

Solutions to predicate Logic Tutorial 1

1.

- $\text{term}(\text{logic}, 1)$
- $\forall C (\text{term}(C, 1) \rightarrow \text{compulsory}(C))$
- $\exists C (\text{term}(C, 2) \wedge \text{compulsory}(C))$
- $\forall C (\text{term}(C, 2) \rightarrow \neg \exists Y \text{prereq}(Y, C) \vee (\exists Y \text{prereq}(Y, C) \wedge \forall X (\text{prereq}(X, C) \rightarrow \text{term}(X, 1))))$
- $\forall X, Y (\text{term}(X, 2) \wedge \text{prereq}(Y, X) \rightarrow \text{term}(Y, 1))$
- $\forall X (\text{term}(X, 1) \vee \text{term}(X, 2) \rightarrow \exists Y (\text{lecturer}(Y) \wedge \text{teaches}(Y, X)))$
- $\exists Y (\text{lecturer}(Y) \wedge \forall X (\text{term}(X, 1) \vee \text{term}(X, 2) \rightarrow \text{teaches}(Y, X)))$

2.

Describing the gate types:

$\text{xorgate}(g1)$

This says g1 is an xor gate.

$\text{xorgate}(g2)$

$\text{andgate}(g3)$

$\text{andgate}(g4)$

$\text{orgate}(g5)$

Describing the inputs:

$\text{input1}(g1, 1)$

$\text{input2}(g1, 0)$

These say the first input of g1 is 1 and the second input of g1 is 0.

$\forall X (\text{input1}(g2, X) \leftarrow \text{output}(g1, X))$

This says the output of g1 is the first input of g2.

$\text{input2}(g2, 1)$

$\text{input1}(g3, 1)$

$\forall X (\text{input2}(g3, X) \leftarrow \text{output}(g1, X))$

This says the output of g1 is the second input of g3.

$\text{input1}(g4, 1)$

$\text{input2}(g4, 0)$

$\forall X (\text{input1}(g5, X) \leftarrow \text{output}(g3, X))$

$\forall X (\text{input2}(g5, X) \leftarrow \text{output}(g4, X))$

Describing outputs of gates:

$\forall X, G, I1, I2 (\text{output}(G, X) \leftarrow \text{andgate}(G) \wedge \text{input1}(G, I1) \wedge \text{input2}(G, I2) \wedge \text{and_result}(I1, I2, X))$

This says if G is an andgate and its two inputs are I1 and I2, then the output of G is the result of and-ing I1 and I2.

$\forall X, G, I1, I2 (\text{output}(G, X) \leftarrow \text{orgate}(G) \wedge \text{input1}(G, I1) \wedge \text{input2}(G, I2) \wedge \text{or_result}(I1, I2, X))$

$\forall X, G, I1, I2 (\text{output}(G, X) \leftarrow \text{xorgate}(G) \wedge \text{input1}(G, I1) \wedge \text{input2}(G, I2) \wedge \text{xor_result}(I1, I2, X))$

$\text{and_result}(1, 1, 1)$

$\forall X (\text{and_result}(0, X, 0))$

$\forall X (\text{and_result}(X, 0, 0))$

$\text{or_result}(0, 0, 0)$

$\forall X (\text{or_result}(1, X, 1))$

$\forall X (\text{or_result}(X, 1, 1))$

$\forall X (\text{xor_result}(X,X,0))$
 $\forall X,Y (\text{xor_result}(X,Y,1) \leftarrow \neg X=Y)$

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