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Modern Complexity Theory

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Assignment 8

Problem 23 (3 points)**:**
A graph is said to contain a *clique* of size k if it has a set of k nodes that form a completely connected graph (i.e. there is an edge for every pair of nodes). In the CLIQUE problem, we are given a graph G, and the goal is to find a clique in G of maximum size.
Show that CLIQUE does not have a PTAS unless P = NP (i.e. it is NP-hard to approximate CLIQUE below some ratio of $1+\epsilon$ for some constant $\epsilon > 0$).
Hints: construct an L-reduction from MAX3SAT to CLIQUE and then use Corollary 8.12 to argue that CLIQUE does not have a PTAS unless P = NP. In order to construct the L-reduction, transform each clause in the 3CNF formula into nodes and connect these nodes in a suitable way.

Problem 24 (4 points)**:**
Find suitable expressions in MAXSNP_0 that show that

1. MAX3SAT is in MAXSNP and
2. k-DEGREE INDEPENDENT SET is in MAXSNP.

Problem 25 (3 points)**:**
Find a way of transforming a circuit consisting of m $\wedge$, $\vee$, or $\neg$ gates into a Boolean expression in 3CNF with $O(m)$ clauses.