

Lecture 5

CSE 331

Sep 7, 2018

HW 1 posted

Homework 1

Due by **11:59pm, Thursday, September 13, 2018.**

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.

Take note of the many(!) notes

! 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 NOT give an error message if you submit non-PDF file, so it is YOUR responsibility to make sure you submit in the correct format. 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 (b) of this problem:

1. **Proof idea**: 18 points.

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

1. **Proof idea**: 17 points for a counterexample idea explaining the insight behind why you think the property does not hold.
2. **Proof details**: 18 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.

Templates

[Download LaTeX template.](#)

[Download Microsoft Word template.](#)

! Note

You must explicitly list your sources and collaborators when you upload your submission to Autolab. Note that you can only use one of the five allowed sources. If you have used a source that is not allowed, please do not submit your homework. If you did not consult any source or did not collaborate with anyone just say **None**.

Various lecture related stuff

Notation used in lecture

Pre-lecture video

Wed, Sep 5

Algorithms for Stable Matching Problem



F18



F17

x²

[KT, Sec 1.1]



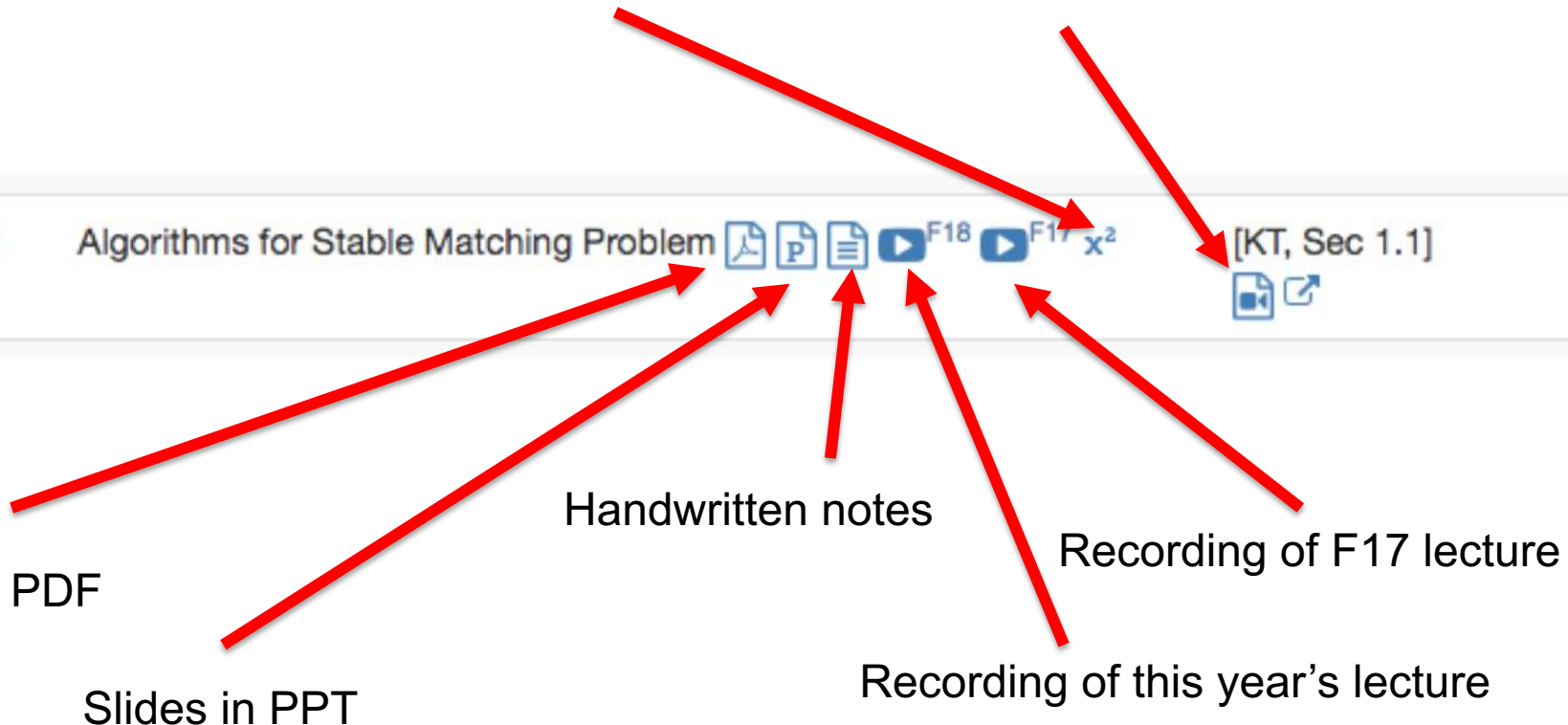
Slides in PDF

Slides in PPT

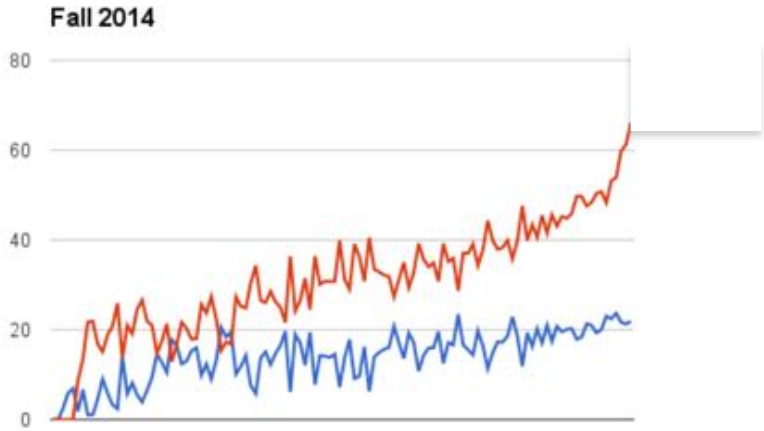
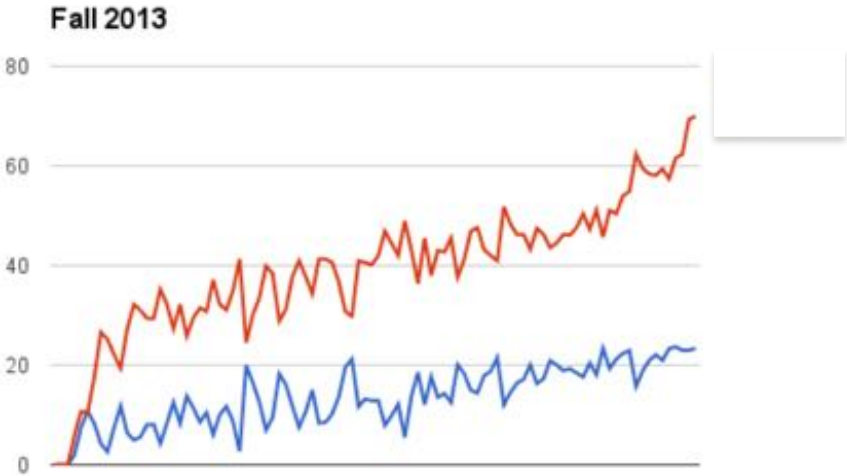
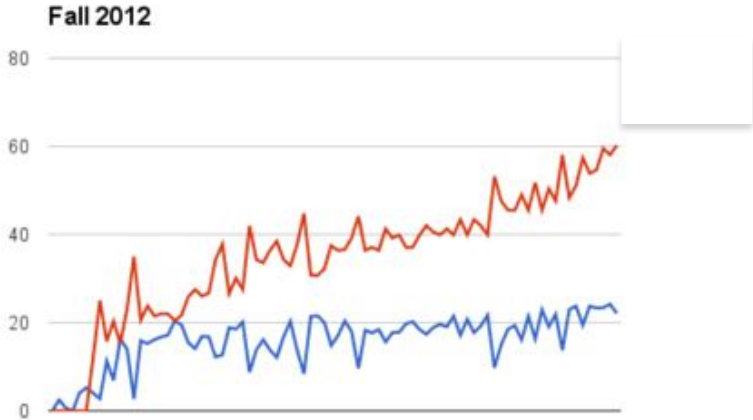
Handwritten notes

Recording of this year's lecture

Recording of F17 lecture



Can you guess the correlation?



