1. Consider the following rules:

   ```
   p(X,Y) :- a(X,Y), a(Y,Z).
   p(X,Y) :- p(X,Z), p(Y,Z).
   ```

   and the following EDB:

   ```
   A = { (0,1), (1,2), (2,3), (3,4), (4,5), (5,2), (5,6) }
   ```

   (a) Using T_P operator, find the minimal model of the database. Show values after each iteration.

   (b) Write SQL queries for the IDB relations. Show the values of the relations after each iteration of the Naive algorithm.

   (c) Write SQL queries for the delta-relations. Show the values of the all relations after each iteration of the Semi-Naive algorithm.

2. Consider the following rules:

   ```
   p(X,Y) :- a(X,Y).
   p(X,Y) :- q(X,Z), b(Z,Y).
   q(X,Y) :- c(X,Z), p(Z,Y).
   ```

   and the following EDB:

   ```
   A = { (1,2), (2,3), (3,4), (4,5), (5,6) }
   B = { (1,2), (2,3), (3,4), (4,5), (5,6) }
   C = { (1,2), (2,3), (3,4), (4,5), (5,6) }
   ```

   (a) Perform the magic-set transformation for the query

   ```
   query(X) :- p(3,X).
   ```

   (b) Compute the answer to the query using the transformed program and by following the order of predicated indicated by the dependency graph. Show the values of the relations after each iteration of the Naive algorithm executed on the transformed database.

3. Weak Well-Founded Model.

   (a) Precisely define the T_P^F operator.

   (b) Consider the ground program:

```
p(a) :- p(c), not p(b).
p(b) :- not p(a).
p(c).
p(d) :- p(e), not p(f).
p(d) :- p(f), not p(g).
p(d) :- p(h).
p(e) :- p(d).
p(f) :- p(e).
p(f) :- not p(c).
p(i) :- p(c), not p(d).
```

Compute the weak well-founded model for the above program. Show values after each iteration.

4. Consider the following IDB rules of P:

```
p(X) :- a(X,Y,Z), p(Y), not p(Z).
p(X) :- b(X).
```

Compute the weak well-founded model for P with the following EDBs:

(a) $EDB1 = \{b(1), b(2), a(1,2,3), a(3,2,1)\}$.

(b) $EDB2 = \{b(1), a(1,2,3), a(2,1,3), a(2,3,3)\}$.

(c) $EDB3 = \{b(1), a(1,2,3), a(2,3,1), a(3,1,3)\}$.

Show values after each iteration.

5. Well-Founded Model.

(a) Precisely define the concept of unfounded sets and greatest unfounded sets.

(b) Consider the program:

```
a(1).
a(3).
b(1,2).
b(2,3).
c(3).
p(X) :- a(X), not q(X).
q(X) :- b(X,Y), p(Y).
q(X) :- c(X).
```

Construct the well-founded model for the program. Show the values after each iteration.

6. Paraconsistent Algebra. Consider the following two paraconsistent relations:

```
P+ = { (a,b), (b,c) }
P- = { (a,c), (c,a), (c,b) }
Q+ = { (c,b), (b,c) }
Q- = { (a,a), (c,c) }
```

Compute the paraconsistent relation corresponding to the following expression:

$$\dot{\pi}_{X,Z}(P(X,Y) \dot{\bowtie} Q(Y,Z))$$