Lecture 3

CSE 331

Aug 30, 2019

Enroll on Piazza

https://piazza.com/buffalo/fall2019/cse331/

Please do keep on asking Qs!

The only bad question is the one that is not asked!

Read the syllabus CAREFULLY!

No graded material will be handed back till you pass the syllabus quiz!

Autolab FAQ


CSE 331
Autolab
Details on Autolab, which will be used for all homework submissions in CSE 331.
Signing up
What happens next

TA office hours

Finalized by today

Details on 1-on-1 meeting by Monday

HW 0 Solution posted

Solutions to Homework 0

Please note that we will provide online solutions for HW 0 **only**. From HW 1 onwards, we will only hand out hard copies of the solutions.

What is a proof?

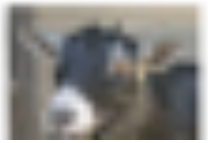
The goal of this question is to present a gentle start to proofs. In particular, the idea is to highlight a common mistake students make while writing proofs.

The Problem

Consider the following "proof":

1. Brad Pitt has a beard.

2. Every goat has a beard.



Two comments on Programming

Programming is worth about 15% of your final grade

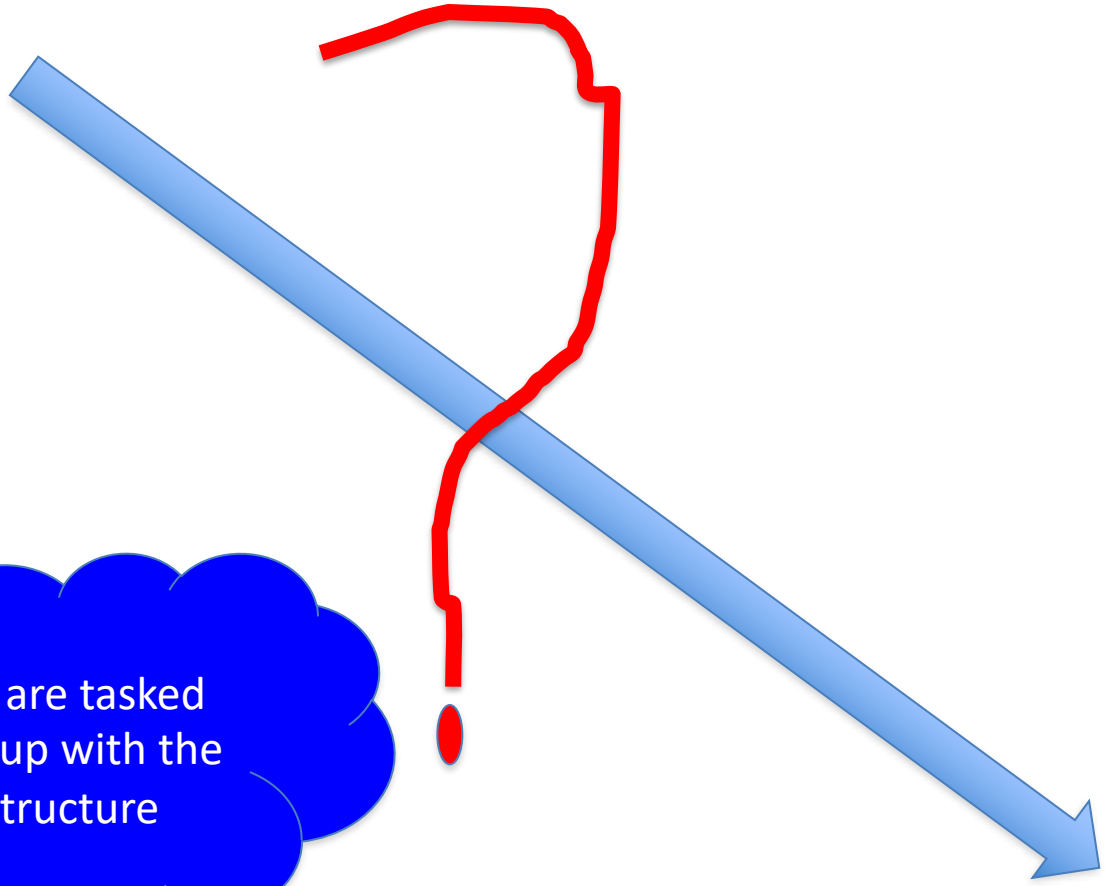
Algorithm design/proofs are worth about 80% of your final grade

Invest your time wisely

331 is not the place to learn a new language!

