

CS 701 - Final Term 2015

1. Show that A is **NP-Complete**.
2. Prove that Double SAT is **NP-Complete** (by reducing from 3 SAT)
3. Prove that SET SPLITTING is **NP-Complete**.
4. Prove Multi SAT is **NP-Complete**.
5. Show that directed hamiltonian cycle is **NP-Complete**.
6. Show that half clique is **NP-Complete**.
7. Let $CNF-k = \{\langle \phi \rangle \mid \phi \text{ is satisfiable CNF-formula where each variable appears in at most } k \text{ places}\}$. Show that $CNF3$ is **NP-Complete**.
8. A subset of nodes of a graph is a dominating set if every other node of G is adjacent to some node in the subset. Let $DOMINATING-SET = \{\langle G, k \rangle \mid G \text{ has a dominating set with } k \text{ nodes}\}$. Show that it is **NP-Complete** by giving a reduction from VERTEX-COVER.
9. Let TRUE-SAT; given Boolean expression E that is true when all the variables are made true, is there some other truth assignment besides all true that make E true. Show that TRUE-SAT is **NP-Complete** by reducing SAT to it.
10. Let NEAR TAUT; given Boolean expression E all the variables are made f , is there some other truth assignment besides all f that make E true. Show that NEAR TAUT is **NP-Complete** by reducing SAT to it.
11. Let NEAR-TAUT: E is a Boolean expression having when at most one true makes it false. Show that complement of NEAR-TAUT is in **NP-Complete** using reduction it to SAT.
12. Let G represent an undirected graph. Also let $LPATH = \{\langle G, a, b, k \rangle \mid G \text{ contains a simple path of length } k \text{ for } a \text{ to } b\}$. Show that LPATH is **NP complete**. You may assume that NP-completeness of UHAMPATH the HAMPATH problem of undirected graph.
13. A directed Graph is STRONGLY-CONNECTED if every two nodes are connected by a directed graph in each direction. Let $STRONGLY-CONNECTED = \{\langle G \rangle \mid G \text{ is strongly connected graph}\}$. Show that STRONGLY-CONNECTED is **NP-Complete**.
14. Let $A = \{\langle M, x, \#^t \rangle \mid \text{NTM, } M \text{ accepts input } x \text{ within } t \text{ steps on at least one branch}\}$. Show that A is **NP-Complete**.
15. Prove cycle-length problem is **NL-Complete**.
16. Let $ADD = \{\langle x, y, z \rangle \mid x, y, z > 0 \text{ are binary integers and } x + y = z\}$. Show that $ADD \in LSPACE$.
17. Let $PAL-ADD = \{\langle x, y \rangle \mid x, y > 0 \text{ are binary integers where } x + y \text{ is an integer whose binary representation is palindrome}\}$. Show that $PAL-ADD \in LSPACE$.
18. Nim game question to prove unbalance and balance
19. See the Questions of Sipser Book 2013 edition 3
Exercises: 7.17, 7.22, 7.28, 7.30, 8.13, 8.19, 8.22, 8.22b, 8.27
20. Winning strategy (q 8.3)