# Final Exam (CSCI6339, Fall 2020)

## Due 11:59pm Monday Dec 7, 2020

## Instruction: Dr. Bin Fu

Name: ID Number:

Please submit exam in MS word format.

1. a) Design an automata to accept $\{(10^2)^i \mid i \geq 0\}$.
   b) Prove that the language $\{0^i 1^{2i} \mid i \geq 0\}$ is not regular.

2. Let L be the set of undirected graphs. Prove that L is in NL.

3. For a Turing machine M(.) with an input w, let M(w) be the output on the output tape if it stops in finite steps. Let L={(M1, M2, w)| M1 and M2 are Turing machines, w is an input, and M1(w ) is not equal to M2(w)}. Prove that L is undecidable by finding a reduction from $A_{TM}$ to it, where $A_{TM}$ ={<M,w> |Turing machine M accepts w}.

4. The subgraph-isomorphism problem takes two graphs G1 and G2 and asks whether G1 is isomorphic to a subgraph of G2. Show that
a) the subgraph-isomorphism problem is in NP; and
b) it is NP-complete by giving a polynomial time reduction from SAT problem to it.

Note: Two graphs G1=(V1, E1) and G2=(V2, E2) are isomorphic if there exists a one-one and onto function f( ) from V1 to V2 such that for every two nodes u and v in V1, (u,v) is in E1 if and only if (f(u), f(v)) is in E2. For examples, G1 is isomorphic to a subgraph with vertices {1,2,5,4} of G2 below.