HW 9 CMSC 452. Morally Due April 10

1. (0 points but you MUST READ THIS) For this HW $A \in DTIME(T(n))$ means that there is a JAVA program $M$ such that
   
   If $x \in A$ then $M(x) \downarrow$ and outputs YES.
   
   If $x \in A$ then $M(x) \downarrow$ and outputs NO.

   On input of length $n$ $M$ takes $O(T(n))$ steps.

2. (5 points) What is your name? Write it clearly. Staple the HW.

3. (20 points) Assume $L_1 \in DTIME(T_1(n))$ and $L_2 \in DTIME(T_2(n))$.
   Show that $L_1 \cap L_2 \in DTIME(T_1(n) + T_2(n))$. (You can write pseudo code and note how long the program runs. We ignore multiplicative and additive constants.)

4. (25 points) Formally define a 1-tape Turing Machine that has three heads on the tape. (It’s okay if they end up reading the same symbol.)

5. (25 points) A CNF-Boolean Formula is of the form
   
   $$(L_{11} \lor L_{12} \lor \cdots \lor L_{1k_1}) \land \cdots \land (L_{m1} \lor L_{m2} \lor \cdots \lor L_{mk_m}).$$

   Describe, in terms of common data structures, a way to represent an arbitrary CNF-Boolean Formula in a computer program.

6. (25 points) Let $L \in DTIME(T(n))$. Find a polynomial $p$ such that $L^* \in DTIME(p(T(n))$. Give the algorithm that achieves this (it can use the algorithm for $L \in DTIME(T(n))$ and should be in pseudocode).