

Semantic Theory 2023: Exercise sheet 1

Exercise 1

Translate the following sentences into first-order predicate logic. You can freely introduce predicates, but try to retain as much of the structure as possible. Also provide the key to the translation.

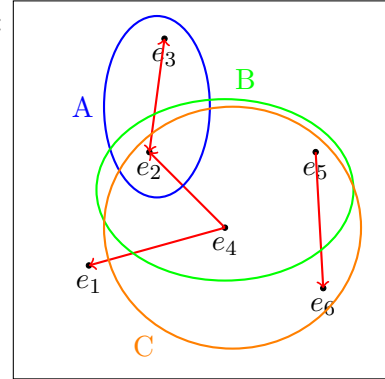
- Link is scared of nothing.
- Every princess loves her saviour.
- The Master Sword is the only sword that can defeat Agahnim.
- If the leader of the Dark World is defeated, the Light World is free.

Exercise 2

Consider the following model $M_1 = \langle U_1, V_1 \rangle$, with $U_1 = \{e_1, e_2, e_3, e_4, e_5, e_6\}$. The interpretation function V_1 is defined as follows:

- $V_1(j) = e_1$
- $V_1(m) = e_4$
- $V_1(b) = e_6$
- $V_1(A) = \{e_2, e_3\}$
- $V_1(B) = \{e_2, e_4, e_5\}$
- $V_1(C) = \{e_2, e_4, e_5, e_6\}$
- $V_1(R) = \{\langle e_2, e_3 \rangle, \langle e_3, e_2 \rangle, \langle e_4, e_1 \rangle, \langle e_4, e_2 \rangle, \langle e_5, e_6 \rangle\}$

M1:



Let the assignment function g_1 be defined as follows:

$g_1(x) = e_4$, $g_1(x') = e_2$, $g_1(x'') = e_3$ and for all other variables x'^* : $g_1(x'^*) = e_5$.

2.1 Evaluate the following formulas in model M_1 , with respect to assignment function g_1 . First, derive the truth conditions (showing all relevant steps of the derivation) and then evaluate these truth conditions with respect to M_1 and g_1 .

- $\llbracket R(x', x'') \wedge R(x''', b) \rrbracket^{M_1, g_1} = ?$
- $\llbracket \exists x'' (A(x'') \rightarrow R(x'', j)) \rrbracket^{M_1, g_1} = ?$
- $\llbracket \forall x (B(x) \rightarrow (A(x) \vee \neg \exists x'' (R(x'', x)))) \rrbracket^{M_1, g_1} = ?$

2.2 Provide a graphical representation of a model that satisfies the following formulas (NB: c_1 and c_2 are constants):

- $R(x, x')$
- $\forall x(A(x) \vee \exists x'(R(x, x')))$
- $\neg \exists x(R(x, c_1))$
- $\exists x''(A(x'') \wedge \neg \exists x'(A(x') \wedge R(x', x'')))$
- $\forall x'(B(x') \rightarrow (A(x') \vee R(x', c_2)))$

2.3 (Bonus) Can you think of a sensible (or: funny) interpretation for the predicates A, B and R , and the constants c_1 and c_2 in your model of the previous exercise? Given this interpretation, what is the natural language translation of the formulas given in exercise 2.2?