Sample Midterm

Saturday, November 3, 2018 11:33 PM

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EECS 118 - Knowledge Engineering and Software Engineering
Fall, 2017
Midterm Examination (80 minutes)

(Version 1)

Name: _____

SID: _____

This is a closed book examination. Time available: 120 minutes. Answer all questions on these sheets. Number any continuations of answers to clearly indicate the corresponding question. Partial credit will be given to partially correct answers.

1. (20%) Let A ="John is Italian" and B ="Bob is English". Formalize the following sentences in Propositional Logic:

1. "John isn't Italian"
2. "John is Italian while Bob is English"
3. "If John is Italian then Bob is not English"
4. "John is Italian or if John isn't Italian then Bob is English"
5. "Either John is Italian and Bob is English, or neither John is Italian nor Bob is English"

1) $\neg A$

2) $A \wedge B$

3) $A \supset \neg B$

4) $A \vee (\neg A \supset B)$

5) $(A \wedge B) \vee (\neg A \wedge \neg B)$

English -> Predicate define own functions

2. (20%) Define an appropriate language and formalize the following sentences in First Order Logic. State the semantics of your predicates clearly.

1. All Students are smart.
2. There exists a student.
3. There exists a smart student.
4. Every student loves some student.
5. Every student loves some other student.
6. There is a student who is loved by every other student.
7. Bill is a student.
8. Bill takes either Analysis or Geometry (but not both).
9. Bill takes Analysis and Geometry.
10. No students love Bill.

imply: ⊃

always works

and: ∧

doesn't work

1) $(\forall x)[Student(x) \supset smart(x)]$

not this bc not everyone is a student and smart

2) $\exists(x)\ Student(x)$

3) $\exists(x)[smart(x) \wedge Student(x)]$

4) $\forall(x)\ Student(x) \supset \exists(y)\ Student(y) \wedge Loves(x,y)$

imply

If A then B

Given A ... B

A is a sub set of B

And

A while B

A and B

5) $\forall(x)\ Student(x) \supset \exists(y)\ Student(y) \wedge Loves(x,y) \wedge \neg(x=y)$

6) $(\exists x)\ Student(x) \wedge \forall(y)\ student(y) \wedge \neg(x=y) \supset Loves(x,y)$

7) $Student(Bill)$

8) $(A \vee B) \wedge \neg(A \wedge B)$ //not full answer

9) $(A \wedge B)$

10) $\neg(\exists x)(Student(x) \wedge Loves(x, Bill))$

or

$\forall(x)\ \neg(Student(x) \wedge Loves(x, Bill))$

3. (20%) Use resolution and unification to solve the problem below.

Given:

$\forall x\,(P(x)) \supset \exists y Q(y))$
$\neg\exists x\,(Q(x) \wedge \exists y\,\neg W(y))$
$\forall x(P(x) \wedge W(x) \supset S(x))$

Prove: P(Mary)

4. (10%) Transform the following sentences into natural language (Note: “The Scream” is a famous painting):

1. $\forall x\ (Bag(x) \supset \exists y(Coin(y) \wedge Contains(x, y)))$
2. $\exists x\ (Telephone(x) \wedge \forall y\ (Secretary(y) \supset \neg Uses(x, y)))$
3. $\exists x\ (Buyer(x) \wedge Bought(x, TheScream) \wedge \forall y(Buyer(y) \wedge Bought(y, TheScream) \supset x = y))$

5. (20%) Define the following terms:

(a) The PSAT problem

(b) Conjunctive Normal Form

(c) Refutational Theorem Proving

(d) Resolution

6. (10%) Transform the following sentences into First Order Logic. State the semantics of your predicates clearly.

1. Tom is a car or a truck but cannot be both of them.
2. The fathers of dogs are dogs.
3. There are at least two students enrolled in every course.
4. No region is part of each of two disjoint regions

7. (10%) Convert the following to clause form:

$$(\forall x)[P(x) \supset Q(x,y)] \supset ((\exists y)[P(y)] \wedge (\exists z)[Q(y,z)])$$