



## CSE 015: Discrete Mathematics

## Homework 1

Fall 2021

## Preliminary Notes

- **This homework must be solved individually.** You can discuss your ideas with others, but when you prepare your solution you must work individually. Your submission must be yours and yours only. No exceptions, and be reminded of the CSE academic honesty policy discussed in class.
- Your solution must be exclusively submitted via CatCourses. Pay attention to the posted deadline because the system automatically stops accepting submissions when it expires. You only need to submit the PDF and you have to use the template file provided in CatCourses. Please note that the system does not allow to submit any other file format. Do not submit the  $\text{\LaTeX}$  source of your solution.
- As you are still learning  $\text{\LaTeX}$ , it is understandable that you do not yet fully master all details. Focus your attention on determining the correct answers. In this first assignment, you will not be penalized for not properly using the appropriate  $\text{\LaTeX}$  features. Suggestion: first write your complete solution on paper, and then type it in  $\text{\LaTeX}$ . You are encouraged to collaborate to solve any  $\text{\LaTeX}$  issue you may have.
- Start early.

## 1 Translating English Sentences

Consider the following atomic propositions, where XYZ stands for a generic person's name:

$p$ : "XYZ scored 100% in the CSE015 final."

$q$ : "XYZ scored at least 90% in the labs."

$r$ : "XYZ receives an A+ in CSE015."

$t$ : "XYZ is a CSE major."

Using the above definitions, translate the following compound propositions in English.

a)  $\neg t$

b)  $\neg q$

c)  $(p \vee q) \rightarrow r$

d)  $(p \wedge q) \rightarrow r$

e)  $\neg(t \rightarrow r)$

## 2 Truth Tables

Write the truth tables for the following compound propositions.

- a)  $p \oplus (q \vee \neg r)$
- b)  $(p \vee q) \rightarrow (\neg r \vee p)$
- c)  $((p \rightarrow q) \wedge p) \rightarrow q$

## 3 Logical Equivalences

Using truth tables, prove the following logical equivalences.

- a) Distributive law:  $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$
- b)  $(p \rightarrow q) \wedge (p \rightarrow r) \equiv p \rightarrow (q \wedge r)$

Important: you must show the intermediate steps justifying your answer. If you jump straight to the conclusion without justification you will not receive any credit.

## 4 Tautologies, Contingencies, and Contradictions

Consider the following compound propositions. Determine if they are tautologies, contradictions, or contingencies. Justify your answers with truth tables.

- a)  $p \rightarrow (p \vee q)$
- b)  $(p \wedge q) \rightarrow \neg p$
- c)  $(p \rightarrow (q \vee r)) \rightarrow (\neg q \vee p)$

## 5 De Morgan's Laws

Using De Morgan's Laws, rewrite the following sentences in English.

- a) You cannot be late and you cannot smoke.
- b) It is not the case that you can take an annuity and you can take a lump sum.

To solve this exercise, it is useful to first translate the sentence from English into symbolic form, apply the appropriate De Morgan's law, and then translate the sentence back in English.