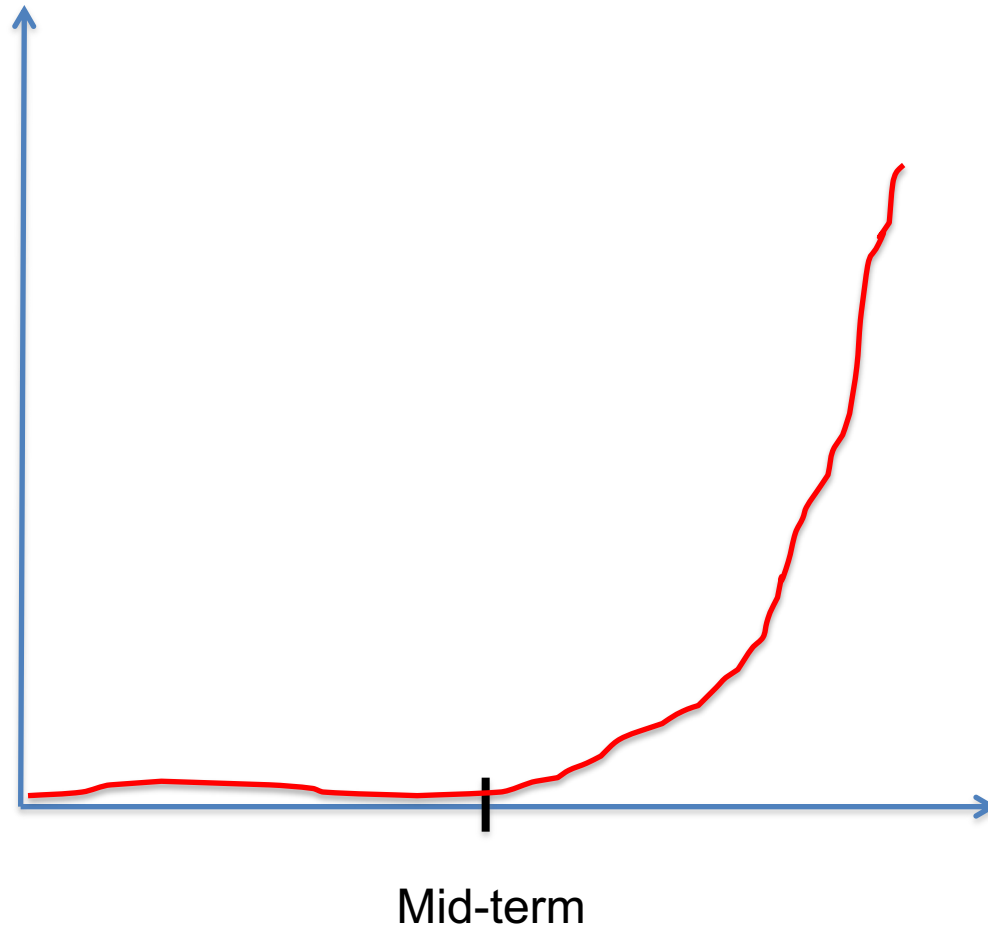
Another comment

Discomfort with proofs

I will not cover proof basics in class

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

Lecture pace



We're not mind readers



If you need it, ask for help



Peer Notetaker Request

note ☆ stop following 65 views Actions

Peer Notes Request

A student in your 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. Notetakers who qualify may also be paid a stipend by Accessibility Resources at the end of the semester. If you are interested in becoming a Peer Notetaker for this course, please contact 716-645-2608 or stu-notes@buffalo.edu as soon as possible. Notetakers are accepted on a first come, first serve basis.

(If you do end up volunteering for being a peer notetaker, please also let me know so that I know I do not have to send more reminders. --Atri)

#pin

logistics lectures

edit good note

Updated 7 hours ago by Atri Rudra

Sign-up for mini projects

Deadline: Monday, Sep 24, 11:59pm

CSE 331 Syllabus 1-on-1 meetings Piazza Schedule Homeworks - Autolab **Mini Project -** Support Pages - Youtube channel

CSE 331

Fall 2018

CSE 331 Mini project choices

Fall 2018

Please check the table below before submitting your mini project team composition to make sure your case study is not being used by another group. Case studies are assigned on a first come first serve basis.

