

# CS-171, Intro to A.I. — Quiz#3 — Winter Quarter, 2012 — 20 minutes

YOUR NAME AND EMAIL ADDRESS: \_\_\_\_\_

YOUR ID: \_\_\_\_\_ ID TO RIGHT: \_\_\_\_\_ ROW: \_\_\_\_\_ NO. FROM RIGHT: \_\_\_\_\_

**1. (30 pts total, 5 pts each) RESOLUTION.** Apply resolution to each of the following pairs of clauses, then simplify. Write your answer in Conjunctive Normal Form (CNF), or write “None” if no resolution is possible.

**1.a. (1 pt)**  $(P \ Q \ \neg R \ S) \ (P \ \neg Q \ W \ X)$ . \_\_\_\_\_.

**1.b. (1 pt)**  $(P \ Q \ \neg R \ S) \ (\neg P)$ . \_\_\_\_\_.

**1.c. (1 pt)**  $(\neg R) \ (R)$ . \_\_\_\_\_.

**1.d. (1 pt)**  $(P \ Q \ \neg R \ S) \ (P \ R \ \neg S \ W \ X)$ . \_\_\_\_\_.

**1.e. (1 pt)**  $(P \ \neg Q \ R \ \neg S) \ (P \ \neg Q \ R \ \neg S)$  \_\_\_\_\_.

**1.f. (1 pt)**  $(P \ \neg Q \ \neg S \ W) \ (P \ R \ \neg S \ X)$  \_\_\_\_\_.

**2. (30 pts total, 5 pts each) LOGIC-TO-ENGLISH.** For each of the following FOL sentences on the left, write the letter corresponding to the best English sentence on the right. Use these intended interpretations: (1) “Student(x)” is intended to mean “x is a student.” (2) “Quiz(x)” is intended to mean “x is a quiz.” (3) “Got100(x, y)” is intended to mean “x got 100 on y.”

$\forall s \exists q \text{ Student}(s) \Rightarrow [ \text{Quiz}(q) \wedge \text{Got100}(s, q) ]$	A	For every quiz, there is a student who got 100 on it.
$\exists q \forall s \text{ Quiz}(q) \wedge [ \text{Student}(s) \Rightarrow \text{Got100}(s, q) ]$	B	For every student, there is a quiz on which that student got 100.
$\forall q \exists s \text{ Quiz}(q) \Rightarrow [ \text{Student}(s) \wedge \text{Got100}(s, q) ]$	C	Every student got 100 on every quiz.
$\exists s \forall q \text{ Student}(s) \wedge [ \text{Quiz}(q) \Rightarrow \text{Got100}(s, q) ]$	D	Some student got 100 on some quiz.
$\forall s \forall q [ \text{Student}(s) \wedge \text{Quiz}(q) ] \Rightarrow \text{Got100}(s, q)$	E	There is a quiz on which every student got 100.
$\exists s \exists q \text{ Student}(s) \wedge \text{Quiz}(q) \wedge \text{Got100}(s, q)$ .....	F	There is a student who got 100 on every quiz.

\*\*\*\* TURN PAGE OVER. QUIZ CONTINUES ON THE REVERSE \*\*\*\*

**3. (10 pts total, -2 each error, but not negative) CONJUNCTIVE NORMAL FORM (CNF).** Convert the following logical sentence to Conjunctive Normal Form. **Show your work.**

$$B \Leftrightarrow (P \Rightarrow Q)$$

**5. (5 pts each, 30 pts total) LOGIC TERMINOLOGY.** In each of the following, KB is a set of sentences,  $\{\}$  is the empty set of sentences, and S is a single sentence. Recall that  $\models$  is read “entails” and that  $\vdash$  is read “derives.”

**S** = Sound.

**U** = Unsound.

**C** = Complete.

**I** = Incomplete.

**Sat** = Satisfiable.

**Unsat** = Unsatisfiable.

**V** = Valid.

**N** = None of the above.

For each blank below, write in the key above that corresponds to the best term.

**5a.** Let S be given in advance. Suppose that  $\{\} \models S$ . Then S is \_\_\_\_\_ .

**5b.** Let S be given in advance. Suppose that for some KB1,  $KB1 \models S$ ; but that for some other KB2,  $KB2 \models \neg S$ . Then S is \_\_\_\_\_ .

**5c.** Suppose that for any KB and any S, whenever  $KB \models S$  then  $KB \vdash S$ . Then the inference procedure is \_\_\_\_\_ .

**5d.** Suppose that for some KB and some S,  $KB \vdash S$  but not  $KB \models S$ . Then the inference procedure is \_\_\_\_\_ .

**5e.** Suppose that for some KB and some S,  $KB \models S$  but not  $KB \vdash S$ . Then the inference procedure is \_\_\_\_\_ .

**5f.** Suppose that for any KB and any S, whenever  $KB \vdash S$  then  $KB \models S$ . Then the inference procedure is \_\_\_\_\_ .