Questions/Comments?

Make broadband more available



Say you are tasked to come up with the infrastructure

Make broadband more available

Input requirements

Where are the customers located?

What are the bandwidth requirements?

How is the input represented?

What objective are we optimizing?

How should the connections be configured?

Output requirements

Problem Definition

Where should we lay down the physical stuff?

What algorithm should be use to do this?

Algorithm Design

Decide whether this will be for-profit enterprise

What are technology should we use?

Get regulatory approval

Get funding

Hire people

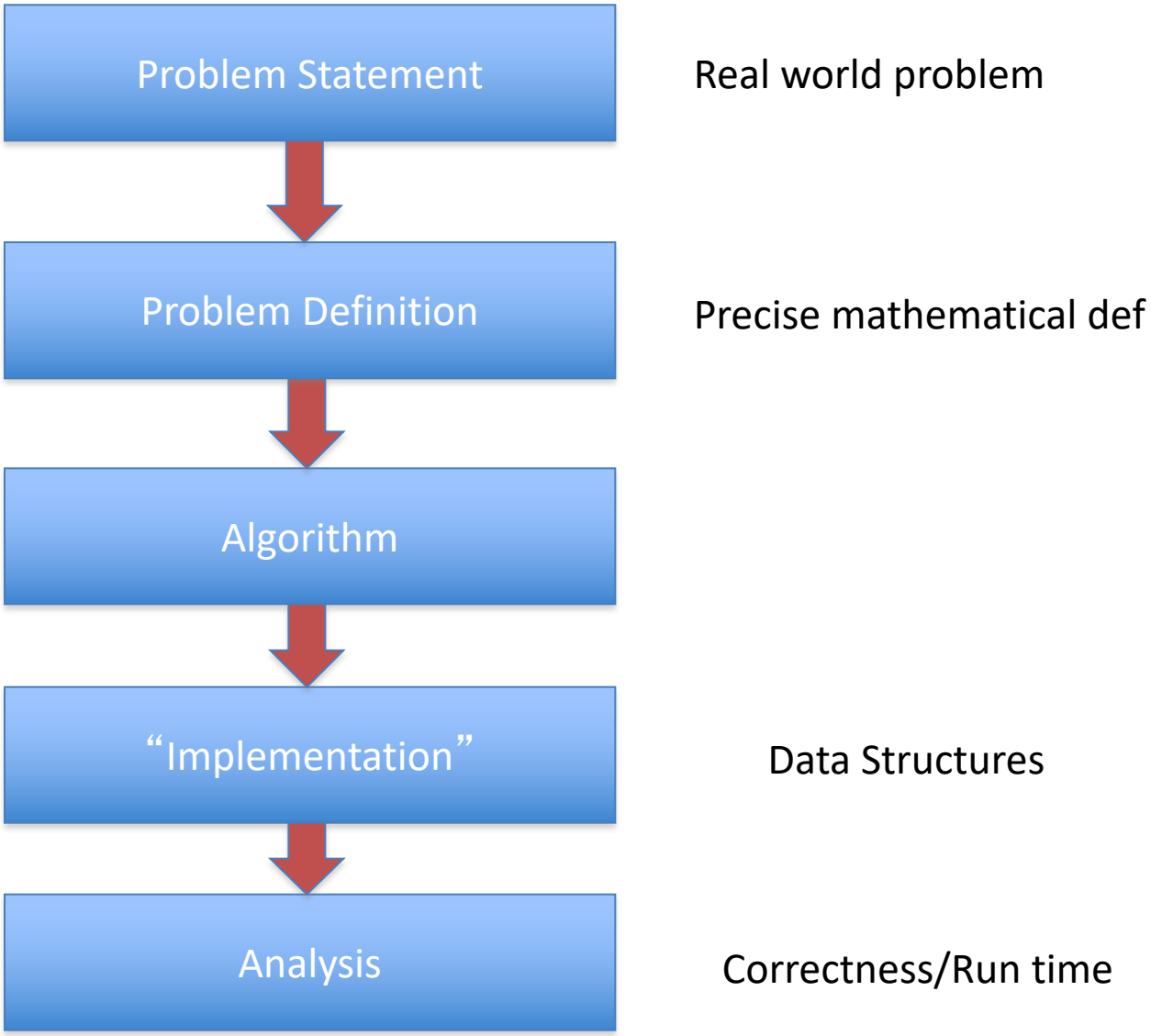
Get access to physical space

Outreach

Implement the scheme

