

## OPTIONAL HW TO HELP YOU STUDY

I WILL BE GOING OVER THIS ON NOV 4.

1. For every language below say if its
  - (1) Finite OR (2) Regular but not finite OR (3) CFL but not regular OR (4) P but not CFL.Explain your answer (NOTE- this is all for own good and not being collected so if you guess you are in a stupid state.)
  - (a)  $\{w \mid n_a(w) = n_b(w) = n_c(w) = n_d(w)\}$ .  
( $n_\sigma(w)$  is how many times  $\sigma$  appears in  $w$ .)
  - (b)  $\{a^n b^n c^n \mid n \in \mathbf{N}\}$ .
  - (c)  $\{a^n b^m c^n \mid n, m \in \mathbf{N}\}$ .
  - (d)  $\{a^{2n} b^{3n} \mid n \in \mathbf{N}\}$ .
  - (e)  $\{a^n b^n c^{2n} \mid n \in \mathbf{N}\}$ .
  - (f)  $\{a^{n^3} \mid n \in \mathbf{N}\}$ .
  - (g)  $\{a^{2n+5} \mid n \in \mathbf{N}\}$ .
  - (h)  $\{a^n \mid n \text{ is an even prime}\}$ .
2. For each of the following say if its true or false. If true then prove it, if false then give a counterexample
  - (a) If  $L_1$  and  $L_2$  are Reg then  $L_1 L_2$  is Reg.
  - (b) If  $L_1$  and  $L_2$  are CFL's then  $L_1 L_2$  is a CFL.
  - (c) If  $L_1$  and  $L_2$  are in P then  $L_1 L_2$  is in P.
  - (d) If  $L$  is Reg then  $L^*$  is Reg.
  - (e) If  $L$  is CFL then  $L^*$  is CFL.
  - (f) If  $L$  is in P then  $L^*$  is in P.
3. Let  $L \in DTIME(T(n))$ .
  - (a) Give an algorithm for  $L^*$ .
  - (b) Fill in the following sentence: *My Algorithm shows that  $L^*$  is in  $DTIME(XXX(n))$ .*
4. Show that there exists a decidable language that is NOT in  $DTIME(2^n)$ .