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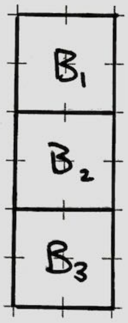
All code that was added to complete this assignment was written by me.

signed: 

CSC384 QUIZ 1 Zachary LaPointe

1 a) My model of ϕ is as follows:



In this scenario, in English, we would describe B_2 as under B_1, B_3 as under B_2, and B_3 as under B_1. In other words, the english description of under is transitive.

However, this model and the predicate symbol under(y,x) do not satisfy the English def'n:

$$Under(B_3, B_1) \longleftrightarrow (B_1 \text{ is immediately above } B_3)$$
$$\vee (B_1 \text{ is not above any blocks } \wedge B_1 = B_3)$$

B_1 is obviously above B_2 and B_3 by definition and is not equal to B_3 obviously. We can also see B_2 is immediately above B_3, so B_1 is obviously not. We can substitute false for these statements:

$$Under(B_3, B_1) \longleftrightarrow (\text{false}) \vee (\text{false} \wedge \text{false})$$
$$Under(B_3, B_1) \longleftrightarrow \text{false}$$

Therefore by definition B_3 is <u>not</u> under B_1, which conflicts with the English definition.

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2. $\forall x((\forall y(P_1(x,y) \rightarrow P_2(y) \vee P_3(y)))$

$\longrightarrow ((\forall y(P_1(x,y) \rightarrow P_2(y))) \vee (\forall y(P_1(x,y) \rightarrow P_3(y)))))$

First we simplify the implication symbols highlighted in green.

$\forall x(\neg(\forall y(\neg P_1(x,y) \vee P_2(y) \vee P_3(y)))$

$\vee ((\forall y(\neg P_1(x,y) \vee P_2(y))) \vee (\forall y(\neg P_1(x,y) \vee P_3(y)))))$

We can then coalesce the second and third terms disjuncted together.

$\forall x(\neg(\forall y(\neg P_1(x,y) \vee P_2(y) \vee P_3(y)))$

$\vee (\forall y(\neg P_1(x,y) \vee P_2(y) \vee \neg P_1(x,y) \vee P_3(y))))$

We can then simplify with the identity $x \vee x = x$

$\forall x(\neg(\forall y(\neg P_1(x,y) \vee P_2(y) \vee P_3(y)))$

$\vee (\forall y(\neg P_1(x,y) \vee P_2(y) \vee P_3(y))))$

And then we substitute $P_4(x,y)$ for $\neg P_1(x,y) \vee P_2(y) \vee P_3(y)$

$\forall x(\neg(\forall y\ P_4(x,y)) \vee (\forall y\ P_4(x,y)))$

We can therefore see this is a tautology as $\forall x \forall y\ \neg P_4 \vee P_4$ is always true. QED.

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3. a)

- $\exists x((Murder(x, M, L, T) \wedge (\forall y(Murder(y, M, L, T) \rightarrow (y = x))))$
- $\forall x(At(x, L, T) \rightarrow O(x))$
- $At(P, L, T)$
- $\exists x, \exists y(Mo(x) \wedge Mo(y) \wedge (x \neq y))$
- $Murder(x, M, L, T) \longleftrightarrow (Mo(x) \wedge O(x))$

b) $Murder(P, M, L, T) \longleftrightarrow (Mo(P) \wedge O(P))$

$At(P, L, T) \rightarrow O(P)$

$\boxed{Mo(P)?}$

However, even though Mrs. P had an opportunity to murder Mr. M, we do not know from the given information that Mrs. P had a motive to kill Mr. M. Therefore, we cannot conclude that Mrs. P murdered Mr. M.