

**Assignment #1 part 1, Total points: 50**  
(Course: CS 401)

These are the first two problems for Assignment 1. **The remaining problems of Assignment 1 will be given out later.**

For regular students, the deadline is **February 9, Monday, in class.**

For special needs students, the deadline is **February 16, Monday, in class.**

**Please submit a hard copy of your solution (handwritten or typed) in person in class. No late assignments will be accepted.**

**Special note:** Any answer that is not sufficiently clear even after a reasonably careful reading will not be considered a correct answer, and only what is written in the answer will be used to verify accuracy. No vague descriptions or sufficiently ambiguous statements that can be interpreted in multiple ways will be considered as a correct answer, nor will the student be allowed to add any explanations to his/her answer after it has been submitted.

**Problem 1 (25 points):** Consider the stable matching problem as taught in class. Suppose that we have only three men, say  $m_1$ ,  $m_2$  and  $m_3$ , and only three women, say  $w_1$ ,  $w_2$  and  $w_3$ , with their corresponding preference lists. Suppose also that the matching  $m_1-w_1$ ,  $m_2-w_2$ ,  $m_3-w_3$  is a stable matching. We make the following claim:

in this case the matching  $m_1-w_1$ ,  $m_2-w_3$ ,  $m_3-w_2$  can **never** be a stable matching.

Your task is to decide if our claim is true or false. For this purpose, do the following.

- Either prove the claim is indeed correct. Such a proof should work **no matter** what the preferences of the men and women are, as long as  $m_1-w_1$ ,  $m_2-w_2$ ,  $m_3-w_3$  is a stable matching.
- Or, prove the claim made is wrong by giving a counter-example. The counter-example should provide the preferences lists of every man and woman, and show that for these preference lists **both**  $m_1-w_1$ ,  $m_2-w_2$ ,  $m_3-w_3$  and  $m_1-w_1$ ,  $m_2-w_3$ ,  $m_3-w_2$  are indeed stable matchings.

**Problem 2 (25 points):** Give examples of two continuous functions  $f(n)$  and  $g(n)$  of positive real inputs  $n$  such that  $f(n) \neq O(g(n))$ ,  $g(n) \neq O(f(n))$ ,  $f(n) \neq \Omega(g(n))$  and  $g(n) \neq \Omega(f(n))$ .

HINT: You can specify some of the values of  $f(n)$  and/or  $g(n)$  depending on some condition on  $n$ , such as when  $n$  is even or odd, but make sure that your function is continuous and defined for all positive real  $n$ .