IITJ (2014-15), 3rd Year, II Sem.
32002-Artificial Intelligence, Quiz#1

Roll No.....

Duration: 30 Minutes (Max Marks: 10)

1. Find out the clauses for the following FOPL formulas. [4]
   $\forall x \forall y((P(x) \wedge Q(y)) \Rightarrow \exists z R(x, y, z))$

Ans. The clauses can be deduced as follows:

$$\begin{aligned}
&\forall x \forall y((P(x) \wedge Q(y)) \Rightarrow \exists z R(x, y, z)) \\
&\Rightarrow \forall x \forall y(\neg(P(x) \wedge Q(y)) \vee \exists z R(x, y, z)) \\
&\Rightarrow \forall x \forall y(\neg(P(x) \wedge Q(y)) \vee R(x, y, f(x, y))) \\
&\Rightarrow \forall x \forall y((\neg P(x) \vee \neg Q(y)) \vee R(x, y, f(x, y))) \\
&\Rightarrow \forall x \forall y(\neg P(x) \vee \neg Q(y) \vee R(x, y, f(x, y))) \\
&\Rightarrow \neg P(x) \vee \neg Q(y) \vee R(x, y, f(x, y))
\end{aligned}$$

2. Determine whether the expression p and q unify with each other in the following cases. If so, give the *mgu*, if not justify it. The lowercase letters are variables, and upper are predicate, functions, and literals. [3]
   $p = F(x_1, G(x_2, x_3), x_2, B);\ q = F(G(H(A, x_5), x_2), x_1,\ H(A,\ x_4), x_4)$

Ans. The mgu θ is derived as follows:

$$\begin{aligned}
&\theta = \{G(H(A, x_5), x_2)/x_1, x_1/G(x_2, x_3), H(A, x_4)/x_2, x_4/B\} \\
&\Rightarrow \theta = \{G(H(A, x_5), x_2)/G(x_2, x_3), H(A, x_4)/x_2, x_4/B\}
\end{aligned}$$

3. Use resolution to show that the following set of clauses is unsatisfiable. [3]

$$\{p(a, z), \neg p(f(f(a)), a), \neg p(x, g(y)) \vee p(f(x), y)\}$$

Ans. For unifier $\{f(f(a))/f(x), a/y\}$, the expressions $\neg p(f(f(a)), a)$ and $\neg p(x, g(y)) \vee p(f(x), y)$ become as:

$\neg p(f(f(a)), a)$ and $\neg p(x, g(y)) \vee p(f(f(a)), a)$. Resolving these we get net expression as: $\{p(a, z), \neg p(x, g(y))\}$. Resolving this last expression for unifier $\{a/x, z/g(y)\}$, we get null expression, which is proof for the same.