CMSC 671 (Introduction to AI) – Fall 2016

Homework 5: Knowledge and Logic (85 points)
Due: 11/22 at 11:59pm.
Turnin: Blackboard. *(Reminder: one submission only.)*

Please submit all parts I–IV together as a **single PDF file** named *lastname*_hw5.pdf, with parts clearly marked and delineated. Files must start with your last name and have your full name in the file, at/near the top. This is an individual homework – no groupwork.

PART I. KNOWLEDGE-BASED AGENTS (15 POINTS)

(Adapted from R&N 2nd edition, Exercise 7.1.) Use the description of the Wumpus world from the book (R&N pg. 236–237), not any of the online variations or variations from class.

Assignment: Answer the following questions about an agent in Wumpus World.

1. Describe the Wumpus world according to the properties of task environments listed in Chapter 2 (i.e., the seven characteristics described in Section 2.3.2). Your answer should include a brief (single sentence or phrase) justification for each of the seven answers.

2. How would your answer change in a world in which the Wumpus could move according to fixed rules (i.e., rules that are known to the agent)? Your answer should include a brief (single sentence or phrase) justification for each property *that changes*.

3. Now consider a variation of this world that contains a **bat**. When you are one square from a bat, you hear squeaking; if you enter the room with a bat, it carries you off and drops you elsewhere. Does that change the environment description? Your answer should include a brief (single sentence or phrase) justification for each property *that changes*.

PART II. LOGIC (40 POINTS)

Assignment: turn in complete versions of the following problems.

1. Russell & Norvig Exercise 7.7, page 281		*15 pts*
2. Russell & Norvig Exercise 7.22 (a), page 284		*10 pts*
3. Russell & Norvig Exercise 8.28 (a,c,f,h,k.l), page 320-321		*15 pts*

PART III. FOL & INFERENCE (30 POINTS)

Assignment: Construct the following knowledge base (list the sentences in it).

(A) Represent the following knowledge base *in first-order logic*. Use the predicates: *9 pts*

- `attend(x)` • `fair(t)` • `prepared(x)` • `smart(x)`
- `fail(x,t)` • `pass(x,t)` • `study(x)` • `umbc-student(x)`

where arguments `x` have the domain of all people, and arguments `t` have the domain of all tests.

1. Everyone who is smart, studies, and attends class will be prepared.
2. Everyone who is prepared will pass a test if it is fair.
3. A student passes a test if and only if they don't fail it.
4. A student passes a test if and only if they don't fail it.
5. Every UMBC student is smart.
6. Aidan is a UMBC student.
7. Sandy passed the 471 exam.
8. Aidan attends class.
9. John was not prepared for the 471 exam.

(B) Convert the KB to conjunctive normal form (list the new set of sentences in the KB).   *9 pts*

Assignment: Next, we wish to prove that: `study(Aidan)` $\Rightarrow$ `pass(Aidan, 471-exam)`

(C) Express the *negation* of this goal in *conjunctive normal form*.   *2 pts*

(D) Add the negated goal to the KB, and use forward chaining to prove that it is true.   *10 pts*

Show your proof as a series of sentences to be added to the KB. You must clearly show which sentences are used to produce each new sentence.