4511W, Spring-2020
ASSIGNMENT 6:
Assigned: 04/27/20 Due: 05/04/20 at 11:55 PM (submit via Canvas, you may take a picture of handwritten solutions, but you must put them in a pdf) Submit only pdf or txt files

Written/drawn:

Problem 1. (10 points)
Consider the following sentences:

$$\forall x\ Large(x) \iff GasGiant(x) \lor Star(x)$$
$$\forall x\ \neg Large(x) \land Water(x) \Rightarrow Habitable(x)$$
$$\forall x\ Water(x) \lor \neg Habitable(x)$$
$$\forall x\ System(x) \Rightarrow \exists y\ Star(y)$$
$$System(Sol)$$
$$\exists x\ Habitable(x)$$

Convert these sentences into CNF while remaining in first-order logic.

Problem 2. (20 points)
Use backward chaining on the following sentences to determine whether: Exists x Traps(Felicidad,x)

$$\exists x\ Troll(x)$$
$$\forall x\ Troll(x) \Rightarrow Large(x)$$
$$\exists x\ Troll(x) \land Aggressive(x)$$
$$\forall x\ Large(x) \land Aggressive(x) \Rightarrow Dangerous(x)$$
$$\forall x, y\ Hunter(x) \land Dangerous(y) \land Bounty(y) \Rightarrow Traps(x, y)$$
$$Hunter(Felicidad)$$
$$\exists x\ Troll(x) \land Bounty(x)$$

Problem 3. (20 points)
Apply resolution on the following KB to determine if: $KB \models \alpha$
You must show what variables you are unifying/substituting to make resolution possible between parts/clauses.

KB:
$(A(cat) \lor C(x, y))$
$\land (\neg B(x, y) \lor C(x, y))$
$\land (\neg A(x) \lor B(hippo, x))$

$\neg\alpha$ as shown below: (Note: this is already negated)
$(\forall x\ \neg B(hippo, x) \vee B(x, F(x)))$
$\wedge(\forall y\ \neg C(cat, y))$

Problem 4. (15 points)
Use resolution to determine (show work... as always) if KB entails α, where:
$$\alpha = \forall x\ \exists y\ S(f(f(f(Cat))), x, y)$$

KB:
$\forall x\ S(Cat, x, x)$
$\forall x, y, z\ \left(\neg S(x, y, z) \vee S(f(x), y, f(z))\right)$

Problem 5. (15 points)
Use forward-search to solve the following planning problem. Use a breadth-first-search to approach for searching the space until a goal is found. Show all possible states at the depth the goal was found as well.

Objects = $\{CSci4511\}$
Initial = $\neg Study(CSci4511) \wedge \neg Passed(CSci4511)$
Goal = $Study(CSci4511) \wedge Passed(CSci4511)$

Action = $Cram(x)$,
Precondition:
Effect: Study(x)

Action = $PassTest(x)$,
Precondition: $Study(x)$
Effect: $\neg Study(x) \wedge Passed(x)$

Problem 6. (20 points)
Apply graph-plan for 3 state levels (initial state + 2 more) and 2 action level. Show both action and state muxes on the part of the graph made.

Initial: $A \wedge \neg B \wedge \neg C$

Action(W,
Preconditions: A
Effects: $\neg B \wedge C$)

Action(X,
Preconditions: C
Effects: $\neg C$)

Action(Y,
Preconditions: $A \wedge C$
Effects: $\neg A \wedge B$)

Action(Z,
Preconditions: $B \wedge \neg C$
Effects: $\neg B \wedge C$)