Lecture 5

CSE 331

Sep 6, 2019

HW 1 posted

Homework 1

Due by **11:00am, Friday, September 13, 2019**.

Make sure you follow all the homework policies.

All submissions should be done via Autolab.

Post questions on Piazza!

Some Questions on Stable Matching

Sample Problem

The Problem

Decide whether the following statement is true or false:

In every Stable Marriage problem instance where a man m and woman w have each other as their least preferred partner, the following is true. There is no stable matching for the instance where (m, w) are matched.

If you state true then you will have to formally argue why the statement is correct. If you state false, then you have to give a counter-example.

Click here for the Solution

Take note of the many(!) notes

Submission

> **! Submit part (a) and (b) separately**
>
> You need to submit **two (2) PDF** files to Autolab: one for part `(a)` and one for part `(b)`. While you can assume part `(a)` as a given for part `(b)`, to get credit for part `(a)` you have to submit you solution for part `(a)` separately from part `(b)`.
>
> We recommend that you typeset your solution but we will accept scans of handwritten solution-- you have to make sure that the scan is legible.

> **! PDF only please**
>
> Autolab might not be able to display files in formats other than PDF (e.g. Word cannot be displayed). **If Autolab cannot display your file, then you will get a zero (0) on the entire question. Note that Autolab will "accept" your submission even if you submit non-PDF file, so it is YOUR responsibility to make sure you submit in the correct format.** However, after submission, Autolab will try and disaplay your non-PDF submission and it should give an error message then. Also the file size has to be **at most 3MB**.

Grading Guidelines

We will follow the usual grading guidelines for non-programming questions. Here is a high level grading rubric specific to part `(a)` of this problem:

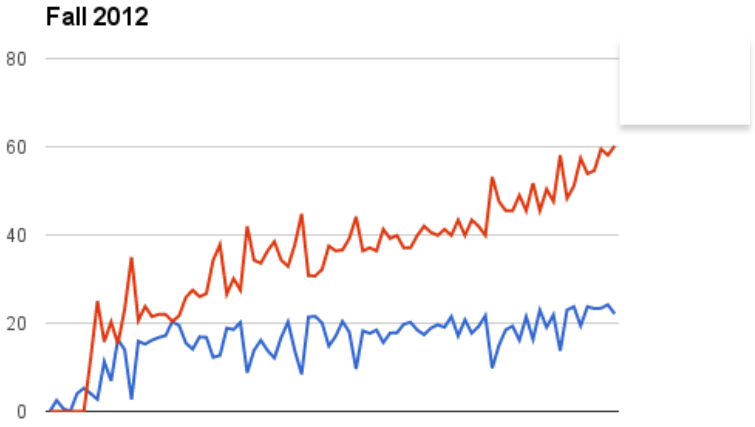
1. `Proof idea`: `10` points.

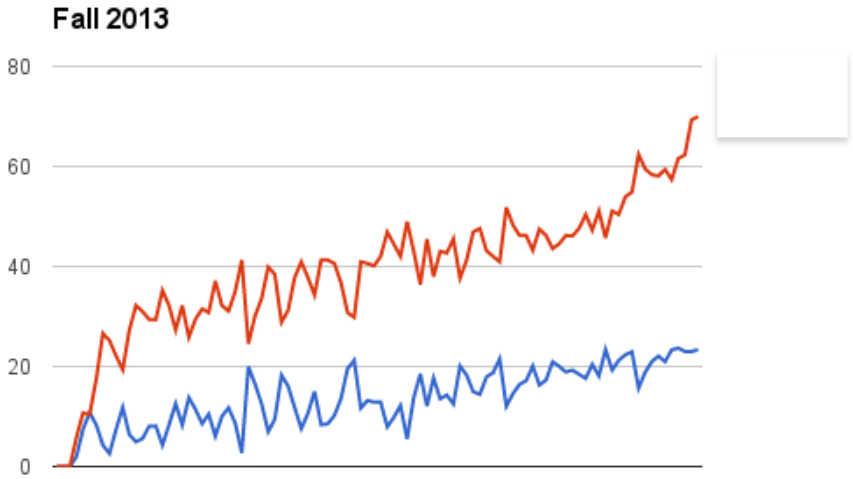
and here is the high level grading rubric for part `(b)`:

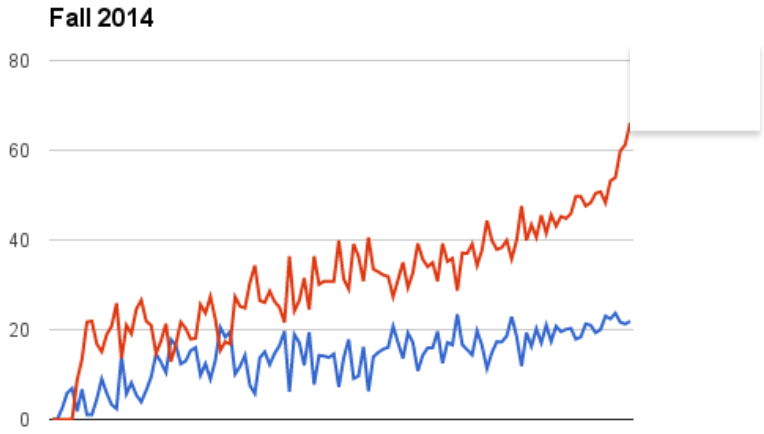
1. `Proof idea`: `20` points for a counterexample idea explaining the insight behind why you think the property does not holds.
2. `Proof details`: `20` points for a complete description of a counterexample *and* a complete proof for why the given counter example does not have any stable schedule.

