1. (5 points) What is your name? Write it clearly. Staple the HW.

2. (20 points) Assume $L_1 \in \text{DTIME}(T_1(n))$ and $L_2 \in \text{DTIME}(T_2(n))$. Show that $L_1L_2 \in \text{DTIME}(n(T_1(n) + T_2(n)))$. (You can write pseudo code and note how long the program runs. We ignore additive constants.)

3. (25 points) Formally define a 2-tape Turing Machine that has a head on each tape.

4. (25 points) A Graph is a set $(V, E)$ where $E \subseteq \binom{V}{2}$ (set of pairs of elements from $V$). Fix $k$. A $k$-hypergraph is a set $(V, E)$ where $E \subseteq \binom{V}{k}$ (set of $k$-sized sets of $V$). A hypergraph is a set $(V, E)$ where $E \subseteq 2^V$ (the set of all subsets of $V$).

For any of these objects let $n = |V|$ and $m = |E|$.

SO $n$ is the NUMBER OF VERTICES and $m$ is THE NUMBER OF EDGES. (Recall that $|A|$ is the NUMBER OF ELEMENTS IN THE SET $A$.)

You an also assume that $V = \{1, \ldots, n\}$.

(a) Describe two ways to store a graph in a computer. How much space does it take as a function of $n$ and $m$?

(b) Describe two ways to store a $k$-hypergraph in a computer. How much space does it take as a function of $n$ and $m$?

(c) Describe two ways to store a hypergraph in a computer. How much space does it take as a function of $n$ and $m$?

5. (25 points) Let $L \in \text{DTIME}(T(n))$. Find a polynomial $p$ such that $L^* \in \text{DTIME}(p(T(n)))$. Give the algorithm that achieves this (it can use the algorithm for $L \in \text{DTIME}(T(n))$ and should be in pseudocode).