

## HW2 on Normal Forms (Due on Mar. 9)

1. Give the simplest DNF and CNF of the following statements:

$$1) ((P \rightarrow Q) \leftrightarrow (\neg Q \rightarrow \neg P)) \wedge R$$

$$2) P \vee (\neg P \vee (Q \wedge \neg Q))$$

$$3) (P \wedge (Q \wedge S)) \vee (\neg P \wedge (Q \wedge S))$$

2. Give the full DNF of the following statements:

$$1) (\neg P \vee \neg Q) \rightarrow (P \leftrightarrow \neg Q)$$

$$2) (\neg R \wedge (Q \rightarrow P)) \rightarrow (P \rightarrow (Q \vee R))$$

$$3) (P \rightarrow (Q \wedge R)) \wedge (\neg P \rightarrow (\neg Q \wedge \neg R))$$

3. Give the prenex normal forms of the following statements:

$$1) (\forall x)(P(x) \rightarrow (\exists y)Q(x,y))$$

$$2) (\forall x)(\forall y)((\exists z)P(x,y,z) \wedge (\exists u)Q(x,u)) \rightarrow (\exists v)Q(y,v))$$

4. Give the prenex DNF and CNF of the following statements:

$$1) ((\exists x)P(x) \vee (\exists x)Q(x)) \rightarrow (\exists x)(P(x) \vee Q(x))$$

$$2) (\forall x)(P(x) \rightarrow Q(x,y)) \rightarrow ((\exists y)(P(y) \wedge (\exists z)Q(y,z)))$$