

Homework 3

Due Date: 06/14/2024

- Please submit your answers as a single consolidated PDF file, and upload the file to Canvas.
- You may submit multiple times, but only the last submission made before the due date will be considered for grading.
- Make sure you submit the right file to Canvas. Wrong file submissions will not be graded.
- Note: Inquiries about homework must be sent to the TAs or instructor within 3 days after grades are published.
- **10 Bonus points** if you create your document in LaTeX and submit the compiled result in .pdf.

Questions

1. (10 points) Rewrite the statements in if-then form.
 - (a) This loop will repeat exactly N times if it does not contain a **stop** or a **go to**.
 - (b) Freeze or I'll shoot.
 - (c) Fix my ceiling or I won't pay my rent.
2. (10 points) Construct truth tables for the statement forms.
 - (a) $\sim p \vee q \rightarrow \sim q$
 - (b) $(p \vee q) \vee (\sim p \wedge q) \rightarrow q$
 - (c) $(p \rightarrow r) \leftrightarrow (q \rightarrow r)$
3. (10 points) Suppose that p and q are statements so that $p \rightarrow q$ is false. Find the truth values of each of the following:
 - (a) $\sim p \rightarrow q$
 - (b) $p \vee q$
 - (c) $q \rightarrow p$

4. (10 points) In the following exercises: (a) use the logical equivalences $p \rightarrow q \equiv \sim p \vee q$ and $p \leftrightarrow q \equiv (\sim p \vee q) \wedge (\sim q \vee p)$ to rewrite the given statement forms without using the symbol \rightarrow or \leftrightarrow , and (b) use the logical equivalence $p \vee q \equiv \sim(\sim p \wedge \sim q)$ to rewrite each statement form using only \wedge and \sim .
- $p \wedge \sim q \rightarrow r$
 - $p \vee \sim q \rightarrow r \vee q$
 - $(p \rightarrow r) \leftrightarrow (q \rightarrow r)$
 - $(p \rightarrow (q \rightarrow r)) \leftrightarrow ((p \wedge q) \rightarrow r)$
5. (10 points) Write negations, contrapositives, converse and inverse for each of the following statements. (Assume that all variables represent fixed quantities or entities, as appropriate.)
- If P is a rectangle, then P is a square.
 - If today is New Year's Eve, then tomorrow is not February.
 - If n is prime, then n is odd or n is 2.
 - If Jane is Ann's mother, then Jim is her uncle and Sue is her aunt.
6. (10 points) Some of the arguments are valid, whereas others exhibit the converse or the inverse error. Use symbols to write the logical form of each argument. If the argument is valid, identify the rule of inference that guarantees its validity. Otherwise, state whether the converse or the inverse error is made.
- If Jules solved this problem correctly, then Jules obtained the answer 2.
Jules obtained the answer 2.
 \therefore Jules solved this problem correctly.
 - If I go to the movies, I won't finish my homework. If I don't finish my homework, I won't do well on the exam tomorrow.
 \therefore If I go to the movies, I won't do well on the exam tomorrow.
 - If at least one of these two numbers is divisible by 6, then the product of these two numbers is divisible by 6.
Neither of these two numbers is divisible by 6.
 \therefore The product of these two numbers is not divisible by 6.
 - If this computer program is correct, then it produces the correct output when run with the test data my teacher gave me.
This computer program produces the correct output when run with the test data my teacher gave me.
 \therefore This computer program is correct.
 - Sandra knows Java and Sandra knows C++.
 \therefore Sandra knows C++.

7. (10 points) Explain in your own words what distinguishes a valid form of argument from an invalid one. In addition what make an argument a sound argument.
8. (10 points) Use truth tables to determine whether the argument forms are valid. Indicate which columns represent the premises and which represent the conclusion, and include a sentence explaining how the truth table supports your answer. Your explanation should show that you understand what it means for a form of argument to be valid or invalid.
- (a) $p \rightarrow q$
 $q \rightarrow p$
 $\therefore p \vee q$
- (b) $p \vee q$
 $p \rightarrow \neg q$
 $p \rightarrow r$
 $\therefore r$
- (c) $(p \wedge q) \rightarrow \neg r$
 $p \vee \neg q$
 $\neg q \rightarrow p$
 $\therefore \neg r$
- (d) $p \rightarrow r$
 $q \rightarrow r$
 $\therefore (p \vee q) \rightarrow r$
9. (20 points) In the following exercises a set of premises and a conclusion are given. Use valid argument forms to deduce the conclusion from the premises, giving a reason for each step. Assume all variables are statement variables.
- (a) $\sim p \vee q \rightarrow r$
- (b) $s \vee \sim q$
- (c) $\sim t$
- (d) $p \rightarrow t$
- (e) $\sim p \wedge r \rightarrow \sim s$
- (f) $\therefore \sim q$