cis32 homework # 3
sklar/spring-2006

- The homework is due in class on **Wednesday April 26**.
- This homework is worth **9 points** in total. The distribution of points is indicated below.

1. (1 point)
   Using the following propositions:
   
   \( p \)  It is raining  
   \( q \)  I have an umbrella  
   \( r \)  I get wet  

   formulate the following expressions in words:

   (a) \( p \land (q \lor r) \)
   
   (b) \( \neg p \lor r \)

2. (1 point)
   Write the truth table for:
   
   \(((p \land (q \Rightarrow r)) \lor s) \land t\)

3. (2 points)
   For each of the following propositional logic formulae, determine whether it is: a **tautology** (always true), **consistent** (true for some domains), **inconsistent** (never true).

   (a) \( p \lor q \lor \neg r \)
   
   (b) \( (p \land q) \Rightarrow r \)
   
   (c) \( p \Rightarrow (q \Rightarrow p) \)
   
   (d) \( (p \land (q \lor p)) \Leftrightarrow \neg p \)

4. (1 point)
   Convert the following sentences to predicate logic form:

   (a) Every cloud has a silver lining.
   
   (b) Nobody knows the trouble I seen.
5. (4 points)
Using the proof rules in the lecture notes and those given below, try to prove the following:

(a) \((p, p \Rightarrow (q \land r)) \vdash (p \lor r)\)
(b) \((p \land (p \Rightarrow (q \land r))) \vdash (p \lor r)\)

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

\[
\begin{align*}
\vdash \phi \equiv \psi & \quad \equiv-E \\
\vdash \phi \Rightarrow \psi; \vdash \psi \Rightarrow \phi & \quad \equiv-I \\
\vdash \phi \Rightarrow \psi; \vdash \psi \Rightarrow \phi & \quad \equiv-I \\
\vdash \neg \neg \phi & \quad \neg-E \\
\vdash \phi & \quad \neg-I
\end{align*}
\]

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