CS 172, Spring 1999
Midterm #1
Professor Manuel Blum

This is a CLOSED BOOK examination.
Calculators ARE permitted.
Do all your work on the pages of this examination.

Problem #1

a) Define the number of steps taken by a NDTM on input x.
b) Define the nubmer of steps taken by a NDTM on inputs of length n.

Problem #2

Define two (computational) problems p1, p2 to be poly-time equivalent iff it is possible to solve p1 in polynomial time given an algorithm to solve p2 in polynomial time (p1 <= p2), and vice-versa (p2 <= p1).

Are the following two problems poly-time equivalent?
If so, prove it.
If not, explain why not.

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Decision:                                        <--m-->    m
Instance: NDTMi, x in {0,1}*, m in unary (ie 1.....1 = 1 ).
Question: Does NDTMi accept x in m steps? ie does there exist a y in
{0,1}* s.t. DTMi accepts (y,x) in m steps?

Optimization:
Input: NDTMi, x in {0,1}*, m in unary
Output: y in {0,1}* s.t. DTMi accepts (y,x) in m steps, if any (ie
if such y exists);
        "NONE" if there is no such y.
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Problem #3

Explain what problems if any you encounter in doing the above reductions in the case that m is given in binary instead of unary.
