Intelligent Information Systems  
SS 16

Exercise 6

Exercise 1 (SIPS - sideways information passing strategy). Consider the following set of rules:

\[ p(X, X) \leftarrow q(X, Y), \ r(Y, Y). \]
\[ p(X, Y) \leftarrow q(X, Z), \ e(Z, Y, X, X), \ t(X, W), \ s(W). \]

Let us now consider the two SIP strategies 'most bounded' and 'minfree'. The first strategy reorders the body literals in such a way that the maximal number of variables is bound per literal. The second one orders the body literals such that the number of free variables is minimal per literal. In case that a SIPS does not uniquely determine the next body literal to be evaluated, the original left-to-right ordering is applied for choosing the next literal.

a) Determine the body literal order for the query \( p(a, X) \) and the SIPS 'most bounded' and 'minfree'.

b) Show that the SIPS 'minfree followed by smallest relation first' does not necessarily lead to an optimal literal evaluation order.

Exercise 2 (Magic Sets). Consider the following rules and facts:

\[ p(X, Y) \leftarrow s(X, Y), \ q(Y). \]
\[ n(X) \leftarrow q(X), \ t(X). \]
\[ q(Y) \leftarrow r(Y). \]
\[ q(Y) \leftarrow t(Y). \]
\[ m(X) \leftarrow r(X). \]
\[ m(X) \leftarrow s(X, Y), \ m(Y). \]

\[ s(2, 1). \ s(2, 2). \ s(2, 3). \ s(3, 4). \ s(5, 2). \]
\[ r(1). \ r(3). \ r(4). \ t(5). \ t(6). \ t(7). \]

a) Determine the Magic Sets transformed rules for R and the query \( p(2, Y) \).

b) Compute the fixpoint \( F^* \) of \((R,F)\) and compare the intermediate results with the facts generated for the Magic Sets transformed rules.
Exercise 3 (Properties of Magic Sets). Consider the following rules:

\[
\begin{align*}
q(X, Y) & \leftarrow r(Y, Z), \ q(X, Y). \\
p(X, Y) & \leftarrow q(X, Z), \ q(Y, Z).
\end{align*}
\]

\[
q(X, Y) \leftarrow r(Y, X).
\]

a) Determine all possible adorned rule sets for R. How many rules may result from a Magic Sets transformation?

c) Determine the Magic Sets transformed rule set for the query \( p(d, c) \).

d) Compute the fixpoint \( F^* \) of \((R, F)\) and compare the intermediate results with the facts generated for the Magic Sets transformed rules using the following facts:

\[
\begin{align*}
r(a, b). \ r(a, c). \ r(b, d). \ r(b, e). \ r(c, f). \ r(c, g). \ r(f, h). 
\end{align*}
\]

Exercise 4 (Efficiency of Magic Sets). Show with the following rule and fact set that a (naive) fixpoint calculation without a Magic Sets transformation can sometimes be more efficient for determining the answer set:

Query: \( q(X, Y) \)

Rules R:

\[
\begin{align*}
q(X, Y) & \leftarrow p(X, Y), \ r(X, Y). \\
p(X, Y) & \leftarrow b_1(X, Y). \\
p(X, Y) & \leftarrow b_1(X, Z), \ p(Z, Y). \\
r(X, Y) & \leftarrow b_2(X, Y). \\
r(X, Y) & \leftarrow b_2(X, Z), \ r(Z, Y).
\end{align*}
\]

Facts F:

\[
\begin{align*}
b_1(2, 1). \ b_1(2, 3). \ b_1(3, 5). \ b_1(3, 6). \ b_1(5, 7). \\
b_1(6, 8). \ b_2(2, 1). \ b_2(2, 6). \ b_2(6, 8). \ b_2(6, 9).
\end{align*}
\]