Chosen Case Studies

Mini Project Details

Signup form

Group	Chosen Algorithm	Case Study	Links
Chirmayee Bandal, Sarah Peters, Tracy Zheng	Dijkstra's Algorithm	Google Maps	Link 1 , Link 2

Questions/Comments?



Stable Marriage problem

Set of men M and women W

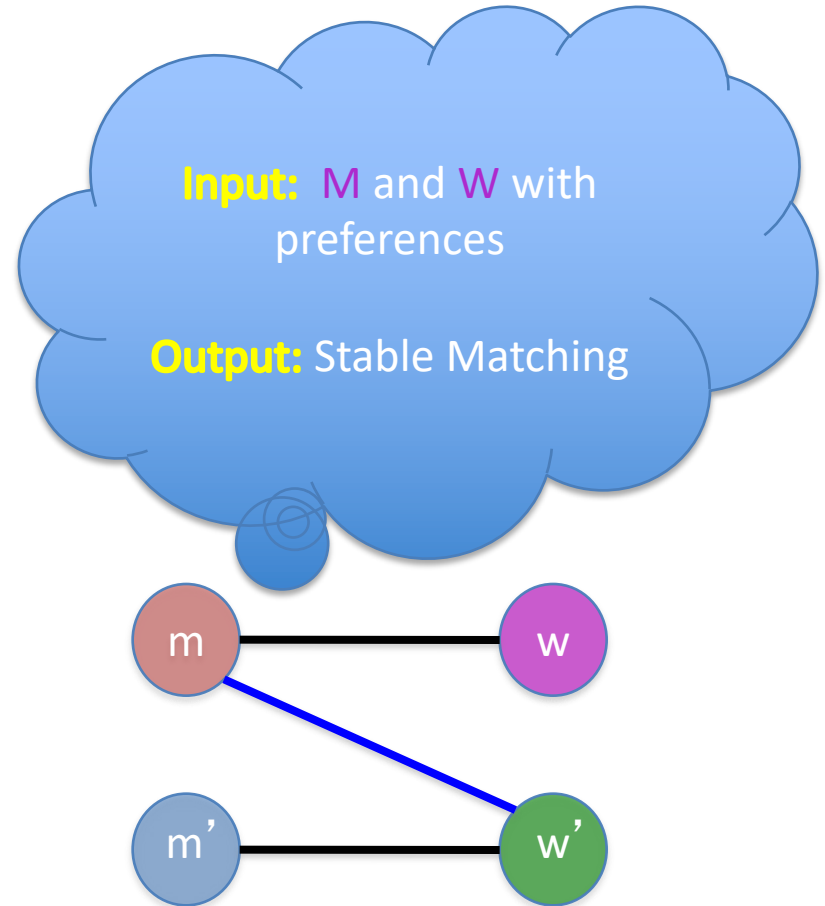
Preferences (ranking of potential spouses)

Matching (no polyandry/gamy in $M \times W$)

Perfect Matching (everyone gets married)

Instability

Stable matching = perfect matching + no instability



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

The naïve algorithm

Incremental algorithm to produce all $n!$ perfect matchings?

