For Quiz #3, “Perfect” gives the percentage of students who received full credit, “Partial” gives the percentage who received partial credit, and “Zero” gives the percentage who received zero credit.

(Due to rounding, etc., values below may be only approximate estimates.)

Problem 1
Perfect: ~35% (~69 students), Partial: ~65% (~131 students), Zero: ~0% (~0 students)

Problem 2
Perfect: ~16% (~31 students), Partial: ~82% (~164 students), Zero: ~2% (~5 students)

CS-171, Intro to A.I. — Quiz#3 — Fall Quarter, 2015 — 20 minutes

YOUR NAME: ____

YOUR ID: ____________ ID TO RIGHT: _____________ ROW: _________ SEAT: _________

1. (70 pts total, 10 pts each) Correspondence of English sentences and FOPC (FOL) sentences.
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) __B__ "All persons are mortal."

A. $\forall x$ Person(x) $\wedge$ Mortal(x)
B. $\forall x$ Person(x) $\Rightarrow$ Mortal(x)
C. $\exists x$ Person(x) $\wedge$ Mortal(x)
D. $\exists x$ Person(x) $\Rightarrow$ Mortal(x)

1.a "All persons are mortal."
A. Everything (x) is a mortal person.
B. Correct.
C. There is something (x) that is a mortal person.
D. Vacuously true if there is anything (x) that is not a person. E.g., x = a brick.

1.b (10 pts) __C__"Somebody likes everybody."

A. $\exists x \forall y$ Person(x) $\wedge$ Person(y) $\wedge$ Likes(x, y)
B. $\exists x \exists y$ Person(x) $\wedge$ Person(y) $\wedge$ Likes(x, y)
C. $\exists x \forall y$ Person(x) $\wedge$ [Person(y) $\Rightarrow$ Likes(x, y)]
D. $\exists x \exists y$ Person(x) $\wedge$ [Person(y) $\Rightarrow$ Likes(x, y)]

1.b "Somebody likes everybody."
A. There is some person (x) and everything is a person (y) and person x likes everything y.
B, There is some person (x) who likes some person (y).
C. Correct.
D. Vacuously true if there is a person (x) and anything (y) that is not a person. E.g., y = a brick.

1.c (10 pts) __A__ "Food is defined to be something that somebody eats."
(I.e., define the predicate Food(x) to be true whenever somebody eats x, and false otherwise.)

A. $\forall x \exists y$ Food(x) $\Leftrightarrow$ [Person(y) $\wedge$ Eats(y, x)]
B. $\forall x \exists y$ [Food(x) $\wedge$ Person(y)] $\Leftrightarrow$ Eats(y, x)
C. $\exists x \exists y$ Food(x) $\Leftrightarrow$ [Person(y) $\wedge$ Eats(y, x)]
D. $\forall x \forall y$ Food(x) $\Leftrightarrow$ [Person(y) $\wedge$ Eats(y, x)]

1.c "Food is defined to be something that somebody eats."
A. Correct. **Definitions are universally quantified.**
B, Vacuously true if there is something (y) that is not a person, and y does not eat anything. E.g., y = a brick.
C. Vacuously true if there is any one food that any one person eats (e.g., I eat broccoli), or if there is something that is not a food and nobody eats it.
D. Food(x) is true only when everyone (y) eats food x.

1.d (10 pts) __D__ "Every hammer is a tool."

A. $\exists x$ Hammer(x) $\wedge$ Tool(x)
B. $\forall x$ Hammer(x) $\wedge$ Tool(x)
C. $\exists x$ Hammer(x) $\Rightarrow$ Tool(x)
D. $\forall x$ Hammer(x) $\Rightarrow$ Tool(x)

1.d "Every hammer is a tool."
A. There exists a hammer and it is a tool.
B, Everything is a hammer and also is a tool.
C. Vacuously true if anything is not a hammer. E.g., x = a brick. (It could be used as, but is not, a hammer.)
D. Correct.

1.e (10 pts) __C__ "A grandparent x of y is defined to be x is a parent of a parent of y."

A. $\exists x\ \forall y\ \forall z$ Grandparent(x, y) $\Leftrightarrow$ [Parent(x, z) $\wedge$ Parent(z, y)]
B. $\forall x\ \exists y\ \forall z$ Grandparent(x, y) $\Leftrightarrow$ [Parent(x, z) $\wedge$ Parent(z, y)]
C. $\forall x\ \forall y\ \exists z$ Grandparent(x, y) $\Leftrightarrow$ [Parent(x, z) $\wedge$ Parent(z, y)]
D. $\forall x\ \forall y\ \forall z$ Grandparent(x, y) $\Leftrightarrow$ [Parent(x, z) $\wedge$ Parent(z, y)]

1.e "A grandparent x of y is defined to be x is a parent of a parent of y."
A. A grandparent x of y is defined to be that there is something (x) that is the parent of everything (z) and everything (z) is the parent of y.
B, A grandparent x of y is defined to be that x is the parent of everything (z) and there is something (y) such that everything (z) is the parent of y.
C. Correct. **Definitions are universally quantified.**
D. A grandparent x of y is defined to be that x is the parent of everything (z) and everything (z) is the parent of y.

