

COS10003 Computer and Logic Essentials – Assignment 2

Semester 1 2021

Aim

This assessment task allows you to demonstrate your problem solving ability on problems covering sets, logic, relations and boolean algebra. It is worth **20%** of your mark for this unit.

Due date

This assignment is due by **11:59pm Sunday 25 April 2021**.

Due date and submission

Each individual student should submit their assignment via Canvas before the deadline. You can submit several times before the deadline; each new submission will overwrite your previous submission.

Note that while the due date is a Sunday, no teaching assistance will be available after 4pm Melbourne time on Friday. You need to seek help well ahead of submission.

Before submitting the assignment, please ensure that you have undertaken the following activities:

- Checked Canvas for announcements/discussions related to the assignment and for any updates/clarifications;
- Ensured that the work submitted by you is your original work. If this is not the case, then further investigation will take place and a penalty or sanction may be applied. Note this includes:
 - sharing your original work with other students either on purpose or by accident – under no circumstances should you show or give your assignment to another student, nor should you ask to see another student's assignment;
 - soliciting answers from online forums and tutoring sites (even if money has **not** changed hands);
 - copying answers publicly posted online.

- Reviewed the declaration at <https://www.swinburne.edu.au/current-students/manage-course/exams-results-assessment/submit-work/assessment-declaration/>. Electronic submission of your assignment signifies that you agree with this declaration. Note a cover page is not required, however please put your preferred name and student ID on at least the first page, ideally all pages.

If you have exceptional circumstances that mean you are unable to submit the assignment by the due date and time, please contact the convenor as soon as practicable *prior to the due date*. Note evidence of circumstances will be required.

For students with EAPs allowing extensions: you are required to request an extension *on or before the Friday before the due date* by emailing the convenor and nominating your ideal due date. In general, up to seven days' extension can be allowed; any more than this will most likely require an alternative assessment task or a hint to withdraw from the unit.

General instructions

This is an individual assignment. It is preferred that you use word processing software to create your submission; if handwriting is required or preferred please scan your document as a **single** PDF rather than submitting images.

Before submitting, please check that your PDF contains all your images, working, and text. After submitting, please check that the submitted document is as you expected; instructions for how to do this are in Canvas. With the number of submissions we expect, **we are unable to inform you individually that your submission appears to be incomplete**. Resubmissions are allowed only during the late submission window and will attract a late penalty.

Marking scheme

Marks will be awarded in accordance with the scheme allocated for each sub-part of the problems as indicated in the assignment. Partial marks will be awarded to the extent that the component parts of the question have been correctly answered. Please note that if a problem requires the answer to be justified, no marks will be awarded for simply giving the correct answer.

Stars

The stars suggest the difficulty of the problem:

- ★ Should be straightforward based on lecture and tutorial material.
- ★★ Should be more challenging but still based on lecture and tutorial material.
- ★★★ Might require some further thought or extra research beyond lecture and tutorial material.

Questions

Sets

1. [10 marks] After an unremarkable year, everyone has decided to undertake some new activities. We are interested in exploring patterns around what students have done since the start of 2021, considering which of these activities they did at least once. The following data is calculated for 465 students:

- 220 joined a student club
- 159 ate at a cafe
- 208 went to a gym
- 68 joined a student club and ate at a cafe
- 126 joined a student club and went to a gym
- 32 joined a student club, ate at a cafe and went to a gym
- 101 did not join a student club, eat at a cafe, or go to a gym

a) [2 marks] ★ A value needed for the Venn diagram is missing. Explain how to formally find it and calculate the missing value.

b) [3 marks] ★ Draw a Venn diagram with each activity as a set and label each part of the diagram with the correct values.

c) [3 marks] ★ Provide counts for the following. **Show the numerical expression** using the values from the Venn diagram you used to find your answer: correct answers without expressions will be awarded 0 marks.

- i. Did not go to a gym.
- ii. Joined a student club but did not eat at a cafe.
- iii. Did one **only** of joined a student club, eat at a cafe or went to a gym.

d) [2 marks] ★ Using each club as a set, represent the following using set operators (\cup , \cap , C or $'$):

- i. Did not go to a gym nor eat at a cafe.
- ii. Joined a student club and ate at a cafe but did not go to a gym.

Logic

2. [3 + 3 = 6 marks] For this question the following statements and symbols should be used:

- a : Adita plays esports
- d : David plays esports
- h : Huyen plays cricket

a) ★★ Translate the following into English.

- i. $h \wedge (d \vee a)$
- ii. $d \rightarrow \neg a \vee h$
- iii. $\neg(h \vee d)$

b) ★★ Translate the following into symbolic logic (do not simplify your answer).

- i. If David plays esports, then Adita plays esports.
- ii. Neither Adita nor David play esports.
- iii. Adita plays esports if and only if Huyen plays cricket and David plays esports.

3. [4 marks] ★★ You have a colleague who has written the following condition statement in their code:

If (height \leq 100 or width $>$ 10) and (height $>$ 100 or width $>$ 10) and height \leq 100

Show using the laws of logic that this condition statement can be simplified to:

If width $>$ 10 and height \leq 100

For each step, state which law of logic you have used.

Relations and functions

4. [4 marks] ★★ Given the following relation S on $Z \times Z$ where $Z = \{a, b, c, d, e\}$:

$$S = \{(a, a), (b, b), (a, b), (b, a), (c, c), (d, d), (e, e), (c, e), (d, e), (e, c), (e, d)\}$$

determine whether it is an equivalence relation, by showing whether it satisfies the three criteria needed. State your final answer.

5. [2 + 3 + 1 = 6 marks] ** For the domain $X = \{x, y\}$ and co-domain $Y = \{x, y, z\}$:

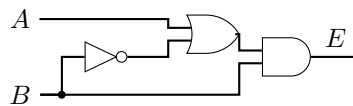
- how many functions $f : X \rightarrow Y$ are possible? Provide an example of a function, using formal notation or a diagram.
- how many of the functions in a) are injective? Provide an example that is injective and an example that is not.
- how many of the functions in a) are bijective? Provide an example if one exists, if not explain why not.

Circuits

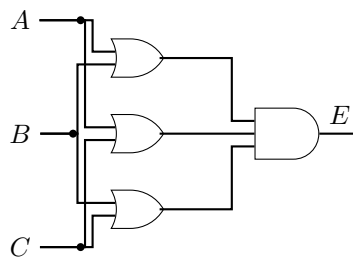
6. [2 + 2 = 4 marks] Given the following circuits, a) and b):

- ** determine the expression using Boolean algebra notation (do not excessively simplify);
- * provide the output value when A is 1, B is 1 and all other inputs are 0. Justify your answer using annotation or a truth table.

a)



b)



7. [3 + 2 + 1 = 6 marks] ** Given the following expression:

$$E = (z' + y)yz$$

- draw the circuit that represents this expression as is.
- simplify the expression using Boolean algebra rules. State your steps and the rules used.

- c) given the simplified circuit, state in a sentence how the depth and size of the circuit have changed compared to the original. The simplified circuit diagram does not need to be included in your submission.