Assignment 3: Logic
Due October 23 at 12:30pm
37 marks total, worth 5% of final grade

This assignment is to be done individually.

Important Note: The univeristy policy on academic dishonesty (cheating) will be taken very seriously in this course. You may not discuss the specific questions in this assignment, nor their solutions with any other student. You may not provide or use any solution, in whole or in part, to or by another student.
You are encouraged to discuss the general concepts involved in the questions in the context of completely different problems. If you are in doubt as to what constitutes acceptable discussion, please ask! Further, please take advantage of office hours offered by the instructor and the TA if you are having difficulties with this assignment.

Question 1 (6 marks)

Consider a propositional logic vocabulary with only four propositions, A, B, C, and D. How many models are there for the following sentences?
(a) $(A \wedge B) \vee (B \wedge C)$
(b) $A \vee B$
(c) $A \Leftrightarrow B \Leftrightarrow C$

Question 2 (8 marks)

Decide whether each of the following sentences is valid, satisfiable, or neither.
(a) $(Big \wedge Dumb) \vee \neg Dumb$
(b) $Big \Rightarrow Big$
(c) $Fire \vee Smoke \vee \neg Fire$
(d) $((Smoke \wedge Heat) \Rightarrow Fire) \Leftrightarrow ((Smoke \Rightarrow Fire) \vee (Heat \Rightarrow Fire))$

Question 3 (5 marks)

Consider a first-order logic knowledge base containing just two sentences: $P(A)$ and $P(B)$. Does this knowledge base entail $\forall x\ P(x)$? Explain your answer in terms of models.

Question 4 (10 marks)

Represent the following sentences in first-order logic, using a consistent vocabulary (which you must define):
(a) Every student who takes French passes it.
(b) More than one student took French in Spring 2008.
(c) Only one student took Greek in Spring 2008.
(d) The best score in Greek is always higher than the best score in French. (*Hint: use two first-order logic sentences for this.*)

Question 5 (8 marks)

(a) Write a successor-state axiom that describes the behaviour of the `HaveArrow` predicate in the Wumpus World.
(b) Within situation calculus, write an axiom to associate time 0 with the situation S_0 and another axiom to associate the time t with any situation that is derived from S_0 by a sequence of t actions.

Submitting Your Assignment

This assignment is a written one, and is to be submitted on paper (hardcopy). The assignment should be turned in at the beginning of lecture on Oct. 23. Please write legibly or typeset your document using your favourite word processor.