PHIL 120 Assignment 3 – Symbolic Logic I

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Question 1: Is the following an expression of FOL? (0.5 points)

$$Q(x, y) \to \vee B(x)$$

No, the $\vee$ and $\to$ don't correctly act as quantifiers in this expression.

Question 2: What are the scopes of the two quantifiers in the following sentence? (0.5 points)

$$\forall x \left(Q(p) \leftrightarrow \left(A(x, c) \wedge \exists y \left(R(y) \wedge Q(x)\right)\right)\right) \to T(d, a)$$

$$\underbrace{\forall x(Q(p) \leftrightarrow (A(x, c) \wedge \underbrace{\exists y \left(R(y) \wedge Q(x)\right)}_{\forall y}))}_{\forall x} \to T(d, a)$$

Question 3: Which are, if any, the free variables in the following formula of FOL? (0.5 points)

$$G(b, y) \to \exists x F(a, x)$$

The free variables are b, y, and a.

Question 4: Is the following a formula of FOL? (0.5 points)

$$\exists y \left(Q(y) \wedge R(y)\right)$$

Yes, specifically a sentence of FOL.

Question 5: Is the following a sentence of FOL? (0.5 points)

$$\forall y A(y) \leftrightarrow \exists x B(a, x)$$

No, the variable a is free.

For the next 5 questions (6-10):

1. Provide a symbolization key (one key for all sentences)
2. A domain
3. Symbolize the following English sentences into FOL

Question 6: "Not all movies are artsy" (0.5 points)

- Domain: Movies
- Symbolization Key:
  - $M(x)$: x is a movie
  - $A(x)$: x is artsy
- $\neg\forall x\,(M(x) \rightarrow A(x))$

Question 7: "All teachers like some movies" (0.5 points)

- Domain: People
- Symbolization Key:
  - $T(x)$: x is a teacher
  - $L(x, y)$: x likes y
  - $M(x)$: x is a movie
- $\forall x\,(T(x) \rightarrow \exists y\,(M(y) \wedge L(x, y)))$

Question 8: "Some artsy movies are boring, and some boring teacher is artsy" (0.5 points)

- Domain: Movies and People

- Symbolization Key:
  - $M(x)$: x is a movie
  - $A(x)$: x is artsy
  - $B(x)$: x is boring
  - $T(x)$: x is a teacher
- $\exists x\left((M(x) \wedge A(x)) \wedge B(x)\right) \wedge \exists y\left((T(y) \wedge B(y)) \wedge A(y)\right)$

Question 9: "Only Amy likes artsy movies" (0.5 points)

- Domain: People and Movies
- Symbolization Key:
  - a: Amy
  - $M(x)$: x is a movie
  - $L(x, y)$: x likes y
  - $A(x)$: x is artsy
- $\forall x \forall y\left(((M(y) \wedge L(x, y)) \wedge A(y)) \rightarrow (x = a)\right)$

Question 10: "At least one artsy movie is not boring" (0.5 points)

- Domain: Movies
- Symbolization Key:
  - $M(x)$: x is a movie
  - $A(x)$: x is artsy
  - $B(x)$: x is boring
- $\exists x\left((M(x) \wedge A(x)) \wedge \neg B(x)\right)$