Go through all possible perfect matchings S

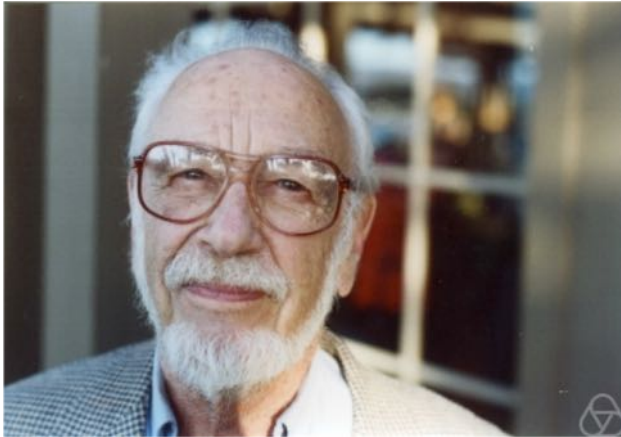
If S is a stable matching

then Stop



Else move to the next perfect matching

Gale-Shapley Algorithm



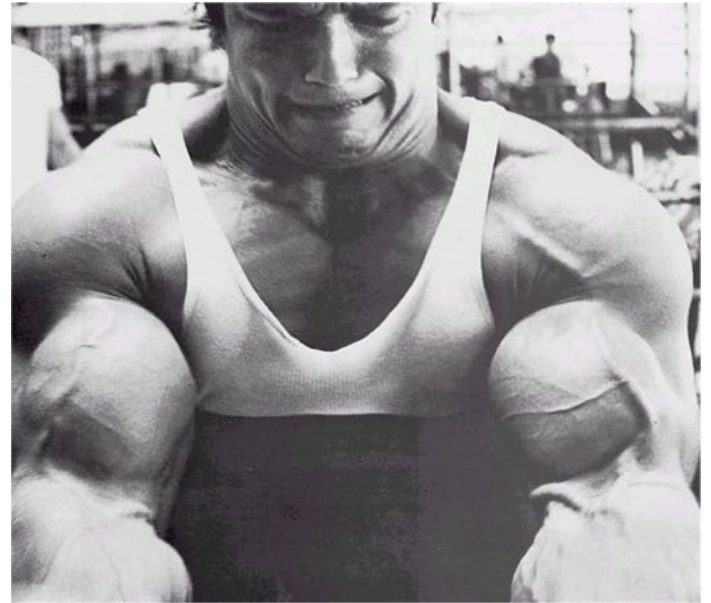
David Gale



Lloyd Shapley

$O(n^3)$ algorithm

Moral of the story...



Questions/Comments?



Rest of today's agenda

Run of GS algorithm on an instance

Prove correctness of the GS algorithm

Gale-Shapley Algorithm

Initially 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

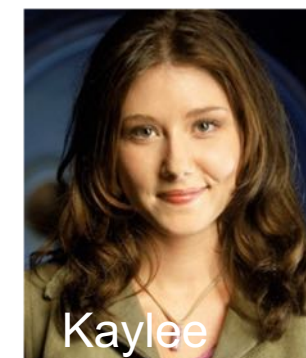
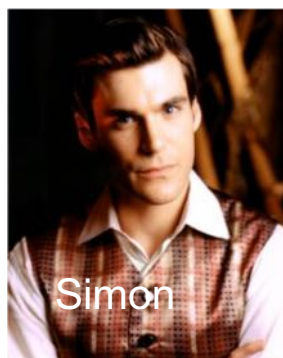
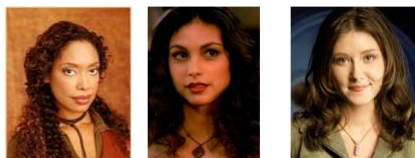
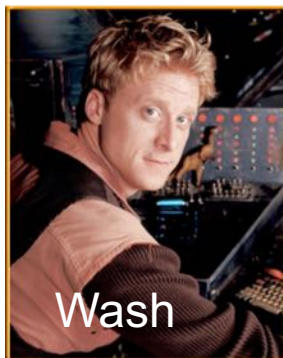
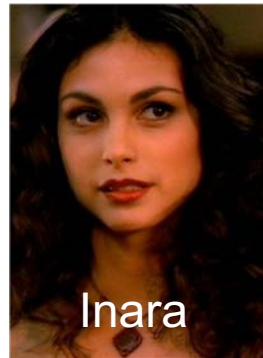
w remains **free**

