Solutions to CS 381 Test 1

February 19, 2003

1. Convert the following statements to if-then form in English:

(a) Few people can solve difficult problems.
   If problems are difficult, then few people can solve them.
(b) Healthy diet is necessary for healthy body.
   If a body is healthy, then the diet is healthy.
(c) Further technological advances are possible only if there are free discussions.
   If further technological advances are possible, then there are free discussions.
(d) You can not cash a check which is void. [20]
   If a check is void, then you can not cash it.

2. Negate the following statements in English. Give a form other than simply putting "not" or "it is not the case that" in front:

(a) If today is Tuesday then I have a test in Computer Science or in Biology.
   Today is Tuesday and I don't have a test in Computer Science or in Biology.
   Or Today is Tuesday and I don't have a test in Computer Science and I don't have a test in Biology.
(b) Everyone visited some room in this building.
   Someone has not visited any room in this building.
(c) Someone likes it but does not eat it.
   Everyone doesn't like it or eats it.
(d) Tomorrow it is going to rain or snow. [20]
   Tomorrow neither it is going to rain nor is it going to snow.

3. Find the converse and contrapositive of the following statement in English:

(a) If it is sunny, people are happy.
   Converse: If people are happy, then it is sunny.
   Contrapositive: If people are not happy, then it is not sunny.
(b) Some people like mathematics only if it is fun for them. [20]
   Converse: If mathematics is fun for some people then they like it.
   Contrapositive: If mathematics is not fun for some people then they don't like it.

4. Find the dual of \([True \land (P \lor \neg Q) \land \neg(Q \lor False)]\). [5]
   \([False \lor (P \land \neg Q) \lor \neg(Q \land True)]\]

5 (a) Express the argument given below using the symbol indicated for each proposition. [8]
(b) Check whether or not the reasoning is correct using inference rules on the propositions in symbolic form. [12]

**Argument:**
If I like mathematics(L), then either I study it hard(H) or I enjoy studying it(E). If I enjoy studying mathematics, then I pass the mathematics course(P). If I study mathematics hard, then I don’t like mathematics and if I enjoy studying mathematics then I study mathematics hard. But I like mathematics. Therefore I don’t pass the mathematics course.

(a)

\[
L \rightarrow (H \lor E) \\
E \rightarrow P \\
H \rightarrow \neg L \\
E \rightarrow H \\
L
\]

\[\neg P\]

(b)

\[H \rightarrow \neg L\]

\[L\]

\[\neg H\]

\[L \rightarrow (H \lor E)\]

\[L\]

\[H \lor E\]

\[\neg H\]

\[E\]

\[E \rightarrow P\]

\[P\]

This \(P\) contradicts the conclusion of the argument \(\neg P\).

Hence the argument is not correct.

6. Fill in the blanks:

(a) \(\neg[ [ P \land Q ] \rightarrow P ] \Leftrightarrow [ P \land [ Q \land \neg P ] ] \)

\(\Leftrightarrow [ [ P \land \neg P ] \land Q ] \Leftrightarrow [ F \land Q ] \)

(b) \([ P \land \neg ( \neg P \land Q ) ] \Leftrightarrow [ P \land [ F \lor \neg Q ] ] \)

\(\Leftrightarrow [ P \land [ F \lor \neg Q ] ] \Leftrightarrow [ P \lor [ F \land \neg Q ] ] \)

\(\Leftrightarrow [ P \lor [ F \land \neg Q ] ] \Leftrightarrow P\)

(c) \([ P \lor [ Q \land R ] ] \Leftrightarrow [ P \lor [ Q \land R ] ] \land [ P \lor R ] \)

[15]