> **! Note**
>
> **If you do not have separated out proof idea and proof details for part `(b)`, you will get a zero(0) irrespective of the technical correctness of your solution..**

Can you guess the correlation?







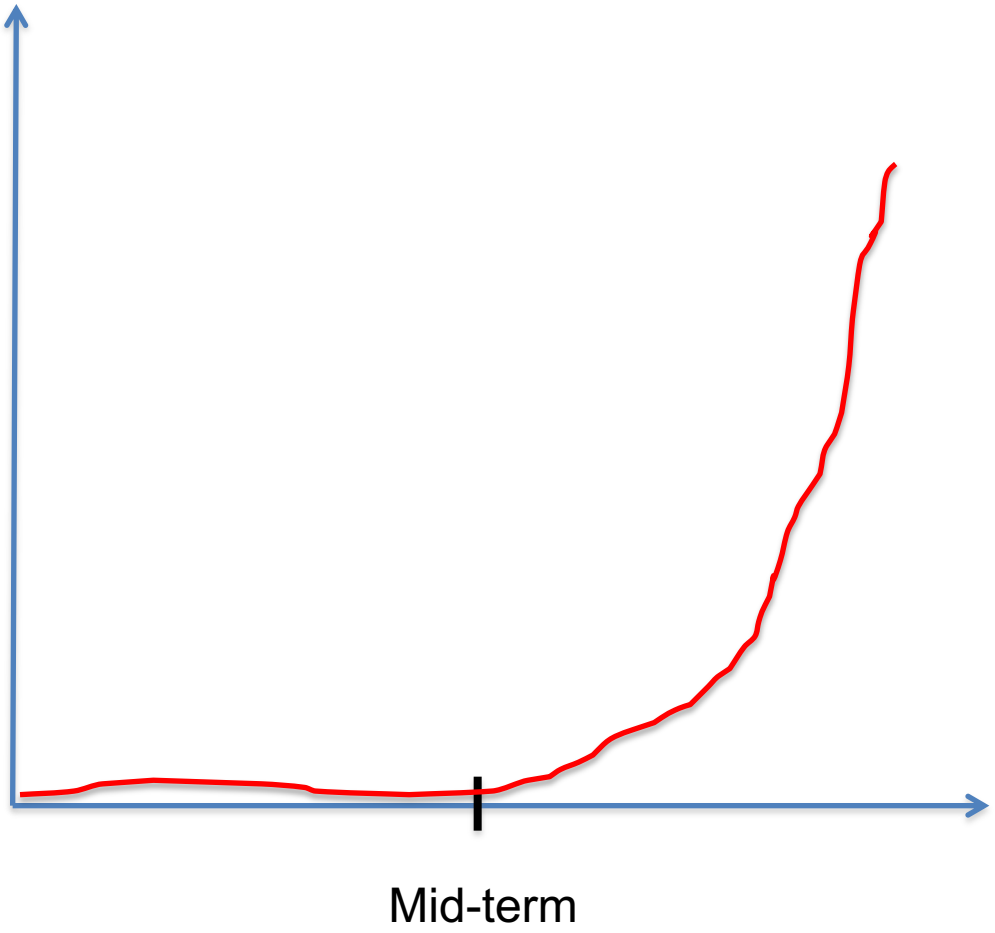
Another comment

Discomfort with proofs

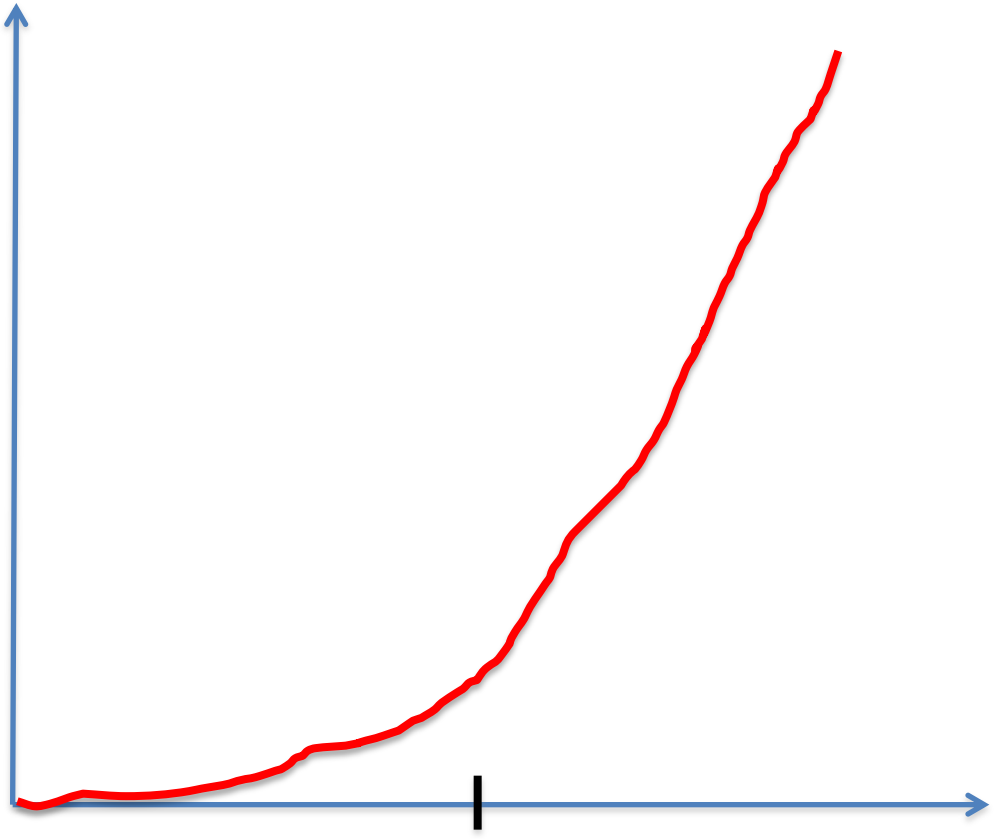
