

Logical Foundations of CS – CS5303

Programming Assignment

You are given a programming assignment mostly focused on expression manipulation. For this assignment, you will have to pick between Option 1 and Option 2.

1 Option 1: Propositional Logic

Given any propositional logic formula, design a computer program that allows to:

- Transform it into CNF
- Transform it into DNF
- Transform it into full DNF
- Transform it into full CNF
- Evaluate its truth value given truth values of the atoms
- Decide whether the formula is satisfiable, a tautology, or a contradiction
- BONUS: given a set of premises Γ and a conclusion c (as propositional formulas), prove whether c follows from Γ (i.e., whether $\Gamma \models c$).

Your program should offer options for the user to use any or all of the above functionalities. It should also make it easy to enter formulas.

The syntax we will use for propositional formulas is the following: i.e., here are rules that should be used when putting together propositional formulas.

- All letter from our roman alphabet $A = \{a, \dots, z\}$ are atoms and are therefore propositional formulas.
- Given any propositional formula p , not (p) will be represented as $!p$.
- Given any two propositional formulas p and q :
 - the conjunction of p and q will be represented as $(p \ \& \ q)$.
 - the disjunction of p with q will be represented as $(p \ | \ q)$.
 - the implication of p to q will be represented as $(p \ - \ > \ q)$.
 - *note that the parentheses are important, and part of the syntax to be used.*

2 Option 2: Predicate Logic

Given any predicate logic expression:

- Transform it into prenex form
- Skolemize the prenex form
- Transform the Skolemized form into CNF
- Transform the Skolemized form into CNF
- BONUS: given a set of predicate logic premises Γ and a conclusion c , prove whether c follows from Γ .

Your program should offer options for the user to use any or all of the above functionalities. It should also make it easy to enter formulas.

The syntax we will use for propositional formulas is the following: i.e., here are rules that should be used when putting together propositional formulas.

- All letter from our roman alphabet $A = \{a, \dots, z\}$ can be used as variables.
- Skolem constants are denoted by alphabet letters from A with a subscripted integer value (e.g., x_3).
- Skolem functions are denoted by $f_n(\cdot)$ where n is a given integer.
- The existential quantifier \exists is represented by TE .
- The universal quantifier \forall is represented by FA .
- Predicate names start with a capital letter.
- Given any predicate logic formula \mathfrak{P} , not (\mathfrak{P}) will be represented as $! \mathfrak{P}$.
- Given any two propositional formulas \mathfrak{P} and \mathfrak{Q} :
 - the conjunction of \mathfrak{P} and \mathfrak{Q} will be represented as $(\mathfrak{P} \ \& \ \mathfrak{Q})$.
 - the disjunction of \mathfrak{P} and \mathfrak{Q} will be represented as $(\mathfrak{P} \ | \ \mathfrak{Q})$.
 - the implication of \mathfrak{P} and \mathfrak{Q} will be represented as $(\mathfrak{P} \ - \ > \ \mathfrak{Q})$.
 - *note that the parentheses are important, and part of the syntax to be used.*

3 What you have to do

Once you have chosen an option (1 or 2) for your programming assignment, you will have to complete it. For this, you are expected to use **Java** or **C**. If you plan to use another language, please check first with your instructor.

You will have to turn in **your code** and a **user manual**.

Additional points (on top of the already announced bonus) will be given to students who go above and beyond with the functionalities provided to the user and ease of use of their algorithms. Of course, no additional points will be given when the original assignment has not been completed properly (receiving at least 75% before bonuses).

4 Timeline

This assignment is being released on March 22, 2018. You have to submit it for grading by May 4, 2018, which means that you have 6 weeks to complete this assignment.

My advice is to start early to assess a strategy of completion and be sure not to submit late. Late submissions will not be accepted, given that the deadline of this project is the actual end of the semester.