

Name: _____ SUID: _____ NetID: _____

Run the forward-chaining algorithm to determine whether the given knowledge base entails the query.

KB: A C $A \rightarrow B$ $C \wedge D \rightarrow B$	Inferred				Count		Agenda	
	A	B	C	D	$A \rightarrow B$	$C \wedge D \rightarrow B$	← FIFO	
	F	F	F	F	1	2	A, C	
	T	F	F	F	0	2	C, B	
	T	F	T	F	0	1	B	
Query: $D?$	T	T	T	F	0	1		

return F

The notation $\{..., x \rightarrow t, ...\}$ means that each occurrence of the variable x is to be replaced by the term t . t can be any term containing function symbols, constant symbols, and/or other variables. Compute

SUBST(
 $\{x \rightarrow z, y \rightarrow b, z \rightarrow a\},$
 $P(x, y, F(G(a, b), G(z, x)))$)

Where P is an FOL predicate, and F and G are FOL function symbols.

$$\begin{array}{c}
 P(x, y, F(G(a, b), G(z, x))) \\
 \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\
 P(z, b, F(G(a, b), G(a, z)))
 \end{array}$$

Compute the composition of substitutions $\text{SUBST}(\{x \rightarrow y\} \circ \{y \rightarrow z\}, P(x, y))$. What is the result? Rewrite the composition $\{x \rightarrow y\} \circ \{y \rightarrow z\}$ as a single substitution.

$$\begin{array}{lcl}
 \text{Subst}(\{x \rightarrow y\} \circ \{y \rightarrow z\}, P(x, y)) & & P(x, y) \quad \{x \rightarrow y\} \circ \{y \rightarrow z\} \\
 \downarrow & & \downarrow \quad \downarrow \\
 P(x, z) & & P(y, z) \\
 \downarrow & & \\
 P(y, z) & & \boxed{\{x \rightarrow y, y \rightarrow z\}}
 \end{array}$$

Full composition rule:

$$\begin{array}{l}
 \{x \rightarrow y\} \circ \{y \rightarrow z\}: \\
 \{x \rightarrow y, y \rightarrow \text{subst}(\{x \rightarrow y\}, z)\} \\
 \{x \rightarrow y, y \rightarrow z\} \\
 y \text{ is not } z, \text{ so don't remove } y \rightarrow z \\
 x \notin \{y\}, \text{ so don't remove } x \rightarrow y
 \end{array}$$

[AIMA exercise 9.4] Run the unification algorithm on the following two expressions: $Q(y, G(A, B))$ and $Q(G(x, x), y)$. Don't forget to standardize apart first.

$$Q(y, G(A, B))$$

$$Q(G(x, x), y)$$

Standardize apart:

$$Q(y, G(A, B))$$

$$Q(G(x, x), z)$$

$$\theta_1 = \{y \rightarrow G(x, x)\}$$

$$Q(G(x, x), G(A, B))$$

$$Q(G(x, x), z)$$

$$\theta_2 = \{z \rightarrow G(A, B)\} \circ \theta_1$$

$$Q(G(x, x), G(A, B))$$

$$Q(G(x, x), G(A, B))$$

Unifier:

$$\theta_2 = \{z \rightarrow G(A, B), y \rightarrow G(x, x)\}$$