I will not cover proof basics in class anymore

Please read support pages and talk to us in person if you need help

Lecture pace (till Fall 18)



Lecture pace



We’re not mind readers

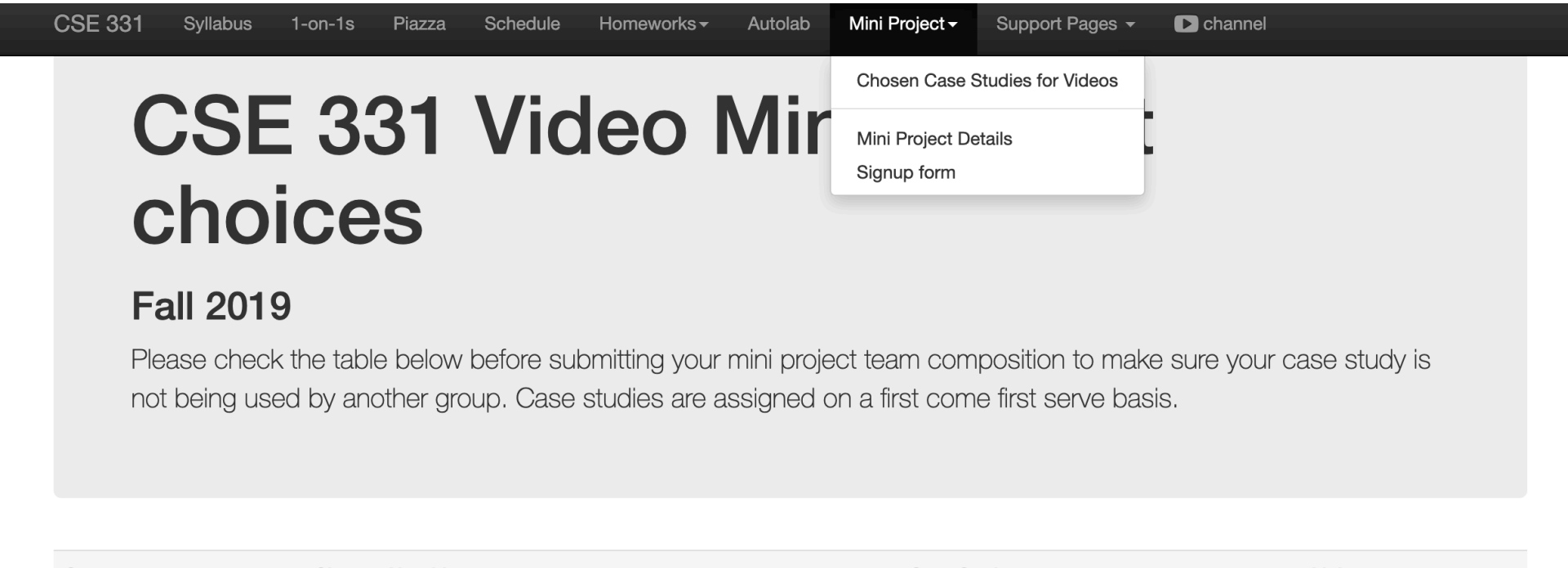
If you need it, ask for help

Potential change to OH interaction

Stay tuned for an announcement over the weekend!

