

Guidelines for submission:

- (1) You need to upload a handwritten submission in PDF format.
- (2) Any form of plagiarism will lead to a penalty. You may refer to this [link](#) to know more about plagiarism.

Questions:

(1) (2 marks) Write on your own two simple propositions in English based on some specific situation/issue of your choice (e.g., Covid-19, Work from home, etc.) that will be your KB, and a query proposition such that it should derive from the KB.

(2) (3 marks) Let $p = \text{"I major in CS"}$, $q = \text{"I will find a good job"}$, and $r = \text{"I can program"}$. Translate the following English sentence into a propositional logic formula: "A prerequisite for finding a good job is that I can program".

(3) (4 marks) Consider the following sentences:

- (a) If Ram carries an umbrella, it is raining.
- (b) Ram is not carrying an umbrella.
- (c) Therefore it is not raining.

Translate these sentences into propositional logic by defining appropriate symbols, and derive (c) given (a) and (b). If it is not possible to derive (c) given (a) and (b), justify.

(4) (4 marks) Convert the following propositional logic formula into CNF:

$$A \vee \text{False} \wedge B \leftrightarrow C \rightarrow D$$

(5) (3 marks) Consider the following two formulas in propositional logic:

- (a) $p \wedge q \rightarrow r$
- (b) $p \rightarrow (q \rightarrow r)$.

Question: True/False: "These two formulas are semantically equivalent." Justify your answer using a truth-table.

(6) (4 marks) Consider the FOL formula:

$$\text{ForAll } x (\text{circle}(x) \rightarrow (\text{Exists } y. (\sim \text{circle}(y) \wedge \text{sameColor}(x,y))))$$

Translate it into CNF.

(7) (6 marks) Prove "Exists x . father(x ,Evan)" from the following premises:

- (a) $\text{ForAll } x. \text{ForAll } y. ((\text{parent}(x,y) \wedge \text{male}(x)) \rightarrow \text{father}(x,y))$
- (b) $\text{parent}(\text{Tom}, \text{Evan})$
- (c) $\text{male}(\text{Tom})$