CSc 144 — Discrete Mathematics for Computer Science I
Spring 2023 (McCann)

http://u.arizona.edu/~mccann/classes/144

Homework #3
(50 points)

Due Date: February 10th, 2023, at the beginning of class

───────────── **Directions** ─────────────

1. **This is an INDIVIDUAL assignment; do your own work! Submitting answers created by computers or by other people is NOT doing your own work.**

2. <u>Start early!</u> Getting help is much easier n days before the due date/time than it will be n hours before.

3. Write complete answers to each of the following questions, in accordance with the given directions. <u>Create your solutions as a PDF document such that each answer is clearly separated from neighboring answers, to help the TAs easily read them.</u> Show your work, when appropriate, for possible partial credit.

4. The questions that have section numbers are found in the Rosen text, available via D2L. Note that "(w,z)" is asking you to complete parts w and z only, not parts x and y.

5. If you have questions about any aspect of this assignment, help is available from the class staff via piazza.com and our office hours.

6. When your answers are ready to be turned in, do so on gradescope.com. Be sure to assign pages to problems after you upload your PDF. Need help? Visit https://help.gradescope.com/ and search for "Submitting an Assignment."

7. **Solutions submitted more than five minutes late will cost you a late day. Submissions more than 24 hours late are worth no points.**

───────────────────────────────

<u>Section 1.1: Propositional Logic</u>:

1. (2 points) Section 1.1, 12(g)

2. (4 points) Section 1.1, 24(b,f)

<u>Section 1.3: Propositional Equivalences</u>:

3. (4 points) Section 1.3, 12(a)

4. (4 points) Section 1.3, 16(a)

5. (4 points) Page 116, 4(c) (from the Review Questions at the end of Chapter 1)

<u>Section 1.4: Predicates and Quantifiers</u>:

6. (2 points) Section 1.4, 8(b)

7. (2 points) Section 1.4, 10(c)

8. (4 points) Section 1.4, 14(a,c)

9. (4 points) Section 1.4, 18(a,f)

<u>Section 1.5: Nested Quantifiers:</u>

10. (4 points) Section 1.5, 6(b,e)

11. (4 points) Section 1.5, 12(c,d)

<u>Not–from–the–textbook Questions:</u>

12. (4 points) We know that exclusive–or means "one or the other but not both." Table IV line (d) of the Page O' Logical Equivalences states that $p \oplus q \equiv (p \wedge \neg q) \vee (\neg p \wedge q)$. That covers the "one or the other" part, but it doesn't include "$\wedge \neg (p \wedge q)$" (the "but not both" part). Explain why the "but not both" part isn't needed in the equivalence.

13. (4 points) In the following English sentence, "it is not the case that" is meant to say that the rest of the sentence should be negated:

> It is not the case that overnight lows are not in the 60s or the furnace is running.

Such sentences are difficult to interpret, but we can apply principles of logic to improve them. Identify the simple propositions and logical operators in that sentence, express the sentence as a logical expression, apply double negation and the appropriate DeMorgan law to simplify the expression, and finally express the simplified expression in conversational English.

14. (4 points) "I got my CSc 110 program submitted at 4am. It works, I swear, but I have an if–statement condition in it that is a huge mess. You know logic and stuff, right? Can you show me how to clean it up?" Here's the Python condition your roommate is talking about:

```
temperature <= 206 and not (temperature > 206 and pressure <= 3) and
temperature <= 206 or pressure > 3 and pressure <= 3
```

He's already turned it in, so you can help him without committing an academic integrity violation. Use the Page O' Logical Equivalences to show him, step by step, how his condition can be simplified, and show the final simplified Python condition. Start by assuming that the two simple propositions are t: `temperature <= 206` and p: `pressure > 3`. *For those who don't (yet!) know Python*: In Python, AND is conjunction, OR is inclusive disjunction, NOT is negation, and AND has precedence over OR.