Sign-up for mini projects

Deadline: Monday, Sep 23, 11:00am



Peer notetaker request

note

0 views

Actions

Peer notetaker request

Hi all,

Please see the message below from accessibility resources: please do help out if you can. In addition to the contact information below, I believe you can also email stu-notes@buffalo.edu

If you do end up being a peer note-taker, please let me know so that I can stop sending reminders in the future :-)
Thanks!
Atri

A student in your CSE 331 class is eligible for the services of a Peer Notetaker. Notetakers provide an essential service that helps ensure equal access to education for students who receive accommodations. Students often find volunteering to be a Peer Notetaker enhances the classroom experience by encouraging more thorough, quality notes. Notetakers who qualify may receive a letter of recommendation or, if they qualify, an honoraria at the end of the semester.

If you are interested in becoming a Peer Notetaker for this course, please stop by our office as soon as possible. We are able to accept Notetakers on a first come, first serve basis.

Thank you in advance,

Megan Vaughan
Access Support Coordinator
Accessibility Resources
60 Capen Hall
University at Buffalo
Buffalo, NY 14260
(t) 716-645-2608
(f) 716-645-3116

logistics lectures

Questions/Comments?

(Perfect) Matching

A matching $S \subseteq M \times W$ such that following conditions hold:

S is a **set** of pairs (m,w) where m in M and w in W

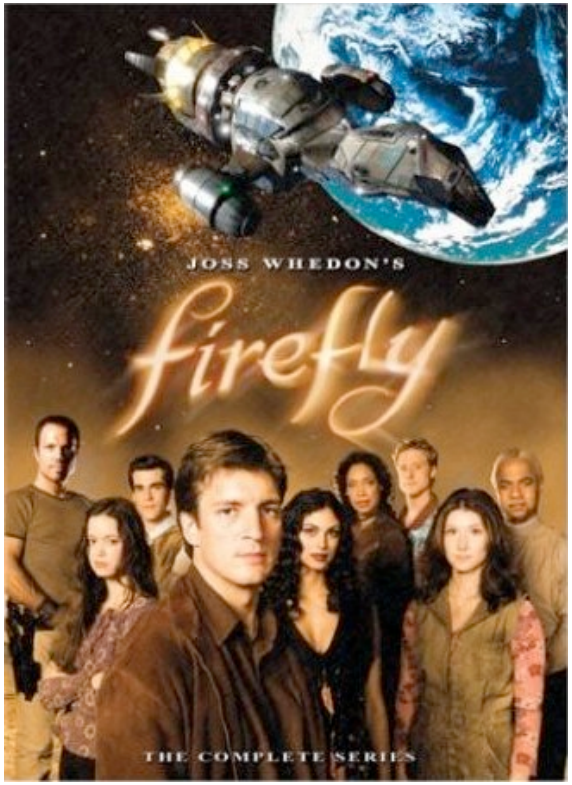
(1) For every woman w in W, exist *at most* one m such that (m,w) in S