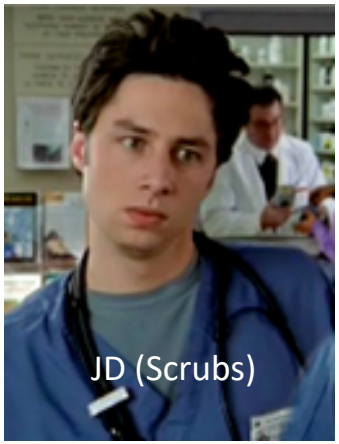
How should we do testing and maintenance?

Main Steps in Algorithm Design



National Resident Matching

(Screen) Docs are coming to BUF



What can go wrong?

The situation is unstable!

What happens in real life

Preferences

NRMP
National Resident Matching Program

Information

NRMP
National Resident Matching Program

Preferences

NRMP
National Resident Matching Program

NRMP plays matchmaker

Stable Matching Problem

David Gale

Lloyd Shapley

Questions/Comments?

Matching Employers & Applicants

Input: Set of employers (E)
Set of applicants (A)
Preferences

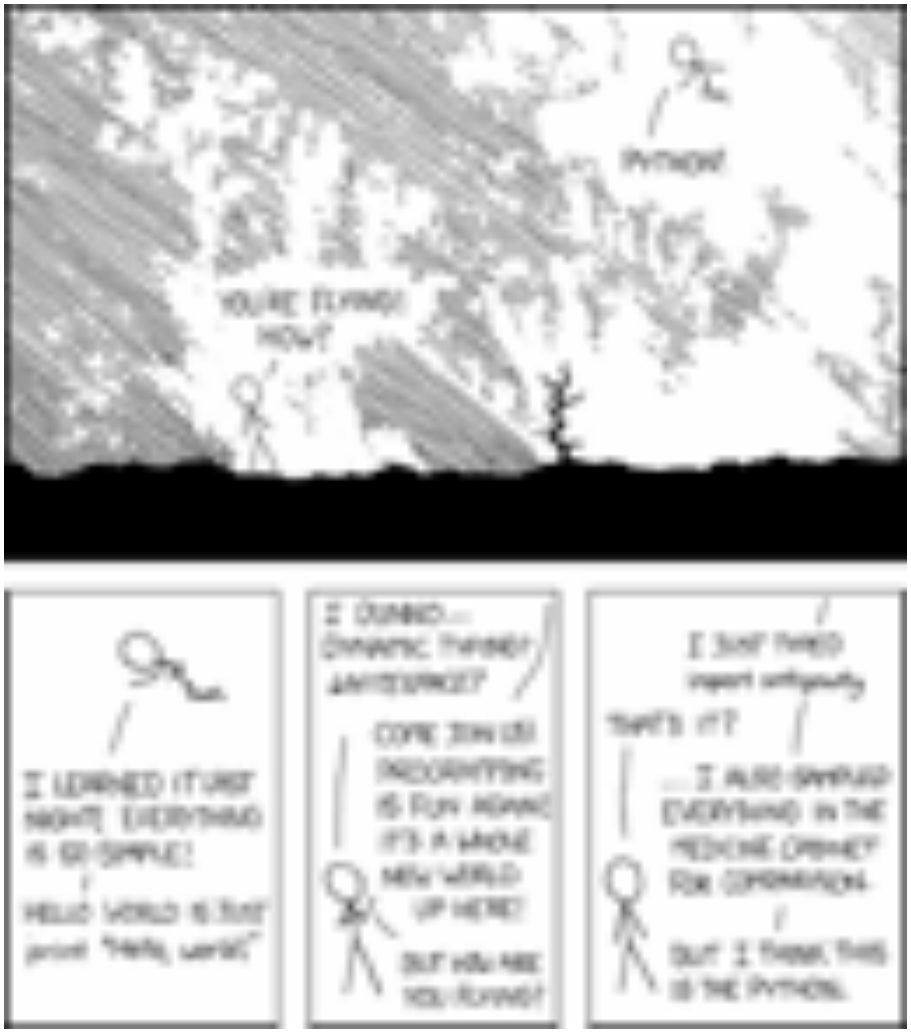
Output: An assignment of applicants to employers that is "stable"

