Optional Project. Due Dec 18, the day OF the final. 90 points.

I will only look at this after the final is graded and final grades are ABOUT to be entered. If you get a failing grade in this course (D+ or lower) then I will look at your project and, if its good enough, will bump you to a C-. Throughout this document “prove” means “give a construction and discuss why it works.” What you hand in must be TYPED or VERY GOOD HANDWRITING. Write your name at the top NEATLY!!!!

NOTE- this is TWO pages long.

1. (15 points) Let $L$, $L_1$ and $L_2$ be regular. Prove or Disprove or state that it is unknown to science.
   
   (a) $L_1L_2$ is regular.
   (b) $L^*$ is regular.
   (c) $L^R = \{w | w^R \in L\}$ is regular. (RECALL that $w^R$ is the string $w$ written backwards. So $(aaab)^R = baaa$.)

2. (15 points) Let $L$, $L_1$ and $L_2$ be context free languages (CFL’s). Prove or Disprove or state that it is unknown to science.
   
   (a) $L_1L_2$ is CFL.
   (b) $L^*$ is a CFL.
   (c) $L^R = \{w | w^R \in L\}$ is CFL.

3. (15 points) Let $L$, $L_1$ and $L_2$ be in P. Prove or Disprove or state that it is unknown to science.
   
   (a) $L_1L_2$ is in P
   (b) $L^*$ is in P.
   (c) $L^R = \{w | w^R \in L\}$ is CFL.

4. (15 points) Let $L$, $L_1$ and $L_2$ be in NP. Prove or Disprove or state that it is unknown to science.
   
   (a) $L_1L_2$ is in NP
   (b) $L^*$ is in NP.
   (c) $L^R$ is in NP.

5. (15 points) Let $L$, $L_1$ and $L_2$ be decidable. Prove or Disprove or state that it is unknown to science.
   
   (a) $L_1L_2$ is in decidable.
   (b) $L^*$ is decidable.
   (c) $L^R$ is is decidable.
6. (15 points) Let $L$, $L_1$ and $L_2$ be c.e. Prove or Disprove or state that it is unknown to science.

(a) $L_1L_2$ is c.e.
(b) $L^*$ is c.e..
(c) $L^R$ is c.e.