1. Consider a 3-CNF-SAT problem with n variables denoted $x_1, \ldots, x_m$ and m clauses. We wish to reduce it to a 0-1 ILP problem:

3 / 3 points

Find $z_1 \in \{0,1\}, \ldots, z_n \in \{0,1\}$ such that a set of m linear inequality constraints $c_1 z_1 + c_2 z_2 + \cdots + c_n z_n \geq c_0$ are all satisfied.

Select all the true facts about the reduction.

- [x] We use a 0-1 variable z_i corresponding to each variable x_i in the original 3-CNF-SAT problem.

Correct
This is quite natural since we can always map false to the value 0 and true to the value 1.

- [x] A clause of the form $x_i \vee x_j \vee x_k$ translates into an inequality $z_i + z_j + z_k \geq 1$

Correct
Correct

- [ ] The logical negation of a variable x_i can be modeled as the negation $-z_i$

- [x] The logical negation of a variable x_i can be modeled as the arithmetic operation $1 - z_i$

Correct
Correct

- [x] The clause $\overline{x_i} \vee x_j \vee \overline{x_k}$ is translated to the inequality $-z_i + z_j - z_k \geq -1$

Correct
Correct: $(1 - z_i) + z_j. + (1 - z_k)$ is equivalent to $2 - z_i + z_j - z_k$ which in turn gives us the inequallity shown above.

- [x] The reduction yields as many inequalities as the number of clauses in the 3-SAT formula

Correct
Correct

2. An independent set in a graph is a subset of vertices such that no two vertices in the independent set have an edge between them.

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k-Indpendent-Set Problem

Given a graph G and a number k, we wish to know if there is an independent set of size at least k in G.

- [x] The k Independent-Set problem is in NP since the certificate can involve just the set of k vertices that we claim to belong to an independent set.

Correct
Correct: we can verify the certificate by checking that there are no edges between any two vertices in our claimed independent set.

- [ ] To show that k-independent-set is NP complete we can reduce from the problem to k-clique problem which is already shown to be NP complete

- [x] A graph G has an independent set of size k if and only if its complement has a clique of size k.

Correct
Correct: two vertices have an edge in completement iff they do not have an edge in the original graph.

- [x] We can reduce the problem of finding k-clique in a graph G to that of finding a k-independent-set in its complement $\overline{G}$.

Correct
Correct