For every x in A and y in E such that x is **not** assigned to y, either

(i) y prefers *every* accepted applicant to x; or

(ii) x prefers her employer to y

Simplicity is good



http://xkcd.com/353/

Questions to think about

1) How do we specify preferences? Preference lists

2) Ratio of applicant vs employers 1:1

3) Formally what is an assignment? (perfect) matching

4) Can an employer get assigned > 1 applicant? NO

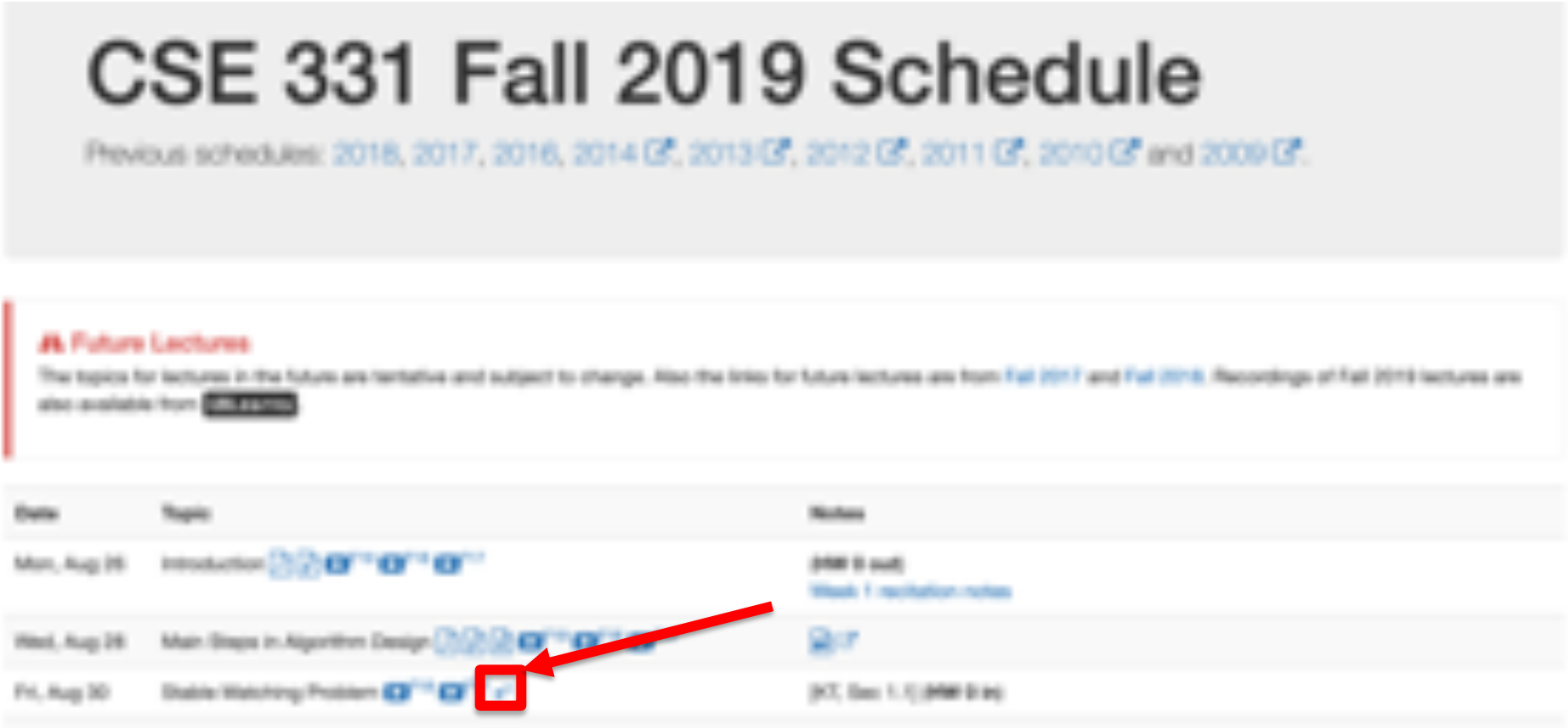
5) Can an applicant have > 1 job? NO

6) How many employer/applicants in an applicants/employers preferences? All of them

7) Can an employer have 0 assigned applicants? NO

8) Can an applicant have 0 jobs? NO

Lost in Notation….



Questions/Comments?