(2) For every man m in M, exist *at most* one w such that (m,w) in S

Perfect matching

On matchings

Mal

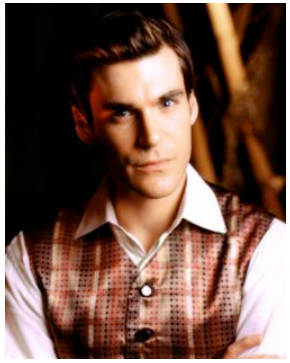


Inara

Wash

Zoe

Simon

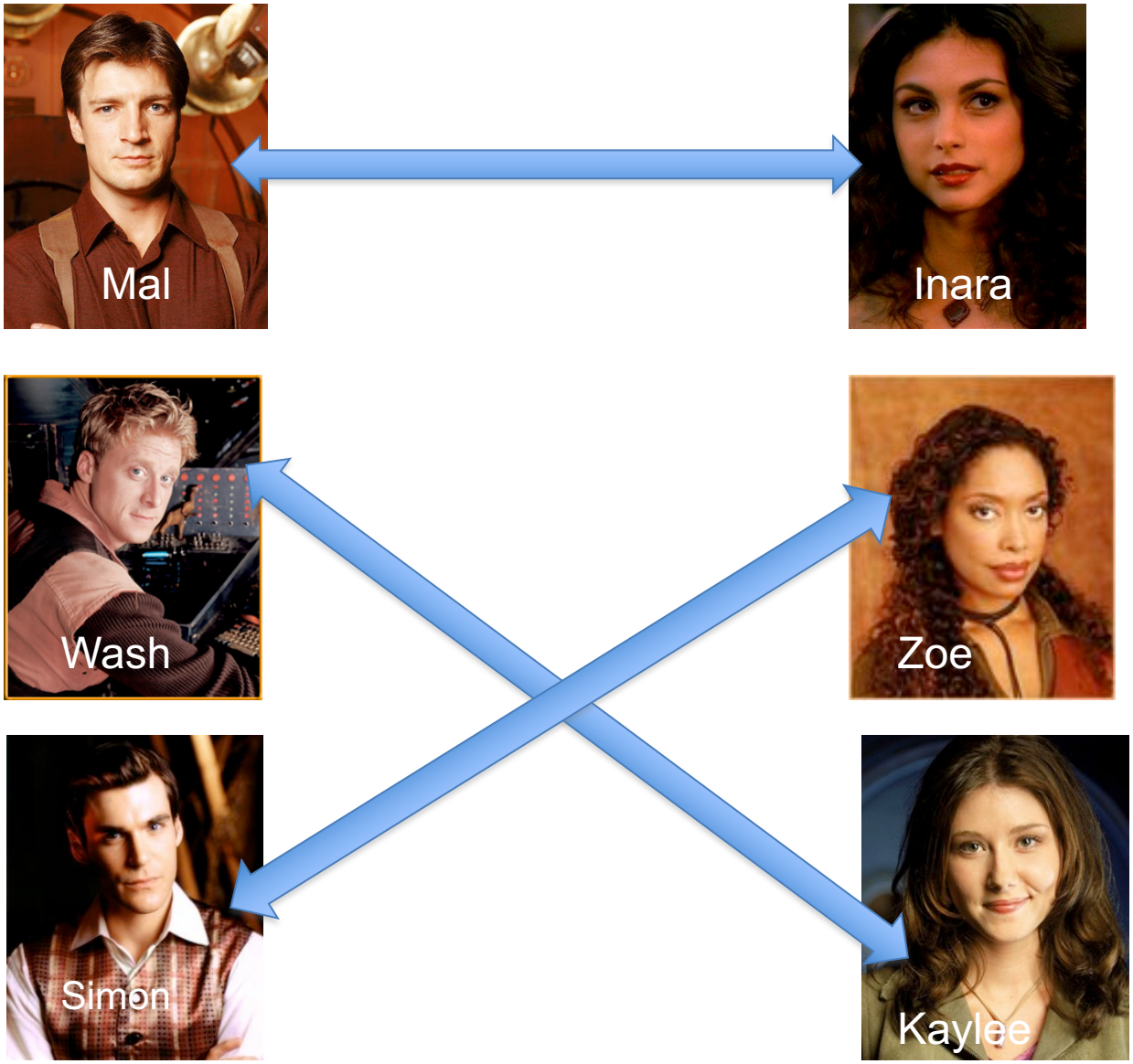


Kaylee

A valid matching

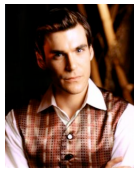
Not a matching

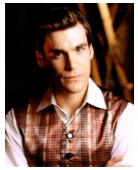
Perfect Matching

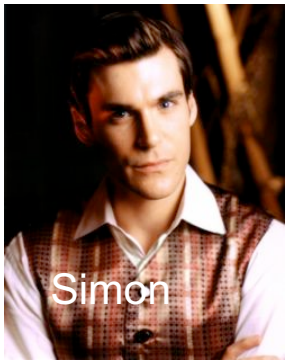


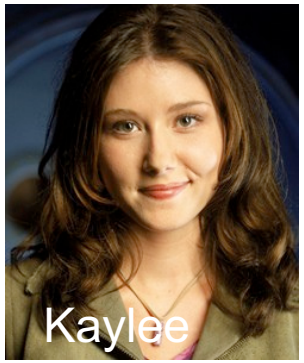
