CSc 144–002 — Discrete Mathematics for Computer Science I — Spring 2024 (McCann)
https://cs.arizona.edu/classes/cs144/spring24-002/

# Homework #2

(50 points)

*Due Date: February $2^{nd}$, 2024, 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. Start early! Getting help is much easier $n$ days before the due date/time than it will be $n$ hours before. Help is available from the class staff via piazza.com and our office hours.
3. Write complete answers to each of the following questions, in accordance with the given directions. Create your solutions as a PDF document such that each answer is clearly separated from neighboring answers, to help the TAs easily read them. Show your work, when appropriate, for possible partial credit.
4. When your PDF is ready to be turned in, do so on gradescope.com. Be sure to assign pages to problems after you upload your PDF. Need help? See "Submitting an Assignment" on https://help.gradescope.com/.
5. **Solutions submitted more than five minutes late will cost you a late day. Submissions more than 24 hours late are worth no points.**

Topic: Propositional Logic

1. (5 points) For each English statement provided, write its negation, also in conversational English.
   (a) That dog is shedding.
   (b) Francine stepped in that puddle yesterday.
   (c) Your shoelaces are untied.
   (d) Horace's bike weighs 16 pounds.
   (e) Tucson got at least half an inch of rain Tuesday.
2. (5 points) Let $p$ be "Vernon got a tetanus booster," and let $q$ be "Vernon has a sore arm." Convert each of the following logical expressions into a conversational English sentence.
   (a) $p \wedge q$
   (b) $q \oplus p$
   (c) $p \vee \overline{q}$
   (d) $\neg p \vee \neg q$
   (e) $p \vee (p \wedge q)$
3. (4 points) Let $w$ be "The wind is stiff," and let $t$ be "The trash cans are upright." Express each of the following English sentences as equivalent logical expressions in terms of $w$, $t$, and the logical operators $\wedge$, $\vee$, $\oplus$, and negation, as appropriate.
   (a) The trash cans are upright but the wind is stiff.
   (b) The wind is not stiff or the trash cans are upright.
   (c) The trash cans are on their sides but the wind is not stiff.
   (d) The trash cans are upright or the wind is stiff, but not both.

(Continued on the back . . . )

4. (6 points) For each of the following compound propositions, is the statement true or it is false? Briefly explain your answers.

   (a) $0 \in \mathbb{Z}^+$ or $0 \in \mathbb{Z}^*$ ("$a \in b$" is claiming that $a$ is an element of set $b$)

   (b) $71 \,\%\, 14 > 5$ or $9 \mid 117$, and $192 \setminus 3 \neq 62$.

   (c) Multiplication distributes over subtraction or Tucson's elevation above sea level is higher than Phoenix's, but not both.

5. (6 points) For each of the following disjunctions, is the disjunction inclusive or exclusive? Briefly explain your answers.

   (a) The math prerequisite for CSc 144 is College Algebra or a high score on a math placement exam.

   (b) Your rental choice is a new subcompact car or an old mid–size SUV.

   (c) The eyewitnesses reported that the thief wore a red hoodie or dark jeans.

6. (9 points) Build a complete truth table for each of the following compound propositions. When constructing a truth table, be sure to follow the table construction rules explain in class on Wednesday Jan 24 – order the rows by the pattern I explained, build up to the desired proposition one operator at a time, and use T and F for true and false.

   **In addition**, answer this question: Is the proposition a tautology, a contradiction, or a contingency? When constructing a truth table, be sure to use the row ordering explained and demonstrated in our in–class examples.

   (a) $(p \wedge q) \oplus (q \vee p)$

   (b) $(\neg p \vee q) \vee (\neg q \vee r) \vee (\neg r \vee q)$

7. (3 points) Internet search engines allow users to express queries with logical operators (either explicit or implied) to help narrow the search results. Google, for example, accepts AND and OR, and we can ask for terms to be excluded from results by prefixing them with a hyphen (e.g., `winter and -January`).

   Let's say that you want to find pictures of balls that are either red or green, but not yellow. Construct at least three queries to find pictures that satisfy those conditions. Then, try them in searches at `images.google.com`. Which queries did you try, and which one(s) seemed to work best?

8. (3 points) A CSc 144 UGTA is passing out handouts to a row with three students. The UGTA asks, "Do you all want a copy?" The first student replies, "I don't know." The second student says, "I don't know, either." The third student says, "Not all of us want copies." The UGTA immediately hands copies to the students who want them. Which students wanted a copy, and how did the UGTA know which of the three students wanted them?

> *NOTE: The last two questions use bit–wise logical operations. We probably won't cover that idea in class until Monday Jan 29. Want to answer these questions sooner? See Table 6 and Example 18 in Chapter 1 of "Kneel Before $\mathbb{Z}^{odd}$," available from the class web page. (The class web page's URL is at the top of this handout; scroll down to the Reference section to find the KbZ links.)*

9. (6 points) In class we showed how logical operators can be applied to strings of bits. Evaluate each of the following bit–string expressions, and show the result. All operators are our logical operators, not the bit–wise operators used by Python and Java.

   (a) $\overline{110101} \vee (000101 \wedge 010001)$

   (b) $(101101 \vee 010011) \oplus (011101 \wedge 111110)$

10. (3 points) In class I showed (or will show!) how UNIX and UNIX–like operating systems determine how permissions are determined for new files. If the umask is 000 100 111, and the base permissions are 111 110 100, what are a newly—created file's nine permission bits (in terms of `r`, `w`, `x`, and/or `-`)? Show your work for possible partial credit.