Non-feminist reformulation

n men

n women

Each with a preference list

Match/marry them in a “stable” way

On matchings

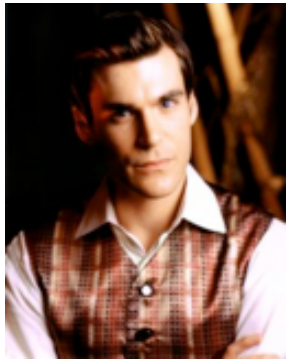
Mal

Inara

Wash

Zoe

Simon

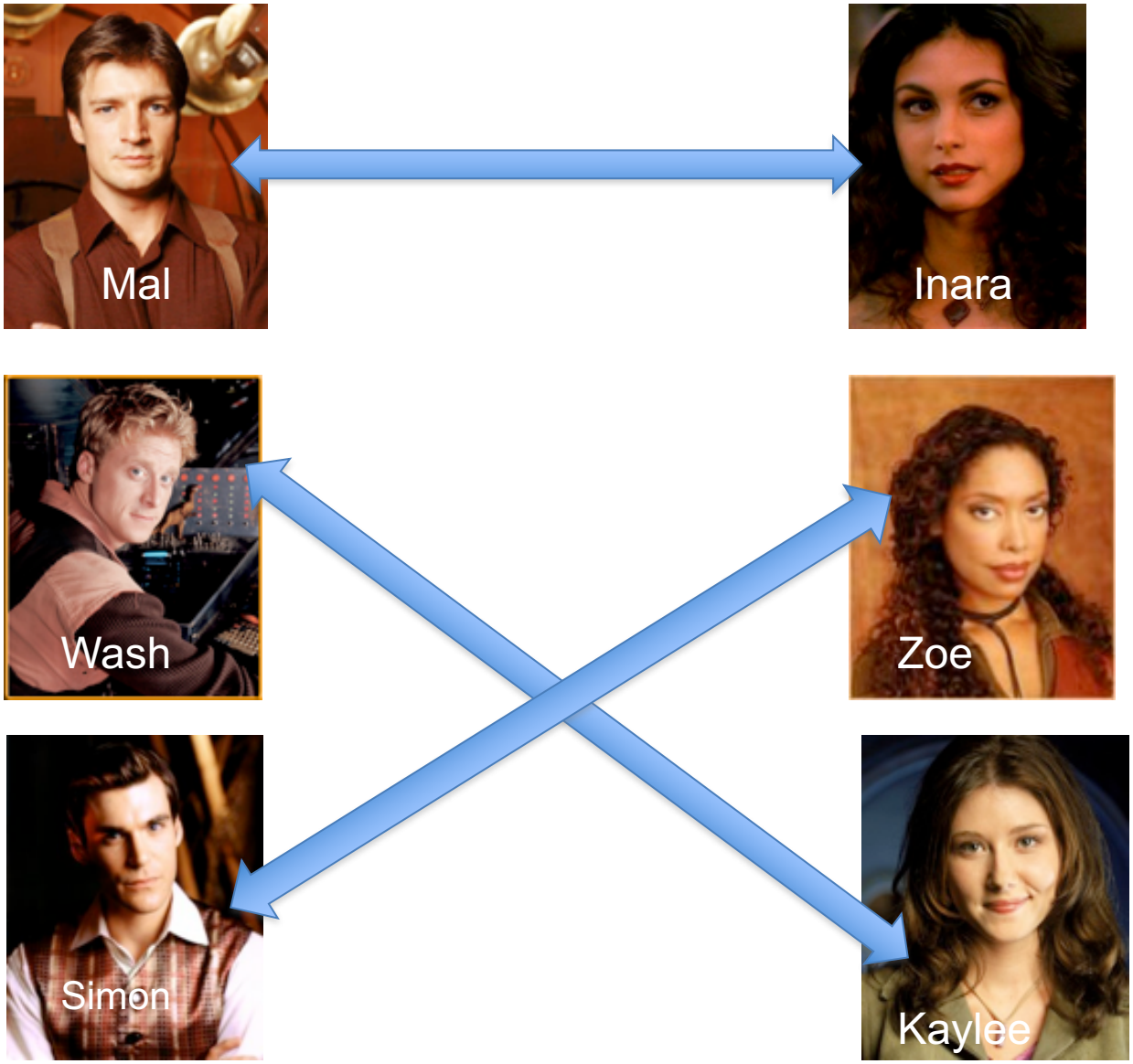


Kaylee

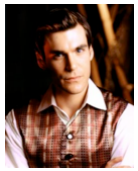
A valid matching

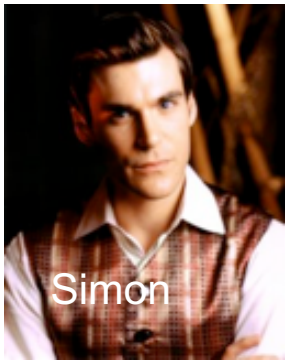
Not a matching