Back to couple more definitions

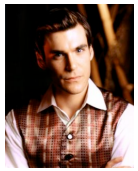
Preferences



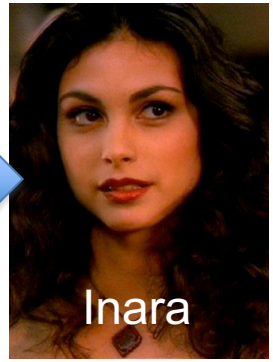


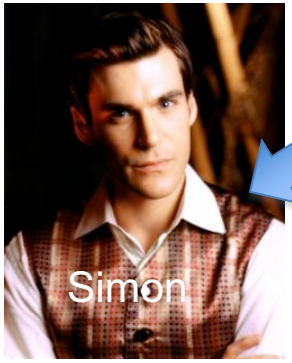


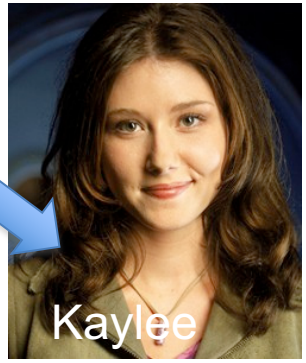




Instability

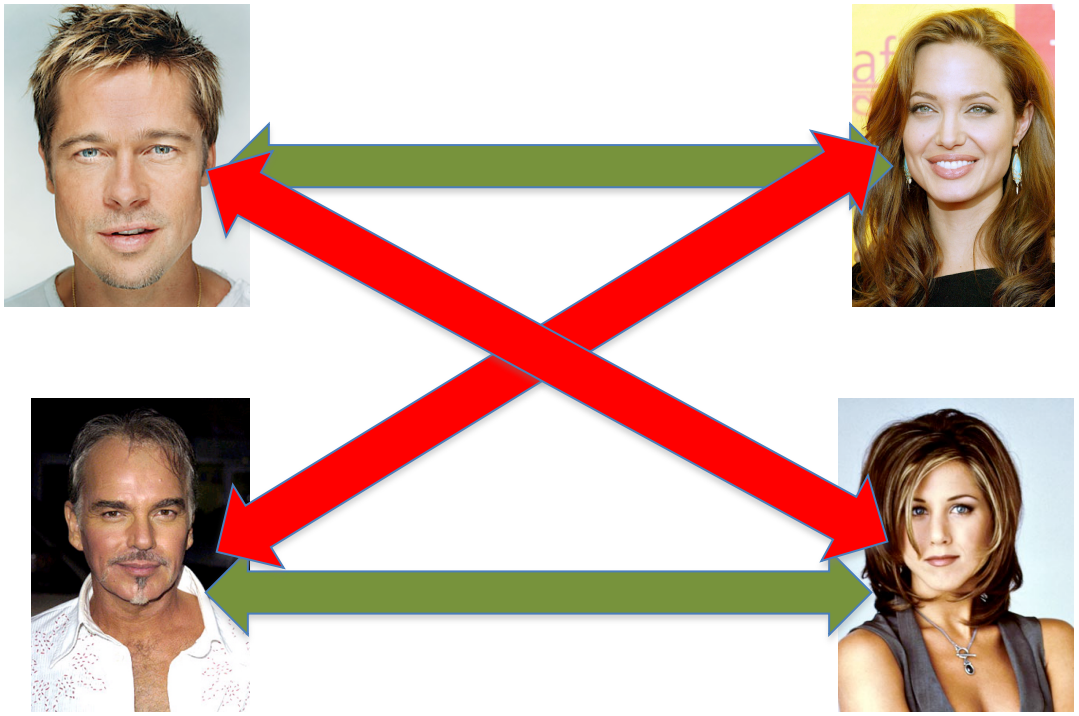




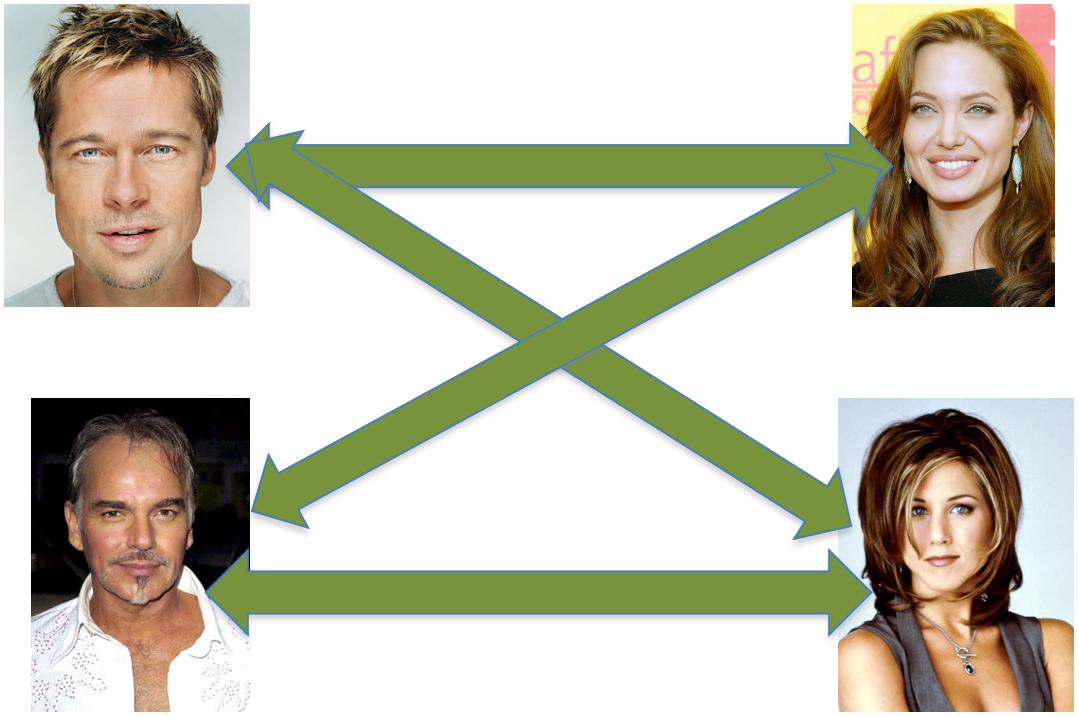


A stable marriage

Even though BBT and JA are not very happy



Two stable marriages



