ARTIFICIAL INTELLIGENCE
5th Assignment

1. Translate the following natural language sentences into first-order logic (FOL) formulas.

   a. "Pluto loves its master"
   b. "Every dog has a master"
   c. "John either hates George or is ambitious"
   d. "Apples are a kind of food"
   e. "Every carnivorous animal eats all animals smaller than itself"
   f. "No man likes a woman who is vegeterian"

2. Convert the following FOL formulas in their Clause Normal Form.

   a. $(\forall x)\ (\forall y)\ (\forall z)\ ((pet(x) \wedge master(x, y) \wedge lives(y, z)) \Rightarrow lives(x, z))$
   b. $((\forall x)\ ((\exists y)\ a(y) \Rightarrow b(x, y))) \vee ((\forall x)\ c(x))$

3. Check whether theliterals in the following couples can be unified. In case they can, find the most general unifier. Otherwise, explain why they cannot.

 a. $p(x, y)$, $p(a, z)$
 b. $p(x, x)$, $p(a, b)$
 c. $descendant(x, father\text{-}of(x))$, $descendant(john, bill)$
 d. $descendant\ (x, y)$, $descendant(bill, father\text{-}of(bill))$
 e. $q(x, a, y)$, $q(z, z, b)$
 f. $q(x)$, $\neg q(a)$

4. The following FOL formulas are given:

   (1)   works-in (george, patras)
   (2)   works-in (paul, rio)
   (3)   master (george, pluto)
   (4)   master (paul, boby)
   (5) $(\forall x)\ (\forall y)\ (works\text{-}in\ (x, y) \Rightarrow lives\text{-}in\ (x, y))$
   (6) $(\forall x)\ (\forall y)\ (\forall z)\ ((master\ (x, y) \wedge lives\text{-}in\ (x, z)) \Rightarrow lives\text{-}in\ (y, z))$

where x, y, z are variables.
(α) Using resolution refutation, prove that "Pluto lives in Patra".
(β) Using resolution refutation, answer the question "Who lives in Rio?".