Problem Set 1 **Due: Feb 2** **cs2me3 Winter 2007**

Instructions

1. You are encouraged to work in groups of two. If you cannot find a partner, you can work alone.
2. Please submit one copy of the assignment; if you are working with a partner, both names should appear on the assignment.
3. For **Part A** of the assignment, you must submit an electronic copy of your Java application via WebCT (by the time of the lecture on the due date of the assignment).

Part A

Write a Java application which implements the extended Euclid algorithm for computing the greatest common divisor of two numbers. Your program, call it `euclid`, should take two integers as command line input, i.e., `euclid m n`, and output `x y`, such that $x \cdot m + y \cdot n = \gcd(m, n)$.

Part B

1. Consider the version of the stable matching problem where b's and g's may be *indifferent* between certain options. That is, each b and each g has a ranking of the members of the opposite group where besides $<$ (indicating preference) there may be $=$ (indicating indifference). For example, b_1 might have the following list

$$g_2 =_1 g_5 <_1 g_1 <_1 g_4 =_1 g_3 =_1 g_6 <_1 g_7.$$

With indifference allowed, consider the following two notions for stability.

(a) A *strong instability* in a perfect matching M consists of b and g such that each of b and g prefers the other to their partner in M. Does there always exist a perfect matching with no strong instability?

(b) A *weak instability* in a perfect matching M consists of a b and a g such that their partners in M are g' and b', respectively, and one of the following holds:

- b prefers g to g', and g either prefers b to b' or is indifferent between these two choices; or
- g prefers b to b', and b either prefers g to g' or is indifferent between these two choices.

Does there always exist a perfect matching with no weak instability?

In both questions, either give an (updated) algorithm, or give a counter example.

2. In the algorithm given in class, can a b or a g end up better off by lying about their preferences? More precisely, suppose each b and g has a *true* preference list. Suppose that they submit a list which is not their true list of preferences, but they will end up better off with respect to their true preferences. Is that possible?

   Do one of the following:

   (a) For any set of preference lists, and for any given g, switching the order of a pair on g's list cannot improve g's partner; or

   (b) Give an example of a set of preference lists for which there is a switch that would improve the partner of a g who switched preferences.

   You may assume that everyone, except g, submits their true list. You may also assume that g can see the lists of the others, and g submits her list once she has examined the lists of the others.