

## #1 Membership

Show that each of the following languages are in NP.

1.  $A_1 = \{ \langle P \rangle \mid P \text{ is a satisfiable boolean formula} \}$ .
2.  $A_2 = \{ \langle S, t \rangle \mid S \subseteq \mathbb{Z} \text{ and there exists } x_1, \dots, x_k \in S \text{ such that } \sum_i^k x_i = t \}$ .
3.  $A_3 = \{ \langle G, k \rangle \mid G = (V, E) \text{ is a graph and there exists some } V' \subseteq V \text{ is a } k\text{-covering of } G \}$ .  
A  $k$ -cover of a graph is a subset of vertices that includes at least one endpoint of every edge in the graph.

## #2 Completeness

Define the following languages:

$$\begin{aligned}\text{CLIQUE} &= \{ \langle G, k \rangle \mid G \text{ is a graph and } G \text{ contains a } k\text{-clique} \} \\ \text{ISO} &= \{ \langle G, H \rangle \mid G \text{ and } H \text{ are graphs and there is a subset } G' \text{ of } G \text{ isomorphic to } H \}\end{aligned}$$

Show that  $\text{CLIQUE} \leq_p \text{ISO}$ .

(Hint: what is the type of the mapping function  $f$  in this case?)