CIS 716 Homework 4

1. Using the proof rules in the lecture notes and those given below, try to prove the following:

   (a) $(p, p \Rightarrow (q \wedge r)) \vdash (q \vee r)$

   (b) $(p \wedge (p \Rightarrow (q \wedge r))) \vdash (q \vee r)$

   (c) $(p \Rightarrow (q \wedge r))) \vdash (p \Rightarrow q)$

   (30 points)

   Some proof rules that aren't in the lecture notes are:

   $$\frac{\vdash \phi \Leftrightarrow \psi}{\vdash \phi \Rightarrow \psi; \vdash \psi \Rightarrow \phi} \Leftrightarrow\text{-E}$$

   $$\frac{\vdash \phi \Rightarrow \psi; \vdash \psi \Rightarrow \phi}{\vdash \phi \Leftrightarrow \psi} \Leftrightarrow\text{-I}$$

   $$\frac{\vdash \neg\neg\phi}{\vdash \phi} \neg\text{-E}$$

   $$\frac{\phi \vdash \bot}{\vdash \neg\phi} \neg\text{-I}$$

   For the last of these rules, remember that $\bot$ stands for any formula which is inconsistent (for example $\phi \wedge \neg\phi$).

2. Use the truth table method to determine whether:

   $$(p \wedge (p \Rightarrow (q \wedge r))) \models (q \vee r)$$

3. Let

$D(x)$	means that x is a day
$R(x)$	means that x is rainy
$S(x)$	means that x is sunny

Symbolise each of the following:

(a) Every day is sunny.

(b) Some days are not sunny.

(c) Every day that is not sunny is rainy.

(15 points)

4. Convert the following sentences to predicate logic form:

   (a) Every prime number other than 2 is odd.

   (b) Every cloud has a silver lining.

   (c) Nobody knows the trouble I seen.

   (d) Everybody hates grunge music.

   (e) Everybody hates all grunge music except that by Nirvana.

   (25 points)