Stable Marriage problem

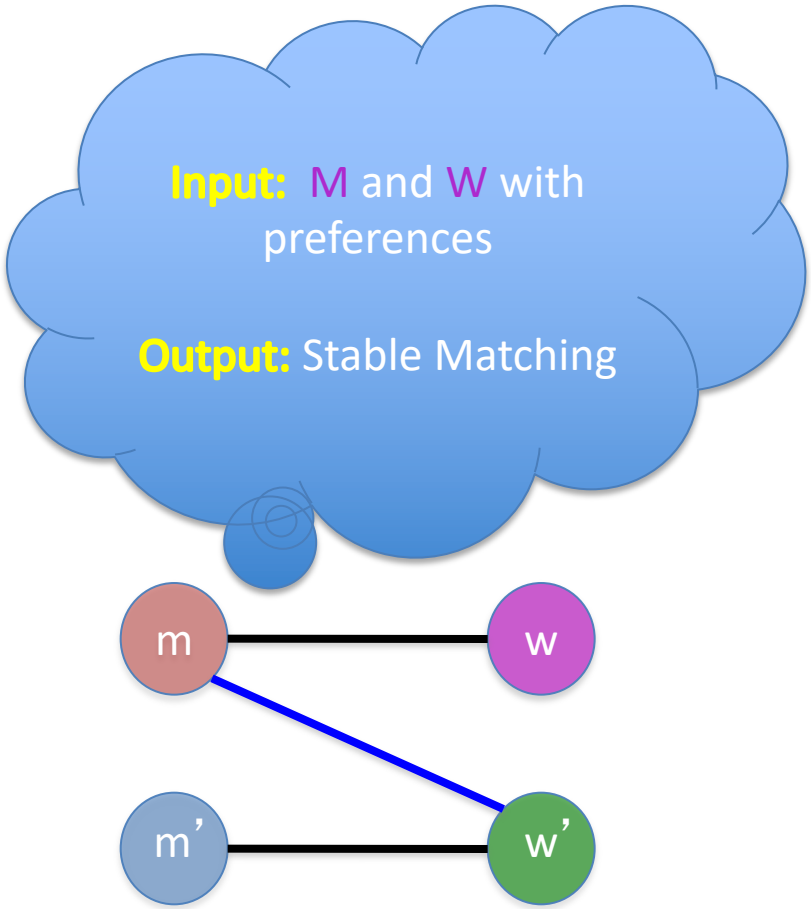
Set of men M and women W

Preferences (ranking of potential spouses)

Matching (no polyandry/gamy in M X W)

Perfect Matching (everyone gets married)

Instablity



Stable matching = perfect matching+ no instablity

Two Questions

Does a stable marriage always exist?

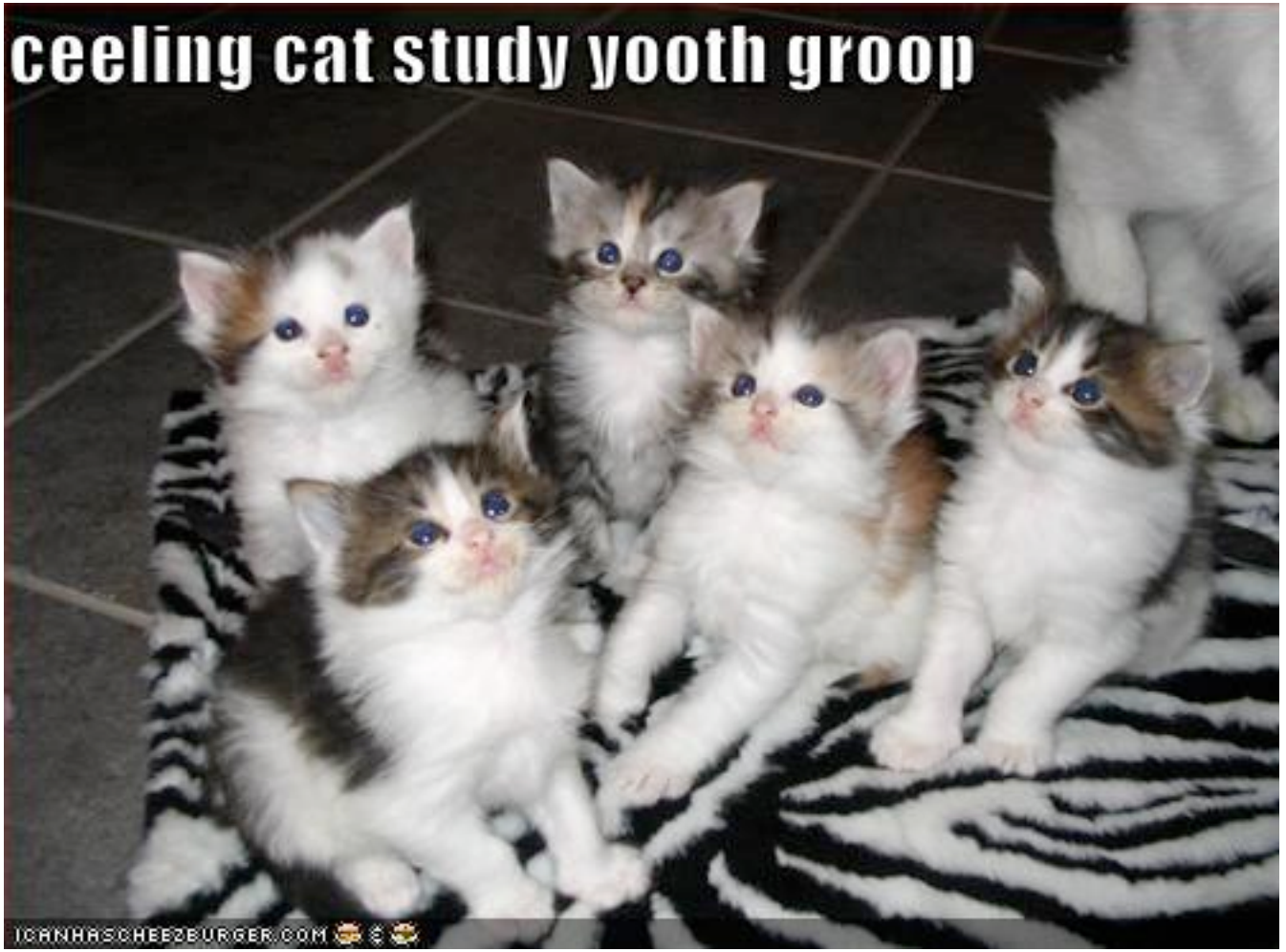
If one exists, how quickly can we compute one?

