Homework 1

Out Thu., 01/23
Due Thu., 01/30

INSTRUCTIONS:

• This assignment is due at the beginning of class on the indicated due date.

• Please include your name and student ID number on your assignment, and staple your pages together.

• Please write legibly and communicate your ideas clearly and precisely.

• The work you turn in must be your own (see “Class Policies” in the syllabus).

• It is not possible to cover every type of problem in an assignment, so don’t limit yourselves to just the problems given. For practice, you should work out additional problems from the text. (Answers to the odd-numbered problems are given at the end of the text.)

• Above all, have fun! Some of the problems have the flavor of recreational puzzles—and should be just as enjoyable.

Please hand in your answers to the following problems from the seventh edition of the Rosen text:

1. (4 points) p. 13, #12 (b), (e) and p. 13, #14 (c), (e). In #12, in some cases you may need to express your answer more naturally than what a literal translation of the proposition yields. In #14, the alternative forms of the conditional on p. 6 will be useful.

2. (3 points) Write the converse, inverse, and contrapositive of the proposition below. (The alternative forms of the conditional on p. 6 will be useful.)
   “The picnic will take place unless it rains.”

3. (5 points) (a) Suppose that you are marooned on a remote island that is inhabited by two types of people: “knights” who always tell the truth and “knaves” who always lie. You meet three people, A, B, and C. A says “If B is a knight then so is C”, B says “Either A or C, but not both, is a knight”, and C says “A is a knight”.
   Based on this information, determine who’s who, if it is possible. If not, then state so.
   Define appropriate propositional variables and use these to write suitable propositions for the above statements. Then draw your conclusion by reasoning directly from your propositions. (Do not use a truth table.)
4. (5 points) p. 23, #12. Write down appropriate propositions and determine your answer from these. *Do not use a truth table.* Explain your reasoning.

5. (5 points) p. 24, #34. If it is possible to do so, then determine who is chatting and who is not. Write down appropriate propositions and determine the answer from these. *Do not use a truth table.* Explain your reasoning.

6. (8 points) Establish each of the following logical equivalences using the equivalences given in Tables 6–8, Section 1.3. Follow the approach used in class and in Examples 6–8 p. 29–30. *Do not use truth tables.* Be sure to justify each step.
   
   (a) \((p \leftrightarrow q) \equiv (p \land q) \lor (\neg p \land \neg q)\).
   
   (b) \((p \to q) \land (q \to r) \to (p \to r) \equiv T\).

   *Note 1:* The equivalence in (a) above is already listed in Table 8; ignore this fact and derive it from first principles, using the other equivalences in Tables 6–8.

   *Note 2:* Examples 6–8 on p. 29–30 cite other examples as justification for some steps. Instead of doing this, you should cite the appropriate equivalence from Tables 6–8.

7. (5 points) p. 36, #50. For parts (a) and (b), show the equivalences directly from the definition of \(\downarrow\). *Do not use truth tables.* Note that in part (c), “Exercise 49” should really be “Exercise 45”. You will find it helpful to first read the paragraphs just above Exercises 43 and 46 and be aware of the result in Exercises 45.