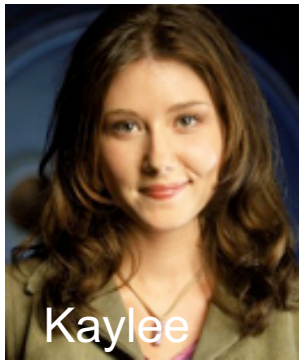
Perfect Matching

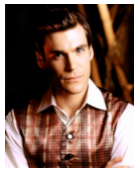


Preferences

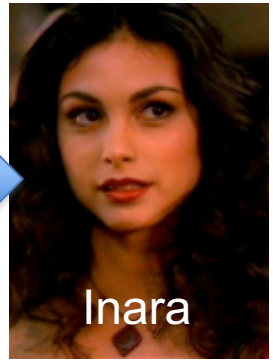


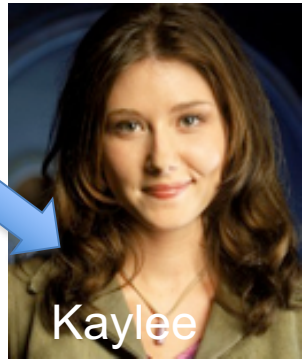






Instability





Questions/Comments?

Discuss: Naïve algorithm!

The naïve algorithm

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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