CSci 3501 Lab 5
30 points (See canvas for due date)
Work in pairs

- All lab submissions should be done by canvas. Please be sure to include your group members.
- When working on the lab, please comment your work so that it is clear what the contributions from each person are.
- At the end of the lab each group should submit the results of their in-class work. Please indicate if this is your final submission. Don't forget to answer all the questions below.
- If your submission at the end of the lab time was not final, please submit a final copy before the due time.

Grading

- Correct non-cyclic algorithm: 15 pts
- Programming aspects: data structures used, input/output, code styles, clarity, documentation, etc.: 5 pts
- Testing: 3 pts
- Efficiency evaluation and correcteness discussion: 7 pts

Matching Problem

Your task is to design and implement an algorithm that finds a solution to the following problem:

> N programmers are looking for a job;
> N companies are looking to hire a programmer.
> Each programmer has a ranking of the companies based on his/her preferences for a workplace.
> Likewise, each company has a ranking of the N programmers based on whom they would like to hire.

Given a set of rankings, it may be impossible to find a pairing of programmers with companies when everyone gets their first choice (what would be an example of such ranking, say, among 3 programmers and companies?). However, it is always possible to find a *satisfactory* pairing. A pairing of programmers with companies is called *satisfactory* if there is no pair of assignments (P1, C1), (P2, C2) (denoting programmers as P and companies as C) such that P1 ranks C2 higher than C1 and C2 ranks P1 higher than P2 (in other words, P1 can switch to C1 to increase both their own and C1's level of satisfaction).

Below is an example of preferences of five companies A, B, C, D, E and five programmers 1, 2, 3, 4, 5:

A	**B**	**C**	**D**	**E**	**1**	**2**	**3**	**4**	**5**
2	1	5	1	2	E	D	D	C	A
5	2	3	3	3	A	E	B	B	D
1	3	2	2	5	D	B	C	D	B
3	4	1	4	4	B	A	E	A	C
4	5	4	5	1	C	C	A	E	E

The pairing A1 B3 C2 D4 E5 is unsatisfactory since A prefers programmer 2 to programmer 1 and programmer 2 prefers company A to company C. Find a satisfactory pairing; you may use it as your test example.

Your task is to do the following:

1. Develop an algorithm that, given preferences for N programmers and N companies, finds a satisfactory pairing. If there is more than one satisfactory pairing, you need to find just one.

2. Implement your algorithm and test it on several cases of preferences. It does not matter how your algorithm takes data, but you should clearly explain this in the documentation so that we know how to test it. Also make sure to document all your test cases and results. Check that the pairings found by your program are satisfactory (write a method to do this to save yourself some time).

3. Explain why your algorithm is correct (i.e. **it always stops and outputs a satisfactory pairing**). You don't need to go into low-level

details of your program, but your argument must be precise enough to convince someone who has not seen your program before that it is indeed correct.

4. Find the efficiency of your algorithm in the worst case, justify your answer.

What to submit

- Your program, appropriately documented. Your program may read data in any convenient format (from the Java console or from a file). The comments in the program should clearly explain how it reads the data (examples help). If you are reading data from a file, please include the test files, otherwise just copy/paste the test data into a separate file or into comments at the end of the program.
- The test data and the results.
- A clear explanation of your algorithm in English.
- Answers to all questions above, with required explanations.