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Exercise Information

Module:	70051 Introduction to Symbolic Artificial Intelligence (MSc AI)	**Issued:**	Tue - 20 Oct 2020
Exercise:	2 (CW)	**Due:**	Tue - 03 Nov 2020
Title:	Logic	**Assessment:**	Individual
FAO:	Craven, Robert (rac101)	**Submission:**	Electronic

Student Declaration - Version 1

- I declare that this final submitted version is my unaided work.

Signed: (electronic signature) Date: 2020-11-03 16:47:46

For Markers only: (circle appropriate grade)

ZHOU, Yuebing (yz1220)	01916867	t5	2020-11-03 16:47:46	**A* A B C D E F**

Coursework 1: Logic

Question 1:

I. Propositional logic formulas: $((\neg(A \lor C)) \rightarrow (\neg B))$
Propositional atoms: A is " Michel is fulfilled or rich "
C is "Michel is rich "
B is " Michel live another five years"

II. Propositional logic formulas: $(((\neg A) \lor B) \land C)$
Propositional atoms: A is " the snowstorm arrive "
B is " Raheem will wear his boots "
C is " I am sure it will arrive"

III. Propositional logic formulas: $((A \land D) \rightarrow (B \leftrightarrow C))$
Propositional atoms: A is " Akira is on set "
D is "Toshiro is on set "
B is " the filming will begin "
C is " the caterers have cleared out "

IV. Propositional logic formulas: $((A \lor (\neg B)) \land (\neg(A \land (\neg B))))$
Propositional atoms: A is " Irad arrived "
B is " Sarah arrived "

V. Propositional logic formulas: $((\neg A) \rightarrow (\neg(B \land C)))$
Propositional atoms: A is " the Anne-Sophie answer her phone call
B is " Herber heard the performance "
C is " Anne-Sophie heard the performance

Question 2:

I. A propositional formula A is satisfiable only when there is some v such as $h_v(A) = \mathbf{t}$

II. Two propositional formula A and B are logical equivalence only when $h_v(A) = h_v(B)$ for every v evaluating function

III. iff it is no case that $\neg\neg A \equiv \top$, therefore, it is no case that $\neg A \equiv \bot$, then, $h_v(\neg A) = \top$.
Therefore, the propositional formula ¬A is satisfiable.

Question 3:

p	q	r	(p	∧	¬q	↔	¬(	¬r	∨	¬p))	→	(¬	¬q	→	r)
t	t	t	t	f	f	f	t	f	f	f	t	t	f	t	t
t	t	f	t	f	f	t	f	t	t	f	f	t	f	f	f
t	f	t	t	t	t	f	f	f	f	f	t	f	t	t	t
f	t	t	f	f	f	t	f	f	t	t	t	t	f	t	t
t	f	f	t	t	t	f	f	t	t	f	t	f	t	t	f
f	t	f	f	f	f	t	f	t	t	f	f	t	f	f	f
f	f	t	f	f	t	t	f	f	t	t	t	f	t	t	t
f	f	f	f	f	t	t	f	t	t	t	t	f	t	t	f

Question 4:

I. a,c,g are CNF and e,h are DNF

II. the property of the refutation-soundness and -completeness of a resolution derivation is defined that S be in CNF and only if S|=⊥, then S|—res(PL) ∅. Also, this property can build all possible resolution derivations from the original set of premises, then if one derivation is an empty set, the original formulas are unsatisfiable.

III. a: pure rule:
{{p, s}, {q, r}, {¬s, q}, {¬p, ¬r, ¬s}}
⇒ {{p, s}, {¬p, ¬r, ¬s}} [q is pure]
⇒{{p, s}} [¬r is pure]
⇒{ } [s is pure]
⇒Satisfiable [since no conditions for further application of rules apply]

b: unit propagation tule:
{{¬p, q, r}, {¬q}, {p, r, q}, {¬r, q}}
⇒{{¬p, r}, {p, r}, {¬r}} [unit clause {¬q}]
⇒{{¬p}, {p}} [unit clause {¬r}]
⇒{{}} [unit clause {p}]
⇒Unsatisfiable [since Ø is in the set]

Question 5:

It can be formalised that $p \to \neg q$, $\neg q \to \neg s$, $s \lor \neg p$, $s \lor p$ therefore q

p: I am going

q: you are going

s: Tara is going

Then, it should be checked that $p \to \neg q, \neg q \to \neg s, s \lor \neg p, s \lor p \models q$

Therefore it also should be checked whether $(p \to \neg q) \land (\neg q \to \neg s) \land (s \lor \neg p) \land (s \lor p) \land q$

The clausal-form CNF: $\{\{\neg p, \neg q\}, \{q, \neg s\}, \{s, \neg p\}, \{s, p\}, \{q\}\}$

Based on DL:

$\{\{\neg p, \neg q\}, \{q, \neg s\}, \{s, \neg p\}, \{s, p\}, \{q\}\}$

$\Rightarrow \{\{\neg p\}, \{\neg s\}, \{s, \neg p\}, \{s, p\}\}$ [unit clause $\{q\}$]

$\Rightarrow \{\{\neg p\}, \{\neg p\}, \{p\}\}$ [unit clause $\{\neg s\}$]

$\Rightarrow \{\{\}\}$ [uint clause $\{p\}$]

$\Rightarrow$Unsatisfiable [since $\varnothing$ is in the set]

Because the CNF is not satisfiable, the original argument is valid

Question 6:

I. The signature: C={Andrea}
P2={cupcake}
F1={aunt}
L={C, P2, F1}
$\forall X(aunt(X) \to \exists Y(cupcake(X,Y) \land \neg(Y=Andrea)))$
and cupcake(X,Y) (X gave cupcake to Y), $X \in$ Andrea' s aunts

II. The signature: P1={computer}
P2={connect}
L={P1, P2}
$\exists X \forall Y(computer(X) \land connect(X,Y) \land computer(Y) \land \neg(X=Y))$

III. The signature: C={Paul Klee, Kandinsky}
P1={BritishGallery}
P2={hangs}
F1={painting}
L={C,P1,P2,F1)
$\forall X \forall Y((X=painting(Paul Klee)) \land (Y=painting(Kandinsky) \land hangs(X,Y) \land BritishGallery(X,Y))$

IV. The signature:P2={love}
L={P2}
$\exists X(\forall Y(\neg love(X,Y)) \to \neg \forall Y(love(Y,X)))$

Question 7:

I. Flase, because when X=j, a(k, j) can be True and $\neg(X=j)$ will be false.

II. True, because when c(l) is true, and there are X=k or j which can make b(X), c(X) as well as a(l,X) become true. So it is totally true.

III. True, when X is the square object which is filled “ black”, this object can point to itself. Then, there is no Y and there is an arrow around the X object. Therefore, it is totally true.

IV. False, if ¬s(X) is true, X only can be k, j, l. Meanwhile, when X=j, Y only can be set as k in order to make c(Y) and b(Y) true; however, the a(j,k) will be false. Therefore, it is totally false.

V. False, there is X=k which can make ∃Y (a(X, Y) ∧ a(Y, X)) false; therefore, it is false that for any X, a(X, Y) ∧ a(Y, X) is true. It is totally false.

VI. False, if a(X, j) ∧ a(Y, j) is true, X can be equal to Y=k. In this case, a(X,Y) or a(Y,X) will be false. So it is totally false.