4511W, Fall-2018
ASSIGNMENT 5:
Assigned: 11/29/18 Due: 12/5/18 at 11:00 PM (submit via moodle, you *__must combine your__* *__submission into a single PDF__* with the question numbers clearly labeled. Moodle does not allow submission over 20MB.)

Problem 1. (20 points)
Convert the following English sentences to first order logic:
1. "A TA will grade this problem."
2. "It is always cold in Alaska, yet hot in Arizona."
3. "Sally sells shells by the sea shore."
4. "Only one person is the president."
5. "Everyone with the same last name share an ancestor."

Problem 2. (15 points)
Use forward-chaining to decide whether the following first-order logic sentences can entail α. You must be clear on your substitution/unification.
$$\alpha = \exists x \; Traps(Felicidad, x)$$

KB:
$$\exists x \; Troll(x)$$
$$\forall x \; Troll(x) \Rightarrow Large(x)$$
$$\exists x \; Troll(x) \wedge Aggressive(x)$$
$$\forall x \; Large(x) \wedge Aggressive(x) \Rightarrow Dangerous(x)$$
$$\forall x, y \; Hunter(x) \wedge Dangerous(y) \wedge Bounty(y) \Rightarrow Traps(x, y)$$
$$Hunter(Felicidad)$$
$$\exists x \; Troll(x) \wedge Bounty(x)$$

Problem 3. (25 points)
Use resolution to determine if the following first-order logic sentences can entail α. You must be clear on your substitution/unification.
$$\alpha = \forall x \; \exists y \; A(x, f(f(Snail)), y)$$

KB:
$$\forall x \; A(x, Snail, x)$$
$$\forall x, y, z \; (\neg A(x, y, z) \vee A(x, f(y), f(z)))$$

Problem 4. (15 points)
Solve the following planning problem using backwards search. You mush show all possible branches and substitutions/unifications at each step. You may choose to explore the tree however you want.

Initial: $Class(csci, 4511) \land Class(csci, 5211) \land Class(math, 4401) \land Have(time)$
Goal: $Graduate(college)$

    Action: $Study(x, y)$
Preconditions: $Class(x, y) \land Have(time)$
Effects: $\lnot Have(time) \land Prepared(x, y)$

    Action: $PassEasy(math, x)$
Preconditions: $Class(math, x) \land Prepared(math, x)$
Effects: $Have(time) \land Finish(math, x)$

    Action: $PassHard(x, y)$
Preconditions: $Class(x, y) \land Prepared(x, y)$
Effects: $Finish(x, y)$

    Action: $Degree(x, y)$
Preconditions: $Finish(math, x) \land Finish(csci, y)$
Effects: $Graduate(college)$

Problem 5. (25 points)
Show 2 layers of graphplan (i.e. 2 action rounds and 3 sets of states) for the following planning
problem. Then show a copy of your answer with all muexes between actions clearly shown.

Initial: $\lnot Overgrown \land \lnot Happy \land \lnot Money$

    Action: $MowLawn()$
Precondition:
Effects: $\lnot Overgrown \land \lnot Happy$
    Action: $Lawncare()$
Precondition: $Money$
Effects: $\lnot Overgrown \land \lnot Money$

    Action: $Relax()$
Precondition:
Effects: $Happy \land Overgrown$

    Action: $Work()$
Precondition:
Effects: $Money \land \lnot Happy$