Homework #1

Due: 2/19/23 @ 11:59pm

Content Covered: Propositions, logical operators, truth tables

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Submission Instructions

Submit your completed homework to UBLearns electronically in PDF format. Any submissions that are not a PDF or not a legible PDF will not receive credit. We need to be able to read your submission to be able to grade your work. Your write-up should contain enough information from the problem so that a reader doesn't need to return to the text to know what the problem is (it is a good habit to rewrite each problem prior to solving it). There is no general rule for how much information from the problem to include, but it should be possible to read your homework and ascertain what the problem was and what your solution is accomplishing.

When writing up the solution, you may hand write the solutions and submit a scanned PDF, or write up the solutions electronically and convert them to a PDF. If you hand write your solutions, make sure that you write clearly and your writing is legible. Double check your scans to make sure that your scanned copy is legible. After you submit your work, make sure the file is visible. Download your submitted copy, open it, and see whether you submitted the correct file and your submitted file has not been corrupted during the upload.

You are able to upload your submission multiple times. Only the last file will be graded. Keep in mind that if your completed work consists of multiple pages and you submit a separate file for each page, only the last file submitted will be graded. In this case, only one page of your submission would be graded. **You are responsible for making sure that your submission goes through as intended.**

Your submitted work must be your own. Please review the course Academic Integrity Policy as outlined in the syllabus. **Failure to adhere to this policy will result in an F in the course.**

Late Policy

Late homework will be accepted up to 1 day late for a penalty of 25% of the total points. For example, if the homework is worth 100 points and you submit it one day late, you will receive the maximum of (your score earned minus 25 points) and 0 points.

Please be mindful of the deadlines, and start assignments early. Course staff will likely be less available after 5PM and during weekends, so plan accordingly if you need assistance.

Problems   [50 points]

Problem 1   [10 points]

For each sentence below, state if it is a proposition or not. Then, if it is a proposition, write its negation, otherwise explain why it is not a proposition.

RUBRIC: 1 point for correct Yes/No, 1 point for correct negation or reasonable explanation.

a) $2 + 7 = 6$ Yes. $2 + 7 \neq 6$

b) I like coffee and I like tea   Yes. I don't like coffee and tea.

c) 5x > 10   No. It contains a variable with an unknown value.

d) Frankenstein is a good book   Yes. Frankenstein is not a good book.

e) What time is lecture?   No. It is a question, not a declarative statement.

Problem 2   [10 points]

Assume the propositions *p*, *q*, *r*, *s* have the following truth values:

       p: TRUE   *q*: FALSE   *r*: FALSE   *s*: FALSE

Evaluate the truth value for each of the following compound propositions. Show your work.

RUBRIC: 1 point for correct TRUTH value, 1 point for showing work.

a) $p \oplus \neg q \wedge q$ TRUE. Evaluate $\neg q \wedge q$ to F, then $p \oplus F = T \oplus F = T$.

b) $\neg(p \wedge q) \rightarrow (r \leftrightarrow s)$ TRUE. $\neg(T \wedge F) = T$. $F \leftrightarrow F = T$. $T \rightarrow T = T$.

c) $p \vee (q \vee r) \rightarrow (s \wedge \neg p)$ FALSE. $T \vee (F \vee F) = T$. $(T \wedge \neg T) = F$. $T \rightarrow F = F$.

d) $p \oplus q \oplus r \oplus s$ TRUE. $(T \oplus F) \oplus F \oplus F = (T \oplus F) \oplus F = T \oplus F = T$.

e) $p \wedge q \oplus (r \rightarrow (s \vee \neg q))$ TRUE. $T \wedge F \oplus (...) = F \oplus (F \rightarrow (...)) = F \oplus T = T$.

Problem 3   [10 points]

Construct a truth table for each of the following compound propositions.

RUBRIC: Subtract 1 point for each incorrect row (min score of 0)

a) $p \rightarrow (q \oplus \neg p)$ See last page.

b) $p \rightarrow q \rightarrow (r \wedge \neg q)$ See last page.

Problem 4 [10 points]

Consider the following propositions:
- **p:** You get an academic integrity violation case against you.
- **q**: You copy your friend's assignment.
- **r:** You can pass the course.

For each of the following, write the corresponding English sentence:
RUBRIC: 2 points for a correct sentence in English.
a) $p \to \neg r$ If you get an academic integrity violation, then you can't pass the course.

b) $q \to p$ If you copy your friend's assignment, then you get an a.i. violation.

c) $\neg q \lor p$ You don't copy your friend's assignment, or you get an a.i. violation.

d) $\neg r \leftrightarrow (q \land p)$ You can't pass the course iff you copy and you get an a.i. violation.

e) $(p \land q) \lor r$ You get an a.i violation and you copy or you can pass the course.

Problem 5 [10 points]

Consider the following propositions:
- **b:** I will read a book
- **g:** I will play a game
- **m:** I will listen to music

Write the symbolic representation of the compound proposition that corresponds to each of the following English sentences as they are written (do not change the order of the expression):
RUBRIC: 2 points for a correct formula.
a) I will read a book or play a game, but not both. $b \oplus g$

b) I will not play a game or listen to music. $\neg(g \lor m)$

c) I will listen to music but not read a book. $m \land \neg b$

d) If I will play a game, then I will not read a book $g \to \neg b$

e) I will not play a game if I read a book or listen to music $b \lor m \to \neg g$

Problem 6 (Extra Credit) [5 points]

Using a truth table, determine if $p \leftrightarrow (\neg q \land p)$ is a tautology, contradiction, or contingency.
RUBRIC: 1 point for stating contingency. 1 point for each correct row of truth table.
Contingency. See last page for truth table.

Answer for (3a)

p	q	$\neg p$	$q \oplus \neg p$	$p \rightarrow (q \oplus \neg p)$
F	F	T	T	T
F	T	T	F	T
T	F	F	F	F
T	T	F	T	T

Answer for (3b)

p	q	r	$\neg q$	$r \wedge \neg q$	$p \rightarrow q$	$p \rightarrow q \rightarrow (r \wedge \neg q)$
F	F	F	T	F	T	F
F	F	T	T	T	T	T
F	T	F	F	F	T	F
F	T	T	F	F	T	F
T	F	F	T	F	F	T
T	F	T	T	T	F	T
T	T	F	F	F	T	F
T	T	T	F	F	T	F

Answer for (6)

p	q	$\neg q$	$\neg q \wedge p$	$p \leftrightarrow (\neg q \wedge p)$
F	F	T	F	T
F	T	F	F	T
T	F	T	T	T
T	T	F	F	F