CS-171, Intro to A.I. — Quiz#3 — Fall Quarter, 2016 — 20 minutes

YOUR NAME AND EMAIL ADDRESS: ____

YOUR ID: ________________________ ROW: __________ SEAT: _________

1. (70 pts total, 10 pts each) For each English sentence below, write the letter corresponding to its best or closest FOPC (FOL) sentence (wff, or well-formed formula). The first one is done for you, as an example.

1.a (example) __D__ **"Everybody likes somebody."**

A. ∀x ∀y Person(x) ∧ Person(y) ∧ Likes(x, y)
B. ∀x ∃y Person(x) ∧ Person(y) ∧ Likes(x, y)
C. ∀x ∀y Person(x) ⇒ (Person(y) ∧ Likes(x, y))
D. ∀x ∃y Person(x) ⇒ (Person(y) ∧ Likes(x, y))

1.b (10 pts) _____ **"All persons are mortal."**

A. ∀x Person(x) ∧ Mortal(x)
B. ∀x Person(x) ⇒ Mortal(x)
C. ∃x Person(x) ∧ Mortal(x)
D. ∃x Person(x) ⇒ Mortal(x)

1.c (10 pts) ____ **"For every food, there is a person who eats that food."**

A. ∀x ∃y Food(x) ∧ Person(y) ∧ Eats(y, x)
B. ∀x ∃y [Food(x) ∧ Person(y)] ⇒ Eats(y, x)
C. ∀x ∃y Food(x) ⇒ [Person(y) ∧ Eats(y, x)]
D. ∀x ∀y Food(x) ∧ Person(y) ∧ Eats(y, x)

1.d (10 pts) _____ **"Every person eats every food."**

A. ∀x ∀y [Person(x) ∧ Food(y)] ⇒ Eats(x, y)
B. ∀x ∀y Person(x) ⇒ [Food(y) ∧ Eats(x, y)]
C. ∀x ∀y Person(x) ∧ Food(y) ∧ Eats(x, y)
D. ∀x ∃y [Person(x) ∧ Food(y)] ⇒ Eats(x, y)

1.e (10 pts) _____ **"There is someone at UCI who is smart."**

A. ∀x Person(x) ∧ At(x, UCI) ∧ Smart(x)
B. ∃x Person(x) ∧ At(x, UCI) ∧ Smart(x)
C. ∀x [Person(x) ∧ At(x, UCI)] ⇒ Smart(x)
D. ∃x Person(x) ⇒ [At(x, UCI) ∧ Smart(x)]

1.f (10 pts) _____ **"Everyone at UCI is smart."**

A. ∀x Person(x) ∧ At(x, UCI) ∧ Smart(x)
B. ∃x Person(x) ∧ At(x, UCI) ∧ Smart(x)
C. ∀x [Person(x) ∧ At(x, UCI)] ⇒ Smart(x)
D. ∃x Person(x) ⇒ [At(x, UCI)] ∧ Smart(x)

1.g (10 pts) _____ **"Every person eats some food."**

A. ∀x ∃y [Person(x) ∧ Food(y)] ⇒ Eats(x, y)
B. ∀x ∃y Person(x) ∧ Food(y) ∧ Eats(x, y)
C. ∀x ∀y Person(x) ∧ Food(y) ∧ Eats(x, y)
D. ∀x ∃y Person(x) ⇒ [Food(y) ∧ Eats(x, y)]

1.h (10 pts) _____ **"Some person eats some food."**

A. ∃x ∃y Person(x) ∧ Food(y) ∧ Eats(x, y)
B. ∃x ∃y [Person(x) ∧ Food(y)] ⇒ Eats(x, y)
C. ∃x ∃y Person(x) ⇒ [Food(y) ∧ Eats(x, y)]
D. ∀x ∀y Person(x) ∧ Food(y) ∧ Eats(x, y)

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3. (30 pts total) Resolution Proof.

Mr. Smiley knows there is a spy in the Circus. He's narrowed it down to three suspects: Alice, Beth, and Carrie. He knows that the spy will always lie, while the others will always tell the truth. When asked:

Alice said: *Beth is the spy!*
Beth said: *Carrie is the spy!*
Carrie said: *I'm not the spy!*

Use these propositional variables:

A= Alice is the spy. **B**= Beth is the spy. **C**= Carrie is the spy.

You translate the evidence into propositional logic (recall that the spy is lying):

Alice: $(A \vee B)$
Beth: $(B \vee C)$
Carrie: $(C \vee \neg C)$

There is exactly one spy:

$(A \vee B \vee C)$ $(\neg A \vee \neg B)$ $(\neg B \vee \neg C)$ $(\neg A \vee \neg C)$

The above clauses form a Knowledge Base (KB) already in Conjunctive Normal Form.

(Side note: To find the spy, you might normally start three proofs, one for each goal sentence: A, B, C. Only the proof of B would succeed, and you would know Beth is the spy. For this test, we will do only one proof.)

Prove that **"Beth is the spy."** The goal is (B), so you adjoin the negated goal to your KB:

$(\neg B)$

Produce a resolution proof, using KB and the negated goal, that "Beth is the spy."

Repeatedly choose two clauses, write one clause in the first blank space on a line, and the other clause in the second. Apply resolution to them. Write the resulting clause in the third blank space, and insert it into the knowledge base. Continue until you produce ( ). If you cannot produce ( ), then you have made a mistake. The shortest proof I know is only three lines. It is OK to use more lines, if your proof is correct. It is OK to use abbreviated CNF, i.e., $(\neg A \ \neg B)$ instead of $(\neg A \vee \neg B)$. It is OK to omit the parentheses.

Resolve ______________________________ with ____________________ to produce: ____________________

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Resolve ______________________________ with ____________________ to produce: ____________________