Massachusetts Institute of Technology

16.410 Principles of Automated Reasoning and Decision Making

Problem Set #4

Problem 1 (50 points)

Consider the following quote, taken from (Barwise and Etchemendy, 1993):

> If the unicorn is mythical, then it is immortal, but if it is not mythical, then it is a mortal mammal. If the unicorn is either immortal or a mammal, then it is horned. The unicorn is magical if it is horned.

You will represent this quote in propositional logic using the following propositional symbols:

MY	=	"Mythical Unicorn"
IU	=	"Immortal Unicorn"
MM	=	"Mortal Mammal"
HU	=	"Horned Unicorn"
MG	=	"Magical Unicorn"

Part A Restate the above English sentence as a sentence in propositional logic.

Part B Reduce your propositional sentence to conjunctive normal form (i.e., a list of clauses).

- Walk through your reduction step by step, starting from sentence S and ending with your set of clauses. Your reduction should be similar in style to the reduction given in the appendix of the class notes.
- List your resulting clauses, labeling them C1 … Cn.

Part C Given your propositional logic sentence, does the following logically follow?

the *unicorn is mythical*

Include a proof of your claim.

Part D Given your propositional logic sentence, does the following logically follow?

the *unicorn is magical*

Include a proof of your claim.

Part E Given your propositional logic sentence, does the following logically follow?

the *unicorn is horned*

Include a proof of your claim.

Problem 2 – Propositional Logic and Inference (50 points)

Part A – Interpretations

Let **S** be the propositional sentence:
(A implies B) implies (C implies D)
and let **I** be the interpretation:
A = True, B = False, C= True, D = False

Is **I** a model for **S**, that is, does **I** satisfy **S** (Yes or No)?
Demonstrate the correctness of your answer.

Part B – Reduction to Clauses (Conjunctive Normal Form)

Reduce the following three propositional sentences to conjunctive normal form (CNF) (i.e., a set of clauses). Derive each result step by step:

Part B.1 Convert **[not ((not A and B) or (C and D))]** to CNF.

Part B.2 Convert **(A iff A)** to CNF

Part B.3 Convert **[(A iff B) or C]** to CNF

NOTE: Please indicate the time that you have spent for each problem.

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