Exercise 9.1
Consider the following program $P$:

\[
\begin{align*}
p & \leftarrow p. \\
p & \leftarrow r. \\
q & \leftarrow \neg r, p. \\
r & \leftarrow \neg p. \\
t & \leftarrow q. \\
t & \leftarrow r, \neg q. 
\end{align*}
\]

(a) Construct the dependency graph $D_P$ of $P$.
(b) Give a stratification of $P$.
(c) Use your stratification to compute the standard model $M_P$ of $P$.

Exercise 9.2
Consider the following program $P$:

\[
\begin{align*}
p(X) & \leftarrow q(X), \neg p(b). \\
p(b) & \leftarrow \neg q(b). \\
q(a). 
\end{align*}
\]

(a) Give all Herbrand interpretations $I \subseteq HB_{\{p,q\},\{a,b\}}$ that are models for $P$.
(b) Which of the Herbrand models found in a) are supported?
(c) Give all standardised Herbrand interpretations $I_\equiv$ that are a model for $\text{comp}(P)$.

Exercise 9.3
Consider the following clauses defining addition and multiplication:

\[
\begin{align*}
\text{add}(X, 0, X). \\
\text{add}(X, s(Y), s(Z)) & \leftarrow \text{add}(X, Y, Z). \\
\text{mul}(0, X, 0). \\
\text{mul}(s(X), Y, Z) & \leftarrow \text{mul}(X, Y, U), \text{add}(U, Y, Z). 
\end{align*}
\]

Explain whether the program is recurrent.