CIS 1600 Assigned: August 27, 2024

Homework 1T

Due: 11:59PM EDT, August 28, 2024

This homework is due electronically on Gradescope at 11:59PM EDT, August 28, 2024. To receive full credit all your answers should be carefully justified. **Additionally, make sure to fill out the Gradescope Policy Quiz!**

Please make note of the following:

A. LaTeX: Normally, we require all solutions to be typeset in LaTeX. We have provided a LaTeX primer video on Piazza and on the course website under the 'resources' tab, and have provided a template, should you choose to use LaTeX. However, LaTeX is not strictly required **for this first assignment only.**

B. Standard Deductions:

- 5 points will be deducted from your homework if you do not select pages when submitting to Gradescope.

C. Solutions: Please make sure to keep your solutions clear and precise. While no points will be deducted for overly verbose solutions, clarity and brevity are important skills that can be developed through CIS 1600.

D. Collaboration: You may not collaborate with anyone via any means.

E. Citations: All solutions must be written in your own words. If you would like to use part of a solution from a problem presented in lecture, recitation, or past homework solutions you may do so with attribution; i.e., provided you add a comment in which you make clear you copied it from these sources.

F. Outside Resources: Any usage of resources outside of the course materials on the course website or Canvas is strictly prohibited. Violations may seriously affect your grade in the course.

G. Late Policy: We will allow you to drop two homework assignments assigned on a Tuesday and two homework assignments due on a Thursday (i.e. two 'T' homeworks and two 'H' homeworks). Because of this, we will not accept late homework under any circumstances. If you will be missing school for an extended period of time due to severe illness, please notify the professor.

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1. [12 pts] Propositions in Paris

Let p, q, and r be the following propositions.

p: Breakdancing was the worst sport of the Paris Olympics.

q: E-Liu-d Kipchoge would beat Jan-kob Ingebrigtsen in a 100 meter dash.

r: Sharpshooter Eric Yu-suf Dikec will get gold in the 2028 Olympics.

Express the following propositions using p, q, r and logical operators.

Including a line or two of explanation for your solution may be helpful in guiding your thought process, but don't worry too much about providing justification. For this problem specifically, we'll only be grading your final answer.

(a) E-Liu-d Kipchoge would beat Jan-kob Ingebrigtsen in a 100 meter dash or breakdancing was the worst sport of the Paris Olympics.

(b) Sharpshooter Eric Yu-suf Dikec will not get gold in the 2028 Olympics, and breakdancing was the worst sport.

(c) If breakdancing was not the worst sport of the Paris Olympics or if sharpshooter Eric Yu-suf Dikec will get gold in the 2028 Olympics, then E-Liu-d Kipchoge would not beat Jan-kob Ingebrigtsen in the 100 meter dash.

(d) As long as breakdancing was the worst sport of the Paris Olympics, E-Liu-d Kipchoge will be able to beat Jan-kob Ingebrigtsen, and sharpshooter Eric Yu-suf Dikec will get gold in the 2028 Olympics.

(e) Breakdancing was the worst sport of the Paris Olympics if and only if E-Liu-d Kipchoge would not beat Jan-kob Ingebrigtsen in the 100 meter dash.

(f) It is necessary that E-Liu-d Kipchoge beats Jan-kob Ingebrigtsen in the 100 meter dash for breakdancing to be the worst sport of the Paris Olympics. It is also necessary that E-Liu-d Kipchoge beats Jan-kob Ingebrigtsen in the 100 meter dash for sharpshooter Eric Yu-suf Dikec to not get gold in the 2028 Olympics.

2. [8 pts] Tautology Olympics

Maxwell Li-yles, having won gold in the 100m, needs to prove that he is better at tautologies than Maggie Du-rant. Unfortunately, Maxwell Li-yles is feeling under the weather (we hope he can still do well in the 60m!), and needs YOU to do the following:

- Fill in the truth tables.
- Write explicitly whether the logical expression is a tautology or not.

Note: Make sure you fill out the entire table, even if you do not need the entire table to determine whether the given expression is a tautology.

(a) $[(p \vee q) \vee (p \wedge \neg q)] \wedge (p \implies \neg q)$

(b) $[(\neg p \wedge q) \implies (p \vee \neg q)] \implies (p \vee \neg p)$

3. [10 pts] A Zhang-ky Final

Vincent Zhang-kovic is chasing his dream of winning Olympic gold in tennis. But on the day of the finals, he twists his ankle! Luckily, his opponent, Yinqi Al-chen-raz, takes pity and proposes an alternative competition: a logical quantifier face-off! Help Vincent answer the following questions correctly and achieve his dream.

For parts (a), (b), and (c), replace each ? with either the universal quantifier ($\forall$) or the existential quantifier ($\exists$) such that the resulting statement is *true*. Write the resulting statement in **both** logical notation and plain English. Then, explain briefly but rigorously why the statement is true. Note that the replacement of ? with quantifiers is the only modification allowed.

(a) $\forall m \in \mathbb{Z} \quad ?n \in \mathbb{Z} \quad m + n = 15$

(b) $?m \in \mathbb{N} \quad \forall n \in \mathbb{Z} \quad (n \leq m \vee n > 2m)$

(c) $?m \in \mathbb{Z} \quad \forall n \in \mathbb{Z} \quad ?p \in \mathbb{Z} \quad 4p - n \leq m$