

Assignment 1

Responsible TA: Claudi Lleyda Moltó

Delivery instructions

To deliver an assignment you have to make sure you deliver both parts. You can deliver as many times as you want before the deadline on Blackboard. Delivery should be done in two separate files according to the following specifications.

The theoretical question answers must be uploaded as PDF, how you answer the questions (handwritten scans, Word, LaTeX etc.) doesn't matter, as long as they are delivered as a single PDF file and the answers are readable. The filename should contain your NTNU username and the assignment number, for instance: `karinor-01.pdf`.

The notebook should be delivered in full (as `.ipynb`). That way the TAs can easily run your code and verify the output. The filename should contain your NTNU username and the assignment number, for instance: `karinor-01.ipynb`.

Theory

Task 1 - Explaining stable matching

Explain, in your own words, what it means for a matching to be *stable*.

Task 2 - Stable matching problem

Prove or disprove the following statement.

Consider an instance of the stable matching problem in which there exists an element x of the first matched set and an element y of the second matched set such that x is ranked first on the preference list of y and y is ranked first on the preference list of x . Then in every stable matching S for this instance, the pair (x, y) belongs to S .

Task 3 - College admissions with ties

Consider college admissions where applicants have preferences for multiple colleges and are indifferent between them. Similarly, colleges may have multiple applicants they consider equally suitable. The challenge lies in creating a stable matching that reflects these preferences and indifference options, while ensuring no better-off pairs can form.

We define a student-college pair (s, c) as unstable if

1. student s prefers college c to the college c' that is assigned to him or is indifferent between c and c' , or
2. college c prefers student s over some other student s' who is currently assigned to c , or is indifferent between the two students s and s' .

Does there always exist a perfect matching with this notion of stability? Justify your answer.

Programming

This part should be solved in the corresponding Jupyter Notebook. Refer to the notebook for further details and instructions regarding the programming tasks.

Assignment submission

The assignments will be given out on Blackboard where each assignment has a written theoretical part and a programming part in Python using Jupyter Notebook. The notebook task can be solved locally (for instance in VSCode), or you can upload the notebook to JupyterHub and run the code there.

The notebooks will guide you through a, more or less, specific solution to a problem. You are however encouraged to attempt to implement your own/other solutions, as long as

- you don't use any additional libraries or packages,
- you don't alter the input values or structures, and
- your solution solves the problem described in the assignment.