CSC2401F **Problem Set 3** **Due: Dec 13, 2001**

1. Show that E^{PH} contains a language L: $\forall n L_n$ requires circuit size MaxC(n)

2. We argued in class that $DTIME(2^{O(S(n))}) \subseteq ASPACE(S(n)$ for a space constructible $S(n) \geq logn$. Discuss why the proof does not show $NTIME(2^{O(S(n))}) \subseteq ASPACE(S(n)$. That is show where the proof breaks down and if possible discuss how some "immediate ways" to salvage the proof do not work. (This question, and especially the second part, is rather vague but there is nothing wrong with trying to make some sense of this question.)

3. For each of the following, determine if the statement is provably true or false given any results stated in class or in the text. If you believe there is a proof, sketch the reasoning. If you believe there is no such proof known, state what you think is the most "likely" conjecture (say based on an "unlikely" consequence that would result if the conjecture is false).

   - If $BPP = RP$, then $BPP = ZPP$.
   - $P^{RP} = RP$.
   - $P^{BPP} = BPP$.
   - If $P = NP$, then $P = BPP$.