1. Show that every language accepted by a polynomial-size bounded-width branching program is in NC$^1$.

2. A $k$-CNF is an AND of OR’s of at most $k$ literals. Show that if $f$ and $\neg f$ are both representable as a $k$-CNF for some constant $k$ then $f$ is in NC$^0$.

3. Give estimates for upper and lower bounds for $g(n, s) = \text{the number of functions over } \{0,1\}^n \text{ that have circuits of size } s \text{ with AND, OR and NOT gates and unbounded fan-in.}$

4. Prove that SAT is not in L $\cap$ DTIME($n \log^k n$).
   Hint: First prove the following two lemmas.
   
   (a) First prove that DSPACE($\alpha(n) \log n$) for $\alpha(n) \leq n$ is computable with a polynomial-time alternating Turing machine using $\alpha(n)$ alternations.
   
   (b) Show that if SAT is in DTIME($n \log^k n$) then for some unbounded $\alpha(n)$, all problems computable with a polynomial-time alternating Turing machine using $\alpha(n)$ alternations are in P.