CS 771 Artificial Intelligence
Spring 2019 Homework 4 (75 points)

Assigned: Monday, March 25, 2019
Due: Wednesday, April 03, 2019

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1. (10 points) Express the following sentences in propositional logic.
   (a) If P is false then Q is also false.
   (b) Q and P are either both false or both true.
   (c) Either P is true or Q is true.
   (d) Both P and Q are true and M is false.
   (e) John is tall and Peter has short hair (Define the proposition symbol you use).

2. (15 points) Which of the following are correct? Justify your answer. Note that in order to answer if $\alpha \models \beta$ find the models $M(\alpha)$ in which α is true, similarly find the models $M(\beta)$ in which β is true and then check whether $M(\alpha)$ is a subset of $M(\beta)$ or not.
   (a) $(A \wedge B) \models (A \Leftrightarrow B)$.
   (b) $(A \Leftrightarrow B) \models (A \vee B)$.
   (c) $(A \Leftrightarrow B) \models (\neg A \vee B)$.

3. (10 points) Which of the following sentences are valid? Justify your answer i.e., if it is valid mention why it is valid, similarly if it is not valid mention why it is not valid.
   (a) $Smoke \Rightarrow Smoke$.
   (b) $Smoke \Rightarrow Fire$.
   (c) $(Smoke \Rightarrow Fire) \Rightarrow (\neg Smoke \Rightarrow \neg Fire)$.
   (d) $Smoke \vee Fire \vee \neg Fire$.
   (e) $Big \vee Dumb \vee (Big \Rightarrow Dumb)$.

4. (20 points) Derive the indicated statements using inference rules for propositional logic from the KB provided.
   KB :
   1. $P \Rightarrow (\neg Q \wedge S)$.
   2. $S \Rightarrow (\neg Q \wedge T)$.
   3. $S \wedge \neg W$.
   4. $R \rightarrow W$.
   5. $P \vee R$.

   Derive : $\neg(Q \wedge S)$.

5. (20 points) Derive the indicated statements using inference rules for propositional logic from the KB provided.
   KB :
   1. $\neg P$.
   2. $P \Rightarrow (Q \vee R)$.
   3. $T \wedge \neg Q$.
   4. $T \Rightarrow S$.

   Derive : $(S \vee R)$.