

hw7

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Date: 3/2/2022
Course C241

Question one

- (a) rewrite: $\neg\forall x(F(x) \rightarrow V(x))$
 1. $\exists x\neg(F(x) \rightarrow V(x))$
 2. $\exists x(F(x) \vee \neg V(x))$
- (b) rewrite: $\neg\exists x(F(x) \wedge L(x))$
 1. $\forall x\neg(F(x) \wedge L(x))$
 2. $\forall x(\neg(F(x) \vee \neg L(x)))$
- (c) rewrite: $\forall x(F(x) \rightarrow L(x))$
 1. $\forall x(\neg F(x) \vee V(x))$
 2. $\forall x\neg(F(x) \wedge \neg V(x))$
 3. $\neg\exists x(F(x) \wedge \neg V(x))$
- (d) rewrite: $\exists x(F(x) \wedge \neg V(x))$
 1. $\exists x\neg(\neg F(x) \vee V(x))$
 2. $\neg\forall x(\neg F(x) \vee V(x))$

Question two

- (a) M1, M2, M3, M4, M6, M8
- (b) There is no uppercase vowel.
- (c) M3, M4, M8
- (d) All vowels are uppercase
- (e) m3, m4, m8
- (f) There is no lowercase vowel.
- (g) m1, m2, m4, m6, m8
- (h) There is an uppercase vowel

Question three (recheck)

- (a) $\neg\exists x(V(x) \wedge F(x))$
- (b) $\neg\forall x(L(x) \rightarrow F(x))$
- (c) $\exists x(V(x) \wedge \neg F(x))$
- (d) $\neg\exists x(V(x) \wedge F(x))$
- (e) $\forall x(\neg V(x) \rightarrow F(x))$

Question four

- $\neg\forall x(V(x) \rightarrow L(x)), \exists x\neg(V(x) \rightarrow L(x)), \exists x(V(x) \wedge \neg L(x))$
- $\forall x\neg(V(x) \wedge L(x)), \neg\exists x(V(x) \wedge L(x)), \forall x(\neg V(x) \vee \neg L(x)), \forall x(V(x) \rightarrow \neg L(x))$
- $\forall x\neg(V(x) \rightarrow L(x))$

Question five

- (a) square points to circle, triangle points to square
- (b) not possible, if all objects point to one object, then all objects point to some object.
- (c) square points to circle, circle points to itself.
- (d) square points to itself, circle points to itself.
- (e) m1, m2, m3
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- (f) All solids point to an object.
- (g) m2
- (h) An object is pointed to by all solids.
- (i) m10
- (j) If an object is solid, then it is pointed to by all objects.
- (k) solid square and solid triangle point to eachother and solid square points to itself
- (l) All objects point to a solid.
- (m) $\exists x\forall y((S(y) \wedge C(x)) \rightarrow P(x, y))$
- (n) $\exists x\forall y((C(x) \wedge S(y)) \rightarrow P(y, x))$
- (o) $\forall x\exists y((C(y) \wedge S(x)) \rightarrow P(y, x))$
- (p) $\forall x\exists y((C(y) \wedge S(x)) \rightarrow P(x, y))$

Question six

- (a) m1, m2, m3, m4
- (b) Every object is not connected to every object
- (c) m1
- (d) No objects connect to any objects
- (e) m1, m2
- (f) There exists an object with no connections

Question seven

- (a) m1, m2, m3, m4, m5
 - (b) $\exists x \neg \forall y (S(x, y))$
 - (c) m1, m2, m4
 - (d) $\exists x \forall y (\neg S(x, y))$
 - (e) $\neg \exists x \forall y ((T(x) \wedge R(y)) \rightarrow L(x, y))$;
 - (f) m1, m2, m3, m4, m5
 - (g) There is a five letter word that does not share a letter with a word.
 - (h) rewrite $\forall x \exists y (T(y) \wedge \neg L(x, y))$
1. $\forall x \exists y (\neg (\neg T(y) \vee L(x, y)))$
 2. $\forall x \neg \forall y (\neg T(y) \vee L(x, y))$
- (i) rewrite $\forall x \exists y (T(y) \wedge \neg L(x, y))$
1. grab result from h: $\forall x \neg \forall y (\neg T(y) \vee L(x, y))$
 2. $\neg \exists x \forall y (\neg T(y) \vee L(x, y))$
- (j) m7, m8
 - (k) All words are shorter than a word starting with t