Else

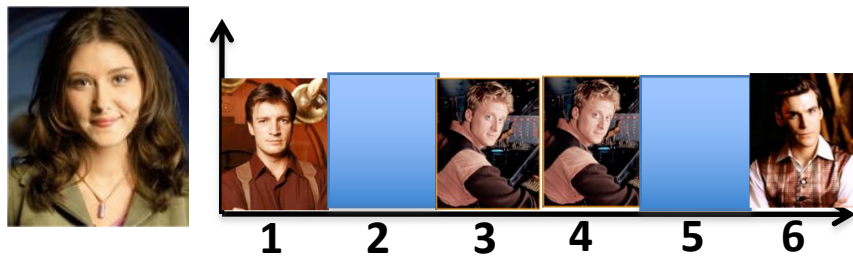
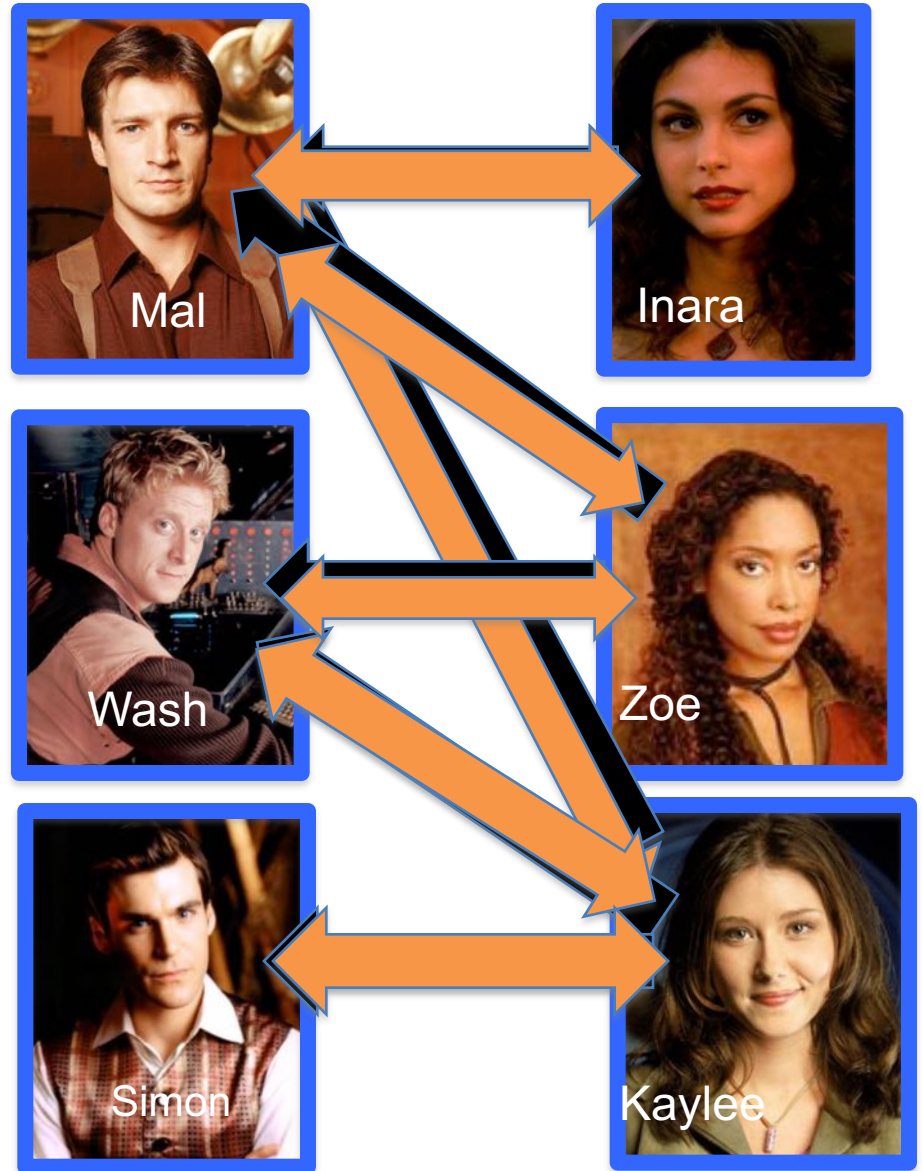
(m,w) get **engaged** and w' is **free**

Output the engaged pairs as the final output

Preferences



GS algorithm: Firefly Edition



Observation 1

Initially 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

Initially 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

