

Beykoz University

Department of “Computer Engineering”

“Graph Theory Applications”

Project Interim Report

- Stable Matching Problem -

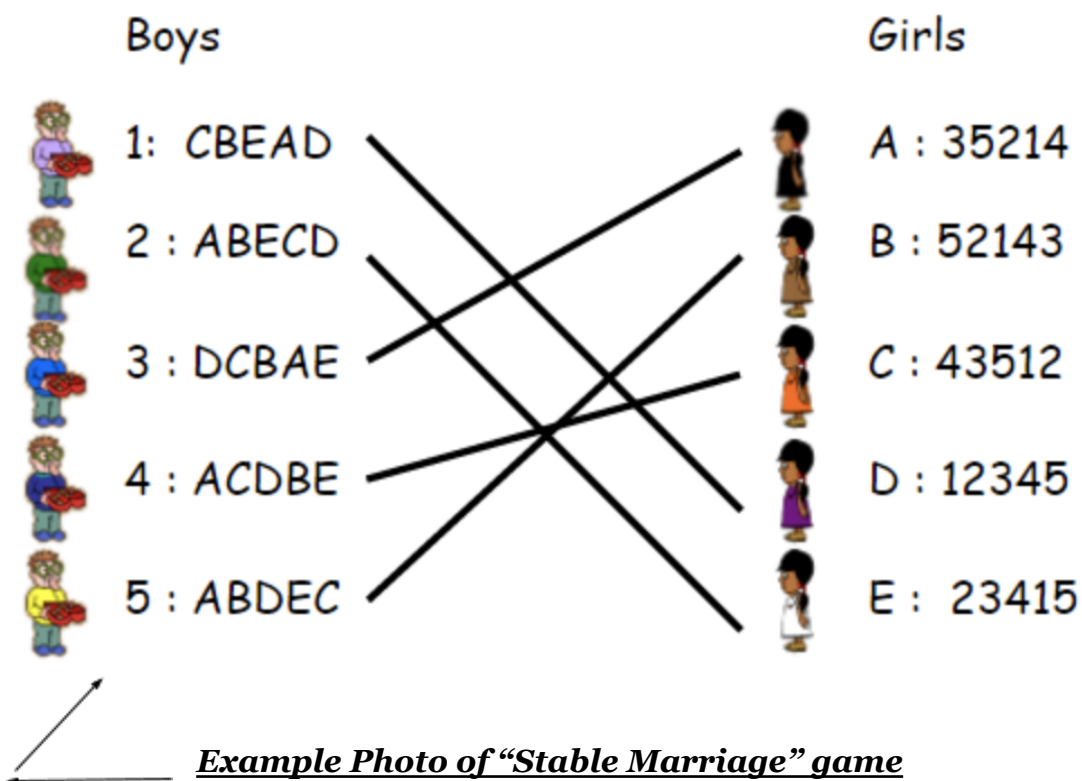
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Brief Explanation and background:

“Stable Matching problem” is also known as the “Stable Marriage Problem”. This problem was found by Gale Shapley and it’s called “Gale Shapley” algorithm. Gale–Shapley algorithm provides a solution for finding stable relationships given a set of men and women. This algorithm can be used to solve a large number of problems, one such use case is matching interns to companies such that each company finds a suitable intern and each intern gets a desirable company. The Gale-Shapley Algorithm always returns a **stable matching**.

The Stable Matching Problem states that given N men and N women, where each person has ranked all members of the opposite sex in order of preference, marry the men and women together such that there are no two people of opposite sex who would both rather have each other than their current partners. If there are no such people, all the marriages are “stable”.



The stable marriage problem asks to pair (match) the men and women in such a way that no two people prefer each other over their matched partners.

Problem Statement:

Goal. Given n men and n women, find a "suitable" matching.

- Participants rate members of opposite sex.
- Each man lists women in order of preference from best to worst.
- Each woman lists men in order of preference from best to worst

	favorite ↓ 1 st	2 nd	least favorite ↓ 3 rd
Xavier	Amy	Bertha	Clare
Yancey	Bertha	Amy	Clare
Zeus	Amy	Bertha	Clare

Men's Preference Profile

	favorite ↓ 1 st	2 nd	least favorite ↓ 3 rd
Amy	Yancey	Xavier	Zeus
Bertha	Xavier	Yancey	Zeus
Clare	Xavier	Yancey	Zeus

Women's Preference Profile

Perfect matching: Everyone is matched monogamously.

- Each man gets exactly one woman.
- Each woman gets exactly one man.

Stability: no incentive for some pair of participants to undermine assignment by joint action.

- In matching M , an unmatched pair m - w is unstable if man m and woman w prefer each other to current partners.
- Unstable pair m - w could each improve by eloping.

Stable matching: perfect matching with no unstable pairs.

Stable matching problem: Given the preference lists of n men and n women, find a stable matching if one exists.

Q: Is assignment X-C, Y-B, Z-A stable?

	favorite ↓ 1 st	2 nd	least favorite ↓ 3 rd
Xavier	Amy	Bertha	Clare
Yancey	Bertha	Amy	Clare
Zeus	Amy	Bertha	Clare

Men's Preference Profile

	favorite ↓ 1 st	2 nd	least favorite ↓ 3 rd
Amy	Yancey	Xavier	Zeus
Bertha	Xavier	Yancey	Zeus
Clare	Xavier	Yancey	Zeus

Women's Preference Profile

Q: Is assignment X-C, Y-B, Z-A stable?

A: No. Bertha and Xavier will hook up.

	favorite ↓		least favorite ↓
	1 st	2 nd	3 rd
Xavier	Amy	Bertha	Clare
Yancey	Bertha	Amy	Clare
Zeus	Amy	Bertha	Clare

Men's Preference Profile

	favorite ↓		least favorite ↓
	1 st	2 nd	3 rd
Amy	Yancey	Xavier	Zeus
Bertha	Xavier	Yancey	Zeus
Clare	Xavier	Yancey	Zeus

Women's Preference Profile

Q: Is assignment X-A, Y-B, Z-C stable?

A: Yes.

	favorite ↓		least favorite ↓
	1 st	2 nd	3 rd
Xavier	Amy	Bertha	Clare
Yancey	Bertha	Amy	Clare
Zeus	Amy	Bertha	Clare

Men's Preference Profile

	favorite ↓		least favorite ↓
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Women's Preference Profile

Upcoming things that I'll do in this project:

- 1) Defining another "Stable Matching" problem.
- 2) Designing proper algorithms for this concept.
- 3) Writing and analyzing code for the "Stable Matching" problem.

References:

<https://towardsdatascience.com/stable-matching-as-a-game-a68c279d70b>

https://en.wikipedia.org/wiki/Stable_marriage_problem