1.f (10 pts) __C__ "Everyone in Irvine is in Southern California."

A. $\forall x$ Person(x) $\wedge$ In(x, IRVINE) $\wedge$ In(x, SOUTHERNCALIFORNIA)
B. $\exists x$ Person(x) $\wedge$ In(x, IRVINE) $\wedge$ In(x, SOUTHERNCALIFORNIA)
C. $\forall x$ [Person(x) $\wedge$ In(x, IRVINE)] $\Rightarrow$ In(x, SOUTHERNCALIFORNIA)
D. $\exists x$ Person(x) $\Rightarrow$ [In(x, IRVINE)] $\wedge$ In(x, SOUTHERNCALIFORNIA)

1.f "Everyone in Irvine is in Southern California."
A. Everything is a person and everything is in Irvine and everything is in Southern California.
B, There is something that is a person and is in Irvine and is in Southern California.
C. Correct.
D. Vacuously true if there is anything (x) that is not a person.

1.g (10 pts) __D__ "Every dog likes some bone."

A. $\forall x\ \exists y$ [Dog(x) $\wedge$ Bone(y)] $\Rightarrow$ Likes(x, y)
B. $\forall x\ \exists y$ Dog(x) $\wedge$ Bone(y) $\wedge$ Likes(x, y)
C. $\forall x\ \forall y$ Dog(x) $\wedge$ Bone(y) $\wedge$ Likes(x, y)
D. $\forall x\ \exists y$ Dog(x) $\Rightarrow$ [Bone(y) $\wedge$ Likes(x, y)]

1.g "Every dog likes some bone."
A. Vacuously true if there is anything(y) that is not a bone.
B. Everything(x) is a dog and there is a bone(y) and x likes y.
C. Everything(x) is a dog and everything(y) is a bone and x likes y.
D. Correct.

1.h (10 pts) __B__ "Something there is that doesn't love any wall." (adapted from Frost, "Mending Wall")

A. $\exists x\ \exists y\ Wall(y) \wedge \neg\ Love(x, y)$

B. $\exists x\ \forall y\ Wall(y) \Rightarrow \neg\ Love(x, y)$

C. $\exists x\ \exists y\ Wall(y) \Rightarrow \neg\ Love(x, y)$

D. $\forall x\ \forall y\ Wall(y) \wedge \neg\ Love(x, y)$

1.g "Every dog love some Wall."

A. There is something (x) and there is some wall (y) such that x does not love y.

B. Correct

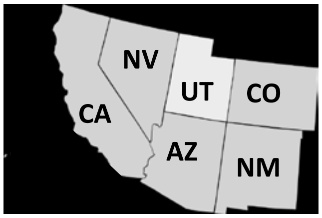
C. Vacuously true if there is anything (y) that is not a wall.

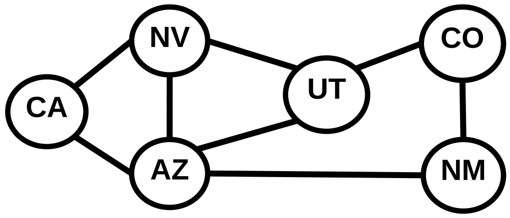
D. Everything (y) is a wall and everything (x) does not love anything (y).

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

2. (30 pts total, 10 pts each) Constraint Satisfaction Problems.

See Chapter 6.





You are a map-coloring robot assigned to color this Southwest USA map. Adjacent regions must be colored a different color (R=Red, B=Blue, G=Green). The constraint graph is shown.

2.a. (10 pts total, -5 each wrong answer, but not negative) MINIMUM-R (MRV) HEURISTIC. Consider the assignment below. NV is assigned and s been done. List all unassigned variables that might be selected by the Mi (MRV) Heuristic:**<u>CA, AZ, UT</u>**.

CA, AZ, UT have two remaining values, while CO and NM have three.

CA	NV	AZ	UT	CO	NM
R B	G	R B	R B	R G B	R G B

2.b. (10 pts total, -5 each wrong answer, but not negative) the assignment below. (It is the same assignment as in proble constraint propagation has been done. List all unassigned va Degree Heuristic:**<u>AZ</u>**.

AZ has degree three to unassigned variables (CA, UT, NM), while UT, CO, NM have degree two and CA has degree one.

CA	NV	AZ	UT	CO	NM
R B	G	R B	R B	R G B	R G B

2.c. (10 pts total, -5 each wrong answer, but not negative) LEAST CONSTRAINING VALUE (LCV) HEURISTIC. Consider the assignment below. (It is the same assignm above.) NV is assigned and constraint propagation has been done.

CO has been chosen as the next variable to be explored (despite the possible value orderings might be returned by the Least Constraining Value

<u>(G R B) (G B R)</u>.

G constrains only NM while R and B constrain both UT and NM.

CA	NV	AZ	UT	CO	NM
R B	G	R B	R B	R G B	R G B