2. all X (dolphin (X) --> ~literate (X))
3. exists X (dolphin (X) ^ intelligent (X))

(a translation of ``Some dolphins are intelligent")

``Are there some who are intelligent but cannot read?"

4. exists X (intelligent(X) ^ ~read (X))

Set of clauses (1-3):

1. ~read(X) v literate(X)
2. ~dolphin(Y) v ~literate(Y)

3a. dolphin (a)

3b. intelligent (a)

Negation of 4:

~(exists Z (intelligent(Z) ^ ~read (Z)))

In Clausal form:

~intelligent(Z) v read(Z)

2

Resolution proof (on board)