Exercise 8.1
Consider the following program $P$ computing the permutation of a list:

perm([], []).
perm(Xs, [X|Ys]) :- select (X,Xs,Zs), perm(Zs, Ys).
select(X, [X|Xs],Xs).
select(X, [Y|Xs],[Y|Zs]) :- select(X,Xs,Zs).

(a) Let $Q$ be the query $\neg \text{perm}([a,b,c],[b,a,d])$. Draw the SLDNF-tree for the $P \cup \{Q\}$.
(b) Explain whether $P \models \neg \text{perm}([a,b,c],[b,a,d])$.
(c) Write $\text{Comp}(P)$.
(d) Explain whether $\text{Comp}(P) \models \neg \text{perm}([a,b,c],[b,a,d])$.
(e) Is it possible that the given query will give floundering? Explain your reasons.
(f) Is $P$ an allowed program? Is it hierarchical? Is it strict wrt to $Q$?

Exercise 8.2
Consider the following program $P$, where clauses have been numbered:

1 even(0).
2 even(s(s(X))) :- even(X).
3 num(X) :- even(X).
4 num(X) :- odd(X).

(a) Write the completion $\text{Comp}(P)$.
(b) Is $P$ strict? Hierarchical? Stratified?
(c) Show a formula $F$ such that $\text{Comp}(P) \not\models F$.

Exercise 8.3
Consider the following program $P$, where clauses have been numbered:

1 even(X) :- zero(X)
2 even(s(s(X))) :- even(X).
3 odd(X) :- even(X).
3 num(X) :- even(X).
4 num(X) :- odd(X).
5 zero(0).
(a) Write the completion \( \text{Comp}(P) \).

(b) Draw \( D_P \); does \( num \) depend evenly on \( \text{zero} \)? Does \( num \) depend oddly on \( \text{zero} \)?

(c) Is \( P \) strict wrt the query \( ? \odds (s(0)). \)?

(d) Is \( P \) strict wrt the query \( ? \evens (X), \neg \odds (X) \).

Exercise 8.4

Consider the following program \( P \):

1. \( p(X, Y) : \neg r(X), s(Y) \).
2. \( p(X, Y) : \neg q(X), \neg t(a), r(Y) \).
3. \( r(a) \).
4. \( r(X) : \neg \neg q(Z), \neg t(X) \).
5. \( t(X) : \neg s(f(X)) \).
6. \( s(f(X)) : \neg r(X) \).

(a) Is \( P \) allowed?

(b) Let \( Q \) be the query \( ? \odds(Z), \neg q(Z) \). Is \( P \) strict wrt to \( Q \)?

(c) Is \( P \) stratified?

(d) What is the dependency of predicate \( t \) on \( q \)?