Today's lecture

Naïve algorithm

Gale-Shapley algorithm for Stable Marriage problem

Discuss: Naïve algorithm!



The naïve algorithm

Incremental algorithm to produce all n! prefect matchings?

Go through all possible perfect matchings S

If S is a stable matching

then Stop

Else move to the next perfect matching

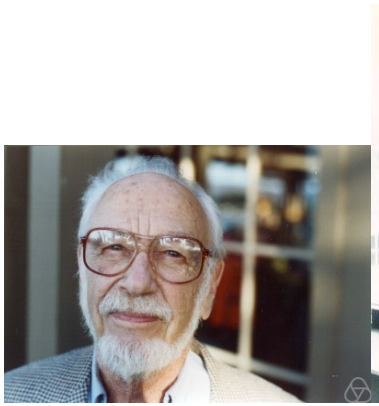
Gale-Shapley Algorithm

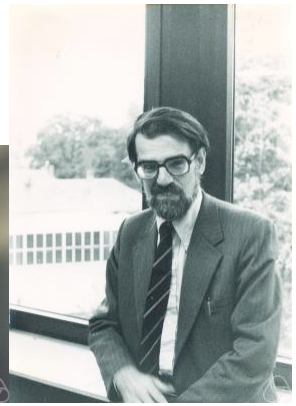
David Gale

Lloyd Shapley

$O(n^3)$ algorithm

Moral of the story…





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Questions/Comments?

Rest of today's agenda

Run of GS algorithm on an instance

Prove correctness of the GS algorithm

Gale-Shapley Algorithm

Intially all men and women are free

While there exists a free woman who can propose

Let w be such a woman and m be the best man she has not proposed to

w proposes to m

If m is free

(m,w) get engaged

Else (m,w') are engaged

If m prefers w' to w

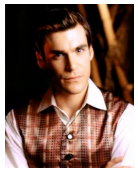
w remains free

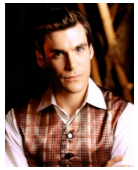
Else

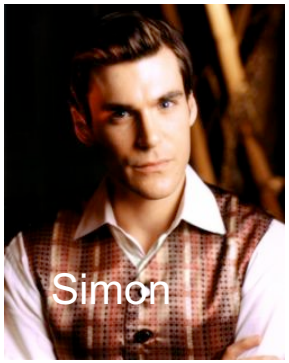
(m,w) get engaged and w' is free

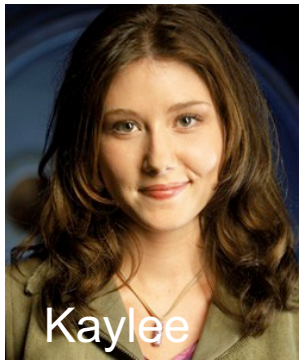
Output the engaged pairs as the final output

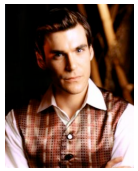
Preferences











GS algorithm: Firefly Edition

Observation 1

Intially all men and women are free

While there exists a free woman who can propose

Let w be such a woman and m be the best man she has not proposed to

w proposes to m

If m is free

(m,w) get engaged

Else (m,w') are engaged

If m prefers w' to w

w remains free

Else

(m,w) get engaged and w' is free

Once a man gets engaged, he remains engaged (to "better" women)

Output the engaged pairs as the final output

Observation 2

Intially all men and women are free

While there exists a free woman who can propose

Let w be such a woman and m be the best man she has not proposed to

w proposes to m

If m is free

(m,w) get engaged

Else (m,w') are engaged

If m prefers w' to w

w remains free

Else

(m,w) get engaged and w' is free

If w proposes to m after m', then she prefers m' to m

Output the set S of engaged pairs as the final output

Questions/Comments?

Why bother proving correctness?

Consider a variant where any free man **or** free woman can propose

Is this variant any different? Can you prove it?

GS’ does not output a stable marriage